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Advanced Research Projects Agency Project Agile Remote Area Conflict Research + Engineering Semi-Annual Rpt 1 Jul – 31 Dec 1963

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Technical Report

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ADVANCED RESEARCH PROJECTS AGENCY

PROJECT AGILE

REMOTE AREA CONFLICT RESEARCH & ENGINEERING

Semiannual Report

1 July - 31 December 1963

Reproduced by
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1 February 1964

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Previous Reports in This Series

QR-7, 1 July - 30 September 1962, AD 342163
QR-8, 1 October - 30 December 1962, AD 342165
QR-9, 1 January - 31 March 1963, AD 342164
QR-10, 1 April - 30 June 1963, AD 338491

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FOREWORD

This is the first Project AGILE Semiannual Report. This and subsequent reports prepared by this office replace the Quarterly Reports as the means of communicating the AGILE RDT&E program to all interested Governmental agencies.

This report includes a description of existing and planned research and development programs as well as the status of the various RDT&E tasks currently under way. In the Quarterly Report series, each of Project AGILE's eight subprojects was tabbed separately; beginning with this report Subprojects I, II, and VIII have been consolidated for reporting purposes.

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 retransmitted to existing or potential Government contractors.

R. C. Phelps

R. C. Phelps
Director for
Remote Area Conflict

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INTRODUCTION

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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, whereas 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 the Offices of the Secretary of Defense 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 that 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 materiel requirements.

The not unlimited economic, military, and technological assets of the U. S. support to these 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 Research and Development Centers - the Combat Development and Test Center in Vietnam, CDTC-V, and the Military Research and Development Center, MRDC, in Thailand. Until recently the MRDC was known as CDTC-T, but has been renamed in accordance with the preference of the host country. The Director of each Center 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 these Centers pairs a military officer from the host country with each U. S. military officer. Although the initial emphasis of Project AGILE was with Southeast Asia, and the presently existing Field Units are concerned with Southeast Asia, similar representation is being considered by OSD in other areas of the world.

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 enhance substantially the capability of U. S. and friendly foreign governments threatened with, or engaged in, this form of conflict.

REPORTS

Each Field Unit issues a monthly report, and in the past a quarterly report was prepared in Washington summarizing the activities of the individual Field Units and the work performed in CONUS. Beginning with this report, however, the Washington summary report will be issued semiannually.

In addition to a change in timing, changes in organization are reflected in this report. Technical Areas and Tasks previously divided among Subproject I - Tactical Unit Weapons Systems, II - Area Fire Weapons Systems, and VIII - Research and Exploratory Development have been grouped into one Subproject called AGILE Subproject I - Weapons, Individual Equipment, and Rations. Subproject VIII is being reconstituted with new tasks, and Subproject II is being held open for possible reactivation with different tasks. This report, therefore, consists of six subproject sections instead of eight, but subproject numbering remains the same, with no tasks presently assigned to Subprojects II and VIII.

Both the Field Unit monthly reports and the Washington quarterly, now semi-annual, 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 Field Unit and Washington reports.

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AGILE SUBPROJECT I
WEAPONS, INDIVIDUAL EQUIPMENT, AND RATIONS

(Combines former Subprojects I, II, and VIII)

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AGILE SUBPROJECT I

WEAPONS, INDIVIDUAL EQUIPMENT, AND RATIONS

SUBPROJECT OBJECTIVE

To provide significant improvement in the weapons, individual equipment, and rations required by the friendly local forces engaged in remote area conflict. Through research and engineering, efforts are undertaken to develop effective, or improve the effectiveness of, essential items which will provide maximum flexibility and superiority in application for the local forces. The scope of this effort is from individual equipment through tactical unit equipment, for both surface and tactical air employment.

SUBPROJECT BACKGROUND

Research and engineering requirements are to a great extent influenced by the nature of the conflict in which the local forces of a friendly government are engaged. Coupled with the nature of the conflict, the physical environment - such as terrain, vegetation, climate, etc. - exerts a considerable influence on these requirements. In general, such conflict places greater emphasis on the small tactical unit as the primary combat element and stresses mobile, lightweight individual and supporting weapons and equipment, rather than heavy support weapons such as tanks and large artillery.

These tactical units, to a considerable degree, must rely on individual weapons and equipment capable of being hand carried into the combat areas. In these operations, the enemy generally is armed with lightweight and portable equipment consisting of hand weapons, light machine guns, mortars, mines, etc., but possesses, in most instances, the distinct advantage of being able to control the time and locale of contact and, to a great extent, the degree of contact. Typical of one such advantage and one of the most effective and common actions of the opposing enemy forces is the ambush.

One method of offsetting these significant enemy advantages is through better equipment and more effective fire power. For the ambush situation, instantaneous and saturating area fire, as well as aimed fire, is essential for enhanced survivability and successful reaction.

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

CONDUCT OF PROGRAMS

Technical Area 1 – Weapons

The program for this technical area encompasses studies and development efforts designed to provide local forces with improved weapon/ammunition systems that are more compatible to their requirements, the environment of the area and the nature of remote area conflict. Studies will be conducted to determine requirements, establish feasibility, and select appropriate types of hardware. Development efforts will be concerned with either the modification of existing U.S. military weaponry or the complete cycle of weapon development from concept to end item, whichever is required to meet identified requirements.

Technical Area 2 – Individual Equipment

The program conducted for this technical area is designed to provide the necessary research and development to produce the various items of clothing and individual equipment, other than weapons, required by local forces engaged in remote area conflict. Since conditions will vary from one country to another, research will be conducted to accumulate data on the physical characteristics and sociology of the local people for whom the equipment is intended, the environment of the area, the type of conflict being fought, the availability of local materials and manufacturing sources, etc., which will be taken into consideration in meeting the clothing and individual equipment requirements of the particular country. Development will be concerned with (1) the modification of existing items to make them more effective and suitable to the local forces or (2) the production of a new item for which there may be a need.

Technical Area 3 – Rations

The program for this technical area is directed toward the research and development of individual and group tactical rations which will sustain the local soldier for long periods of extended combat operations without resupply. Research will be conducted to determine the food products best suited to the taste and nutritional needs of the people for whom the rations are intended. Development will utilize the large body of technical knowledge that has been generated by the U.S. military and by private industry on food and food packaging to provide these improved rations for the local forces. The program will be conducted on a cooperative basis between the U.S. and the local military and technical establishments using local resources and manufacturing capabilities.

SUBPROJECT I TECHNICAL AREAS, TASKS, AND SUBTASKS

Listed below are the major technical areas, and the tasks and subtasks in each area, with which this subproject is concerned. Succeeding pages contain the summaries of their objectives and status.

Technical Area 1. Weapons

Task A. Individual Weapons

(1) Assault Rifle

(2) Special Shotguns

(3) Portable Flamethrowers

(4) Rifle Grenades

Task B. Surface-Borne Crew-Served Weapons

(1) Cupolas for M-113 Armored Personnel Carrier

(2) Quad Machine Guns

(3) Salvo Squeeze-Bore .50/.30 Caliber Machine Guns

(4) Multiple Grenade Launcher

(5) Lightweight Mortars

(6) Stoner 63 Weapons System

Task C. Aerial Weapons and Munitions

(1) Counterinsurgency Aircraft

(2) Assisted Take-Off

(3) Delayed Proximity Fuze

(4) Target-Marking Munitions and Devices

(5) Illuminating Flares

(6) Antipersonnel Bombs

Task D. Special Weapons

(1) Camouflaged Antipersonnel Mines

(2) Microrocket Pistol and Projectile

(3) Fuel-Air Explosive (FAX)

(4) Helicopter Trap Weapon (HTW)

(5) Strip Bullets

(6) High-Intensity Sound Generator

(7) Village and Outpost Security

Task E. Lethal and Nonlethal Weapon Systems

(1) Weapon Systems Studies and Research

Technical Area 2. Individual Equipment

Task A. Clothing and Equipment

(1) Improved Individual Combat Equipment

Task B. Remote Area Power Sources

(1) Power-Sources Study

(2) Thermoelectric Generator

(3) Hydroelectric Generator

Task C. Lightweight Armor Materials and Protective Devices

(1) Penetration Mechanics Phenomenology

(2) Projectile-Energy Absorption

(3) Materials Research

Technical Area 3. Rations

Task A. Individual and Group Rations

Technical Area 1 – Weapons

Task A – Individual Weapons

Background

The environment and nature of conflict in remote areas place considerable emphasis on the individual soldier and the effectiveness of his weapons. The use of standard U.S. military weapons does not always meet the requirements peculiar to the local forces in this type of conflict where there are significant differences existing between the local soldier and his U.S. counterpart for whom these weapons were designed. These differences, in the main, are physical stature, military training, and combat experience.

To overcome these differences, concentration is required on the development of individual weapons that are lighter in weight, less complicated, easier to maintain, more accurate, and capable of higher rates of fire. The over-all goal is to achieve a greater compatibility among these weapons, the individual soldier, and the environment in which he must fight.

(1) Assault Rifle

Objective - To develop a lightweight individual weapon/ammunition system that is better suited to the local soldier, is more effective, and has a greater capability for delivery of accurate, high rates of fire.

Progress to Date - 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.

Following favorable observations of AR-15 Rifle demonstrations in Vietnam during August, 1961, it was decided to procure sufficient numbers to conduct a full-scale combat evaluation of the AR-15 Rifle by selected RVNAF. In December, 1961, the Secretary of Defense approved the procurement of 1000 AR-15 Rifles, necessary ammunition, spare parts, and accessories for the evaluation. Operational evaluation and testing in Vietnam began in February and was terminated in July, 1962, followed shortly thereafter by a final report of test.

The original AR-15 test weapons have been undergoing a program of rehabilitation at the ARVN 80th Ordnance Rebuild Depot. This program is of particular interest at this time because of the quantity procurement of the AR-15 Rifles for the U.S. Forces. Repair-parts usage data obtained from the rehabilitation program will be of considerable value in determining the appropriate number of repair parts to procure for these units.

In addition to the repair-parts usage data, other data are being compiled under field conditions on wound effects, malfunctions, and parts failures, together with the causes and suggested modifications for correction.

Plan and Schedule to Complete - The rehabilitation program and the data collection were terminated 31 December 1963. A field report will be rendered shortly, which will be sent to the interested Services for their information and appropriate action. The rendition of that report will bring this subtask to completion.

(2) Special Shotguns

Objective - To develop special shotgun/ammunition systems for use by local military and paramilitary forces in village defense and counterambush situations.

Progress to Date - In order to fulfill the objective, a three-part program was undertaken in November, 1962, by the U.S. Army Weapons Command for ARPA/AGILE to provide answers to the following questions. First, based on present technology, which of the commercially available shotguns are most suitable for use by local 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, based on the most advanced state of weapon design, what are the desired characteristics for the optimum military shotgun.

The program was comprised of the following:

(1) Part I - A "quick fix" of commercial shotguns/ammunition most suited for military use.

(2) Part II - A study of a shotgun/ammunition system having limited life, low production cost, low recoil, and light weight, which will be suitable for use by a small-statured individual in the defense of a village or hamlet.

(3) Part III - Establishment of the technical design characteristics of an optimum military shotgun/ammunition system.

In addition to the U.S. Army Weapons Command, work on this subtask was also conducted by the Ballistic Research Laboratories, Frankford Arsenal, and Springfield Armory.

Because of Military Assistance Program (MAP) procurement of large numbers of shotguns for use in the Republic of Vietnam, the urgency of this subtask was reduced. Additionally, the study for Part II of the program was completed in July, 1963. For these and other reasons it was decided to terminate this program on 30 September 1963 and bring the work in progress to a logical conclusion as soon thereafter as practicable.

Final reports on all parts of the program have been received and reflect the following accomplishments:

(1) Part I - Based on extensive testing, the following commercially manufactured 12-gauge shotguns, with modifications, were selected:

Pump Action - Remington Model 870

Semiautomatic - Remington Model 11-48

Bolt Action - Mossberg Model 195 KA

Based on the results of the ammunition testing conducted, it was determined the Winchester experimental plastic shot-shell, folded crimp-hard, loaded with No. 4 buckshot was the best.

(2) Part II - The study confirmed the feasibility of developing a limited-life shotgun/ammunition system for use by individuals of small stature in village and hamlet defense. It was determined that:

(a) Shotguns having a mechanically controlled life of 100 rounds can be produced at a cost of $15.00 to $20.00 each.

(b) Ammunition life can be controlled by the use of encapsulated corrosive materials, fungi, and/or unstable propellant or primer mix. However, additional investigations will be required to determine which method or methods are most feasible from the standpoint of safety, reliability, and economic fabrication.

(3) Part III - Several analytical, experimental, and parametric effectiveness studies were conducted to establish the technical design characteristics of an optimum military shotgun/ammunition system. Although

considerable work was accomplished in this part prior to program termination, much remains to be done before the design characteristics are complete.

Plan and Schedule to Complete - Although this program was terminated prior to completion, it had, nonetheless, generated a considerable amount of valuable data on shotgun/ammunition systems. These data are available to all interested Governmental agencies through the final reports of the ARPA Shotgun Development Program prepared by the U.S. Army Weapons Command.

Since no further effort in this area is planned at this time, this subtask will not appear in future Project AGILE reports.

(3) Portable Flamethrowers

Objective - To develop portable flamethrowers which are light enough to be carried on deep patrols and which have greater range and lethality.

Progress to Date - The U.S. portable flamethrower available to ARVN is the M2A1, which carries approximately 5 gallons of fuel and has a combat weight of about 72 pounds. The M2A1 has been found to be too heavy for the ARVN soldier to carry in combat operations. Based on anthropometric studies, it was determined that the combat load of the ARVN soldier should not exceed one-third of his body weight, or about 35 pounds maximum.

In the search for a flamethrower of lighter weight than the M2A1 the CDTC-V conducted tests to determine the suitability and operational utility of the U S. One-Shot Portable Flamethrower, M8, and the West German Single-Burst Flamethrower, DM-14, as portable, lightweight flame weapons for Vietnamese Forces. The M8 has a capacity of approximately 2 gallons of fuel and weighs about 27 pounds when combat loaded. The DM-14 utilizes a solid fuel and weighs about 20 pounds. The results of this test are contained in the CDTC-V Report of Test dated 30 June 1963. The report concludes the ARVN requires a portable flamethrower of lighter weight than the M2A1; the DM-14 does not satisfy this requirement; the M8 is about the correct weight for the ARVN soldier (approximately 30 pounds) and has the advantage of an adjustable flame over the solid-fuel flamethrower. A satisfactory solid-fuel-projection portable flamethrower could be designed, but would require a protracted period of development; and since the M8 is an obsolete item of equipment, the standard U.S. Army Portable Flamethrower, M9-7, could be modified within a few months to meet ARVN requirements.

The report of test recommended that there be no additional procurement of the DM-14; that R&D agencies investigate the feasibility of designing a satisfactory solid-fuel portable flamethrower; and that the M9-7 Portable Flamethrower be lightened from

50 to 30 pounds by removing one fuel tank and making other modifications, and that a number be sent to the CDTC-V for operational test. The U.S. Army has been asked for its comments on these recommendations.

The Institute of Defense Analyses completed a confidential study "Research Guidance for the Development of Flame Weapons" (U) for ARPA in September, 1963. The study was conducted to answer two questions: (1) What are the potentials for improving flame weapons through further research and development?, (2) Are there flame weapons with unique applicability to counterinsurgency? The study investigated fundamental problems influencing new directions in flame weapons, technical efforts justifying immediate additional support, resurrection of devices developed during WW II, and technical problems of secondary priority. In brief, the study recommends that primary effort be devoted to research in advancing the state of the art for use of flame as a weapon, with secondary efforts being directed toward the improvement of flame devices for counterinsurgency.

Plan and Schedule to Complete - Following resolution of the recommendation for the modification of the M9-7 Portable Flamethrower, efforts in this subtask are now scheduled for completion and will not appear in future Project AGILE reports. It is planned, however, that any future efforts in this technical area will be devoted to research to advance the state of the art of flame as a weapon.

(4) Rifle Grenades

Objective - To investigate methods of (1) launching rifle grenades with standard ball ammunition rather than with the special grenade-launching cartridges, (2) achieving improved fuzing, and (3) attaining an air-burst capability in order to provide higher lethality per pound of weight.

Progress to Date - 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 weighs 1.3 pounds and has a maximum range of 250 yards when launched from the .30-caliber M-1 or M-14 rifles and 150 yards 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 provide a path of least resistance, which insures that the bullet is contained within the momentum-transfer device, and the disks have elastic properties under high-impact loading which enable effective momentum transfer from the bullet to the grenade. 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.

The most suitable fuze found for this grenade is the M538 mechanical-electric fuze made by Eureka-Williams Company of Bloomington, Illinois. A development contract with this firm was negotiated by the U.S. Naval Ordnance Test Station for modifying the M538 fuze for grenade use. The fuze includes a mechanical time-inertia arming device, a one-second delay after firing before the fuze arms, and a very sensitive impact firing device.

Work on this subtask has been temporarily suspended following the firing of five grenades (complete with modified fuze) to test compatibility of grenade, fuze, and "bullet catching" technique.

Plan and Schedule to Complete - Future plans for this subtask will depend on the outcome of a technical review of the program which is currently under way. This should be accomplished during the next quarter.

Task B - Surface-Borne Crew-Served Weapons

Background

Most, if not all, enemy targets at this level of conflict are "soft" targets. Targets may generally be described as individual people, small groups of people, houses or storage huts, small boats, domesticated animals, gun emplacements, etc. Protection for these targets is usually no more than foliage, which serves as camouflage as well as a degree of physical protection; open slit trenches or caves for people; and soft embankments for gun emplacements.

The predominant weapons requirement is therefore for munitions effective against soft targets, which are most often "people" targets. Within this test area requirements are recognized for support weapons which will provide superior fire power for the friendly local forces, weapons which are capable of applying immediate and saturating area fire as well as aimed fire to counter ambushes set against vehicles and convoys, and reasonable protection to the vehicle and armament operators so that the weapon system may be effectively employed in combat.

(1) Cupolas for the M-113 Armored Personnel Carrier

Objective - To determine the most practical and effective means of providing protection to the armament operator aboard the M-113 APC when used as an offensive weapon system.

Progress to Date - Gunner shields, which were manufactured in RVN out of scrap armor steel plate as an interim measure, are continuing under evaluation.

Four of the five modified Navy cupolas (Navy 100E) have been undergoing evaluation since arriving in RVN in May, 1963. One of these cupolas was lost in the destruction of an M-113 vehicle during the recent change of government in the Republic of Vietnam. The fifth Navy cupola remains in CONUS and will be shipped to RVN as soon as the field evaluation determines that no further essential modifications will be required to this cupola. The Navy cupola mounts a single .30-caliber machine gun.

Of the ten cupolas fabricated by Aircraft Armaments, Inc.; four were shipped by air transport and five by surface to RVN in November, 1963. One AAI cupola has been retained in CONUS and it will also be shipped to RVN as soon as it can be determined that no further essential modifications are required. The AAI cupola mounts twin .30-caliber machine guns; see Figures 1 and 2.

Plan and Schedule to Complete - Present indications are that the only outstanding actions on this subtask are the shipment of the two remaining cupolas to RVN, the completion of the evaluation, and the rendition of a final report by the field unit. It is anticipated that this subtask will be completed during the subsequent reporting period.

(2) Quad Machine Guns

Objective - To evaluate Quad machine guns as a weapon system to provide saturating area fire, as well as aimed fire, in counterambush actions.

Progress to Date - Ten Quad .50-caliber machine guns complete with M55 trailers were shipped to the CDTC-V in October, 1962. These Quad machine guns are utilized in a Convoy Protection Unit being established. Training of the indigenous Convoy Protection Unit personnel is continuing.

Plan and Schedule to Complete - The provision of Quad .50-caliber machine guns for field test and evaluation is complete. Evaluation of the Quad .50 machine guns will be given in reports concerned with the Convoy Protection Unit. This completes the R&D activity on Quad machine guns.

(3) Salvo Squeeze-Bore .50/.30-Caliber Machine Gun

Objective - To determine whether the squeeze-bore principle is a practical, effective means of increasing the fire power from a single barrel.

Progress to Date - The feasibility of increasing the effective fire power of a single machine gun by barrel modification and use of special ammunition has been

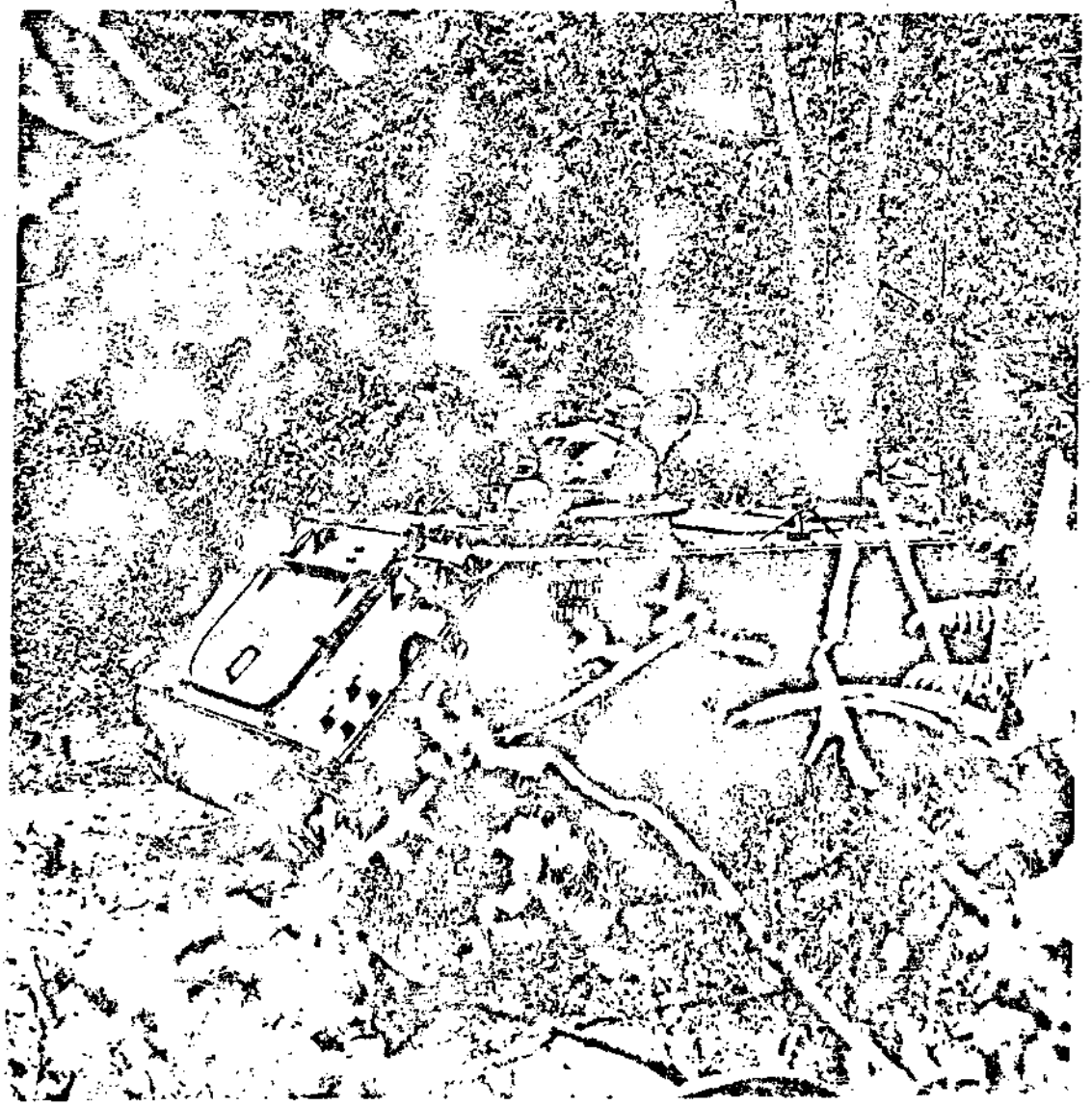

FIGURE 1. ARMORED PERSONNEL CARRIER WITH CUPOLA MOUNTING TWIN .30-CALIBER MACHINE GUNS

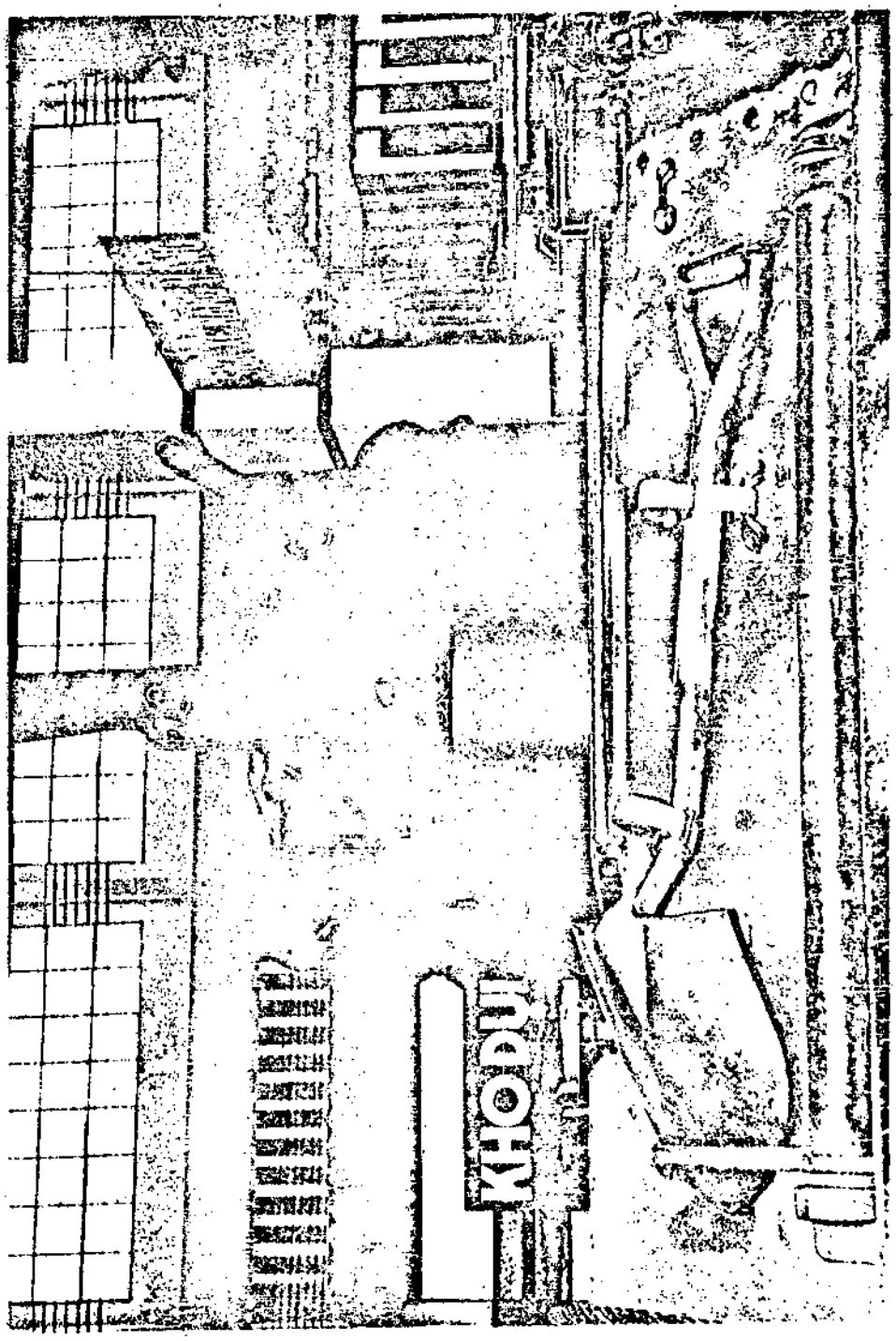

FIGURE 2. ARMORED PERSONNEL CARRIER CUPOLA MOUNTING TWIN .30-CALIBER MACHINE GUNS

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.

During the past year the U.S. Army Limited War Laboratory, at the request of ARPA/AGILE, has been conducting a program of test and evaluation of the salvo squeeze-bore principle. Test material, fabricated by the Robinson Improved Conventional Arms, (RICA), Costa Mesa, California, and furnished under contract, consisted of 11,040 rounds of caliber .50 salvo squeeze-bore ammunition with five subprojectiles and six tapered barrels. The caliber .50/.30 salvo squeeze-bore projectile, as shown in Figure 3, consists basically of five stacked 125-grain machined cones or subprojectiles. Half of the ammunition furnished for test had the mating surfaces of the subprojectiles tin-soldered, and the other half had the subprojectiles bonded together with a wax material. The barrels furnished for the test were caliber .50 M2 heavy machine-gun barrels that had been modified by a 19-inch-long tapered barrel screwed onto a mating thread cut on the front of the trimmed machine-gun barrel, as shown in Figure 4.

Both types of ammunition were tested to determine their time of flight, velocity, accuracy, functioning, and reliability in burst fire at ambient temperature and after conditioning at 160°F., wear and temperature buildup in the tapered squeeze-bore barrel attachment, pine-board penetration, and pressure-time characteristics. The results shown in the U.S. Army Limited War Laboratory Technical Report 63-1, "Test and Evaluation of Caliber .50/.30 Salvo Squeezebore System (U)," indicate that:

(1) The salvo squeeze-bore principle is sound and may be applied effectively in converting caliber .50 antimateriel ammunition into antipersonnel ammunition having effective penetration from 200 meters.

(2) Tinned-and-waxed rounds are effectively, but not reliably bonded, but rounds with only wax or vinyl bonding are unsafe.

(3) There is no degradation in ammunition accuracy during firing of 2000 rounds that can be correlated to the extensive salvo squeeze-bore barrel muzzle wear.

(4) The salvo squeeze-bore system is not yet sufficiently reliable to permit recommendation for immediate field use.

Plan and Schedule to Complete - It is planned to hold in abeyance further developmental effort on the salvo squeeze-bore pending the outcome of an effectiveness study of the system in comparison with lighter-weight systems. This study is being conducted by the U.S. Army Limited War Laboratory and will evaluate the casualty effectiveness of the salvo squeeze-bore weapon system and compare it to competitive systems. The comparative factors will be weighted according to their relative significance. The study is scheduled for completion early in the next reporting period.

SALVO SQUEEZEBORE system provides an antipersonnel capability by modification of an antimateriel system. Five lethal antipersonnel projectiles in each round provide increased area coverage giving greater probability of striking a target.

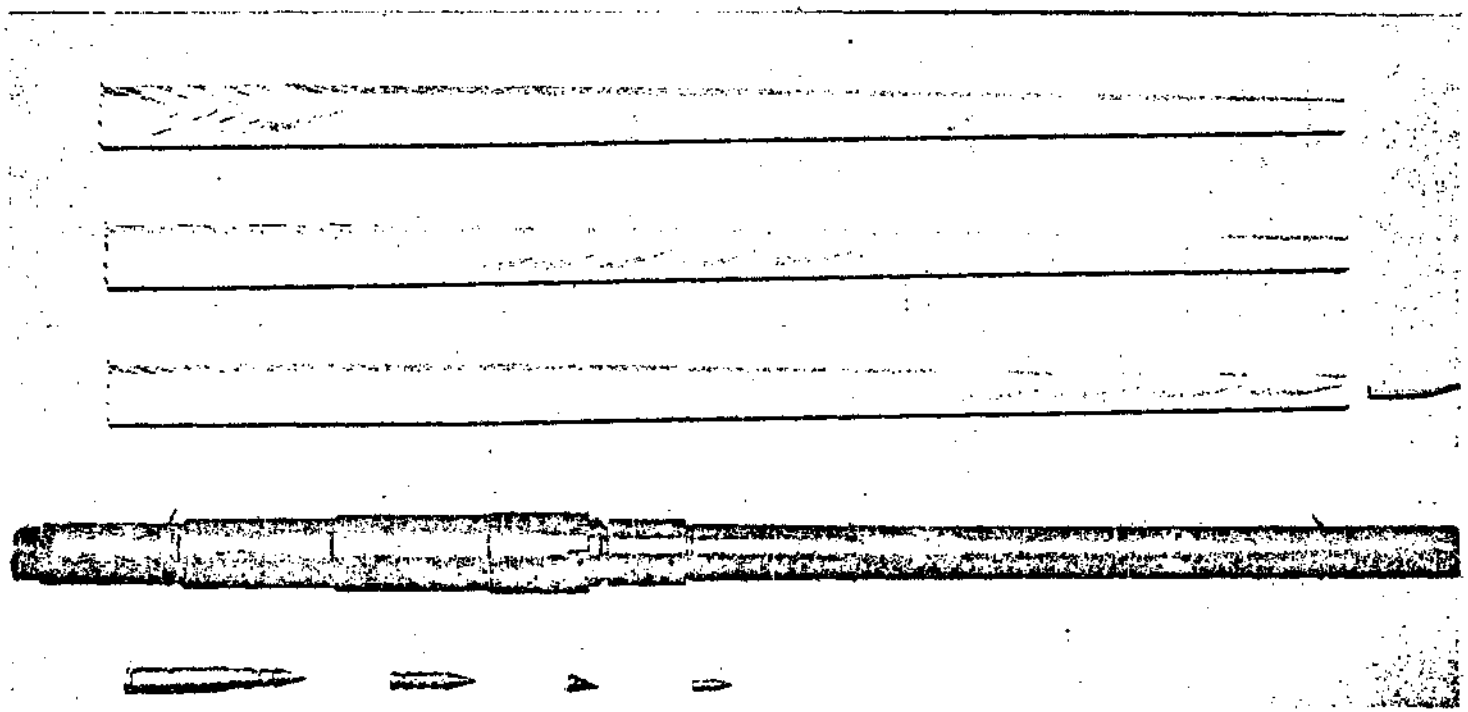

FIGURE 3. CALIBER .50/.30 SALVO SQUEEZE-BORE PROJECTILE SYSTEM

CONFIDENTIAL

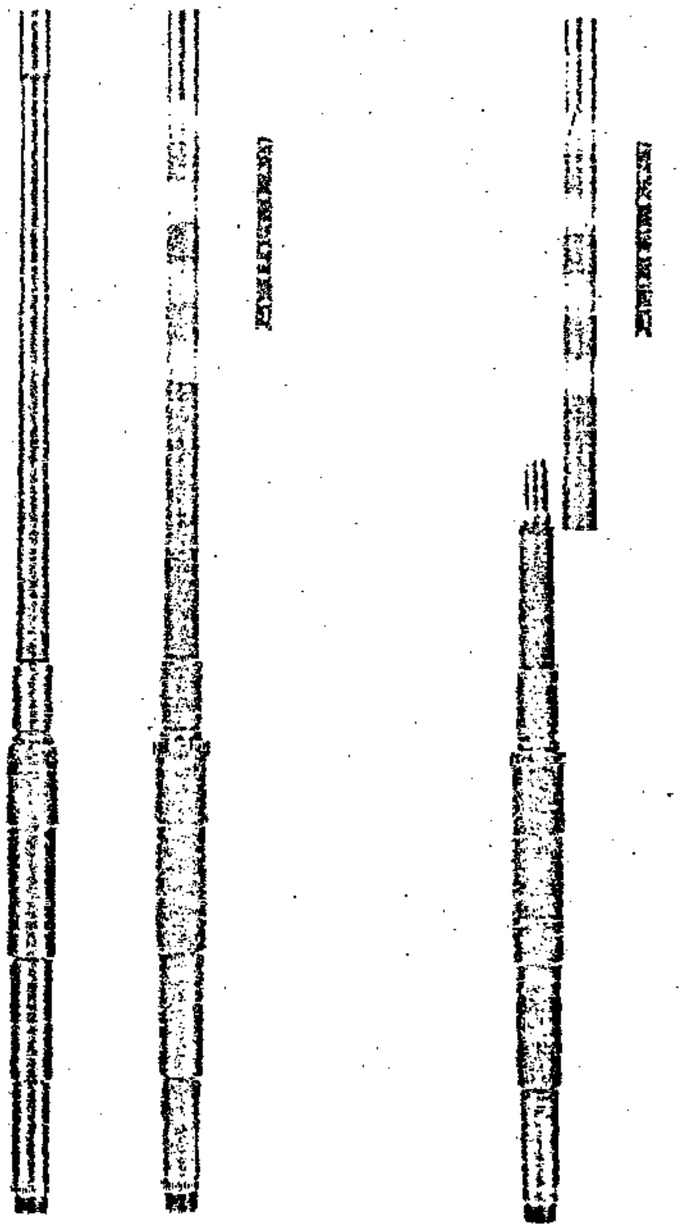

FIGURE 4. HEAVY MACHINE-GUN BARRELS MODIFIED FOR TEST OF SALVO SQUEEZE-BORE PROJECTILES

(4) Multiple Grenade Launcher

Objective - To provide a capability to immediately apply saturating area fire as a counteraction during vehicular ambushes.

Progress to Date - The vehicle-mounted multiple grenade launcher is one of the primary armaments for the Convoy Protection Unit (CPU). In addition to the grenade-launching systems provided from CONUS, several units have been manufactured in RVN. Six 2-1/2-ton trucks for the CPU have been equipped with these launchers and the training of CPU personnel has resumed after an appreciable time interval. A view of a front mount on a 2-1/2-ton truck is shown in Figure 5 and the firing control box is shown in Figure 6.

The "dead" area from vehicle side out to about 35 meters is still an area of concern. The CDTC-V has investigated a 70-mm "blunderbuss" type weapon, but has not found this approach very practical. The Army Limited War Laboratory (LWL) has been working independently on weapons which are designed for effective coverage of the area described as a sector of a circle having a radius of 50 meters and an inclosed angle of 150 degrees. Three systems are being considered by the LWL:

(1) A weapon consisting of forty-eight 12-gauge shortened shotgun barrels contained in a housing mountable either in a truck cab or bed. Each barrel is capable of firing one round and can be manually reloaded. Firing control is electrical, and various firing options can be available. Testing of a prototype system is currently under way at Aberdeen Proving Ground and should be completed by 1 March 1964.

(2) Utilization of the M18A1 antipersonnel mine or its principle as a truck-mounted weapon. The most logical has been determined to be a standard mine mounted on the truck bumper. The only real problem is the possible eardrum damage from overpressure. Tests have shown that the design did not damage the vehicle and that it would withstand roadability tests. A report describing this work is being prepared for publication.

(3) Tests of a smaller M18A1 antipersonnel mine (previously referred to as a claymorette) packaged in plastic containers and mountable in 23 units per truck side, will be conducted in March, 1964. Each small mine contains seventy 11-grain steel balls. Limited tests show effective coverage for counterambush use.

Plan and Schedule to Complete - AGILE-sponsored CONUS research and development efforts are complete for the specific requirements identified, and further reports will not be made in this publication. Evaluation of these weapons in the CPU armament role will be made by the CDTC-V as appropriate.

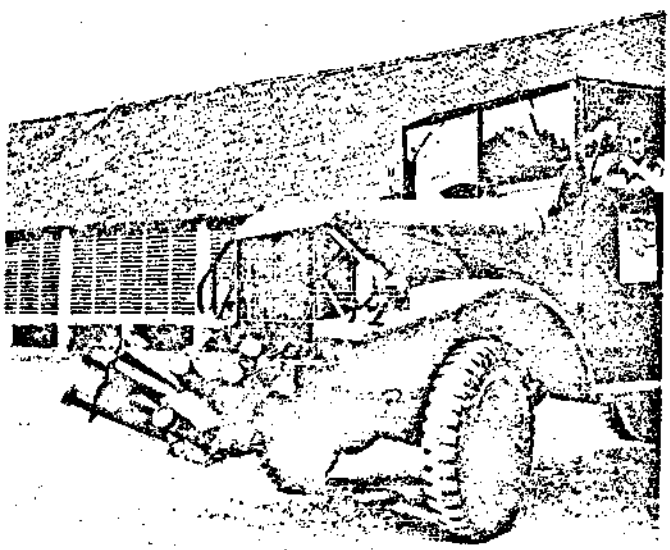

FIGURE 5. MULTIPLE GRENADE LAUNCHER MOUNTED ON FRONT OF 2-1/2-TON TRUCK

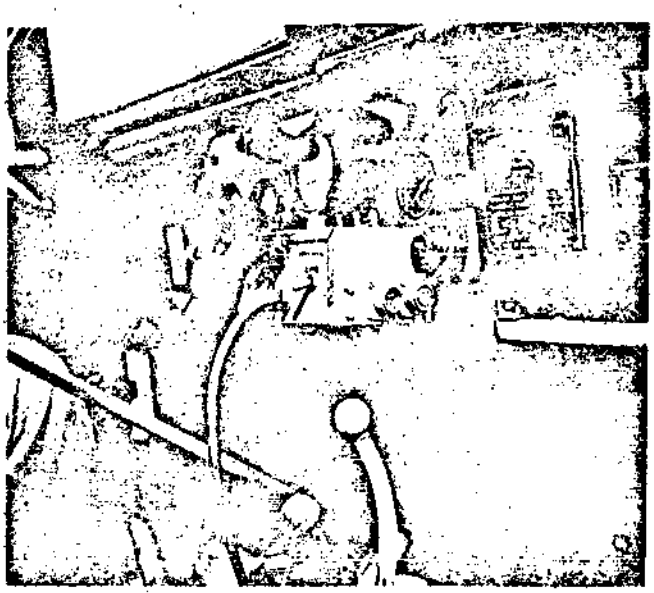

FIGURE 6. FIRING CONTROL BOX FOR MULTIPLE GRENADE LAUNCHER MOUNTED ON 2-1/2-TON TRUCK

(5) Lightweight Mortars

Objective - To develop improved lightweight mortars and mortar ammunition for use by local forces in remote area conflict.

Progress to Date - The study on indirect fire, high-trajectory mortarlike, manportable weapons and their applications to counterinsurgency in remote area conflict, being conducted by the Weapons Planning Group of NOTS, continued during the reporting period.

In response to a field requirement for an improved 60-mm mortar round with enhanced lethality, a query was directed to the U.S. Army for a solution. In addition, a proposal for an improved 60-mm mortar round from the Ordnance Research and Development Corporation was considered. On the basis of the foregoing efforts, three possible alternatives for fulfilling this requirement appeared:

(1) Undertake a six-month development effort, proposed by Picatinny Arsenal, to produce a 60-mm mortar round utilizing cast pearlitic malleable iron in lieu of a forged steel body, and have a 74 per cent increase in fragmentation effectiveness.

(2) Initiate a search of Army ammunition stocks to determine whether 60-mm mortar rounds manufactured prior to 30 November 1956 were made of malleable iron.

(3) Undertake development of an improved 60-mm mortar round utilizing controlled fragmentation, as proposed by Ordnance Research and Development Corporation.

Of the three alternatives, the first offers the most promising solution. The search of U.S. Army ammunition stocks revealed the 60-mm mortar rounds manufactured prior to 30 November 1956 were of cast steel rather than malleable iron. The proposed Ordnance Research and Development Corporation round appears to be less lethal than the current steel round. However, before further consideration is given to the initiation and funding of the Picatinny Arsenal proposal, the field has been asked to reconfirm the requirement for this round. In addition, Military Assistance Program (MAP) interest in the procurement of this round, once it is developed, is also being determined.

Plan and Schedule to Complete - Written conclusions and recommendations based upon the study being conducted by the Weapons Planning Group at NOTS will be submitted to ARPA in January, 1964, with a final report published by 1 April 1964.

Future action on the Picatinny Arsenal proposal for a 60-mm mortar cast iron round will depend on the answers received from the field and MAP offices.

(6) Stoner 63 Weapons System

Objective - To develop an improved family of lightweight individual and crew-served weapons capable of high rates of automatic fire for use in small unit operations.

Progress to Date - Since the negotiation of a contract with the Cadillac Gage Company for the procurement of 25 machine guns, medium, Stoner 63, considerable interest has been expressed by ARPA and the Services in the entire Stoner 63 weapons system. The system comprises, in addition to the medium machine gun, five other configurations, including a fixed machine gun, a light machine gun (belt fed), a light machine gun (magazine fed), an assault rifle, and a carbine. Chambered for the 5.56-mm (.223 caliber) round, all six configurations in the system are fabricated from one common basic-component group with interchangeable parts used to build up a particular weapon.

Because of expressions of interest in this weapons system by the U.S. Army, Air Force, and Marine Corps, it was decided to conduct a joint program of test and evaluation, coordinated by ARPA. The joint program is to be conducted in three phases: I - Engineering tests, II - User tests, and III - Troop tests. Phase I testing, which began 2 December 1963, is currently under way at Aberdeen Proving Ground under the over-all supervision of the U.S. Army Materiel Command. Testing is being conducted, in accordance with a jointly approved plan of test, by the Development and Proof Services, Human Engineering Laboratory, and the Ballistic Research Laboratory.

In order to provide the weapons required for Phase I testing, the original contract with the Cadillac Gage Company was modified to procure five complete systems, of which three went to the U.S. Army and two to the U.S. Marine Corps, and six fixed machine guns went to the U.S. Air Force for use in conducting pod-mounted tests for aircraft armament applications.

Preliminary to the initiation of Phase I testing at Aberdeen Proving Ground, the Stoner 63 medium machine gun was subjected to accuracy, endurance, barrel-performance, and rain tests at the H. P. White Laboratory. These tests were conducted to get a sampling of the accuracy, safety, reliability, and performance characteristics of this weapons system. Test results obtained were very promising. For example, an average mean radius of 1.5 inches, with the greatest extreme spread being 9.2 inches, was attained during accuracy tests on fifteen 20-round burst targets fired at a range of 100 yards. The machine gun was mounted on an M 122 tripod which was resting on firm ground and fired at each of three deflections - zero degrees, maximum left, and maximum right. In the barrel-performance tests, with the weapon fired in 20-round bursts at a rate of approximately 80 rounds per minute, 2,480 rounds were expended before firing was discontinued because of keyholing in excess of 15 per cent. All parts of the weapon except the barrel completed the 10,000-round endurance test.

Following initial difficulties caused by the emulsification of the lubricating oil used, the weapon was relubricated with Lubriplate and functioned properly during the

remainder of the rain tests. Of more than 13,700 rounds of ammunition fired in all tests, only 19 malfunctions occurred; and of these, just one - a light firing-pin blow - could be attributable to the weapon.

Plan and Schedule to Complete - The Phase I testing at Aberdeen Proving Ground is scheduled to be completed the first part of February, 1964, with a report of test to be rendered within 30 days thereafter. U.S. Air Force testing of the pod-mounted Stoner 63 Fixed Machine Gun, as a part of Phase I of the Joint ARPA/Service Program for Test and Evaluation of the Stoner 63 Weapons System, is planned for late January, 1964, following the delivery of the pods by the Cadillac Gage Company.

It is planned for Phase II of the Joint Program to begin in April, 1964, with Phase III following within approximately 60 days. Initiation of these phases, however, will depend on the outcome of the Phase I testing.

Task C - Aerial Weapons and Munitions

Background

Targets for air strike consist largely of targets appearing on the ground and generally are the same targets as presented to the ground forces. Dense foliage, such as that in tropical rain forests and jungle, provides a natural and effective camouflage for these targets. A degree of physical protection against air-delivered munitions is also provided by this dense foliage canopy.

In general, the equipment and systems employed in counterinsurgency actions have been hardware available in the U.S. inventory and, for the most part, obsolescent or surplus to U.S. needs. Even though modifications have sometimes been made to this equipment to improve its effectiveness, totally adequate systems have not resulted. Specific design for the intended support role and the environment is 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 desirable.

(1) Counterinsurgency Aircraft

Objective - To develop a light attack/reconnaissance aircraft system optimized to perform the various missions of this role in remote area conflict actions.

Progress to Date - A detailed feasibility and cost study program directed toward the development of a light attack/reconnaissance aircraft system was approved by DDR&E. This program is under the direction of an OSD/Services Steering Committee

composed of the Assistant Secretaries of R&D for the Army, Navy, and Air Force; the Deputy Chief of Staff for R&D of the Marine Corps; and representatives from DDR&E Tactical Warfare Systems and ARPA/AGILE. The Assistant Secretary of the Navy (R&D) is chairman of the committee and the Navy is the action Service. Through the committee membership, aircraft specifications of Service and Agency interest were placed before the Navy (Bureau of Naval Weapons), who prepared the aircraft specifications necessary for the publication of the Request for Proposal (RFP). The specifications are intended to describe a versatile airplane of minimum size, suitable for operations by field forces in a primitive environment with a minimum of logistic support.

Initially the plan of action was specifically aimed at a time-limited and 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. However, as aircraft specifications were developed and the RFP took form, it appeared possible that the aircraft specifications might be sufficiently well established that industry could propose directly on the development of an aircraft rather than on further study.

The RFP was published 5 December 1963. Industry was requested to propose directly on the design, development, and construction of four prototype airplanes.

Plan and Schedule to Complete - Proposals from industry are due during March, 1964, and it is expected that evaluation and decisions can be made by the end of FY-1964. If upon evaluation of the proposals, it is determined that further study is required, funding has been approved to proceed with the initially planned feasibility and cost study with about three independent contractors. If the proposals reveal that further study is not required, further action will depend upon approval and funding to proceed with the prototype aircraft. It is anticipated that this decision will be available in the first quarter of FY-1965. Prototype aircraft may be expected to be in flight test within 12 months, and production-aircraft delivery could start within 24 months after the contract is let.

(2) Assisted Take-Off

Objective - To investigate rocket-assist systems, other than JATO, designed to permit aircraft operation from unimproved remote airstrips.

Progress to Date - A proposal submitted by Arde, Inc., for a study of the required parameters for an autogenetic rocket take-off assist system was selected as most promising.

Plan and Schedule to Complete - Budget limitations have prevented allocation of funds for such work. This subtask has been terminated.

(3) Delayed Proximity Fuzes

Objective - To provide a fuzing system for U.S. standard high-explosive bombs which would produce optimum results against personnel targets shielded by jungle canopy.

Progress to Date - To achieve bomb detonation below the jungle canopy and above ground level for antipersonnel application, the M188 proximity fuze was modified by substituting a delay detonator for the instantaneous detonator normally used. Based upon the general average jungle canopy height and thickness, a time delay of 75 milliseconds was incorporated. This time delay allows an additional 40 to 50 feet of travel after the fuze is electrically initiated upon coming into proximity with the foliage before bomb burst. This modified fuze, designated the XM 914, retains the same MinSAT (Minimum Safe Air Travel) of 3600 feet as the original M188 fuze.

One thousand of the M188 fuzes were modified by Harry Diamond Laboratories (previously known as the Diamond Ordnance Fuze Laboratories). Approximately 70 of the modified fuzes were used by the Air Force in jungle tests conducted in Panama, and the remainder were shipped to RVN for environmental evaluation. A Diamond Ordnance Fuze Laboratories confidential report TR 1096 titled "The XM914 Fuze" (U), dated 15 November 1962, describes in detail the XM914 Fuze and reports the test results obtained in Panama. A final report by the CDTC-V on environmental testing in RVN is titled "Operational Test XM914 Proximity Bomb Nose Fuze", dated 5 August 1963. This report concludes that the XM914 fuze will give acceptable results in "area" bombing operations when the sensitivity setting is properly selected and that in addition to providing air bursts under a high jungle canopy, the fuze will operate acceptably for many target types if properly employed.

In consideration of the generally low overcast and cloud coverage in much of RVN throughout the year and the increased bombing accuracy that can be achieved from lower-altitude bomb releases, another 1000 M188 proximity fuzes were modified with the delay detonator, in which the MinSAT was reduced from 3600 to 2300 feet. The XM914 fuze with the reduced MinSAT is designated the XM914E1 fuze. These XM914E1 fuzes were tested by the Air Force for release restrictions. Approximately 950 XM914E1 fuzes were then shipped by surface vessel to RVN in September, 1963. HDL confidential report DM-63-2 titled "Notes on Development Type Materiel Fuze, Bomb : Nose, Proximity, Delay XM914E1" (U), dated 25 April 1963 describes the XM914E1 fuze.

Plan and Schedule to Complete - All remaining XM914 and XM914E1 fuzes in RVN have been transferred to operational units for their use.

This concludes AGILE efforts on the subtask Delayed Proximity Fuzes.

(4) Target-Marking Munitions and Devices

Objective - To develop the required marking system(s) necessary for effectively marking ground positions. These marking requirements are for target marking for either ground or air strike or for marking the positions of friendly forces for purposes such as resupply actions and protection.

Progress to Date - Within the past two years several devices have been evaluated against these various marking-system requirements.

Standard hand smoke grenades have proved to be unsatisfactory in that insufficient smoke was generated to mark targets in heavy foliage or for the desired period of time.

The 3.5-inch white phosphorus head has been mated to the 2.75-inch rocket as a target-marking device for aerial delivery. A two-tube MA-2 rocket launcher on the O-1A aircraft is used to deliver this marking munition. The accuracy achieved is far superior to that obtained from the hand smoke grenades. A report on this device is contained as Annex I to the CDTC-V monthly report for July, 1963.

The E72R1 Smoke Munition has also been evaluated as an aerial marking munition from O-1A aircraft. This munition has been found to be a satisfactory smoke marker when employed on forested or dry-land areas. Unsatisfactory performance was obtained when employed on swamps or water because the munition was extinguished. The white smoke of the E72R1 is identified as one shortcoming and the heavy case as another. A report on the E72R1 is entitled "Operational Test of E72R1 Smoke Munition" dated 30 June 1963.

For a ground-emplaced position marker a British balloon marker system has been evaluated. However this system was determined to be too big and too heavy and required too much water for the generation of the hydrogen used to inflate the balloon to be useful for patrols. Even though the inflated balloon was 7 feet high and 4 feet in diameter, no appreciable difficulty was encountered in getting it up through the forest canopy.

Plan and Schedule to Complete - Currently under investigation is a colored smoke marker developed by the Navy for use on water, and two small completely self-contained balloon systems for position markers.

The goal for the complete packaged balloon system is a volume of less than 100 cubic inches and a weight of less than 1 pound. It is expected that some, if not all, of these devices will be available for evaluation before the end of this fiscal year.

(5) Illuminating Flares

Objective - To determine the requirements and specifications for illuminating flares for night tactical operations as dispensed by either aerial or surface vehicles.

Progress to Date - The CDTC-V has participated with the Air Force units in RVN in evaluation of the M139(T10E6), a flare with 3-million candle power and 3-minute duration. This flare has been compared with the Mk6Mod6 flare, which has been employed in large quantities in the RVN. Mk5 flares have also been employed. Operationally, it is generally considered that one M139 flare is equivalent to two Mk6Mod6 flares or three Mk5 flares. However, the steel case of the M139 flare is likely to survive major damage upon impact and thus be useful to insurgent weapon makers. For this reason the M139 is not considered by all users as an acceptable flare for counterinsurgency operations.

Plan and Schedule to Complete - Determination of the specifications of an illuminating device which will fulfill the unique requirements for counterinsurgency operations, and which is sufficiently different from existing flares to require research and development, remains outstanding. The CDTC-V is attempting, with the assistance of those units having illumination requirements, to establish the essential specifications. Further reporting of this task will be held in abeyance until such time as a development program is established.

(6) Antipersonnel Bombs

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

Progress to Date - The AN-M1A2 cluster of M41 20-pound fragmentation bombs is used operationally by the VNAF. The CDTC-V states that these bomb clusters are regarded as one of the most effective air-delivered munitions being used by the VNAF.

A limited number of MK54 depth bombs have been dropped to test their effectiveness in dense jungle growth. These tests have determined that neither the XM914 proximity fuze (see Subtask 3, this task) nor the standard M116 proximity fuze is compatible with the MK54. No further reports on these items are anticipated.

Plan and Schedule to Complete - No effort is currently under way in this subtask area. All future efforts which could have been identified under this general area will be identified as specific subtasks. Therefore, no subtask entitled "Antipersonnel Bombs" will appear in future ARPA/AGILE Semiannual Reports.

Task D - Special Weapons

Background

By the very nature of remote area conflict and the environment in which it is waged, it is necessary to develop special-purpose weapons and ammunition to fulfill unusual requirements that are generated. Weapons in this task differ from those in the other weapon tasks in that each is designed for a particular tactical application. These weapons employ rather unique concepts or applications of existing technology; they include flame weapons, self-propelled small-caliber projectiles, separating bullets, explosive fuel vapors, and others. The development of such special-purpose weapons and ammunition is intended to overcome peculiarities of the terrain, such as dense foliage that conceals targets; insurgency tactics which often result in the presence of but fleeting targets, and, to a degree, the lack of conventional heavy supporting weapons.

(1) Camouflaged Antipersonnel Mines

Objective - To develop a new antipersonnel mine which may be either emplaced by hand or air-dropped and will defy visual detection because of its close resemblance to indigenous materials.

Progress to Date - Two R&D efforts are involved in this task:. (1) the development of castable mines which are shaped to resemble local materials; and (2) a low-cost, antidisturbance fuze for use with these explosives. At the time this program was initiated, PBX mines cast 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 the color and texture of stones had been developed.

On 1 November 1961, at the request of ARPA/AGILE, NOTS undertook a research and development program on cast PBX mines with antidisturbance fuzes.

Two hundred mines cast to resemble rocks indigenous to South Vietnam and two hundred antidisturbance fuzes were shipped by NOTS to the ARPA R&D Field Unit in Vietnam in September, 1962. Mr. Joseph Petit, an explosives expert at the Harry Diamond Laboratories, was sent to Saigon by ARPA/AGILE to inspect, evaluate, and demonstrate the "rock" mines.

Inspection of the fuzes and mines showed that they were incompatible; many fuzes did not fit the fuze wells in the mines. After arming, some of the mines exploded spontaneously. Because of the poor manufacturing tolerances applied to the mine fuze wells and the unsafe fuzes, the remaining units were withdrawn from test and will be disposed of by appropriate ordnance disposal procedures.

Plan and Schedule to Complete - Future efforts will be directed toward the following tasks: (1) developing an "out-of-line" fuze; (2) developing the required manufacturing drawings for the fuze; (3) arranging for the manufacture of a limited but sufficient number of complete units to provide the test quantities necessary to assure that the units meet all required specifications; (4) providing for the manufacture of enough additional units for shipment to the ARPA R&D Field Unit for environmental test and evaluation.

The program will be conducted in the steps indicated, with each succeeding step being predicated upon the successful completion of the preceding step. Probable completion date is about the end of October, 1964.

(2) Microrocket Pistol and Projectile

Objective - To investigate the potential uses of very-small-caliber microrocket projectiles in various weapons systems and to develop a very-low-cost, defensive hand-held weapon suitable for use by local paramilitary or civilian forces.

Progress to Date - The feasibility study and experimental research program initiated in July, 1962, to investigate small-caliber microrocket projectiles was concluded during the period. Participating in this effort were the U.S. Naval Ordnance Test Station, the Naval Weapons Laboratory, the U.S. Army Ballistic Research Laboratory, and MB Associates. Two secret reports were received late in the reporting period covering this effort. One is from the U.S. Naval Ordnance Test Station and is entitled "Microrockets; Applied Research on the Performance Characteristics of Microrockets" (U). It reaches conclusions and makes recommendations in problem areas such as: projectile propellant, ignition, nozzles, and shape, and launcher design. The other, "Report on Parametric Evaluation of Hand-Held Microjet Weapon" (U), is from the U.S. Naval Weapons Laboratory. It is a study of the effectiveness of the hand-held microjet weapons against personnel targets.

Under contract to ARPA, MB Associates fabricated a test quantity of experimental .49-caliber microrocket pistols and projectiles. As reported in the 1 April - 30 June 1963 Quarterly Report, these weapons were subjected to engineer design tests at the H. P. White Laboratory. The results of these tests disclosed reliability and accuracy problems that required correction before proceeding further. Following these tests, MB Associates modified a number of the pistols and improved the projectiles in an attempt to overcome the deficiencies noted. The modified weapons and improved ammunition were retested at White Laboratory in September, 1963. The results of this test showed improvement over those of the first test. However, considerable development effort is still required before this weapon can meet the objective of a low-cost, defensive, hand-held weapon suitable for use by local paramilitary or civilian forces.

Plan and Schedule to Complete - No further effort on a hand-held microrocket weapon is planned until such time as the state of the art in small-caliber microrocket

projectiles is advanced to a point of greater assurance of success than now exists. Therefore, with the rendering of a final report, this subtask is completed.

(3) Fuel-Air Explosive (FAX)

Objective - To develop a munition which will be effective against area targets concealed and shielded by heavy vegetation or protected by earthworks and tunnels.

Progress to Date - Detonation of a fuel-air explosive cloud was achieved by the Naval Ordnance Test Station during January, 1961. The cloud consisted of ethylene oxide dispersed by a burster charge and detonated by a high-explosive booster. Studies showed that the detonation velocity was of the order of 1500 meters per second and that overpressures of 250 psi developed throughout the area covered by the clouds. Such a system could 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 would be less effective because the vapor cloud is all-enveloping within its area of dispersal; the cloud might even penetrate tunnels for considerable distances.

In January, 1963, an accelerated program to develop an air-droppable FAX weapon was undertaken by NOTS at the request of ARPA/AGILE.

A 5-pound device having an internally mounted dispersion and detonation mechanism was developed. Because the small size of the cannister made it difficult to space the burster charge and the delay-detonation unit correctly, the design was changed to a 10-pound, 7-inch-diameter size.

Twenty 10-pound units were tested by dropping them from a 40-foot tower. In all cases the burster charge produced a satisfactory cloud of ethylene oxide. However, five of the clouds did not explode, but burned, indicating that they had been ignited prematurely, i.e., before adequate dispersion to form an explosive fuel-air mixture could take place.

As larger sizes may allow the use of techniques not feasible with the small sizes, studies of an 80-pound size are in progress.

A fiber-glass launcher for 7-inch bomblets was developed, and a contract for the manufacture of 66 of the launchers has been let.

Plan and Schedule to Complete - Presently under study.

(4) Helicopter Trap Weapon (HTW)

Objective - To develop a munition capable of destroying bamboo stakes and other barriers used to deny to helicopters the use of probable landing zones.

Progress to Date - The Viet Cong forces in Vietnam have developed the tactic of erecting bamboo stakes in probable helicopter landing areas. These stakes are sufficiently tall to cause damage to the rotor blades of the descending aircraft. The effect has been to deny the use of some landing zones or to limit the number of possible helicopter landing sites to the point where ambushes may be profitably prepared.

To counter this tactic, an accelerated development program was initiated at the Naval Ordnance Test Station to provide a weapon capable of destroying these antilanding materials. A free-fall bomb, designated as the EX115 Mod O, was developed employing the M155A1 mechanical time fuze, a modified Mk 41 Mod O Zuni continuous-rod warhead, a FIST ribbon drogue parachute with a deployment bag, a parachute canister, and two modified Mk 105 Practice Bomb strap-type bomb lugs. The physical characteristics of the bomb are: nominal diameter, 5 inches; over-all length, 31.5 inches; and loaded and fuzed weight, 55 pounds.

This modified Zuni warhead will yield a normally continuous ring of steel expanding at an average velocity of 4700 to 4800 feet per second to its opening diameter of 50 to 56 feet. Vertical or near-vertical bomb strike, which is necessary to achieve the maximum effectiveness of the continuous rod, is accomplished by use of the drogue chute, which, in addition to providing the bomb attitude control necessary for low-level bomb release, also provides the necessary high drag force which allows the attacking aircraft to escape from the danger area of the bomb. This system is designed for low-level, low-speed delivery by either fixed- or rotary-winged aircraft.

Final CONUS tests of the production weapon revealed a deficiency in the black powder fuze booster which must be corrected before the system can be released to the field for test and evaluation.

A detailed description of this weapon is contained in NOTS Technical Publication 3416 (Confidential), titled "Description and Instruction for Use of the High-Explosive Bomb EX 115 Mod O Helicopter Trap Weapon" (U), dated November, 1963.

Plan and Schedule to Complete - It is anticipated that the fuze-booster deficiency can be corrected and the weapon can be retested and readied for shipment to RVN for environmental test and evaluation by 1 February 1964. Shipping plans are to transport 40 bombs and five inert practice rounds by air, with the remaining 160 bombs to be transported by ship.

(5) Strip Bullets

Objective - To provide an increased capability for rifles and automatic weapons used against fleeting targets at short ranges.

Progress to Date - The development program designed to improve the kill capability of small arms conducted over the past year by the U. S. Naval Ordnance Test Station has been concluded. Effort was concentrated on the design and test of strip bullets made of a number of short lengths of lead wire pressed into a die to form a core of conventional bullet size and shape and then clad with a thin copper foil. When the strip bullet is fired through a bore, the centrifugal force imparted by the rifling causes the strips to separate as they leave the barrel. This produces a shotgun effect and increases the hit probability. The principle may be applied in weapons ranging from pistols to .50-caliber machine guns.

Although tests have demonstrated the feasibility of this concept, considerably more development effort is required to produce a bullet of this nature that is practicable for field use.

Plan and Schedule to Complete - Since other means of improving the kill capability of small arms appear to offer greater probability of success, no further effort will be expended on this subtask.

(6) High-Intensity Sound Generator

Objective - To study the use of detonation techniques for the generation of sustained, very high sound power levels for weapon application.

Progress to Date - A single-tube sound generator has been built. The device is shown schematically in Figure 7 and functions in the following manner. Air is blown into the mixing plenum where it is mixed with propane to form a detonable mixture. The mixture is forced through the check valves and fills the combustion chamber. At the desired time, the gaseous mixture is ignited by an electric discharge across the spark plug. The flame front is transferred from the combustion chamber to the echo tube where it is intensified and appears at the exit as an explosion or detonation. The contour of the 127.2-db sound level is shown in Figure 8. Detailed sound field measurements are in progress.

Plan and Schedule to Complete - A multitube sound generator is being assembled. The interaction of close-packed parallel tubes will be studied. Tests will be completed by 31 January 1964. Further work will depend upon evaluation of the results.

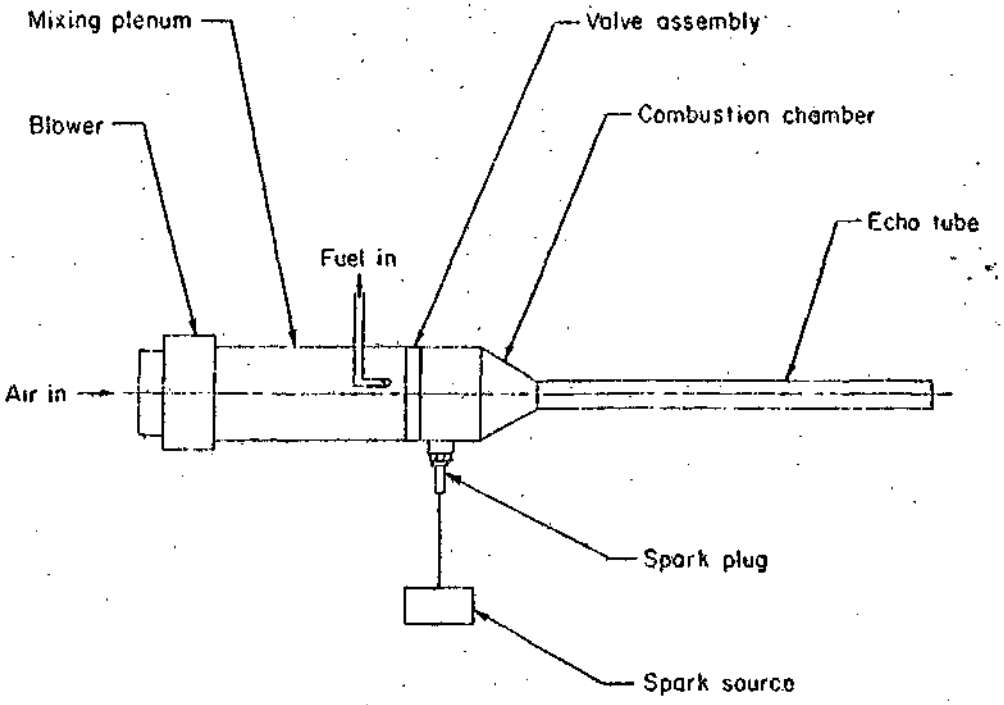

FIGURE 7. HIGH-INTENSITY SOUND GENERATOR

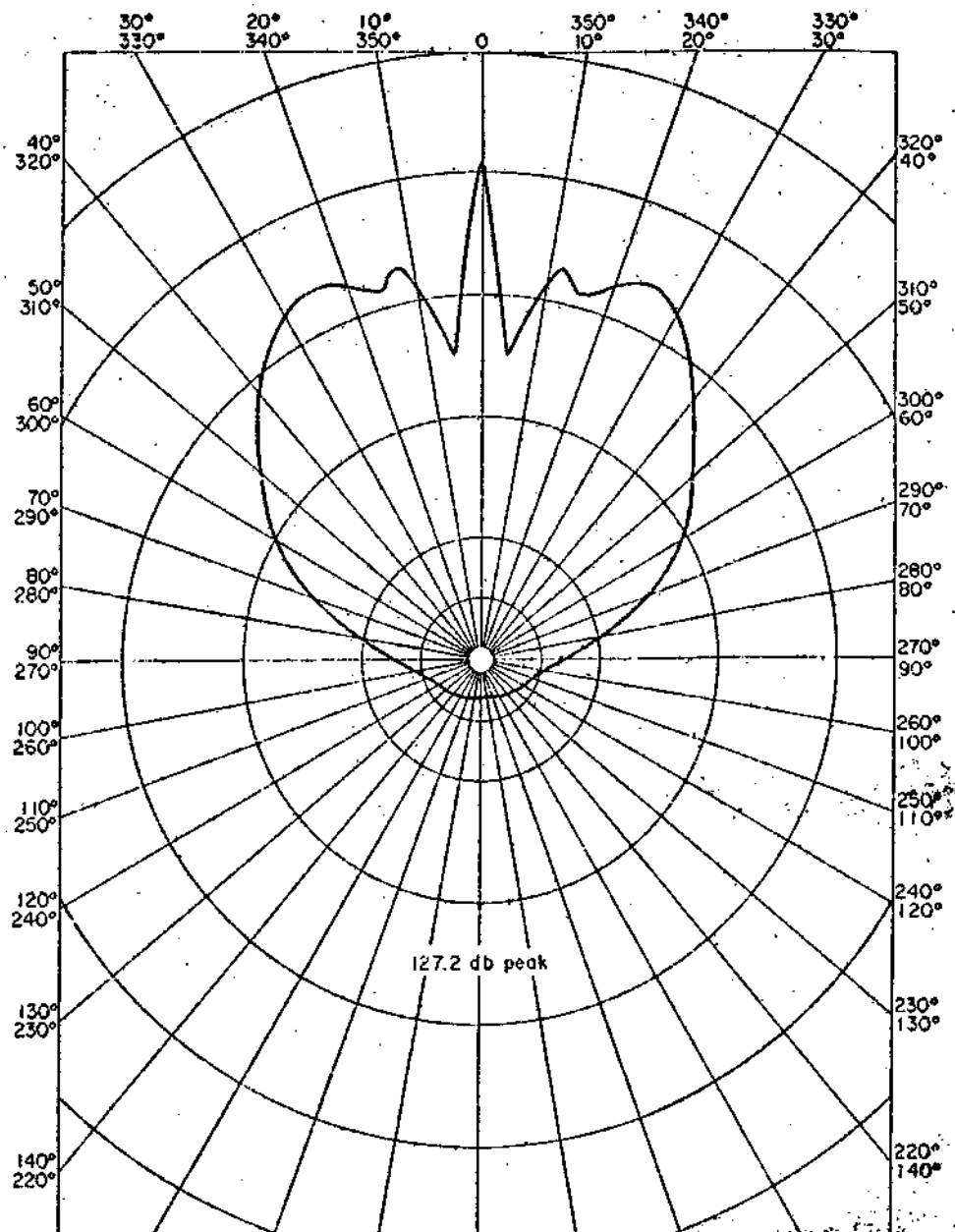

FIGURE 8. ISOINTENSITY CONTOUR OF DETONATION SOUND WITH A 1.5-INCH DETONATION TUBE AT 35 CPS, USING A MIXTURE OF AIR AND PROPANE

(7) Village and Outpost Security

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

Progress to Date - A mock-up of the command firing point of a village defense plan utilizing surplus 75-mm Skysweeper mines has been built and demonstrated in Vietnam. About 5 million rounds of the ammunition are being held in reserve in CONUS depots pending requirement information from CDTC-V.

Plan and Schedule to Complete - No further R&D work is planned for this task; therefore it will not be included in future reports.

Task E - Lethal and Nonlethal Weapon Systems

Background

Weapon requirements for remote area conflict are influenced by environmental and tactical considerations. Hence the 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 or 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 logistic impact, and the level of skill and training required to employ them is essential to the generation of new lethal weapons and to the use of existing ones.

In some instances, it may be desirable to incapacitate the enemy temporarily; captured troops might be a valuable source of information on enemy positions, or civilians in an area under attack could be returned to productive occupations after the insurgents had been apprehended. Thus, for intelligence, psychological, and humane reasons, nonlethal weapons are sometimes required.

(1) Weapon Systems Studies and Research

Objective - To provide a comprehensive program within which all weapon tasks can be coordinated, and to provide a wide base of resources to examine the various parameters affecting weapon development for remote area conflict.

Progress to Date - A group was assembled to define the approaches and tasks and to recommend the level of effort to be established in the various weapon systems areas. Tasks consistent with the background and experience of the Naval Ordnance Test Station,

the Research Analysis Corporation, the RAND Corporation, and the Institute for Defense Analysis were agreed upon and assigned to the appropriate organizations. A preliminary report entitled "A Survey of River Mine Countermeasures for use in Remote Area Conflict" was published by the Research Analysis Corporation on 15 November 1963.

Plan and Schedule to Complete - Since the objectives of this subtask are to be attained during the prosecution of specific weapons programs, accomplishments will be reported within the appropriate technical area and Weapon Systems Studies and Research will not be reported as a separate subtask in the future.

Technical Area 2 - Individual Equipment

Task A - Clothing and Equipment

Background

Because of the nature of remote area conflict and the environment in which it normally occurs, a considerable amount of material transport requirements is fulfilled by man, or sometimes animal, portage. Coupled with the generally small stature of the local peoples involved, this places an extremely high premium on the weight and bulk of the material which must be transported.

This technical area is concerned with items of individual-issue equipment, except for weapons, which a soldier needs to be properly prepared for extended operations or needs in order to be effective in combat. Its purpose is to provide the best solution to problems encountered by local forces in improving this equipment, and hence the capabilities and effectiveness of the individual soldier as regards personal equipment.

Since these requirements will vary with the particular country concerned, the approach to this technical area may be divided into the following three general efforts.

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

Second, 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 local forces and provide the technical assistance necessary to the host country's manufacturers to enable them to provide the materials or equipment to supply their needs.

Third, where a requirement exists for an item for which a country has neither the resources nor the manufacturing capability to supply it, and it does not exist in the U.S. inventory, U.S. R&D efforts will be marshalled to develop an item which will meet the requirement.

(1) Improved Individual Combat Equipment

Objective - This task has a twofold purpose: (1) to obtain and evaluate information which can be used to design and develop improved individual clothing and equipment for local forces engaged in or threatened by conflict in Southeast Asia; (2) to develop prototypes of improved items.

Progress to Date - (1) An anthropometric survey of 2,950 men of the Armed Forces of the Kingdom of Thailand and of 2,130 men of the Armed Forces of the Republic of Vietnam has been conducted; about 52 body measurements were made on each man. The data are now undergoing analyses. It is expected that the analyses will be completed and final reports issued early in the next reporting period.

Inspection of the data showed that the height of the average Vietnamese soldier (50th percentile) is 5 feet 2-1/2 inches and that of the Thai soldier, 5 feet and 4-1/2 inches, in contrast with an average of 5 feet 8-1/2 inches for the U.S. soldiers. In addition, the average Vietnamese weighs only 108 pounds, and the Thai, only 120 pounds, in contrast with 152-1/2 pounds for the U.S. soldier.

Using the rule of thumb that the soldier's load should not exceed one-third of his body weight, it is evident that whereas a load of 50 pounds is permissible for U.S. soldiers, only 35 pounds should be carried by Vietnamese and Thai soldiers. Therefore clothing and personal equipment provided to these troops should be about one-third lighter in weight than that provided to the U.S. soldier.

The Engineering Psychology Laboratory, Pioneering Research Division, conducted a human-factors study of problems and considerations associated with use of equipment and clothing by local ground forces of the Royal Thai Army and the Army of the Republic of Vietnam. Recommendations concerning human-factor considerations for each item of equipment were published in a report entitled, "Human Factors Evaluation of Clothing and Personal Equipment in Thailand and the Republic of Vietnam", by J. M. Chaffin, Major, QMC, and E. W. Youngling, Research Psychologist, U.S. Army Natick Laboratories, Natick, Massachusetts, August, 1963.

(2) Operations in Vietnam often involve three-day or longer missions without resupply rather than the one-day patrols conducted by U.S. forces. Thus we have the problem of a smaller man needing equipment that in total weighs a third less than the load carried by the corresponding U.S. soldier, but who must carry supplies for a mission three times as long. The need for lightening the weight of everything the Vietnamese soldier carries is therefore particularly important. Accordingly, an inspection of the clothing and equipment of the Royal Thai Army and the Army of the Republic of Vietnam was undertaken by Dr. S. J. Kennedy and Mr. E. C. Metzger of the Clothing and Organic Materials Division of the U.S. Army Natick Laboratories. A series of recommendations was made to the chief of the research and development center of each country.

While the specific recommendations are being considered by the Thai and by the Vietnamese governments, 12 samples of a load-carrying system based on materials that could be produced locally have been completed under the direction of Mr. Metzger in Bangkok. Ten of these pack systems were furnished to a Thai Ranger Battalion for evaluation; one was sent to the ARPA R&D Field Unit in Vietnam for illustration; and the remaining one was shipped to the Natick Laboratories. Figure 9 is a photograph of the pack system.

Plan and Schedule to Complete - After evaluation of the results of the anthropometric and human-factors studies, tasks will be formulated to implement the specific recommendations adopted by the Thai or by the Vietnamese governments. It is estimated that the tasks in both the above countries will be completed early in FY-65.

Task B - Remote Area Power Sources

Background

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 these reasons this task is concerned with the total problem of the 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 locally.

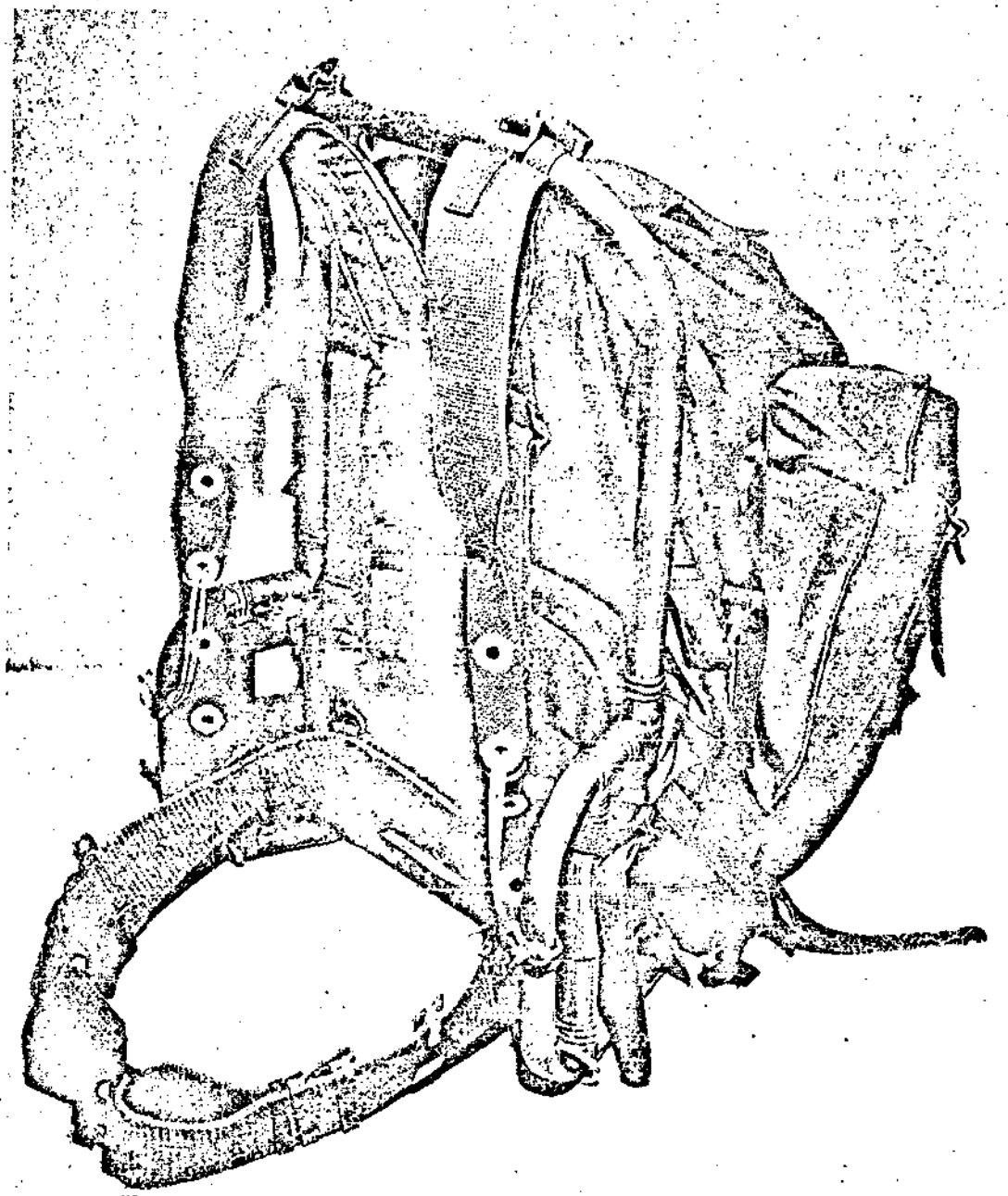

FIGURE 9. RANGER PACK

(1) Power-Sources Study

Objective - (1) To identify requirements for power and potential power sources for Southeast Asia; (2) to identify those power sources which have the optimum capability of satisfying the requirements of a ranger on a three- to five-day mission.

Progress to Date - A study of the power requirements for ranger operations and for strategic village defense, in Southeast Asia, has been completed. A report has been prepared and the following recommendations are made.

(1) For Man-Pack Radios

(a) The development of alkaline-manganese dioxide primary batteries for radio communication on missions of up to three days' duration.

(b) The development of silver-cadmium rechargeable batteries and fast battery chargers (one- to three-hour battery chargers).

(c) For missions of more than three days, the development of lightweight foot-pedal generators with silver-cadmium rechargeable batteries.

(d) The development of closed-cycle Rankine charcoal- and gasoline-fired steam engine and turbo-alternator generators if this substantially larger capital investment is considered advisable.

(2) For Trail-Type Vehicle Communication:

The development of charcoal- and gasoline-fired steam engines with adequate boiler capacity.

(3) For Village Defense Communication

Human-foot-pedal generators and animal-treadmill generators to recharge automobile-type lead-acid batteries. (The generators may be standard automobile generators modified to operate in the humid environment of Southeast Asia.)

Plan and Schedule to Complete - The final report is being printed. It should be available for distribution during the month of January, 1964. As distribution of this report will complete the power-sources study, this subtask will not be included in future AGILE reports. Development of specific hardware, if any, will be carried on under Subproject IV, Communications Systems.

(2) Thermoelectric Generator

Objective - To examine the applicability of thermoelectric generators to the power requirements of remote area conflict.

Progress to Date - Two thermoelectric units have been evaluated under field conditions in Southeast Asia. The results are reported under Subproject IV, Communications Systems.

Plan and Schedule to Complete - Future work on thermoelectric generators will be carried on under Subproject IV, Communications Systems.

(3) Hydroelectric Generators

Objective - To examine methods of producing power from shallow, slow-moving streams.

Progress to Date - A contract for the study of turbogenerators 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 2 knots was awarded during the month of April, 1963. This contract has been cancelled because of lack of performance on the part of the contractor.

Plan and Schedule to Complete - Inasmuch as the turbogenerators are intended to serve as a power source for communications equipment, any future work on hydroelectric generators will be reported as part of the Subproject IV, Communications Systems.

Task C - Lightweight Armor Materials and Protective Devices

Background

Since a characteristic of the type of warfare with which the AGILE program is primarily concerned is that it is a conflict of foot soldiers armed with light weapons, protection of the local forces of friendly governments against the effects of small arms fire and antipersonnel 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 presently available materials and methods to decrease the vulnerability of the forces of friendly governments to antipersonnel 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 a 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.

(1) Penetration Mechanics Phenomenology

Objective - To gain a quantitative understanding of the effects of molecular variables on the behavior of heterogeneous composite structures under ballistic loading conditions.

Progress to Date - Work on a contract for a one-year study of homogeneous and fiber-reinforced polymers as lightweight armor materials was initiated on January 17, 1963, by the Aeronutronic Division of Ford Motor Company. The results to date are as follows:

(1) Methods of fabrication have been developed which result in reproducible high-quality reinforced plastic composites of known properties in which variables such as cross-link density, molecular weight, and crystallinity may be investigated as they affect mechanical and ballistic behavior.

(2) Thermoplastic film - glass fabric composites have been developed which, at lower density and cost, possess higher ballistic limits and integrity after ballistic impact than their thermoset resin counterparts.

(3) Under certain conditions, a unique penetration defense known as "projectile turning" was observed in experiments with fiber-glass-roving epoxy-resin composites. In this defense, the projectile, after progressing to a certain depth into the target, changes direction to proceed parallel to the laminations of the composite before coming to rest at some distance from its original point of entry. The occurrence of this effect depends upon projectile geometry, angle of incidence, and orientation angle of the fiber reinforcement with respect to the plane of the projectile obliquity.

(4) Ballistic-limit and residual-velocity determinations on epoxy-resin fiber-glass-roving, polyester-resin glass-fabric composites, and unreinforced thermoplastic materials, using both .30-caliber AP M2 bullets and 6-mm chrome-steel spheres, have been conducted.

Plan and Schedule to Complete - A final report on the present contract will be issued during the month of February, 1964. The direction of future efforts will be determined after the final report is evaluated.

(2) Projectile-Energy Absorption

Objective - To determine the optimum techniques for absorbing the energy of a projectile.

Progress to Date - A literature survey has been made by Utah Research and Development Company. It became apparent to URDC that the basic mechanisms for the dissipation of the energy of the projectile upon impacting armor had not been considered in detail by previous investigators. Some of the means of dissipating energy which Utah Research and Development will study in more detail are phase changes, elastic storage, armor deformation, projectile deformation, frictional heating, chemical reaction, crack propagation, and increasing spall in the direction of projectile origin.

Plan and Schedule to Complete - The present contract expires on 8 May 1964. Further research in this area will be based on the results obtained from current studies.

(3) Materials Research

Objective - To evaluate improved armor materials developed by various Service and industry laboratories.

Progress to Date - No new materials were submitted for testing during the period 1 April to 31 December 1963.

Plan and Schedule to Complete - Test requirements on armor materials will be provided within other subtasks concerned. This subtask will not be included as a specific subtask in future AGILE reports.

Technical Area 3 - Rations

Background

In remote area conflicts where much of the military endeavors may consist of patrols, probes, scouting expeditions, or counterattacks, many operations are limited in range and duration simply by the amount of food the men can carry. This restriction in time and radius of action reduces the efficiency and effectiveness of the local forces by a significant amount.

This technical area has as its objective the development of individual and group tactical rations which are lightweight, of minimum bulk, nutritionally adequate, and suited to the taste of the user. In order to achieve these objectives, a program is necessary to examine the nutritional needs of the local 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 local 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 package, 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 local food substances are also carried on in CONUS to determine what modern techniques for food packaging are applicable to the solution of the problem.

Task A - Individual and Group Rations

Objective

To develop a lightweight, nutritionally adequate ration suited to the taste of local forces.

Progress to Date

Two types of rations have been developed. Type 1 provides about 3600 calories per day and weighs about 2-1/2 pounds. Two different menus are provided for breakfast, two for dinner, and two for supper. Each menu includes about 1/2 pound of precooked, dehydrated Vietnamese-type rice which may be rehydrated with hot or cold water. Shredded and compressed, precooked dehydrated fish, pork, or shrimp, precooked dehydrated cabbage or spinach, vacuum-packed roasted peanuts and sesame seeds, instant coffee or tea, granulated sugar, lemon powder, garlic powder, and salt are included in the appropriate meals.

Type 2 ration is intended only for use on special missions. It consists of single packets weighing less than 1/4 pound and providing approximately 500 calories.

Carbohydrates furnish 44 to 50 per cent of the caloric content of the packs, fats, 37 to 41 per cent, and protein, 13 to 17 per cent. This is about the highest caloric density known to be tolerated by the average soldier for a period of 10 days. Two or three packets are to be used daily, as the tactical situation and availability permit.

Ninety prototype packets, representing ten of each menu, have been shipped to CDTC-V; 45 of these will be reshipped to MRDC in Bangkok. These prototype packets will serve as preliminary field-test specimens.

Plan and Schedule to Complete

Three thousand meals will be prepared in accordance with the results of the preliminary tests; 1500 will be shipped to Vietnam and an equal number to Thailand. The meals will be tested during the next six months, and a final report will be written. The ration task in Vietnam and in Thailand is scheduled to be completed by 30 June 1964.

AGILE SUBPROJECT II

Tasks formerly carried under Subproject II have been included under Subproject I – Weapons, Individual Equipment, and Rations.

~~CONFIDENTIAL~~

AGILE SUBPROJECT III

REMOTE AREA MOBILITY AND LOGISTICS SYSTEMS

~~CONFIDENTIAL~~

AGILE SUBPROJECT III

REMOTE AREA MOBILITY AND LOGISTICS SYSTEMS

SUBPROJECT OBJECTIVE

To improve the air, ground, and water mobility capabilities of friendly local forces engaged in or threatened with conflict in remote areas. Included are land vehicles, aircraft, and watercraft to transport tactical units and to deliver supplies and equipment in support of military operations.

SUBPROJECT BACKGROUND

General Discussion

Remote area conflict typically requires military operations where the topography and climate preclude or minimize the use of conventional military mobility equipment. While 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, 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 a limited off-road capability in many parts of this area, especially during the rainy season. Conventional watercraft and aircraft also often lack satisfactory design and performance characteristics for the environment.

Similarly, remote area conflict situations impose particularly difficult constraints on aerial resupply and place a premium on air mobility. Again, topography, vegetation, and climate often render conventional techniques ineffective and wasteful. New techniques and devices for aerial resupply and for the improvement of air mobility appropriate to the region and type of operation and lack of facilities must therefore be developed.

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 effective off-road mobility was a major contributing factor to the defeat of the French forces in Indochina.

The interface between ground and water presents unique mobility problems. Devices optimized for waterborne performance which also incorporate a capability for mobility over land obstacles of various types are desired. Since military operations must be conducted in this boundary zone in certain areas, several approaches to the interface problem areas are also under investigation.

CONDUCT OF PROGRAMS

I - Mobility Environmental Research Studies (MERS)

A detailed study will be made of the environmental factors in Southeast Asia which constrain 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 in remote area conflict conditions. Necessary information includes data on soil properties, terrain geometry, effects of climate 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 further constrain vehicle design parameters.

II - Logistics

Data will be acquired on Thai mobility/logistics requirements and capabilities at various levels of conflict, ranging from small-scale counterinsurgency operations to open warfare involving the commitment of SEATO military units in force. Initially an analytical concept of the Thai mobility/logistics systems will be developed. The analytical techniques so developed will then be applied to other areas faced with defense problems. Various input studies are required before a comprehensive concept can be produced, such as a hypothesized counterinsurgency conflict analysis, a study of counterinsurgency organizational structures, and studies on existing logistic systems.

III - Air Mobility

The Services are actively engaged in research on aircraft for remote area operations; this project is monitoring those programs. At present this task is concentrated on problems of aerial delivery and pickup in remote areas. Several subtasks are in progress, the major of which concerns use of the flex-wing principle for aerial delivery.

IV - Surface Mobility

Work under this program is conducted under three subheadings:

Mobility Research and Testing (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 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 local armed forces concerned under the direction of MRDC, Bangkok, and in coordination with MAAG personnel.

Vehicle Test and Evaluation (VETE)

Selected materiel items and systems currently available from military or civilian sources will be tested to determine their immediate suitability for adoption by local armed forces engaged, or likely to be engaged, in conflict in remote areas. Tests will be conducted by and for the armed forces concerned, under the direction of MRDC, Bangkok, and CDTC, Saigon, based upon requirements developed by the U.S. and host-nation Commands, MRDC, CDTC, and the ARPA staff. The ARPA staff, MRDC, and CDTC will then review currently available equipment 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 site for test and evaluation.

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. Exotic, elaborate, or complex amphibious vehicles or surface craft are not supportable logistically and cannot be employed.

This task will develop boats, amphibious vehicles, and propulsion systems which will substantially increase military mobility in delta areas while retaining simplicity and ease of maintenance. This involves analysis of the performance, capabilities, and limitations of vehicles in use in Delta operations and is divided into two subtasks: small craft and amphibious vehicles.

SUBPROJECT III TECHNICAL AREAS, TASKS, AND SUBTASKS

Listed below are the major technical areas, and the tasks and subtasks in each area, with which this subproject is concerned. Succeeding pages contain the summaries of their objectives and status.

Technical Area 1. Mobility Environmental Research (MERS)

Task A. Classification Systems

Task B. Measurements

Task C. Field Tests

Task D. Data Collection and Environmental Analysis

Task E. Vehicle Design and Analysis

Technical Area 2. Logistics Analyses: Investigation, Development, and Evaluation of Techniques and Devices

Task A. Thai Logistics Facilities

Task B. Logistics Implications of Thai Weapons and Weapon Systems

Task C. Logistics Command and Control Problems

Task D. Transportation, Communications, and Supply Problems

Technical Area 3. Air Mobility: Investigation, Development, and Evaluation of Techniques and Devices

Task A. STOL Troop/Cargo Aircraft

Task B. Remote Area Airstrips

Task C. Improvement in Aerial Delivery Means

Technical Area 4. Surface Mobility: Investigation, Development, and Evaluation of Techniques and Devices

Task A. Development of Requirements for Land, Water, and Amphibious Items or Systems

Task B. Mobility Research and Testing (MORT)

Task C. Vehicle Test and Evaluation (VETE)

Task D. Delta Mobility

Technical Area 1 – Mobility Environmental Research (MERS)

Background

Basic data must be obtained 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.

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.

Task A – Classification Systems

Objective

Collection and collation of environmental data sufficiently descriptive of topography, hydrology, and vegetation to support theoretical analysis of surface transport mobility; classification of soils for mobility purposes; climatic techniques for defining state of the ground.

Progress to Date

The report of a short-term mobility team provided by the Army from in-house resources to make a six-month preliminary study of the environment of Thailand has been distributed. This study, "Environmental Factors Affecting Ground Mobility in Thailand", (U. S. Army Engineers Waterways Experiment Station Technical Report No. 5-625) has further delineated the problem areas to be studied during the long-range program.

A survey of literature currently available in the U. S. on the environment in Thailand is in progress. A bibliography was compiled of data available in the Washington, D. C., area.

Work is in progress on streamlining previously developed systems for classifying environmental factors for the determination of specific effects imposed on ground mobility operations.

Microrelief and vegetation surveys and soil testing and sampling were initiated on beaches in Franklin Country, Florida, by Florida State University.

Work plans on tasks to be conducted in-house and by contractors are under preparation.

Evaluation of existing environmental classification systems will continue.

Wilson, Nuttall, Raimond Engineers, Inc., have completed preparation of test data sheets and wheeled- and tracked-vehicle specifications. Analysis of existing data is continuing.

Plan and Schedule to Complete

The subtasks under this heading will be essentially complete before June, 1964, except for topography and soil classification (end FY-65).

Task B - Measurements

Objective

Improvement of photo-interpretation techniques for tropical environments; design and acquisition of instruments suitable for evaluation of cross-country vehicle performance under all conditions of terrain and weather; acquisition and modification of instrumentation vehicle and equipment, and a system of measuring and recording instruments; data manipulation and reduction in the field; and laboratory processing of soil samples as required by the general research program.

Progress to Date

Most of the equipment needed has been shipped to Thailand. Various component parts comprising the automatic load-dynamometer mechanism for vehicle drawbar-pull tests have been ordered, and design plans and specifications for the instrumentation vehicle have been prepared.

Texas Instruments, Inc., capability in noncontact sensing and interpretation of tropical terrain has been examined. It has a B-25 aircraft equipped with multiple sensors including balck-and-white photography, infrared and KA-band radar, which can be made available. A larger aircraft equipped in addition with P-band radar will be available in the near future.

Massachusetts Institute of Technology is investigating the influence of environment on the strength behavior of saturated clays.

Colorado State University has furnished instrumentation personnel to design, maintain, modify, and operate vehicle test equipment and to train Thailand engineers in the above.

Plan and Schedule to Complete

With the exception of noncontact sensing and interpretation of tropical terrain, all subtasks under this heading will be essentially completed during FY-64. The noncontact sensing task will extend into FY-66, as will data manipulation.

Task C – Field Tests

Objective

Development of vehicle performance relations, consisting of development of one-pass soil trafficability criteria and obstacle capability criteria; establishment of the properties of rice fields in the U.S. and Caribbean areas for comparison with those in Southeast Asia (to establish analogs); development of a mathematical model of ground mobility to include selection and description of test areas, design of mobility tests, test of mobility in landform types, verification of mobility predictions in terrain types of geographic regions, and development of an expression for ground mobility.

Progress to Date

Evaluation of existing first-pass immobilization laboratory data for various types of tires is in process, and a field-test program has been initiated in the Vicksburg area with three tracked and three wheeled vehicles to determine various data on a one-pass basis.

Wilson, Nuttal, Raimond Engineers, Inc., have tabulated data from most of the Waterways Experiment Station self-propelled traffic tests on forms for one-pass soil trafficability studies. Vehicle specifications are nearly complete, and preliminary analysis has been started.

Plan and Schedule to Complete

Most of the work in this area takes place during FY-65, concluding late in FY-66, since the major portion of these subtasks depends upon information and data derived from Tasks A, B, and D.

Task D – Data Collection and Environmental Analysis

Objective

Collection and exploitation of environmental data in Southeast Asia; classification of terrain types in Southeast Asia; analogs of Southeast Asia in the U.S. and vicinity to include tropical soils and terrain; airphotos of test areas and study areas in Southeast Asia, the U.S., and the Caribbean area as required by the general research program; and development of terrain intelligence portrayal techniques for mobility.

Progress to Date

Studies leading to the development of a method of identifying terrain types in Thailand and in Puerto Rico (to permit an analogy) from aerial photographs have been initiated. Identifiable patterns in photos of diverse terrain types are being described and delineated. Classification is in terms of two-dimensional geometry, degree of repetition, and tonal variance.

Collection of terrain data in the rice fields in the vicinity of Stuttgart and Kelso, Arkansas, and Crowley, Louisiana, to determine seasonal characteristics and the effects of cultural practices on ground mobility has been completed. Tabulation and analysis of data are in progress.

Equipment for approximately 25 soil moisture-strength study sites in Thailand has been shipped, and a plan of tests in the range of environment to be found in Thailand has been prepared.

A manual of instructions for collecting environmental data in Thailand for project MERS has been drafted, and coordination effected in the field on a vegetation data-collection program.

Plan and Schedule to Complete

Starting late in FY-64, this task will be essentially completed in FY-65, with some field data collection continuing to mid-FY-66.

Task E – Vehicle Design and Analysis

Objective

Integration of all pertinent environmental, as well as all mechanical and engineering factors as design parameters, to improve and formalize the procedures and methodologies used in the design of vehicles.

Use will be made of data made available through the environmental research programs, the testing programs, and the study of existing design procedures to formalize a series of general analytically derived statements defining parameters and the various vehicle-terrain relations.

Progress to Date

A contract with Wilson, Nuttall, Raimond, Engineers, Inc., for a state-of-the-art vehicle design study was executed in November. A search for new contractors is continuing.

Arrangements have been made for modifying available test vehicles and requisitioning additional test vehicles.

Plan and Schedule to Complete

Since this task depends primarily upon data derived from other tasks, most of the effort is scheduled for late FY 65 through FY 66.

Technical Area 2 – Logistics Analyses: Investigation, Development, and Evaluation of Techniques and Devices

Background

A broad study of mobility requirements for a spectrum of potential conflicts in Southeast Asia is desired.

Analyses are proposed to consider, in conjunction with the trafficability study being made separately under Project AGILE in Thailand, weapons and weapon systems, command, control, transportation, communication, and supply problems peculiar to Southeast Asia. This will supplement MERS by defining mobility requirements more precisely from the operational standpoint, and will permit determination of points of weakness in present systems so that techniques and/or equipment can be developed to remedy deficiencies.

Task A – Thai Logistics Facilities

Objective

To determine capacity and potential of Thailand logistic facilities.

Progress to Date

The report "POL Distribution System in Thailand" RACSEA-FS-5 has been staffed, and the field edition is in print.

The conclusions of the report are:

(1) About 90 per cent of the POL products distributed within Thailand enter the country through the oil company terminals in the Port of Bangkok.

(2) The major bottleneck which severely limits the amount of POL that can be brought in through the Port is the constricted means of egress from the Port area; one single-track rail line, one road, and the Chao Phraya River on which passage through the city is prohibited to vessels carrying aviation or motor gasoline.

(3) Some years hence, as the road and rail network develop, products of the 36,000 bbl/day TORC refinery (now being built on the east coast of the Gulf of Thailand) could be distributed without passing through the Bangkok bottleneck.

(4) Under the present distribution system, it is believed that sufficient POL to support counterinsurgency operations can be delivered as far as up-country distribution points. The crucial gap is between distribution points and small units in remote and inaccessible parts of the country. Delivery would have to be made in 55-gallon drums or some equivalent containers.

The mode of delivery, land or air, to counterinsurgency forces in remote areas requires analysis. Major reliance on air may be necessary.

(5) This paper is part of a study based on counterinsurgency operations, but the data on the POL distribution in Thailand can be used to compare present capacities with the requirements of larger and more complex force structures.

Plan and Schedule to Complete

Additional studies are to be initiated as personnel become available. A formal plan will be submitted in the near future.

Task B – Logistics Implications of Thai Weapons and Weapon Systems

Objective

To determine the logistic implications of Thailand weapons and weapon systems considering organization for combat, operational plans, training methods and status, and types of warfare anticipated.

Progress to Date

Work continues with the MRDC weapon study teams in Thailand.

Plan and Schedule to Complete

Planning depends upon production of a counterinsurgency conflict concept, and is not complete.

Task C – Logistics Command and Control Problems

Objective

To study logistics command and control problems peculiar to Southeast Asia.

Progress to Date

RAC SEA-FS-1 "Counterinsurgency Organizational Structure in Thailand" has been put in final form for printing.

Plan and Schedule to Complete

Additional studies are to be initiated as personnel become available. A formal plan will be submitted in the near future.

Task D - Transportation, Communications, and Supply Problems

Objective

To study transportation, communications, and supply problems peculiar to Southeast Asia.

Progress to Date

A revised statement of the proposed terms of reference for a transportation study in Vietnam has been prepared, and a report has been published on work done in Thailand to develop a new route capacity formula for Southeast Asia. The report includes a review of present road capacity methods, a description of the field-test results, details of the new method, and road capacity tables calculated with the new method. Figures 10 through 18 point up the transportation problems peculiar to Southeast Asia.

Plan and Schedule to Complete

Additional studies are to be initiated as personnel become available. A formal plan will be submitted in the near future.

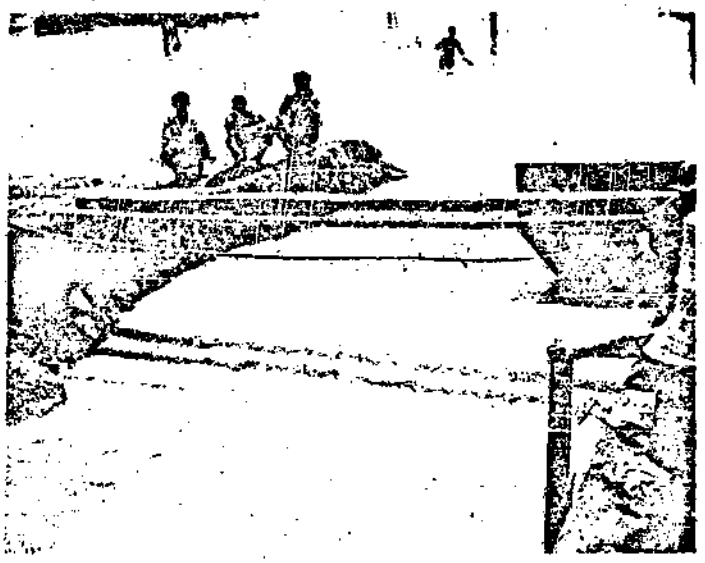

FIGURE 10. WASHOUT AT CONCRETE BRIDGE NORTHEAST OF KORAT

FIGURE 11. ERECTING WOODEN BARRIERS AT WASHOUT

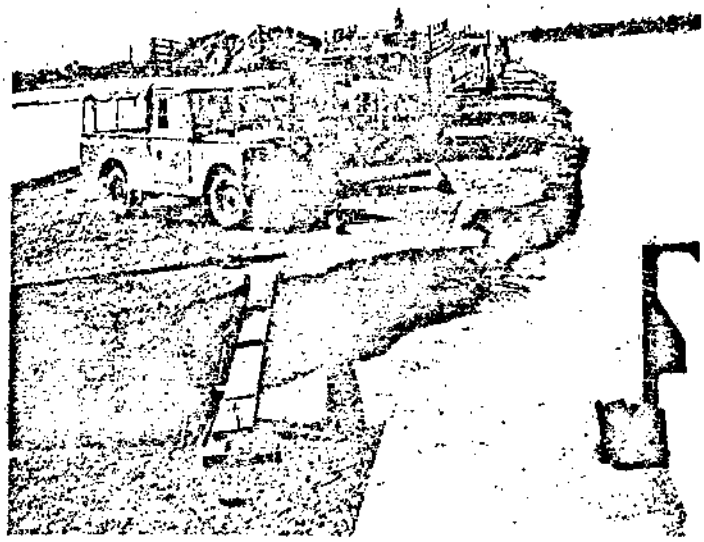

FIGURE 12. COMPLETED WOODEN BARRIER IN PLACE AND BACKED-UP TRUCKS AT WASHOUT

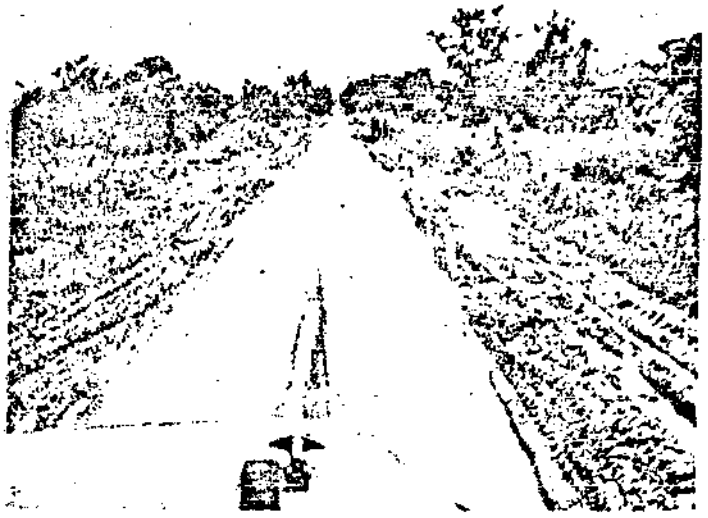

FIGURE 13. VIEW NORTHEAST OF KHOK SAMRONG SHOWING MUD AT ROADSIDE

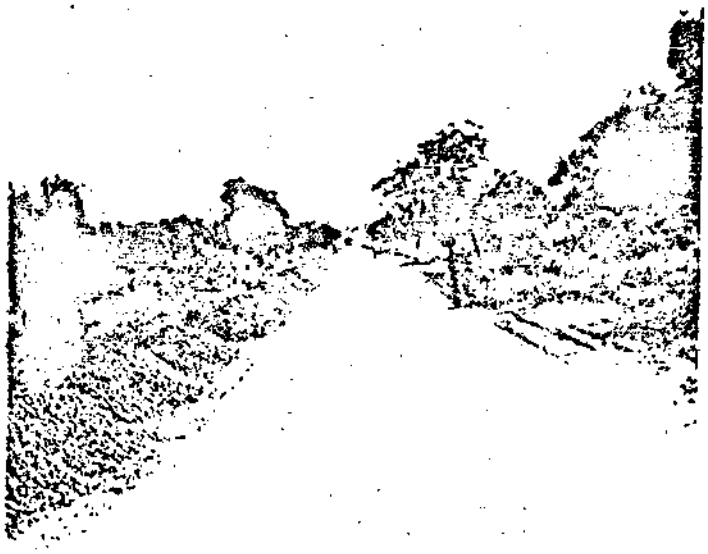

FIGURE 14. VIEW NORTH OF KHOK SAMRONG SHOWING PILES OF LATERITE AT ROADSIDE

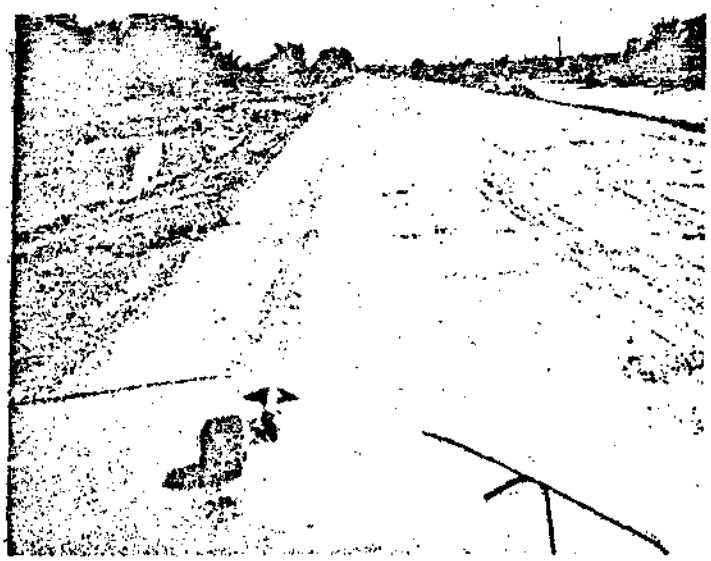

FIGURE 15. SPEED-REDUCING WET-SEASON ROAD DETERIORATION

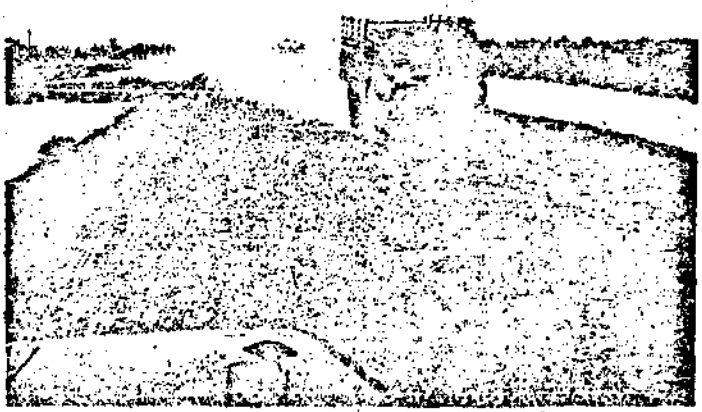

FIGURE 16. VIEW SHOWING LATERITE DUST HELD TO MODERATE INTENSITY BY SEASONAL MOISTURE

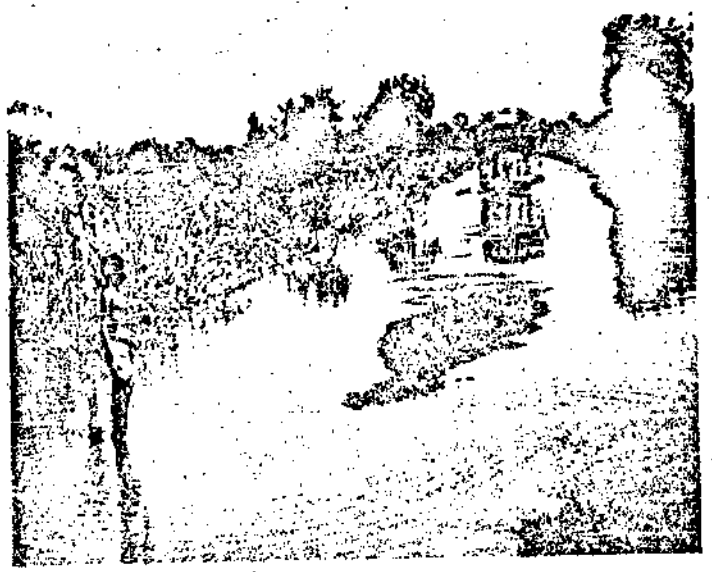

FIGURE 17. VIEW OF FLOODED BUT PASSABLE ROAD SOUTH OF LAMNARAI

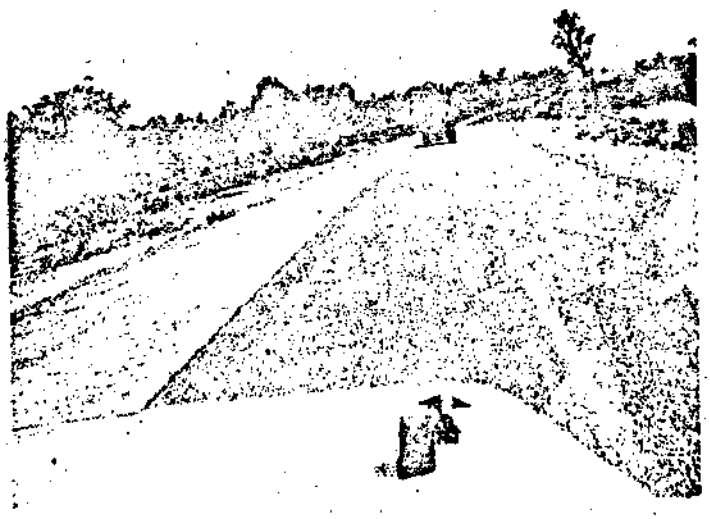

FIGURE 18. NEW PAVED HIGHWAY NORTHEAST OF KORAT

Technical Area 3 – Air Mobility: Investigation, Development, and Evaluation of Techniques and Devices

Background

The three tasks in this area stem from a general requirement for improved means of transporting people and equipment.

Tasks are undertaken to assess the usefulness of current equipment and to investigate, and where indicated, develop, and evaluate new devices and techniques.

Task A – STOL, Troop/Cargo Aircraft

Objective

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

Progress to Date

A Y-model DeHavilland Caribou, gross weight 26,000 pounds, loaned to ARPA by the Army, has been tested in Southeast Asia under many diverse conditions of loading, weather, and landing surface.

These tests included reversible thrust propellers, which were found to reduce landing roll, particularly on wet, muddy surfaces, by as much as 50 to 60 per cent.

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 airflow over a portion of the wing flaps and control surfaces, while drawing air over other portions to reduce the boundary-layer thickness.

Fabrication and bench test of a full-scale model of the jet-pump boundary-layer control system is proceeding; however, technical difficulties have been encountered in three areas:

(1) Reliable ignition

(2) Sustained uniform burning

(3) Acceptable temperature range.

The ignition problem was resolved during November, and work is progressing toward a solution for the other two problems. Sustained burning and repeated instantaneous light-offs have been obtained with a new fuel-air injector. However, the fuel-air

mixture is richer than theoretically required for sustained uniform burning; hence the temperature problem is aggravated.

The temperature problem has been attacked by use of zirconium oxide coatings, and a new motor design using zirconium inserts, which may be replaced if necessary by other high-temperature material such as tungsten. If the heat problem cannot be met practically in this manner, an alternative design will be used, consisting of a manifold around the motor bore to cool the motor wall. It will also, through preheating entering air about 200°F, permit a lower combustible fuel-air ratio of the mixture, thereby reducing flame temperature in the combustion chamber by about 400°F. This design, however, would be more complex.

Design and fabrication of the test duct is complete, and further progress awaits development of the motor.

Plan and Schedule to Complete

Tests of the Caribou are essentially complete, and 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, and so will continue in service in Southeast Asia, where it supports tasks of the MRDC in Thailand and the CDTC in Vietnam.

Since the jet-pump boundary-layer control system is a high-risk, high-pay-off approach, the program is phased to provide decision points before each major element.

Technical problems mentioned above have resulted in schedule slippage, now estimated as about 2 months for Phase I, so that a completion date of 15 March 1964 for Phase I is now estimated.

As soon as the technical difficulties have been overcome, a firm schedule will be prepared.

Task B – Remote Area Airstrips

Objective

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

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.

A subsidiary task involves verification of the existence, condition, and potential of land-plane and seaplane facilities in Thailand.

Progress to Date

An air-transportable landing mat suitable for use on soils of low density and bearing strength has been designed for ARPA.

Preliminary designs have been built in sample quantities, and dynamic tests have been made. Joint design has gone through at least three sets of changes. It is now felt that the rigidity of the airstrip is limited by the strength of the aluminum mat itself.

The list of 297 Thailand airfields reported by MRDC in September, 1963, has been reduced to 288. Additional strips reported could not be located by recent aerial surveys.

The MRDC list classifies airfield runways according to length, usability status, surface, and aircraft type or weight-bearing capacity. Approximately 38 per cent are unknown with regard to length; 55 per cent are between 400 and 4,999 feet, and the remaining 7 per cent are between 5,000 and 9,800 feet.

Usability status is given for 75 per cent of the runways. The surface is given for 53 per cent, and the aircraft type and/or weight bearing capacity is given for 51 per cent of the runways. The aircraft type or weight-bearing capacity is based upon known construction factors and aircraft with single, dual, and dual tandem landing gears that have been known or reported to have used these runways. (See Figures 19 through 22 for aerial views of runways.)

Plan and Schedule to Complete

Prototype fabrication of a landing mat will begin as soon as a contract can be consummated. Tests will be conducted both in CONUS and in Vietnam during FY 65. The program will be completed by January 1965.

The survey of Thai airfields should be completed by the end of FY 64.

Task C – Improvement in Aerial Delivery Means

Objective

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"; and to develop and evaluate an improved disposable parachute for aerial

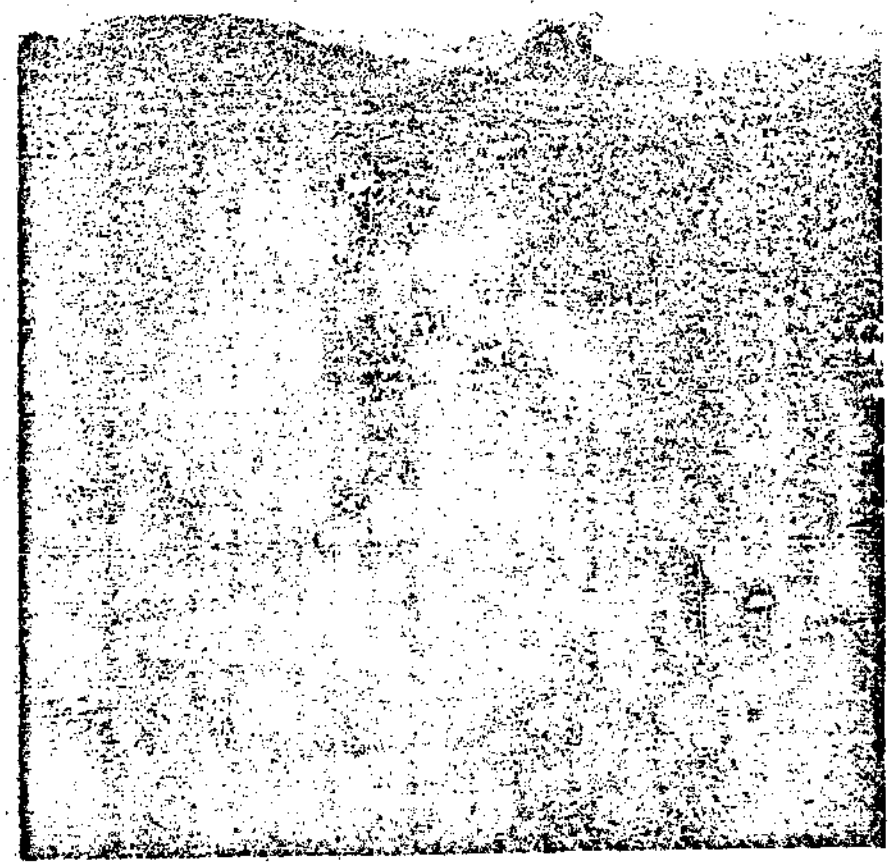

FIGURE 19. DONG, AN OVERGROWN AND ABANDONED AIRSTRIP

FIGURE 20. CHIANG RAI IN NORTHERN THAILAND

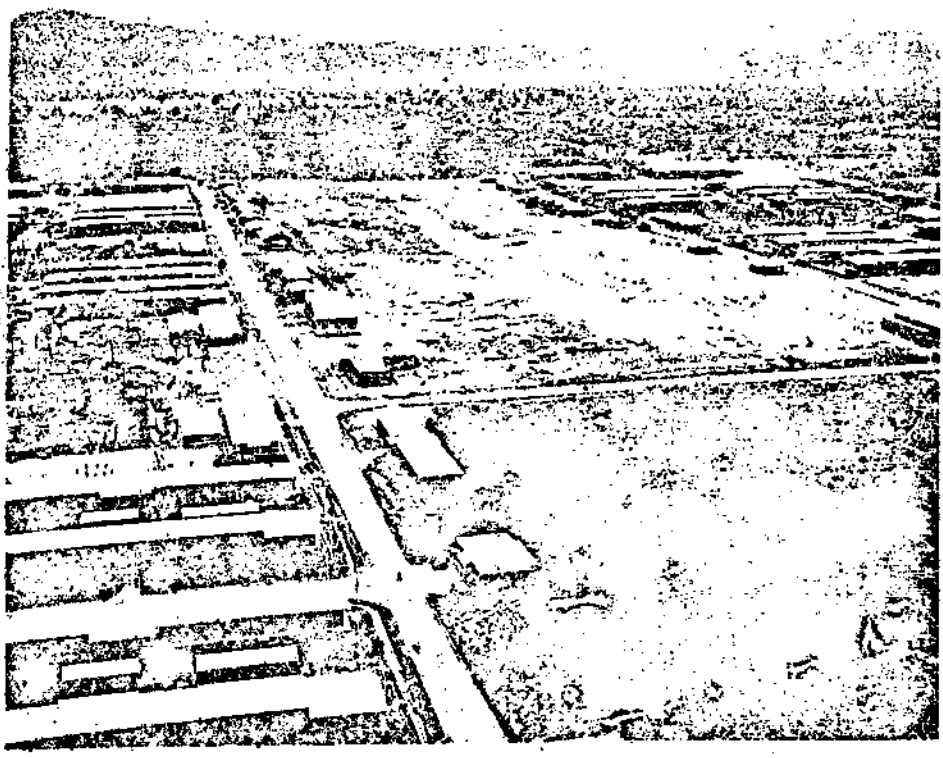

FIGURE 21. PRANBURI, SOUTHWEST OF BANGKOK NEAR THE BURMA BORDER

FIGURE 22. CHIANG KHONG NEAR THE LAO BORDER IN NORTHERN THAILAND

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 parachutes as are under Service development.

Development models of a Precision Drop Glider and a towed Air Cargo 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 Flexible Wing Aerial Utility Vehicle or the Flying Jeep will be flight tested and evaluated as a logistical carrier.

Tests will be conducted of parachutes and equipment already developed to determine utility for remote area situations. New equipment will be developed if the need for such a program is established.

Progress to Date

Tests to date have demonstrated the feasibility of the flexible wing as a device for precise delivery of cargo and for offset delivery where terrain, enemy action, or the desire to avoid disclosure of the drop zone by orbiting aircraft so dictates, and have indicated the feasibility of using these devices to provide a larger cargo-transport capability for various helicopters, including light observation helicopters, and to provide a flying truck in the 1000-pound-cargo class.

The Thailand phase of the 300-pound payload Precision Drop Glider test program was successfully concluded in July, 1963. No problems were involved in training Thailand crews to assemble, check, and operate the equipment. A simplified system of controlling the glider was developed during radio-controlled tests which calls for less skill on the part of the operator and reduces controller training time.

Maintenance of the equipment, particularly bonded areas, became quite difficult as the rainy season arrived. Bonding cement required refrigerated storage, and did not set properly. A detailed report on this phase of the test program is contained in the Combat Development and Test Center (now Military Research and Development Center), Thailand Quarterly Report, July - September 1963. TRECOM has been conducting a series of drops at Camp Pickett and Fort Eustis, further extending the performance envelope delineated by the contractor. A successful drop has been made from 500 feet (see Figure 23), and one was made from 2500 feet in a 40-knot wind, far in excess of that at which parachutes are used, with delivery to a point 100 yards from the target. During this drop, using manual radio control, the glider was demonstrated as able to hold into the wind, using a series of right and left turns, and full 360-degree turns were made both clockwise and counter-clockwise. Further instrumented tests are to be made to determine the distribution of opening shock loads on risers, and to develop better means of stowing lines not used during the parachute mode.

FIGURE 23. PRECISION DROP GLIDER IN "PARACHUTE" CONFIGURATION DURING LOW-ALTITUDE (500-FOOT) DROP TEST

The 1000-pound-payload Air Cargo Glider has been successfully airlifted, towed, and landed by a CH 34 helicopter, and also has been successfully radio-controlled to landing after being cut loose from the tow plane. Maximum- and minimum-gross-weight flights have been made, tow and free flight. Instrumented flights and flights with varied tow-cable lengths have also been made as well as tests of modified configurations. The final report is now at TRECOM for review. The next phase of testing will concentrate on expanding the utility envelope and operational capabilities of the system.

The "flying Jeep" or "Fleep" as it is often called, which is really a basic airplane using the flexible wing for lift, is envisioned as a flying truck. It weighs 1000 pounds and will carry a 1000-pound payload at speeds of about 75 mph, taking off from and landing on minimal forward-area air strips. Some flight tests have been performed, and numerous taxi runs and lift-offs to check the effects of various modifications to the horizontal tail, addition of a trim tab, and addition of a spanwise batten at each outboard end of the wing trailing edge. Twelve and one-quarter hours of taxi and flight time was accumulated, and for 40 minutes of this time the vehicle was airborne, the longest flight being for 8 minutes.

Tests indicated that a more desirable body angle during take-off could be obtained by moving the wing forward about 12 inches with respect to the body. This change has been made.

Redesigned steel aileron hinges, auxiliary elevators, and wing battens have been installed on both vehicles.

Plan and Schedule to Complete

The final Precision Drop Glider test report is being distributed by the U. S. Army Transportation Research Command as TRECOM Technical Report 63-64.

The Precision Drop Glider is also to be used as the vehicle for development by the Contractor, Ryan Aeronautical Co., of a reliable automatic homing system for flex-wing vehicles, and a contract has recently been let to this effect. The objectives of the program will be to establish existing and required parameters for glider control and electronic link automatic-homing compatibility, and to develop a system which will permit homing upon the signals generated by field radios of the PRC 10 type. A weekly drop will continue to be made by TRECOM personnel as they proceed with an in-house program. This phase of development will last about six months.

Plans are under consideration to scale up the Air Cargo Glider to 3500- and 5000-pound-payload configurations, so that it may serve to increase the payload capability of such helicopters as the H 23 and UH 1. For example, present data indicate that with this device the H 23 should be able to air-deliver a fully loaded mechanical Mule, and the UH 1, with a 5 per cent reduction in range and about 15 per cent reduction in speed, can deliver 5200 pounds of cargo versus 1000 pounds without the glider.

The draft of the final report on the Fleep was submitted to TRECOM for staffing on 5 November. A flight-test program had been approved and funded by ARPA in May, 1963, but extended contract negotiations between the manufacturer and TRECOM, as ARPA's agent, delayed contract signing. Additional funds required to cover the maximum possible fee of an incentive-type contract were provided by ARPA in December, 1963.

Technical Area 4 – Surface Mobility: Investigation, Development, and Evaluation of Techniques and Devices

Background

Various preliminary or input studies are required before a comprehensive set of requirements for surface transport can be determined. These studies are to be undertaken principally by RAC and RAND.

Concurrently with these studies, a program of controlled testing of selected items of ground 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; and a program consisting of tests of selected items by and for local forces in their own environment will be undertaken to determine the suitability of the items to satisfy immediately a pressing military requirement.

In a large portion of Southeast Asia, such as the Mekong Delta Area (Figure 24), the road network is meager, but there is an intricate complex of rivers, canals, and creeks. Shallow-draft craft which can navigate the majority of these waterways at high speeds can make a significant contribution to mobility there. Special hull designs and propulsion systems may be necessary to traverse shallow, vegetation-choked waters.

A vast number of sailing junks and motor-driven vessels comprise the fishing fleet and coastal traders of Southeast Asia. These vessels often are used by insurgent forces to carry contraband and infiltrators. Patrol craft must have a significant speed advantage over the commercial fleet, yet be economical to operate, be capable of long endurance on station, and yet be easy to maintain and fabricate locally.

The nature of the terrain throughout Southeast Asia during the rainy season, and perennially in large areas such as the Mekong Delta, indicates a requirement for amphibious vehicles of various types.

Task A – Development of Requirements for Land, Water, and Amphibious Items or Systems

Objective

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 systems of material to perform a specific military function.

Progress to Date

This task is closely associated with the logistics analyses of Technical Area 2. At present a study of Royal Thai Army vehicle requirements is in process.

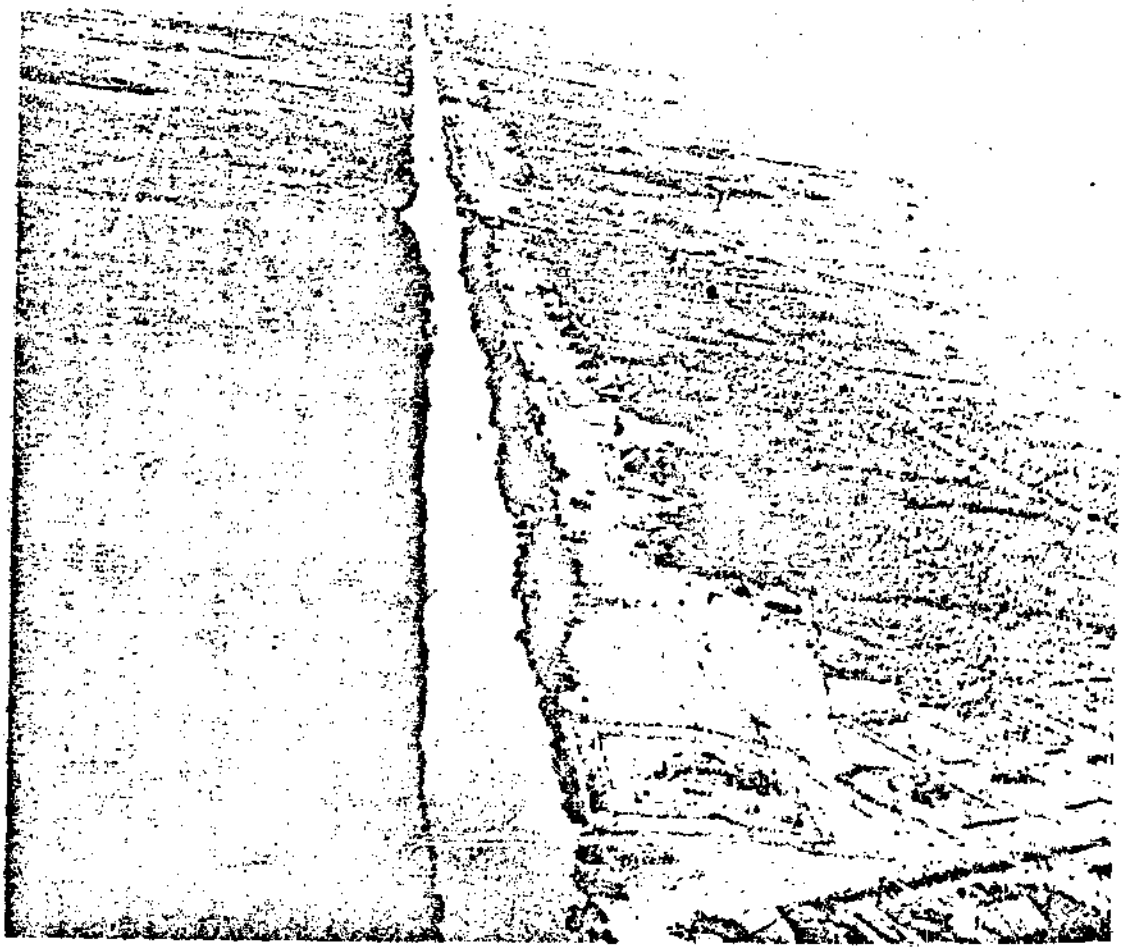

FIGURE 24. VIEW OF MEKONG DELTA AREA

Plan and Schedule to Complete

Planning is not complete.

Task B – Mobility Research and Testing (MORT)

Objective

To conduct a program of controlled testing of selected items of equipment 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.

Progress to Date

Several tests have been completed, others are in process as noted below, and test plans are being completed for testing most of the rest of the vehicles programmed for this task. Several standard vehicles, for which adequate stateside test data exist are programmed for control and comparative purposes, and as test vehicles for Project MERS, which is closely coordinated with MORT.

Vehicles currently programmed for this task are:

Thiokol Tracknaster – tests completed
Nodwell 110 D 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 – tests to start third quarter, FY-64
Thiokol Spryte
XM571 Articulated Tracked Cargo Vehicle
M116 Cargo/Personnel Carrier Vehicle
JERED ASP Platform Vehicle (see Figure 25)
JERED Viper Platform Vehicle – development suspended
Centipede Vehicle – tests suspended
Tote Gote Scooter with and without trailers – tests under way
JIGER – tests under way
Vickers Hovertruck – undergoing tests by TRECOM at Fort Eustis

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

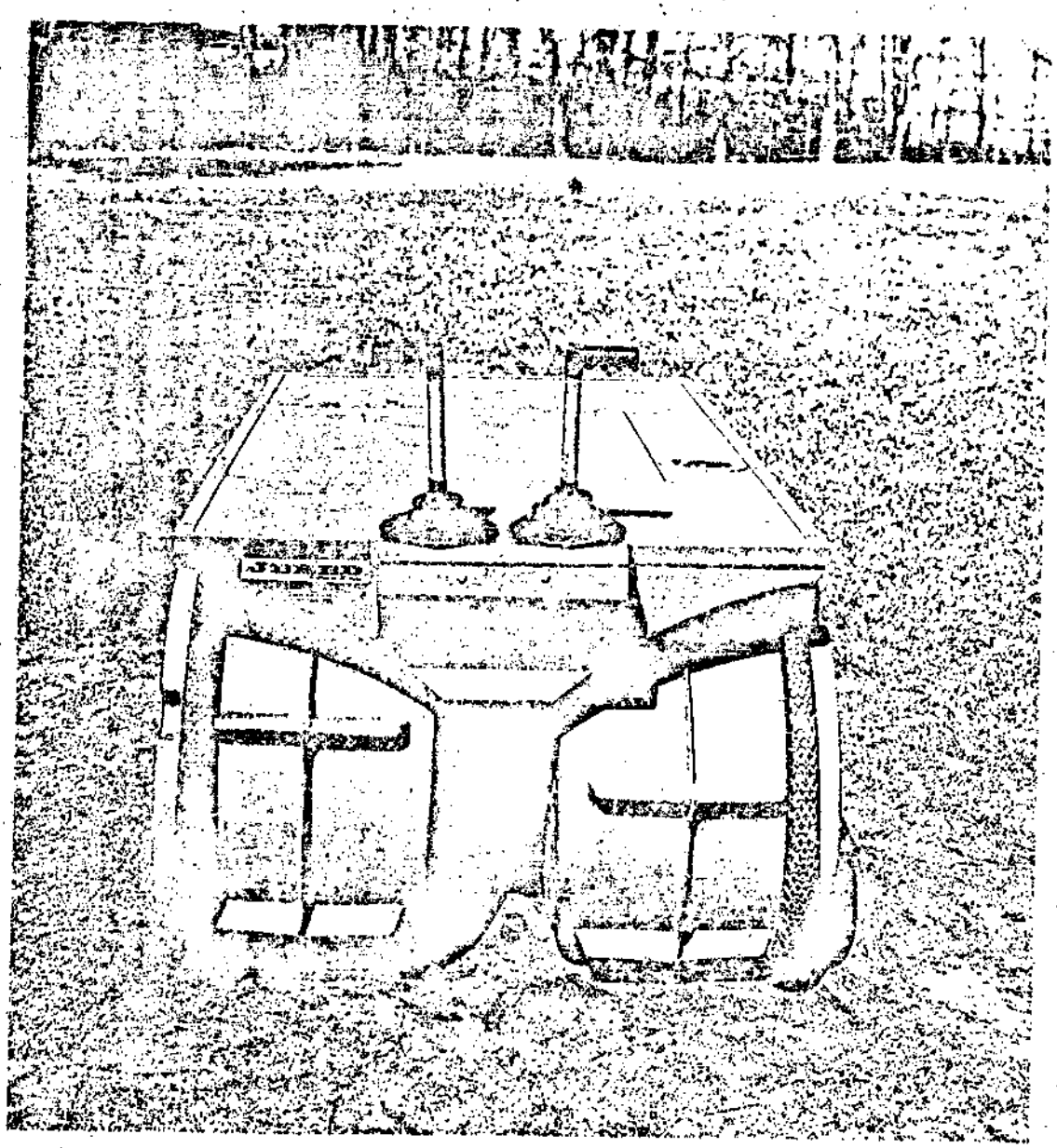

FIGURE 25. AMPHIBIOUS SUPPLY PLATFORM (ASP) VEHICLE

the MERS Program to insure that the empirical analysis resulting therefrom is demonstrably sound. Thus this portion of the over-all mobility subproject is not intended to be an evaluation of each vehicle, per se.

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 incorporated in a new design being prepared by an engineering organization in Detroit.

A new group of Thai engineers has been trained to work on vehicle test programs.

The Thiokol Trackmaster 4T2, now designated Model 105, proved quite susceptible to damage. In particular, road wheels were easily damaged by tree trunks and concealed stumps. Track grousers were repeatedly damaged but did not immobilize the vehicle. A complete report is in preparation with distribution expected shortly after the first of the year. Following completion of tests, the vehicle was overhauled and shipped to Pakchong, Korat Province, Thailand, for use in support of SEA CORE operations. A log of operational use has been kept for use in preparing a supplementary report. (See Figures 26 through 29 for the condition of the trail this vehicle operated over.) The trail became so severely rutted as to be passable only with extreme difficulty and at considerable risk of damage to the vehicle. The vehicle is now used only for reconnaissance of unrutted trails in the area.

Tote Gote tests have been completed and the report is in preparation. Driver skill was determined to be an important operational factor with these vehicles. (See Figures 30 through 32.)

Linear-traverse evaluations indicated that a small unit equipped with Tote Gotes can traverse extremely difficult terrain at an average speed of 3 kph, with 50-pound payloads, for an extended period of time. This compares with an estimate that Thailand soldiers, with combat pack only, can climb such trails at approximately 1.5 kph.

Tests on the Canadian JIGER started late in the reporting period, having been delayed about four weeks to incorporate several ATAC-recommended changes. (See Figures 33 and 34.)

Plan and Schedule to Complete

Most of the vehicles scheduled for testing under this task will be shipped during the next 6 to 8 months. It is anticipated that this task, except for tests in support of MERS, will be completed by mid-FY-65.

FIGURE 26. TRAIL TO THE SEA CORE TRANSMITTER SITE PRIOR TO HEAVY USE

FIGURE 27. TRAIL SHOWN IN FIGURE 26 AFTER HEAVY DAILY TRAFFIC DURING RAINY SEASON

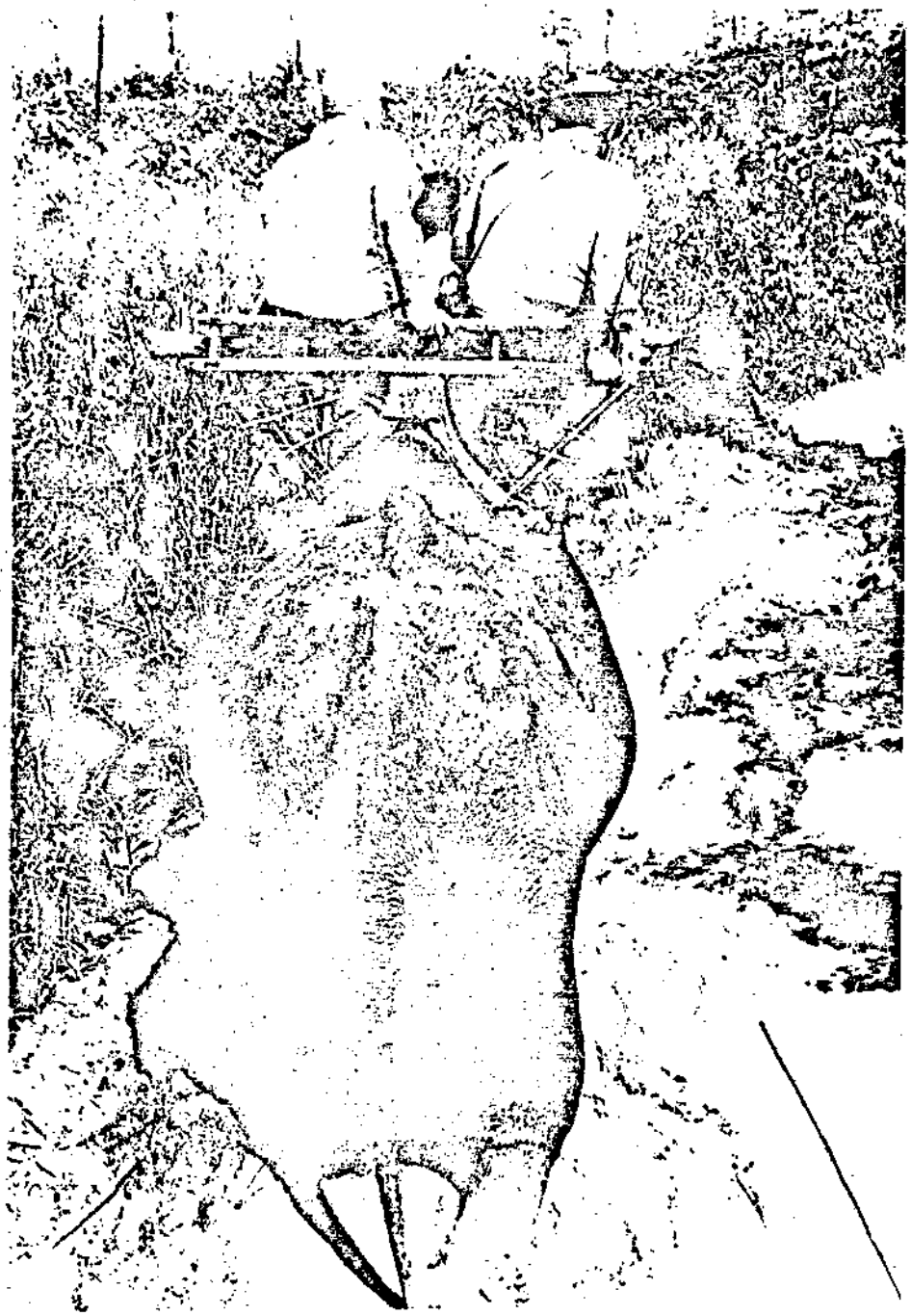

FIGURE 28. THE ONLY RELIABLE MEANS FOR ALL-WEATHER, CROSS-COUNTRY MOBILITY IN THAILAND

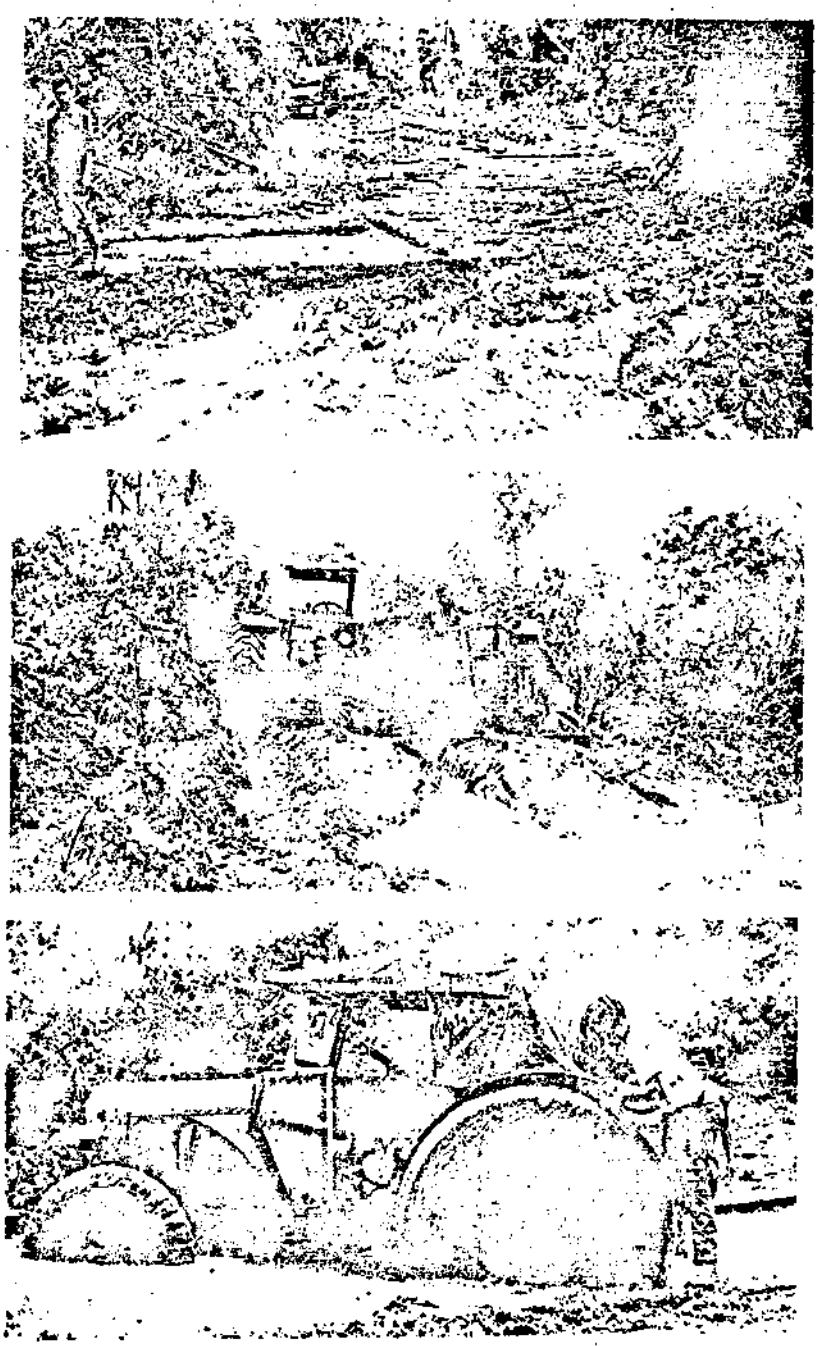

FIGURE 29. SCENES ALONG THE TRAIL TO THE SEA CORE TRANSMITTER SITE

No vehicle makes the passage without use of a winch, including the Australian tractor shown.

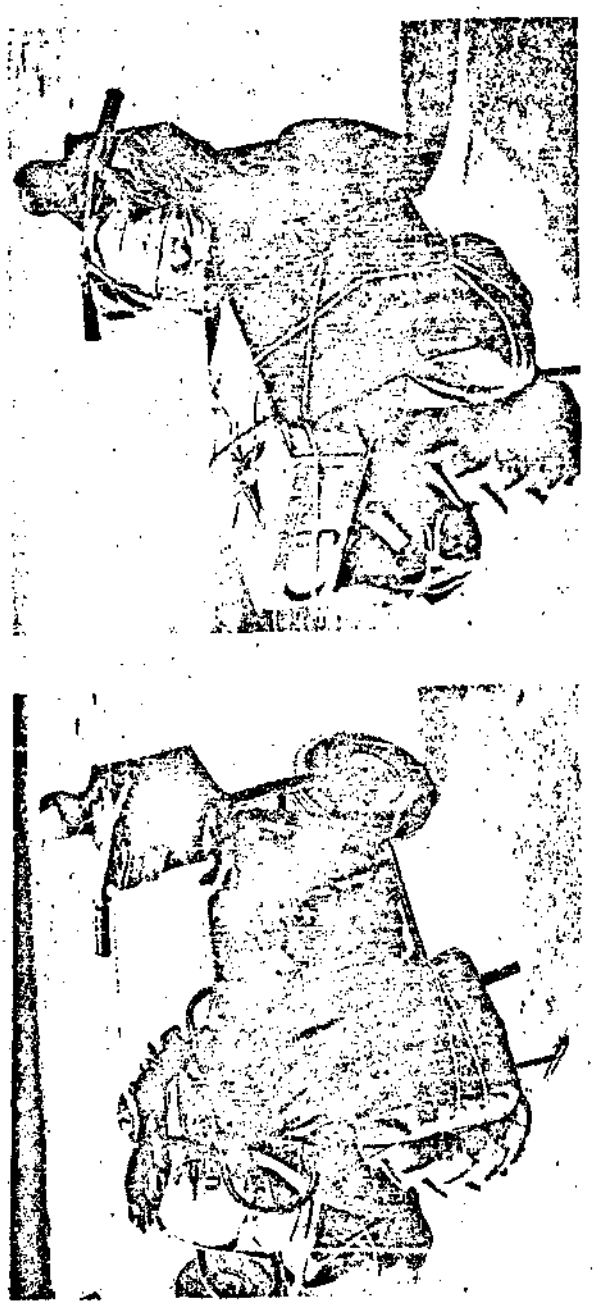

FIGURE 30. TYPICAL LOADS TRANSPORTED BY TOTE GOTES DURING TRAVERSE OF A 54-KILOMETER TRAIL

Loads on the six machines varied from 30 to 163 pounds.

FIGURE 31. TOTE GOTE IMMOBILIZED WHILE ATTEMPTING TO FORD A SMALL STREAM

FIGURE 32. TRAIL WIDTHS AS NARROW AS 1 METER OR LESS ARE FREQUENTLY ENCOUNTERED

FIGURE 33. JIGER EXITING FROM FLOODED PADDIES, BANG PU, 19 NOVEMBER 1963

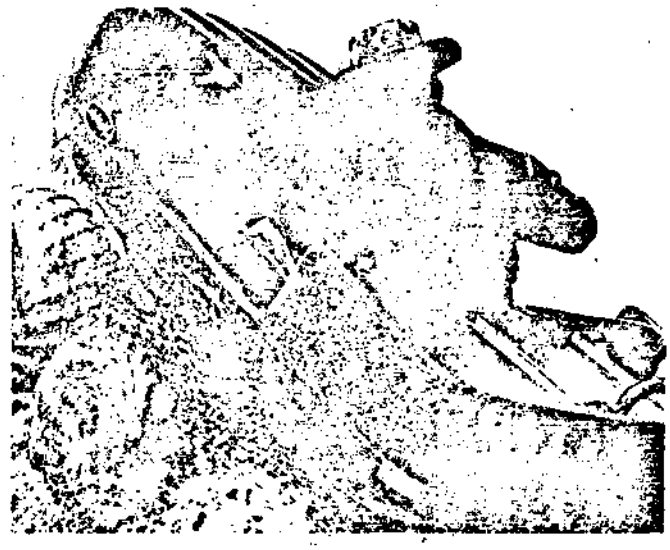

FIGURE 34. JIGER EXITING FROM WATER OVER DIRT MOUND, BANG PU, 19 NOVEMBER 1963

Task C – Vehicle Test and Evaluation (VETE)

Objective

To test selected items or systems of materiel, currently available from military or civilian sources, to determine their suitability for adoption by local armed forces to satisfy immediately pressing military requirement.

Progress to Date

To meet a requirement for an armored convoy-escort vehicle to replace, in Vietnam, the aging M-8 armored cars used for that purpose, ARPA underwrote development of an armored car by the Cadillac Gage Division of Ex-Cell-O Corp. (See Figure 35.) Two of these vehicles are now enroute to Vietnam. One of the two cars was tested by the Army's Test and Evaluation Command at Aberdeen, and the ATAC-designed turret with which they are equipped was given acceptance tests at Erie Depot. Minor modifications found desirable as a result of these tests have been incorporated into the two vehicles.

Plan and Schedule to Complete

Upon receipt in Vietnam, the two Cadillac Gage "Commando" Armored Cars will be incorporated into a convoy-escort unit for training and extensive testing under combat conditions. The testing period will cover about six months; however, its actual duration is dependent upon the whims of the Viet Cong to a considerable extent.

Task D – Delta Mobility

Objective

Multiple objectives of this task are:

(1) To perform research leading to the development of a family of light-weight, high-speed, shallow-draft boats which substantially increase military mobility in the Delta region of South Vietnam

(2) To determine the applicability of unusual propulsion systems to problems of mobility in shallow, vegetation-choked streams and swamps

(3) To investigate the feasibility of developing high-speed sailing craft for patrol operations in coastal and broad inland waterways, such craft having reduced fuel and maintenance requirements and an attendant improvement in operational capability

(4) To improve military mobility in the Mekong Delta area by means of suitable amphibious vehicles and to study operations in that area for the purpose of determining military concepts and requirements.

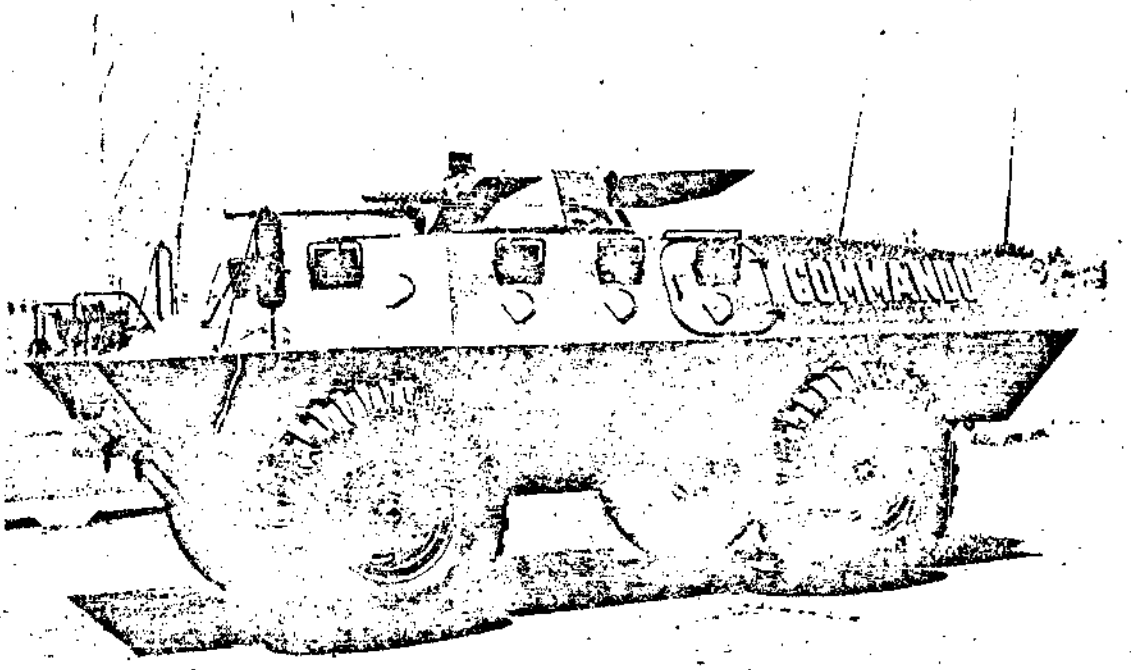

FIGURE 35. CADILLAC GAGE COMMANDO ARMORED CAR

CDTC-Vietnam is to test two of these as convoy-escort vehicles.

Progress to Date

A modified swimmer support boat weighing about 350 pounds and constructed of bonded Styrofoam planks covered with fiber glass 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, locally named "Dong Nai", are 14 feet 1 inch long by 6 feet 10 inches wide. (See Figure 36.) Powered by a 40-hp commercial outboard, they make about 20 knots carrying eight or nine Vietnamese Marines. As a subsidiary to this program, silent power sources are also being investigated.

Tests of one Dong Nai boat with plywood-reinforced bottom indicate a considerable increase in durability can be expected. (See Figure 37.)

Tests of the swimmer support boats in Thailand have led to the conclusion that finer-lined hulls powered by long-shaft outboards would be necessary for practical operation in that country. A 6-1/2-meter-long craft has been built to meet military requirements for a light-weight, high-speed, shallow-draft boat. With a 45-hp outboard motor it is expected to carry eight armed men at 40 kilometers per hour. (See Figures 38, 39, and 40.)

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

Several unusual types of propulsion systems have been examined to date, but at present only two are of continuing interest: a sine-disc propulsion system under investigation by the Army at TRECOM, and an unusual air-propelled boat, privately developed, which will be undergoing trials early in 1964.

The sail-driven catamaran appears to be a proved design principle for a high-speed patrol craft requiring reduced fuel and maintenance, in that it should have 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 weapon platform, and can be locally constructed.

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

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

Typical of such modifications successfully applied is a capstan device for the M-113 Armored Personnel Carrier, which permits a vehicle to haul itself out of a canal or stream with banks too steep for normal egress. An augur-type of ground anchor is used where conventional anchoring devices are lacking, and an adaptor bolted to the drive sprocket of the vehicle accommodates a removable capstan used to effect self-recovery. (See Figures 41, 42, and 43.)

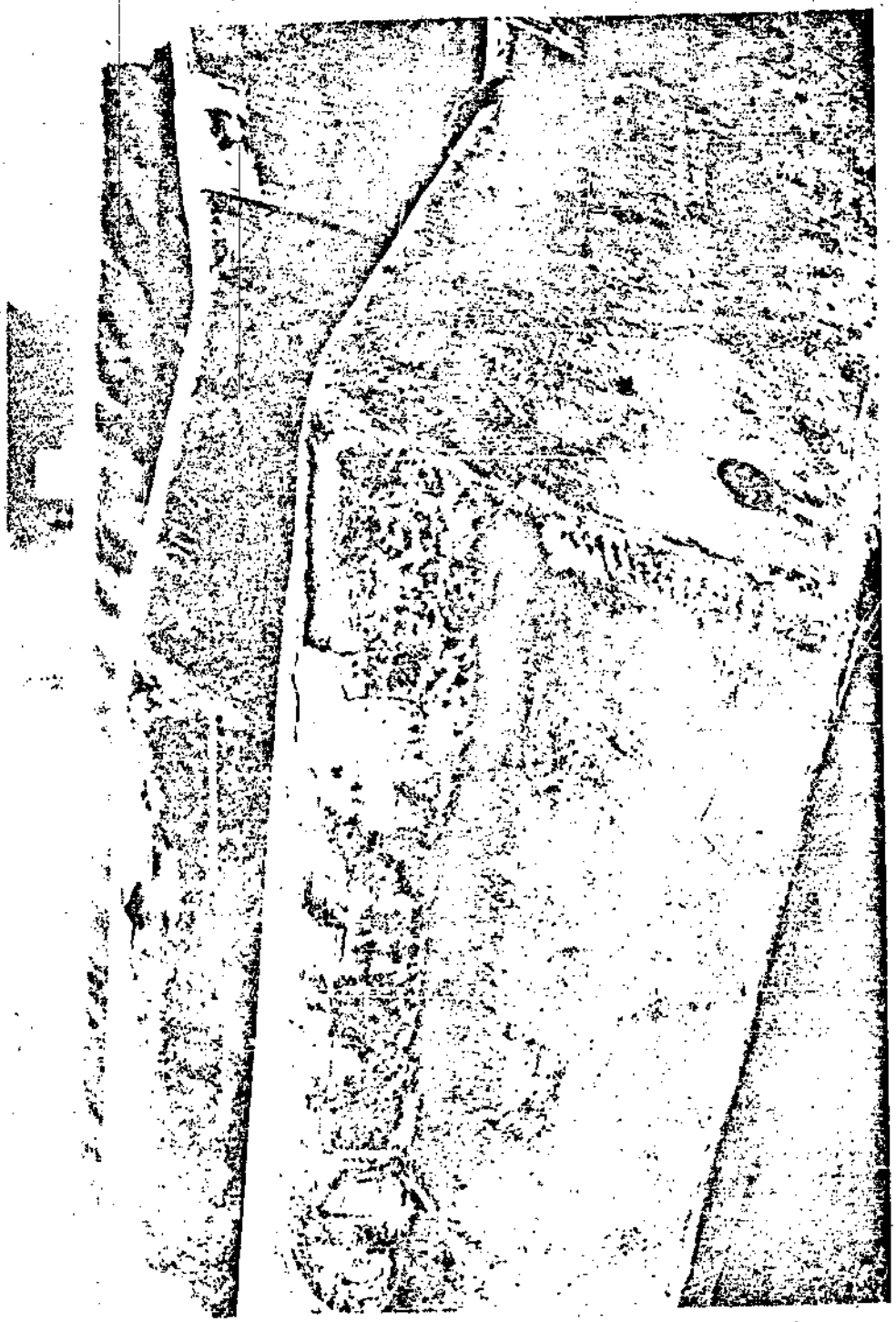

FIGURE 36. IMPACT DAMAGE TO STYROFOAM DONG NAI BOATS

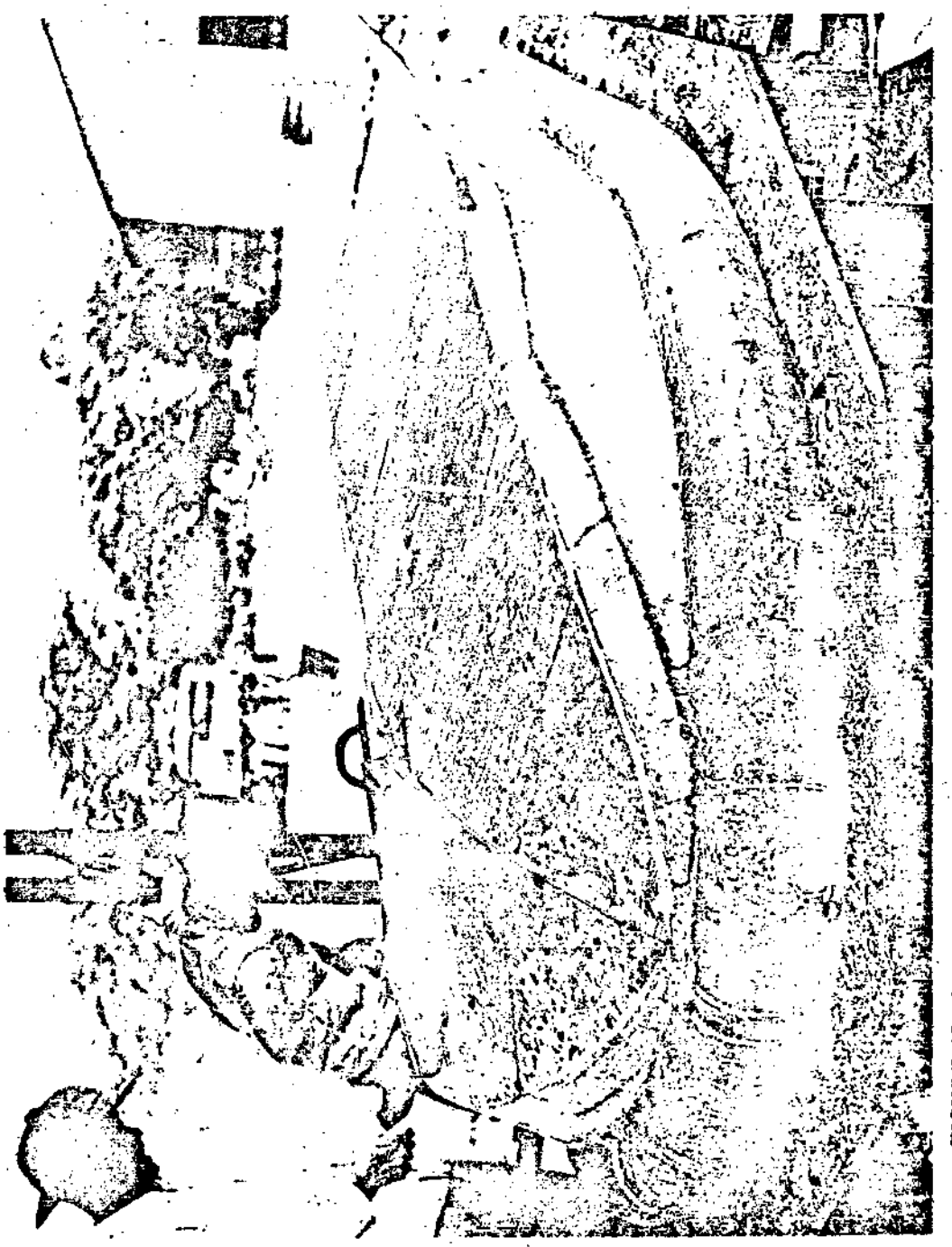

FIGURE 37. BOTTOM OF DONG NAI BOAT IS REINFORCED WITH PLYWOOD TO PROVIDE GREATER IMPACT RESISTANCE

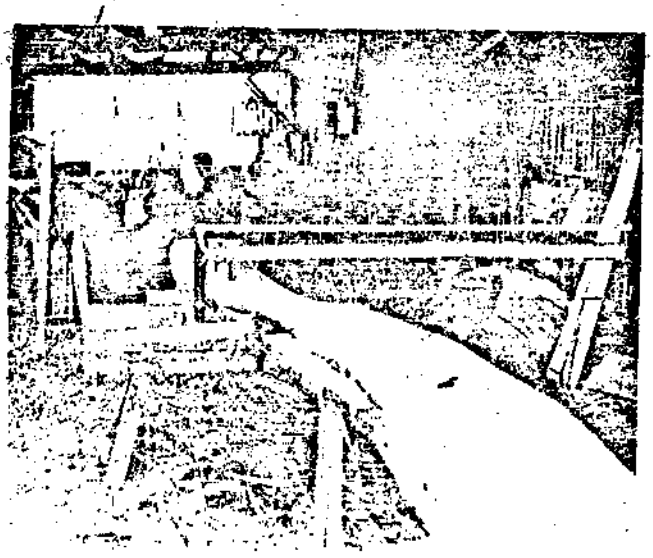

FIGURE 38. RIPPING THE LOG FOR THE THAILAND SHALLOW-DRAFT BOAT

The wood is Maitakien.

FIGURE 39. SHAPING THE WOOD USING DRY HEAT

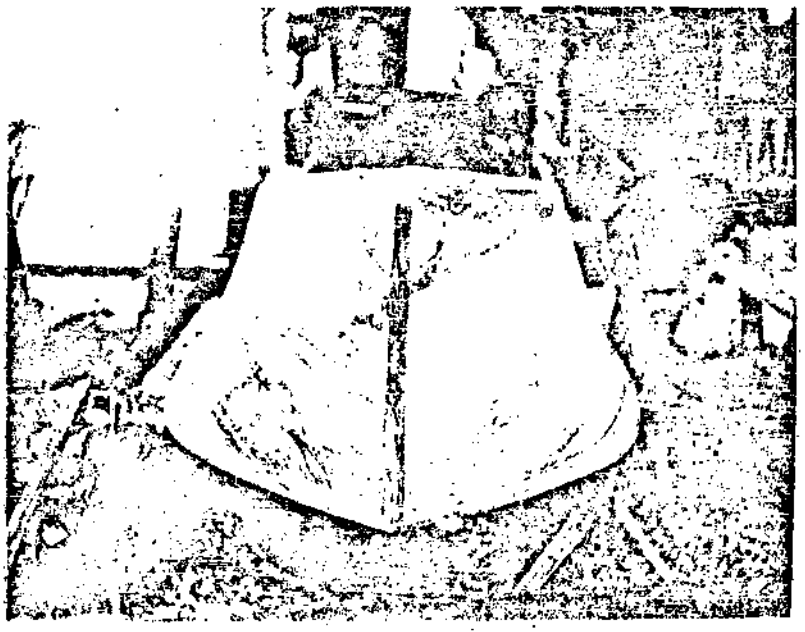

FIGURE 40. UNFINISHED HULL

Design is based on the Thai Klong boat.

FIGURE 41. M-113 ARMORED PERSONNEL CARRIER SHOWING CAPSTAN ADAPTER INSTALLED ON DRIVE SPROCKET

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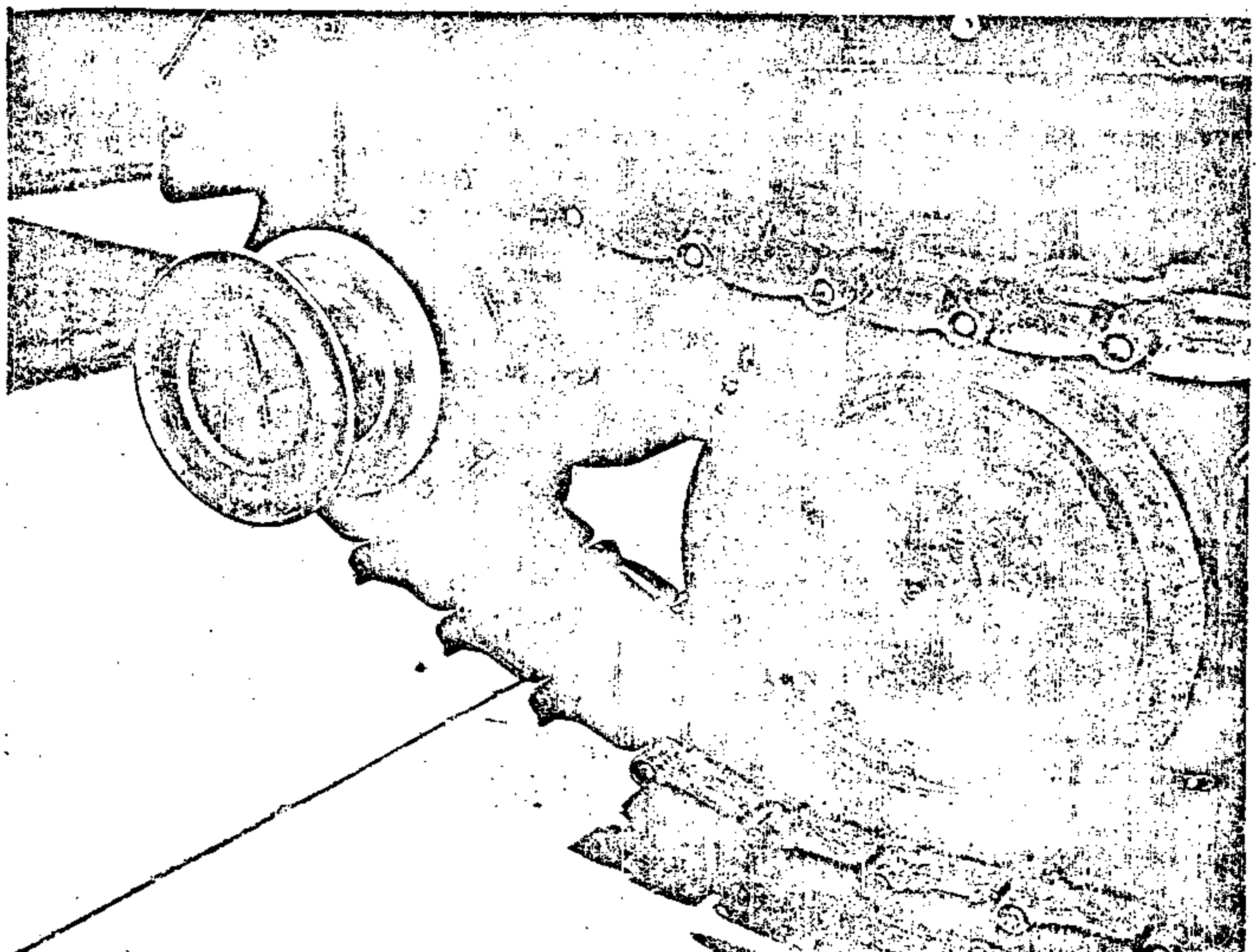

FIGURE 42. M-113 ARMORED PERSONNEL CARRIER SHOWING REMOVABLE CAPSTAN IN PLACE

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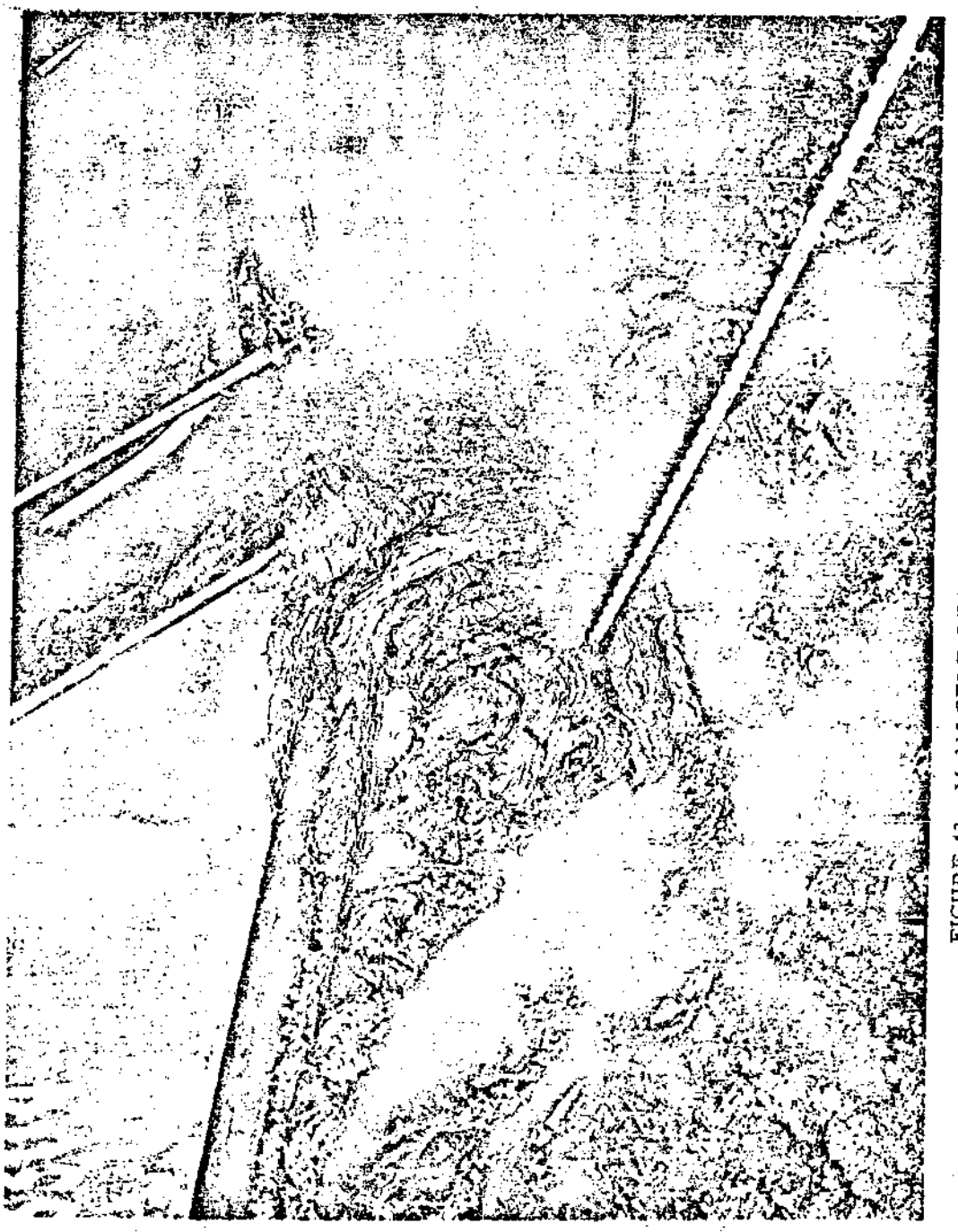

FIGURE 43. M-113 SELF-RECOVERY CAPSTAN IN USE

Maintenance records are examined and frequency of repairs 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 (Figure 44), has completed 200 hours of testing in the Louisiana marshes and by the Waterways Experiment Station at Vicksburg. The test report is currently being printed. A second, the Marine Corps-funded Airoll Vehicle (Figure 45), has been undergoing tests by the USMC. 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.

A Marsh Screw development program is being prepared which will be oriented toward determination of the 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, and directional control is not possible. Films of the test series and a company test report are available and have been distributed to the MRDC and CDTC. Overseas tests also may be conducted.

The ARVN 80th Ordnance Rebuild Depot is building a CDTC-V designed vehicle-launched tactical bridge on a rebuilt M24 tank chassis to provide a rapid means of crossing canals and narrow streams. Twelve M4T6 bridge balks are being used to form two scissors treadway sections.

Installation of the bridge erection booms, power take-off assemblies, and hydraulic cylinders is nearing completion. The center treadway hinge design is complete, and most of the problems associated with boom siting and location of the sub-assemblies required to activate the erection cylinders have been resolved.

Plan and Schedule to Complete

A small-craft development program is presently being prepared. This program will probably be completed during FY-65.

The search for unusual and silent propulsion systems is a continuing task with development funding indicated only as studies and/or model tests indicate feasibility.

The desirability of a special type of patrol craft will be determined as a result of analyses and investigations to be conducted under Technical Area 2.

Development of a suitable family of amphibians should be well along toward completion by the close of FY-65.

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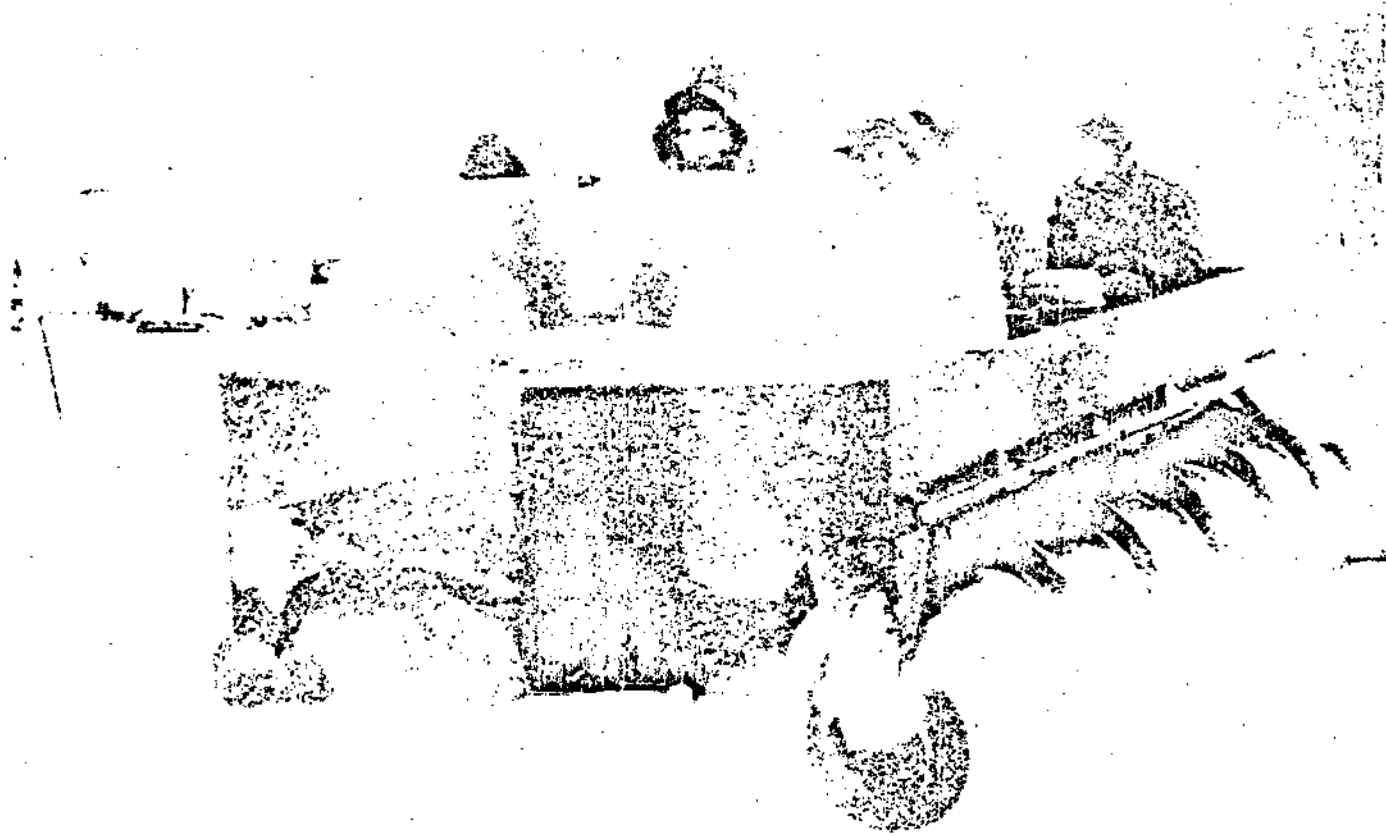

FIGURE 44. THE MARSH SCREW AMPHIBIAN IS AN OUTSTANDING PERFORMER IN SNOW

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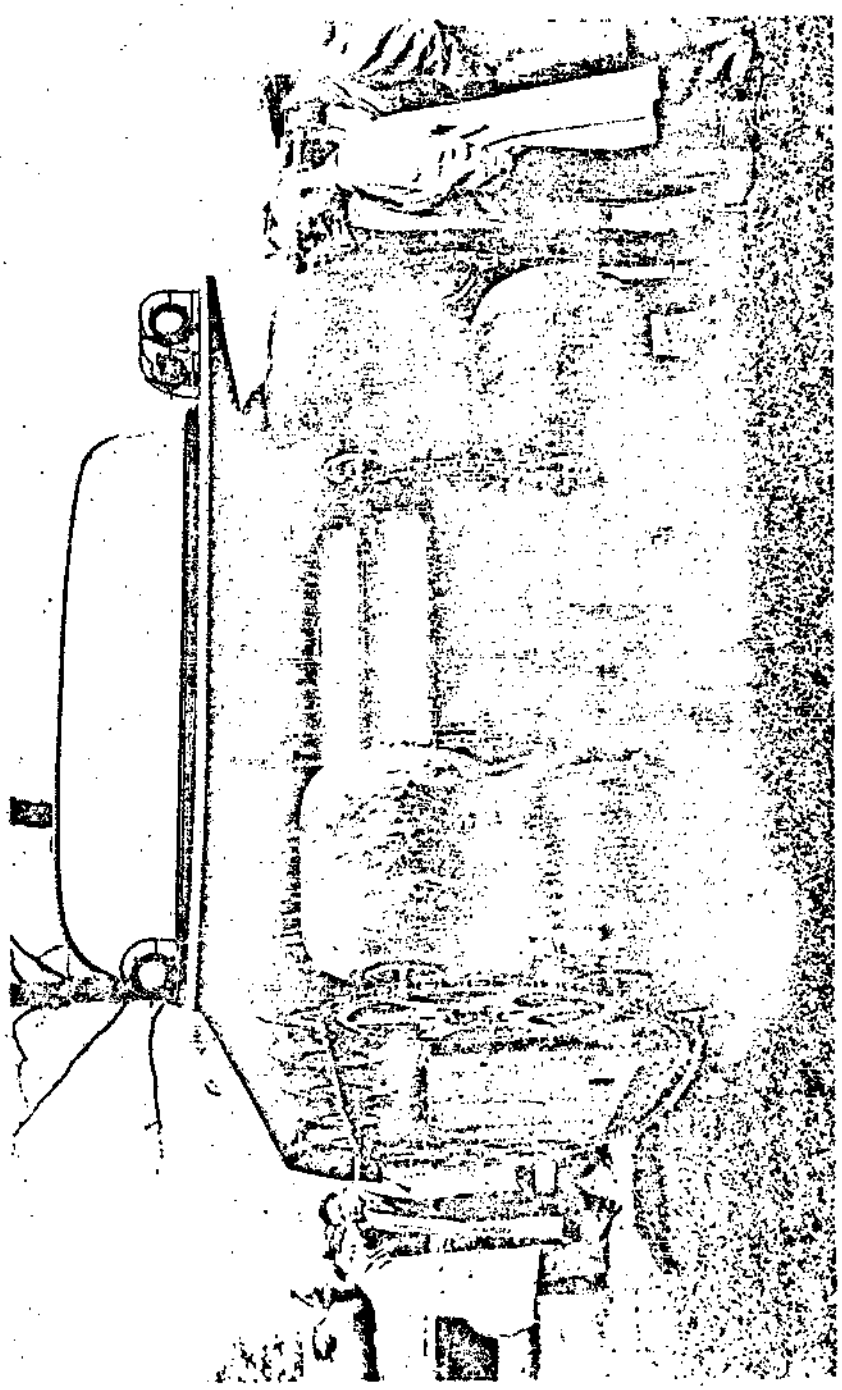

FIGURE 45. THE AIROLL VEHICLE

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AGILE SUBPROJECT IV

COMMUNICATIONS SYSTEMS

~~CONFIDENTIAL~~

AGILE SUBPROJECT IV

COMMUNICATIONS SYSTEMS

SUBPROJECT OBJECTIVE

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

(1) Tactical communications within and among units and for control of support aircraft

(2) Communication of alarm signals from villages, strategic hamlets, convoys, and outposts in the event of attack

(3) Communications for control and operation of naval units primarily composed of river and coastal craft.

SUBPROJECT 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 surface-to-surface and air-to-surface 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, vocal, 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.

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 to 100 kilometers 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

Technical Area 1 - Communications 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:

(1) 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.

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

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

Conduct

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 the support and under the supervision of the MRDC and CDTC in the respective host countries. This program will be extended to selected areas outside of Southeast Asia as rapidly as possible.

Technical Area 2 - Investigation, Development, and Evaluation of Communications Techniques and Devices

Objective

To determine the applicability of specific techniques and devices to the requirements determined in the Phase 1 study.

Data Required

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

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

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

Conduct

In order to acquire a timely improvement in the capabilities of existing equipment, test and evaluation of commercial and military communications equipment 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 U. S. and then in Southeast Asia and other selected areas in order to assure evaluation appropriate to the requirements imposed by the environment.

SUBPROJECT IV TECHNICAL AREAS, TASKS, AND SUBTASKS

Listed below are the major technical areas, and the tasks and subtasks in each area with which this subproject is concerned. Succeeding pages contain the summaries of their objectives and status.

Technical Area 1. Communications Research

Task A. Tactical Field Studies

Task B. Phenomenological Research

Task C. Development of Host-Nation Electronic Research Capabilities

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

Task A. Tropical Intra-Patrol Radio Communications

Task B. Tropical Man-Pack Radio Communications

Task C. Remote Area Conflict Vehicular Radio Communications

Task D. Remote Area Conflict River and Coastal Flotilla Communications

Task E. Hamlet and Outpost Alarm Communications

Task F. Power Supplies for Communications Equipment

Task G. Special Antennas

Technical Area 1 - Communications Research

Background

As indicated in the Communications Subproject description, communications research will be carried out as follows:

Task A. Analysis of the capacity, reliability, and limitations of existing local communications and of those factors of the physical, political, military, and social environment which pose special problems or constrain the application of conventional communications equipment.

Task B. Measurement and analysis of parameters of electromagnetic propagation such as path loss, atmospheric noise levels, ionospheric data, effects of terrain and vegetation which affect the performance of communications equipment.

Task C. Provision of laboratory facilities, mobile and portable measurement and test equipment, and training of host-nation personnel to enhance local capabilities for communications research.

Task A - Tactical Field Studies

Objective

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.

Progress to Date

Activity under this task is being implemented as a major portion of the ARPA Southeast Asia Communications Research Program (SEA CORE) with the U. S. Army Electronic Research and Development Laboratory (USAELRDL) as service agent.

The Thailand portion of the program is a part of a contract with Stanford Research Institute (SRI) awarded in February, 1963.

Preliminary data collection in CONUS, observation of SEATO maneuvers in June, and planning for full-scale data collection in Thailand have been the principal efforts on this task.

A plan for Thailand data collection has been prepared and approved. Several SRI professionals are now on site in Bangkok.

Plan and Schedule to Complete

The following subtasks have been approved for implementation in Thailand:

(1) Small unit and patrol communications

(2) Survey of existing communications systems

(3) Estimate of communications situation

(4) Thai police and military interface

(5) Communication system implications of major Thai dialects

(6) Human engineering – Thai aptitudes

(7) Special studies as agreed between MRDC, resident COTR, and SRI.

This task effort in Thailand is funded for approximately 16 months. Monthly and semiannual technical reports will be submitted. Effort in other geographical areas is being planned for implementation in FY 65.

Task B.- Phenomenological Research

Objective

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.

Progress to Date

A contract has been placed with Jansky & Bailey (J&B) through USAELRDL as a part of SEA CORE to carry out measurements as follows in Thailand:

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

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.

J&B made a site survey in Thailand and selected an area of the Thai National Forest in Central Thailand for the first series of path-loss measurements and associated terrain studies. Aerial photography of the area was carried out by the USAF and used in CONUS by J&B for detailed site and path selection and in part as a basis for terrain studies. The Army MAP service assisted J&B in preparing photo mosaics and has retained copies of the photo coverage for its use in updating maps. J&B technical

personnel and equipment are now on site in Thailand. Site preparation at the base camp is essentially complete although difficulties in transportation during the rainy season delayed this work.

SRI as a part of its SEA CORE contract has initiated effort in Thailand on several subtasks pertaining to phenomenological research. These are:

(1) Recording and analysis at six frequencies of levels and variations of radio noise.

(2) Analysis and measurement of the effects of the earth's magnetic field on the desired orientation of field antennas.

The U. S. Army Radio Propagation Agency (USARPA) as a part of SEA CORE has procured, shipped to Thailand, and is now operating a vertical ionospheric sounder (C-2) in Bangkok. Data on the ionosphere are now being recorded.

Plan and Schedule to Complete

J&B path-loss measurements at the primary site in Thailand will begin early in the next quarter and continue for a period of approximately ten months. J&B will be given direction on expansion of the program to other areas in early FY-65. Monthly and semiannual technical reports are being submitted.

SRI will conduct additional subtask investigations in Thailand as follows:

(1) Measurement of ground conductivity and dielectric constant

(2) Measurement of earth potential

(3) Study of equatorial flutter fading

(4) Study of the effects of noise and ionospheric behavior on radio-frequency prediction

(5) Operation of an oblique ionospheric sounder to study selected effects on point-to-point communications

These investigations in Thailand will continue for a period of approximately 16 months.

USARPA will operate the vertical ionospheric sounder in Bangkok for a period of approximately one year. A determination will be made in FY-65 as to a requirement for continued data collection.

Task C - Development of Host-Nation Electronic Research Capabilities

Objective

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.

Progress to Date

This task is currently being implemented in Thailand as a part of SEA CORE. Sylvania (EDL) on subcontract to SRI fabricated and assembled shelters and equipment for the base-laboratory facility and for the mobile-field-laboratory facilities to be utilized by SRI and the MRDC.

The Thailand laboratory has been operational since June, 1963, and was formally opened in October, 1963. (See Figure 46.)

Thai and U. S. personnel of the MRDC will use the facilities together with contractor personnel in a joint program of field investigations of communication techniques and devices. Currently there are seven Thai commissioned officers, four warrant officers, and several noncommissioned technicians assigned to the laboratory. These Thai personnel, many of whom have excellent academic backgrounds, are gaining valuable experience in electronic experimentation.

Plan and Schedule to Complete

A participative program of Thai-U. S. experimentation in connection with the SRI SEA CORE contract is now planned to extend until the end of FY-65.

Efforts of this type in other areas are planned to begin in FY-65.

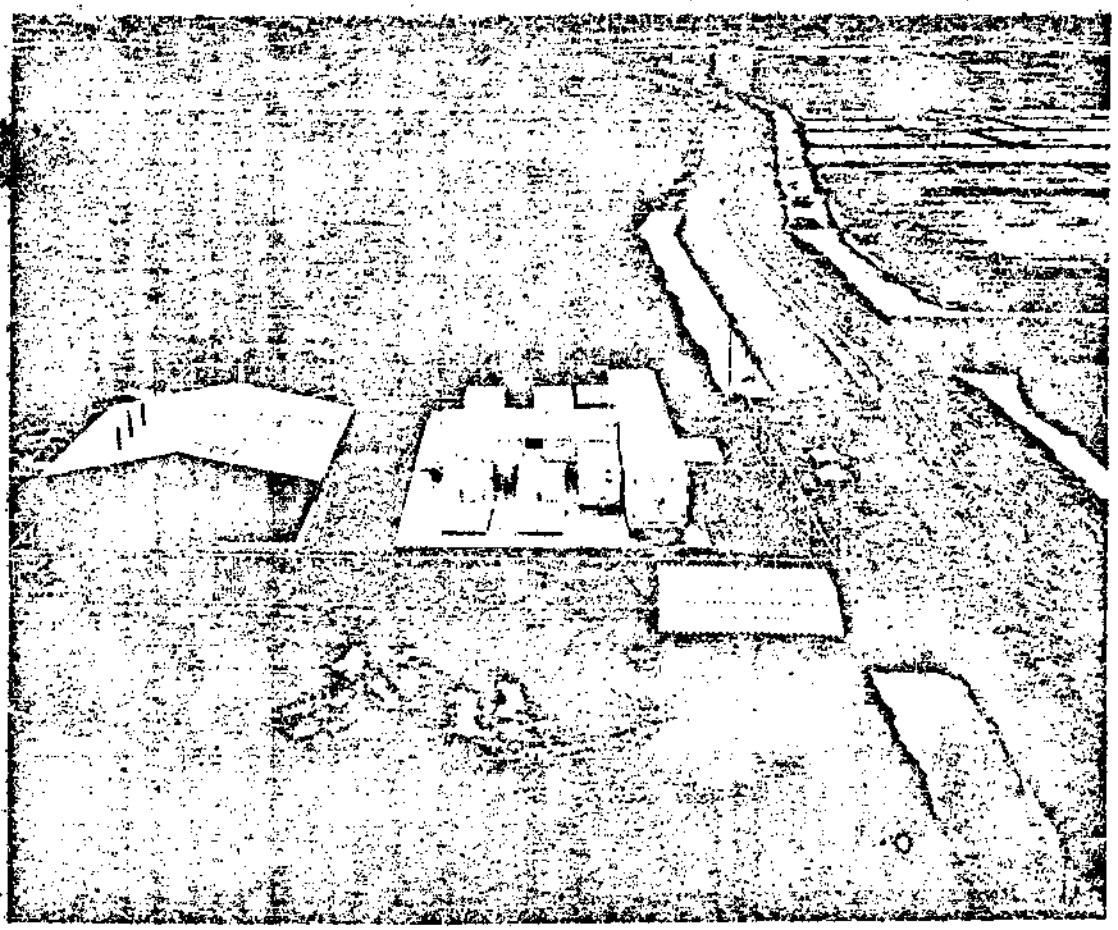


FIGURE 46. MRDC COMMUNICATIONS LABORATORY

Technical Area 2 - Investigation, Development, and Evaluation of Communications Techniques and Devices

Background

Effort in this technical area encompasses field investigations of communications techniques, test, and evaluation of equipment and devices in order to derive information on the suitability of the devices in the particular environment of interest, and development of specialized techniques, equipment, and devices to the point of demonstrating feasibility by a field evaluation.

Effort in Thailand in this technical area is a part of the SRI SEA CORE contract.

Task A - Tropical Intra-Patrol Radio Communications

Objective

To provide a small radio set of extremely light weight and simplicity, for use between squad-sized combat elements on patrol or in ambush locations in remote area conflict. 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 interfering with his combat capability. Ranges of up to 1,000 meters under most terrain and vegetation conditions, a capability of silent, semi-automatic transmission of simple coded alarm messages, and compatibility with standard U.S. military VHF-FM portable sets, are required.

Progress to Date

A number of available military and commercial radios have been developed or purchased for evaluation in this area.

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 1 pound (plus 1 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 being conducted by the U. S. Marine Corps.

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 six sets for field evaluations in Thailand.

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 watt. Three sets have been shipped to Thailand for field evaluation. This set meets with all standard U. S. military VHF-FM equipment.

In addition, a power amplifier for the AN/PRC-25 has been developed by RCA to provide a capability to exercise power levels of 0.3, 1, 1.4, 2, 15, and 30 watts in field experiments in Thailand.

ARPA has funded development by RCA and ITT of pocket-sized jungle message entry devices (JMED) which provide silent, semiautomatic, two-way communications (using simple prearranged messages) compatible with standard U.S. military radio sets.

Plan and Schedule to Complete

Field experimentation, test, and evaluation of the available radios in Thailand are planned during the remainder of FY-65.

It is planned to continue development of the rifle-butt radio to explore feasibility of multichannel communications with the device.

JMED devices will be evaluated in conjunction with small field radios.

Task B - Tropical Man-Pack Radio Communications

Objective

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.

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

(1) 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 to 100 kilometers.

(2) Man-pack, VHF-FM voice transceivers weighing 15 pounds or less, low-drain, battery powered, and having a range of 5 to 10 kilometers under typical tropical terrain and vegetation conditions.

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

Progress to Date

In order to obtain necessary data on which to base action to procure an interim high-frequency set as described in Item (1), above, and to determine the range of performance of HF and VHF sets in typical terrain and vegetation in Southeast Asia, MRDC utilizing SRI field teams, undertook a series of comparative field tests of a number of available man-pack radios. A report of the tests has been distributed as SRI RM-3. 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:

(1) High-Frequency Man-Pack Radios

(a) 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 1-KC steps from 2 to 12 MC.

(b) 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 six preset channels in the range 3 to 8 MC. The sets under test have been modified by EDL to add a voice capability.

(c) 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.

(d) 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 six preset channels between 2.5 and 8 MC.

(e) 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.

(2) VHF-FM Man-Pack Radios

(a) 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 to 76 MC. It is in production for the U. S. Army as a replacement for the AN/PRC-10.

A 15- and 30-watt power amplifier for this set, developed and purchased under an ARPA-funded program is available for evaluation with the AN/PRC-25.

(b) AN/PRC-10. This is the standard FM-VHF transceiver in use in Southeast Asia. It weighs about 25 pounds and radiates about 1 watt over the range of 50 to 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, N.C. 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.

On the basis of this test series in flat jungle, rice paddy, and mountainous areas, the following conclusions appear to be warranted:

(1) VHF sets, with ordinary whip antennas provide ranges of less than one-tenth mile in the most dense forest and up to 2 miles in less dense forest. Extension of these ranges was possible only by elevating antennas.

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

(3) 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.

(4) 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.

(5) 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 & Bailey.)

(6) 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 the tests ARPA has funded an effort by Hughes to produce five models of an improved HC-162. These sets have been shipped to CDTC-V for field evaluation.

ARPA has also funded a development program for the RS-100, a man-pack high-frequency set of significantly different and advanced design. This set features a miniaturized frequency synthesizer and a capability for burst transmission.

Plan and Schedule to Complete

(1) Continued evaluation of the Hughes HC-162 in Vietnam.

(2) Field experiments with man-pack VHF sets in Thailand.

(3) Evaluation of the RS-100 when available. Expected date first quarter of FY-65.

It is planned to fund development and evaluation of relay/retransmission devices to extend the useful range of standard VHF FM voice radios during FY-64.

Task C - Remote Area Conflict Vehicular Radio Communications

Objective

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

Progress to Date

ARPA has procured six 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 to 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. Three of the MRC-95s have been shipped to CDTC-V for operational evaluation in Vietnam.

Plan and Schedule to Complete

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 618-T transceiver in the Caribou which is on loan to CDTC-V for tests of long-range air-surface communications.

Task D - Remote Area Conflict River and Coastal Flotilla Communications

Objective

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. 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.

Progress to Date

CDTC-V conducted a test of two single-sideband HF transceivers manufactured by RF Communications Associates aboard the prototype command junk. A report of test has been received and distributed. It was concluded that these equipments were not suitable for this application.

A decision has been made to procure and install the AN/GRC-87 on the junk fleet in Vietnam.

CDTC-V in July conducted a test of several antenna configurations on the junk and is providing assistance to the Vietnamese Navy in the radio installation.

Plan and Schedule to Complete

Work on this task will continue to assure that satisfactory communications are available for river and coastal flotillas.

Task E - Hamlet and Outpost Alarm Communications

Objective

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

Progress to Date

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

radio 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- and 10-watt units.

Ryan Concealable Alarm Transmitter - Coincidentally with the development of the hamlet alarm system by Radio Industries Inc., 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. This transmitter was given an evaluation with the TR-20 village radio in Vietnam, but did not prove to offer significant advantages.

RCA Hamlet Alarm System - RCA, under an 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 shipped to Thailand for evaluation.

Chaff Rockets - A report of test has been prepared by CDTC-V and distributed. Results of testing the chaff-rocket concept are not encouraging because of the low rate of radar detection of rockets when fired. The particular rockets tested, which were of Japanese manufacture, had the advantage of being inexpensive, but did not achieve sufficient altitude to permit a high probability of detection by radar.

Plan and Schedule to Complete

Field experimentation and requirement studies in Thailand will be continued to determine optimum solutions to the hamlet alarm problem.

No further effort in Vietnam is planned.

Task F - Power Supplies for Communications Equipment

Objective

To provide efficient power supplies and accessory equipment for a tactical field radio. Remote area conflict situations require the highest possible life-to-weight ratio. Included are primary power sources, battery-charging equipment, and testing equipment.

Progress to Date

ARPA has funded development with Minnesota Mining and Manufacturing Company of a thermoelectric generator which burns simple solid fuels such as charcoal, wood chips, or dried animal dung; a nickel-cadmium storage battery; and a converter. The unit will directly power a field radio supplying 60 watts at 12 volts. Total unit weight is 15 pounds.

Funds have been provided to develop a Rankine-cycle engine as a primary power source. This is a sealed engine using an organic fluid as the heat-transfer medium, fueled by solid dry materials such as charcoal. The unit is expected to deliver 100 watts and weigh 9 pounds.

Funds have also been provided for development of a magnesium-air fuel cell with replaceable magnesium electrodes. This unit is expected to deliver 60 watts and weigh about 16 pounds.

Plan and Schedule to Complete

Delivery of experimental models of each of the above units is expected in early FY-65.

It is planned to initiate effort on battery-charging equipment during FY-64.

Task G - Special Antennas

Objective

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 these environments. The efforts to be performed under this task include 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.

Progress to Date

CDTC-V has designed, fabricated, and demonstrated a number of field-expedient antennas for tactical VHF voice radios such as the AN/PRC-10. These include a simple three-element YAGI array, whips and ground plane antennas elevated and fed by coaxial cable or field wire, and a folded dipole of unique design. CDTC-V reports have been prepared and distributed describing the performance of these antennas.

The CDTC-V MARK III Patrol Antenna, which is the most successful of the types fabricated to date, is a folded dipole made from 300-ohm tubular transmission line, fed by 35 feet of TV flat twin lead. This antenna can be fabricated locally for a cost of less than $10 and weighs less than 3 pounds. Its performance has been at least equal to that of the standard RC-292 antenna, which weighs very much more and is bulky to carry.

Plan and Schedule to Complete

CDTC-V will continue to experiment with field-expedient antennas and to assist in their introduction in Vietnam.

SRI as a part of its SEA CORE effort in Thailand is scheduled to conduct investigations on the design and use of antennas with field radios including optimum location and orientation, effects of terrain and vegetation, and use of new or novel types of antennas.

~~CONFIDENTIAL~~

AGILE SUBPROJECT V

COMBAT SURVEILLANCE AND TARGET ACQUISITION SYSTEMS

~~CONFIDENTIAL~~

AGILE SUBPROJECT V

COMBAT SURVEILLANCE AND TARGET ACQUISITION SYSTEMS

SUBPROJECT OBJECTIVE

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

(1) Detect, locate, and maintain surveillance of hostile units, bases, stores, and supply routes.

(2) Detect infiltration of borders and incipient ambushes or attacks on outposts and communities.

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

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

(5) Exploit the knowledge of communication techniques and equipment to locate, neutralize, or destroy hostile bases and headquarters.

SUBPROJECT BACKGROUND

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 the adverse ratios of friendly to hostile forces that in the past have been necessary to achieve suppression of guerrillas and insurgents. To offset this handicap, friendly local forces urgently require the enhancement of their combat effectiveness that can be achieved through the application of superior scientific and technical efforts to the problems of combat surveillance and target acquisition.

Limitations on Equipment

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 available aircraft will include rotary-wing and fixed-wing tactical and transport aircraft in the light and medium classes.

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 two phases as follows:

Technical Area 1 - Surveillance 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, which will be followed by a field measurement program to fill in significant data gaps for each selected distinctive environment. The areas of specific interest and investigation are as follows:

(1) Acoustic and Seismic

(a) 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 each selected area.

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

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

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

(e) 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.

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

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

(2) Electromagnetic

(a) 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.

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

(c) Emission of electromagnetic energy (detected by a microwave radiometer), as a function of frequency, by individuals armed as in paragraph (2)(a), above, and by surface or subsurface metals such as nail-boards and caches of weapons.

(d) 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.

(e) Propagation attenuation factors for electromagnetic emissions in each selected area as a function of frequency, antenna, ionospheric and atmospheric conditions, terrain profile, vegetation, and climate conditions (joint undertaking with Subproject IV).

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

(3) Infrared, Optical, and Visual

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

(b) 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.

(c) Apparent temperature contrast for individuals armed as in paragraph (2)(a), above, when viewed against typical vegetation and terrain backgrounds and for typical ambient temperatures found in each selected area.

(d) 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.

(4) Chemical

(a) Chemical emanations which are characteristic of individuals armed as in paragraph (2)(a), above, and of cooking and heating fires.

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

(c) 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, target and threat analysis will be conducted to determine the particular surveillance and target acquisition techniques and devices that are useful to friendly local forces in their own distinctive environments.

Technical Area 2 - Investigation, Development, and Evaluation of Techniques and Devices

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:

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

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

(3) Applicable detailed performance characteristics to provide a basis for development of equipment.

Conduct

It is intended that Service agencies be selected to investigate each promising technique area (radar, infrared, 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.

SUBPROJECT V TECHNICAL AREAS, TASKS, AND SUBTASKS

Listed below are the major technical areas, and the tasks and subtasks in each area, with which this subproject is concerned. Succeeding pages contain the summaries of their objectives and status.

Technical Area 1. Surveillance Research

Task A. Target and Threat Analysis

Task B. Phenomenological Research

Task C. Development of Host-Nation Surveillance Research Capabilities

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

Task A. Airborne Systems

(1) Infrared

(2) Radar

(3) Illuminated Night Photography

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

(5) Spectra-Zonal Photography

(6) Electromagnetic Detection

Task B. Surface Systems

(1) Night Vision

(2) Doppler Personnel-Surveillance Radar

(3) TIARA (Target Illumination and Rescue Aids)

(4) Persistent Identification Chemicals

(5) Hidden-Metal and Subsurface-Cavity Detectors

Task 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

Task D. Security and Protection Systems

(1) Railway, Pipeline, Powerline, and Road Security

(2) Airborne Ground-Fire Detectors

(3) Patrol and Outpost Intrusion Detectors

Technical Area 1 - Surveillance Research

Background

Effort in this technical area consists of the following:

(1) Analysis of remote area conflict situations to derive information on detectable indicators of hostile activity.

(2) Measurement and analysis of the target and background factors outlined in the preceding discussion and where appropriate propagation and attenuation data on radiation typical of the physical environment.

(3) Derivation of requirements for equipment and techniques applicable to specific remote area conflict situations.

(4) Assistance to host nations in the development of an improved capability for conduct of research investigations of the type described above.

Task A - Target and Threat Analysis

Objective

To derive from analysis of military operations including hostile insurgent activity those patterns of behavior which provide a basis for detection and identification of the location, extent, and nature of a hostile unit or facility. In addition, this task includes analysis of the nature and degree of the threat of attack upon vital, friendly installations, facilities, and lines of communication.

Progress to Date

A report has been received and distributed from a contract with the Defense Research Corporation entitled "Guerrilla Activity Detection Study," DRC 63 1236. This was a preliminary theoretical study covering broad aspects of detection phenomena applicable to counterinsurgency.

A follow-on effort with the Defense Research Corporation has been funded. This is a one-year data collection and analysis effort intended to develop information on the nature and degree of the threat of insurgent attack upon vital lines of communication facilities and installations in a large number of countries which are now or may be faced with an organized insurgent movement.

Funds have been committed to Stanford Research Institute as a part of the Southeast Asia Surveillance Research Program (SEA SURE) for a two-year program of target and threat analysis based upon Thailand.

Plan and Schedule to Complete

It is planned to expand effort of this type to other geographical areas beginning in FY-65.

Task B - Phenomenological Research

Objective

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.

Environmental 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.

Progress to Date

Part 1 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 (IST), University of Michigan, with the USAELRDL acting as ARPA agent. The study report has been received and distributed to interested Service agencies. Implementing action on a program of target and background measurements is being planned in coordination with MRDC. Funds have been committed as follows:

(1) Acoustic and seismic measurements will be made in Thailand under contract to Jansky & Bailey. A subcontract to IST, University of Michigan, will provide for design of experiments, procurement of necessary instrumentation, and supervision of field measurements by J&B technicians.

(2) Extension of the J&B path-loss measurements (see Subproject IV) to encompass short-range electromagnetic path-loss measurements at selected frequencies up to 10 GC. This extension also

covers microwave point-to-point measurements and refractive-index measurements which are of principal interest in communications.

(3) Radar reflectivity and doppler spectra measurements will be made in CONUS on men with and without weapons, in isolation, and viewed against clutter backgrounds, as a function of frequency polarization and elevation aspect angles. Doppler spectra will be obtained on moving targets and representative foliage types moving in the wind.

As part of SEA SURE, MRDC 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 MRDC 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. See Figure 47.

Plan and Schedule to Complete

In the near future it is planned to commit funds for the following efforts:

(1) An extension of the Conductron Corporation radar foliage penetration measurements described in Technical Area 2, Task A, Subtask 2, below, to encompass measurements at selected frequencies up to 10 GC on one-way foliage penetration in several different kinds of forests in the U. S. and Puerto Rico.

(2) Thailand measurements of targets, background, and where appropriate of propagation factors in optical, infrared, magnetic, chemical, and earth resistivity phenomena.

(3) Meteorological data collection both in direct support of other environmental measurements and to collect historical data as a basis for analysis of weather patterns in Southeast Asia.

Task C - Development of Host-Nation Surveillance Research Capabilities

Objective

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

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.

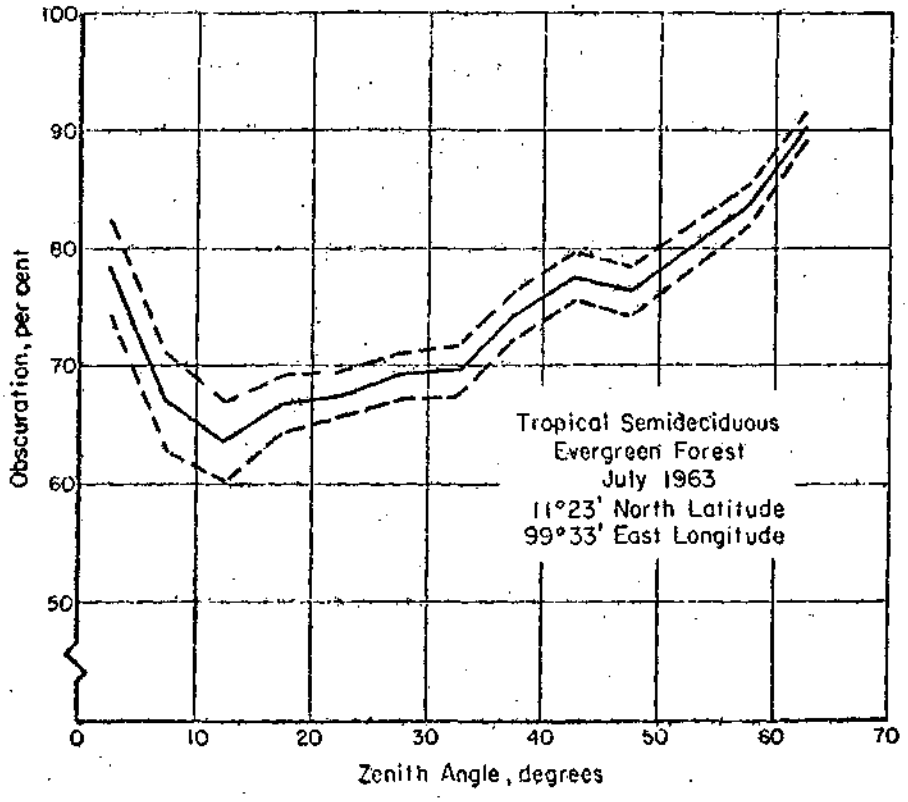


FIGURE 47. EXAMPLES OF MRDC FOLIAGE-OBSCURATION DATA

Progress to Date

Thai personnel have participated in measurement programs and in test and evaluation of devices which are reported in Technical Area 2 below.

Plan and Schedule to Complete

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 (Subproject IV) and SEA SURE (Subproject V) 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.

Technical Area 2 - Investigation, Development, and Evaluation of Techniques and Devices

Task A - Airborne Systems

(1) Infrared

Objective - To evaluate the use of airborne infrared equipment for detection of hostile activities.

State-of-the-art infrared scanners are available with high resolution and high sensitivity. Detectors are available in the short-wave-length region (4 to 6 microns) for detection of fires and other active radiation sources and also in the long-wave-length region (8 to 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.

Progress to Date - To enable the study of the 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 infrared 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 exceeds minimum requirements.

Plan and Schedule to Complete - ARPA is now planning and expects to commit funds in the near future to a comprehensive one-year evaluation program of the use of modern infrared scanners employing both short- and long-wave-length detectors against a wide spectrum of targets in Thailand. Targets will include cooking and camp fires, personnel, huts, ambush positions, caves and tunnels, activity on roads and trails, and such other potentially hostile phenomena as can be obtained or simulated.

(2) Radar

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

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.

Progress to Date - ARPA has a joint program with the USAF Systems Command Reconnaissance Laboratory to accelerate measurement efforts for some specific aspects of foliage penetration by radar.

The effort encompasses one-way measurements of the amplitude and phase defect on transmission through selected foliage cover at a number of selected frequencies.

At these same frequencies measurements will be made of two-way propagation using calibrated targets in forests. These measurements will provide a basis for determining the feasibility of obtaining a useful coherent synthetic-aperture side-looking radar to detect the types of targets described above under forest cover.

Plan and Schedule to Complete - The current measurement program will be completed early in FY 65. ARPA plans to extend the frequency range of the one-way measurements as discussed under Task B in Technical Area 1.

(3) Illuminated Night Photography

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

Standard aerial photography equipment applicable to a variety of purposes is available for use in daylight aerial reconnaissance. This task, using lasers or strobe lights for selective illumination, is aimed at providing an equivalent capability for night reconnaissance; it incorporates characteristics which minimize the hazards attendant with alerting hostile forces, 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 forces in such situations.

Progress to Date - ARPA funds have been provided to the USAF Systems Command for implementation of a program of investigation of techniques of illuminated night photography by the Reconnaissance Laboratory of the Aeronautical Systems Division. 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. The first experimental model has been delivered for flight test.

(2) Ultraviolet System

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

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 has been taken and processed to evaluate the technique.

Plan and Schedule to Complete - It is planned to continue effort under each of the categories listed above sufficiently far to permit assessment of the promise of the technique before proceeding further.

Additional funds will probably be committed in this area in FY-64.

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

Objective - To improve the capability of human observers in aircraft to detect hostile surface activities.

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.

Progress to Date - MRDC 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 effort was an important contribution to a better understanding of the capabilities and limitations of visual reconnaissance, and prerequisite to investigation of equipment techniques, or tactics that might be used in counterinsurgency operations.

The RTAF implemented a test plan 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 the RTAF facilities at Ubon because the desired visual backgrounds are conveniently close. A report of the initial test results was prepared and distributed; additional tests are planned.

DDR&E has directed that ARPA fund a program to evaluate low-light-level television in counterinsurgency aircraft. An Air Force program plan to accomplish this effort has been received, reviewed, coordinated with Army and Navy, and forwarded to DDR&E for approval.

Models of a binocular stabilizer manufactured by Kenyon have been purchased and shipped to Vietnam, where they are being evaluated. These devices are intended to enhance the capability of visual observation from helicopters and vehicles in motion.

Plan and Schedule to Complete - Additional visual observation tests in Thailand will be conducted in FY-64.

Funds will be committed early in the next quarter for evaluation of low-light-level television in counterinsurgency aircraft.

(5) Spectra-Zonal Photography

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

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 these 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, and the location and extent of activity on roads and trails will be studied.

Progress to Date - 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.

Plan and Schedule to Complete - ARPA plans to conduct a comprehensive evaluation of the technique of spectra-zonal photography in Thailand against all of the targets cited above. This effort will be coordinated with the IR work discussed under Technical Area 2, Task A, Subtask 1, above.

(6) Electromagnetic Detection

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

Progress to Date - None.

Plan and Schedule to Complete - Consideration is being given to studies and materiel programs to test the effectiveness of airborne magnetometers and radiometers.

Task B - Surface Systems

(1) Night Vision

Objective - To provide friendly local forces with effective aids to vision to assist in detection, surveillance, movement, and employment of weapons at night. Effort under this task encompasses evaluation of active light sources, active and passive portable infrared 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.

Progress to Date - 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 in the near future.

Plan and Schedule to Complete - ARPA will continue to monitor the U. S. Army program in night-vision devices, particularly the development of passive image intensifiers, and will schedule evaluation of these devices in Southeast Asia as appropriate.

(2) Doppler Personnel-Surveillance Radar

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

Progress to Date - The final report on evaluation of the AN/PPS-4 doppler personnel-surveillance radar by MAAG-Vietnam has been distributed. 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.

Plan and Schedule to Complete - The AGILE surveillance research program will provide general data on expected detection range of targets of interest in different types of ground cover.

No additional equipment development or evaluation is planned at this time.

(3) TIARA (Target Illumination and Rescue Aids)

Objective - 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.

TIARA is a fluid chemiluminescent 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 and remain visible on dry surfaces for periods of 30 to 45 minutes and on wet surfaces for periods of ten 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.

Progress to Date - 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 been fully 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.

Additional research funds have been provided to American Cyanamid Company to study other chemiluminescent compounds.

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

Plan and Schedule to Complete - ARPA has terminated its support for additional weaponization efforts in view of unresolved problem areas such as toxicity, explosive compatibility, and the lack of suitable plastic container materials.

Research in chemiluminescence will continue throughout FY-64.

(4) Persistent Identification Chemicals

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

(1) Chemicals which fluoresce under ultraviolet 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 human beings.

(4) Chemicals which produce odors which are detectable by dogs or by chemical sensors, but that 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.

Progress to Date - 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 very small quantity of squaline.

Experimentation on means of disseminating squaline in dust and liquid formulations and determining the quantity required to contaminate a selected area has been done in CONUS.

A final report will be distributed in the near future. Results appear very promising for the use of this technique in selected situations.

The Army Chemical Center also has a program to investigate the use of disseminated chemicals for tracking, detection, and identification of intruders. ARPA expanded the study to include the use of various types of encapsulated chemical marking agents.

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 provide an absolutely reliable 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 five enlisted men and one officer from a RTA Security Battalion in Thailand underwent a four-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. A report of these trials has been distributed.

ARPA has funded an investigation of the detection mechanism employed by the housefly for specific chemicals. This effort is directed toward the eventual synthesis of detectors which have a very high sensitivity.

Plan and Schedule to Complete - ARPA is considering a field evaluation of the use of dogs and squaline in Southeast Asia.

Research on chemical emanations in Thailand is planned under Technical Area 1, Task B.

(5) Hidden-Metal and Subsurface-Cavity Detectors

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

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 subsurface 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 subsurface cavities in the course of sweep and search operations and in the screening of personnel on land and those involved in 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 subsurface 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, lightweight devices for the detection of hidden metal and small subsurface anomalies.

Progress to Date - ARPA has funded the Naval Ordnance Laboratory at Corona, California, to investigate the use of the Hall effect in thin semiconductor films, and their incorporation into magnetometers for detection of buried metals. This program is a one-year effort and includes delivery of ten lightweight, portable magnetometers suitable for field evaluation.

An additional program of technique investigation has been funded by ARPA and is being undertaken by the U. S. Army Engineer Research and Development Laboratory, Ft. Belvoir.

It includes:

(1) Magnetic-loop-detection of personnel carrying weapons.

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

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

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

The devices described above are intended for field evaluation in Thailand.

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

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

MRDC has conducted experiments on detection of metal in sampans using a wire loop erected over a canal. Results of these experiments were not encouraging because of the high noise level of the galvanometer used as the detector. Better results are expected from the buried loop and sensitive low-noise amplifiers being developed under the Ft. Belvoir program. A report of test has been distributed.

Plan and Schedule to Complete - Delivery of an experimental magnetic-loop detection system for test in Thailand is expected in early 1964.

Additional experimental work is planned on the Hall-effect magnetometer in an attempt to find a suitable solution to the problem of cancelling the effect of the earth's magnetic field.

Task C - Navigation and Beacon Equipment

(1) Aerial Navigation System

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

In several remote area conflict situations, the environment and the nature of the operation place 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 with a reasonably high probability of success, the aircraft must be equipped with effective navigation systems. The aircraft involved are predominantly rotary-wing and subsonic fixed wing, and reduction in the volume and weight of navigation equipment to be placed aboard is generally of critical importance. Furthermore, the problems associated with providing for the security of any system which must rely on a number of widely dispersed fixed ground stations place 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 subsonic 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 airborne and mobile ground receivers.

Progress to Date - 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 has been evaluated by the U. S. Army Aviation Board at Fort Rucker, Alabama, in comparison with the RYANAV IV. A report of this test confirmed the superiority of the RYANAV IV.

The evaluation of the RYANAV IV in RVN has been hampered by equipment malfunctions not encountered in prior CONUS tests. The latest model is now installed in the Caribou, and the evaluation is continuing.

ARPA has funded a program to evaluate the airborne, vehicular, and man-pack receivers of the Army-developed position fixing and navigation system (PFNS) in Vietnam against a DECCA ground system installed by the USAF. This system depends upon reception of low-frequency signals from a master and two or more slave stations on the ground.

Plan and Schedule to Complete - ARPA will continue the evaluation of the RYANAV IV and the PFNS systems in Vietnam, both of which should be completed in FY-64.

ARPA will monitor the development and evaluation of other navigation systems by the Services.

(2) Terminal Guidance Beacon

Objective - 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.

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.

Progress to Date - 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 for evaluation in Vietnam. These beacons, like the Westmont, operate with the standard ADF equipment, but have proved superior in CONUS tests. Tests of the HRT-2 and HRT-6 are under way. Preliminary results on the HRT-2 indicate that good bearing accuracy and adequate range are obtained, but that a suitable drop-release signal is not provided.

Plan and Schedule to Complete - Testing of the HRT-2 and HRT-6 should be completed in early 1964.

(3) Identification and Location of Air-Dropped Equipment

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

Air-dropped equipment is difficult to locate in the 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-drooped 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).

Progress to Date - A development program has been completed with Ryan Electronics Corporation to obtain interim test models of transmitter and receiver units suitable for field testing. This program was not successful because of a technical problem encountered in the design of an antenna, which must be part of or affixed to drop bundles and radiate effectively regardless of the aspect of the bundle on the ground.

Plan and Schedule to Complete - Additional development efforts to obtain a satisfactory solution to this problem will be funded in FY-64.

(4) Tactical Maps

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

Progress to Date - Re-evaluation 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 has been investigated by CDTC-V with the ARVN Engineer Topographic Company.

A report of this task has been distributed and the task is complete.

(5) Patrol Locating System

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

Progress to Date - 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 and CDTC-V program.

Plan and Schedule to Complete - Delivery of PFNS receivers to Vietnam is expected in FY-64. Scheduled test duration is six months.

Task D - Security and Protection Systems

(1) Railway, Pipeline, Powerline, and Road Security

Objective - To provide a capability to detect activity associated with sabotage or preparation for ambush on railroads, pipelines, powerlines, and roads. The problem is one of detecting an act of sabotage such as detonation of an explosive charge, or detection of activity involved in emplacement of demolitions, placement of barricades across roads or rails, removal of sections of railroad track, or preparation of ambush firing positions. The capability must include remote detection of the activity and means to provide warning in advance of an ambush.

Progress to Date - ARPA funded a feasibility investigation by Picatinny Arsenal of remote detonation of mines by electromagnetic radiation. Picatinny Arsenal reported that this technique is quite uncertain of success and therefore not recommended for implementation.

ARPA also funded a study of feasibility of the use of "Y guide" to detect disturbance on a railroad bed. IDA made the investigation and concluded that the system is expensive and easily disabled or spoofed.

Other studies of rail and powerline security are discussed under Subproject VI.

Plan and Schedule to Complete - ARPA plans to fund in FY-64 a nine-month feasibility study of the use of acoustic, seismic, and magnetic-loop sensors as a rail security detection and alarm system.

Other detection and alarm systems for railroad, pipeline, and powerline security will be investigated.

Detection of road ambush positions is included in the IR and photographic surveillance investigations reported elsewhere in this section.

(2) Airborne Ground-Fire Detectors

Objective - To provide devices which will detect the fact that an aircraft has been fired upon by small arms.

Rotary and subsonic 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.

Progress to Date - 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 and to identify the quadrant of closest passage.

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

Evaluation by the Limited War Laboratory indicated less than satisfactory performance of the Bissett-Berman and Thiokol systems.

Plan and Schedule to Complete - It is planned to continue efforts to develop a suitably simple and reliable bullet detector and to provide models for evaluation in Vietnam.

(3) Patrol and Outpost Intrusion Detectors

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

Lightweight, 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.

Progress to Date - The AN/GSS-9 break-wire intrusion detection device has been obtained from USAERDL for evaluation by MRDC 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 have been distributed. Results indicated that the device is potentially very useful but that some redesign was required; ARPA has funded development of improved models by Scope, Inc.

Plan and Schedule to Complete - Improved models will be shipped to CDTC-V, MRDC, and interested Service agencies for evaluation early in 1964.

~~CONFIDENTIAL~~

AGILE SUBPROJECT VI

INDIVIDUAL AND SPECIAL PROJECTS

~~CONFIDENTIAL~~

AGILE SUBPROJECT VI

INDIVIDUAL AND SPECIAL PROJECTS

SUBPROJECT OBJECTIVE

This subproject 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 subproject covers a wide range of technical areas and involves varying applications of research and engineering resources in a broad spectrum of disparate fields. While the technical areas and tasks currently being pursued under this subproject are shown on the immediately following page, it should be emphasized that its composition is, by design, flexible and subject to change.

SUBPROJECT VI TECHNICAL AREAS, TASKS, AND SUBTASKS

Listed below are the major technical areas and the tasks and subtasks in each area, with which this subproject is concerned. Succeeding pages contain the summaries of their objectives and status.

Technical Area 1. Military Chemistry

Task A. Defoliation

(1) HIDAL Herbicide Spray System

(2) FIDAL Herbicide Spray System

(3) Modified MC-1/C-123 Herbicide Spray System

(4) FS-AMD/C-130 Herbicide Spray System

(5) Herbicidal Chemical Research and Test Program

Task B. Crop Destruction

(1) Herbicidal Bomblet Cluster System

Technical Area 2. Psychological Warfare

Task A. Mobile Audio-Visual Unit

Task B. High-Power Voice-Amplifier System

Task C. Man-Portable, Self-Contained PA System

Technical Area 3. Medical Research and Equipment

Task A. Individual Aid Kits

Task B. Leech Repellents

Task C. Jungle Litter

Technical Area 1 - Military Chemistry

Background

Historical experience in remote area conflict, and more especially in counter-insurgency, has revealed a number of special problems. Typically, insurgent forces employ concealment and surprise in their conduct of operations, especially ambush operations along lines of communication. Moreover, for establishment of insurgent operations bases relatively large, secure, and naturally sequestered areas are necessary. Especially in humid tropical locations where floral and vegetative covering is dense, insurgents may have a significant advantage. Conversely, provision of food has generally been one of the most difficult problems for insurgent groups to solve. Frequently cut off from normal economic channels of distribution, and without a dependable supply system of their own, insurgents must often resort to raising crops as a collateral military function or foraging for wild edible items.

These conditions existed and continue to exist in Vietnam. At the request of the RVN, Project AGILE has undertaken the development of chemical systems designed on the one hand to defoliate indigenous vegetation and on the other hand to destroy edible plants on which the Viet Cong depend. The primary emphasis has been on the development and aerial dissemination of these chemicals. Since the inception of these tasks, the focus of geographical interest has been extended beyond Vietnam.

Task A - Defoliation

Objective

To identify new herbicidal chemicals more effective than presently available commercial compounds and to develop advanced 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.

(1) HIDAL Herbicide Spray System

Objective - To develop an herbicide spray system for employment from helicopters.

Progress to Date - The acronym HIDAL is derived from Helicopter Insecticide Dispersal Apparatus - Liquid. This herbicidal spray system was conceptualized as a modified version of a U. S. Navy stock item originally designed for insect control. Its components are a 200-gallon glass-fiber tank, a positive-displacement electrically driven pump, two stainless steel booms, each 25 feet long and equipped with spray nozzles, and ancillary plumbing. The system can be mounted in H-34, H-19, and similar rotary-wing aircraft. As modified for defoliation use, the electric motor/pump has been changed to allow approximately three times the original flow rate and continuous rather than intermittent operation. Boom hangers on the aircraft have also been

strengthened. The loaded weight of this system is approximately 2,500 pounds, depending upon the density of the agent fill. (See Figure 48).

In November, 1962, the U. S. Army CBR Agency, on AGILE's behalf, undertook the modification task outlined above. Modifications were made and ground tests were completed by February, 1963. During the period May-July, 1963, aerial tests were performed at Eglin AFB to determine deposition pattern, droplet size, and agent recovery at two altitudes and at two airspeeds. Flight stability and operational functioning/reliability were also confirmed. No difficulties were encountered. New pump motors, electrical components, and spray nozzles have been sent to Vietnam to be used in modifying the five RVNAF operational HIDAL systems. A special report entitled "The Employment of Helicopters in Defoliation Operations in the Republic of Vietnam" (C) has been published and is available from the Defense Documentation Center under AD 346489.

Plan and Schedule to Complete - A final report is in preparation by Edgewood Arsenal and Ft. Detrick and should be available in early 1964. No further effort beyond this final report is planned.

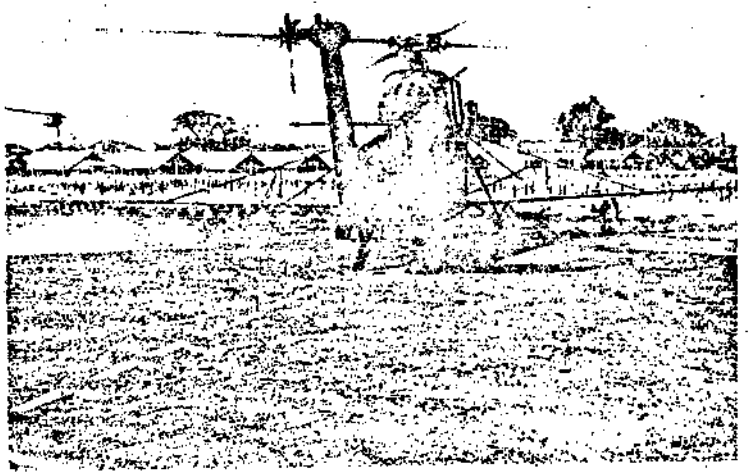
(2) FIDAL Herbicide Spray System

Objective - To develop an herbicide spray system for employment on fixed-wing aircraft of the AD-6 class.

Progress to Date - The acronym FIDAL is derived from Fixed-Wing Insecticidal Dispersal Apparatus - Liquid. This system was conceptualized as a modified 300-gallon auxiliary fuel tank (Aero 1B) fitted at the front with an electrically controlled variable-pitch fan. Upon activation, the fan positions itself to a preselected pitch, rotates in the airstream, and drives a centrifugal pump. The pump, which is self-priming, picks up the agent from the bottom of the tank, and when sufficient pressure is built up (15 psi), forces the agent through a boom at the rear that is fitted with 14 spray nozzles. The loaded weight of the tank is approximately 3,300 pounds, depending upon the specific gravity of the agent fill. An AD-6 aircraft can carry three of these tanks. (See Figure 49).

In November, 1962, the U. S. Army CBR Agency, on AGILE's behalf, undertook the development of the U. S. Navy concept outlined above. By February, 1963, a commercial organization had fabricated six prototype systems and subjected them to ground and preliminary company flight testing. The six units were delivered to Eglin AFB in March, 1963, for full-scale calibration testing and system evaluation. During the period May-July, 1963, calibration tests and flight evaluations revealed a number of engineering deficiencies. Analysis of data collected during this three-month test cycle was carried out during August, 1963. On the basis of this analysis a list of further modifications was prepared and the prototypes will be returned to the contractor for rework.

Plan and Schedule to Complete - The contractor is expected to have completed the rework of the six units and to have conducted in-house reliability ground and flight tests early in 1964. The units will then undergo full-scale system evaluation and calibration at a U. S. Government facility. It is currently expected that a final report will be available by mid-1964.



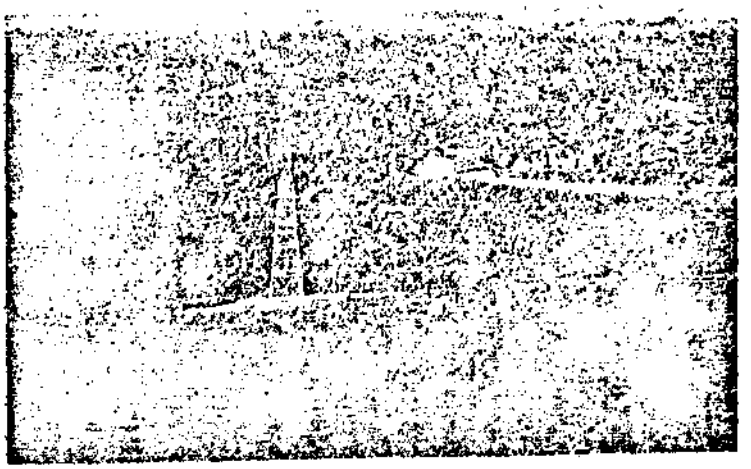


FIGURE 48. HIDAL HERBICIDE SPRAY SYSTEM

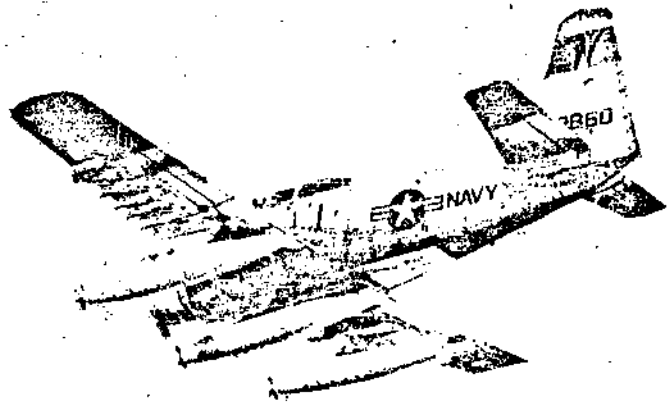


FIGURE 49. FIDAL HERBICIDE SPRAY SYSTEM

(3) Modified MC-1/C-123 Herbicide Spray System

Objective - To develop an improved herbicide spray system for employment with longer range, high-load-capacity aircraft of the C-123 type.

Progress to Date - This system was conceptualized as a modified MC-1, 1000-gallon tank and two 20-hp gasoline engines driving centrifugal pumps plumbed to two wing-mounted spray booms and one tail boom. The pumps and booms are manually valved to permit any combination of single or multiple boom-pump operation. The loaded weight of this equipment will be about 7 tons. The modified system is to produce a droplet size of approximately 300-micron diameter, homogeneity of deposition in a 500-foot spray swath and a homogeneous deposition rate of 3 gallons per acre when used with herbicides with physical characteristics comparable to agent "PURPLE." (See Figure 50)

In May, 1962, the U. S. Army CBR Agency undertook, on AGILE's behalf, the task of re-engineering the MC-1 system to meet the above concept. This work was to be carried out in two concurrent phases; one to re-engineer the spray nozzles to achieve 300-micron droplet size and a homogeneous 500-foot spray swath, the other to re-engineer plumbing and motor/pump assembly to achieve a deposition rate of 3 gallons per acre. The re-engineered prototype was installed in a C-123 aircraft during February, 1963, and spray trials were begun at Eglin AFB in May, 1963. Minor design deficiencies were noted and corrected during this period and spray trials continued intermittently during June as weather and grid-area availability permitted. In July, 1963, terminal spray tests were run using the finalized version of the system. In August, 1963, the aircraft was returned to Olmstead AFB for recording and production drawings of the modifications. This recording was completed in December, 1963, and the modified system is being offered to USAF for their retention and use.

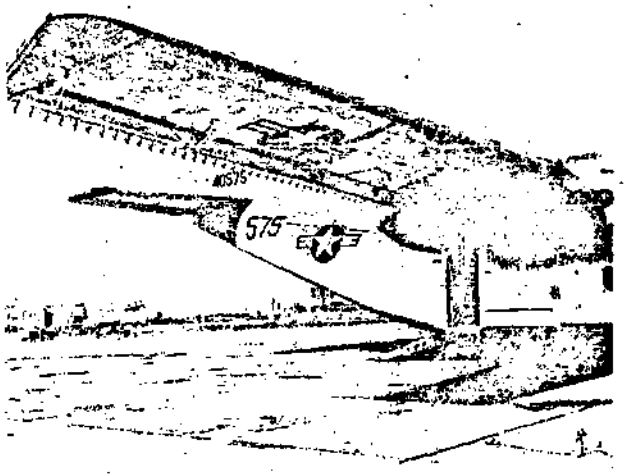
Plan and Schedule to Complete - The data collected during the spray trials run between May and July, 1963, are being reduced and analyzed. A final report is in preparation by Edgewood Arsenal/Ft. Detrick and is expected to be available early in 1964. This report will complete this subtask.

(4) FS-AMD/C-130 Herbicide Spray System

Objective - To develop a modular, high-capacity herbicidal spray system for use on aircraft of the C-130 type.

Progress to Date - This system was conceptualized to consist of 500-gallon modules which can be installed and removed readily from an aircraft (under one hour), will not require aircraft modification, and will be powered by pressure bottles rather than pumps.

In May, 1963, USAF-SC, acting on AGILE's behalf, began work to develop a system to meet the above concept. In June, 1963, a contract was let with the Aircraft-Missiles Division, Fairchild-Stratos Corporation, for the design, development, and production of six complete systems for aircraft testing and one tank unit for specimen testing. Work under this contract is continuing. A detailed evaluation of performance to date is expected in January, 1964.



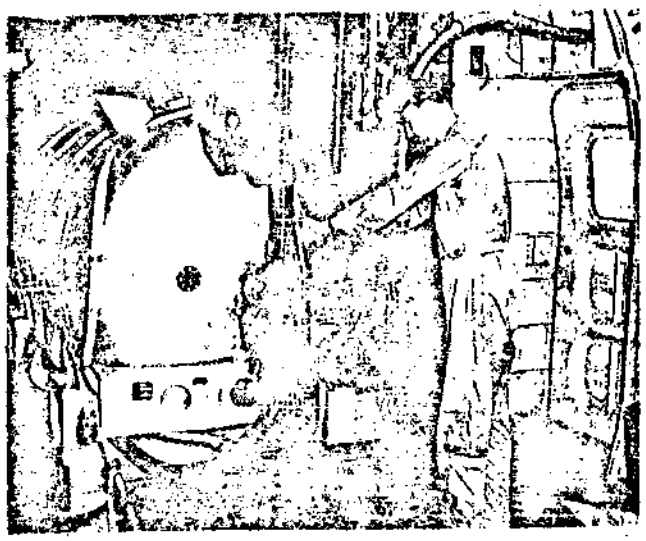


FIGURE 50. MC-1/C-123 HERBICIDE SPRAY SYSTEM

Plan and Schedule to Complete - Pending the receipt of the above-mentioned evaluation it is projected that delivery to Det 4, ASD, ASQW, Eglin AFB, will be effected in the first quarter of 1964 and that flight tests and system evaluation will be accomplished during the second quarter of 1964.

(5) Herbicidal Chemical Research and Test Program

Objective - To acquire and screen a variety of newly developed herbicidal chemical compounds with a view to identifying better agents for use in military defoliation and crop destruction.

Progress to Date - This subtask is being carried out in four phases under a joint arrangement with the U. S. Army Biological Laboratory, Ft. Detrick, Maryland, and the Agricultural Research Service, U. S. Department of Agriculture, Beltsville, Maryland.

Phase I. In January, 1963, the USABIOLABS was assigned the task of locating sources for and procuring test quantities of new candidate phytotoxic chemical compounds. A number of synthesis contracts were let with leading companies in the herbicidal chemical field. In addition solicitations were made to the general industry for the submission of new compounds showing promise. As new compounds are received they are subjected to primary screening tests for phytotoxic activity. Compounds which pass this primary screening are advanced to Phase II.

Phase II. In January, 1963, the Agricultural Research Service, U. S. Department of Agriculture, was given the responsibility for establishing two CONUS field-plot test sites at which secondary screening and research in principle of kill, evaluation systems, time-rate of kill, and environmental effects could be investigated. For time-phase reasons the program initiation was delayed until April, 1963. College Station, Texas, and Mayaguez, Puerto Rico, were chosen as site locations and normal personnel and facilities buildups were carried out during the period May-December, 1963. Several subprograms, including field spray testing, were initiated during the fourth quarter of 1963. Examples include: screening spray tests on plots of whitebrush, smilax, huisache, gum, sumac, and sweet bay (Texas); movement and persistency of soil-applied herbicides in three discrete environmental areas and seasonal susceptibility of guava to selected foliar-applied herbicides (Puerto Rico).

Phase III. In January, 1963, the USABIOLABS was requested to establish a Thailand test site and a program for on-site tertiary evaluation of various phytotoxic chemicals. It was expected that definitive testing of already established phytotoxic compounds would be carried out during the first year with new compounds added as they became available from Phase II. Normal facilities and personnel buildup were carried out between April and December, 1963. Although agreements had been reached with the Thai Government on test sites some difficulties were encountered during the Summer and Fall of 1963. Resolution of the majority of these problems had been accomplished by December, 1963. Test quantities of several chemicals were sent to Thailand, negotiations for a C-45 spray configured aircraft were concluded in November, 1963, with delivery of the aircraft in Thailand effected in December, 1963. Substantive progress

has been made on several subprograms and is continuing. Examples include hand spraying of special test plots, surveying and lane clearing in larger test plots, with the major effort to date devoted to a botanical collection and identification program in collaboration with members of several Royal Thai Government facilities.

Phase IV. In January, 1963, the Agricultural Research Service, U. S. Department of Agriculture, was asked to acquire, categorize, and evaluate botanical information needed for the interpretation of reaction selectivity of various phytotoxic chemicals. Correlations between vegetation in CONUS, Puerto Rico and Southeast Asia will also be derived. Time-phasing considerations dictated an initiation date of April, 1963. An in-depth literature survey of the botany of Southeast Asia and special surveys on pteridophytes and spermatophytes of the Caribbean area were launched in April, 1963. By October, 1963, a complete plant genera list for the Caribbean area was complete and many data had been obtained for the in-depth survey of the flora of Southeast Asia. In November, 1963, one senior botanist began a 2-1/2-month field trip in Southeast Asia which is expected to provide much additional information.

Plan and Schedule to Complete - All phases are expected to continue their missions at anticipated rates during the next reporting period. Current schedules call for completion of Phases I and III by January, 1965, and Phases II and IV by March, 1965. Periodic program reviews will determine whether additional work will be carried out.

Task B - Crop Destruction

Objective

To develop systems for the accurate delivery of crop-destroying chemicals to small plots of edible crops as a means of supporting, through technical assistance, local friendly forces in their denial of the insurgents' capability to use this method of logistically supporting their operations against the local government.

Progress to Date

The majority of the subtasks described under Task A - Defoliation also have some application to this task. Under Task B one major effort is specifically devoted to crop destruction:

(1) Herbicidal Bomblet Cluster System - The conceptualization of this system was:

> "The herbicide bomblet is a one-quart wide-mouth tin-can container fitted with a booster and impact-detonated fuze. These bomblets are clustered in two designs. The designated X7 is composed of seven bomblets clustered in a cylindrical shape approximately 11 inches in diameter by 11 inches high. This cluster is dropped from an aircraft in a manner such that a lanyard is unrolled (yo-yo fashion) and snaps the cluster open, allowing the bomblets to scatter and burst upon impact. The loaded cluster weight is 37 pounds. The X28 design cluster contains 28 bomblets in a cylindrical configuration approximately

11 inches in diameter. Fitted with a ballistic nose cone and boat tail, the cluster is 62 inches long and weighs, filled, 162 pounds. The cluster can be hung from standard 14-inch-centered bomb shackles and functions in the same manner as the X7."

In November, 1962, the U. S. Army CBR Agency undertook, on AGILE's behalf, the development and testing of systems to meet the above concept. During February-March, 1963, testing was carried out to determine bomblet source strength, particle-size distribution, distribution patterns, deposition rates, cluster dispersion patterns and cluster trajectories. During May, 1963, tests of functioning and dispersion on marsh-land vegetation were carried out. During June, 1963, static firing tests to determine dose rates versus area coverage for marsh-land vegetation were carried out. During July, 1963, flight compatibility, stability and fit tests on AD-5 aircraft (see Figure 51) were carried out at speeds of 120 to 220 knots and under stresses up to 2-1/2 G. During August, 1963, an Edgewood Arsenal committee evaluated the accumulated test data and in September, 1963, submitted their report which stated that:

"Two clusters have been developed and tested to fulfill referenced requirement.

"(1). The E-156, 150-pound cluster contains 28 one-quart E-138 bomblets that burst on impact. The cluster is designed for level-flight bomb-release delivery from light aircraft that are equipped with 14-inch mounting brackets. Tests have been successfully conducted releasing the cluster from L-19, L-20, and U. S. Navy AD-5 aircraft. It is compatible with AD-6 and Mohawk aircraft. If desired, it may be manually jettisoned from H-34, H-19, UH-1, and C-123 aircraft.

"(2). The E-155, 40-pound cluster contains seven one-quart E-138 bomblets. This cluster is designed for manual jettison only from H-34, H-19, UH-1, L-20, L-19, and C-123 aircraft."

The evaluating committee estimated, based on accumulated test data, that:

(1) The E-138 bomblet could be filled in the field by semiskilled personnel without special equipment other than a funnel, a hose, or a spigot

(2) The clusters could be assembled in the field with hand tools and a simple jig

(3) Mission preparation could be carried out by a normally trained aircrew.

Receipt in October, 1963, of the report of the Task Force Saigon Herbicide Evaluation Team led AGILE to query CDTC-V on their interest in receiving test quantities of the E-138 bomblet and both the E-155 and E-156 clusters. An affirmative reply was received and action is under way to implement this field testing.

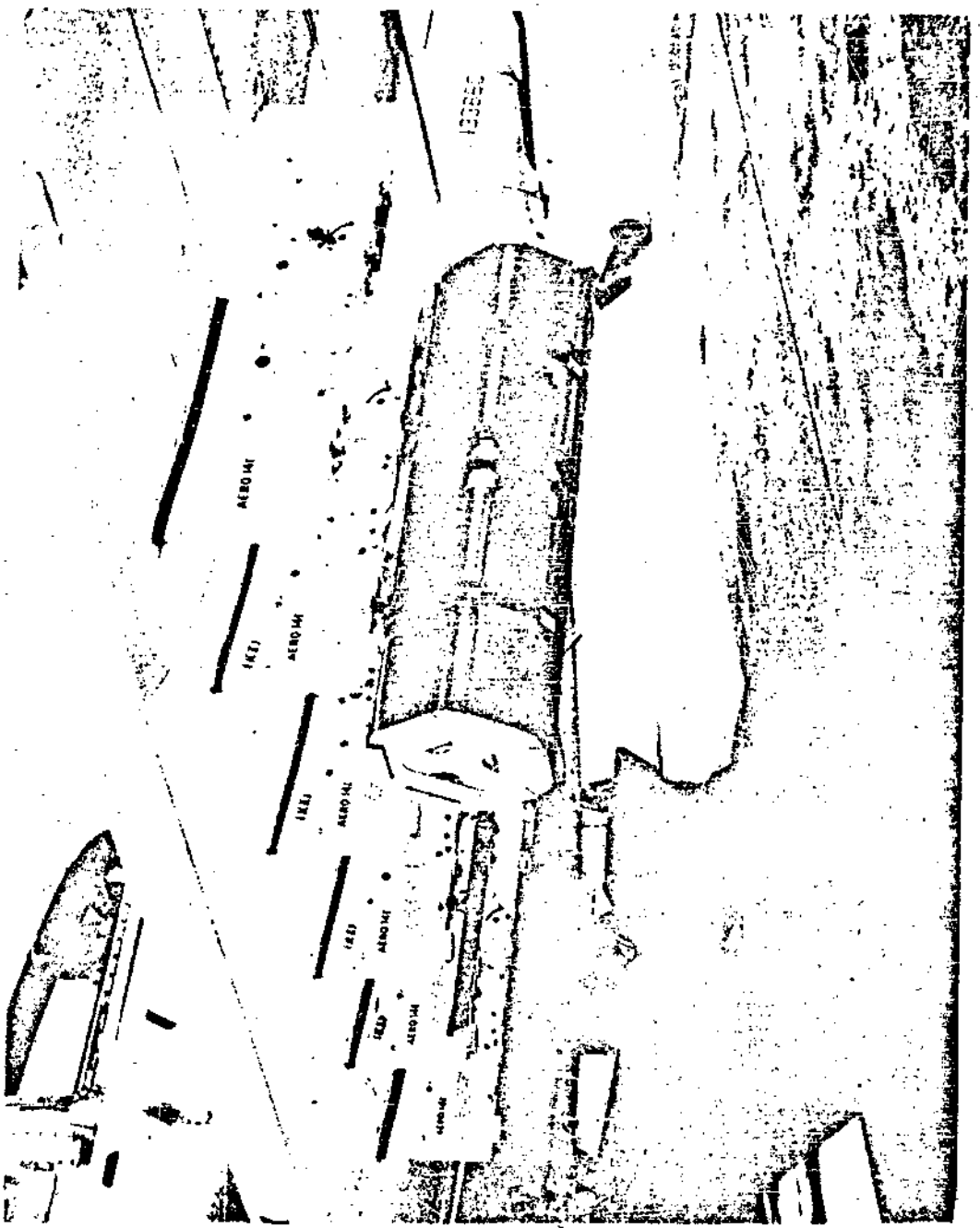


FIGURE 51. FIT TEST OF E-156 CLUSTER ON AD-5 AIRCRAFT

Plan and Schedule to Complete

It is anticipated that test quantities of the E-138 bomblet and the E-155 and E-156 clusters will be made available to CDTC-V by April, 1964. No estimate of the date for completion of field testing can be made at this time.

Technical Area 2 – Psychological Warfare

Background

The general consensus of expert thought on the problems of counterinsurgency has almost universally emphasized the need to obtain the cooperation of the masses. One of the methods of obtaining this mass cooperation is the application of a variety of standard psychological-warfare techniques. It is, however, necessary to modify these standard techniques, and any associated equipments, to adequately cope with the constraints imposed by the unusual and highly variant nature of the environment, the conflict and, in fact, the masses themselves. This technical area addresses itself to the definition of these new constraints, their evolution into R&D requirements, and the generation of new techniques and equipments to satisfy such requirements.

Task A - Mobile Audio-Visual Unit

Objective

To produce a mobile audio-visual unit capable of operating in remote tropical areas with the following capabilities: public-address system for voice and music; motion-picture projection system; and a self-contained power supply.

Progress to Date

In the hope that already available equipment might fulfill this requirement, two Willys Audio-Visual Mobile Units were sent to Thailand in October, 1962. Five field operational tests were conducted in different environmental areas of Thailand during the period October, 1962 - March, 1963. These tests covered hot, cool, wet, and dry seasons and utilized four crews of drivers and operators. A final test report was issued in April, 1962, by the Joint Thai-U.S. Combat Development and Test Center under the title "Evaluation of the Willys Audio Visual Mobile Unit for Potential Indigenous Use by Thai Forces" and is available from the Defense Documentation Center under AD 413044. In summary the report concludes that the Willys unit does not meet the established requirement primarily because the vehicle and audio-visual equipment do not withstand the rigors of the environment in which they must operate.

Plan and Schedule to Complete

The field tests already completed indicate the need to revise the performance requirements for the modular audio-visual system to insure that the resulting system is rugged enough to survive in the environment, is packaged for man-portability, and is capable of being operated from a self-contained power source. Such a system could then be adapted to available local transportation whether it be man, animal, or vehicle. Pending an evaluation of various alternative solutions, no further hardware R&D or field tests have been planned.

Task B - High-Power Voice-Amplifier System

Objective

To define a suitable high-power voice-amplifier system for use from aircraft.

Progress to Date

Two commercial systems were sent to CDTC-V in October, 1962. One 500-watt unit was loaned to ACTIV by CDTC-V for installation on a UH-1B helicopter. Preliminary test results indicated ranges of over one mile with good intelligibility and highly directional qualities.

Plan and Schedule to Complete

The requirement has been satisfied through joint effort by the U. S. groups in Vietnam. It is not presently planned that a final test report will be issued and no further reporting will be made.

Task C - Man-Portable, Self-Contained PA System

Objective

A very lightweight, completely self-contained medium-power PA system is needed for psychological-warfare operations in remote areas.

Progress to Date

Utilizing ARPA funds the Naval Ordnance Test Station has designed a PA system tailored to the requirement. This system (self-contained weight less than 80 pounds, 120-watt power output, range in excess of 1000 meters) was sent to the MRDC in Thailand where field tests were run in open country, hilly country, and jungle environments. The results of these tests were published in May, 1963, by the Joint U. S. - Thai Combat Development and Test Center under the title "Test of Naval Ordnance Test Station Portable Public Address System". This report is available from the Defense Documentation Center under AD 427200. (See Figure 52.)

In summary the test report concludes that the unit is compact, powerful, easy to operate, and reliable. NOTS has now designed a second generation model which weighs 55 pounds and retains the other technical-performance characteristics of the model tested. ARPA considers, however, that the test of the first model demonstrated the satisfaction of the original requirement.

Plan and Schedule to Complete

This task is complete.

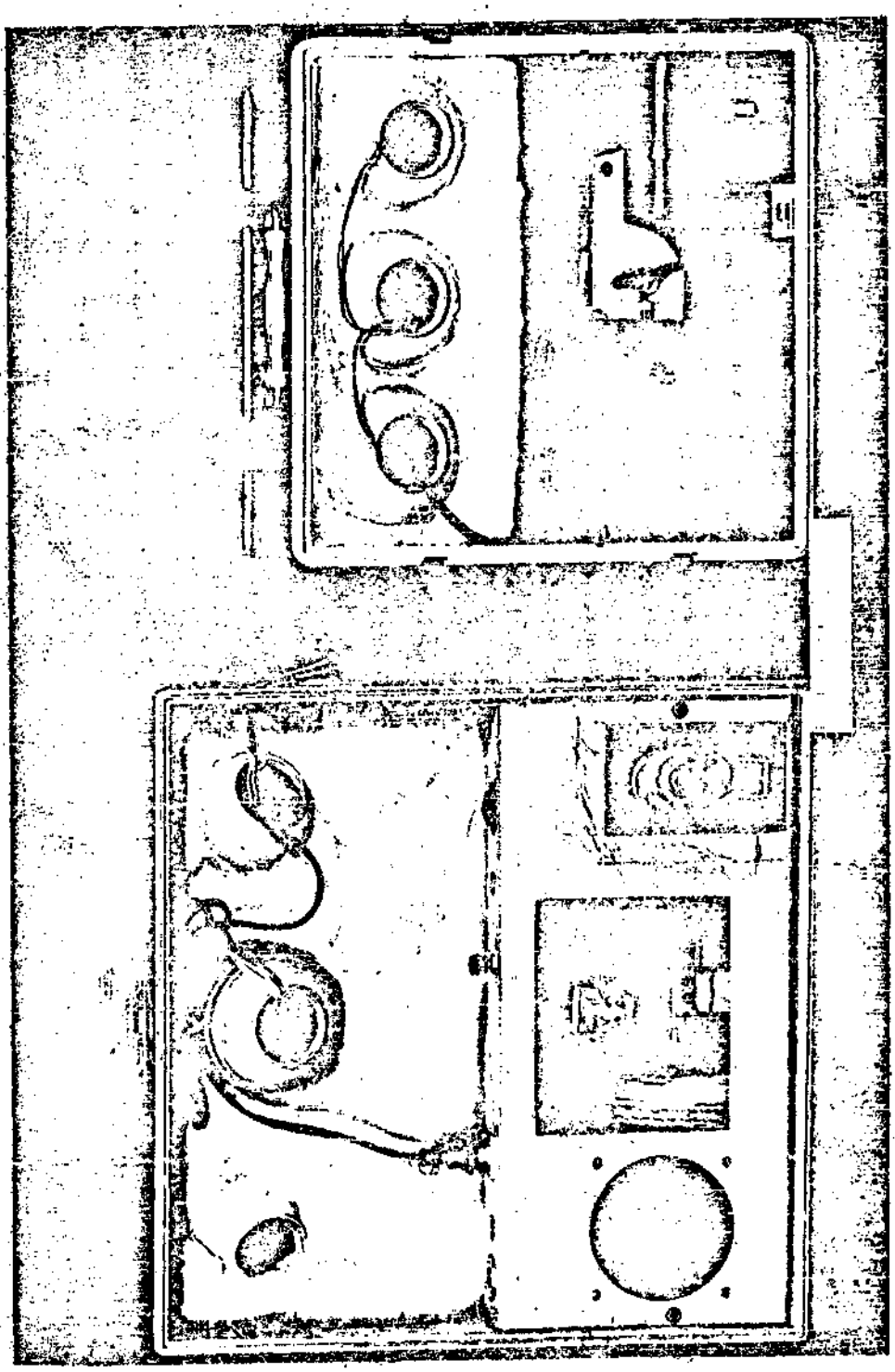


FIGURE 32. MARK I AND II PA SYSTEM UNITS, REAR VIEW

Technical Area 3 - Medical Research and Equipment

Background

Typically, in those geographic locations of the world where remote area conflict is likely to develop, there is a very meager national medical capability. This lack of capability expresses itself not only in a lack of trained professionals and facilities, but also in a dearth of individual knowledge of basic first aid and hygienics in the military establishment. Complicating this situation is the general military requirement that combat echelons have a long-range, self-sustaining capability when involved in conflict. To aid in a solution of this problem, this technical area is attempting to devise techniques and items of medical equipment which can be effectively used by unskilled military personnel, which are light and durable, and which are specially tailored to meet endemic military medical problems.

Task A - Individual Aid Kits

Objective

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

Progress to Date

In September, 1961, ten individual aid kits and four augmentation packets were shipped to CDTC-V for preliminary evaluation by selected ARVN troops. These kits were developmental items being investigated for U. S. Special Forces use. In April, 1962, the Commanding Officer, 77th Inter-Battalion, ARVN, reported that troop testing showed the kits to be very useful but that some modification for ARVN use on isolated missions and separate operations would be required. The report requested expeditious attention to these problems and the establishment of a full-scale test program.

In August, 1962, 130 individual aid kits were shipped to CDTC-V for use in this full evaluation. These kits were the current model of the U. S. Special Forces Individual Medical Aid Kit which had already incorporated several of the modifications suggested as a result of the earlier tests. Field testing was conducted by both RVN and U. S. personnel over a period of several months. RVN personnel comprised 73 per cent of the individuals testing the kit with U. S. personnel making up the other 27 per cent. RVN troops included members of the 10th Special Battalion, 77th Special Forces, and the ARVN Surgeon General's office. U. S. personnel included the MAAG Surgeon's Office and the Surgeon, U. S. Special Forces as well as U. S. Advisors assigned to the ARVN troop units. Results of testing were obtained through questionnaires and personal field interviews with the troops involved. The kit was rated valuable by 97.5 per cent of the testing personnel. The balance of 2.5 per cent failed to fill in that question. Over 80 per cent felt the kit was usable in its present configuration. Those recommending changes were remarkably consistent in their desires for change. These suggested

modifications are detailed in a Report of Test published in August, 1963, by the Combat Development and Test Center, Vietnam, under the title "Evaluation of Individual Medical Aid Kit for Special Forces". This report is available from Defense Documentation under AD 424769. The report concludes that the kit has a very high utility for Special Forces, Rangers, and other special units who must operate on extended patrol without medical support. The report has been circulated to the U. S. military medical community for consideration of the several modifications recommended for inclusion in future kits.

Plan and Schedule to Complete

Pending reaction from the medical community no further action is planned.

Task B - Leech Repellents

Objective

To provide more effective leech repellents for aquatic and terrestrial species.

Progress to Date

Acting on Project AGILE's behalf, the Battelle Memorial Institute has carried out a state-of-the-art study on leech repellents. The report includes sections on historical review, contemporary studies and research programs, a review of repellent testing techniques, world geographic distribution of leeches, sensitivity of leeches to stimuli and suggested gaps in repellent research. This study is available from the Defense Documentation Center under AD 413979.

Arrangements have been made to procure several different aerosol packagings in quantities sufficient to enable evaluation by RVNAF and Royal Thai Army personnel to determine the utility of the aerosol method of application, the optimum size and configuration of the cans, and the efficacy of the local language instructions printed on the items. The first shipment was made to Vietnam and Thailand in October, 1962. The balance of the aerosol configurations should be ready for shipment in early 1964. No test data are presently available.

Plan and Schedule to Complete

Several new research efforts are under consideration but have not yet been accepted. Pending field reports on the aerosol configuration and decisions on new programs this task will continue as medium priority.

Task C - Jungle Litter

Objective

To develop or identify a suitable jungle litter for medical evacuation use.

Progress to Date

In accordance with the philosophy of examining available items before engaging in R&D, information relating to existing Service, commercial, and developmental litters with jungle potential was collected and forwarded to CDTC-V for discussion with MACV and RVNAF medical personnel. Based on the results of the above discussions, three items were shipped to Vietnam for testing in parallel with litters already in country. A test plan was drawn up and coordinated with MAAG medical advisors and test items were issued to RVNAF medical units for evaluation. These evaluations have been completed and a final test report is in preparation.

Plan and Schedule to Complete

No further action will be taken prior to receipt of the field test report. If the report is favorable the task will be terminated.

~~CONFIDENTIAL~~

AGILE SUBPROJECT VII

TECHNICAL PLANNING AND PROGRAMMING

~~CONFIDENTIAL~~

AGILE SUBPROJECT VII

TECHNICAL PLANNING AND PROGRAMMING

SUBPROJECT OBJECTIVE

This subproject incorporates operations research tasks directed toward the identification of requirements for new or improved counterinsurgency weapons and equipment. Through data acquisition and analysis and the application of interdisciplinary scientific techniques to the analysis of military and related civil problems, this subproject points the way to new ideas and requirements, helps establish priorities, and aids in integrating ARPA/AGILE's counterinsurgency RDT&E effort.

SUBPROJECT 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 local governments involved in counterinsurgency to consider the effects 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 over-all point of view. The mission of effecting this function for ARPA/AGILE has been assigned to the Technical Planning and Programming Subproject.

Another prerequisite for the identification of RDT&E requirements is the collection and analysis of sufficient valid data. Although many data already exist 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 weapon 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 suitable retrievable form for purposes of comparison, contrast, establishment of project and subproject parameters, maintenance of informational continuity, and the identification of data gaps. Such a system should be susceptible to expansion and should incorporate a quick-response capability.

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

SUBPROJECT VII TECHNICAL AREAS, TASKS, AND SUBTASKS

Listed below are those major technical areas, and the tasks and subtasks in each area, with which this subproject is concerned. Succeeding pages contain the summaries of the objectives and status of each.

Technical Area 1. Environmental Data Collection and Analysis

Task A. Physical Environment Methodology (Project DUTY)

Task B. Vegetation Study

Technical Area 2. Military Data Collection and Analysis

Task A. Morbidity and Casualty Study

Task B. SEATO Medical Analysis

Task C. RVNAF After-Action Report Study

Task D. Border Surveillance and Control

Task E. Ambush Patterns and Countertechniques

Task F. Field Communication Systems Performance

Task G. Analysis of Large-Scale Viet Cong Operations

Technical Area 3. Sociological Data Collection and Analysis

Task A. Studies of Northeast Thailand

Task B. Analysis of Mobile Development Unit (MDU) Operations

Technical Area 4. Historical Studies

Task A. Algerian Study

Task B. Historical Survey of Patterns and Techniques of Insurgency Conflicts in Post-1900 Latin America

Technical Area 5. Special Studies

Task A. Adviser-Counterpart Communication

Task B. Operations Research Lectures

Task C. Effects of the Strategic Hamlet Program in Vietnam

Technical Area 6. Data Storage and Retrieval

Task A. Remote Area Conflict Information Center

Technical Area 1 - Environmental Data Collection and Analysis

Background

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, SEA CORE, SEA SURE, and defoliation) are already under way, there exists a wealth of more general physical environmental data which are neither systematized, related, nor in many cases readily retrievable. It is with these general problems that this technical area is concerned.

Task A - Physical Environment Methodology (Project DUTY)

Objective

The objective of this task is to develop a methodology which will permit integration of the various factors of the physical environment into a total picture usable in specific R&D efforts and to develop a descriptive system which will permit adequate differentiation, for example, between the various types of forest and jungle, their incidence, features, and location.

Progress to Date

The contractor has carried out the following:

(1) Climate - A bibliographic search has been completed; extensive studies on the state of the art and user needs have been carried on.

(2) Terrain - In this area intensive effort has been placed on evaluation of current taxonomic systems for terrain analysis with a view to developing an optimized system for Project AGILE's needs.

(3) Vegetation - An extensive literature search has been launched and is still under way as a first step in defining exhaustively those elements of vegetation which are germane to AGILE's problems and which will require quantification. A preliminary list of those elements has been developed.

(4) Military use of parameters - A survey has been completed of various organizations and agencies to determine what environmental factors are generally considered to have relevance or significance to military R&D by competent professionals. These factors will be synthesized with other aspects of Project DUTY.

To assist Project DUTY and the Army Research Office - Durham, an advisory committee consisting of environmental experts from the Services, industry, and the

academic community has been formed. The first meeting of this advisory committee was held in September, 1963, and proved to be a valuable asset to the Project. The original concept of Project DUTY had envisioned the actual collection of all available environmental data as well as the design of a methodology to provide for their storage and manipulation. Shortly after the inception of the project it became apparent that the actual collection of total available data would require far more effort than was available in Project DUTY. The advisory committee confirmed this belief and was instrumental in sharpening the focus of the program. The project now has as its single purpose the development of a physical environmental methodology whose application will be to the needs of Project AGILE. While such a methodology will have much utility to other R&D organizations the inclusion of total information is not possible under the present program.

Plan and Schedule to Complete

During the next six months it is anticipated that tentative models for discrete portions of the methodology will be formulated and subjected to test and verification using sample data. Depending on the success of these tests, limited field verification may be carried out.

No completion date can be stated because of the theoretical nature of the program.

Task B - Vegetation Study

Objective

The objective of this task is to provide 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 to the on-going efforts in mobility, communications, surveillance, defoliation, and munitions research programs.

Progress to Date

Contract negotiations with the Thai Department of Forestry (DOF) have been completed. DOF scientific teams will perform technical investigations and studies of vegetation and associated environmental factors found in Thailand in accordance with the general work outline published in the Project AGILE Quarterly Report (QR-10), pp 162-163.

Thus far the teams have made two field trips to the Chieng Mai area in the North, the Loei area in the Northeast, the Kra Peninsula area in Surat Thani Province in September, and the Korat area in central Thailand in October. Thirty-two sample plots or forest profiles have been made by the team to date. Sample plots made by other botanists and foresters in Thailand and by visiting scientists from other countries will also be included in the over-all data collection effort. Two soil engineers are accompanying the vegetation teams and collecting soil samples to provide trafficability data useful to the MERS program. Canopy measurements and forward-visibility

measurements are being accomplished at the same time in the same forest areas. The existence of types of vegetation such as thorny rattan, lawyer vines, or other plants which cause excruciating pain, skin irritation, or other hazards to troops is also being recorded.

Plan and Schedule to Complete

Open-end project.

Technical Area 2 - Military Data Collection and Analysis

Background

The purpose of this technical area is to define the nature of the conflict in as precise terms as possible and to relate this definition to RDT&E requirements and quantitative parametric data for hardware. The emphasis is on system studies and includes data collection and analysis on border control; logistic systems; night operations; boat, lake, and river warfare; casualty statistics; ambush patterns; food control; and internal security systems.

Task A - Morbidity and Casualty Study

Objective

The objective is to determine the specific weapons and techniques of the enemy 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.

Progress to Date

The primary source of information is the RVNAF hospital admission records. All of the 1962 admission records from all military hospitals are being examined. Pertinent data are being extracted and transferred to IBM cards so that machine techniques may be applied in the statistical phase of the analysis. A study on this machine processing is being prepared, and a study "Spike Wounds in the Vietnamese Guerrilla War" (RACSEA-FS-2, 3 Sept 1963, Confidential) will be distributed shortly. Major findings were that spikes account for about 4.5 per cent of all battle casualties admitted to hospitals and that different devices are found in different parts of the country. Leg wounds are more often incurred in the uplands, whereas wounds of the buttock and thigh are more common in the Delta. Finally, spike wounds tended to be less severe than other battle wounds.

Plan and Schedule to Complete

The schedule for this task is dependent upon the prompt reporting of RVN personnel from the Surgeon General's office to aid in translation and transcription of the data. If this condition is met, it is expected that the analysis will be completed by 15 March 1964.

Task B - SEATO Medical Analysis

Objective

The objective of this task is to assess the significance of medical factors in Southeast Asian military exercises performed under SEATO.

Progress to Date

Considerable data from the U. S., Thai, and U. K. elements participating in Exercise Dhanarajata have been gathered and a preliminary memorandum has been prepared. Work on the final memorandum, however, has had to be suspended because of higher priority tasks. In early 1963 a similar study was done on JTF 116 (Statistical Analysis of Medical Records of Joint Task Force 116 in Thailand in Spring and Summer of 1962; RAC-SP-2 (SEA), April, 1963 OUO). Major findings were that heat disorders were lower than anticipated primarily because the troops were preconditioned and physically fit and because work rates were lower than would be experienced in combat. The report recommended that problems of acclimatization would require continuing analysis. The need for very close attention to preventive-medicine techniques was also pointed up.

Plan and Schedule to Complete

It is hoped that a final memorandum can be completed by the second quarter of 1964.

Task C - RVNAF After-Action Report Study

Objective

The objective of this task is to obtain on a systematic basis more complete and definitive RVNAF reporting of actions between elements of the RVNAF and the Viet Cong. The specific intent is to collect data of the type that will permit systematic analysis to determine RDT&E requirements.

Progress to Date

Questionnaires have been designed, translated, and introduced into several civil guard units. A very small amount of return has been realized to date. When sufficient data have been collected to permit an evaluation of the questionnaires, an analysis of this system will be undertaken.

Plan and Schedule to Complete

The system analysis may be possible by early 1964. Further plans and schedules will be formed from that analysis.

Task D - Border Surveillance and Control

Objective

The objective of this task is to ascertain the feasibility of detecting and eventually diminishing illicit traffic in men and materials into and out of South Vietnam.

Progress to Date

A report has been completed and is being edited prior to publication and distribution. The most salient conclusion of this study is that the resources of Vietnam, together with the likely assistance to be provided by the U. S. and other foreign governments, are insufficient at the present time to effect a high degree of conventional border control. The study suggests that the most practicable and expeditious manner for achieving control of the border areas is through the rapid implementation of the Strategic Hamlet Program. Nevertheless, the study believes that, meanwhile, methods of making border crossings less secure and less attractive would have utility.

Plan and Schedule to Complete

It is expected that the aforementioned study will be distributed in the first quarter of CY-1964.

Task E - Ambush Patterns and Countertechniques

Objective

The objective of this task is to analyze the ambush in all its forms, identify typical ambush patterns, and develop parametric data from which RDT&E requirements for counterweapons, devices, and equipment can be developed.

Progress to Date

First emphasis was placed on river and canal ambushes and vehicular convoy ambushes. Two reports have so far been published: "Counter-Ambush Techniques to Protect Military Vehicular Traffic on Major Highways in South Vietnam" RAC-SP-3 (SEA), May 1963, Confidential, and "River and Canal Ambush Problems, Republic of Vietnam, 1962" RAC-SP-4 (SEA), April, 1963, Secret. Some conclusions of the former were: that protection and firepower are currently inadequate against large-scale ambushes, that escort procedures for escorting armored vehicles require considerable improvement, that air escort has a useful psychological effect, and that new types of barrage weapons systems should be investigated. The rivers and canals study pointed up the fact that during 1962 river and canal ambushes have had little destructive effect on the RVN armed forces. The study notes, however, that threat of such ambushes impedes traffic on these routes and that in the event of major pacification operations in the Delta, a problem of large proportions would exist. Specific R&D tasks to alleviate the potential problem in this form of ambush are given.

Plan and Schedule to Complete

It is expected that the railway ambush study will be published in February, 1964. No firm schedule has been established for the foot-patrol ambush analysis.

Task F - Field Communication Systems Performance

Objective

The objective of this task is to analyze 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 RDT&E requirements in the communication equipment area.

Progress to Date

Data have been gathered 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 unit and associated communication equipment. Four separate reports are intended. Initial drafts are still undergoing extensive reviews.

Plan and Schedule to Complete

Indeterminate.

Task G - Analysis of Large-Scale Viet Cong Operations

Objective

The objective of this task is to obtain some insight into Viet Cong attack patterns and tactics as they correlate with time of day and with the lunar cycle.

Progress to Date

Analysis of large-scale Viet Cong operations between mid-September 1962 and mid-April 1963 has been completed, and an RDFU report has been published. The significant finding of this report was to demonstrate the high probability of Viet Cong attacks at night and in the middle of the lunar month, when the moon is new.

Plan and Schedule to Complete

Completed.

Technical Area 3 - Sociological Data Collection and Analysis

Background

This technical area is concerned with the provision of sociological information related to requirements and specifications for equipment in remote areas. It includes analyses in such subject areas as religious systems, value systems, group dynamics, civil-military relationships, and elements of predictive behavior.

Task A - Studies of Northeast Thailand

Objective

The objective of this task is to determine the most likely sources of social conflict in Northeast Thailand, concentrating on those local problems and attitudes which could be exploited by the Communists.

Progress to Date

A RAND study, "Certain Effects of Culture and Social Organization on Internal Security in Thailand" is ready for distribution. The study discusses village views of its problems, government authority at the local level, contrasting views of local authorities, and leadership patterns.

Plan and Schedule to Complete

As noted in "Progress to Date".

Task B - Analysis of Mobile Development Unit (MDU) Operations

Objective

The MDU's in Thailand are basically civic-action teams, put into the field by the National Security Organization, which seek to combine and apply the talents of all civilian and military departments under a single commander. Primary missions are to persuade villagers to have faith and confidence in the RTG, to study local conditions as a basis for development planning, and to collect useful information. An analyst was assigned to spend seven weeks in Northeast Thailand with one of the MDU's and evaluate its performance.

Progress to Date

A report, titled "Observations on National Security Organization Mobile Development Unit - 2 Operations" has been published. The findings generally were that the MDU concept shows great promise. Success depends primarily upon leadership and team attitude toward villagers. The need for follow-up visits and attention to primary village needs - such as potable water, medicine, and hygiene - and educational materials was stressed.

Considerable interest in the report has been evinced by several departments and agencies of the U. S. Government, as well as by the Thai Government. It is probably the most definitive study of MDU Operations to date.

Plan and Schedule to Complete

Completed.

Technical Area 4 - Historical Studies

Background

This technical area attempts to develop R&D requirement inputs from case studies and analyses of previous remote area conflicts. Especially emphasized are trend analyses, comparative studies in insurgency patterns, unique techniques which have had success in countering insurgency, and evaluation of the performance of hardware in these conflicts.

Task A - Algerian Study

Objective

The objective of this task is to analyze the French campaign in Algeria at the level of company-size units.

Progress to Date

A draft study titled "Pacification in Algeria, 1956-1958" has been completed; publication and distribution are expected shortly. The study is in three primary sections, including an appreciation of the situation in the Summer of 1956, the struggle for control of the population, and conclusions. Particular attention has been given to the methodology employed for bridging the civilian military interface and the cross cultural interface, as well as to methods of population control and area denial.

Plan and Schedule to Complete

The task will be completed with the distribution of the report in the near future.

Task B - Historical Survey of Patterns and Techniques of Insurgency Conflicts in Post-1900 Latin America

Objective

The objective of this task is to identify patterns of significant national and lower-scale insurgency activity, strategy, and tactics in Latin America since 1900 in order to determine whether and to what extent such insurgency:

(1) Conformed to communist doctrines of "protracted war" as defined by Mao Tse Tung, Vo Nguyen Giap, and Che Guevara

(2) Gave evidence of commonality in a distinctively Latin American style of insurgency

(3) Followed no discernible pattern.

Progress to Date

The index of all insurgency incidents in Latin America for the recent past as reported in The New York Times has been completed. Extraction of detailed data on insurgency incidents as contained in The New York Times has been completed for nine countries. Supplementary data on 1960-63 insurgency have been extracted from Brazilian, Colombian, Peruvian, and Venezuelan newspapers and periodicals.

Plan and Schedule to Complete

A final technical report is due at the end of January, 1964.

Technical Area 5 - Special Studies

Background

This technical area includes data collection and analysis on subjects not immediately relatable to any of the technical areas described previously and on subjects which encompass two or more elements of those technical areas.

Task A - Advisor-Counterpart Communication

Objective

The objective of this task is to survey the problem in human communication between U. S. advisors and their Vietnamese counterparts and to determine which of these problems are susceptible to improvement through research and development.

Progress to Date

Efforts under way in CONUS on this problem have been preliminarily surveyed. A researcher has been sent to Vietnam to survey measures and techniques currently being used there. In the course of conducting this research, only U. S. personnel in Vietnam will be contacted.

Plan and Schedule to Complete

It is expected that the Vietnam phase of this task will be completed in April and that a final report will be completed in the Summer of 1964.

Task B - Operations Research Lectures

Objective

The objective of this task is to provide basic training in operations research techniques to host-country personnel, thereby increasing local analytic capability in the R&D process.

Progress to Date

A six-lecture course has been prepared introducing the R&D process and emphasizing scientific methods of analysis. The lectures give an appreciation of the benefits and limitations of modern techniques of operations research, war gaming, systems analysis, etc. The lectures were given to a predominantly Thai audience in Bangkok on September 3 to 10, 1963, and were extremely well received.

Plan and Schedule to Complete

The possibility of expanding these lectures and giving them to audiences in other countries is being explored.

Task C - Effects of the Strategic Hamlet Program in Vietnam

Objective

The objective of this task is to evaluate the economic, military, and general effects of the Strategic Hamlet Program in Vietnam and its role in the long-term security of the country.

Progress to Date

This analysis has been divided into four general areas – military effects, economic effects, political and social effects, and problems and difficulties in implementation. To date work has been generally completed on the military-effects section, stressing the long-range role of the Program in the conflict.

Plan and Schedule to Complete

The sections on economic and politico-social effects are due in the first quarter of CY-64. The section on implementation is due in the second quarter, and the final report is due June, 1964.

Technical Area 6 - Data Storage and Retrieval

Background

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 are extremely diverse in substance and geographic location. In order to monitor an effort of this scope and complexity, a system of collection, screening, abstracting, 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 system should substantially reduce the inherent risks and associated expenses of needless repetition of research projects as well as enhance the capability of AGILE to respond to new requirements.

Task A - Remote Area Conflict Information Center (RACIC)

Objective

The objective of this task is to establish an information system 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.

Progress to Date

Essentially all of the information procured from AGILE's backlog has been completely processed into RACIC-Columbus. The extract cards are now being integrated into the RACIC-Washington files. Attention is being given to the acquisition of pertinent material from non-AGILE sources. State-of-the-art studies on leech repellents and analogs for human performance at high altitudes have been completed.

Plan and Schedule to Complete

This will be a continuing task which will be continuously employed in the AGILE programs.

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AGILE SUBPROJECT VIII

Tasks formerly carried under Subproject VIII have been included under Subproject I – Weapons, Individual Equipment, and Rations.

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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 Guerrilla 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
(20) Special Shotguns
(21) Quad Machine Guns
(22) Delayed Proximity Fuzes
(23) Microrocket Pistol and Projectiles
(24) Strip Bullets
(25) Village and Outpost Security
(26) Weapon Systems Studies and Research
(27) Power-Sources Study
(28) Thermoelectric Generators
(29) Hydroelectric Generators
(30) Materials Research
(31) Tactical Maps
(32) High-Power Voice-Amplifier System
(33) Man-Portable, Self-Contained PA System
(34) Analysis of Large-Scale Viet Cong Operations
(35) Analysis of Mobile Development Unit (MDU) Operations

TRANSFERRED

(1) M79 Grenade Launcher – ACTIV
(2) Helicopter Armament – Army
(3) Maximum Aerial Surveillance – ACTIV
(4) Analyses of Laotian Operation – OCRD
(5) M-113 Armored Personnel Carrier Evaluation – ACTIV

CANCELLED

(1) Wire Gun Canister
(2) Ultra-Portable Recorder/Reproducer
(3) High-Speed Press
(4) Tape Recorder, Field Use
(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
(10) Assisted Take-Off
(11) Antipersonnel Bombs

APPENDIX B

COMPLETED REPORTS AND STUDIES

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Appendix C: "Soil Trafficability Preliminary Survey"
Appendix D: "Vegetation Preliminary Survey"
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