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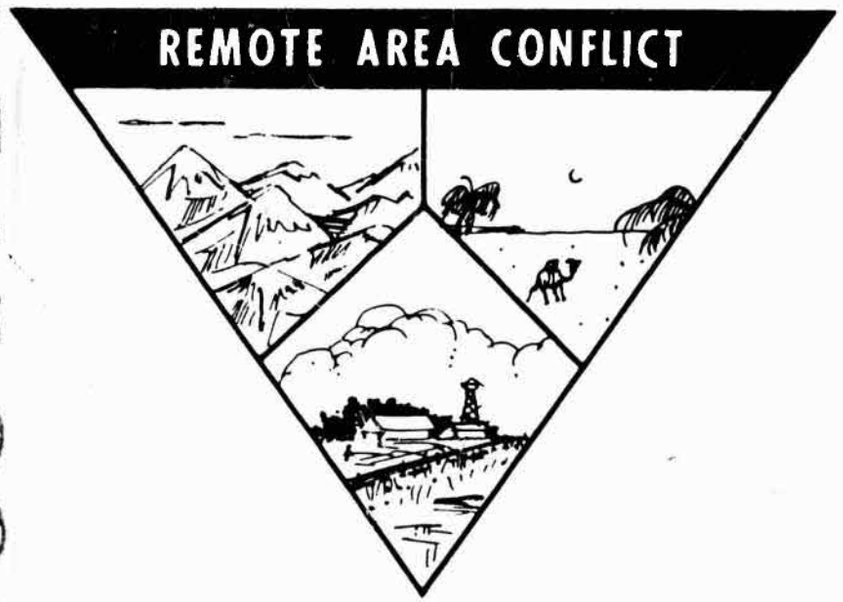
**QUARTERLY REPORT**

1 Apr.-30 June 1963

# PROJECT AGILE




ADVANCED RESEARCH PROJECTS AGENCY

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# ADVANCED RESEARCH PROJECTS AGENCY

## PROJECT AGILE

## QUARTERLY REPORT

1 April - 30 June 1963

Issued by
Battelle Memorial Institute
under Contract SD-171, AO-324

15 July 1963

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## FOREWORD

This issue of the Project AGILE Quarterly Report includes a description of the existing and planned research and development programs for each of the eight sub-projects as well as the status of the various RDT&E tasks currently under way.

This report is classified CONFIDENTIAL and is released to the foreign governments participating in Project AGILE on a need-to-know basis. Information relating to some of the tasks that require a higher classification is excluded and so noted. Also, because this project contains the longer range programs and objectives of Project AGILE it should not be re-transmitted to existing or potential Government contractors.

R. C. Phelps

R. C. Phelps
Director for Remote Area Conflict
Advanced Research Projects Agency
Washington 25, D. C.

# INTRODUCTION

ADVANCED RESEARCH PROJECTS AGENCY

PROJECT AGILE

REMOTE AREA CONFLICT RESEARCH & ENGINEERING

## MISSION

Project AGILE performs research and engineering support for the military and paramilitary forces engaged in or threatened by conflict in remote areas of the world. Its activities are oriented toward the requirements of the local forces in these areas, while the Service research and development agencies are primarily concerned with the requirements of the U.S. forces.

At the present time, Project AGILE is providing research and engineering support for the forces engaged in Vietnam and to the Ministry of Defense in Thailand. Preliminary discussions with the U.S. officials in other countries to explore the feasibility and desirability of R&D support for those forces have been approved by OSD and State and are under way.

## REQUIREMENT

There are several forms of conflict which lie below the threshold of that categorized by the term "Limited" War, and there are many remote areas of the world where discretely different environmental conditions affect the nature of any level of conflict which can or does exist. The counterinsurgency conflict in Vietnam and the border war between India and Red China are two current examples of quite different types of warfare - each of which has some discrete material requirements.

Until quite recently, U.S. Country Teams faced with these conditions could draw only on supplies of weapons and equipment designed fundamentally for employment by U.S. Forces, with their attendant logistical support systems, in General and Limited Wars. Past and present experience has demonstrated that weapons and equipment supplied under the MAP program in these situations are often less effective than current technology is capable of developing and the U.S. is able to supply at an acceptable cost.

The not unlimited economic, military, and technological assets of the U.S. support to those Free World countries threatened by or experiencing insurgency and other forms of conflict in remote areas, the increasing

capability of the Communist Bloc to mount and support such activity, the wide-ranging commitments of the United States to aid in the defense of threatened countries, the environmental and tactical peculiarities of these conflicts, and the physiological and psychological nature of the indigenous personnel engaged all combine to establish the necessity that an integrated and improved capability be developed within the U.S. Government to counter these threats. Project AGILE was created to provide one of the essential elements - that of performing the research, development, test, and engineering of more suitable and effective devices, weapons, and equipment for employment under these conditions.

ORGANIZATION

The mission assigned and the tasks to be performed have determined the general form of Project AGILE organization.

Development of a capability to acquire and analyze data, from which requirements for remote area conflict research and development are derived, has been accomplished by the creation and implementation of a plan for Research and Development Field Units; two of the units are now in Southeast Asia, one located in Saigon and the other in Bangkok. These field units bring to bear a broad spectrum of military and technical capability; they are staffed by officers with research, development and combat experience from each Service, and by civilians with scientific or technical specialties particularly suited to the tasks assigned to these units. The capabilities of the field units are augmented from time to time by the assignment of teams of research, or technical specialists on an ad hoc basis. Such teams are organized and staffed to perform specific tasks which are either beyond the normal capability of the field unit to accomplish or of such immediate concern that the task must be accomplished more rapidly than the capability and capacity of the permanent staff of the field unit permit.

These Research and Development Field Units are combined with a contingent of military officers from the various Services of the host country to form Combat Development and Test Centers (CDTCs). The Director of the CDTC is a senior officer of one of the Services of the host country; his deputy is the senior American on the permanent staff of the Field Unit. Basically, the organization plan for the CDTCs pairs a military officer from the host country with each U.S. military officer. Although the initial emphasis of Project AGILE and the presently existing Field Units are concerned with Southeast Asia, similar, although initially smaller Field Units are being considered by OSD for other areas of the world.

On August 1, 1962, a plan for establishing a Joint Operations Evaluation Group in Vietnam (JOEG-V) was implemented. The Secretary of Defense subsequently directed that the Research and Development Field Unit and JOEG-V operate from the same facility under the control of a single U.S. director, who is responsible for both U.S. elements. JOEG-V was assigned responsibility for evaluation of combat operations and user (U.S. Service) tests. Project AGILE continues to be responsible for all research, development, test and evaluation for remote area conflict in support of indigenous forces, for the development of research and development requirements, and the engineering tests of equipment and systems.

An AGILE staff in Washington performs those functions which are beyond the capability of the Field Units to perform in-country. It also provides the means for integrating and controlling the total effort, provides the scientific and technical support for the various tasks and projects described below, and assembles and coordinates those ad hoc groups which are sent into the field from time to time to augment the capability of the Field Units. In addition, the Staff reviews the efforts of Field Units to insure that valid data and requirements have been obtained or developed, and conducts broader studies into the elements of Remote Area Conflict.

The Staff provides or obtains the scientific and/or technical assistance required to accomplish the various tasks, either in the field or in the U.S. It is charged with the responsibility of maintaining liaison with all Service and civilian laboratories engaged in or capable of supplying the specific talents required by the Project within the U.S. and within other nations with whom the U.S. is closely allied. One of the major objectives of Project AGILE is to bring the broadest applicable spectrum of scientific and technical capability to bear on the unique problems of Remote Area Conflict, in an endeavor to substantially enhance the capability of U.S. and friendly foreign governments threatened with, or engaged in this form of conflict.

The various tasks undertaken by Project AGILE have been grouped into the following sub-project areas:

1. Tactical Unit Weapons Systems
2. Area Fire Weapons Systems
3. Remote Area Mobility and Logistics Systems
4. Communications Systems

5. Combat Surveillance and Target Acquisition Systems

6. Individual and Special Projects

7. Technical Planning and Programming

8. Research and Exploratory Development

REPORTS

Each Field Unit issues a monthly report, and a quarterly report is prepared in Washington summarizing the activities of the individual Field Units and the work performed in CONUS. Both the monthly and quarterly reports receive wide distribution within the Department of Defense; additional copies are provided to other interested Departments and Agencies and, on a need-to-know basis, to the foreign governments participating in Project AGILE.

Interim and final test reports for the individual tasks are prepared and distributed as the information becomes available. These reports are summarized in the monthly and quarterly reports.

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# AGILE SUB-PROJECT SUMMARIES

## SUB-PROJECT I

## TACTICAL UNIT WEAPONS SYSTEMS

## TAB 1

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## AGILE SUB-PROJECT I

## TACTICAL UNIT WEAPONS SYSTEMS

### SUB-PROJECT OBJECTIVE:

To provide significant improvement in selected weapons and equipment employed by small tactical units engaged in conflict in remote areas. Under this task, research and engineering efforts to significantly improve the weapons, equipment and devices used by the individual soldier and by ground forces operating in tactical units up to the Company level of organization are undertaken.

### SUB-PROJECT BACKGROUND:

AGILE research and engineering efforts to be accomplished are to a great extent influenced by the nature of the conflict in which the indigenous forces of friendly governments are engaged at this time. Such operations place a much greater emphasis on the small tactical unit as the primary combat element while, at the same time, the use of heavy ground support weapons, such as tanks and artillery, is diminished.

In these operations, the enemy generally is armed with small hand weapons, recoilless rifles and mortars, and strikes at the time and place where he has a high probability of success. Definite battle lines are rarely drawn. These forces rely heavily on the natural topographic and climatic advantages of the remote areas in which these conflicts take place. Often both terrain and weather combine to create conditions under which the sophisticated mechanization of modern armies is of little use. Under certain conditions, it is the foot soldier operating in small "hunter/killer" groups which will provide a counterthreat to guerrilla domination of an area. It is the function of the Tactical Unit Weapons Systems sub-project to provide scientific and technical support to friendly indigenous forces by developing weapons and weapons systems which will eventually improve their capability to win in this form of conflict.

### SUB-PROJECT DESCRIPTION:

In order to accomplish the requirements of AGILE Sub-Project I, a series of tasks has been established.

1. Individual Weapons

A. Assault Rifle - This task was initiated to provide a weapon better suited to the individual soldier. A lighter, more effective weapon/ammunition system capable of delivering accurately aimed, high rates of fire at fleeting targets is desired.

B. Special Shotguns - The shotgun is particularly suitable to the needs of friendly military and paramilitary forces where quick reaction and high lethality at moderate ranges are required. This sub-task deals with the design and development of shotguns designed expressly for such needs.

C. Microrocket Pistol - One of the presently feasible applications of microrocket projectiles is in a very simple, low-cost, hand gun designed for defensive purposes. Under study is a semi-automatic pistol which fires seven .49 caliber microrocket projectiles and which is expected to cost an order of magnitude less than any equivalent small arm presently available. An experimental quantity of these pistols is being produced for evaluation.

2. Crew-Served Weapons

A. Lightweight Automatic Weapons - This task is devoted to feasibility studies and development of improved automatic weapons for use by small tactical units of ground forces.

B. Lightweight Mortars - As in the case with the lightweight automatic weapon, a need exists for improved mortar weapons designed for use in remote areas. New designs for mortars will be based on reduced weapon weights and increasing the lethal effect of the shell in order to reduce the weight per round as much as possible to allow either a reduction in the total weight carried or an increase in the number of rounds which might be used for the same weight.

3. Special Purpose Weapons and Ammunition

A. Portable Flame Throwers - The role of flame weapons in remote area warfare is being investigated at present. Although needs have increased for new flame weapon systems, very little work has been done in this area since World War II. This task proposes to take advantage of the many new advances which have been made in materials of construction and in improved systems design which have resulted from

research and development in the rocket industry to produce man-portable flame weapons of increased effectiveness, lower weight and greater safety.

B. Microrocket Projectiles - This sub-task has been initiated to provide detailed information on the feasibility of small caliber rocket projectiles as ammunition for individual weapons. Investigation of the cost, lethality, weight and accuracy of a family of microrocket projectiles is being performed both by theoretical analyses and experimental testing.

C. Strip Bullets - Experimental bullets have been produced which can be fired from conventional arms to give a shotgun-like effect. The applicability of these bullets to various weapons is being studied and further experiments are being conducted to improve dispersion, lethality and mechanical characteristics for a number of calibers ranging from .30 to .50.

D. Rifle Grenades - Investigation will be made into new and improved rifle grenades particularly as adapted to the assault rifle. The requirement is to produce a rifle grenade which can be fired by using the standard rifle cartridge rather than a special grenade launching cartridge.

REQUIREMENTS AND TASKS:

Listed below are those major requirement areas and the status of tasks with which this project is concerned. Succeeding pages contain summaries of the purpose and the current status of each task.

1. Individual Weapons
   - A. Assault Rifle
   - B. Special shotguns
   - C. Microrocket Pistol
2. Crew-Served Weapons
   - A. Lightweight Automatic Weapons
   - B. Lightweight Mortars
3. Special Purpose Weapons and Ammunition
   - A. Portable Flame Throwers
   - B. Microrocket Projectiles
   - C. Strip Bullets
   - D. Rifle Grenades

Requirement: Individual Weapons

Task: Assault Rifle

Problem: Because of the smaller physical stature of the individual soldier, the environment and the nature of conflict in remote areas, a lighter, more effective weapon/ammunition system capable of delivering accurately aimed, high rates of fire on fleeting targets is desirable. Standard U.S. military arms do not provide these capabilities to the extent available within existing technology.

Description: As one of the alternative means of providing a weapon/ammunition system which can better satisfy the requirement for an improved basic infantry weapon, the Armalite Rifle (AR-15) was selected for test and evaluation. The Armalite AR-15 rifle is a lightweight, gas-operated rifle capable of fully automatic fire and is equipped with a 20-round detachable magazine. It is chambered for a .223 caliber cartridge, firing a 55-grain fully-jacketed bullet at a muzzle velocity of 3200 feet per second. The empty weight of the weapon is 6-1/4 pounds. An integral muzzle device is incorporated as part of the barrel which serves as flash-suppressor, grenade launcher and front support for a bayonet. Standard accessories include bayonet with scabbard, bipod with case, grenade launching sight and cleaning rod.

Current Status: The original AR-15 test weapons which have now been in use in Vietnam for more than one year are currently undergoing rehabilitation at the ARVN 80th Ordnance Rebuild Depot. This program of rehabilitation is of particular interest at this time due to the procurement of AR-15 rifles for U.S. Forces. From this program it is hoped that usage data can be obtained which may be of value in determining the appropriate number of repair parts to procure for the U.S. Forces. By the end of the period, data on approximately 300 AR-15 rifles had been compiled. Rehabilitation of the balance of the test weapons is continuing and further data will be compiled in the future. It should be borne in mind that it is not a safe assumption that the parts usage data collected during this rehabilitation program will be applicable, without interpretation, to U.S. Forces. The differences between U.S. and VN troops in training, maintenance, discipline and other factors must be considered.

Data on wound effects, lethality, malfunctions, and parts failures under field conditions, together with causes of failures are also being compiled.

The required repair parts for the conduct of this rehabilitation program are being furnished by the Cooper McDonald Company under contract. Thus far, eight sets of repair parts have been furnished to the CDTC-V.

Improved tracer ammunition is currently under development by Remington Arms through a contract negotiated for the procurement of 35,000 rounds of .223 caliber tracer ammunition. 10,000 of these rounds will be shipped to Vietnam for field tests, the remaining 25,000 rounds will be shipped to the Cadillac Gage Company for use in the development and testing of the Stoner 63 weapon system.

VN SOLDIER WITH AR-15 RIFLE

Tab 1

VIETNAMESE PARATROOPER WITH AR-15 AND OTHER COMBAT EQUIPMENT NORMALLY CARRIED ON COMBAT JUMPS IN VIETNAM

Tab 1

Requirement: Individual Weapons

Task: Special Shotguns

Problem: To develop special shotguns suitable for use by indigenous military and paramilitary for village defense and counter-ambush situations.

Description: In order to provide an orderly solution to the problem of providing suitable shotguns to military and paramilitary indigenous personnel engaged in remote area conflict, a program has been undertaken which will seek to provide answers to the following questions. First, based on present technology, which of the commercially available shotguns are most suitable for use by indigenous military personnel and what rapid modifications can be made at this time to standardize commercial designs in order to best suit the military purpose? Second, based on the needs of paramilitary or civil defense forces, what shotgun design is best suited to their requirements taking into account the much larger numbers of such weapons which would have to be supplied and the relatively lower state of training of these forces? Third, to perform studies based on the most advanced state of weapon design, to provide recommendations for the optimum military shotgun.

Current Status: The three-part special shotgun program is continuing under the direction of U.S. Army Weapons Command. Part I has the objective of selecting one each of three types of 12-gage shotgun actions – bolt, pump, and semiautomatic – that appear best suited for military use. These guns, selected from commercial manufacturers, are remodified where possible and as necessary to improve the effectiveness of the 12-gage shotgun ammunition. At the conclusion of this part of the program and CONUS test, samples of the final selections will be sent to Southeast Asia for field evaluation. Thus far CONUS tests have been completed on the bolt action and semiautomatic shotguns.

Firings have been made to measure the recoil obtained with shotguns having fixed chokes. Firings will be conducted later with compensators attached to the muzzles of the shotguns. The results will be compared to determine the reduction in recoil.

Testing under Part I will continue on the 12 Remington Model 870 AP pump action shotguns. Shotguns and selected ammunition should be ready for shipment to Vietnam by 15 August 1963.

Part II of the program is a study concerned with the provision of an optimum village defense type of shotgun and ammunition system. Thus far Springfield Armory with out-of-house support has prepared two weapon

mechanism concepts, one for each of the proposed Frankford Arsenal rounds. The concepts indicated a low recoil force, single shot system that has limited life as well as odd gage capabilities. Submission of a final report on the "village defense" study is expected next quarter. The report will include conclusions and recommendations on future work in this area.

The Directorate of R&D, U.S. Army Weapons Command, Rock Island, Ill., has submitted a proposed increased scope of work for Phase II of Part II. The purpose of the increase scope of work is to provide ARPA with the general features and characteristics of a cheap shotgun weapon system and to outline an eight month development program for the design, development, fabrication and evaluation of the weapons systems. The proposal was under consideration at the end of the reporting period.

Part III of the program is concerned with an optimized military shotgun and ammunition system. Special shotgun loads have been developed that will project payloads ranging from 200 to 600 grains at muzzle velocities between 1,000 and 3,000 fps. Test firings of these experimental loads will provide measurements of the payload velocity chamber pressure and recoil impulse.

Effort is continuing for the improvement of choke design, shotshell loading techniques, projectile shapes and densities, and use of other than spherical projectiles, such as flechettes.

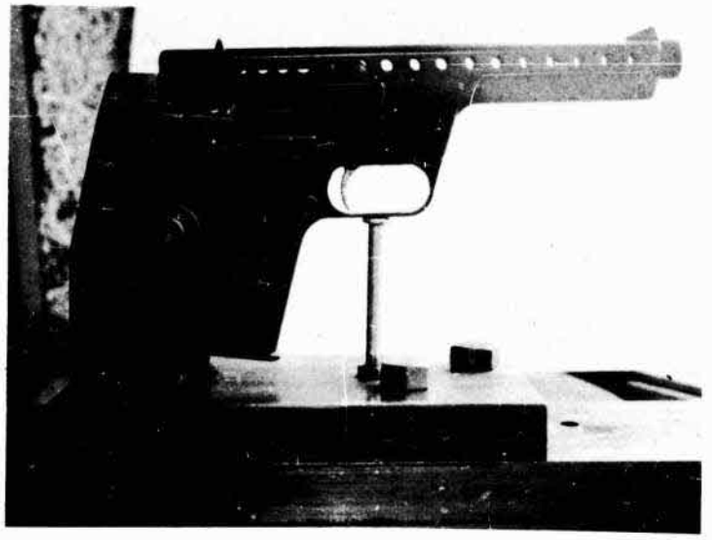
Requirement: Individual Weapons

Task: Microrocket Pistol

Problem: To develop a very low cost, defensive weapon suitable for use by indigenous paramilitary or civilian forces against guerrilla attacks.

Description: The present state-of-the-art in the development of the microrocket projectiles permits development of simple weapons where short range and moderate dispersion are acceptable. MB Associates is producing a test quantity of experimental pistols firing .49 caliber microrocket projectiles; these weapons will be evaluated as one possibility of satisfying the requirement for a low cost defensive weapon. The gun is to be die cast of zinc or aluminum alloy and will fire .49 caliber microrocket projectiles which are loaded into a magazine in the handle. The ignition of the rockets is by means of a percussion primer and the gun will be capable of semi-automatic fire. The .49 caliber rocket projectile is spin-stabilized and is expected to equal or surpass the lethality of the .45 caliber ACP cartridge.

Current Status: Under contract to ARPA, the H. P. White Laboratory conducted engineer design tests on the MB Associates caliber .49 gyrojet pistol and ammunition. MB Associates furnished 101 pistols and 1,000 rounds of ammunition for the tests. Preliminary report of tests indicates problems on reliability and accuracy were encountered which require correction before additional production is undertaken.



GYROJET PISTOL SHOWN IN MACHINE REST DURING TESTING

Tab 1

MICRO-ROCKET



MICROROCKET PROJECTILE SHOWN LOADED WITH PROPELLANT

Tab 1

Requirement: Crew-Served Weapons

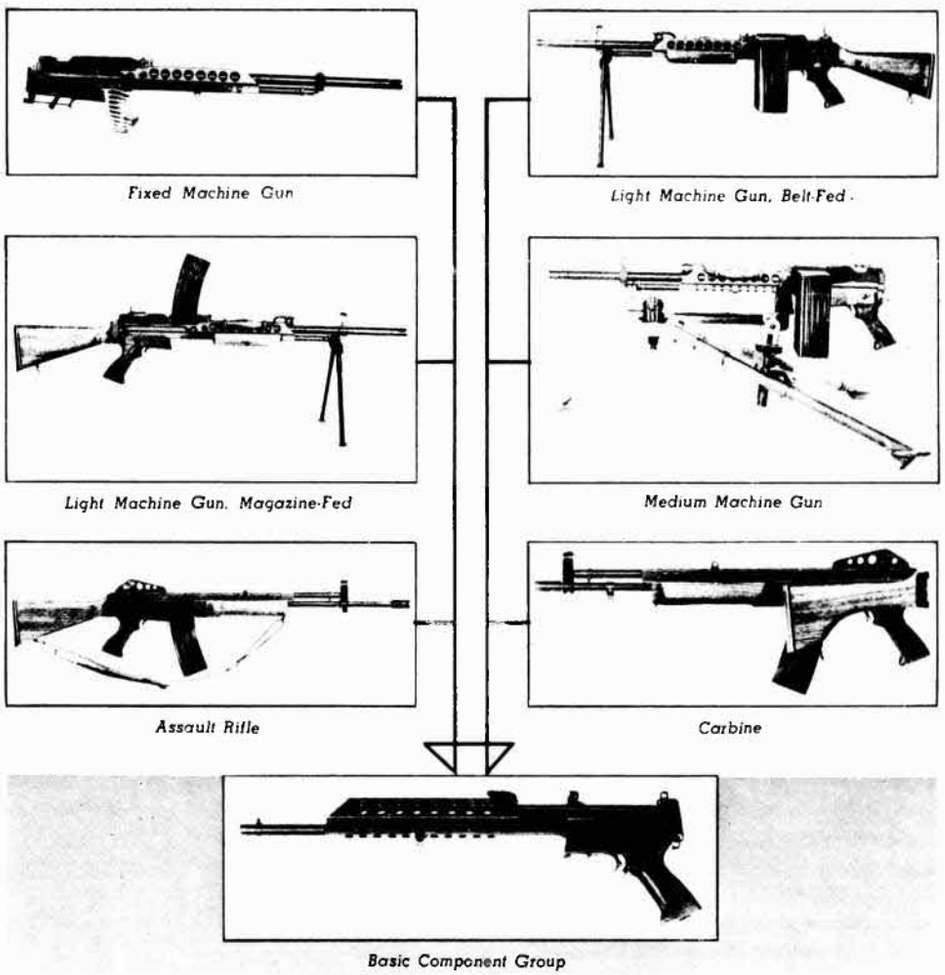
Task: Lightweight Automatic Weapons

Problem: To develop improved lightweight, automatic individual and crew-served weapons for use in small unit operations.

Description: The firepower of indigenous forces is limited by the weight of weapons and ammunition that can be carried by small units and also by the lack of a sophisticated logistics chain. This is one of several integrated tasks aimed at providing maximum kill potential for the individual and small unit; specifically, it includes belt-fed light machine guns and multiple-round salvo ammunition for use in conventional machine guns.

Current Status: A contract has been negotiated with the Cadillac Gage Company for the procurement of 25 machine guns, medium, Stoner 63, along with spare parts kits, accessories and 11,000 rounds of linked ammunition per gun for experimental evaluation. Estimated time of delivery on the Stoner 63 machine guns is August 1963. The Stoner 63 machine gun is acually a small arms weapons system. The system comprises six separate arms, all built from one common basic component group. The six configurations are: (1) fixed machine gun for use on vehicle mounts or in aircraft weapons pods; (2) light machine gun, belt fed; (3) light machine gun, magazine fed; (4) medium machine gun mounted on tripod; (5) assault rifle; and (6) folding stock carbine. The weapons system is .223 caliber, lightweight, rugged, simple to operate and maintain, and constructed primarily of sheet steel stampings.

Negotiations are underway with the H. P. White Laboratory of Bel Air, Maryland, to conduct an engineer test of the Stoner 63 caliber .223 machine gun. Testing of the Stoner 63 weapon system will be initiated by the White Laboratory during the next quarter. Plans are being made for user/service tests of the weapon system.




THE STONER 63 WEAPON SYSTEM

Tab 1

Requirement: Crew-Served Weapons

Task: Lightweight Mortars

Problem: To provide improved light mortars and mortar ammunition for use by small tactical units.

Description: Available mortars impose a severe burden in both weight of weapon and weight of ammunition. This task encompasses investigation of light metal alloys and reinforced plastic as weapon materials and development of improved ammunition which has reduced weight, increased lethal radius, and/or reduced noise level.

Current Status: The Weapons Planning Group at the Naval Ordnance Test Station will conduct a study of mortars and their application to counter-insurgency. The study will include:

(1) Historical description of mortar operations, a tabulation of mortar characteristics, and bibliography of mortar publications.

(2) Analysis of missions currently assigned to mortars to define their relevance to remote-area-conflict situations and to determine parameters of importance to weapon selection.

(3) Investigation of relevant technological state-of-the-art, e.g., propulsion, warheads, launchers.

(4) Parametric analysis of weapon performance to evaluate tradeoffs between such things as weapon range and warhead size.

(5) Conclusions and recommendations regarding the usefulness of weapon systems now in inventory, possible new weapon systems requiring minimum hardware development effort and possible new weapon systems requiring extensive hardware development effort.

Tab 1

Requirement: Special Purpose Weapons and Ammunition

Task: Portable Flamethrowers

Problem: To provide indigenous forces with portable flamethrowers which are light enough to be carried on deep patrol and which offer greatly improved range and lethality.

Description: Effort under this task is aimed at adapting pressure pumping techniques and liquid fuels developed by the rocket industry to the design of small, self-pressuring flamethrowers.

Current Status: The CDTC-V report of test on portable flamethrowers was cheduled for completion by the end of the quarter. The report will cover the tests conducted with the U. S. M-8 One-Shot Portable Flamethrower and the West German Single Burst Flamethrower. Results will be reflected in next quarter's report.

The U. S. Army Chemical Research and Development Laboratory has under investigation the feasibility and techniques for shoulder firing the M2A1 flamethrower, and also the portable flame gun attached to a fuel air section of the M 10-8.

The CRDL has been asked to submit a program proposal to ARPA to investigate the characteristics of encapsuled flame fuel weapons CRDL will consider the proposal of Armour Research Foundation in connection with the proposed program.

The Institute of Defense Analyses is currently conducting a study for ARPA to determine the potentials for improving current flame weapons and what unique flame weapons or applications should be developed for use in Remote Area Conflict.

Tab 1

Requirement: Special Purpose Weapons and Ammunition

Task: Microrocket Projectiles

Problem: To investigate the potential uses of very small caliber microrocket projectiles in various weapons systems.

Description: A feasibility study and an experimental research program has been initiated through the Bureau of Naval Weapons to investigate small caliber microrocket projectiles. Participating in this effort are the U. S. Naval Ordnance Test Station, the Naval Weapons Laboratory, the Army Ballistic Research Laboratory and MB Associates. The objective of this task is to determine, by parametric studies of small caliber rockets, the realistically achievable velocities, dispersion, sizes and weights of such projectiles in order to provide a data base for assessing their potential value in various weapons systems. Of particular interest is the possible application of these rockets in hand-held or vehicle-mounted, salvo-fired weapons designed for suppressive, quick-reaction fire to be used in countering ambushes.

Current Status: The applied research program described in the last Project AGILE Quarterly Report continued during the period. The final report on the program is due for completion during the next quarter. The report will contain data on the following:

1. Feasibility of employing microrockets for hand-held weapon application.

2. Development and evaluation of prototype units to establish the basic requirements for the design of microrockets.

3. Reliability and performance data based upon statistical numbers of ballistic assessments.

4. Fabrication techniques and materials for producing microrockets along with production cost estimates.

5. Methods for achieving the optimum over-all kill probability with microrockets in hand-held weapons including a comparison of the effectiveness of single shot, ripple, and salvo fire.

6. Ignition methods applicable for rates of fire as listed above.

7. Recommendations for the optimum hand-held microrocket weapon.

Tab 1

Requirement: Special Purpose Weapons and Ammunition

Task: Strip Bullets

Problem: To provide an increased capability for rifles and automatic weapons used against fleeting targets at short ranges. Of particular interest is an improved anti-ambush cartridge for use with available weapons.

Description: A development program has been undertaken by the U. S. Naval Ordnance Test Station on a bullet designed to improve the kill capability of small arms. Strip bullets are made of a number of short lengths of lead wire which is pressed into a die to form a core which is then clad with a thin copper foil into a conventional bullet size and shape. Upon firing such a pressed bullet through the bore of the rifle, the centrifugal force imparted by the rifling causes the strips to separate when leaving the barrel, giving a shotgun-like effect and increasing the hit probability of the weapon in quick reaction counterambush fire. This principle may be applied in weapons ranging from pistols to .50 caliber machine guns. The experimental bullets have been shown to function satisfactorily in automatic weapons such as the .45 caliber sub-machine gun and to significantly increase the hit probability of such weapons at close ranges.

Current Status: In an effort to produce strip bullets in the most economical manner, a number have been fabricated with lead as the principal material. Firing of these strip bullets has resulted in bore fouling. A test was conducted by NOTS to determine the magnitude and effect of this bore fouling on the continued firing of the item. A further objective of the test was to determine whether standard ball ammunition could be safely and effectively fired interchangeably, disregarding the bore fouling.

In preparation for the bore fouling test, 1,000 rounds of .45 caliber lead strip bullets were selected at random from a lot of 1,200 rounds. A .45 caliber submachine gun, M-3, was chosen as the test weapon due to its previous satisfactory firing of strip bullets and its design feature which permits easy removal of the barrel for examination.

Some 600 rounds of the lead strip bullets were fired through the M-3 submachine gun without the bore being cleaned. After 450-500 rounds the dispersion pattern was considerably reduced due to the lead fouling preventing the rifling in the bore from imparting sufficient rotational energy to the bullet.

Following the firing of the 600 rounds of lead strip bullets and without cleaning the bore, 50 rounds of standard .45 caliber ball ammunition were fired in two 25-round bursts. No stoppage or malfunction occurred;

however, the bore fouling did reduce the effectiveness of this type of ammunition.

Toward the solution of the bore fouling problem, copper gilding metal jackets have been fabricated for the .30 caliber lead strip bullets in much the same manner as conventional ammunition. Prototype rounds with the new jacket have been successfully loaded and fired. In addition, special cores have been fabricated from quadrant-shaped sections of lead wire.

Tab 1

Requirement: Special Purpose Weapons and Ammunition

Task: Rifle Grenades

Problem: To investigate methods of (1) launching grenades with standard rifle ball ammunition thereby eliminating the necessity for special grenade launching cartridges, (2) achieving improved fuzing, and (3) developing an air-burst capability in order to provide higher lethality per pound of weight.

Description: At the present time, experimental studies are under way at the U.S. Naval Ordnance Test Station on "bullet catching" techniques for launching rifle grenades with a standard ball cartridge. Various kinds of energy transfer mechanisms are being tested. The trade-offs between recovering the kinetic energy of the bullet as opposed to or in combination with the force of the propelling gases are being studied.

Current Status: The experimental anti-personnel rifle-gernade project under way at the U.S. Naval Ordnance Test Station is directed at meeting the following requirements:

1. The grenade should be launched from the rifle using a conventional ball or armor-piercing cartridge.

2. Equipping the rifle to launch the grenade should not prevent the rifle from being used for its normal purpose.

3. The recoil should be as light as possible.

4. The maximum range of the grenade should be similar to that of existing rifle grenades using conventional grenade-launching cartridges.

A grenade capable of being launched from the M-1, M-14 or AR-15 rifles has been developed by the U.S. Naval Ordnance Test Station. The grenade which weighs 1.3 lbs has a maximum range of 250 yds when launched from the .30 caliber M-1 or M-14 rifles and 150 yds when launched from the .223 AR-15 rifle. The energy to drive the grenade is derived from two sources, high-pressure propellant combustion products and momentum transfer from the bullet. The first source is simply the confinement of the hot gases in the rear portion of the grenade which drives the grenade like a piston. The second source of energy is momentum transfer effected by trapping the bullet in a stack of titanium disks alternated with aluminum washers. The aluminum washers serve to provide a path of least resistance which insures that the bullet is contained within the momentum transfer device while the disks have elastic properties under high-impact loading which enable effective momentum transfer from the bullet to the

grenade to be achieved. Use of this latter propulsion method results in recoil impulse of lower amplitude and longer duration than with the usual blank-fired grenade. The discomfort felt by the shooter is significantly reduced.

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# AGILE SUB-PROJECT II

# AREA FIRE WEAPONS SYSTEMS

# TAB 2

~~CONFIDENTIAL~~

## AGILE SUB-PROJECT II

## AREA FIRE WEAPONS SYSTEMS

### SUB-PROJECT OBJECTIVE:

To develop effective, or improve the effectiveness of, area fire weapons systems for both surface and tactical air employment which will provide maximum flexibility in application and superiority in fire power to the friendly local forces engaged in remote area conflicts.

### SUB-PROJECT BACKGROUND:

In remote area conflict, the primary combat unit of friendly indigenous forces is generally a company or smaller size infantry unit. These units, as a general rule, rely on individual weapons and equipment capable of being hand carried into the combat area. Opposing enemy forces are generally similarly, or less well armed and supplied; however, they do have the advantage of being able to control the time and locale and, to a great extent, the degree of contact. One method of off-setting these significant enemy advantages lies in the use of area fire supporting weapons tailored to the particular tactical and physical environment of the conflict.

Air power, in both the tactical close air support role and the offensive strike role, can provide a significant advantage to the friendly forces. However, existing air weapons systems do not provide as great a capability as is desired and can be developed within the existing state-of-the-art.

Surface based direct support weapons which can provide a pronounced fire power superiority to the friendly forces are also necessary to offset the distinct inherent advantages generally present to the opposing forces. Typical of one such advantage, and one of the most effective and common actions of the opposing forces, is the ambush. For counter-ambush action, instantaneous and saturating area fire, as well as aimed fire, is essential for enhanced survivability and successful reaction to the ambush.

### SUB-PROJECT DESCRIPTION:

To approach the objectives specified for area fire weapons systems, and to develop a capability which is optimized for the situation and environment, this sub-project is presently sub-divided into the following requirement areas. It should be recognized that the emphasis on one or more

requirements may well shift as the research and development programs involved begin to produce more measurable results, or there are changes in the underlying objectives brought about by further definition of the threats to which they are related.

1. Armament for Surface Vehicles:

The determination of the vehicle best suited falls within the mobility sub-project; the requirement identified here is for an optimum armament system to be applied to that vehicle. An armament system must be effective in both counter-ambush action as well as its offensive role.

2. Counter-Ambush Weapons:

Efforts under this requirement are directed principally to achieving optimum counter-ambush weapons systems for logistic vehicles. Such weapons systems, where possible, should have practical and effective application in other support roles of counterinsurgency actions. Optimum counter-ambush weapons must possess the features of instantaneous application and saturating area fire, as well as aimed fire.

3. Aircraft and Air-Ground Armament and Munition Systems:

In general, suitable air strike targets are mobile "people targets" consisting of only a few people (either isolated or sparsely grouped) and often protected by dense surface vegetation. In general, those equipments and systems employed in counterinsurgency actions have been those existing in the hardware state within the U.S. inventory and, for the most part, which are obsolete by U.S. standards or are surplus to U.S. needs. Even though modifications have been made to some of these equipments to improve their effectiveness, totally adequate systems have not resulted. Systems specifically designed for the intended support role and the environment are essential to achieve efficient air weapons systems. Development of a light attack/reconnaissance aircraft system, optimized to perform the various missions of this type in counterinsurgency conflicts, is being considered.

4. Surface Based Direct-Support Weapons:

Support weapons, effective against the targets described in 3 above and sufficiently mobile to be efficiently employed in the environment, are urgently required to provide the friendly indigenous tactical unit with a

marked superiority in fire power over the opposing forces. The weapons must be sufficiently light to be carried or towed intact by a light vehicle (a helicopter or jeep) with possible greater weight limitations imposed by the environment. They must also be capable of being readily broken down into a limited number of units which are reasonably man portable and then capable of being quickly reassembled into functionable weapons. The ammunition must be sufficiently light in weight so that a usable amount may accompany the weapons without undue manpower requirements.

REQUIREMENTS AND TASKS:

Listed below are those major requirement areas and the status of tasks with which Sub-Project II is concerned. Succeeding pages are summaries of the purpose and the current status of each task.

1. Armament for Surface Vehicles

   A. Cupolas for the M-113 Armored Personnel Carrier

2. Counter-Ambush Weapons

   A. Quad Machine Guns

   B. Salvo Squeeze Bore .50 - .30 Caliber Machine Gun

   C. Multiple Grenade Launchers

   D. Mobile Flame Throwers

3. Aircraft and Air-Ground Armament and Munition Systems

   A. Counterinsurgency Aircraft

   B. Delayed Proximity Fuzes

   C. 2.75" Rocket Launcher Systems

   D. Target Marking Munitions and Devices

   E. Anti-Personnel Bombs

   F. Illuminating Flares

4. Ground Based Direct-Support Weapons

   A. "State-of-the-Art" Survey

Tab 2

Requirement: Armament for Surface Vehicles

Task: Cupolas for the M-113 Armored Personnel Carrier

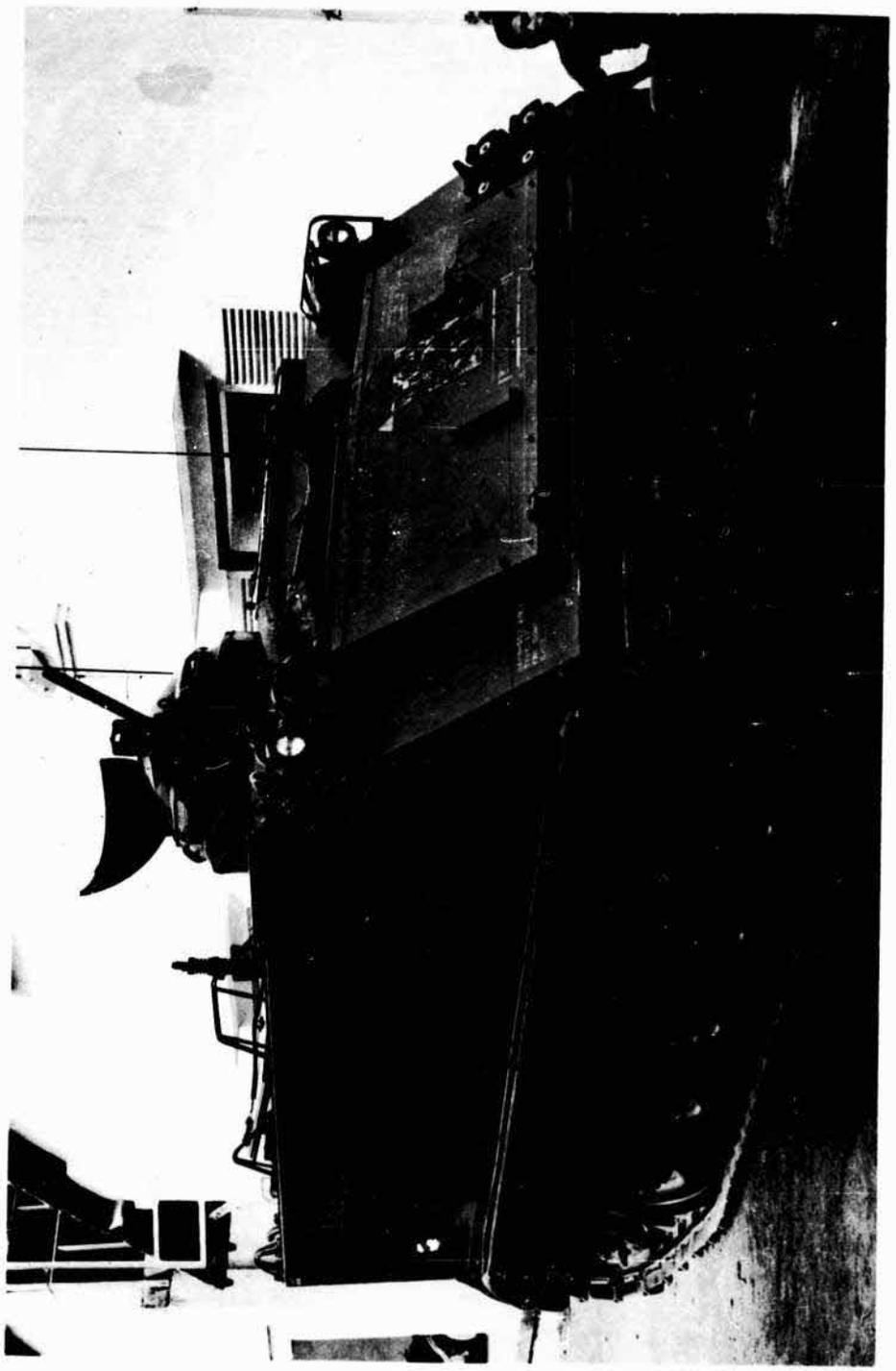
Problem: Armament, in addition to armor, is required for vehicles employed in patrol, convoy escort, and similar roles. Besides the normal offensive fire power requirement, the threat of ambushes requires the capability for instantaneous area and aimed fire reaction.

Description: Complete self-protection in the form of armor is impractical for application to all vehicles of concern. Overwhelming fire power must be combined with sufficient armor to provide reasonable protection to the vehicle and armament operators if the weapon system is to be effectively employed in a combat role. The capability for convoy escort or patrol vehicles to survive the initial fire of an ambush and immediately return saturating area fire is required. Further, this capability can be expected to act as a strong deterrent to the setting of ambushes by the opposing forces.

Current Status: Evaluation of gunner shields, which were locally manufactured out of scrap-armor steel plate as an interim measure while awaiting closed cupolas, is continuing in RVN. It is estimated that a final evaluation report will be available within 90 days.

Modification of the five Navy cupolas was completed in April, and limited CONUS tests were performed by the Army CDEC at Fort Ord, California. As a result of these tests, further modifications were made to the cupolas. Four of these cupolas, complete with spacer rings and machine guns, were then air shipped to RVN in mid-May. The monthly CDTC-V report for June indicates that these cupolas have been installed and are being evaluated; however, there are no reports to indicate whether any of the cupolas have been exposed in military actions.

Work is progressing satisfactorily on the ten cupolas being fabricated by Aircraft Armaments, Inc. The first unit is scheduled for completion by mid-July. CONUS testing will commence immediately on that unit. It is anticipated that these cupolas can be at CDTC-V for test and evaluation by late October or early November this year.



A MODIFIED NAVY CUPOLA IS SHOWN INSTALLED ON AN M-113 ARMORED PERSONNEL CARRIER

Tab 2

Requirement: Counter-Ambush Weapons

Task: Quad Machine Guns

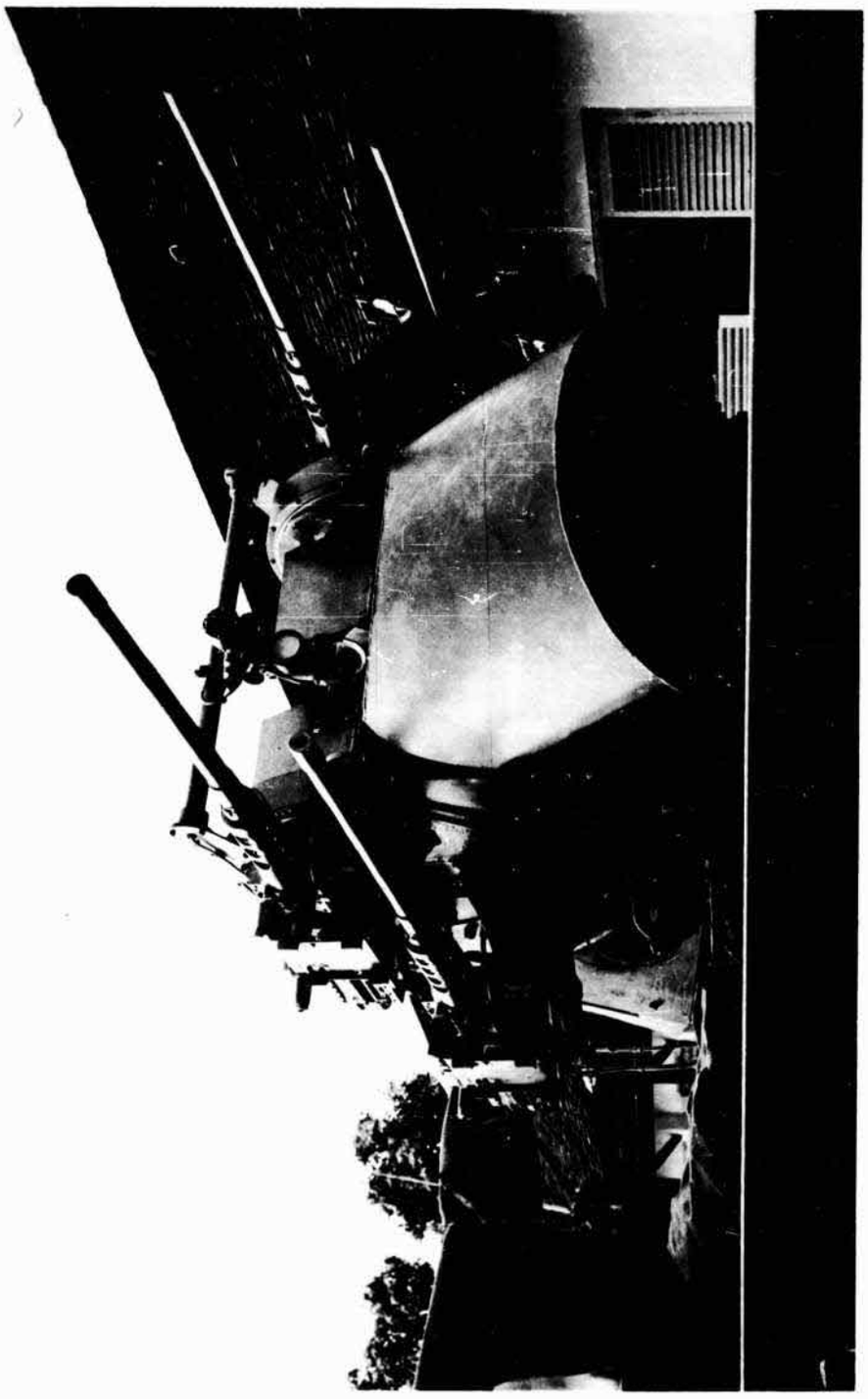
Problem: To provide a capability for applying immediate and saturating area return fire in counter-ambush actions. The ability to apply saturating area fire can be expected to provide a strong deterrent to setting ambushes as well as to provide effective counter-ambush action capabilities.

Description: Quad mounted machine guns mounted in patrol, convoy or convoy escort vehicles appear promising as a solution to this problem. The high rate of fire of Quad mounted machine guns provides a good saturating fire to a reasonably large area from one vehicle such as patrol or scout vehicles. In convoys where several vehicles may have Quad mounts, a large area can be swept with nearly instantaneous saturating fire.

Current Status: As of 30 June the CDTC-V reports that the test and evaluation of the Quad caliber .50 machine guns is proceeding on a routine basis and should be completed by the end of August.

It has been determined that it is feasible to mount high cyclic rate caliber .30 machine guns on the Quad 50 mounts. However, it also has been determined that this approach is not practical for at least two reasons. First, the desired machine guns are at present not available in sufficient quantity. Second, the .30 caliber machine guns would be greatly "over mounted" in the Quad 50 mount with the attendant unneeded bulk and excessive weight.

Tab 2



A QUAD 50 IS SHOWN INSTALLED ON A 2-1/2 TON TRUCK FOR USE WITH THE CONVOY PROTECTION UNIT AS AN INSTANTANEOUS AREA FIRE WEAPON TO COUNTER AMBUSH ATTACKS

Tab 2

Requirement: Counter-Ambush Weapons

Task: Salvo Squeeze Bore .50 - .30 Caliber Machine Gun

Problem: To provide a capability for applying saturating area fire to deny choice ambush positions to the enemy and to provide the capability of applying instantaneous area fire in counter-ambush actions. The ability to apply saturating area fire can be expected to provide a strong deterrent to setting ambushes as well as to provide effective counter-ambush capabilities.

Description: The feasibility of increasing the effective fire power of a single machine gun by barrel modification and employing special ammunition has been demonstrated. For a .50 caliber machine gun the increase in fire power is a factor of five. The technique is to fire one caliber .50 cartridge, fitted with a special bullet, through a squeeze bore barrel which separates the bullet into five individual caliber .30 projectiles. These projectiles emerge from the barrel in series and strike the target in salvo. If the practicality of this approach is verified, this increase in fire power will be significant in applying saturating area fire in counter-ambush actions and also should have application in close air support and other tactical roles in counterinsurgency action against soft targets.

Current Status: Testing of the squeeze bore barrels and ammunition has not progressed at the rate anticipated when the last Quarterly report was written. Informal information from the Limited War Laboratory indicates that the test report will be available very soon.

Tab 2

Requirement: Counter-Ambush Weapons

Task: Multiple Grenade Launcher

Problem: To provide a capability to immediately apply saturating area fire for counter-ambush actions. The ability to apply saturating area fire can be expected to provide a strong deterrent to setting ambushes as well as to provide effective counter-ambush action capabilities.

Description: For medium and close-in ranges, salvo delivery of appropriate anti-personnel type munitions would appear to be an effective means of applying area saturating, quick reaction fire for counter-ambush action. The Army has developed and tested a multiple launcher capable of salvo firing a variety of desirable munitions. This launcher unit is readily mountable on a variety of surface vehicles and is subject to manufacture with minimum skills and materials normally available in-country. With HE grenades there is a "dead" area from 0 out to 35 meters. This is the area from vehicle side out to the minimum safe distance for HE grenade employment. Auxiliary devices must be provided to cover this area.

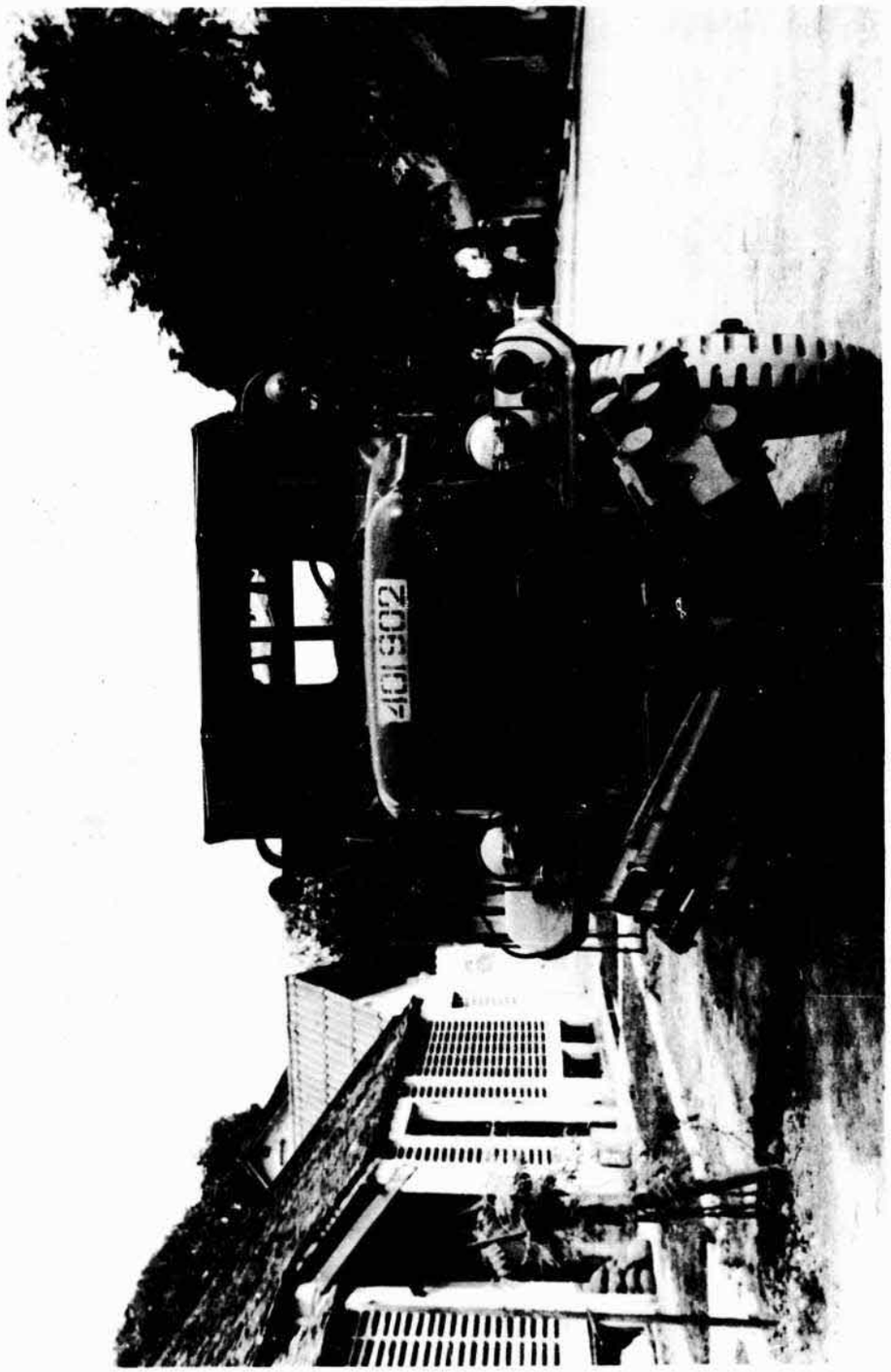
Current Status: Training of the indigenous Convoy Protection Unit personnel in the use of the multiple grenade launchers is continuing. Four sets of Task V type grenade launchers were locally fabricated to allow six sets for the use of the unit. The CDTC-V estimates that field tests and evaluation of these multiple grenade launchers will be completed by the end of August.

The CDTC-V has designed and fabricated locally a blunderbuss (essentially an oversize sawed off shotgun shooting ball bearings) as an interim short range ancillary device to the grenade launchers. It is intended that this weapon be mounted either under or on the truck bed and fired by either manual or electrical means. Fire testing of the blunderbuss has just started. The CDTC-V reports that they are still experimenting with the Claymore mine as a short-range device.

The Army Limited War Laboratory is currently testing a reduced-charge Claymore (frontal about 2" x 2" and known as a Claymorette) for this purpose. Test results should be available in about 30 days. Also the LWL is expecting delivery of their shotgun system from Remington Arms Company early in August. This system is made up of 48 guns of 8" barrel length. Each cartridge will fire 41 pellets of No. 4 magnesium buckshot. A continuous-salvo fire or a ripple of 3 barrels at a time is planned for the firing sequence.

Up to this time the use of Gyrojets (small rockets of .25 to .50 caliber) as projectiles in area-fire armament systems has not shown any great promise.

Tab 2



TASK V TYPE MULTIPLE GRENADE LAUNCHER INSTALLED ON FRONT END OF RVN 2-1/2 TON TRUCK

Tab 2

Requirement: Counter-Ambush Weapons

Task: Mobile Flame Throwers

Problem: To determine the suitability and utility of large-capacity, long-range, mobile flame weapons as anti-personnel area fire weapons in remote area conflicts.

Description: The M10-8 flame unit is being tested under this task. It has a capacity of 200 gallons of fuel and a maximum range of about 200 meters. The fuel can be ejected in a continuous stream and the system has sufficient fuel capacity for approximately 40 seconds of continuous operation. Installation of the M10-8 flame unit has been standardized for the M-113 armored personnel carrier and it can also be adapted to other vehicles having sufficient load-carrying capacity.

Current Status: A final test report of the M10-8 flame unit, "OPERATIONAL TEST OF THE M10-8 FLAME UNIT", 25 April 1963, has been received from the CDTC-V. The report concludes that large-capacity, mobile flame throwers are useful in areas of Vietnam where VC tactics include fighting from prepared positions. It also concludes that the mobility of the M-4 Service Unit is not compatible with the mobility of the M-113 which was the carrier of the 10-8 flame unit. Specific conclusions, recommendations and deficiencies noted during testing are identified in the official report.

This subtask is considered complete and will not appear in future reports.

Tab 2

Requirement: Aircraft and Air-Ground Armament and Munition Systems

Task: Counterinsurgency Aircraft

Problem: To determine specifications for and develop a light attack/reconnaissance aircraft system optimized to perform the various missions of this role in counterinsurgency actions.

Description: Included in the initial characteristics considered for such an aircraft are: lightweight; very short STOL capabilities; operational capability from roads, rivers and canals in a severe and austere environment; simple and easy maintenance and support; effective support armament and target sensors for all suitable targets; and communications and navigation systems which are compatible with other ground and air systems and low altitude operations.

Current Status: An OSD decision has been made to proceed with Phase I of the light attack/counterinsurgency aircraft program. Phase I is to be a three-month time limited, funded technical feasibility and cost study to include preliminary design studies, wind-tunnel tests, cost estimates, and schedules for both the development program and the production aircraft. This program will be a combined OSD/Service effort under the auspices of a steering group with the Assistant Secretary of Navy, R&D, as chairman.

ARPA will participate in this program as part of Project AGILE and will have representation on the Steering Committee.

It is anticipated that a Request for Proposal will be issued to industry in the near future for the technical feasibility and cost studies. From these proposals, it is planned that three independent contractors will be chosen to participate in Phase I.

Tab 2

Requirement: Aircraft and Air-Ground Armament and Munition Systems

Task: Delayed Proximity Fuzes

Problem: To achieve effective detonation of high-explosive bombs against personnel targets shielded by jungle canopy. The optimum detonation point of HE bombs against multiple soft targets is generally considered to be three bomb lengths above the inhabited surface.

Description: The jungle canopy acts as a reflecting plane for proximity fuzes and initiates detonation of the bomb generally at or above tree top level. This renders the munition ineffective against the target (primarily people) when shielded by a jungle canopy. To allow effective use of HE bombs as anti-personnel munitions, it is necessary to achieve detonation delay after activation of the fuze to allow the bomb to penetrate to below the jungle canopy before detonation and, ideally, above ground level. Based upon the general average jungle canopy height and thickness, a time delay feature of 75 milliseconds has been incorporated in Standard M-188 proximity fuzes which will yield a general detonation height of 10 to 50 feet above the ground in jungle. A standard impact fuze is used to provide contact detonation in cases where the canopy is not sufficient to activate the proximity fuze.

Current Status: Environmental tests and evaluation of the XM914 in the RVN have been completed. The final report on this fuze is scheduled to be published in July. All fuzes remaining after the test program have been transferred to operational units for their use.

Shipment of the XM914E1 fuze (the reduced MinSAT version) is still being withheld pending results from the CONUS tests being conducted at Eglin AFB. Results are expected momentarily, and it is expected that the fuses will be released for shipment before the end of July.

Tab 2

Requirement: Aircraft and Air-Ground Armament and Munition Systems

Task: 2.75" Rocket Launcher Systems

Problem: To evaluate the 2.75" rocket and the various available launchers as an aerial munition for counterinsurgency operations.

Description: The U.S. Air Force and the VNAF in RVN have both the standard LAV-3 (19 rocket capacity) and the MA-2 (2 rocket capacity) launchers for the 2.75" FFARS. Sequencing switches for the LAV-3 launchers which allow selection of fire of two rockets at a time vs. a one shot ripple fire of the entire bank of rockets were provided for evaluation.

Current Status: A summary report on the accomplishments by the CDTC-V in mating the 3.5 inch white phosphorous warhead to the 2.75 inch rocket is expected by 1 August 1963. Future reference and reporting on this item will be under the heading of Target Marking Munitions and Devices.

This specific title as a subtask will be deleted from future Quarterly Reports.

Tab 2

Requirement: Aircraft and Air-Ground Armament and Munition Systems

Task: Target Marking Munitions and Devices

Problem: To mark ground targets, air strike locations, drop zones, etc. The mark must be effective when employed in all types of terrain (to include heavy jungle area and swamps), be visible by the unaided eye from a distance of 10 miles at altitudes of 4,000 feet. "Marks" for air strike purposes must have a duration of at least five minutes. In some instances, "marks" to identify drop zones, etc., must be capable of ground emplacement, of longer duration and be retrievable.

Description: The heavy jungle canopy generally contains the smoke emitted by normal smoke grenades or smoke pots and renders them ineffective as markers. When air delivered, soft, marshy areas extinguish the grenades upon impact. For these smoke devices to be effective as markers in jungle when air delivered, some device which will cause them to hang and burn on the top of the jungle canopy is required.

A small, readily deployable tethered balloon appears to be a promising choice for a longer duration, ground deployed position marker.

Current Status: A final report on the CDTC-V test and evaluation of the E72R1 smoke munition as a target marker is expected by 1 August 1963. Preliminary information indicates that generally this munition is a satisfactory target marking device except when employed over swamp or water areas. It is also indicated that recommendations will be made for several modifications to the munition.

A new target date for the demonstration to be given ARPA on ground-deployed tethered position marker systems is now mid-August. Some unanticipated technical difficulties have been encountered in the system employing hydrogen, which was the system of greatest interest to AGILE.

Tab 2

Requirement: Aircraft and Air-Ground Armament and Munition Systems

Task: Anti-Personnel Bombs

Problem: To determine the best available munitions for anti-personnel application in the environment, those modifications which will increase their effectiveness, and the R&D requirements to achieve optimum munitions.

Description: The scattered nature and size of the targets (normally small numbers of fleeting people), generally dispersed and often protected by heavy vegetation or jungle canopy, render normal HE munitions inefficient and often ineffective. Effective area coverage, fragmentation effect, and jungle penetration capability are required characteristics of munitions.

Current Status: No report is expected on the use of the AN-M1A2 cluster of M41 twenty pound fragmentation bombs which are in operational use by the VNAF. The CDTC-V states that these bomb clusters are regarded as one of the most effective air weapons being used by the VNAF.

Field tests have determined that neither the XM914 proximity fuze nor the standard M-166 proximity fuze is compatible with the MK 54 depth bomb. Further evaluation will be made with the normal fuze backed up by a tail fuze fitted in the rear fuze well which is normally used for hydrostatic fuzing.

Requirement: Aircraft and Air-Ground Armament and Munition Systems

Task: Illuminating Flares

Problem: To determine suitable aerial dispensed illuminating flares for night tactical operations.

Description: The standard MARK 6 MOD 6 aircraft illuminating flare in use in RVN possesses suitable dispensing characteristics (safe for release by hand) but does not provide sufficient burning time or light intensity. M-138 and M-139 flares provide improvement in burning time and light intensity but are unsafe for hand delivery because of fuzing arrangements. A practical approach to this problem appears to be a different fuzing arrangement for the M-138/M-139 flares.

Current Status: There have been no significant changes in the status of this sub-task during this reporting period.

Requirement: Ground Based Direct-Support Weapons

Task: "State-of-the-Art" Survey

Problem: To provide that support to tactical units engaged in counterinsurgency actions necessary to achieve a marked superiority in fire power over the opposing forces.

Description: This requirement is for support weapons highly effective against counterinsurgency type targets and sufficiently mobile to be efficiently employed in the environment. Such weapons need not be restricted by caliber as long as the projectile possesses the desired characteristics. A weight limitation must be imposed as the weapons must be sufficiently light to be carried or towed intact by a light vehicle (a helicopter or jeep). They must also be capable of being readily broken down into a limited number of man packable units and then quickly reassembled into functionable weapons. The ammunition must be sufficiently light in weight so that a usable amount may accompany the weapons without undue manpower requirements.

Current Status: The Weapon Project Team (WPT) effort has been placed in Sub-Project VII and is reported in Tab 8 under the task "Weapons Systems Studies and Research". No further reports will be made under this task title for Sub-Project II until further requirements are defined which become specific sub-tasks in this task area.

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# AGILE SUB-PROJECT III

# REMOTE AREA MOBILITY AND LOGISTICS SYSTEMS

## TAB 3

~~CONFIDENTIAL~~

## AGILE SUB-PROJECT III

## REMOTE AREA MOBILITY AND LOGISTICS SYSTEMS

### SUB-PROJECT OBJECTIVE:

To improve all aspects of air, ground, and water mobility capabilities of friendly indigenous forces engaged in remote area conflict. Included are land vehicles, aircraft, and watercraft for transport of tactical units and for the delivery of supplies and equipment in support of military operations.

### SUB-PROJECT BACKGROUND:

1. General Discussion

Remote area conflict typically requires military operations where the topography and climate preclude or minimize the use of conventional military mobility equipment. Many novel vehicles have been developed to meet requirements for operation in swamps, on muskeg, and in forests and marshes of the U.S. and Canada, but there are other areas of the world in which no systematic approach to the basic military problems of mobility has been attempted. Such an area is Southeast Asia where the geomorphological aspects including extremes of rainfall, man-made features such as rice paddies and canals, lack of roadways, shallow, vegetation-choked waterways, and few improved airfields present formidable barriers to mobility. Conventional wheeled, tracked and amphibious vehicles are roadbound or have an extremely limited off-road mobility capability in many parts of this area, especially in the rainy season. Conventional watercraft and aircraft also often lack satisfactory design and performance characteristics for the environment.

Similarly, remote area conflict situations have unusual requirements for aerial resupply. Again, topography, vegetation and climate render conventional techniques ineffective and wasteful. New techniques of aerial resupply must be developed appropriate to the region and type of operation.

2. Ground Mobility

Present day development of ground vehicles remains essentially an empirical art. Study of available records and interviews with experienced design personnel, both in government and in industry, reveal that the scientific approach has rarely been applied to land vehicles. Rather than adapt the ground system to its operating environment, man has generally chosen to adapt the environment to the system through the construction of roads, bridges, tunnels, etc. Consequently, modern mechanized armies have become increasingly dependent upon road nets for mobility and logistical support. When confronted with environments having only rudimentary transportation networks, as in Korea and South Vietnam, the movement of modern forces is reduced to, or less than, that of "backward" peoples, who are capable of operating without established road systems. This lack of true mobility was a major contributing factor to the defeat of the French forces in Indochina.

Project AGILE will undertake to achieve an improved remote area mobility capability through a three-way research program:

1. Mobility Environmental Research Studies (MERS).

2. Mobility Research and Testing (MORT).

3. Vehicle Test and Evaluation (VETE).

3. Mobility, Ground and Water

The interfaces between air, ground and water present serious, unique mobility problems. Here we must be concerned with devices optimized for waterborne performance, but which retain a high capability for mobility over land and over obstacles of various types. Since operations must be conducted in this boundary zone in certain areas susceptible to involvement in remote area conflicts, this sub-project is investigating approaches to the interface problem areas under the headings: Delta mobility; propulsion systems for shallow, vegetation choked waters; and hull designs particularly suited to the environment.

4. Mobility, Air

Remote area operations place a premium on air mobility. This task is concerned with improvement of air mobility in remote areas, where restrictions of weather, topography, and lack of facilities are acute.

CONDUCT OF PROGRAMS

1. MERS: A detailed study will be made of the factors of the environment in Southeast Asia which are related to surface vehicle mobility to gain the basic data required to develop design parameters, tools, and techniques for use by military and civilian agencies in the development of vehicles capable of satisfactory off-road operation under remote area conflict conditions. Necessary information includes data on soil properties, terrain geometry, effects of climate and weather on soil and terrain, temperature and humidity ranges influencing engine and mechanical design, effects of the environment on deterioration of vehicle materials, and size and spacing of trees, rocks, ditches, etc., which constrain vehicle design parameters.

2. MORT: Studies will be conducted and selective tests run to develop quantitative requirements and characteristics, in engineering terms, for the development, or acquisition for test, of an item or system of material to perform a specific military function in SEA. Advanced vehicles, embodying unique design approaches, and/or improved components, have been selected with the advice of qualified Service development experts. These items will be subjected to controlled tests over carefully defined and selected courses, to determine the value for the intended user in a given remote area of selected concepts, components and configurations. Tests will be conducted by the indigenous armed forces concerned under the direction of CDTC, Bangkok, and in coordination with MAAG personnel.

3. VETE: Selected materiel items and systems currently available from military or civilian sources will be tested to determine their immediate suitability for adoption by indigenous armed forces engaged, or likely to be engaged, in remote area conflicts. Tests will be conducted by and for the indigenous armed forces concerned, under the direction of CDTC, Bangkok, and CDTC, Saigon, based on requirements developed by the U.S. and host nation Commands, the CDTC's and the ARPA staff. The ARPA staff and the CDTC's will then review currently available equipments with competent development agencies; upon determination that an existing item has a reasonable probability of satisfying the requirement, such items will be procured, modified if required, and shipped to the appropriate CDTC for test and evaluation.

4. DELTA MOBILITY: The problem of military mobility in the Delta is critical. The road network is sparse; the terrain is spotted with marshes and rice paddies; and throughout the Delta there is an intricate complex of inland waterways and shallow, weed-choked creeks. Tidal

fluctuations and seasonal variations change the entire nature of much of this network of waterways and introduce additional problems of terrain and currents. This is complicated by the necessity to avoid exotic, elaborate, or complex amphibious vehicles or surface craft.

This task will develop boats and amphibious vehicles which will substantially increase military mobility in delta areas while retaining simplicity and ease of maintenance. The task will involve analysis of the performance, capabilities and limitations of vehicles in use in delta operations. It is divided into two sub-tasks: small craft and amphibious vehicles.

5. MOBILITY, AIR: The Services are actively engaged in research on aircraft for remote area operations; this project is monitoring those programs. Additionally, the STOL Caribou aircraft is under evaluation in Southeast Asia. At present this task is concentrated on problems of aerial delivery and pick-up in remote areas. Several sub-tasks are in progress, the major of which concerns use of the flex-wing principle for aerial delivery.

REQUIREMENTS AND TASKS:

Listed below are those major requirement areas, and the status of tasks in each area, with which this project is concerned. Succeeding sheets are summaries of the purpose and current status of each task.

1. Mobility Research
   - A. Mobility Environmental Research (MERS)
   - B. Mobility Research and Testing
   - C. Vehicle Test and Evaluation
   - D. Ground Mobility Logistics Analysis
   - E. Route Capacity Formula
2. Mobility, Ground and Water
   - A. Delta Mobility
     - (1) Small Craft
     - (2) Amphibious Vehicles
   - B. Propulsion Systems for Shallow, Vegetation Choked Waters
   - C. Special Hull Designs
3. Mobility, Air
   - A. STOL Troop/Cargo Aircraft
   - B. Remote Area Airstrip
4. Aerial Pick-up and Delivery
   - A. Flex-Wing Development
   - B. Disposable Parachutes

Tab 3

Requirement: Mobility Research

Task: Mobility Environmental Research (MERS)

Problem: To gain basic data requisite to the construction of design parameters for use by military and civilian agencies in the development of vehicles capable of satisfactory off-road operation in remote area conflicts. Necessary information includes that on soil properties, terrain geometry, effects of climate and weather on soil and terrain, temperature and humidity ranges influencing engine and mechanical design, effects of the environment on deterioration of vehicle materials, and size and spacing of trees, rocks, vegetation, etc.

Description: A program of experimental scientific research will be conducted in selected portions of Southeast Asia on those aspects of the physical environment directly related to surface vehicle mobility. The object is to produce design parameters in consolidated or tabular form. This effort, which could extend through FY 66, will be closely coordinated with an operations research analysis directed toward integrating all data into a refined design tool. Several advanced-design vehicles have been procured for use in the program.

Current Status: A short-term mobility team, provided by the Army from in-house resources, has completed a six-month preliminary study of the environment of Thailand. This study has further delineated the problem areas to be studied during the long-range program. Planning has been initiated for the long-term program, key personnel have been designated to head the project, and the US Army Engineers Waterways Experiment Station (WES) has been designated as the operating agency. A Technical Advisory Committee reviewed the planned program and suggested improvements, which have been incorporated into the plan. It is anticipated that several study projects will be initiated in the US, and field work will start in Thailand, during the next quarter. One of the experimental vehicles, the Gamma Goat, has completed its tests in Southeast Asia under seven major categories - engineering, vegetation, rice paddy, jungle trail, fordability, gradeability, obstacle and trafficability. Results indicate that this design concept permits the attainment of substantially greater off-road mobility than has been previously possible with wheeled vehicles, provided no changes are made which tend to increase wheel loading and certain critical dimensions. The complete test report has been distributed.

Tab 3

Requirement: Mobility Research

Task: Mobility Research and Testing

Problem: To conduct studies and selective tests in order to develop quantitative requirements and characteristics, in engineering terms, for the development, or acquisition for test, of an item or system of material to perform a specific military function.

Description: A program of controlled testing of selected items of equipment will be conducted over carefully defined and selected courses, to determine the value for the intended user in a given remote area of novel components, configurations, and concepts.

Current Status: Vehicles currently programmed for this task are:

| | |
|---|---|
| Gamma Goat | - Tests Completed |
| Thiokol Trackmaster | - Tests Under Way |
| Nodwell 110D Cargo Carrier | |
| Chance-Vought XM561 Test Rig | |
| M274 Army Mule Unmodified | |
| M274 Army Mule Modified | |
| Dura-Kat Tracked Scooter | |
| Dyna-Mite Wheeled Trail Vehicle | |
| Dodge W-300 Power Wagon | |
| Thiokol Spryte | |
| XM571 Articulated Tracked Cargo Vehicle | |
| M116 Cargo/Personnel Carrier Vehicle | |
| JERED Asp Platform Vehicle | |
| JERED Viper Platform Vehicle | |
| Centipede Vehicle | - Tests Suspended |
| Tote-Goat Scooter with Trailers | - Tests Under Way |
| JIGER | - Tests to start 1st Quarter, FY64 |

It should be noted that these vehicles were selected jointly by ARPA and the Army as representative of various classes of vehicles, the design characteristics of which are particularly suited to operation along jungle trails or through rice paddies and swamps. All vehicles are to be first tested and evaluated in CONUS and are considered as engineering test beds to evaluate power, traction, steering, load-carrying capability, maneuverability, etc., of the various system concepts incorporated in these vehicles. Additionally, certain of these vehicles are to be employed to validate the data gathered during the MERS Program to insure that the empirical analysis resulting therefrom is demonstrably

sound. Thus this portion of the overall mobility sub-project is not intended to be an evaluation of each vehicle, per se, although in the case of the Gamma Goat test, additional data were collected to assist the Army.

The report on the Gamma Goat entitled "Test of the Gamma Goat in Thailand" was completed and distributed.

The Centipede vehicle, which incorporates an unusual traction concept and manual remote control cable was selected as an engineering test bed to determine the feasibility of utilizing these concepts in trail and mountain vehicles. While CONUS tests by the Army Tank Automotive Command have demonstrated the value of these concepts, and vehicle performance in rough hilly areas has been exceptionally good, engineering deficiencies are such that the overseas test program has been suspended. The demonstrated features, however, are to be incorporated in a new design being prepared by an engineering organization in Detroit.

A new group of Thai engineers is currently being trained to work on vehicle test programs.

Tab 3

Requirement: Mobility Research

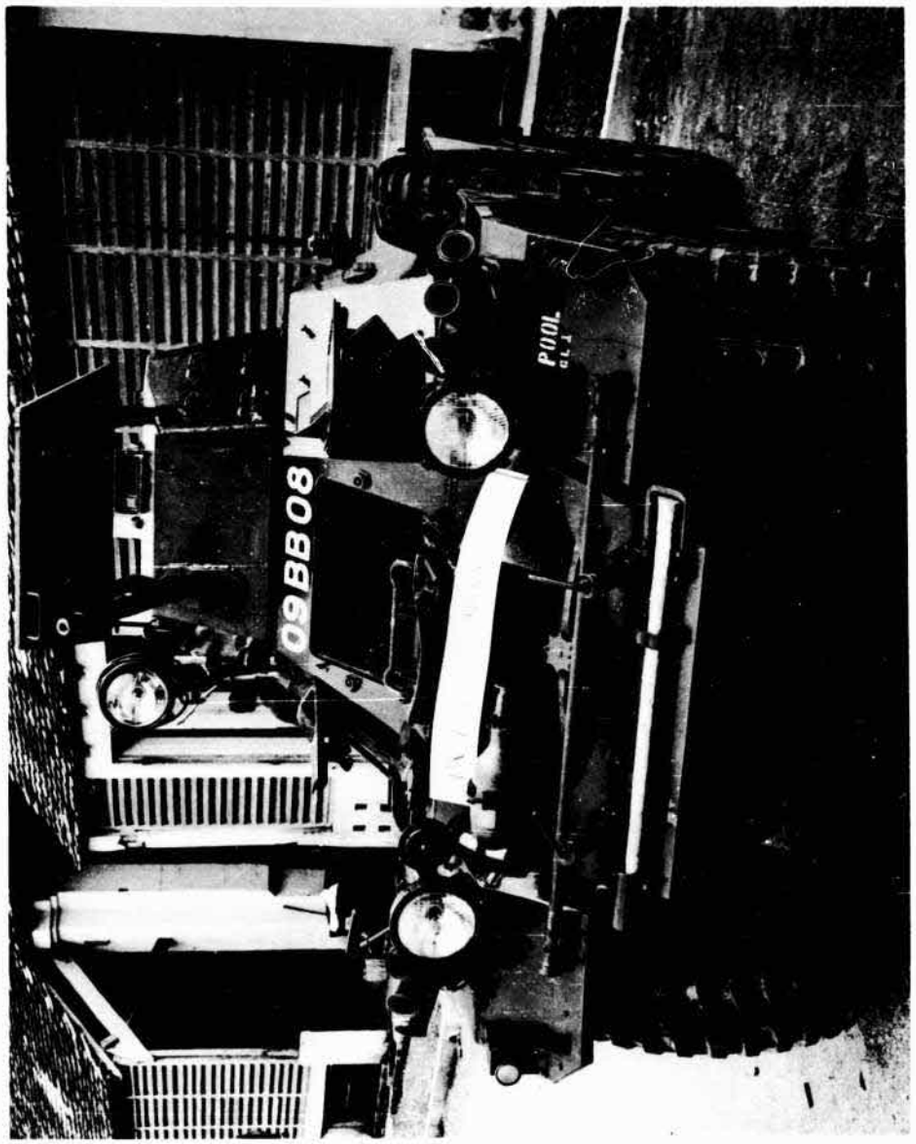
Task: Vehicle Test and Evaluation

Problem: To test selected items or systems of materiel, currently available from military or civilian sources, to determine their suitability for adoption by indigenous armed forces engaged, or likely to be engaged, in remote area conflict.

Description: A program consisting of tests of selected items by and for indigenous forces in their own environment, under ARPA auspices, to determine the suitability of the items to satisfy immediately a pressing military requirement.

Current Status: CDTC-V established a requirement for a wheeled armored car to escort truck convoys. Review of available and developmental equipments, with the assistance of qualified Army Development personnel, indicated the British Ferret and the developmental Cadillac Gage "Commando" armored cars as the two best systems currently available for this purpose. Two UK Ferret Mark 2 armored cars have been released to the ARVN Armor Command and are being evaluated by ARVN personnel under MAAG and CDTC-V supervision. Three Cadillac Gage armored cars are under construction in the U.S. Two of these are funded by ARPA, one by the U.S., Army Materiel Command, Army Tank Automotive Center (ATAC). One of these cars was tested at Aberdeen, Maryland, by the Test and Evaluation Command, AMC during the last reporting period. The only failures reported involved breakage of the hydraulic winch cable and two severe hydraulic leaks. Modifications resulting from these tests will be incorporated in the vehicles on the production line. The two ARPA vehicles are being equipped with a newly designed turret, armed with twin .30 caliber machine guns. One of these cupolas was given acceptance tests at Erie Depot, where it was found that the hull roof deflected considerably when the armament was fired. Additional reinforcing members to increase hull rigidity and several other minor modifications were incorporated into the second vehicle, which was delivered to Aberdeen on 14 June. It is currently undergoing armament testing and 1100 miles of endurance testing, following which the final phase concerned with determining the amphibious capabilities of the vehicle will be conducted.

Tab 3




THE UK FERRET ARMORED CAR. CDTC-V HAS BORROWED TWO OF THESE CARS FROM THE BRITISH FOR TEST IN VIETNAM AS A POSSIBLE REPLACEMENT FOR THE OBSOLETE M-8 ARMORED CARS NOW IN USE THERE. THE LATTER ARE WORN OUT.

Tab 3

Requirement: Mobility Research

Task: Ground Mobility Logistics Analysis

Problem: To accomplish a broad study of mobility requirements for a spectrum of potential conflicts in Southeast Asia.

Description: An analysis to consider, in conjunction with the trafficability study being made separately under Project AGILE in Thailand, weapons and weapons systems, command, control, transportation, communication and supply problems peculiar to SEA. This will supplement MERS by defining mobility requirements more precisely from the operational standpoint.

Current Status: The study of capacities and potentials of Thailand's rivers, canals, railways, roads and air facilities to provide essential logistics support for various levels of armed conflict continues as addi tional personnel become available. A preliminary paper on the POL supply block is expected shortly.

Tab 3

Requirement: Mobility Research

Task: Route Capacity Formula

Problem: To derive a route capacity formula applicable to the environment of SEA to be used by logistics planners within the Theater.

Description: Current practice within the USARPAC is to use a modification of the NATO route capacity formula in calculating logistics requirements for SEA. This formula, developed for use within continental Europe, is not completely satisfactory for SEA; USARPAC requested ARPA to furnish a revised formula for their use in determining logistic requirements. Two employees of RAND Corporation have undertaken a study to develop a new formula for SEA. This new formula will be based on analysis of the road networks, traffic patterns, and operational necessities of the Theater. USARPAC has furnished a consultant to assist in the program.

Current Status: The draft report describing the results of this study is now being reviewed and edited. Additional data involving the effects of the wet season on road traffic will be obtained during the next quarter.

Tab 3

Requirement: Mobility, Ground and Water

Task: Delta Mobility - Small Craft

Problem: The road network in the Mekong Delta is meager, but there is an intricate complex of rivers, canals, and creeks. A shallow draft boat which can navigate a large number of these at high speeds can make a significant contribution to mobility there.

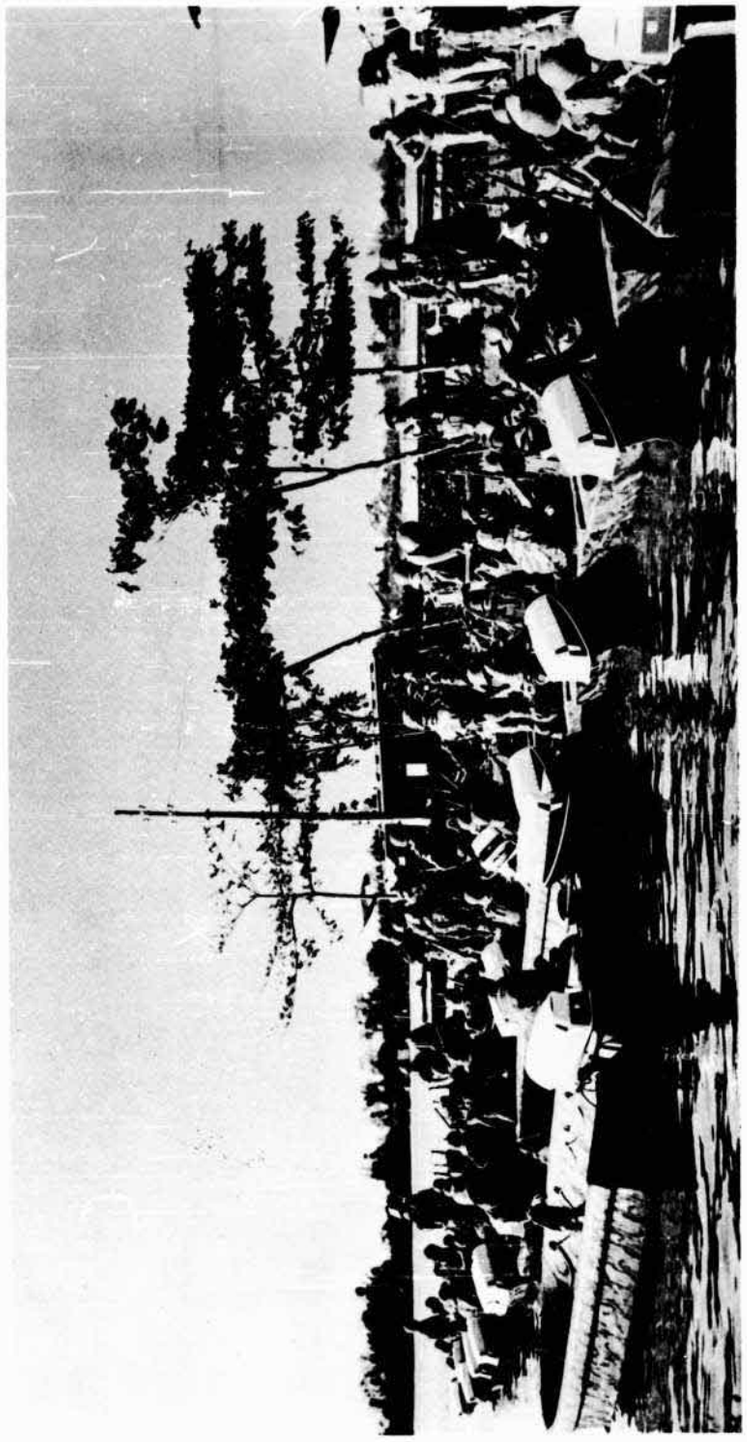
Description: A program has been initiated to perform research leading to the development of a light weight, high speed, shallow draft boat which can substantially increase military mobility in the Delta region of SVN. A modified swimmer support boat weighing about 350 pounds and constructed of bonded styrofoam planks, covered with fiberglass represents a promising approach to the problem; however, a more rugged, lighter weight craft which can be more readily manhandled is desired. The present craft are 14'1" long by 6'10" wide. Powered by a 40 hp commercial outboard, they make about 20 knots carrying eight or nine persons. As a subsidiary to this program, silent power sources are also being investigated.

Current Status: Small Craft. The ARVN rebuild facility has started production line rebuilding of Dong Nai (swimmer support) Boats. Seventeen boats had been completely renovated by 13 June. The quality of workmanship is excellent and the finished boats are considered equal to new craft. Preliminary figures indicate the cost per boat to be about $400. This figure will probably not change significantly throughout the rebuild program.

One plywood reinforced Dong Nai Boat has been completed. Tests of this boat will be completed by 31 July. Use is made of wooden inlays in the styrofoam hull prior to overlaying the bottom with plywood, roving, and cloth.

Tests of the swimmer support boats in Thailand have led to the conclusion that finer lined hulls of similar construction powered by long-shaft outboards would be necessary for practical operation in that country.

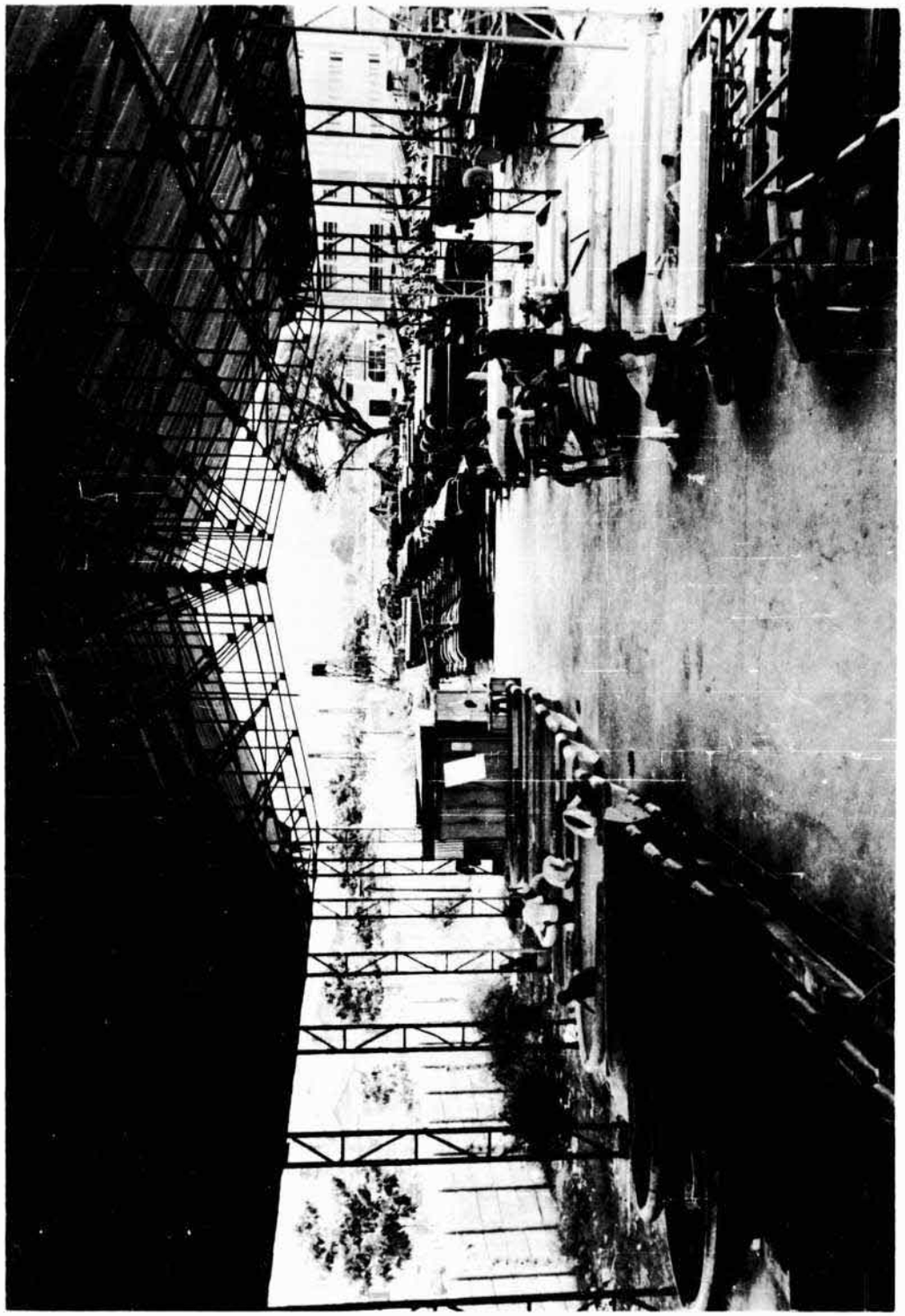
In conjunction with BuShips, APPA is currently evaluating proposals for small craft which may better meet the requirement.



CDTC-V "DONG NAI" OR SWIMMER SUPPORT BOATS BEING USED TO CARRY TROOPS IN THE DELTA AREA OF VIETNAM

CDTC-V "DONG NAI" OR SWIMMER SUPPORT BOATS BEING USED TO CARRY TROOPS IN THE DELTA AREA OF VIETNAM

Tab 3



THE VIETNAMESE FACILITY FOR REPAIRING AND REBUILDING THE "DONG NAI" BOATS DEVELOPED BY CDTC-V

Tab 3

Requirement: Mobility, Ground and Water

Task: Delta Mobility - Amphibious Vehicles

Problem: To improve military mobility in the Mekong Delta area, and to study operations in that area for the purpose of determining military concepts and requirements.

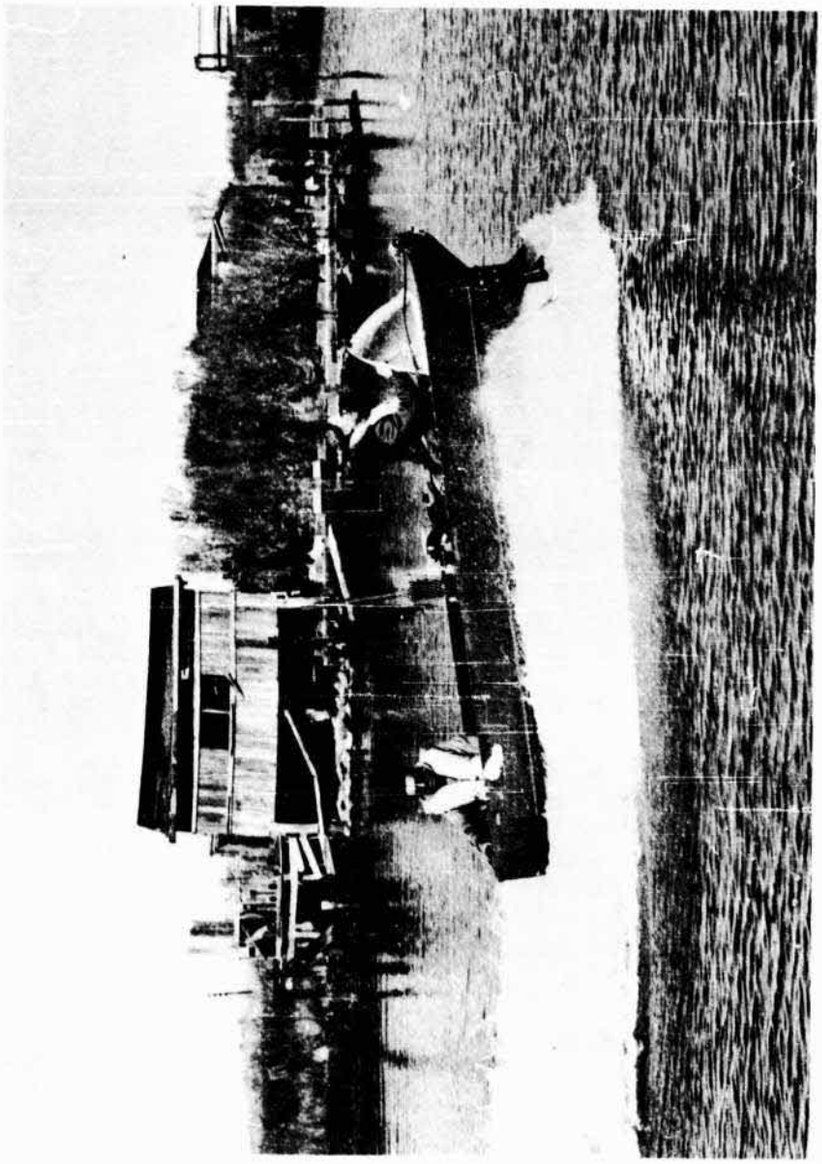
Description: Reports of operations in which amphibious vehicles participated are analyzed, and where limitations are experienced by these vehicles, observations, and where indicated, investigations are made by both U.S. and Vietnamese personnel of the terrain to include soil conditions of stream-flow, bank and bottom.

Modifications may be recommended, where appropriate, to improve the cross-country mobility of the vehicles.

Maintenance records will be examined and frequency of repairs will be studied in order to analyze the reliability of the various components of the vehicles under local operating conditions.

Four developmental vehicles are being tested which have demonstrated potential usefulness under conditions similar to those existing in the Delta area. One of these, the ARPA-funded Marsh Screw Vehicle, which uses the Archimedes screw principle, has completed a one-hundred-hour endurance test in the Louisiana marshes. A second, the Marine Corps-funded Airoll Vehicle, is undergoing tests by the USMC at Quantico. A third, the Plenum Air Tread Amphibian test bed (PATA) is being developed for the Army's TRECOM. The fourth is a GEM-type machine, the Tri-cell, company-funded by Bell Aerosystems.

Current Status: The Marsh Screw is being completely torn down and inspected for wear. A development program is being prepared oriented towards determining optimum lead and pitch angles and rotor diameter and length for conditions such as exist in the Delta area of Southeast Asia. Improved hard-surface capability is desired, since at present the best mode of locomotion on hard ground is sideways. Films of the test series and a company test report are available and will be distributed to the CDTC's. A second vehicle is being built. One is to be used for the above improvement program, and the second is intended for testing by an Army Agency, following which tests may be conducted in Thailand.



MARSH SCREW DURING TESTS IN LOUISIANA

BY-PASSING VIET CONG DAMAGED HIGHWAY. TWO M-113'S IMMOBILIZED.

Six Airoll vehicles have been built for the USMC. Two are undergoing tests at Quantico. Two are are being modified as a result of these tests for engineer-user tests to be performed by the Army. Two will remain at the Borg-Warner Ingersoll Division Plant where further modifications will be performed. No formal test reports are as yet available.

ARPA will continue to follow development of the Airoll, PATA, and Tri-cell vehicles.

Capstans and ground-anchor kits to provide a self-recovery capability for M-113's in the Delta area of Vietnam will be evaluated during the next quarter.

A vehicle-launched tactical bridge is being developed by the CDTC-V, and ARVN Ordnance, to facilitate crossing canals and narrow streams by armored units. A renovated M-24 light-tank hull is being prepared for use as a test bed.

Tab 3

Requirement: Mobility, Ground and Water

Task: Propulsion Systems for Shallow, Vegetation Choked Waters

Problem: To determine the applicability of sine disc propulsion to problems of mobility in shallow, vegetation-choked streams and swamps.

Description: At this time, and in the foreseeable future, this task will involve only monitoring of Army research. If current study indicates that the concept is promising, it will be developed for application to ARPA projects.

Current Status: Contractual study by the Army is continuing.

Tab 3

Requirement: Mobility, Ground and Water

Task: Special Hull Designs

Problem: To investigate the feasibility of developing high speed sailing craft for patrol operations in coastal and broad inland waterways. Such craft would have reduced fuel and maintenance requirements and an attendant improvement in operational capability.

Description: The catamaran appears to be a promising design principle for such a craft in that it can enjoy a pronounced speed advantage over the existing sailing junks and sampans currently in use by insurgents in Southeast Asia. Further, this design provides for a more stable weapons platform and is susceptible to local construction.

Current Status: A draft report covering sailboat performance, price, and a price-effectiveness comparison of single- and twin-hulled vessels is being reviewed by RAND for technical content.

Tab 3

Requirement: Mobility, Air

Task: STOL Troop/Cargo Aircraft

Problem: To assess the usefulness of assault transport aircraft in the combat environment of SVN, and to test methods of improving their STOL characteristics.

Description: A Y-model DeHavilland Caribou, gross weight 26,000 lbs., loaned to ARPA by the Army, has been tested in Southeast Asia under many diverse conditions of loading, weather and landing surface. Tests have included reversible thrust propellers, which were found to reduce landing roll, particularly on wet, muddy surfaces, by up to 50% to 60%. Test reports were distributed in September 1962.

The aircraft is also used as a flying test bed in support of communications research and navigational system tasks, as well as in indirect support of other test programs.

A new project which offers considerable improvement in STOL characteristics, minimizing take-off and landing distance requirements, while at the same time providing positive control at minimum speeds in and near the ground plane is an unusual jet pump system of boundary layer control. The system is of a stored energy type, using jet pumps burning engine fuel to augment air flow over a portion of the wing flaps and control surfaces, while drawing air over other portions to reduce the boundary layer thickness.

Current Status: A contract has been let for fabrication and test of a bench model of the jet pumps boundary layer control system. Since this is a high-risk, high-payoff approach, the program is phased to provide decision points before each major element. Phase I should be completed during the next reporting period.

Tab 3

Requirement: Mobility, Air

Task: Remote Area Airstrip

Problem: To determine the feasibility of preparing a light aircraft and helicopter landing surface, under tactical conditions, on soils of very low bearing strength.

Description: Because of the extremely low soil density in much of Southeast Asia, a landing surface must be developed which has sufficient buoyancy to keep it from sinking of its own weight. High soil acidity also requires that the materials of construction be protected from serious corrosion effects. Such conditions make this area of the world one of the most difficult in which to construct such facilities. Previous studies and prototype methods developed by the Services and industry have not resulted in suitable methods for providing the requisite capability in Southeast Asia.

Current Status: In order to provide information for the study of methods for solving this problem, several members of the short term mobility team from the Waterways Experiment Station made field measurements of the soil properties and obtained soil samples for detailed CONUS analysis. Based on these measurements and data obtained from previous airstrip development programs, studies were made of several designs incorporating the best feature of previous work as adapted to the soil characteristics. The present program calls for the use of polyurethane foam incorporated in aluminum mat planks to give the required buoyancy, as well as the strength to withstand the mechanical stresses imposed by the aircraft. Tests of this concept will be made by the Bureau of Naval Weapons, Launcher Branch acting as Service Agent for ARPA. Panels will be designed and fabricated for a helicopter landing pad which will then be tested by the Waterways Experiment Station at a field installation on the delta of the Mississippi River. If CONUS testing is successful, the pad will be shipped to South Vietnam for further tests at an operational site, if desired by COMUSMAC-V.

Investigations are underway by the CDTC-V of the feasibility of using chemical grouting agents for the stabilization of submarginal soils for airfield construction. Field investigations of several sites (predominantly unsuccessful attempts to produce working airfields in the submarginal soils of the Delta regions) are planned for the current quarter. Design investigations continue on other means of placing a temporary helipad on soils of negligible bearing capacity. One approach involves the use of sand-drains, sand bedding layers, and a sand-asphalt wearing course. A preliminary design sketch has been made of this approach and is being evaluated in-house before any decision is made to pursue the approach further.

Tab 3

Requirement: Aerial Pick-up and Delivery

Task: Flex-Wing Development

Problem: To develop a series of flex-wing devices (including homing and landing system) for precision delivery of supplies to include a 300-pound payload drop glider, a 1,000-pound payload towed glider, and a manned 1000-pound payload cargo carrier called a "flying jeep."

Description: Developmental models of the drop glider and towed glider will be extensively tested to ascertain their utility for aerial delivery in remote areas, and to determine the modifications necessary to adapt these devices to the needs and capabilities of the user prior to entering the production engineering phase.

The flying jeep will be flight tested and evaluated as a logistical carrier.

Current Status: The Precision Drop Glider tests were shifted to Thailand during the past reporting period to obtain indigenous-user input, environmental data, and an evaluation of its potential capabilities and its acceptability and utility to probable users. Such tests have validated the operational feasibility of the concept, revealed several problems not encountered during US testing, demonstrated the capability of indigenous personnel to operate and maintain the system, and indicated the potential utility of such a device for resupply of border outposts when deterioating weather, low visibility, unfavorable terrain, remoteness from base, and the like preclude helicopter or standard parachute delivery.

The usefulness of such a system is dependent upon the reliability of an automatic homing system. A program is under consideration which will establish existing and required parameters for glider control and electronic-link automatic-homing compatability.

An extension of the flight-test program for the Air Cargo Glider, 1,000-pound-payload version, was approved during the reporting period, and a proposal for an increase in scope of the program to expand the utility envelope and operational capabilities is under consideration. The expanded program would include, but not be limited to, qualifying the system for use with various tow aircraft used in normal military operations; determination of techniques required for handling and delivering variable-geometry and random-cargo shipments such as vehicles, ordnance, and bulk commodities;

and simplification of the tow and control systems, cargo-carrying envelopes, and system-handling equipment.

The "flying jeep" flight-test program is to begin shortly. The development program should be essentially completed during the next quarter. A one-third-scale model of the vehicle has been constructed by NASA, and is undergoing free-flight powered tests in one of the Langley wind tunnels. (TRECOM has also built and tested a one-fifth scale model.)

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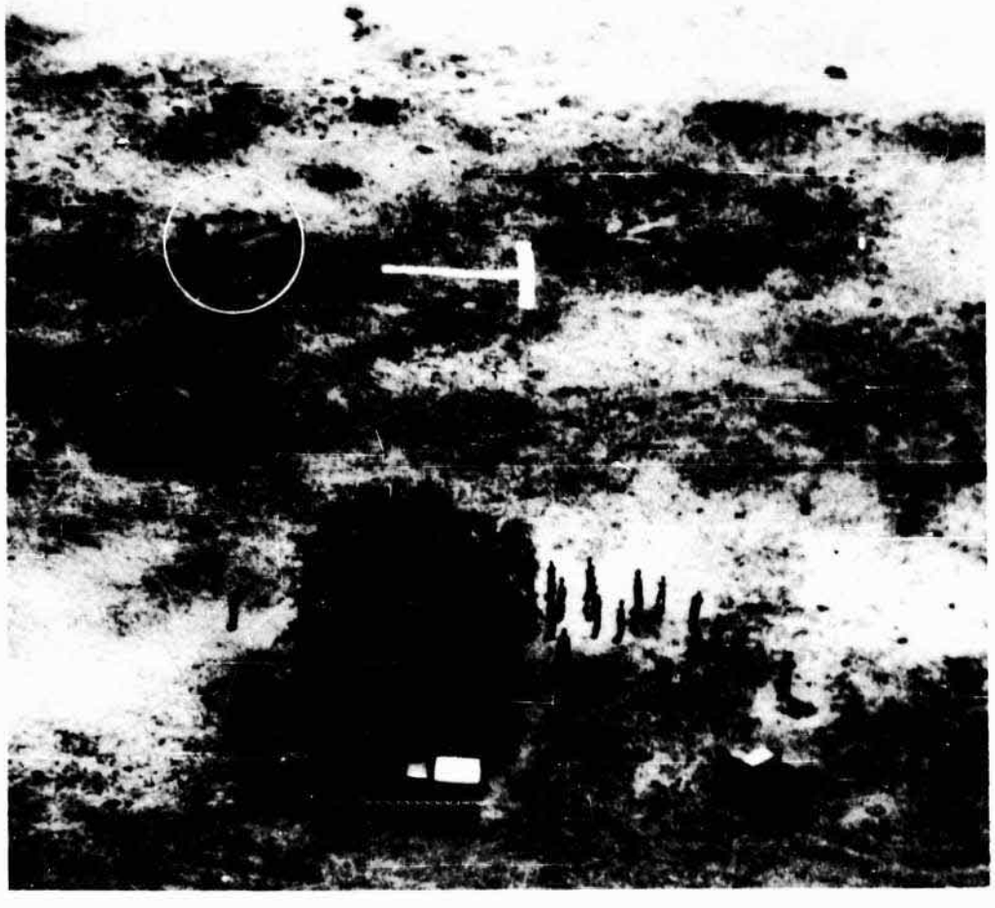

FLEX WING DEVELOPMENT RADIO-CONTROLLED PRECISION DROP GLIDER IMPACTING NEAR GROUND ZERO DURING TESTS IN THAILAND

Requirement: Aerial Pick-up and Delivery

Task: Disposable Parachutes

Problem: Develop an improved disposable parachute for aerial resupply missions from which the load can be readily recovered even though the canopy is hung up in trees 100 to 120 feet high, or adapt such chutes as are under service development.

Description: Perform tests on equipment developed by the Services, to determine its utility for remote area situations. Develop new equipment if the need for such a program is established.

Current Status: The CDTC-V has been requested to clarify the requirement, particularly with respect to whether the disposable parachute must be quickly eradicated with little or no trace, or whether a throw-away item is desired.

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# AGILE SUB-PROJECT IV

# COMMUNICATIONS SYSTEMS

## TAB 4

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Tab 4

## AGILE SUB-PROJECT IV

## COMMUNICATIONS SYSTEMS

SUB-PROJECT OBJECTIVE:

To develop communications equipments, techniques and systems which will provide friendly local forces in remote area conflict situations an effective capability for:

a. Tactical communications within and among units and for control of support aircraft.

b. Communication of alarm signals from villages, strategic hamlets, convoys, and outposts in the event of attack.

c. Communications for control and operation of naval units primarily composed of river and coastal craft.

SUB-PROJECT BACKGROUND:

Friendly local forces in remote area conflict situations are generally likely to be confronted with the requirement for small unit operations against an elusive foe in difficult terrain, remote from maintenance, supply and vehicular transportation facilities. This requirement places a premium on effective ground-to-ground and air-to-ground communications through the use of ultra lightweight, rugged and operationally simple radio equipment. Furthermore, the physical nature of typical remote area conflict situations introduces severe communications problems in the form of high levels of radio-frequency noise, heavy vegetation offering extremely high attenuation of radio waves, rugged terrain which interferes with ground-wave radio propagation, and variable conditions of soil conductivity. Physical and educational qualities, social characteristics, and command and control structures of the local population may also introduce specialized communications requirements. Radio communications equipment for regular U.S. forces generally is not designed to meet these specific types of needs.

It is anticipated that conditions of terrain and vegetation will frequently preclude the use of vehicular communications equipment below battalion or comparable level. Dispersal among units and frequent employment of long-duration patrols at distances of 20-100 KM from base or

parent organization, coupled with the severe attenuation of ground-wave signals in tropical mountainous and jungle environments, further restrict the possibilities for using radio communications equipment standardized for U.S. field army purposes.

These factors lead to the conclusion that communications techniques and equipment which in some cases are special-purpose or at least of limited applicability in conventional warfare are required by friendly local forces in environmentally unique situations.

## CONDUCT OF THE PROGRAM

### Phase I - Operations Analysis and Phenomenological Research

Objective:

To provide a sound basis for selection and development of tactical communications techniques, procedures and devices through a comprehensive program of measurement and analysis of the parameters of electromagnetic propagation applicable to selected, distinctive environments, initially Southeast Asia, and of those operational factors which determine communications requirements.

Data Required:

It is intended that the environmental research program develop the following information for selected, distinctive environments, beginning with Southeast Asia:

a. Data on path loss for all possible propagation modes from VLF through UHF frequencies for the several types of terrain and vegetation peculiar to each selected environment.

b. Data on ionospheric conditions in each selected environment as they affect sky-wave propagation.

c. Requirements for tactical communications traffic between and among military units, bases, convoys, patrols, aircraft, naval units and civil agencies in each selected environment.

Conduct of Phase I:

An agency has been charged with prosecution of the environmental communications research program and is responsible for managing and coordinating the efforts of contractors in the measurement program and in the operations analysis. Contractor teams will operate with support and under the supervision of the CDTC in each host country. This program will be extended to selected areas outside of Southeast Asia as rapidly as possible.

Phase II - Investigation of Techniques:

Objective:

To determine the applicability of specific techniques and devices to the requirements determined in the Phase I study.

Data Required:

a. Definition of the extent to which requirements can be met with existing military and/or commercial equipment and devices.

b. Specific configuration of the equipment desired with respect to size, weight, form factor, and concept of employment.

c. Applicable detailed performance characteristics to provide a basis for the development of equipment and measurement of improved performances.

Conduct of Phase II:

In order to acquire a timely improvement in the capabilities of existing equipment, test and evaluation of commercial and military communications equipments will be conducted concurrently with the environmental research program to provide an improved interim capability in those cases where requirements can be postulated with some assurance. It is not intended that Phase II include extensive equipment development. These tests will ordinarily be conducted first in the United States and then in Southeast Asia and other selected areas in order to assure evaluation appropriate to the environmental requirement.

Phase III - Development and Testing of Equipment

To develop and evaluate test quantities of equipment specifically designed to meet communications requirements of friendly local forces in distinctive remote area conflict situations.

Conduct of Phase III:

In this phase of the program, ARPA will utilize appropriate service agencies to purchase or contract for the development of equipment to meet specific required characteristics derived from Phases I and II. Tests will be conducted in Southeast Asia and other selected areas to determine effectiveness, reliability, maintenance requirements and basis of issue to provide the information necessary for possible MAP procurement of the equipment.

REQUIREMENTS AND TASKS:

Listed below are those major requirement areas and tasks with which this sub-project is concerned. Each task is summarized in the following pages:

1. Remote Area Conflict Communications Research

   A. Operations Analysis

   B. Phenomenological Research

   C. Development of Host Nation Electronic Research Capabilities

2. Investigation, Development, and Evaluation of Communications Techniques and Devices

   A. Tropical Intra-Patrol Radio Communications

   B. Tropical Man-pack Radio Communications

   C. Remote Area Conflict Vehicular Radio Communications

   D. Remote Area Conflict River and Coastal Flotilla Communications

   E. Hamlet and Outpost Alarm Communications

   F. Power Sources for Communications Equipment

   G. Special Antennas

Tab 4

Requirement: Remote Area Conflict Communications Research

Task: Operations Analysis (1A)

Problem: To identify and quantify those factors which are pertinent to specification of the communications requirements of friendly local forces in distinctive remote area conflict situations.

Description: The capacity, reliability, and limitations of existing local communications in selected remote area conflict situations will be analyzed and evaluated. The physical environment of the area will be studied to determine the special problems it poses for the operation of communication equipment in tactical military field exercises, and the importance and special problems of the human element will be studied. The results of these investigations will be used to isolate concrete equipment and systems requirements, and to derive specifications for new or modified techniques, procedures or equipment.

Current Status: The Southeast Asia Communications Research Program (SEA CORE) is being implemented by ARPA with the U. S. Army Electronic Research and Development Laboratory (USAELRDL) as service agent. A major element of this program is the Southeast Asia communications operations analysis effort described above.

The Thailand portion of the program is funded as a major portion of the Stanford Research Institute Contract.

Actions thus far include preliminary data collection in CONUS and observation of the SEATO maneuvers in Thailand during June 1963. Full-scale data collection in Thailand should begin during the coming quarter.

A preliminary data-collection effort by Rand in Vietnam is reported under Sub-Project VII.

Tab 4

Requirement: Remote Area Conflict Communications Research

Task: Phenomenological Research (1B)

Problem: To obtain data on those factors of terrain, vegetation, and ionospheric behavior which affect electromagnetic wave propagation in selected remote area conflict situations and therefore affect the utilization of available radio equipment and the design and development of new equipment.

Description: This task, which currently is focused on Southeast Asia, consists of three main parts:

a. Path Loss Measurements will be made at distances up to 300 miles and throughout the frequency range from 15 KC to 5 KMC; major emphasis will be on various propagation modes which are effective at distances less than 30 miles and in the frequency ranges 100 KC - 8 MC and 30 - 400 MC. Effects of atmospheric noise levels and varieties of antenna types will be studied.

b. Statistical Terrain Studies will be made and directly correlated with path loss measurements in order to obtain data on the effects of terrain on radio propagation modes.

c. Ionospheric Data will be collected over extended periods to provide a basis for accurate prediction of useful frequencies for sky-wave propagation over short ranges in selected areas.

Current Status: A contract has been let to Jansky and Bailey (J&B) to carry out the path loss measurements and statistical terrain studies portions of the SEA CORE Program. Arrangements have also been completed for the U. S. Army Radio Propagation Agency to conduct ionspheric data collection in Thailand.

J&B has completed its site-survey in Thailand, and an area of the Thai National Forest in Central Thailand has been selected for the first series of path loss measurements and associated terrain studies. Aerial photography of the area was carried out by the USAF 2nd Air Division, and the photographs were forwarded to J&B CONUS offices for use in detailed site and path selection. This photographic coverage has also been provided to the Army Map Service for its use in updating military maps of the area. J&B has its advance party on site in Bangkok and has leased a building and grounds to house personnel and equipment. A survey of the road and trail access to the test area has been made and site preparation is under way. Most of the J&B equipment has been shipped to Bangkok. Path loss measurements should begin late in the next quarter.

Tab 4

The ionospheric sounder has been shipped to Bangkok, and U. S. Army Radio Propagation Agency personnel are on site and preparing to install and operate the equipment. Data collection will begin during the next quarter.

Tab 4

Requirement: Remote Area Conflict Communications Research

Task: Development of Host Nation Electronic Research Capabilities (1C)

Problem: To provide equipment, technical training, and assistance to host nations in the development of local capabilities to conduct electronic research and experimentation in support of defense-oriented communications requirements.

Description: This program consists of providing limited laboratory facilities, mobile and portable measurement and test equipment to support field measurements, and of training host nation personnel through a participative program of actual measurements and tests of communications equipment and techniques.

Current Status: This task is currently being implemented in Thailand as part of SEA CORE. Sylvania (EDL) has fabricated and assembled portable shelters and equipment for the base laboratory facility and for the mobile field laboratory facilities to be utilized by SRI and CDTC-T. Additional mobile field laboratory facilities are to be provided by J&B.

Thai and U.S. personnel of the CDTC-T will use these facilities together with SRI and J&B contract personnel in a joint program of field investigations in communications techniques and devices. Through the provision of these facilities and an opportunity to utilize them in an orderly research program, it is planned that Thai capabilities for continuing this type of research will be enhanced to the point that U.S. contract personnel can eventually be phased-out.

SRI personnel are now on site in Thailand, and essentially all of the laboratory equipment is on hand and has been installed in shelters. SRI has leased a site for the facility, and installed the laboratory vans on hard stand. The laboratory was essentially operational by 30 June 1963. Formal opening ceremonies are planned for August.

Requirement: Investigation, Development, and Evaluation of Communications Techniques and Devices

Task: Tropical Intra-Patrol Radio Communications (2A)

Problem: To provide a small radio set, under two pounds and simple in operation, for use between squad-sized elements in ambush locations, on patrol, or in other tactical situations in selected tropical remote area conflict environments.

Description: Modern solid-state circuit design offers promise of a capability to produce very small and lightweight equipment which can be carried and operated by an individual in the tropics without interferring with his combat capability. Ranges of up to 1,000 meters under most terrain and vegetation conditions, a capability of silent, semiautomatic transmission of simple coded alarm messages, and compatibility with standard U.S. military VHF-FM portable sets, are required.

Current Status: 1. Ryan Rifle Butt Radio VHF-FM

This FM transceiver is an experimental unit designed to examine the feasibility of mounting a transceiver in the stock of a rifle employing the barrel as an antenna. This set, encapsulated and transistorized, will add one pound (plus one additional pound for batteries) to the weight of an AR-15 rifle in which it is installed. The unit operates on a frequency of 70 MC, with a CW transmitter and voice receiver and nets with standard military VHF FM sets. Ryan has completed development of the equipment and tests in CONUS are planned for the next quarter.

2. Motorola H21-DCN VHF-FM

This set is one of a number of commercially available hand-held VHF-FM voice-only transceivers using entirely transistorized circuitry. The H21 weighs 33 ounces complete with batteries and radiates 1.4 watts at frequencies between 25 and 54 MC. ARPA has ordered 6 sets for field evaluations in Thailand.

3. AN/PRC-35 VHF-FM

This set was developed by RCA on contract to USAELRDL as a replacement for the AN/PRC-6 and has not yet been standardized for issue. It is transistorized, weighs approximately 5 pounds, and incorporates FM voice capability between 47 and 55 MC at a radiated power of 0.35 watts. Three sets have been shipped to Thailand for field evaluation. This set nets with all standard U.S. military VHF-FM equipment.

Tests at CDTC-T will be conducted using the Motorola radio, the AN/PRC-35, the AN/PRC-10, and the AN/PRC-25. In addition, a 15 and 30 watt power amplifier for the AN/PRC-25 has been developed by RCA under an ARPA funded program, and will be included in these tests. Thus it will be possible to compare voice communication over similar paths at power levels of .3, 1, 1.4, 2, 15 and 30 wats. This effort is designed to provide a practical determination of the power required in tropical terrain and vegetation to achieve reliable ranges of 1,000 meters. This information is one of the necessary elements needed to define the technical parameters for squad-level sets.

Various proposals have been evaluated for a pocket-sized digital message entry device which can provide silent, semi-automatic, two-way communications (using simple prearranged messages), compatible with standard U.S. military radio sets. Development of such a device will be undertaken during the next quarter.

Tab 4

Requirement: Investigation, Development, and Evaluation of Communications Techniques and Devices

Task: Tropical Man-Pack Radio Communications (2B)

Problem: To provide adequate capability for communications among and between patrols, platoon and company sized units, and from such units to outposts, operational bases and support aircraft, in selected tropical remote area conflict environments. Presently available equipments require improvement or ultimate replacement.

Description: Two essentially different capabilities are required of this class of communications equipment:

a. Man-pack, high frequency, voice and CW, AM and/or SSB equipment weighing 25 pounds or less, low-drain, battery powered and having a range in sky-wave communication of 0 – 100 Km.

b. Man-pack, VHF – FM voice transceivers weighing 15 pounds or less, low-drain, battery powered, and having a range of 5 – 10 Km under typical tropical terrain and vegetation conditions.

Each equipment discussed above is required to be compatible with support aircraft radio equipment.

Current Status: In order to obtain necessary data on which to base action to procure an interim high-frequency set as described in "a" above, and to determine the range of performance of HF and VHF sets in typical terrain and vegetation in SE Asia, CDTC-T utilizing SRI field teams, undertook a series of comparative field tests of a number of available man-pack radios.

These tests were conducted hourly throughout the day and night using both voice and CW modes where appropriate and using several different antennas. Paths 5, 10, and 25 miles in length were selected in three different areas of Thailand (flat heavily forested, flat open plain, mountains). The following sets were included:

Requirement: Investigation, Development, and Evaluation of Communications Techniques and Devices

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a. High-Frequency Man-Pack Radios

(1) Hughes HC-162

This set is completely transistorized, weighs approximately 25 pounds complete with batteries, radiates 15 watts PEP on SSB voice and is tunable in 1KC steps from 2-12 MC.

(2) AN/TRC-77 (Modified)

This set was developed by Sylvania (EDL) for Army Special Forces use. It is a 10 watt AM CW set weighing about 25 pounds and has available 6 pre-set channels in the range 3-8 MC. The sets under test have been modified by EDL to add a voice capability.

(3) AN/TRC-88

This is a further modification of the AN/TRC-77 to provide SSB capability. It is otherwise similar to the AN/TRC-77.

(4) OKI TRP-4

This is a partially transistorized HF SSB radio manufactured in Japan which weighs about 30 pounds complete with batteries. It radiates in excess of 2 watts voice or CW on any of 6 preset channels between 2.5 and 8 MC.

(5) AN/GRC-9

The AN/GRC-9 is the standard U. S. Army high frequency AM voice and CW set available in quantity both to U. S. and indigenous forces and has been incorporated in the tests as a control item. The GRC-9 weighs about 90 pounds and radiates 10 watts on CW.

b. VHF-FM Man-Pack Radios

(1) AN/PRC-25

This is a transistorized FM-VHF transceiver which weighs about 15 pounds complete with batteries and radiates about 2 watts voice over the range 30-76 MC. It is in production for the U. S. Army as a replacement for the AN/PRC-10. During the next quarter, a 15 and 30 watt power amplifier for this set, developed and purchased under an ARPA funded program is scheduled to be available for inclusion in the test series.

(2) AN/PRC-10

This is the standard FM-VHF transceiver in use in SE Asia. It weighs about 25 pounds and radiates about 1 watt over the range of 50-70 MC. It is included as a control item in the tests. Some of the tests were conducted with the assistance of Army working observers from Fort Bragg, In addition, an Air Force team participated in some of the tests with a communications package intended for use by forward Air Controller parties. Results of this test will not be reported by ARPA.

The test series in flat jungle, rice paddy, and mountainous areas were completed during the past quarter. Final test reports are expected to be distributed early in the next quarter. Based upon preliminary reports the following conclusions appear to be warranted:

a. VHF sets, with ordinary whip antennas provide ranges of less than 1/10th mile in the most dense forest and up to two miles in less dense forest. Extension of these ranges was possible only by elevating antennas.

b. At 5 miles in forested terrain, apparently no ground-wave signals were received from any of the sets.

c. Of the HF sets, the Hughes HC-162 was generally superior in performance, based upon intelligibility of received signals, to any of the others tested.

d. None of the HF sets can be recommended for immediate procurement. The Hughes HC-162 requires extensive redesign to clear up operating and maintenance deficiencies which have been observed during field and engineering tests.

e. Path-loss measurements to quantify effects of the ionosphere, terrain, vegetation, frequency, and antenna design and polarization are required to provide a better understanding of the variations in propagation conditions noted in these experiments. Events occurred which were unexplainable with the instrumentation available to SRI. (Note: These measurements will be made as part of SEA CORE by Jansky and Bailey, starting in July 1963.)

f. The HF equipment experienced problems which should be thoroughly investigated. These problems did not interfere with these controlled tests, but probably would interfere with operations. For example, when using the HF equipment at night, strong interference was encountered from stations 800 to 4,500 miles distant. Improved antenna design may alleviate this problem.

As a result of these tests ARPA has funded an effort by Hughes to produce 5 models of an improved HC-162. These sets will be given engineering and field tests in CONUS to determine that the set is suitable for field use.

ARPA has also provided funds for support of a development program for the RS-100, a man-pack high-frequency set of significantly different design, as an alternative capability. This equipment is not expected to be available for test until early 1964.

Tab 4

Requirement: Investigation, Development, and Evaluation of Communications Techniques and Devices

Task: Remote Area Conflict Vehicular Radio Communication (2C)

Problem: To provide improved mobile communications equipment for use by local tactical headquarters in selected remote area conflict situations.

Description: Tactical headquarters of local organizations at the equivalent of battalion-level or higher require effective vehicular-mounted communications equipment for control of tactical operations and of support aircraft. Operational and environmental constraints require that the equipment be mounted in vehicles which have mobility compatible with the tactical situation and provide voice, CW and radio teletype capabilities, and be compatible with available equipment in related radio communications nets.

Current Status: ARPA is procuring 6 models of the Collins AN/MRC-95 radio set. This set incorporates the 618-T transceiver which radiates 400 watts PEP SSB and 100 watts AM in the range of 2-30 MC. It is compatible with existing high frequency equipment in both air and ground configurations and provides voice, CW and radio teletype capability for mobile tactical command posts.

It is planned to conduct field evaluation of the AN/MRC-95 on a comparative basis with the AN/GRC-26 which is the current division level high-frequency set in use in RVN.

As an adjunct to these tests, ARPA has installed a 618T transceiver in the Caribou which is on loan to CDTC-V for tests of long-range air-ground communications.

Tab 4

Requirement: Investigation, Development, and Evaluation of Communications Equipment and Devices

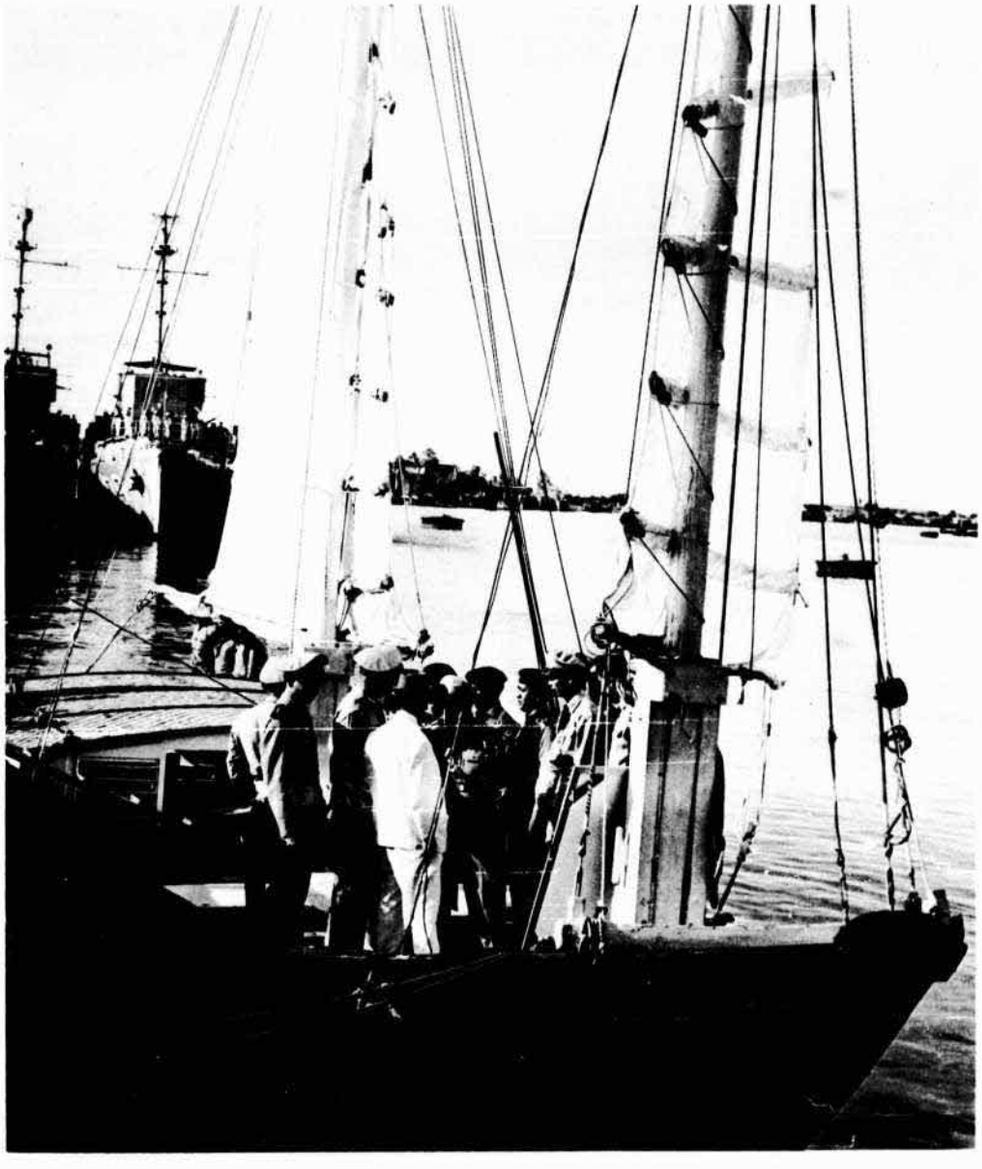
Task: Remote Area Conflict River and Coastal Flotilla Communications (2D)

Problem: To provide effective communications capabilities for local river and coastal flotillas, both among units of the flotilla and between the flotilla and its operations base.

Description: Flotillas are required for operations in coastal waters and rivers. Each such flotilla requires a command ship equipped with long-range radio equipment to communicate with a base of operations, and short-range equipment for communications among units of the flotilla. Where local ships or boats are utilized, the communications equipment should not appreciably alter their external appearance.

Current Status: A decision has been made by the Military Assistance Commanded in RVN to provide MAP funds for procurement of AN/GRC-87 radios for the Command Junk. CDTC-V is providing technical assistance in the installation of this radio (AN/GRC-9 family) in the junk and has provided a loaded vertical monopole antenna for installation on the mainmast of the junk which will be evaluated with the AN/GRC-87.

Tab 4



PRESIDENT DIEM AND GENERAL TY, CHIEF OF THE VIETNAMESE JOINT GENERAL STAFF, ARE BRIEFED ABOARD THE CDTC-V PROTOTYPE COMMAND JUNK.

Requirement: Investigation, Development, and Evaluation of Communications Techniques and Devices

Task: Hamlet and Outpost Alarm Communications (2E)

Problem: To provide an alarm system for hamlets and outposts to send warning of an insurgent attack.

Description: Effective, reliable communications means are required by hamlets and outposts to enable them to flash immediate warning of an attack to a base of operations or to the headquarters of the security forces which are to come to their relief. The equipment should not require extensive training to operate and should require only minimal maintenance and resupply of parts. Radio transmitters should be capable of being concealed in a village hut.

Current Status: 1. Radio Industries Hamlet Alarm System

Radio Industries, under an ARPA funded contract, has developed a hamlet alarm system. This system includes ten 1/2 watt alarm transmitters, ten 10 watt alarm transmitters, two relay units and a terminal station with automatic read-out which operates with the Radio Industries TR-20 Village Radios which is being installed in large quantities by USOM in Vietnam. The system transmits a narrow band tone-modulated signal at frequencies between 30 and 40 MC.

A final report of results of the evaluation of the alarm system was distributed by CDTC-V on 4 February 1963. The results indicated that using properly elevated and sited antennas, the system operates very well with low false alarm rates and high reliability. Recommendations include use of a suitable dry cell battery in place of the rechargeable nickel cadmium batteries, which are expensive and difficult to recharge under field conditions, and provision of an output power intermediate between the 1/2 watt and 10 watt units.

2. Ryan Concealable Alarm Transmitter

Coincidentally with the development of the Hamlet Alarm System by Radio Industries Inc., of Kansas City, Mo., another manufacturer, Ryan Electronics of San Diego, California was asked to engineer a system that would feature very small and easily concealable alarm transmitters.

The system was tested in Vietnam during the past quarter. A final test report is expected to be distributed during the coming quarter.

3. RCA Hamlet Alarm System

RCA, under ARPA funded contract, is developing a self-contained narrow band FM tone-coded alarm system utilizing a very narrow band width to extend the range available with low radiated power. It is intended for use in remote area conflict situations where the USOM village radios used in Vietnam are not installed. In addition, some of its components can be utilized to adapt standard field radios to alarm system applications. Units have been delivered to Thailand for evaluation during the next quarter.

4. Chaff Rockets

A report of test is being prepared by CDTC-V and is expected during the next quarter. Preliminary results of testing the Chaff rocket concept are not encouraging because of the low rate of radar detection of rockets when fired. RAND has attempted to determine the optimum rocket configuration, performance and probability of detection.

Requirement: Investigation, Development, and Evaluation of Communications Techniques and Devices

Task: Power Supplies for Communications Equipment (2F)

Problem: To provide efficient power supplies and accessory equipment for the tactical communications equipment utilized by local forces in remote area conflict situations.

Description: This task encompasses effort designed to assure that tactical field radios utilized by local forces are powered with batteries which have the highest possible life-to-weight ratio and which present the least possible logistics effort and overall system cost. Included are battery testers, recharging equipment, and primary power sources.

Current Status: ARPA is investigating available batteries, battery testers, recharging equipment and primary power sources. Preliminary studies are under way and it is expected that a program to obtain devices and equipment for evaluation will be initiated during the next quarter.

Primary attention will be devoted to investigation of the feasibility of obtaining portable efficient sources of prime power which utilize practical fuels.

Tab 4

Requirement: Investigation, Development, and Evaluation of Communications Techniques and Devices

Task: Special Antennas (2G)

Problem: To enhance the effectiveness of communications through the development of special antennas which are designed to meet the unique requirements of local forces operating in those environments.

Description: The efforts to be performed under this task includes the design, development, test, and evaluation of special antennas which are operationally and economically practicable, and which will aid in overcoming the unique electromagnetic propagation conditions encountered in the selected environments.

Current Status: CDTC-V has initiated a comparative evaluation of a number of field-expedient elevated antennas for use with existing VHF field radios such as the AN/PRC-10. This evaluation is designed to:

1. Compare performance of the CDTC-V portable VHF antenna with some of the VHF field expedient antennas which have been used in country -

2. Obtain factual data on performance of field expedient antennas, and -

3. Determine which of the antennas compared would be most suited for small element troop or patrol use. Some of the antennas tested for merit and for comparison with the CDTC-V VHF antenna are as follows:

a. PRC 10 long whip elevated 30 feet and fed by WDITT field wire.

b. Vertical insulated copper wire same length as "a".

c. 1/4 wave ground plane antenna with elements and transmission line made of field wire.

d. Rotatable vertical 3 element YAGI with elements and transmission line made of field wire, supported by bamboo poles tied together with cord.

e. Vertical half rhombic antenna made of field wire and with 500 ohm terminating resistor and counterpoise.

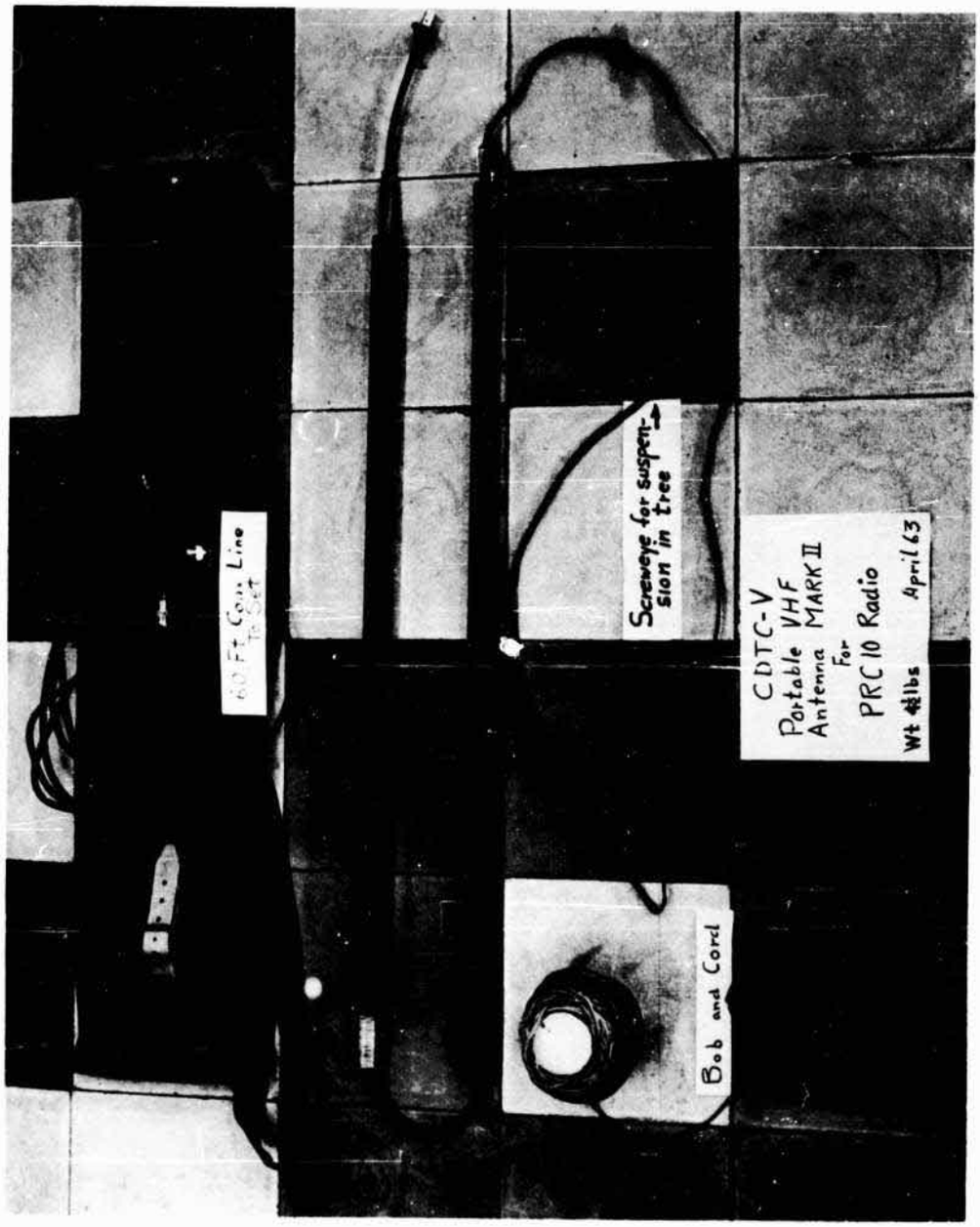
f. 1/4 wave vertical antenna made of RG/59 U transmission line.

g. USA Electronic Research and Development Labs VHF antennas fabricated in accordance with CDTC-V Qualitative Materiel Requirement submitted in November 1962.

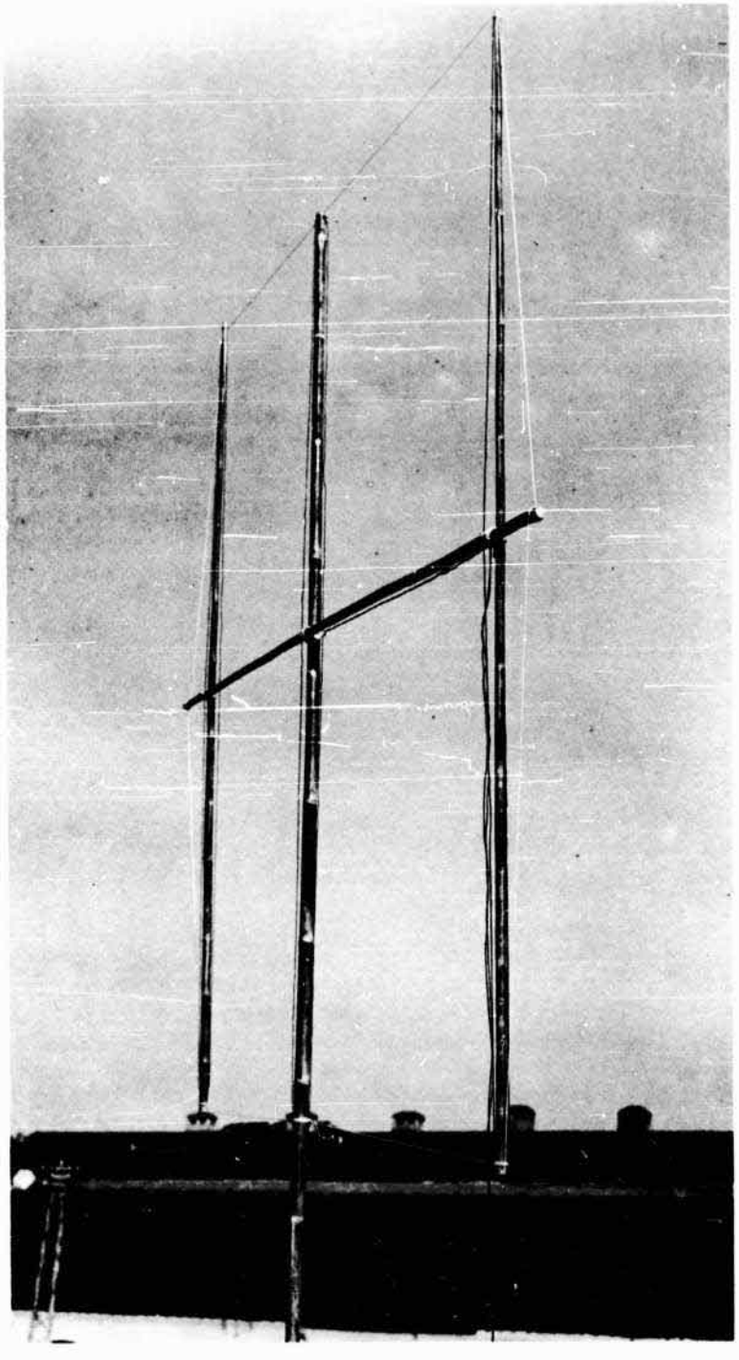
CDTC-V has also initiated experiments with long-wire antennas for HF radios to attempt to obtain improved performance under field conditions.

A broad program of applied research in antennas for use in tropical areas with tactical field radios is planned as a task of the contract with Stanford Research Institute in Thailand under the SEA CORE program. This work has already begun with theoretical studies and some measurements in CONUS and will be expanded during the next quarter.

Tab 4




PORTABLE VHF ANTENNA DEVELOPED BY CDTC-V



YAGI ANTENNA DEVELOPED BY CDTC-V MADE FROM BAMBOO, FIELD WIRE, AND OTHER MATERIALS ABUNDANT IN THE FIELD IN VIETNAM.

~~CONFIDENTIAL~~

# AGILE SUB-PROJECT V

# COMBAT SURVEILLANCE AND TARGET ACQUISITION SYSTEMS

## TAB 5

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Tab 5

## AGILE SUB-PROJECT V

## COMBAT SURVEILLANCE AND TARGET ACQUISITION SYSTEMS

### SUB-PROJECT OBJECTIVE:

To develop combat surveillance and target acquisition techniques, systems, and devices which will enable friendly local forces in remote area conflict situations to:

a. Detect, locate and maintain surveillance of hostile units, bases, stores and supply routes.

b. Detect infiltration of borders and incipient ambushes or attacks on outposts and communities.

c. Effect rendezvous of friendly elements with each other and with supply drops or caches, and guide friendly units to the location of hostile elements.

d. Improve the degree of mobility and the effectiveness of logistic support through better navigation and point-location in remote areas.

e. Exploit the knowledge of communications techniques and equipment to locate, neutralize or destroy hostile bases and headquarters.

### SUB-PROJECT BACKGROUND:

1. General Discussion

Friendly local forces in remote area conflict situations are seriously hampered by the inherent advantages of hostile elements which can attack, withdraw, ambush, and effect logistic support through clandestine methods at times and places of their own choosing. These advantages are reflected in adverse ratios of friendly to hostile forces necessary in the past to achieve suppression of guerrillas and insurgents. To offset this handicap, friendly local forces urgently require the enhancement of their combat effectiveness which can be achieved through the application of superior scientific and technical efforts to the problems of combat surveillance and target acquisition.

2. Limitations on Equipment

a. Airborne and vehicular sensors and navigation equipment must be designed for mounting in vehicles or aircraft which are presently available to or to be procured for friendly local forces. As general guidance, it is expected that relatively limited numbers of standard transport vehicles and vehicles specially designed for remote area operations will be available; further, that aircraft will include rotary-wing and fixed-wing tactical and transport aircraft in the light and medium classes.

b. Man-pack equipment must be rugged, and generally suited to operation in tropical maritime climates and in difficult terrain. As general guidance, such equipment should be capable of being broken down into individual loads of 10 pounds or less. Power supplies should provide for duty-cycle operation of the equipment for at least one week.

CONDUCT OF THE PROGRAM:

The program is intended to be carried on in three phases as follows:

Phase I – Operations Analysis and Phenomenological Research

Objective

To develop and analyze data on those physical and operational parameters of selected distinctive environments, initially for Southeast Asia, and of potential targets which constrain the application of particular surveillance and target acquisition techniques and influence equipment design. This study program will provide a basis for determining the technical, physical and operational requirements of friendly local forces in Southeast Asia and other selected areas for combat surveillance and target acquisition techniques and devices.

Data Required

It is intended that this study develop the following data initially by a search of the available literature and followed by a field measurements program as necessary to fill in data gaps in each selected distinctive environment. The technical areas of specific interest and investigation are as follows:

a. Acoustic and Seismic

(1) The level of acoustic and seismic intensity produced by men walking, singly or in groups, in the various types of terrain and vegetation peculiar to those of each selected area.

(2) The level of acoustic intensity of men speaking to each other.

(3) The level of acoustic and seismic intensity produced by firing of small arms, automatic rifles and machine guns, grenades and light mortars.

(4) The characteristics of seismic signals in the presence of man-made subsurface cavities in the soils of each selected area.

(5) Background noise levels of acoustic and seismic intensity observable under varying weather conditions and in the several types of terrain, soil and vegetation found in each selected area.

(6) Propagation attenuation and diffusion data for acoustic disturbances under varying weather, terrain and vegetation conditions applicable to each selected area.

(7) Propagation of seismic disturbances in soils common to the various characteristic regions of each selected area.

b. Electro-magnetic

(1) Radar echoing area as a function of radar frequency and viewing aspect for individuals armed with hand-held weapons, automatic rifles and machine guns, or light mortars.

(2) Magnitude of the magnetic field associated with individuals armed as a Para b (1) above, and with surface and subsurface metals emplaced by man.

(3) Emission of electro-magnetic energy (detected by a microwave radiometer), as a function of frequency, by individuals armed as in Para b (1) above, and by surface or subsurface metals such as nail-boards and caches of weapons.

(4) Relative magnitude and frequency distribution of the doppler spectrum generated by movement of varying types of foliage and for a range of wind velocities which may be encountered in each selected area.

(5) Propagation attenuation forces for electromagnetic emissions in each selected area as a function of frequency, antenna, ionospheric and atmospheric conditions, terrain profile, vegetation and climatic conditions (Joint undertaking with Project IV).

(6) Levels of background electromagnetic radiation and noise typical to the area of interest as a function of frequency.

c. Infra-red, Optical and Visual

(1) Intensity of the flash produced by firing of small-arms weapons as a function of wavelength.

(2) Variation of optical contrast between targets of interest and typical terrain and vegetation background for a range of ambient light levels from $10^{-5}$ candle power to unobstructed sunlight.

(3) Apparent temperature contrast for individuals armed as in Para b (1) above when viewed against typical vegetation and terrain backgrounds and for typical ambient temperatures found in each selected area.

(4) Propagation and attenuation factors for the near and far infrared through various types of foliage found in each selected area both along the surface and from aircraft to ground, for the expected range of weather conditions.

d. Chemical

(1) Chemical emanations which are characteristic of individuals armed as in Para b (1) above and of cooking and heating fires.

(2) Data on detectability of the above chemical emanations as a function of range, weather conditions, vegetation and terrain applicable to each selected area.

(3) Detectability, rate of dispersion, and persistence of various artificial chemical substances, which may be used to mark hostile individuals, given the expected weather, vegetation and terrain conditions of each selected area.

In addition to the foregoing technical data, operational analysis will be conducted to determine the particular surveillance and target acquisition techniques and devices that are requirements of friendly local forces in their own distinctive environment.

Conduct of Phase I:

It is intended that the study phase be conducted in two parts as follows:

a. Part I

The agency or agencies charged with the prosecution of the program will plan and conduct a comprehensive search of available literature and coordination with all appropriate offices and agencies of the government in order to collect all existing data applicable to the program. Part I will conclude with a submission to ARPA of a specific plan for a measurement program to fill essential gaps in the data.

b. Part II

Part II will comprise the conduct of the necessary field measurements and analysis of data. Data analysis will be directed toward identifying technique areas which have definite promise of solution of the combat surveillance and target acquisition problem.

Phase II – Investigation of Techniques

Objective

To determine the applicability of specific techniques and devices to the requirements determined in Phase I.

Data Required

In each case of a technique, equipment, or device investigated, this phase of the program will determine whether a particular approach can solve or partly solve a requirement. Specifically the investigation will determine by analysis and supporting field measurements the following data:

a. Definition of the extent to which requirements can be met with known or existing equipment and devices.

b. Specific configuration of the equipment desired with respect to size, weight, form factor, and concept of employment.

c. Applicable detailed performance characteristics to provide a basis for development of equipment.

Conduct of Phase II

It is intended that Service agencies be selected to investigate each promising technique area (radar, infra-red, acoustic and seismic, etc.). These agencies will conduct the investigations of techniques and devices, with contractor assistance as required.

No actual development of equipment or devices is planned during Phase II. Every effort will be made to obtain the required information through the use of existing military or commercial equipment.

Tests will be performed in each selected area abroad only to the extent demanded by environmental conditions which cannot readily be duplicated in the U.S. Testing will normally be performed by personnel of the agency designated by ARPA as Service Agent, or by contractor personnel.

Investigation of particular technique areas will be completed and reported upon separately in order to permit development or purchase of equipment as soon as the required information can be obtained.

Phase III – Development and Testing of Equipment

Objective

To develop and evaluate test quantities of equipment specifically designed to meet combat surveillance and target acquisition requirements of friendly local forces in distinctive remote area conflict situations.

Conduct of Phase III

In this phase of the program, ARPA will utilize appropriate service agencies to purchase or contract for the development of equipment to meet specific required characteristics derived from Phases I and II.

Tests will be conducted in Southeast Asia and other selected areas to determine effectiveness, reliability, maintenance requirements and basis of issue to provide the information necessary for possible MAP procurement of the equipment.

Requirements and Tasks

Listed below are those major requirement areas and tasks with which this sub-project is concerned. Each task is summarized in the following pages:

1. Remote Area Conflict Surveillance Research

   A. Operations Analysis

   B. Phenomenological Research

   C. Development of Host Nation Surveillance Research Capabilities

2. Investigation, Development, and Evaluation of Techniques and Devices

   A. Airborne Systems

      (1) Infra-Red

      (2) Radar

      (3) Illuminated Night Photography

      (4) Visual Surveillance and Low-Light-Level Amplification

      (5) Spectra-Zonal Photography

      (6) Electromagnetic Detection

   B. Surface Systems

      (1) Night Vision

      (2) Personnel Surveillance Radar

      (3) TIARA

      (4) Persistent Identification Chemicals

      (5) Hidden Metal and Sub-Surface Cavity Detectors

C. Navigation and Beacon Equipment

(1) Aerial Navigation System

(2) Terminal Guidance Beacon

(3) Identification and Location of Air-Dropped Equipment

(4) Tactical Maps

(5) Patrol Locating System

D. Security and Protection Systems

(1) Railway and Convoy Ambush Detectors

(2) Airborne Ground-Fire Detectors

(3) Patrol and Outpost Intrusion Detectors

Tab 5

Requirement: Remote Area Conflict Surveillance Research

Task: Operations Analysis (1A)

Problem: To derive from analysis of operations those factors pertinent to specifications of requirements of friendly local forces for surveillance and target acquisition equipment.

Description: This task encompasses a comprehensive analysis of operations of local forces, including the effects of the physical environment of the region on the operation of surveillance sensory equipment, special problems relating to human factors which affect the design of equipment, and the unique and special characteristics of the operations of hostile forces. This analysis is intended to furnish a basis for development of specific equipment and systems requirements.

Current Status: Under sub-project VII, several operational studies have been conducted which include consideration of some of the requirements for surveillance and detection capabilities in RVN.

More specific and comprehensive studies are planned to derive suitable models of surveillance and detection problems and to analyze these models in order to derive specific requirements.

Tab 5

Requirement: Remote Area Conflict Surveillance Research

Task: Phenomenological Research (1B)

Problem: To obtain and analyze data on those parameters of the environment and of potential targets in selected remote area conflict situations which constrain the application of particular surveillance techniques and influence equipment design.

Description: Environment research will be conducted as appropriate to obtain the following data:

1. Radiation and reflection characteristics and chemical emanations of personnel, vehicles, equipment and other possible indicators of hostile activity.

2. Physical characteristics of the environment including transmission and attenuation parameters for electromagnetic and acoustic waves and background levels of noise and radiation.

3. Other environmental parameters such as hostile operational characteristics and the physical, technical, and social characteristics of friendly local forces.

Current Status: Part I of this program has been carried out by means of a search of available technical literature and analysis of detection phenomenology leading to a recommended program of field measurements. This study was conducted by the Institute of Science and Technology, University of Michigan, with the USAELRDL acting as ARPA agent. The study report has been received and is being evaluated by ARPA. The report is being distributed to interested service agencies.

ARPA plans to initiate measurement programs based upon the Michigan study during the next quarter.

As part of SEA SURE, CDTC-T has begun collecting information on typical geographical and vegetation conditions in Thailand to define data requirements and to assist in site selection for the measurements to be conducted in that country. Preliminary measurements are being made by CDTC-T to determine foliage obscuration of the sky as a function of viewing angle and length of optical horizontal line-of-sight in forests of various types.

In Thailand, the requirements of the various CDTC-T projects for climatological data are being consolidated under the auspices of this task. These requirements concern a detailed analysis of rainfall, temperature, relative humidity, wind, cloud cover and index of refraction vertical profile for seven geographical areas. A climatological survey is planned to obtain the required data.

Tab 5

Requirement: Remote Area Conflict Surveillance Research

Task: Development of Host Nation Surveillance Research Capabilities (1C)

Problem: To assist host nations in the development of a capability to conduct research, test and evaluation in the area of surveillance techniques and devices.

Description: This task will be accomplished by providing suitable instrumentation facilities and training of local personnel through cooperative implementation of field measurements and experimentation in the host nation environment.

Current Status: It is planned to schedule the maximum possible participation by Thai personnel in the conduct of phenomenological measurements and evaluation of surveillance devices. Instrumentation provided for this purpose under both SEA CORE (Tab 4) and SEA SURE (Tab 5) will be utilized for training Thai personnel and for provision of the necessary instrumentation to enable the Royal Thai Armed Forces to continue with this work following the eventual phase-out of U. S. contract personnel.

Tab 5

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Airborne Infra-Red Systems (2A1)

Problem: To evaluate the use of airborne infra-red equipment for detection of hostile activities.

Description: State-of-the-art infra-red scanners are available with high resolution and high sensitivity. Detectors are available in the short-wave length region (4 - 6 microns) for detection of fires and other active radiation sources and also in the long-wave length region (8 - 12 microns) for mapping of terrain and vegetation. These techniques will be evaluated separately and together for use by friendly indigenous forces in selected remote area conflict situations.

Current Status: 1. Detection of Camp Fires:

ARPA provided funds to the U. S. Army Cold Regions Research and Development Laboratory to enlarge a planned program of tropical vegetation and topographical studies in Puerto Rico. The ARPA funded portion of the TROPICAN program consisted of measurements with high-resolution airborne infra-red scanners of the detectability of charcoal fires in a dense tropical rain forest. The final report of this experiment has been published and distributed. Results obtained were very encouraging. Detection probability in a dense forest is at least 35 per cent.

2. Reconnaissance Program

ARPA is participating with the USAF in equipping specific aircraft which are designed to provide an operational evaluation of infra-red detection of cooking fires in Southeast Asia. Details of this program have a classification higher than that of this report.

Tab 5

PRESIDENT DIEM IS BRIEFED ON THE INFRARED WEAPONSIGHT AND METASCOPE TESTED BY CDTC-V. ASPIRANT HO SI HIEP IS THE PROJECT OFFICER.

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Airborne Radar Systems (2A2)

Problem: To determine the extent to which airborne radar is useful in detection of hostile activities.

Description: Most existing airborne surveillance radars have been designed for detection of vehicles and for gross mapping of principal natural and man-made terrain features. Effort under this task will initially be devoted to investigation of possibilities for detecting armed individuals under cover of various types of foliage at various radar frequencies. In the event that airborne radar techniques appear to have promise of detection of hostile activities, these techniques will be evaluated for use by friendly indigenous forces in selected remote area conflict situations.

Current Status: ARPA has a joint program with the Reconnaissance Laboratory of the USAF Systems Command to accelerate efforts to measure some specific aspects of radar foliage penetration. Details of this program have a classification higher than that of this report.

Tab 5

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Airborne Illuminated Night Photography Systems (2A3)

Problem: To evaluate the use of laser or strobe-light illuminated night photography for detection of hostile activities.

Description: Standard aerial photography equipment applicable to a variety of purposes is available for use in daylight aerial reconnaissance. This task is aimed at providing an equivalent capability for night reconnaissance using lasers or strobe-lights for selective illumination which incorporate characteristics which minimize the hazards of alerting hostile forces and thereby reducing the risk to low-level reconnaissance flights from ground fire. In the event this technique is found to be effective for remote area conflict situations, it will be evaluated for use by friendly indigenous forces in such situations.

Current Status: ARPA funds have been provided to the USAF Systems Command for implementation by the Reconnaissance Laboratory of Aeronautical Systems Division of a program of investigation of techniques of illuminated night photography. Authorization has been granted for the following specific efforts:

(1) Laser-illuminated Airborne Scanner.

A contract has been let to Perkin-Elmer Corporation to fabricate an experimental airborne system using a helium-neon CW laser to scan the earth and provide illumination for an imaging and film-recording system.

(2) Ultraviolet System

This system will utilize a bank of mercury arc lamps for illumination with direct recording on film filtered for the ultraviolet.

It is planned to carry work in each of these areas through a program of flight test and analysis of the resulting imagery in order to determine the extent to which these capabilities are useful in remote area conflict.

Funds have also been provided to the USAF Systems Command for investigation of a technique of photographic integration proposed in the

Michigan study which may greatly enhance the usefulness of airborne photography in forested areas. As a part of this program some selected photography of Thailand will be taken and processed to evaluate the technique.

Tab 5

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Airborne Visual Surveillance and Low-Light-Level Amplification Systems (2A4)

Problem: To improve the capability of human observers in aircraft to detect hostile activities.

Description: A program of testing of the capability of human observers to detect activities of insurgent forces is planned. The program will include controlled experiments with known ground truth and will also encompass evaluation of equipment and devices which enhance the ability of airborne visual observation, including the use of low-light-level amplification techniques and devices for observation during hours of darkness.

Current Status: CDTC-T has completed a field test of detection and identification of human beings from aircraft to provide definite information on the capabilities of an observer in an aircraft, searching for human targets on the ground. This is an important consideration for studying equipment techniques or tactics that might be used in counter-insurgency operations.

The RTAF implemented a plan of testing designed to accomplish these objectives. An H-34 was used as test vehicle since it provides the necessary range of speeds for the tests, can carry a large number of observers on a single flight, and provides a relatively clear field of view. The testing has been done near Ubon because of the RTAF facilities there and because the desired visual backgrounds exist there in convenient relative positions. A report of test results will be distributed during the next quarter.

DDR & E has directed that ARPA fund a program to evaluate low-light-level television in counterinsurgency aircraft. This program is expected to begin during the next quarter.

Tab 5

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Airborne Spectra-Zonal Photography Systems (2A5)

Problem: To evaluate the use of spectra-zonal photography in the detection of hostile activities.

Description: The techniques of using aerial photographs of the same scene taken in selected narrow spectral regions using film and filter combinations which are optimized for particular spectral regions and of combining the resultant imagery in various ways in order to facilitate detection of camouflaged ambush positions and caches of weapons, underground caves and tunnels, location and extent of activity on roads and trails will be studied.

Current Status: ARPA has provided funds to the Amazonia Foundation for a general experimental program in the use of spectra-zonal photography in tropical mountainous areas to determine the extent to which evidence of human activity can be detected by these techniques.

It is planned to conduct additional research and experimentation directed toward detection of ambush positions, caves, and tunnels using spectra-zonal photography.

Tab 5

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Airborne Electromagnetic Detection Systems (2A6)

Problem: To evaluate the use of airborne magnetometers, radiometers, and other electromagnetic detection techniques and devices in the detection of hostile activities.

Description: The use of airborne electromagnetic detection techniques and devices, such as magnetometers and radiometers, for the purpose of locating hostile forces through detection of active and passive electromagnetic emissions associated with those forces will be investigated and evaluated. In particular, this task will attempt to determine the effectiveness of these techniques and devices in locating hostile elements possessing limited amounts of materiel in rough terrain or under dense foliage.

Current Status: Consideration is being given to studies and materiel programs to test the effectiveness of airborne magnetometers and radiometers.

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Surface Night Vision Systems (2B1)

Problem: To provide friendly local forces with effective aids to vision to assist in detection, surveillance, movement, and employment of weapons at night.

Description: Effort under this task encompasses evaluation of active light sources, active and passive portable infra-red devices, passive image intensifiers and other aids to night vision, to determine their effectiveness in selected remote area conflict situations and their utility to friendly local forces in those situations.

Current Status: CDTC-V evaluation of the usefulness in RVN of the standard infrared metascope and weapon sight is completed. A report of test will be distributed during the next quarter.

Tab 5

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Surface Doppler Personnel Surveillance Radar Systems (2B2)

Problem: To evaluate available portable ground radar equipment for use by friendly local forces in remote area conflict situations.

Description: Suitable standard portable doppler personnel surveillance radars will be utilized to evaluate the effectiveness of this technique for detection by friendly local forces of hostile elements in selected environments.

Current Status: The final report on evaluation of the AN/PPS-4 doppler personnel surveillance radar by MAAG-Vietnam has been submitted. This evaluation was conducted with extensive technical assistance of CDTC-V.

The MAAG recommendation that this equipment not be procured for use in Vietnam has received the concurrence of COMUSMACV and CINCPAC.

This recommendation was based upon the limited usefulness of the radar and the extensive requirements for technical training of operation and maintenance personnel.

Tab 5

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: TIARA (Target Illumination and Rescue Aids) (2B3)

Problem: To establish the most suitable formulations, packaging, and delivery mechanisms for utilization of TIARA in remote area conflict situations, and to evaluate its effectiveness as a target illumination and identification aid for use by friendly local forces.

Description: TIARA is a fluid chemo-luminescent material suitable for packaging in a variety of forms. Upon exposure to air during periods of darkness the material exhibits a strong luminescence, which is capable of illumination of an intensity much brighter than moonlight. It will readily adhere to most surfaces with which it comes in contact and remain visible on dry surfaces for periods of 30 to 45 minutes and on wet surfaces for periods of 10 days. This task includes investigations which seek formulations for the production of specified effects in terms of duration, intensity, color, and wave-length. Also included are investigations and experiments involving user and handler safety, and packaging and dissemination mechanisms and techniques.

Current Status: Under the ARPA funded TIARA Program at NOTS, China Lake, hand grenades, rifle grenades, marking sticks, 81 mm mortar shells and land mines have been packaged and tested; quantities of grenades and marking sticks were shipped to Vietnam for field evaluation.

No useful test results have been obtained because of difficulties with TIARA munitions occasioned by chemical deterioration of explosive boosters by the TIARA material and restrictions imposed on use of the items by classification and unresolved questions of toxicity. Tests in Vietnam have been indefinitely suspended.

The U. S. Navy Medical Center at Bethesda has performed tests of toxicity of the TIARA material with laboratory animals in an enclosed space and has issued a report that TIARA is toxic when inhaled in confined space. Toxicity under normal conditions of storage and use has not fully been established. Tests are continuing.

NOTS has been provided with additional funds for research on the mechanism of chemiluminescence to establish means for control of luminosity, color and persistence with the compounds PR 155 and PR 156.

NOTS has also been funded to package TIARA in the form of drop-zone panel markers, frangible capsules for use in perimeter detection and parachute signal flares for use as marking devices. Such new devices are expected to be tested under the auspices of CDTC-T when they become available.

Tab 5

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Persistent Identification Chemicals (2B4)

Problem: To obtain and provide field evaluation of suitable chemical materials which may be dispensed in areas of hostile activity to mark the person or clothing of personnel passing through such areas and thereby facilitate subsequent detection, tracking, and identification.

Description: Several potentially promising chemicals are known which have characteristics suitable for investigation as detection and tracking aids. These are:

1. Chemicals which fluoresce under ultra-violet, to permit detection of suspected hostile individuals by exposing them to an ultra-violet source.

2. Chemicals which produce a lasting discoloration of the skin which is readily detected visually.

3. Chemicals which produce distinctive odors which are detectable by humans.

4. Chemicals which produce odors which are detectable by dogs or by chemical sensors but are not readily detectable by the human nose.

5. Radioactive isotopes of suitably long half-life which can be detected by existing radiation detectors.

Included in this task are investigations of means for dispensing the materials and detection mechanisms and devices.

Current Status: (1) ARPA has a funded program with the U. S. Army Quartermaster Research and Engineering Command to investigate the use of squaline to mark individuals for subsequent tracking and identification by trained dogs.

Training of selected dogs and field trials conducted with the assistance of the scout-dog unit at Fort Benning have established that dogs can be trained to alert on the scent of individuals marked with a small quantity of squaline.

Experimentation now is devoted to developing means of disseminating squaline in a dust formulation and determining the quantity required to contaminate a selected area.

(2) The Army Chemical Center also has a program of investigation into the use of disseminated chemicals for tracking, detection, and identification of intruders. ARPA plans to expand the study to include the use of various types of encapsulated chemical marking agents.

(3) One possible means for post-combat detection of insurgents is the use of the paraffin test to isolate persons who have been using weapons. While it is recognized that the paraffin test cannot give sure-fire indication that a person giving a positive reaction is an insurgent, the test could conceivably be used to screen large numbers of persons to eliminate those who give a negative reaction. The much smaller number remaining can then be subjected to other investigative means. However, it is necessary to determine the rate at which suspects can be screened by the test. To this end, a group of 5 enlisted men and one officer from a RTA Security Battalion in Thailand is undergoing a 4-week training course in the paraffin test at the Scientific Crime Detection Division of the Bangkok Police Department. Preliminary trials at the RTA infantry center were encouraging. Additional tests are being conducted.

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Hidden Metal and Sub-Surface Cavity Detectors (2B5)

Problem: To provide tactical, man-pack equipment for detection of nail boards, buried caches of weapons, other metallic equipment, and small sub-surface cavities used by hostile forces.

Description: Hostile forces in remote area conflict situations utilize various types of metallic devices, such as nail boards, to retard or disrupt pursuit. They also hide weapons and other material, and utilize sub-surface cavities, both natural and man-made, for caches of material, the hiding of personnel, and for escape routes from hamlets or villages which have been under their control. Friendly local forces require a capability to detect hidden metal and sub-surface cavities in the course of sweep and search operations, and in the screening of personnel and river and canal traffic.

Sensitive magnetometers and mine detectors have the capability of detecting very small perturbations in the earth's magnetic field caused by the presence of magnetic materials and sub-surface anomalies. Most available types of sensitive magnetometers are large and complex instruments, or require highly trained personnel and tedious search operations. This task is aimed at obtaining simple, light-weight devices for the detection of hidden metal and small sub-surface anomalies by friendly local forces.

Current Status: (1) ARPA has funded the Naval Ordnance Laboratory at Corona, California for investigation of the use of the Hall Effect in thin semiconductor films to build magnetometers for detection of buried metals. This program is for a one-year effort and calls for delivery of 10 very light-weight portable magnetometers suitable for field evaluation.

(2) A program of investigation into the following techniques of investigation by the U. S. Army Engineer Research and Development Laboratory has been funded by ARPA.

(a) Magnetic loop detection of personnel carrying weapons.

(b) Detection of metal in small boats with a buried magnetic loop.

(c) Detection of buried metal objects by means of a modified metallic mine detector.

(d) Detection of tunnels and caves with a modified nonmetallic mine detector.

These devices are intended for field evaluation in Thailand.

CDTC-V has completed an evaluation of the AN/PRS-4 mine detector. Conclusions of the report are that this equipment does not offer enough performance improvement over the standard AN/PRS-3 to warrant its replacement in Vietnam.

CDTC-T has tested a form of earth auger, the Oakfield punch, for detection of subterranean tunnels. Tests indicated that the method is too slow, and is therefore being abandoned. A test report will be distributed.

CDTC-T has conducted experiments on detection of metal in sampans using a wire loop erected over a canal. Results of the experiments are not encouraging because of the high noise level of the detector, which was a galvanometer. Better results are expected from the buried loop and sensitive low noise amplifiers being developed under the Fort Belvoir program.

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Aerial Navigation System (2C1)

Problem: Friendly local forces require an adequate capability to insure that their aircraft engaged in aerial delivery, fire-power support, and resupply of their surface units can reach their objective area and return to base under all conditions of visibility.

Description: In selected remote area conflict situations, the environment and the nature of the operation places a premium on the capability of friendly local forces to utilize aircraft under all conditions of visibility in order to effect surprise attacks, conduct effective airborne surveillance at times when hostile forces can otherwise move undetected, and provide fire support and resupply of mobile units, outposts and hamlets. To perform these missions effectively, the aircraft must be equipped with effective navigation systems. The greater proportion of the aircraft involved are likely to be rotary-wing and sub-sonic fixed wing, making volume and weight of navigation equipment to be placed aboard of critical importance in most instances. The problems associated with providing for the security of any system which must rely on a number of widely dispersed fixed ground stations places a premium on a system which is self-contained aboard the aircraft. Operation, maintenance and logistics problems impose a need for a system which is usable aboard all types of aircraft likely to be involved; i. e. , a universally mountable system rather than one specially tailored to each separate type of aircraft.

This task involves the selection and evaluation of suitable, universally mountable, self-contained aerial navigation systems for use by friendly local forces aboard the rotary-wing and sub-sonic fixed-wing aircraft they typically utilize in their distinctive environments. Also, for COIN fixed-wing aircraft, a companion effort will include the selection and evaluation of a ground-chain system to operate with air-borne and mobile ground receivers.

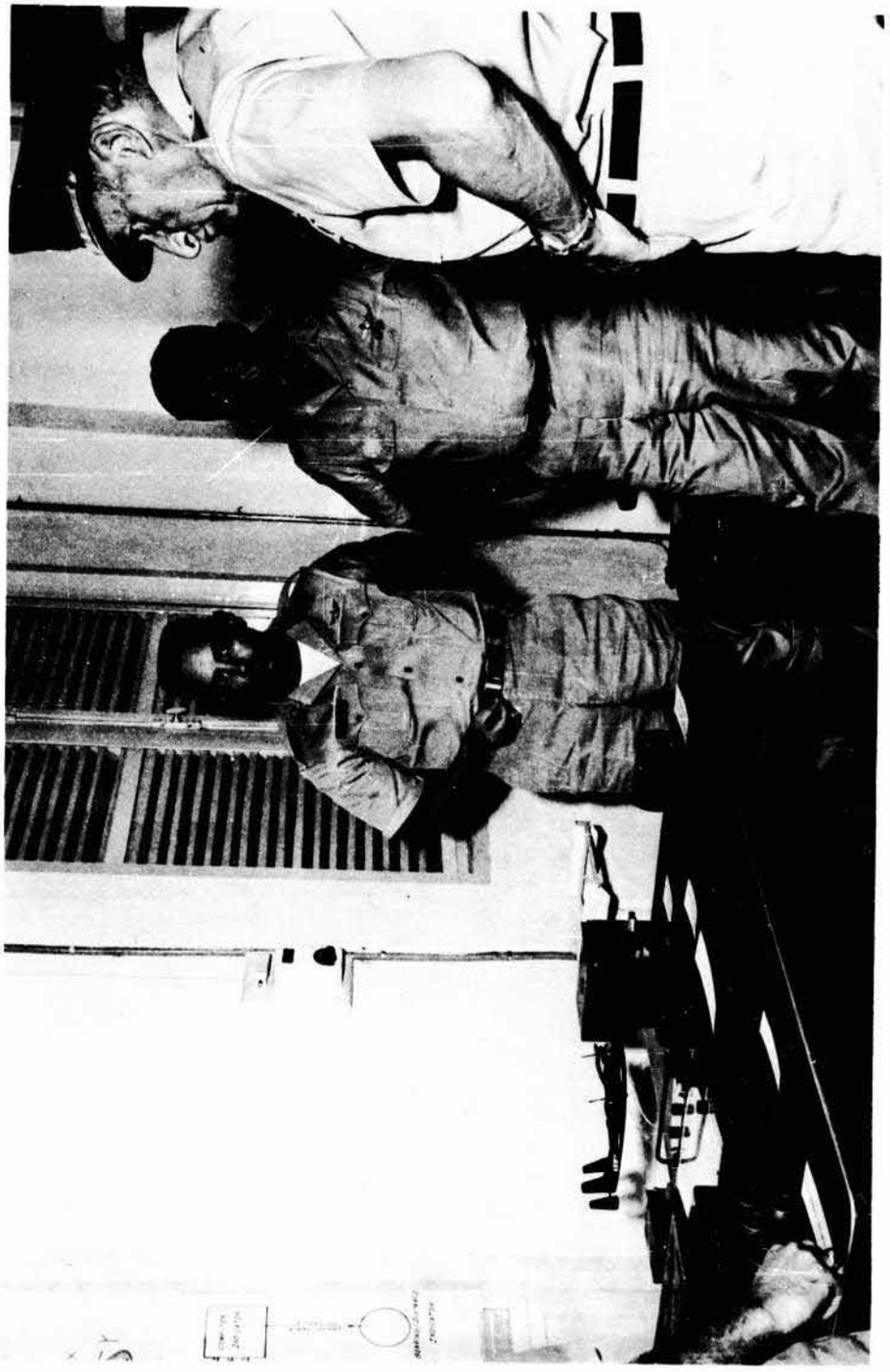
Current Status: The U. S. Navy has been funded to procure three models of the RYANAV IV self-contained doppler navigation system and one model of the LFE doppler navigator.

The RYANAV IV systems are to be mounted in CH-21, CH-34, and YAC-1 Caribou aircraft in RVN for field evaluation in Southeast Asia, following lengthy CONUS testing. The LFE system is being evaluated by the U. S. Army Aviation Board at Fort Rucker, Alabama.

Two RYANAV IV systems have been delivered and installed in the CH-21 and the YAC-1. The remaining RYANAV IV system for the CH-34 is being installed.

At ARPA request, Navy and Army have sent observers to Vietnam who have experience with doppler navigation equipment to assist in preparation of test plans, inspection of installation and calibration, and in the conduct of the field evaluation.

In addition to the foregoing, ARPA has been directed by DDR&E to fund and manage a program to purchase and evaluate a Bendix position finding and navigation system (PFNS) for use in interim and optimum counterinsurgency aircraft, and for use by mobile ground units. ARPA is to insure that this program includes participation by both USAF and Navy aircraft proposed for interim use as a COIN aircraft. This program will draw heavily on the experience gained in the tests of a PFNS system being carried out by the U. S. Army Electronics Proving Ground at Fort Huachuca, and on the work with a similar system which is going on in RVN.



GENERAL HARKINS IS BRIEFED ON THE SELF-CONTAINED AERIAL NAVIGATION SYSTEM BEING TESTED BY CDTC-V. MAJOR MORRIS COOK, PROJECT OFFICER, AND COLONEL VITO S. PEDONE, CHIEF OF THE ARPA R&D FIELD UNIT IN VIETNAM, LOOKS ON.

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

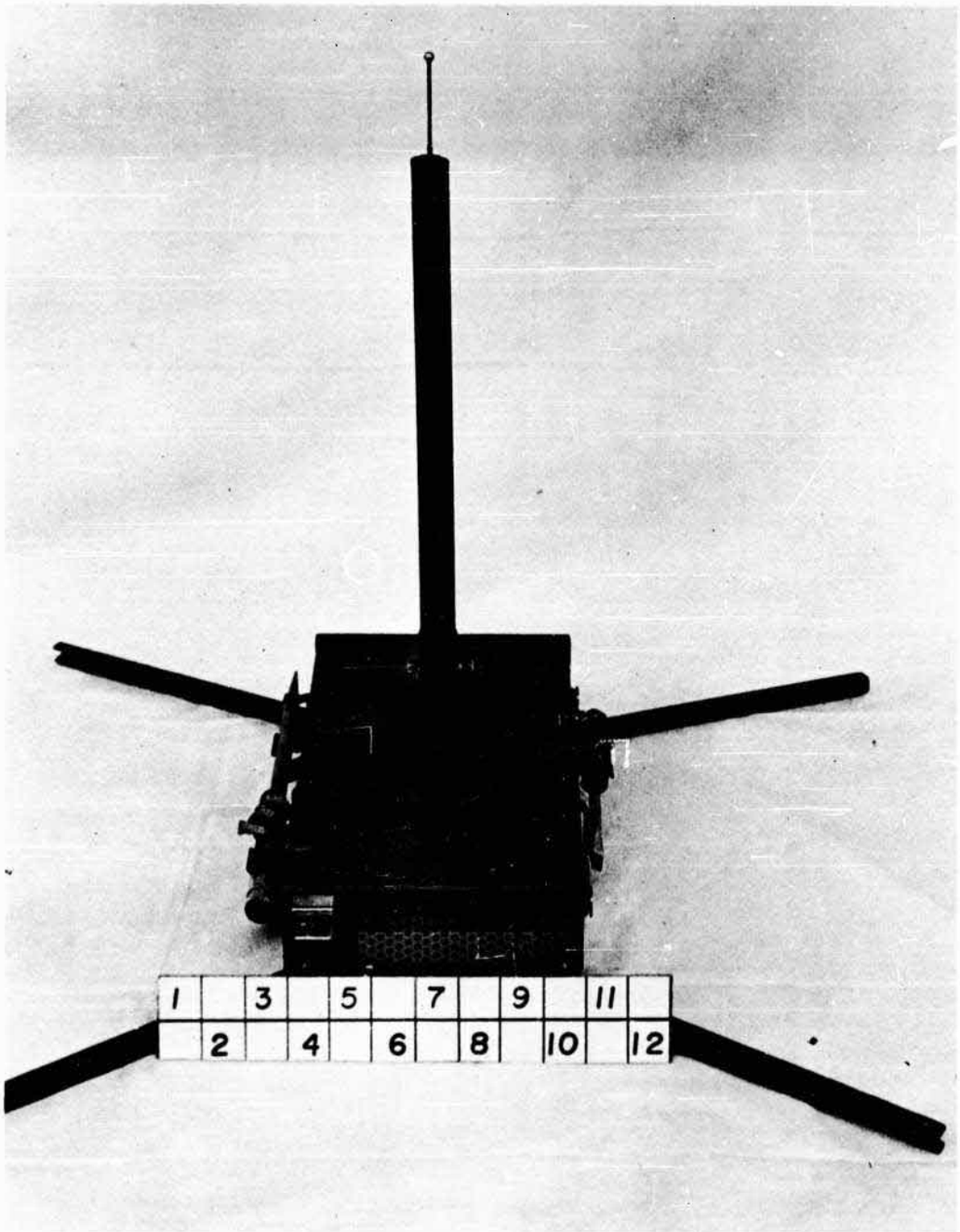
Task: Terminal Guidance Beacon (2C2)

Problem: To provide a suitable radio beacon to permit accurate parachute and helicopter delivery of troops and supplies by friendly local forces into small unprepared drop zones with a single pass of the transporting aircraft.

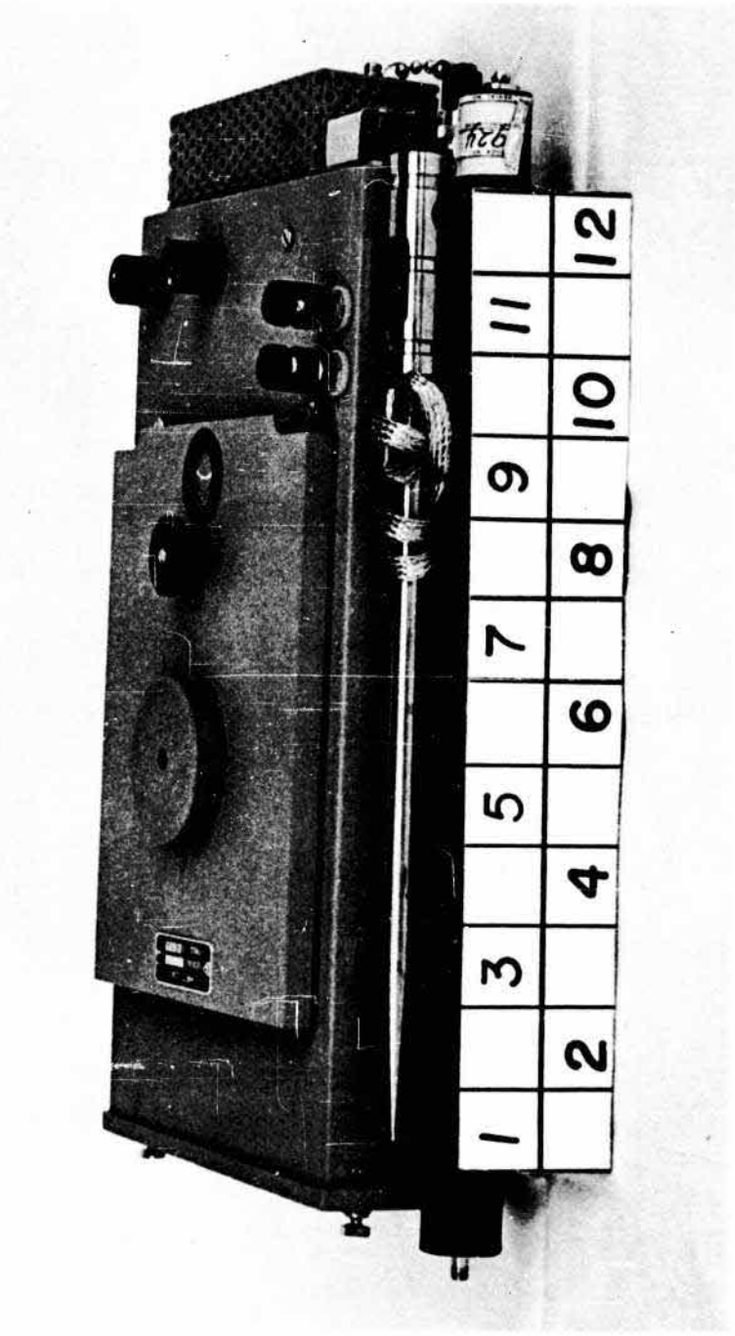
Description: A beacon is required which is compatible with standard ADF equipment currently installed in aircraft available to friendly local forces, rugged and light enough to be landed with a parachutist or carried by a member on an extended patrol, and capable of emitting a coded signal for drop zone or ground unit identification. This task involves the selection and evaluation of suitable beacon equipment for use by friendly local forces in their own distinctive environmental and operational situation, and any necessary development programs.

Current Status: CDTC-V has conducted preliminary evaluation of the Westmont Terminal Guidance Beacon; 50 of these beacons have been distributed for operational evaluation by U.S. Special Forces and ARVN units. This beacon operates by radiating a coded signal which gives azimuth bearing information to an aircraft equipped with standard low-frequency ADF equipment.

ARPA has obtained models of the HRT-2 and HRT-6 beacons and associated equipment and plans for evaluation in Vietnam. These beacons, like the Westmont, operate with the standard ADF equipment, but have proven superior in CONUS tests. Tests of the HRT-2 and HRT-6 are under way.




HRT-2A BEACON WITH TELESCOPIC ANTENNA INSTALLED AND STABILIZING LEGS SPREAD




SIDE VIEW OF THE HRT-2A TERMINAL GUIDANCE BEACON

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Identification and Location of Air-Dropped Equipment (2C3)

Problem: To provide a device which will enable friendly local forces to locate and identify air-dropped equipment or supplies.

Description: Air-dropped equipment is difficult to locate in the difficult terrain and vegetation conditions typically encountered in remote area conflict situations. This problem can be partially alleviated by improving the precision of the air-drop through effective identification of the drop-zone by means such as those described under the TIARA and Terminal Guidance Beacon tasks. Improvement is possible also by increasing the visibility of the air-dropped equipment, such as by marking with TIARA or other chemiluminescent materials. While the foregoing techniques are helpful under some circumstances, a more positive means by which surface units can locate their air-dropped supplies is also needed. Ultra-miniature, battery-operated radio transmitters which are compatible in frequency and modulation with standard portable field radios offer promise of providing a positive means for locating air-dropped equipment. In operation, the devices will be attached to bundles prior to air-drop, and will provide a homing signal for use by ground units in locating the bundle. (Standard FM VHF transceivers used by ground units can be equipped for this purpose with direction finding antennas which are currently available through MAP supply channels.)

Current Status: A development program has been established with Ryan Electronics Corporation to obtain interim test models of transmitter and receiver units suitable for field testing.

A technical problem exists in design of an antenna which can be part of or affixed to drop bundles and radiate effectively regardless of the aspect of the bundle on the ground. An additional effort on the antenna design problem is required and under way.

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Tactical Maps (2C4)

Problem: To determine a suitable material on which to print tactical maps for use in tropical remote area conflict situations.

Description: Map paper normally available does not retain its usefulness in combat when exposed to the tropical climatic conditions. A high wet-strength paper or similar material is required to withstand the long exposure to dampness and high temperatures involved in tropical remote area conflict operations.

Current Status: Reevaluation of samples of Japanese high-wet-strength paper by the U. S. Army Map Service has established that this paper does meet U. S. military specifications.

Maps printed by the National Geographic Service of Vietnam from U. S. Army Map Service plates have proved to be of excellent quality.

Feasibility of printing photomaps in a range of colors is being investigated by CDTC-V with the ARVN Engineer Topographic Company.

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Patrol Locating System (2C5)

Problem: To provide an effective capability for patrols and others mobile elements of friendly local forces operating at extended distances (10 - 100 miles) from their parent unit or base to locate themselves on the ground accurately and reliably.

Description: Penetration patrols and other ground parties operating at extended distances from parent units or bases require a capability to locate themselves precisely on the ground and on maps in order to arrive at pre-selected locations, or to report their location to their base or support aircraft. This equipment should be designed to be transported and operated by a patrol member operating for extended periods in difficult terrain.

Current Status: Arrangements are being made to provide man-pack and vehicular units of the Bendix-Pacific Position Fixing and Navigation System (PFNS), together with operation and maintenance personnel, for field evaluation with the low frequency navigation ground system installed there by the USAF in RVN. The PFNS equipment will be tested and evaluated as a joint U. S. Army ACTIV and CDTC-V program.

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Railway and Convoy Ambush Detectors (2D1)

Problem: To provide equipment to detect activity associated with ambushes of railway or vehicular elements.

Description: Railway and vehicular elements in remote area conflict situations are prime ambush targets. A means of detecting ambushes can aid friendly local forces in destroying ambush parties, and in avoiding the loss of personnel and material. Generally, the problem is one of detecting the ambush itself or of activity associated with preparation of the ambush. This activity can include the preparation of firing positions, the emplacement of mines, preparation of bridges for demolition, the removal of sections of track, or the placing of barricades across roads or rails.

Equipment is required to detect remotely the fact that an ambush has been or is being prepared. Such equipment may be airborne, mounted on train or vehicle, or may be a sensory system emplaced along the road or track. In operation the equipment must provide warning of an ambush to the train or convoy in time to halt the movement at a safe distance, to alert the elements before they are attacked or to alert supporting units in time for them to react effectively.

Current Status: ARPA is investigating the feasibility of detonation of mines by a high powered source of electromagnetic radiation mounted on a locomotive with Picatinny Arsenal. Data on Viet Cong mines was obtained by CDTC-V and furnished to Picatinny for use in this investigation. Picatinny Arsenal has reported that detonation of mines by this means is highly uncertain and the technique is therefore not recommended for implementation.

ARPA has also funded a study of feasibility of the use of "Y guide" with the Institute for Defense Analysis. This device detects a disturbance in the track or roadbed at a distance ahead of the train. IDA reports that the "Y guide" is expensive to install and unreliable because it is easily disabled or spoofed. ARPA plans to investigate other possible techniques of railroad security.

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Airborne Ground-Fire Detectors (2D2)

Problem: To provide devices which will detect the fact that an aircraft has been fired upon by small arms weapons.

Description: Rotary and sub-sonic fixed-wing aircraft employed in remote area conflict support operations are subjected to the hazard of small arms fire. The ambient noise level frequently precludes detection of this ground fire by the pilot or crew unless the aircraft is hit; even then crews have sometimes been unaware that the aircraft has been attacked. However, if the pilot could be alerted to the fact that bullets are passing nearby, evasive action may be possible before the aircraft is hit in a vital spot. This capability would also facilitate the identification of areas containing hostile elements. The effort under this task will be to develop and evaluate devices to provide this capability for use by friendly local forces.

Current Status: ARPA has funded Bissett Berman through the Army to develop an acoustic system to be mounted on aircraft to detect the passage of small arms projectiles close to the aircraft.

The Army has funded development of a different type acoustic system which is intended to detect passage of a bullet and to determine the angular direction from which it was fired.

Both of these systems will be mounted on helicopters and sub-sonic fixed wing aircraft, and evaluated in CONUS to determine the acceptability and utility of the two techniques.

Field evaluation in Vietnam will follow if a workable detection device is obtained from this program.

Tab 5

Requirement: Investigation, Development, and Evaluation of Techniques and Devices

Task: Patrol and Outpost Intrusion Detectors (2D3)

Problem: To obtain and evaluate devices which will facilitate detection of the intrusion by hostile elements of patrol or outpost perimeters.

Description: Light-weight, portable intrusion detection devices are required to permit an outpost or patrol to obtain warning of enemy passage or breach of a defensive perimeter. This task encompasses the selection, or development, and evaluation of various detection devices which have promise in this application.

Current Status: The AN/GSS-9 break wire intrusion detection device have been obtained from USAERDL for evaluation by CDTC-T and CDTC-V. This device is operated by stringing a very fine twisted pair wire along the earth and through bushes; when the wire is broken, a light or buzzer is actuated.

ARPA has also obtained models of a break wire device from Scope, Inc. This device differs from the AN/GSS-9 in the circuitry employed and in the use of a single strand nylon clad wire; they will be given comparative evaluation in Southeast Asia. In addition, models have been furnished to the U.S. Army Special Forces at Fort Bragg, the USMC Landing Force Development Center at Quantico and various other agencies of the U.S. Government for evaluation.

Test reports should be distributed during the next quarter. Preliminary information indicates that some redesign of the devices will be required.

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# AGILE SUB-PROJECT VI

# INDIVIDUAL AND SPECIAL PROJECTS

# TAB 6

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Tab 6

## AGILE SUB-PROJECT VI

## INDIVIDUAL AND SPECIAL PROJECTS

SUB-PROJECT OBJECTIVE:

This sub-project provides for centralized management and control of those AGILE efforts which because of sensitivity, diversity, or uniqueness of application are not included in other segments of the AGILE program. As a consequence, this sub-project covers a range of requirement areas and involves varying applications of research and engineering resources, from field investigations and analyses of insurgency problems to the design and development in the U. S. of hardware and other items designed to fill specified indigenous needs.

While the requirements and tasks currently being pursued under this sub-project are shown on the immediately following page, it should be emphasized that its composition is, by design, flexible and subject to change.

REQUIREMENTS AND TASKS

Listed below are those major requirement areas and the status of tasks in each area with which this group is concerned. Succeeding pages summarize the purpose and current status of each task.

1. Military Chemistry
   - A. Defoliation
   - B. Crop Destruction
2. Psychological Warfare
   - A. Psychological Warfare Equipment
3. Medical Supplies and Equipment
   - A. Medical Kits
   - B. Jungle Litter
   - C. Leech Repellants
4. People Detection and Identification Equipment and Techniques
   - A. Military Dog Breeding

Requirement: Military Chemistry

Task: Defoliation (1A)

Problem: To identify more effective herbicides and dissemination systems for defoliating vegetation in order to improve visibility around installations and along lines of communication, thereby improving the air and ground surveillance capability of the friendly forces and reducing the insurgent's freedom of movement and ability to set up ambushes undetected.

Description: Laboratory and field efforts are directed toward improving existing, and developing new, herbicides and dissemination equipment and techniques.

Current Status: The several R&D activities being carried out under this task are commented on below:

a. HIDAL Spray System - CONUS activity has centered around the procurement of an H34 helicopter for use in spray testing. An aircraft has been made available, and installation of spray equipment is under way. Spray testing will begin shortly.

During the quarter improved pumping motors for the five HIDAL units in use in RVN were obtained in CONUS and sent to the field for installation. These new motors are expected to reduce significantly the former high rate of motor burn-out. As improved HIDAL systems and components become available through CONUS research they will be made available to the CDTC's for field test and evaluation.

b. FIDAL Spray System - Modifications to the AD-6/FIDAL combination, based on earlier test results, were made during the quarter. The installation of a larger-capability fan-pitch-positioning motor has increased the reliability of the system based on preliminary testing only. More exhaustive tests are now in process to further identify and correct deficiencies.

c. MC-1/C-123 Spray System - Modifications to the pump motor and the wing boom were tested during the quarter. Based on these tests the wing booms were returned to their original size (1-1/2 inch in diameter), and further testing is under way with the new pumping motor.

d. FS-AMD/C-130 Spray System - During the quarter a new research project has been established in cooperation with AFSC and Eglin AFB. The requirement is for the design and testing of a new spray boom and dispensing system for use with long-range, large-capacity aircraft of the C-130 type.

The system envisioned will be in the 1000-gallon-capacity area (500 gallon modules), will be readily installed and removed from aircraft (less than one hour), will not require aircraft modification, and will be powered by pressure tanks rather than pumps. A contract with the Aircraft-Missiles Division of the Fairchild-Stratos Corp was let in late June. Design reviews are scheduled for late July. Within seven months the corporation will make available six units for aircraft testing and one tank unit for specimen testing.

e. CONUS Research on New Chemical Defoliants and Herbicides -

1. The acquisition and primary screening portion of the program, being conducted by the USABIOLAB, Ft Detrick, Md., has received several hundred candidate compounds from contractors and as contributions from industry. Preliminary screening of these compounds is proceeding actively and successful candidate compounds are expected to move forward into the secondary screening program during the next quarter.

2. The secondary screening portion of the program, being conducted by the U. S. Department of Agriculture, has established its Texas and Puerto Rico groups and brought them to planned manning levels. Test sites are being prepared for evaluation of chemicals to be received from the Fort Detrick primary screening program.

f. Thailand Defoliation Test Program - A project to evaluate chemicals as defoliants, desiccants, and herbicides in the defoliation and control of woody vegetation of Southeast Asia has been activated during the present quarter. The 2-year program will be conducted in Thailand by personnel from the U. S. Army Biological Laboratories at Fort Detrick with the support of the CDTC personnel in Thailand. Major objectives are to determine effective chemical treatments for the defoliation and control of woody vegetation types in the Southeast Asian areas. Evaluations will be conducted of selected currently available defoliants, desiccants and herbicides as well as CONUS field-tested compounds synthesized and screened from current research and development programs under way at the U. S. Army Biological Laboratories and the USDA secondary screening program.

Establishment of the advance party from USABIOLABS is under way. Four key personnel arrived during April and May to commence on-the-spot planning. Two additional persons are scheduled to arrive during July.

Plans have been developed for a two-year testing program to be conducted principally at the Pranburi Military Reservation near Hua Hin in the Kra Peninsula. In collaboration with officials of the Pranburi Infantry Training Center, test site locations have been selected on two extensive

artillery ranges with suitable vegetation cover and accessibility for ground evaluation and observation of treatments. Projected acreages required for test applications during the two-year program total 3,400 acres at the Pranburi site and 2,500 acres at several supplemental areas representing different vegetation types of Southeast Asia. This includes both areas to be actually treated and the necessary acres to provide separation of individual test plots. Permanent kill is expected on only a small portion of the total area. Arrangements are being made to contact responsible officials of government agencies concerned with land use in the test locations selected as to the general nature of the anticipated program. Initial phases of research have largely centered on familiarization of personnel with the more important woody plants and vegetation types of Thailand. Approximately one month was spent by the plant taxonomist in securing critical data and photographs of important tree species in Thailand in European herbaria and museums prior to his arrival in Thailand. An extensive annotated bibliography of references on the vegetation types and systematic botanical studies of Thailand plants has been prepared by the plant ecologist as a working tool for the project. Field studies by project personnel have resulted in collections of more than 150 species in flowering or fruiting condition needed for identification; bark and fruit samples are taken to accompany each collection. Duplicate collections are furnished to various herbaria and taxonomic specialists for assistance in authentic determination of plant species. Valuable assistance in the designation of vernacular and scientific names of the principal tree species has been given by Tem Smitinand of the Royal Forestry Department, Herbarium and other Forestry Department personnel. Activities under this segment of the program are being coordinated with Task VII - 1A2 (Vegetation Study).

Supplies of currently available herbicides and defoliants to be included in the test program have been received preparatory to test applications. A Nissan Patrol Vehicle and experienced driver have been leased on a yearly basis for field operations. Test applications will be made on 10 or 15-acre plots using a Beechcraft twin-engine plane (C-45) equipped with a suitable spray distributing system to be provided under lease from a local contracting firm. Preliminary calibration tests will be made with the C-45 equipment following its arrival in Thailand.

Tab 6

CDTC-V PROJECT OFFICERS, CAPTAIN TON AND LT. COL. FAIR, BRIEF PRESIDENT DIEM ON THE HIDAL APPARATUS USED IN DEFOLIATION EXPERIMENTS AND OPERATIONS IN VIETNAM.

Requirement: Military Chemistry

Task: Crop Destruction (1B)

Problem: To deny the enemy the capability to utilize indigenously grown field crops as a means of logistically supporting military operations.

Description: Technical assistance is provided to indigenous forces in connection with their operations against crops which are enemy-controlled and which can be clearly identified as not being sources of food for the civilian population.

Current Status: The various sub-tasks listed under the Defoliation task (1A) also have either direct or potential application to this task. Members of CDTC-V continue to provide technical assistance to the appropriate U. S. and RVN committees charged with operational planning in Vietnam.

The only research effort not reported under Defoliation (1A) is described below.

Herbicide Cluster Bombs, E155 and E156: In conjunction with continuing laboratory and flat-grid testing the items are now being tested in both static and free-fall modes against marshland type vegetation. Data is being accumulated on area covered, dose-level effectiveness, pattern distribution, particle sizes, deposition rate, etc. Tests are proceeding on schedule and preliminary evaluation is most favorable. The item should provide an excellent mechanism of small plot application from acceptable aircraft altitudes. Work is under way to establish compatability with higher-performance aircraft of the AD-6 class.

Tab 6

Requirement: Psychological Warfare

Task: Psychological Warfare Equipment (2A)

Problem: To identify more suitable solutions to indigenous psychological warfare equipment problems.

Description: New or improved items of psychological warfare equipment are tested and evaluated against the requirements of the indigenous military and para-military forces.

Current Status: a. Audio Visual Mobile Unit - The final report on the Willys Visual Mobile Unit has been completed and will be distributed shortly. Since this equipment did not fulfill the requirements originally established, action is under way to select individual items of equipment to meet the various sub-requirements, to obtain suitable packaging for these units, and to obtain CONUS evaluation of each segment. The modular subunits will then be sent to Thailand where they will be mounted in a locally fabricated cab and field tested. This approach should lead to a system readily adaptable to any available, usable mode of transportation including animal and man packing as well as indigenous vehicles.

b. High-Power Voice-Amplifier Equipment - One 500 watt unit has been loaned to ACTIV by CDTC-V for installation on a UH-1B helicopter. Preliminary tests indicate ranges of over one mile with good intelligibility and high directional qualities. Fuller testing will be accomplished through joint CDTC-ACTIV activity. Production of a test report on earlier evaluations has been delayed by the above testing, which will be included in the final report.

c. Man-Portable PA System - The field testing of this lightweight unit is proceeding on a routine basis. A report of one series of tests is in publication and should be available for distribution during July.

Tab 6

Requirement: Medical Supplies and Equipment

Task: Medical Kits (3A)

Problem: To develop a more suitable individual first-aid kit for use by counterguerrilla forces, who frequently operate without medical support units and who consequently must depend on self-administered first-aid.

Description: The standard U. S. first-aid packet contains insufficient items to satisfy this requirement; an aid kit containing the necessary items to cope with the medical problems encountered by the indigenous forces is therefore required.

Current Status: Field tests of the medical aid kit have been completed; the test data has been compiled; and the final report is now being prepared. Test personnel included both U. S. and Vietnamese personnel located in all geographic areas from the delta to the mountains with heavy emphasis on ARVN Special Forces units. One kit was also professionally evaluated by the RVN Surgeon General's office who additionally provided monitors for the field tests. Preliminary evaluation of the test results indicate that the kit was extremely well received and that only minor modification needs to be made.

Tab 6

COMPONENTS OF THE ARVN SPECIAL FORCES MEDICAL AID KIT TESTED RECENTLY IN VIETNAM BY CDTC-V
(RULER IS FOR SCALE ONLY)

Tab 6

Requirement: Medical Supplies and Equipment

Task: Jungle Litter (3B)

Problem: To develop a litter of a size and construction which is better suited for use in a jungle environment.

Description: Vietnamese personnel have found that the standard U. S. rigid-pole litter is too long for evacuation of casualties in the jungle.

Current Status: CONUS information relating to existing service, commercial and developmental litters showing some jungle potential was collected and forwarded to CDTC-V for discussion with MACV and RVNAF medical personnel. Based upon the results of the above discussion several items are being shipped by the Dept. of the Army for testing in Vietnam. A test plan has been drawn up and is being coordinated with MAAG medical advisors. Test items will be issued to RVNAF medical units for evaluation.

Requirement: Medical Supplies & Equipment

Task: Improved Leech Repellants (3C)

Problem: RVNAF personnel are frequently exposed to both terrestrial and aquatic leeches. Present repellants and/or their methods of application do not appear to provide acceptable protection.

Description: Effort will be expended on several phases of the problem to include new methods of application, improved instructional material, repackaging, a state-of-the-art survey, and an evaluation of potentially useful research areas.

Current Status: (a) A state-of-the-art survey has been made by a contractor and a report is expected during July.

(b) Arrangements have been made to procure several different aerosol packagings in quantities sufficient to enable evaluation by RVNAF forces to determine the utility of the aerosol method of application, the optimum size and configuration of the cans and the efficacy of the instructions printed on the items. These items are expected from the contractor by mid-July for shipment to the field.

(c) Repellant sticks supplied by the Limited Warfare Laboratory, Dept. of Army have been received in the field and are scheduled for early testing. Based on a single operational test so far carried out they have shown excellent insecticidal qualities causing leeches already attached to the soldiers' bodies to rapidly release their grip. Recommendations for minor modifications have been forwarded to LWL by their liaison officer at the CDTC-V.

Tab 6

Requirement: People Detection and Identification Equipment & Techniques

Task: Military Dog Breeding (4A)

Problem: To provide a regular source of acclimatized dogs at low cost to replace and augment the military dogs which are performing patrol, tracking and sentry duties in the Republic of Vietnam.

Description: Dogs originally procured for military use in Vietnam were imported and maintained at substantial expense. A breeding center was established and is producing dogs which enter training when they are of age. It is anticipated that the dogs will be trained for scouting, sentry and tracking duties.

Current Status: The CDTC-V Military Dog Breeding Center was terminated on 1 July 1963, having served its original purpose. The adult dog population, less bloodhounds, has been turned over to the Dog Training Center. A final report evaluating the program is now in preparation. This report will cover the specific findings during the program with special annexes on medical statistics, a final test report on the bloodhound training program, an evaluation of the utilization of military dogs in Vietnam, the uses of dogs in CI warfare, a cost analysis of the breeding program, and a special section containing recommendations.

COLONEL VITO S. PEDONE, CHIEF OF THE ARPA R&D FIELD UNIT IN VIETNAM, DISCUSSES THE CDTC-V MILITARY DOG BREEDING PROGRAM WITH PRESIDENT DIEM. DR. (LT.) KOTHMANN, AF VETERINARIAN ON DUTY WITH CDTC-V, LOOKS ON.

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# AGILE SUB-PROJECT VII

## TECHNICAL PLANNING AND PROGRAMMING

## TAB 7

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## AGILE SUB-PROJECT VII

## TECHNICAL PLANNING AND PROGRAMMING

### SUB-PROJECT OBJECTIVE:

This sub-project provides for operations research in the identification of requirements for new or improved counterinsurgency weapons and equipment. Through data acquisition, analysis, and the application of interdisciplinary scientific techniques to the analysis of military and related civil problems, this sub-project points the way to new ideas and requirements, helps establish priorities, and helps integrate ARPA's counterinsurgency RDT&E effort.

### SUB-PROJECT BACKGROUND:

The development and validation of RDT&E requirements in the counterinsurgency area requires a number of broad inputs. There is general agreement that Remote Area Conflict, as encountered today, is composed of a number of interdependent and inseparable activities; to name a few: intelligence, psychological warfare, economic warfare, military operations, and political activity. It is incumbent upon those agencies of government involved in counterinsurgency to consider the effect of their actions in all of these areas, and to effect appropriate coordination. In the case of Project AGILE, RDT&E requirements must be thoroughly researched to avoid duplication and to assure that counterproductive side effects do not occur. Moreover, since AGILE itself is organized into functional technical areas, a similar requirement exists to provide an information and evaluative interface within AGILE and to consider new requirements from an overall point of view. The mission of effecting this function for ARPA/AGILE has been assigned to the Technical Planning and Programming Sub-Project.

Another prerequisite for the identification of RDT&E requirements is the collection and analysis of sufficient valid data. Although much data already exists from current and past experiences in counterinsurgency operations, data collection and analysis is a continuing task. Offensive and defensive doctrine and tactics are not fixed; an improvement or variation in one generally affects the other, often with a significant effect on weapons and equipment requirements. The ingredients of success also vary from one tactical situation to another and, thus, data must continually be sought and analyzed to provide better understanding of these variables and to identify valid requirements for RDT&E activity.

Ancillary but extremely important in this connection is the maintenance of a data storage facility, which can serve as the "collective memory" on counterinsurgency. As data collection activities progress, there will be an increasing need for a mechanism to store like elements of information in a suitably retrievable form for purposes of comparison, contrast, establishment of project and sub-project parameters, maintenance of informational continuity, and the identification of data gaps. Such a system should be susceptible to expansion and incorporate a quick response capability.

Technical Planning and Programming is charged with these facets of requirement development for Project AGILE.

SUB-PROJECT DESCRIPTION

1. Data Collection and Analysis

Some of the broader and more basic activities are:

a. Environmental: This includes collection and analysis, from existing and new sources, of data on topography, soil mechanics, plant ecology, climatology and geomorphology.

b. Military: This includes data collection and analysis on ambushes; military casualty statistics; firepower parameters and target analysis; transportation systems; mobility systems; airpower, boat, lake and river warfare; night operations; border security; and food control and internal security systems for their effect on RDT&E requirements.

c. Sociological: This includes collection and analysis of data in such areas as religious systems, value systems, group dynamics, sociological patterns, civil-military relationships, and elements of predictive behavior germane to the establishment of RDT&E requirements.

d. Historical Studies: This includes investigations into the nature of past remote area conflicts and the assessment of the degree to which lessons learned in those conflicts are applicable to present and future RDT&E requirements.

e. Special Studies: This includes data collection in areas not immediately relatable to any of the above discrete categories.

2. Data Storage and Retrieval

Since more and more basic data is becoming available or is being retrieved from its present locations, this sub-project is developing system-storage and retrieval systems.

REQUIREMENTS AND TASKS

Listed below are those major requirement areas and currently active tasks in each area with which sub-project VII is concerned. Succeeding pages summarize the purpose and current status of each task.

1. Data Collection and Analysis

   A. Environmental

      (1) Physical Environment Methodology

      (2) Vegetation Study

   B. Military

      (1) Morbidity and Casualty Study

      (2) SEATO Medical Analysis

      (3) RVNAF After-Action Report Study

      (4) Border Surveillance and Control

      (5) Ambush Patterns and Counter-Techniques

      (6) Field Communications Systems Performance

   C. Sociological Studies

      (1) Studies of Northeast Thailand

   D. Historical Studies

      (1) Algerian Study

   E. Special Studies

      (1) Survey of University Research Potential for AGILE

      (2) Vietnamese Rural Security Study

      (3) Adviser-Counterpart Communication

      (4) Effect of the Strategic Hamlet Program in Vietnam

2. Data Storage and Retrieval

A. Remote Area Conflict Information Center (RACIC)

Requirement: Data Collection and Analysis – Environmental

Task: Physical Environment Methodology (1A1)

Problem: Virtually every aspect of remote area conflict is influenced to a significant degree by the physical environment, particularly in the fields of geomorphology, climatology and plant ecology. The orderly planning of R&D effort in several hardware fields is being hindered by the lack of certain basic physical environmental data and the lack of order in such data already available. While the collection and processing of certain specialized environmental data for Southeast Asia (MERS, SEACORE, SEASURE and Defoliation) is already under way, there exists a wealth of more general physical environmental data which is neither systematized, related nor in many cases readily retrievable. No system now exists which integrates the various factors of the physical environment into a total picture usable in a specific R&D effort nor is there a descriptive system which permits adequate differentiation, for example, between the various types of forest and "jungle", their incidence, features and locations. These conditions also exist for remote areas other than Southeast Asia.

Description: Effort will be addressed to:

a. Identification of the data required for an adequate physical environment description.

b. Identification of critical environmental parameters, which, in turn, influence selection of key data.

c. Development of a methodology which will permit the systematic collection and handling of pertinent data by whatever agency may be involved.

d. Determination and acquisition of available data from existing sources.

e. Identification of the gaps in the data available and development of plans for its acquisition.

f. Testing and verification of the methodology and data.

g. Establishment of an environmental data storage and retrieval system for central reference.

Current Status: Activity under this task for the past quarter has comprised augmentation of the professional personnel strength of the investigating staff and expansion of the scope of data sources through literature searches and personal contacts. The Deputy Chief Investigator visited the Far East and surveyed data sources there. Future activities are contemplated in the areas of intensified data collection and examination of work that has been done in the environmental storage and retrieval areas of potential value to this task.

Tab 7

Requirement: Data Collection and Analysis – Environmental

Task: Vegetation Study (Formerly titled Vegetation Effect on Munitions) (1A2)

Problem: To collect, centralize and analyze data on Southeast Asian vegetation which affect a variety of RDT&E projects.

Description: This task, originally titled Vegetation Effect on Munitions, was previously focussed on providing vegetation data essential to the development of accurate, reliable aerial weapon delivery systems incorporating improved fuzing techniques and weapon configurations to ensure maximum effectiveness in areas of heavy vegetation. This task was requested by APGC, Eglin AFB.

The task has now been expanded and retitled Vegetation Study. It now provides for systematic acquisition and analysis of the location, distribution and characteristics of the botanical species in Thailand and South Vietnam. These data will provide essential input not only to munitions requirements but also to the on-going efforts in mobility, communications, surveillance and defoliation research programs. Data developed under this task will be incorporated into the Physical Environment Methodology and Data Storage Task.

Current Status: Vegetation studies have continued with emphasis placed on canopy and forward horizontal visibility (penetrability) measurements in northeast Thailand. Data on canopy coverage is still being collected and reviewed, however, data collection on forward visibility has been accomplished in typical forest areas at Khoa Yai, Phu Kra Dung, Ubol and Chantaburi. The forests of these areas are representative of the types of vegetation prevalent in northeast Thailand. Additional surveys will be made in Chantaburi to correlate variation of forest type with geographical location and to establish the change in visibility or thickness of undergrowth as a function of altitude, soil type and forest type. Shrubs, trees and vines that make up the undergrowth have been identified. These plant identifications will be included in the more formal complete report at a later date.

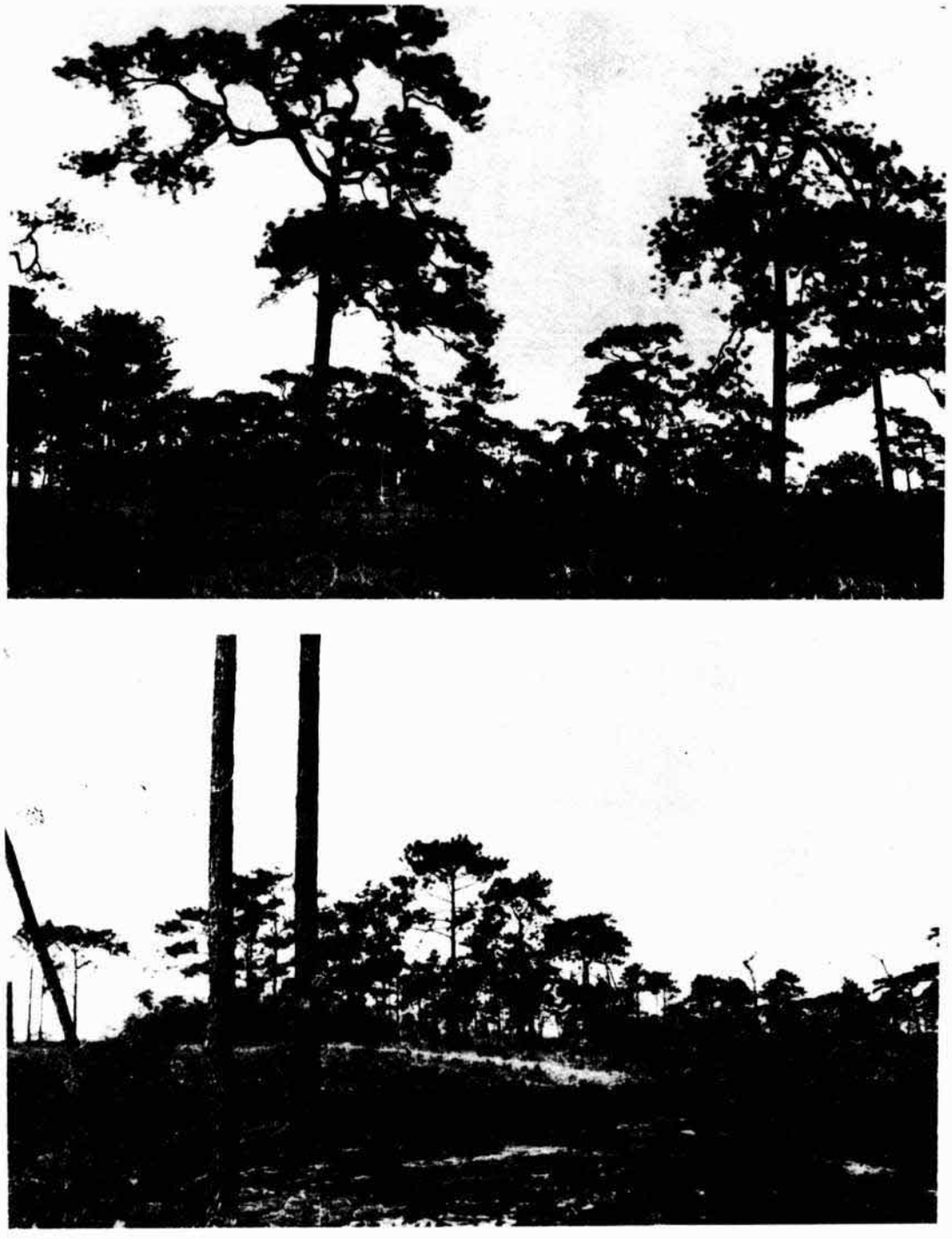
CDTC is completing negotiations to hire the services of a Thai scientific team to perform technical investigations and studies of the nature of the vegetation and its associated environment in Thailand. For the purpose of this work Thailand will be divided into 5 regions according to their physiographic features and characteristics:

a. Northwest Highland
b. Chao Phyraya Plain
c. Northeast Plateau
d. Chanta Buri Region
e. Peninsular Region

The types of forest and vegetation within these geographical areas will be identified. Physical measurements and data will be collected and analyzed to perform diagramatic profiles with horizontal projections of forest strips. Frequency distribution of the basal area will be made on each stand. Floristic composition of each stand will be made. Structure of the forest communities will be analyzed with specific reference to stratification and dispersion of individuals and species over each plot. Where applicable, previous data and site surveys that have been accomplished will be used thereby eliminating unnecessary duplication of studies. In all studies of specific areas associated meteorological data will be integrated with the study, as well as descriptions and data on the associated soils and terrain. Diagrams will be made showing the type forest, the moisture and thermal altitudinal gradient.

Tab 7

TROPICAL RAIN FOREST - KHAO YAI (IN N. E. THAILAND); LAT 14°28'N, LONG 101°25'E, ALTITUDE 800 METERS; MEASURED VISIBILITY 30' AND 36'.



CONIFEROUS FOREST - PHU KRADUNG (IN N.E. THAILAND).
LAT 16°53'N, LONG 101°47'45"E.

Requirement: Data Collection and Analysis – Military

Task: Morbidity and Casualty Studies (1B1)

Problem: To determine the specific enemy weapons and techniques which are causing RVNAF casualties and the relative rate of occurrence of each type of wound. This analysis is intended to give better definitions of RDT&E requirements for improved weapons and armor.

Description: The primary source of data will be RVNAF hospital admission records. All of the admissions records for 1962 from all military hospitals will be examined. Pertinent data from these records will be extracted and transferred to IBM cards so that machine techniques may be applied in the statistical phase of the analysis.

Current Status: A study "Spike Wounds in the Vietnamese Guerrilla War (U)" has been completed and presented to the RVN Surgeon General for review and clearance. Upon the securing of these and other clearances, a field office draft will be published. Further work under this task was suspended for the month of June while the RAC analysts assigned were participating in a special project in Thailand. Analysis will resume in July.

Tab 7

Requirement: Data Collection and Analysis - Military

Task: SEATO Medical Analysis (1B2)

Problem: To discuss the significance of medical factors in Southeast Asian military exercises.

Description: Medical data on the participants in Exercise THANARAT will be analyzed to assess the effects of acclimitization and the incidence of medical problems. This study is a follow-on to a study published in April: "Statistical Analysis of Medical Records of Joint Task Force 116 Troops in Thailand in Spring and Summer of 1962".

Current Status: Forms and instructions to obtain the medical data have been finalized and released for use by U.S. elements. Coordination has been effected with Commonwealth and Thai elements.

Tab 7

Requirement: Data Collection and Analysis – Military

Task: RVNAF After-Action Report Study (1B3)

Problem: To obtain, on a systematic basis, more complete and definitive RVNAF reporting of actions between elements of the RVNAF and the VC. After-action reporting presently being done by the RVNAF does not yield sufficient data of the proper type to permit systematic analyses to determine RDT&E requirements.

Description: Questionnaires, structured to adequately cover all phases of an action, will be designed and validated. After appropriate RVN approval they will be translated and put into use by RVNAF field units. When a sufficient data base has been established, analyses to determine RDT&E requirements will be performed in such fields as weapons, armor, mobility, communications, etc.

Current Status: Collection of after-action data by means of the revised report form continues. Evaluation of the After-Action Report System may be possible within a few months; meanwhile, as the information is collected, it is being used in various on-going analyses.

Requirement: Data Collection and Analysis – Military

Task: Border Surveillance and Control (1B4)

Problem: To ascertain the feasibility of means by which illicit traffic in men and materiel into and out of South Vietnam can be detected and eventually diminished.

Description: This task includes an analysis of the essential features of present unauthorized traffic, an assessment of the effectiveness of past and present control methods which may be applicable, and recommendations for new or different control means.

Current Status: The new data reported last quarter has been analyzed and is being incorporated in the field report. It is expected that the final report will be completed next quarter.

Tab 7

Requirement: Data Collection and Analysis – Military

Task: Ambush Patterns and Counter-Techniques (1B5)

Problem: To analyze the ambush in all its forms, establish typical ambush patterns and develop parametric data from which RDT&E requirements for counterweapons, devices and equipment can be developed.

Description: Ambushes are expected to be a continuing problem as the enemy revises ambush techniques in response to improved counter-techniques. First emphasis will be placed on the security of vehicular convoys with later investigation of both railway and water ambushes. Data sources in RVNAF and MAAG will be identified and preliminary data obtained. Further data will be obtained as part of the After-Action Report effort (4,B).

Current Status: Two studies completed under this task were reported on in QR-9. A draft study on railway ambushes has been submitted for publication. The study is derived from a detailed statistical examination of military after-action reports, railway incident lists, economic data, interviews with personnel involved in rail security, and a five day reconnaissance of the rail right of way in Vietnam.

Requirement: Data Collection and Analysis – Military

Task: Field Communications Systems Performance (1B6)

Problem: To collect data on the operational usage and performance of base and tactical communication systems in use in South Vietnam to provide part of the basis for the identification of communications equipment RDT&E requirements.

Description: RAND personnel are to gather data on such factors as traffic distribution by precedence and time, message volume, delay time, traffic volume by station and net and station down-time, for each type of operational unit and associated communications equipment.

Current Status: Data collected under this task will be published in four separate reports. Initial drafts of the reports are continuing to undergo intensive review.

Tab 7

Requirement: Data Collection and Analysis – Sociological

Task: Studies of Northeast Thailand (1C1)

Problem: To determine the most likely sources of social conflict in this area, concentrating on those local problems and attitudes which could be exploited by the Communists.

Description: A team of two to three RAND analysts who are specialists on Thai problems are performing a CONUS study in Northeast Thailand concentrating on the following substantive problems:

1. Village views of its problems
2. Government authority at the local level
3. Contrasting view of local authorities
4. Leadership patterns

Current Status: The initial draft of the study report, "Certain Effects of Culture and Social Organization on Internal Security in Thailand" has been reviewed and is undergoing extensive revision prior to publication.

Requirement: Data Collection and Analysis – Historical

Task: Algerian Study (1D1)

Problem: To produce an analysis of the French effort in Algeria at the level of company size units.

Description: A RAND consultant who served in Algeria is to prepare a definitive report of his experiences in company level counterinsurgency activities. The study will be in three primary sections including an appreciation of the situation in the Summer of 1956, the struggle for control of the population, and conclusions and lessons learned. The study will focus primarily at company level operations.

Current Status: Colonel Galula's report of the Algerian campaign has been reviewed and is being edited for publication. The volume of the report exceeded expectations, requiring a longer period for editing and publishing than anticipated.

Tab 7

Requirement: Data Collections and Analysis – Special

Task: Survey of University Research Potential for AGILE (1E1)

Problem: To survey and analyze the assets which exist in the American academic community in terms of their application to AGILE's problem areas, culminating in conclusions and recommendations whereby AGILE can most effectively use such assets.

Description: After identifying Project AGILE's problem areas in such a way that they may be readily associated with the various academic disciplines, RAND will survey existing academic assets on a nationwide basis. The study will provide background data on U.S. academic institutions' individual areas of emphasis, their current government and non-government research efforts and their level of information and competence as they relate to the specific AGILE problem areas.

Current Status: The final report of the investigation is in publication and will be issued early next quarter as indicated in the previous quarterly status report.

Requirement: Data Collection and Analysis – Special

Task: Vietnamese Rural Security Study (1E2) (Transferred from Sub-Project VI to Sub-Project VII)

Problem: To identify tasks which may be undertaken with AGILE resources in support of the RVN's rural security program.

Description: A rural security study team, composed of specialists from RAND, RAC, IDA, and ARPA field personnel, has conducted an intensive in-country examination and analysis of the Strategic Hamlet Program, which is the rural security program of the RVN. The team has identified on a priority basis, R&D tasks to which AGILE's resources could most profitably be directed in improving the effectiveness of the program.

Current Status: The three R & D tasks which were proposed as a follow-on research effort under this task are as follows:

(a) Threat Analysis

(b) Continuous Evaluation

(c) Rural Mores

Action on these tasks has been suspended pending the receipt of appropriate clearances.

Requirement: Data Collection and Analyses – Special

Task: Adviser-Counterpart Communication (1E3)

Problem: To develop and improve effective means of communication between U. S. military advisers and their allied counterparts.

Description: The purpose of this task is to survey the state-of-the-communication-art as it applies to adviser-counterpart relations, examine the problem as it exists in Vietnam, and determine which facets of the problem may be susceptible to the application of R&D techniques and resources. The research plan is as follows:

1. Survey of CONUS efforts on the adviser-counterpart problem

2. A concurrent survey of techniques and measures being used in Vietnam

3. Formulation of specific R&D tasks through analysis of the data collected under 1 and 2

Current Status: Specific terms of reference and a research methodology are being developed. It is expected that both the CONUS and Vietnamese phases will get under way during the next quarter.

Requirement: Data Storage and Retrieval – Special

Task: Effect of the Strategic Hamlet Program in Vietnam (1E4)

Problem: To analyze and evaluate the impact of the Strategic Hamlet Program on the military security of the Republic of Vietnam, and to consider both economic and general development problems as they will affect the long term security situation.

Description: This study will be concerned with three facets of the overall Strategic Hamlet Program:

1. Interrelationships of economic, social and military factors in the Strategic Hamlet Program

2. Changes which may occur in the economic structure of Vietnam as a result of the Program and the impact of these changes on the military capabilities of Vietnam.

3. The socio/economic effects of the Program over the long term with a view to optimizing the Program for later conflict periods

Current Status: Principal data sources in CONUS and overseas are being identified and data is being acquired. Preliminary analysis of this material will begin in August.

Requirement: Data Storage and Retrieval

Task: Remote Area Conflict Information Center (RACIC) (2A)

Problem: To establish and operate a Remote Area Conflict Information Center with a data base encompassing a broad area of military and sociological information from which state-of-the-art surveys, interdisciplinary analyses and studies and specific technical information requirements can be derived.

Description: The current ARPA program in remote area conflict requires the analysis of a number of discrete and interrelated problems involving in varying degrees a vast number of technical, scientific and sociological disciplines. Experience and information on this type of subject is extremely diverse in substance and geographic location. In order to monitor an effort of this scope and complexity a system of collection, screening, abstraction, cross-indexing and continuous analysis is needed to keep researchers aware of the state-of-the-art and to enable them to better identify RDT&E requirements. The establishment of this information center is intended to assure the orderly collection and processing of this data. Its evaluation by RACIC is expected to substantially reduce the inherent risks and associated expenses of needless repetition of research projects, as well as to enhance the capacity of AGILE and all other agencies concerned with remote area conflict to fulfill their informational requirements. The need for such a center has been noted in inter-agency investigations in 1962.

Current Status: Microfilming of the informational backlog within AGILE has been completed, and cross-indexing is under way. Sources of information in CONUS and overseas pertinent to the AGILE mission are being sought.

~~CONFIDENTIAL~~

# AGILE SUB-PROJECT VIII

# RESEARCH AND EXPLORATORY DEVELOPMENT

# TAB 8

~~CONFIDENTIAL~~

Tab 8

## AGILE SUB-PROJECT VIII

## RESEARCH AND EXPLORATORY DEVELOPMENT

### SUB-PROJECT OBJECTIVE

To initiate, or conduct in support of one or more of the other AGILE projects, technical feasibility studies, research or exploratory development to fulfill those requirements which necessitate preliminary investigation to either establish the state-of-the-art or to explore the means of extending the state-of-the-art. Efforts of this nature are undertaken within Sub-Project VIII to obtain sufficient data to determine whether or not a development program oriented toward the achievement of a specific end item should be undertaken. This sub-project also encompasses tasks complementary to other AGILE sub-project objectives which are not within the scope of their primary programs.

### SUB-PROJECT BACKGROUND

In many instances a requirement which falls within the objective of one of the other AGILE sub-projects cannot be met by means of extrapolations of present science and technology; or alternately a new device, material, or technique appears to have usefulness in fulfilling a requirement of ARPA/AGILE but so little information is available that no definitive judgement can be made. In such instances, preliminary evaluation by means of either technical studies, laboratory research or feasibility demonstration is carried out within the scope of Sub-Project VIII. Through this means the other AGILE sub-projects are afforded a method of exploring tentative solutions to their requirements without instituting a major program to do so. In addition, AGILE Sub-Project VIII provides a method for initiating or accelerating research programs in government or industry laboratories which may lead to significant technological advances applicable to AGILE requirements without identifying the work with a specific sub-project in its early stages. Additional tasks carried out under Sub-Project VIII are those related to military and paramilitary requirements of indigenous forces which are divorced from the immediate tactical applications of hardware such as weapons, vehicles or communications equipment, but nevertheless, comprise a body of requirements which exert a strong influence on the operational efficiency of the indigenous forces. Under this heading would fall such items as the improvement of clothing, footwear, rations, sleeping gear and load-carrying equipment. In many cases development of improved items of this nature are of parallel importance with that of new weapons since the efficient utilization

of weaponry often depends on the ability of the man to perform his duties effectively in a remote environment where he is solely dependent on the equipment and food he can carry with him. Since this sub-project's tasks are tailored to provide such equipment for indigenous forces of friendly governments in areas remote from the United States, it becomes necessary to accumulate a body of data on the physical characteristics and sociology of the people for whom this equipment is intended. Such effort also falls within the scope of this sub-project.

SUB-PROJECT DESCRIPTION

1. Improved Individual Combat Equipment

This task provides for the necessary research and development programs leading to the production of various items of clothing and individual equipment required by indigenous forces engaged in remote area conflict. These requirements will vary with the particular country concerned, the extent to which satisfactory solutions have already been found and the availability of local manufacturing sources.

In general, the technical aid required from the U.S. in each environment can be considered to be one or more of three types.

a. Where indigenous items of equipment have already been developed and are in use, U.S. technical knowledge and experience might be brought to bear to improve such items both functionally and from the standpoint of durability so that they will serve the military forces better.

b. Where the country concerned has the facilities or the resources to make a particular item but desires additional technical knowledge required to go into production, the problem is to provide this technical assistance to host country manufacturers.

c. Where the country concerned does not have the item which is needed and it does not have either the resources or manufacturing capability to make it, it will be necessary to design a new item or to adapt an item of U.S. military equipment, and to provide technical assistance in arranging to have it manufactured in CONUS, the host country or elsewhere.

2. Individual and Group Rations

The nature of the conflicts with which AGILE is concerned is such that the role of heavy equipment and weapons is minimized while the importance of the individual foot soldier becomes paramount. His ability to

move rapidly and sustain himself for long periods of time without reliance on a heavily mechanically oriented logistic chain emphasizes the need for improved tactical rations which will have the highest possible nutritional value in the smallest, lightest form. This sub-task is directed toward utilization of the large body of technical knowledge that has been generated by the U.S. military and by private industry on food and food packaging in order to provide these improved rations. However, to provide intelligent aid to the armed forces of friendly governments, this knowledge is brought to bear on the problem through cooperative efforts between U.S. and indigenous military and technical establishments in order that the food products are suited to the taste and nutritional needs of the peoples for whom they are intended. Also the indigenous availability of food materials and production capacity are utilized to the maximum extent possible.

3. Defensive Barrier Items and Explosive Devices

Over five thousand strategic hamlets have been constructed by the Republic of South Vietnam at this time, and a total of approximately eleven thousand will have been constructed when the program is complete. It is important to provide defensive measures for these hamlets which will enable them to successfully resist the VC pressures and which will be of sufficiently low cost to make it feasible to distribute such items throughout the entire hamlet system. Some of the measures which are being investigated are mine barriers and better hamlet area illumination.

4. Special Purpose Weapons

In support of AGILE Sub-Project I, this task is intended to provide research and feasibility studies on new techniques and materials applicable to advanced weapons systems. The sub-tasks which fall within the scope of this effort are in general exploratory and not intended to be complete enough to cover all phases of the development of the weapons system which would be carried out by one of the other AGILE Sub-Projects after the initial feasibility studies have shown sufficient promise. An example of such a sub-task is the examination of chemical substances suitable for flame weapons of various kinds. Within the scope of this sub-task only the basic chemical ingredients are investigated to determine their properties and desirability for use in flame weapons; specific flame weapons would be developed as tasks of AGILE Sub-Projects I or II.

5. Remote Area Power Sources

This task was established to obtain improved sources of power for use in remote areas where conventional power sources are not readily or

economically available. Conflict taking place in remote and sometimes underdeveloped countries of the world in which modern weapons, communication and transportation equipment are employed often imposes power requirements which may be several orders of magnitude greater than that which the country can supply. There is, in addition, a serious lack of the necessary facilities such as railroads, power lines and industry on which to build an increased power producing capability. For this reason this task is concerned with the total problem of power requirement and supply inherent in such conflict. The purpose of this task is to obtain a comprehensive spectrum of all of the power requirements which arise from the necessity to conduct war in a remote area and match this with the many means which are available to generate power indigenously. Research and development programs are then initiated, where applicable, on new devices or methods for obtaining the needed power.

6. Air Mobility

Assisted Take-Off – This task is undertaken in support of AGILE Sub-Project III. There is a continuing problem in making effective use of runways subject to severe climatic conditions. Study of all means of assisting take-off from unprepared fields show that there are very few which offer more promise than the conventional JATO bottle; however, the problem in logistics imposed by the necessity of maintaining on-site stores of these units is difficult to solve. The investigation of new techniques which might alleviate this problem continues.

7. Lightweight Armor Materials and Protective Devices

Since a characteristic of the type of warefare with which the AGILE program is primarily concerned is that it is a conflict of foot soldiers armed with light weapons, protection of the indigenous forces of friendly governments against the effects of small arms fire and anti-personnel fragmentation munitions assumes a significant role. It is the purpose of this task to examine the role of armor and other protective materials in the light of the particular characteristics of these small conflicts, and to determine the best utilization of present materials and methods which are available to decrease the vulnerability of the forces of friendly governments to anti-personnel weapons. Armor materials are being examined for possible application to the individual soldier, aircraft, land vehicles and boats. Work being done under this task has been divided into two general categories, that which concerns itself with advancing the state-of-the-art by generating fundamental knowledge on the mechanics of projectile penetration through homogeneous and heterogeneous armor materials and a "quick response" empirical development and test program to provide better, more usable armor materials in

as short time as possible. Additionally, under the term protective devices, new methods of obtaining ballistic protection are being explored which do not depend on passive energy dissipation as do conventional armors, but attempt to act on or react with the projectile to achieve the same purpose.

8. Lethal and Non-Lethal Weapons Systems

To develop an integrated lethal and non-lethal weapons research and development program oriented toward the requirements of the friendly indigenous forces engaged in or threatened with conflict in remote areas. This program shall make maximum use of the weapons technology developed within the free world and encompass only those requirements which cannot be fulfilled by existing weapons systems research programs or by hardware now being provided these forces under the auspices of the Military Assistance Program.

Requirements and Tasks

Listed below are those major requirement areas and the status of tasks with which this sub-project is concerned. Succeeding pages summarize the purpose and the current status of each task.

1. Clothing and Equipment

   A. Improved Individual Combat Equipment

2. Rations

   Individual and Group Rations

3. Defensive Barrier Items and Explosive Devices

   A. Village and Outpost Security

   B. Camouflaged Anti-Personnel Mines

   C. High-Intensity Sound Generator

4. Special Purpose Weapons

   A. Fuel-Air Explosive (FAX)

   B. Helicopter Trap Weapons

5. Remote Area Power Sources

   A. Power Sources Study

   B. Thermoelectric Generators

   C. Hydroelectric Generators

6. Mobility, Air

   A. Assisted Take-Off

7. Lightweight Armor Materials and Protective Devices

   A. Penetration Mechanics Phenomenology

B. Projectile Energy Absorption

C. Materials Research

8. Lethal and Non-Lethal Weapons Systems

Tab 8

Requirement: Clothing and Equipment

Task: Improved Individual Combat Equipment (1A)

Problem: The design and evaluation of those items of individual equipment other than weapons which contribute to the operational effectiveness of indigenous forces.

Description: The purpose of this sub-task is to procure, evaluate, design and develop as necessary various items of clothing and individual equipment required by indigenous forces engaged in remote area conflict. In order to provide the best solution to the problems encountered by indigenous forces in obtaining satisfactory equipment, particularly since these requirements will vary with the particular country concerned, three general types of effort are undertaken under this sub-task.

First, to provide U.S. technical knowledge and experience to improve items of equipment and clothing which have already been developed by the indigenous forces and are in use.

Second, in an instance where the country concerned has the facilities or the resources to make a particular item, to provide the technical knowledge required to develop a production capability, in-country, for the specific item. Here the problem is to develop an item suitable for the needs of indigenous forces and provide the technical assistance necessary to the host country's manufacturers in order to enable them to provide the materials or equipment necessary for their needs.

Third, where the country concerned requires an item for which it has neither the resources nor the manufacturing capability to supply it, U.S. R&D efforts and development will be martialed to meet this need if it cannot be satisfied by existing MAP supplies.

Specific items which appear under this general requirement are:

1. Anthropometric Studies, in order to insure that measurements of selected samples of personnel of military age are made to determine the appropriate size of clothing and other items to be carried or worn by the individual soldier of the indigenous forces.

2. Load Carrying Systems, sub-divided into personnel loads and into logistic loads carried by personnel and by animals.

3. Footwear, suitable for use by indigenous forces, tailored to meet the climate, terrain and other factors of the area of the world where they are to be employed.

4. Clothing, to study the functional and constructional aspects of indigenous clothing and the concepts around which it is constructed. Studies of both the needs and the available materials for production are included.

5. Armor for Personnel, to determine the individual body armor requirements and methods of meeting these requirements.

6. Sleeping Gear and Shelter, to satisfy the essential requirements imposed by field conditions.

7. Other Equipment – Under this heading are listed such items as canteens, bushknives, water-proof bags and covers, individual cooking equipment, entrenching tools, and miscellaneous other items as they emerge during the course of this program.

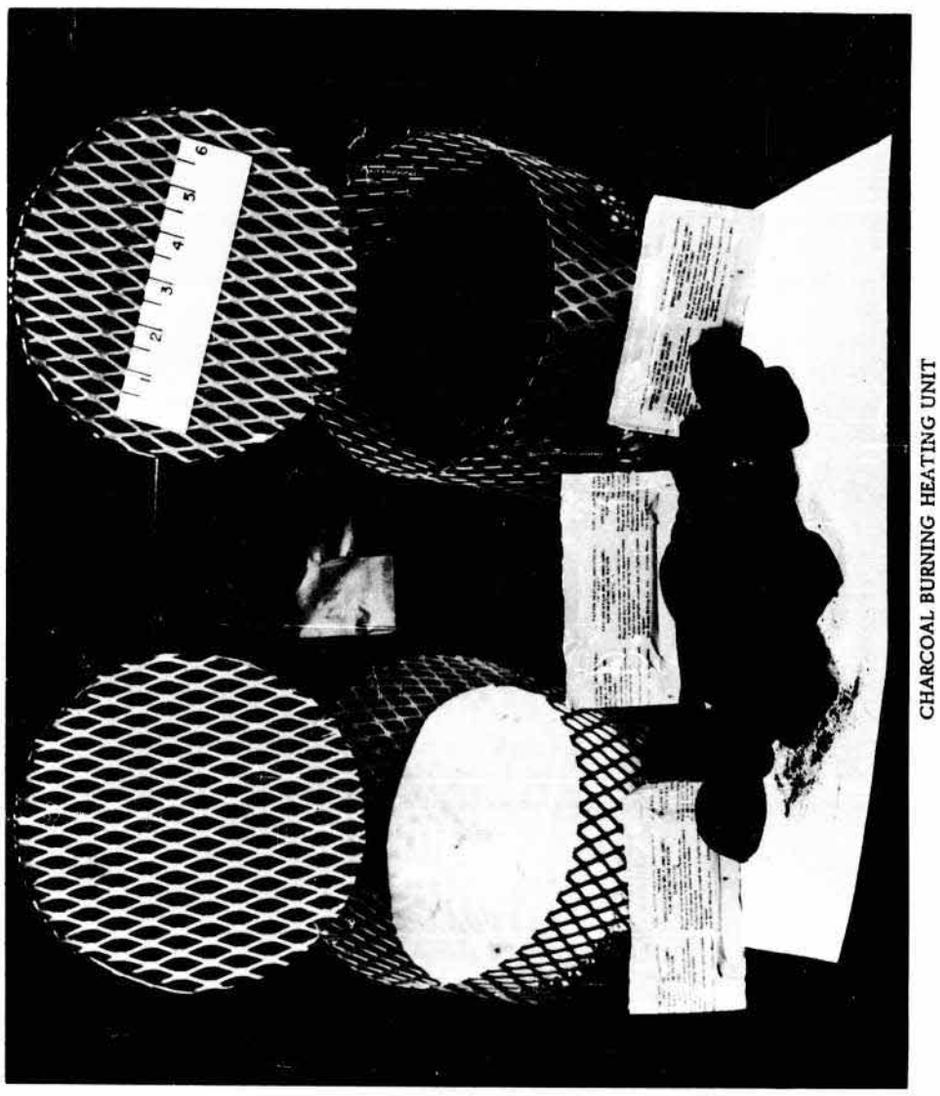
Current Status: Dr. Robert White, an anthropologist from the Quartermaster Research and Engineering Commandat Natick Massachusetts, is on TDY with CDTC-V. He is directing an anthropometric survey of the Armed Forces of the Republic of Vietnam. Personnel from representative units of the Vietnamese Army, Navy, Marine Corps, and Air Force are being measured to develop information on body sizes, dimensions, and proportions of the RVN military population. The data will permit an assesment of existing clothing sizes and size systems and will make it possible to correlate clothing size with body size. It will also be used to establish correct sizes for footwear and for the design and sizing of load-carrying equipment.

Dr. S. J. Kennedy, Director of the Clothing and Organic Materials Division and Mr. E. C. Metzger, Equipment Specialist at the QMR&E Center, Natick, will visit the Republic of Vietnam and Thailand during the month of July. Dr. Kennedy and Mr. Metzger will study present military load carrying systems used by indigenous forces. They will review the adequacies and inadequacies with regard to comfort, balance, ease of adjustment, method of attachment, alternative methods of carry, capacity, and suitability of materials of these systems. Indigenous civilian-type load-carrying equipment will be surveyed and the possibilities of converting desirable ones to military use investigated. Functional and construction aspects of indigenous clothing available for military personnel and normal concepts of fit will be determined in order to develop materials and construction features which will optimize suitability for temperature variations and heavy rainfall associated with SEA climate.

Captain Chaffin and Mr. Youngling of the Engineering Psychology Laboratory of the QMR&E Center will accompany Dr. Kennedy and Mr. Metzger. They will perform a human engineering evaluation of the clothing and of personal equipment used by Vietnamese and Thai soldiers.

A simple charcoal heating unit, which will burn over two hours, has been designed and produced at the Natick QMR&E Center, see photograph. Five of these units have been shipped by air to Saigon. Each unit was packed in a polyethylene bag containing detailed instructions and a box of three trioxane fuel tablets for the easy ignition of locally available charcoal lumps or briquettes. The units will be compared with a CDTC-V developed cook stove, burning jellied alcohol, and with Sterno stoves previously air mailed to Saigon.

Tab 8



CHARCOAL BURNING HEATING UNIT

Unit, with cover opened - empty and loaded with charcoal briquettes; folded foil shield; trioxane in foil wrapping; loose briquettes.

Tab 8

Requirement: Rations

Task: Individual and Group Rations (2A)

Problem: To develop improved individual and group tactical rations.

Description: This sub-task has as its goal an improved tactical ration for use by indigenous forces engaged in field operations. The rations are required to be lightweight, nutritionally adequate and suited to the taste of the user. In order to achieve these objectives, a program has been established to examine the nutritional needs of the indigenous forces including the mineral and vitamin content necessary for an adequate ration. Having established these values, new rations are studied which consider not only the palate of the indigenous soldier, but which also take into account storage life, cooking requirements and handling techniques suitable for use under local climatic conditions. In order to better tailor the ration to local conditions and establish within the country concerned a potential for producing its own ration packages, the availability of ration ingredients and packaging material as well as the related facilities within that country are studied. Research and development on new packaging techniques applicable to the indigenous food substances are also carried on in CONUS to determine what modern techniques for food packaging are applicable to the solution of the problem.

Current Status: Acceptability tests on prototype food items prepared by the Armed Forces Food and Container Institute were carried out by members of the 77th Special Battalion of ARVN. The food items were fabricated from Vietnamese foods furnished to AFFCI by CDTC-V. They represented an attempt to combine Vietnamese foods and the latest US packaging techniques to develop items suitable for incorporation in a lightweight ration for use by Ranger type troops on extended operations.

Three kinds of instant rice, two kinds of dehydrated cabbage, condensed milk, and two kinds of sesame-peanut bars were tested. The rice was packed in three different samples of packaging materials, each of which enabled the soldier to prepare the rice right in the package. The various food items were prepared at the scene of the test and were tasted by combat troops of the Special Battalion. The soldiers' reactions were recorded on questionnaires. Generally, the food samples were well received and the majority of the test troops indicated that they would like to see the various food items included in a field ration for their use. Discussions during the test and on field trips to many areas of Vietnam indicated a great interest and enthusiasm in developing an adequate ranger ration. Many operations are limited in range and duration simply by the amount of food the men can carry.

Tab 8

Dr. Ferdinand P. Mehrlich, Technical Director of AFFCI, visited CDTC-V during May. Dr. Mehrlich brought additional ration component prototypes with him. The items appeared to be quite appropriate for the Vietnamese troops, and they seemed to like them. The Vietnamese government accepted these items and the prototypes previously tested as a basis for further development.

Formerly, the use of US Individual Combat Supplement Food Packets had been contemplated for test until a field test quantity of rations made from Vietnamese foods could be developed and made available to CDTC-V. It now appears that the latter items can be developed and made available during the next few months. Accordingly, all efforts will be directed toward the production and testing of the rations based on Vietnamese food.

During his visit, Dr. Mehrlich briefed President Diem, General Harkins, the Vietnamese Joint General Staff, MAAG-Vietnam, MACV staff officers, and USOM. His briefings were well received and considerable interest in the project was evident.

Before his departure Dr. Mehrlich worked out a detailed questionnaire on Vietnamese food requirements. The desired information has now been transmitted to him at the AFFCI.

To facilitate the preparation of 500 pre-production Ranger ration prototypes, Vietnamese raw materials have been shipped to Dr. Mehrlich at AFFCI.

The material is being processed. After CONUS test the pre-production prototypes will be tested in Vietnam.

Tab 8

PRESIDENT DIEM AND DR. FERDINAND P. MEHRLICH, TECHNICAL DIRECTOR OF THE ARMED FORCES FOOD AND CONTAINER INSTITUTE, DISCUSS THE TASK TO DEVELOP A SUITABLE LIGHTWEIGHT RATION, FOR RANGER TYPE TROOPS, FROM VIETNAMESE FOODS

Tab 8

Requirement: Defensive Barrier Items and Explosive Devices

Task: Village and Outpost Security (3A)

Problem: To test and evaluate devices and equipment that may be employed to advantage in protecting villages and outposts from enemy activity.

Description: The strategic hamlet program of the Republic of Vietnam is becoming increasingly effective as the program grows. With several thousand hamlets already constructed and more under way, the power of the people to resist enemy pressures has increased substantially. In order to provide increased effectiveness in protecting these hamlets against Viet Cong depredations, several approaches have been undertaken. These are:

(1) The initiation of a program to provide better mine barriers for the defense of hamlet perimeters.

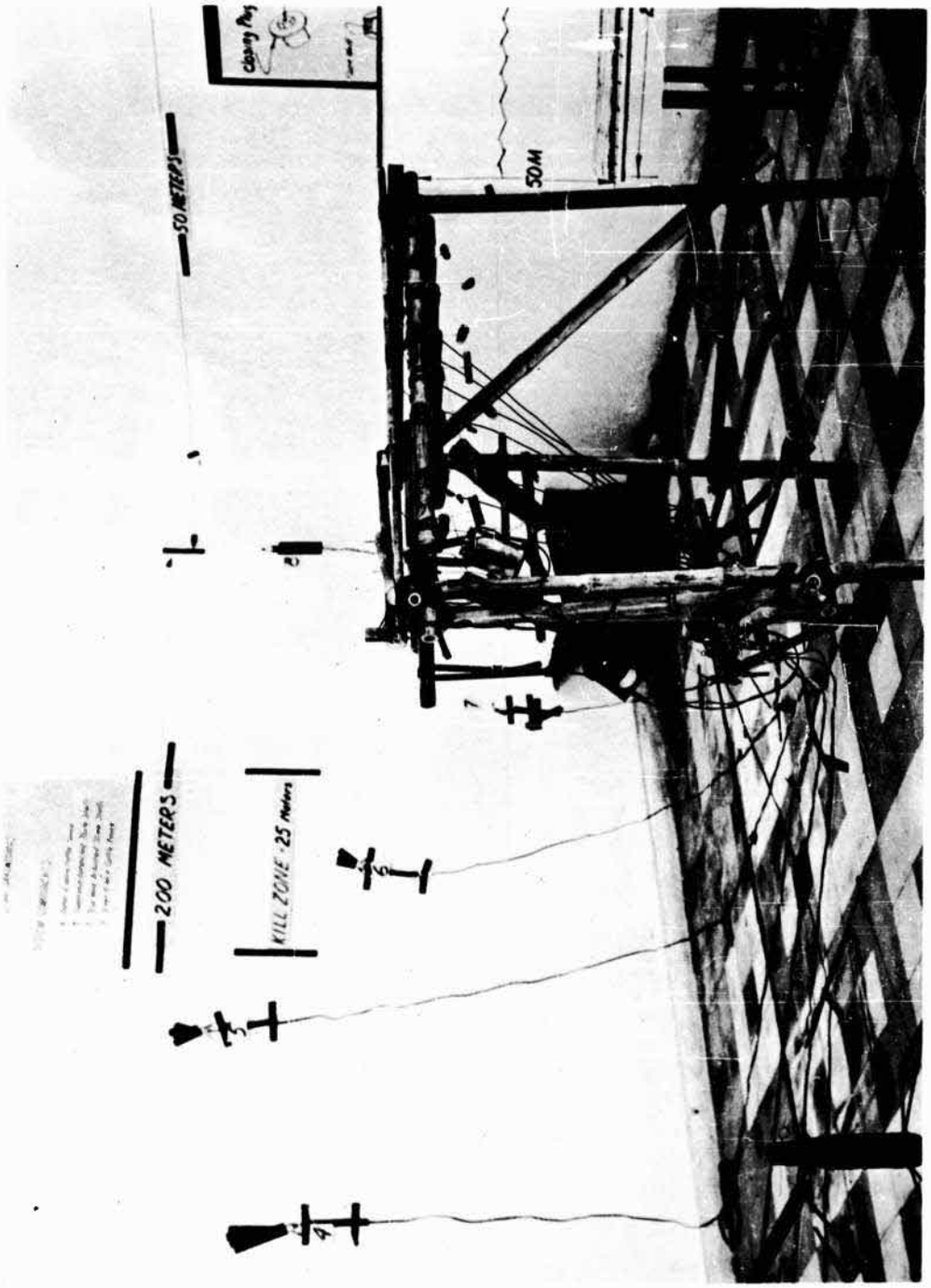
(2) The investigation of cheap, easily emplaced obstacles similar to barbed wire as a defensive measure.

(3) The test and evaluation of methods of providing hamlet perimeter illumination to discourage night forays by the VC.

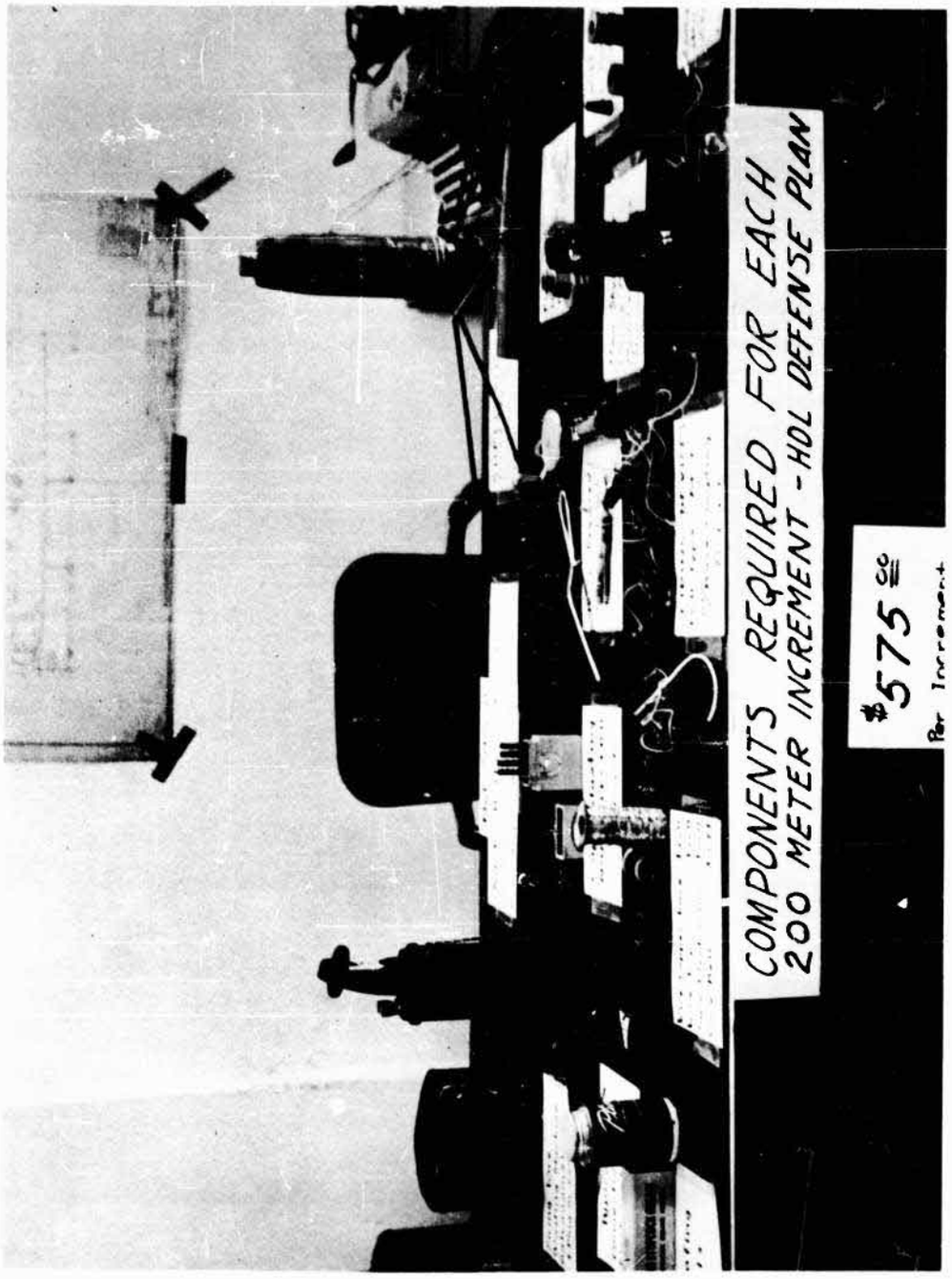
Current Status: Mr. Joseph Petit, an engineer from the Harry Diamond Laboratories on TDY in Vietnam, built a mockup of the command firing point of the HDL Village Defense Plan utilizing surplus 75 mm Skysweeper Mines. This mockup was demonstrated during several briefings to US and Vietnamese personnel.

Construction of a full-scale representative segment of a village protected by live ammunition for demonstration to personnel of JOEG-V, CDTC, RDFU, MAAG, and MACV is planned.

Tab 8




COMMAND FIRING UNIT FOR THE HARRY DIAMOND LABORATORY (HDL) VILLAGE DEFENSE SYSTEM




COMPONENTS REQUIRED FOR EACH 200 METER INCREMENT - HDL DEFENSE PLAN

Tab 8

Requirement: Defensive Barrier Items and Explosive Devices

Task: Camouflaged Anti-Personnel Mines (3B)

Problem: This task is designed to yield a new anti-personnel mine which may be either hand-emplaced or air-dropped and will defy visual detection because of its close resemblance to indigenous materials, such as stones and sticks of wood.

Description: Two R&D efforts are involved in this task: (1) The development of castable, plastic-bonded explosives (PBX) to make them suitable for use in land mines which are shaped to resemble indigenous materials; and (2) a low-cost, anti-disturbance fuze for use with these explosives. At the time this program was initiated cast PBX mines, shaped to resemble small stones, were being made in experimental quantities by the U.S. Naval Ordnance Test Station. The techniques of fabricating these explosives to simulate not only the texture but the color of indigenous stones had been developed. New PBX compounds are being explored to obtain sufficient resilience to permit these devices to be emplaced by airdrop.

Current Status: The units shipped to CDTC-V for evaluation were inspected and demonstrated by Mr. Joseph Petit of the Harry Diamond Laboratories. Twenty units were assembled, armed, and exploded by pulling an attached string. Fourteen units functioned in the desired manner; two units fired spontaneously after the arming period. This malfunction had not been observed during development. As critical examination of the faulty fuzes did not reveal any plausible mechanisms whereby spontaneous detonation could be obtained, the problem will be studied in greater detail in the laboratory.

The two major difficulties experienced during the test were: (1) poor fit of the fuzes into the "rocks", and (2) spontaneous detonation.

The poor fit necessitated hand matching of fuzes to "rocks". It should be possible to overcome this problem by requiring closer tolerances during manufacture.

A thorough review of the causes of poor detonation control is in progress. Complete documentation of the procedures used by the manufacturer of these experimental units is being prepared. Information obtained from the studies and from the field tests will be used to make recommendations for improvements.

Tab 8

Requirement: Defensive Barrier Items and Explosive Devices

Task: High-Intensity Sound Generator (3C)

Problem: To provide a non-lethal barrier to the passage of human beings.

Description: The proposed high intensity sound generator will consist of a multiple array of small generators which if disassembled into component units and distributed into a line may provide a non-lethal barrier to the passage of human beings.

Similarly, the large one million watt unit may be dropped in a zone, suspended from a hovering helicopter, or mounted on a truck and used for harrassment and dispersal of personnel in a particular zone. It is anticipated that the megawatt generator will be audible over an area on the order of 1,000 sq miles.

Another possible use for the high intensity generator is for elimination of fog at an airfield.

Current Status: A contract has been let with Astrosystems International, Inc., for a research and development program for feasibility demonstration of a single detonation tube in the first phase of effort; and the design, construction, and test of an engineering model of a multiple tube system during the second phase.

To date, a single tube sound generator has been built and satisfactorily demonstrated. Work on a multitube generator is in progress.

Requirement: Special Purpose Weapons

Task: Fuel-Air Explosive (FAX) (4A)

Problem: To develop an improved munition for use against area targets concealed by vegetation or protected by earthworks and tunnels.

Description: It has been shown that when proper mixing and ignition techniques are used, a cloud of fuel vapors mixed with air may be detonated to yield high over-pressures over a wide area. This system should have marked advantages over conventional explosives as an area fire weapon against protected or concealed targets. The protection from blast and shrapnel afforded personnel by slit trenches, trees, rocks and man-made barriers will be ineffective because the vapor cloud is all enveloping within its area of dispersal. At present, R&D experiments are being conducted with devices which employ ethylene oxide as a fuel. The present major R&D effort is concentrated on the development of a FAX weapon designed for aircraft delivery against ground targets.

Current Status: Twelve prototype launchers have been received at Naval Ordnance Test Station from the contractor. Inasmuch as they performed satisfactorily, the contract was extended for the production of an additional sixty-six launchers. These will be delivered in July and will be tested to determine the damage and hazard potential of rough handling.

The BLU-7 fuzes have been delivered and tested. Although the fuzes functioned properly, detonation of the fuel cloud was found to be critically dependent upon the position of the detonator on the fuel canister and upon the time delay of detonation. The problem of detonator delay control has been solved. Efforts to optimize the location of the detonator are currently under way.

Tab 8

Requirement: Special Purpose Weapons

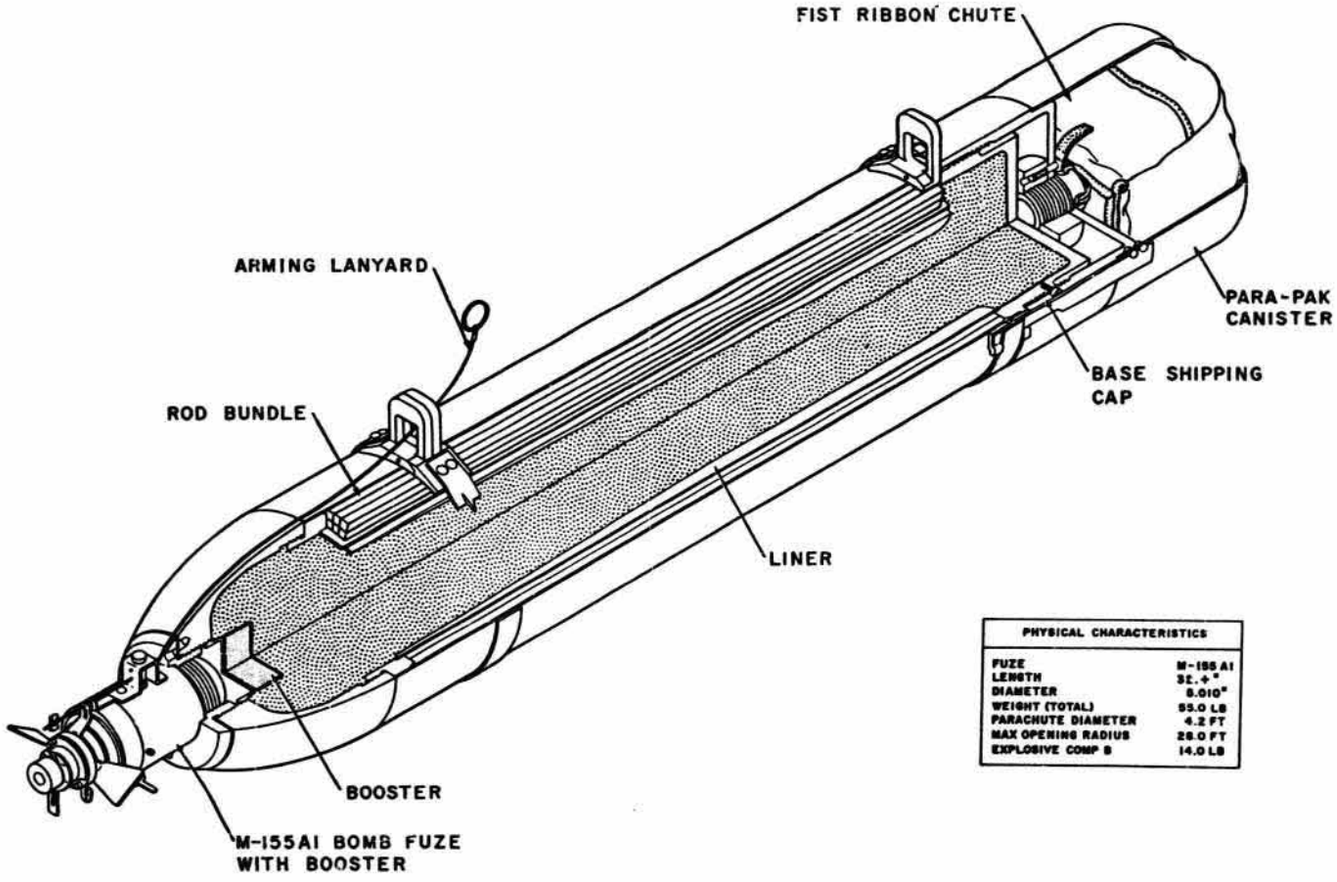
Task: Helicopter Trap Weapon (4B)

Problem: To develop a weapon designed to destroy the bamboo stakes and other barriers used as anti-helicopter devices in probable landing zones.

Description: A recent anti-helicopter tactic employed by the Viet Cong forces is to place bamboo stakes in probable landing zones to damage the blades of the descending aircraft. Blade damage can be severe enough to immobilize the aircraft if not destroy it completely. This tactic has been employed by the Viet Cong to deny the use of some landing zones or to limit the number of areas in which helicopters can operate to the point where the enemy can prepare ambushes in the likely landing areas. In order to counter this tactic, an accelerated development program has been initiated to provide a defensive weapon capable of destroying these traps. Efforts are based on the adoption of existing expanding rod warheads designed for air-to-air weapons. Modifications will be made permitting these warheads to be dropped from helicopters or other aircraft and detonated near the ground where the expanding ring of steel can sever the bamboo poles.

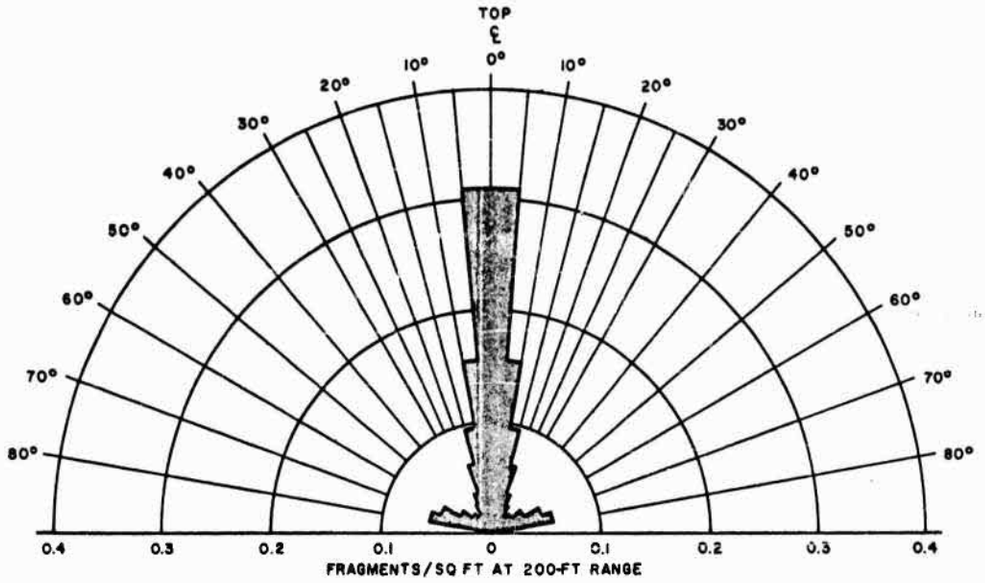
Current Status: A series of tests was conducted to determine the size, number, and velocity of fragments ejected from the back of the Zuni continuous-rod warhead. These tests yielded data used in determining flight-delivery modes, speeds, and altitudes for the various types of aircraft expected to carry the weapon. The purpose for describing the mode of delivery is to point out the "hazardous" and "safe" zones in which the aircraft may be located during certain delivery conditions and, ultimately, to describe which tactics should or should not be utilized with the HTW bomb.

An instructional document will be prepared and will be delivered to the field prior to field evaluation.

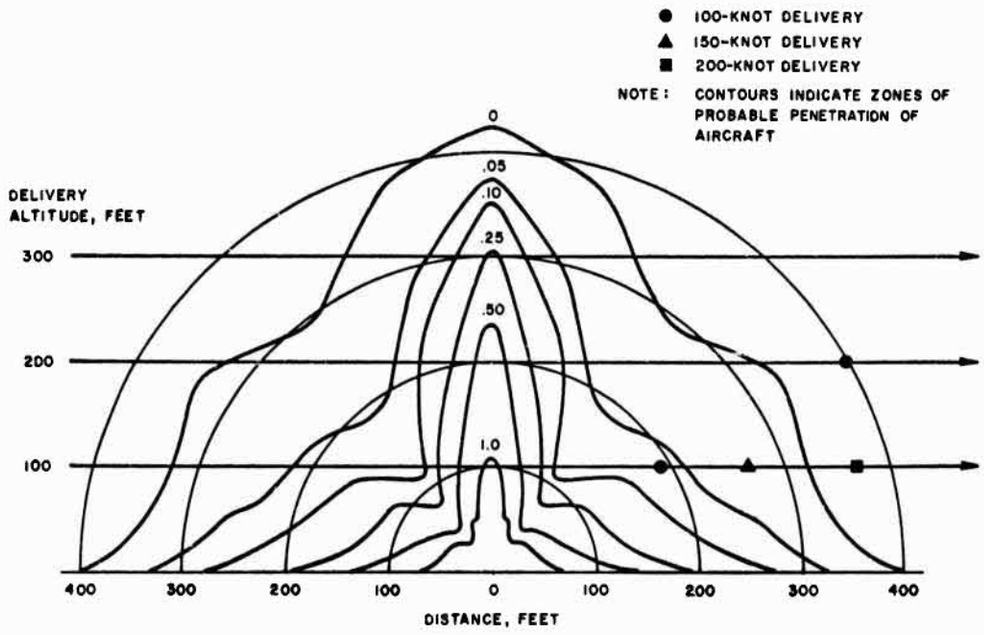



| PHYSICAL CHARACTERISTICS | |
|---|---|
| FUZE | M-155 AI |
| LENGTH | 32.+" |
| DIAMETER | 8.010" |
| WEIGHT (TOTAL) | 93.0 LB |
| PARACHUTE DIAMETER | 4.2 FT |
| MAX OPENING RADIUS | 28.0 FT |
| EXPLOSIVE COMP B | 14.0 LB |

HELICOPTER TACTICAL WEAPON (HTW)




FRAGMENT DISTRIBUTION AND DENSITY PLOT OF HTW BOMB STATIC FIRING




AERIAL CONTOUR PLOT INDICATING DANGER ZONES TO CARRYING AIRCRAFT

Tab 8

Requirement: Remote Area Power Sources

Task: Power Sources Study (5A)

Problem: To study the characteristics of power sources which will be useful for military, para-military and civilian needs in remote areas; to identify requirements for power and potential power sources (with first priority to Southeast Asia); and to identify those power sources which have the optimum capability of satisfying these requirements.

Description: The study will consider such factors as power output, duty cycles, availability, investment costs, operating costs, mobility, reliability, operating techniques, materials requirements, fuel requirements, general limitations and over-all cost effectiveness; statement of specific military operational requirements in sufficient detail to permit a realistic meshing of means and identification of development gaps will be given first priority.

Current Status: The task objectives for the power sources study have been defined as follows:

1. Identify needs.

2. Survey performance and development status of potential power sources, potential power converters and energy storage devices.

3. Accomplish the preliminary design for project evaluation and planning purposes of the power sources and converters most suitable for military and paramilitary forces in remote area conflict.

4. To formulate a proposed program to develop, manufacture, and introduce the most suitable power converters in remote areas.

Initial effort under this task has been directed to acquiring information regarding the power needs of the military and paramilitary forces in remote areas with emphasis on Vietnam and Thailand. A number of trips have been made to various military installations and their contractors to acquire information regarding power sources development programs which may be applicable to the AGILE power sources study. Interviews have been held with personnel in the State Department, AID, the Vietnam Embassy, the Navy and the U. S. Army Research and Development Laboratory personnel; and several of their contractors – including the Battelle Memorial Institute and the Thermoelectron Company in Waltham, Mass.

Technical information has been obtained regarding the performance and development status of solid fuel burners, steam engines, thermoelectric, thermionic, and thermal photo-voltaic power converters. Further technical information is required on engine generators, solar collectors and other power converters. Question lists have been prepared by IDA and ARPA to be forwarded to CDTC-Thailand and CDTC-Vietnam to obtain information which will define in greater detail the power requirements of the indigenous forces in these areas.

Requirement: Remote Area Power Sources

Task: Thermoelectric Generator (5B)

Problem: To examine the applicability of thermoelectric generators to the power requirement of remote area conflict.

Description: As a part of a broad program on indigenous power sources, thermoelectric generators are being evaluated to determine their potential in meeting the needs for an increased capability of generating power in remote areas. Of particular interest are thermoelectric devices which are capable of being used with indigenous fuel supplies such as wood, charcoal, vegetable and animal oils. In order to provide more efficiency in the utilization of indigenous fuels, which might be in short supply, composite devices which will perform multiple functions are also being studied. Such devices are combinations of a thermoelectric power unit and cooking stove or thermoelectric power generator and water distilling apparatus.

Current Status: Further work on thermoelectric generators has been suspended in order to establish in greater detail the requirements, means for meeting these requirements and most promising areas for development of the power sources resulting from the power sources study.

Requirement: Remote Area Power Sources

Task: Hydroelectric Generators (5C)

Problem: To examine methods of producing power from shallow slow-moving streams.

Description: As a part of a program to produce electrical power by utilizing the energy available in remote areas, two turbo-generators are being investigated. These generators are designed to develop 50 watts of electrical power when placed in a stream with a depth of as little as 10 inches and a stream velocity of two knots. Another possible application for these devices will be in areas where tidal action occurs which causes sufficient water flow to meet these velocity and depth requirements.

Current Status: During the quarter additional information was made available on sources for development of the hydroelectric generator. Because of this, previous negotiations with a sole source have been cancelled and invitations to bid have been sent out to all known eligible contractors.

Tab 8

Requirement: Mobility, Air

Task: Assisted Take-Off (6A)

Problem: To investigate new methods designed to permit operation from unimproved remote airstrips.

Description: The operation of aircraft in remote areas often requires landings and take-offs from small unimproved airfields. The use of rocket assistance units may provide an additional performance capability and a margin of safety which will enable the operation of aircraft from airstrips otherwise unusable. Conventional JATO units require that supplies of such units be maintained at remote fields; in many cases this is logistically unsupportable at an acceptable cost.

Current Status: A proposal submitted by Arde', Inc., for a study of the required parameters for an autogenetic rocket take-off assist system for a given aircraft was selected as most promising. Program documents have been prepared, but implementation of the program has been suspended for budgetary reasons.

Requirement: Lightweight Armor Materials and Protection

Task: Penetration Mechanics Phenomenology (7A)

Problem: To provide protection for the individual and water, land and air vehicles against penetration of small caliber ammunition.

Description: Research is being conducted to obtain a basic understanding of projectile penetration in non-metallic composites, together with the effects of certain polymer properties and matrix bonding on resistance to penetration of high velocity projectiles.

The objective of the study is to gain a quantitative understanding of the effects of molecular variables on the behavior of heterogeneous composite structures under ballistic loading conditions. The effect of such variables as molecular weight, cohesive forces between polymer chains, chain flexibility, shape and orientation will be evaluated. A significant portion of the study is directed toward determination of the factors affecting the bonding mechanism between fiber and matrix for optimum behavior of the composite.

The development of a mathematical model which describes dissipation of kinetic energy of an impacting projectile in striking composite materials is included. Experimental evaluation using ballistic methods will be conducted in prototype materials developed under this program.

Current Status: The first quarterly report on the contract for a study of the mechanisms of armor penetration resistance has been issued by the Aeronutronic Division of Ford Motor Company. Progress is reported on the following phases: I. Choice of Polymeric Systems; II. Energy Absorption Processes in Composite Media; III. Mathematical Model for Energy Loss Mechanisms in Composite Media; IV. Factors Affecting Matrix-Fiber Bonding; and, V. Experimental Evaluation of the Response of Materials to Projectile Impact. The cross-linked polymer selected for investigation is a maleic anhydride-phthalic anhydride-propylene glycol unsaturated polyester cross-linked with styrene. Polyamides were selected as representative linear polymer systems because they are well characterized, easily synthesized, and readily available commercially.

A ballistic facility has been established. It consists of a range, timing circuits, Fastex high-speed photography, and the following three weapons: (1) 6 mm smoothbore, capable of firing spheres, cones, and cylinders at velocities up to 5,000 ft/sec; (2) .22 cal rifle, chambered for 0.30 - '06 charge, capable of firing rotating projectiles up to 5,000 ft/sec; and (3) 0.30 - '06 rifle capable of firing a .30 cal bullet or 150 grain projectile up to 3,300 ft/sec.

In summary, substantial progress has been made in Phases I, II, and V wherein polymer selection, definition of energy absorption processes and completion of the ballistic facility, respectively, have been accomplished, these being most critical to the future development of the program.

Tab 8

Requirement: Lightweight Armor Materials and Protection

Task: Projectile Energy Absorption (7B)

Problem: To determine optimum techniques for absorbing the energy of a projectile.

Description: All mechanisms that might dissipate energy will be critically examined as well as literature pertinent to these mechanisms. Concurrent with this study, efforts will be made to formulate mechanisms that might be effective in dissipating energy in a target.

Current Status: Delays have been encountered in contract negotiation on this task. Work should proceed during the next quarter.

Tab 8

Requirement: Lightweight Armor Materials and Protection

Task: Materials Research (7C)

Problem: To evaluate improved armor materials which are being developed by various Service and industry laboratories.

Description: While awaiting the results from the advanced research task on Penetration Mechanics Phenomenology, empirical testing is being conducted on the new armor materials which are being developed in an attempt to identify whether a significant improvement in protection, weight and cost characteristics can be achieved.

Current Status: No new armor materials were tested during this quarter.

Tab 8

Requirement: Lethal and Non-Lethal Weapons Systems

Task: Weapons Systems Studies and Research

Problem: To provide a comprehensive program within which all weapons tasks can be best coordinated and to provide the widest base of resources to examine the various parameters affecting weapons developments for a remote area conflict.

Description: A systematic analysis will be made of the principal materiel and non-materiel factors affecting weapons performance in the several discrete environmental conditions in which they may be employed. The elements to be included in the parametric analysis will encompass the systematic acquisition of data on environment, the nature of actual and potential conflicts in these environments, the duration of the various forms of enemy targets, the incidence and relative effectiveness of the cover and concealment available to friend and foe, the relative effectiveness of available weapons which are or can be employed by both sides, the effect of these weapons on relative mobility, their logistics impact, and the level of skill and training required to employ them. The parametric analysis will also include human factors considerations, lethal and non-lethal casualty causative mechanisms, the various technological elements involved in bringing these mechanisms to bear on the enemy, and the related weapons systems which exist or can be formulated.

Current Status: Preliminary meetings of the Weapons Project Team have been held to further define the approach, statements of tasks and levels of effort to be established by the study groups represented.

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# APPENDIXES

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## APPENDIX A

## TERMINATED TASKS

### COMPLETED

1. Summary Report on Assisted Take-Off From Unprepared Fields
2. Micro-Missiles Study
3. Location Studies
4. Village Protection Systems
5. T-28 Nomad Aircraft
6. Junk Blue Book, South Vietnam
7. Medical Data on JTF 116
8. Symposium on Guerilla Warfare
9. Anemometers
10. Counter-Ambush Techniques to Protect Military Vehicular Traffic on Major Highways in South Vietnam
11. Doppler Personnel Surveillance Radar
12. Yo-Yo
13. Parabolic Microphone
14. Comparative Analysis of Small Unit Weapons and Firepower
15. Boat Sled - Pram Sled
16. Engine Generator
17. Hand-Crank Phonograph
18. Nail-Field Clearing Device
19. Military Dogs

### TRANSFERRED

1. M79 Grenade Launcher - ACTIV
2. Helicopter Armament - Army
3. Maximum Aerial Surveillance - ACTIV
4. Analyses of Loatian Operations - OCRD
5. M-113 Armored Personnel Carrier Evaluation - ACTIV

### CANCELLED

1. Wire Gun Cannister
2. Ultra-Portable Recorder/Reproducer
3. High-Speed Press
4. Tape Recorder, Field Use

CANCELLED
(Continued)

5. High-Speed Leaflet Rolling Machine
6. Lightweight Leaflet Rolling Machine
7. Portable Mimeograph Machine
8. Improved Ammunition Capacity for the T-28 .50 Caliber MG Pod
9. Lessons From the Anti-Huk Campaign

## APPENDIX B

## COMPLETED REPORTS AND STUDIES

1. Test Report on Nail Board and Mine Detectors
2. Preliminary Report of Vegetational Spray Tests
3. Final Report of Operational Testing of the AN/PPS-4 Radar Set
4. Westmont Beacon Test Report
5. Report of Test - General Electric Pacer Two-Way FM Radio 27-50 MCS/15 Watt LB1-3232 12 Vol Mobile Combination
6. Final Test Report, Task 52, Radar Set, AN/PPS-4
7. Field Test of PPS/4 Ground Surveillance Radar
8. Test of High Speed Leaflet Rolling Machine
9. Report of Task 3A Partial Evaluation of the (Westmont) Terminal Guidance Beacon
10. Report on Truck Mounted Grenade Launcher
11. Report of Test, USOM-ARPA Hamlet Alarm System
12. Test of Sequencing Switch for the LAU-3/A Rocket Launcher
13. Preliminary FIDAL Test Results, A. E. Hayward
14. Test of the Swimmer Support Boat Armor Kit
15. Report of Test of M10-8 Flame Unit
16. Report of Test of Feasibility Model, Portable Mine Detector
17. YAGI Field Antenna for AN/PRC 10 Radio Set
18. Summary No. 1 - Comparative Field Tests of Man-Pack Radio Sets
19. Report of Test of Directional Microphone
20. An Anthropometric Survey of Thai Military Personnel
21. Preliminary Report on Road Capacity Tests in Thailand
22. Preliminary Report of Project YO-YO Field Test
23. Environmental Factors Affecting Ground Mobility in Thailand Preliminary Survey

    Appendix A: Results of Survey of Existing Data & Literature
    Appendix B: Soil Classification
    Appendix C: Soil Trafficability
    Appendix D: Vegetation
    Appendix E: Surface Geometry
    Appendix F: Hydrologic Geometry
    Appendix G: Weather and Climate
    Appendix H: Evaluation of Road Observations

24. Evaluation of Airstrip at Binh Hung, South Vietnam
25. Evaluation of Performance of YAC-1 Caribou Aircraft With Reverse Pitch Propeller
26. Final Report on Tests of Armolite Rifle (AR-15)

27. Interim Evaluation of M-113 Armored Personnel Carrier
28. Test of the Dwyer Wind Meter
29. Summary No. 2 - Field Comparative Tests of Man-Pack Radio Sets
30. Test of the Gamma Goat in Thailand
31. Counterinswgency: A Symposium
32. Suitability and Effectiveness of Weapons and Equipment Used in US-Supported Operations With the Royal Loas Army
33. Statistical Analysis of Medical Records of Joint Task Force 116 Troops in Thailand in Spring and Summer of 1962
34. Counter-Ambush Techniques to Protect Military Vehicular Traffic on Major Highways in South Vietnam
35. River and Canal Ambush Problems, Republic of Vietnam, 1962
36. Research and Development Effort in Support of the Vietnamese Rural Security Program
37. Village Protection Systems Study
38. The Vietnamese "Strategic Hamlets": A Preliminary Report
39. Limited War Communication Study
40. Report on Micromissiles
41. Summary Report on Assisted Take-Off From Unprepared Fields
42. Design Characteristics for a Family of Micromissiles
43. Firepower Requirements for Remote Area Combat
44. Democratic Republic of Vietnam Threat Analysis
45. Viet Cong Threat Analysis
46. CI Tactical Communications
47. CI Ordnance Literature Bibliography
48. CI Tactics Literature Bibliography
49. Method for Predicting VC Attacks and Their Correlation With Time of Day and Lunar Cycle
50. Junk Blue Book
51. Light Aircraft Armament Survey
52. A system of Centers for Research into Counter-Guerrilla Operations
53. Guerrilla Activity Detection Study
54. Southeast Asia Environmental Study

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