United States Department of State

Washington, D.C. 20520

JUN 15 2015

Case No. F-2015-06622

Mr. John Greenewald
[redacted]

Dear Mr. Greenewald:

I refer to your request dated March 15, 2014 to the Department of Defense, processed by that agency under case number DTIC-R (FOIA 2014-110), for the release of certain material under the Freedom of Information Act (Title 5 USC Section 552). Of the relevant documents retrieved in response to your request, one was considered to be of significant interest to the Department of State, and was therefore referred to us for appropriate action.

We have determined that the document may be released in full and enclose it herewith.

Sincerely,

John F. Hackett, Acting Director
Office of Information Programs and Services

Enclosures:
As stated.

14-F-0574 Doc 1

UNCLASSIFIED

MILITARY RESEARCH AND DEVELOPMENT CENTER

QUARTERLY REPORT
1 January - 31 March 1964
QRT-2

3 DIVISION
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ROUTE SLIP # 01293

T. W. Brundage
Director
OSD/ARPA R&D Field Unit

Singchai Menasuta
Major General
Commanding General, Military Research and Development Center

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MILITARY RESEARCH AND
DEVELOPMENT CENTER

QUARTERLY REPORT
1 January - 31 March 1964
QRT-2

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Joint Thai-US Combat Development and Test Center

Bangkok, Thailand

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INTRODUCTION

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MRDC MISSION

The Military Research and Development Center, Thailand (MRDC) is a joint Thai-U.S. organization established to undertake research, development, test and evaluation activities in support of the Royal Thai Armed Forces, with special emphasis on strengthening Thai counterinsurgency capabilities.

MRDC is established within the Thai Ministry of Defense Supreme Command Headquarters under the leadership of Major General Singchai Menasuta, Director, and Mr. Thomas W. Brundage, Deputy Director. It is staffed jointly, and its work is conducted jointly, by officers of the Royal Thai Armed Forces and officers and civilians assigned from the U. S. Department of Defense. Representation from the United Kingdom Ministry of Defence has also been provided. Scientific, technical, and military operations experience are represented on the staff. The U. S. component of the MRDC, called the Research and Development Field Unit (RDFU), and requisite financial and materiel support, are provided through the Advanced Research Projects Agency, Office of the Secretary of Defense as part of ARPA's program of research in Remote Area Conflict (Project AGILE).

Primary emphasis in Thailand is placed on research and development effort of a long term nature in fields such as communications, surveillance, mobility, and operations research. Much of the work is theoretical and experimental, and for the time being, is mainly non-hardware oriented. It is felt that fundamental studies in fields such as the foregoing will provide the basis for and eventually lead to specific improvements in the capabilities of Thai forces, and that the basic information acquired in Thailand can often be applied to similar problems facing other U. S. allies.

FORMAT

Insofar as is possible, the format and nomenclature used in this Quarterly Report follows that used in the ARPA Project AGILE Quarterly Report series. Readers are reminded that the ARPA Quarterly Report contains summaries of Project AGILE research tasks conducted in CONUS and South Vietnam as well as in Thailand. The MRDC Quarterly Report is concerned with field tasks conducted in Thailand only.

As announced in previous Quarterly Reports in recognition of the long-term nature of MRDC research tasks, it has been decided that the Monthly Letter Report previously sent by MRDC to OSD/ARPA will be discontinued. Henceforth, the primary periodic reporting document for MRDC will be the Quarterly Report. MRDC Quarterly Reports will be serialized and numbered for ease of reference. This Report is identified as QRT-2.

GENERAL INFORMATION

During the first three months of 1964, the MRDC was pleased to host several distinguished visitors. All were briefed in detail upon AGILE Sub-projects by the MRDC Program Managers. Where time and opportunity permitted, they visited some of our test sites, and Mr. Deitchman and Brig. Gen. Boles were able to visit with the Village Security Pilot Study team for an on-the-spot view of some of their work in northeast Thailand. The visitors were:

DR. R. L. SPROULL, DIRECTOR, ARPA
DR. D. CAWOOD, CHIEF SCIENTIST, WAR OFFICE, LONDON
DR. D. H. SCHWEBS, OASD (Comptroller)
MR. S. J. DEITCHMAN, SPECIAL ASSISTANT FOR COUNTER-INSURGENCY, ODDRE
BRIG. GEN. JOHN K. BOLES, JR., USA, DIRECTOR, OSD/ARPA RDFU-V and JOEG-V
COL. G. CLEVEN, USAF, Chief, OSD/ARPA RDFU-V
MR. WARREN STARK, OSD/ARPA STAFF

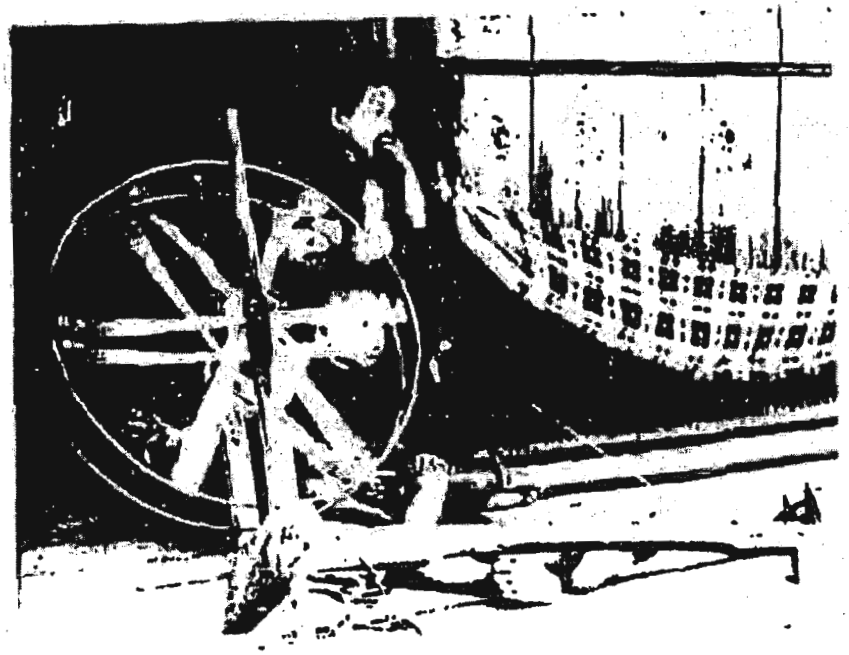
Three Vietnamese members of CDTC-V, CAPTAINS HO and TON and ASPIRANT TUY, spent several days here in January. On 18 - 19 March, Major JOHN MAXWELL, Australian Liaison Officer, FARELF, was apprised of MRDC functions of interest to the Australian Armed Forces. Other visitors for brief periods included DR. LYLE LANIER, VICE-PRESIDENT and PROVOST, University of Illinois; Messrs THOMAS H. MORRIN and GORDON W. WILEY of Stanford Research Institute, DR. G. J. ZISSIS, IDA and Mr. F. W. WOLCOTT and M/Gen G. J. HIGGINS (Ret), Research Analysis Corporation.

A series of seminars and technical reports was launched in March for all members of MRDC. Thirteen weekly sessions are now scheduled through May 1964. They cover most

of the major work underway in MRDC. It is planned that new subjects will be added when appropriate. The series is given informally by MRDC personnel and is intended to inform the audience of the status of work underway and planned throughout the organization. Discussion and suggestions for improvements in the pertinence and quality of work performed by the MRDC are invited. In some instances, exploratory concepts will be presented in order to expose them to critical review prior to implementation.

In the interest of improving mutual understanding, the standard MRDC briefing concerning Mission, Organization and Sub-Projects was given to the JUSMAG staff and later to the US Army advisors in Thailand. The briefing was well received, and will be given wherever and whenever possible to interested agencies. The Thai component of the MRDC is drawing up a similar briefing designed for presentation to Royal Thai Armed Forces organizations.

Manufacture of salt from local soil for home consumption is explained by Captain Sommart, RTMC, (right) to Brigadier General Boles, Dr. Huff and Mr. Dietchman.



Spinning cotton thread to be woven into cloth for the family. Typical finished product is in the background.

Water resources and supply are a problem in Northeast Thailand

Colonel Lua, Mr. Brundage, Captain Sommart, Mr. Dietchman. Representative fences around family plots appear in the background.

MAP


BURMA
LAOS
GULF OF TONKIN
MAE NAM CHAO PHRAYA
KHORAT PLATEAU
LAOS
CAMBODIA
GULF OF SIAM
MALAYA
INDONESIA
THAILAND

SUB-PROJECT I

TACTICAL UNIT WEAPONS SYSTEMS

SUB-PROJECT I

TACTICAL UNIT WEAPONS SYSTEMS

SUB-PROJECT OBJECTIVE:

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

All activity in this Sub-Project is presently conducted in CONUS and CDTC-V.

SUB-PROJECT II

AREA FIRE WEAPONS SYSTEMS

SUB-PROJECT II

AREA FIRE WEAPONS SYSTEMS

SUB-PROJECT OBJECTIVE:

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

Requirement: Aircraft and Air-Ground Armament and Munition Systems

Task: Counterinsurgency Aircraft

Sub-Task (Proposed): Environmental Effects on Aircraft Reliability

This proposed sub-task was withdrawn during the reporting period.

SUB-PROJECT III

REMOTE AREA MOBILITY AND LOGISTICS SYSTEMS

SUB-PROJECT III

REMOTE AREA MOBILITY AND LOGISTICS SYSTEMS

SUB-PROJECT OBJECTIVE:

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

It should be understood that MRDC is not engaged in testing and evaluating vehicles for military application in the Mobility Sub-Project, at this time. The MRDC contribution to the purposes of this Sub-Project is to determine the validity of design concepts and principles from which superior vehicles may subsequently be derived and produced. Vehicles brought to Thailand for test may be experimental designs incorporating radically different design principles, or readily available vehicles possessing particular features needed to be analyzed in controlled test situations. In neither case are the MRDC investigations concerned with "proving" or "disproving" the suitability of the vehicle in question for immediate operational use. In fact, it may be necessary on occasion to test a vehicle already deemed operationally unsuitable in order to investigate a particular feature of interest which is incorporated in its design. Of course, if the vehicles and boats under development and test at MRDC do show promise for more immediate practical application, recommendations to that effect will be made to the appropriate authorities.

Requirement: Mobility Research

Task: Mobility Environmental Research (MERS)

1. Mr. E. E. Garrett arrived in Bangkok on 26 December 1963 from U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. This completed the DA civilian staffing of the MERS Detachment in Thailand.

2. Lt Colonel Arthur R. Simpson, Corps of Engineer, arrived in Bangkok on 15 February to command the MERS Detachment.

3. Discussions were initiated during February and March with the Thai Meteorological Department, SEATO Graduate School of Engineering, Royal Thai Army and Kasetsart University to coordinate MERS activities and requirements.

4. Selection and hiring of Thai administrative and engineering staff members for the MERS Detachment was initiated and completed during the report period. Training of Thai personnel was started.

5. Two field trips for the acquisition of undisturbed and moisture content soils samples were made to the Lopburi area.

Requirement: Mobility Research

Task: Mobility Research and Testing (MORT)

Sub-Task: Trackmaster

Environmental test and evaluation of the Trackmaster was conducted principally for the purpose of determining weak soil performance of a track laying vehicle having a low unit ground pressure (approximately 1 pound per square inch). The data acquired will also be useful in the Mobility Environmental Research Task, where vehicle response data will be used to formulate performance predictions under specified environmental conditions. The final report has been completed, edited, and will be published and distributed during the next quarter.

Requirement: Mobility Research

Task: Mobility Research and Testing (MORT)

Sub-Task: Canadian Jiger

1. During the first week of January, the Jiger was tested on the Mae Khlong River at Ban Pong, Changwad Rajburi, to determine its capabilities in typical Southeast Asia rivers. The river is 150 meters wide at this point, and has a current of about 5 miles per hour. Various bank configurations were used to assess entrance and egress capabilities. The Jiger had little difficulty with the banks up to 60 per cent. Water performance was unsatisfactory because it is too slow. During the last half of January, the Jiger was tested in rice paddies at Lopburi, on slopes at Koke Kathiem, and on a jungle trail near Pakchong.

a. In paddies, the Jiger sucessfully negotiated bunds up to 24 inches in height. Operating in flooded paddies and over packed bunds, it attained an average speed of 5 kilometers per hour (about 3 miles per hour), or slightly faster than a man could walk.

b. The vehicle climbed the natural slopes at Koke Kathiem up to about 30 per cent with the crew's dismounting. It showed an alarming tendency to overturn at every small surface irregularity, however. When the crew dismounted to walk the vehicle up, higher slopes could be climbed, but only at the cost of exhausting the men.

c. The Jiger performed quite well on the Pakchong trail, since it is sufficiently small to by-pass the worst ruts and obstacles. Its average speed was approximately 15 kilometers per hour on this march. One engine froze from overheating, after about 3 hours' operation.

2. The remainder of the quarter has been devoted to data reduction and preparation of the report. The first draft of the report is approximately 60 per cent complete and will be finished during March. Distribution will be made during the next quarter.

Requirement: Mobility Research

Task: Mobility Research and Testing (MORT)

Sub-Task: Tote Gote

Test and environmental evaluation of the Tote Gote has been completed. The final report has been completed in draft form and will be reviewed, edited, published, and distributed within the next quarter.

Requirement: Mobility Research

Task: Ground Mobility/Logistics Analysis

Collection of data for the RAC mobility/logistics analysis continued during the reporting period.

A study of the Thai Highway System is being completed. This will present an overview of the Royal Thai Highway Department organization, the location and condition of the existing road network, the status of highway construction projects currently underway and long range highway development programs. Traffic volume and pattern data are being developed and will be contrasted with accepted civilian and military methods for evaluation of maximum traffic density in order to estimate potential highway traffic capacity available for military operations. Emphasis will be devoted to detailed presentation and analysis of highway capability in Northeast Thailand. This study will provide the road and highway data base requisite for analysis in detail of Thai logistic and mobility capability under conditions of counter-insurgency in Thailand.

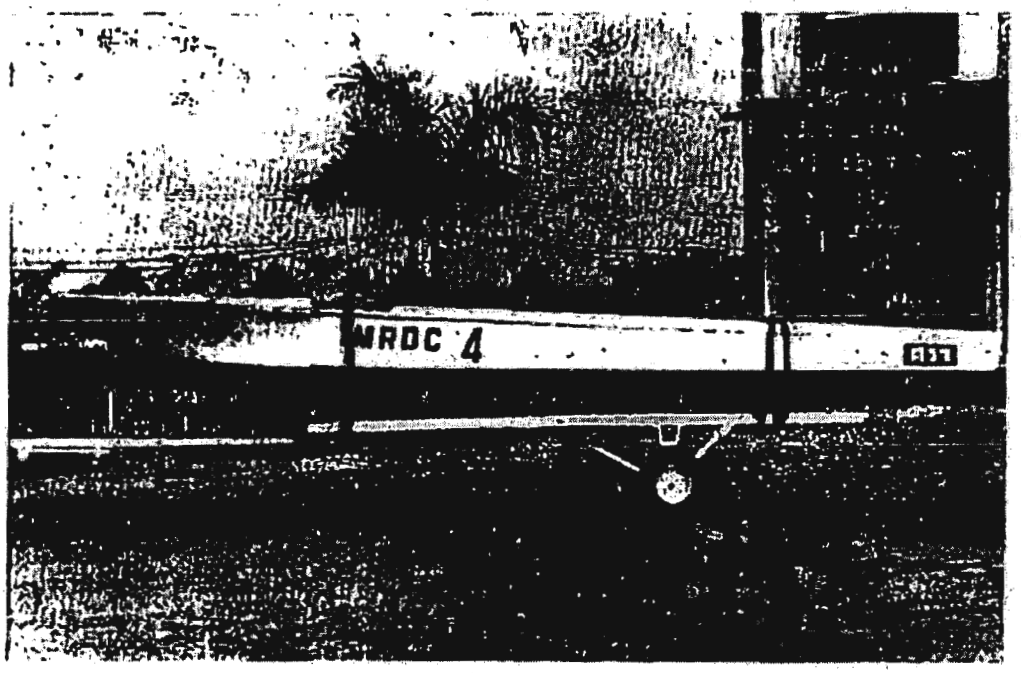
The study of the probable capabilities, limitations, and gaps in the Thai mobility/logistics potential for CI conflict has been initiated. This study, currently in the planning phase, will integrate real environments, available transport, force dispositions, response modes and techniques. Trade-offs among these factors are to be studied to determine preferred equipment and systems operation and to attempt to uncover elements which R&D effort might improve.

Requirement: Mobility, Ground and Water

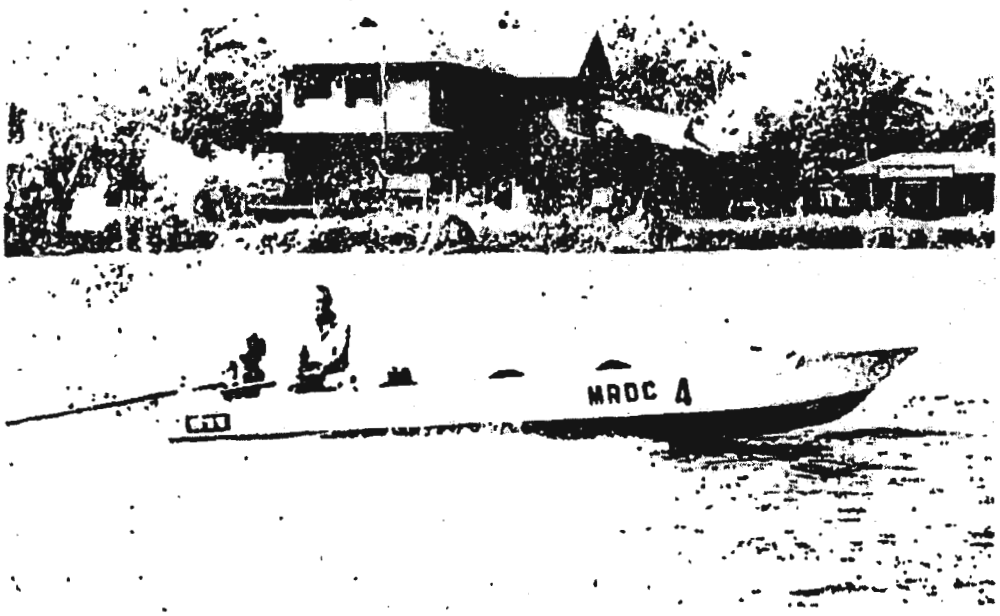
Task: Delta Mobility - Small Craft

The MRDC modified Thai klong boat was discussed and illustrated in MRDC QRT-1 (P. 25). During the reporting period, three boats were completed. One was sent to CDTC-V for evaluation in South Vietnam. The other two are undergoing trials in Thailand. Hull tests with weights up to 950 kg. are being made with two power units: (1) a 45 hpr Mercury engine with an 11 inch prop and (2) a 13 1/2 hpr JLO long-shaft motor. Results to date show that stability of the hull is excellent, and under normal operation in a river the boat is dry. There is no tendency to porpoise.

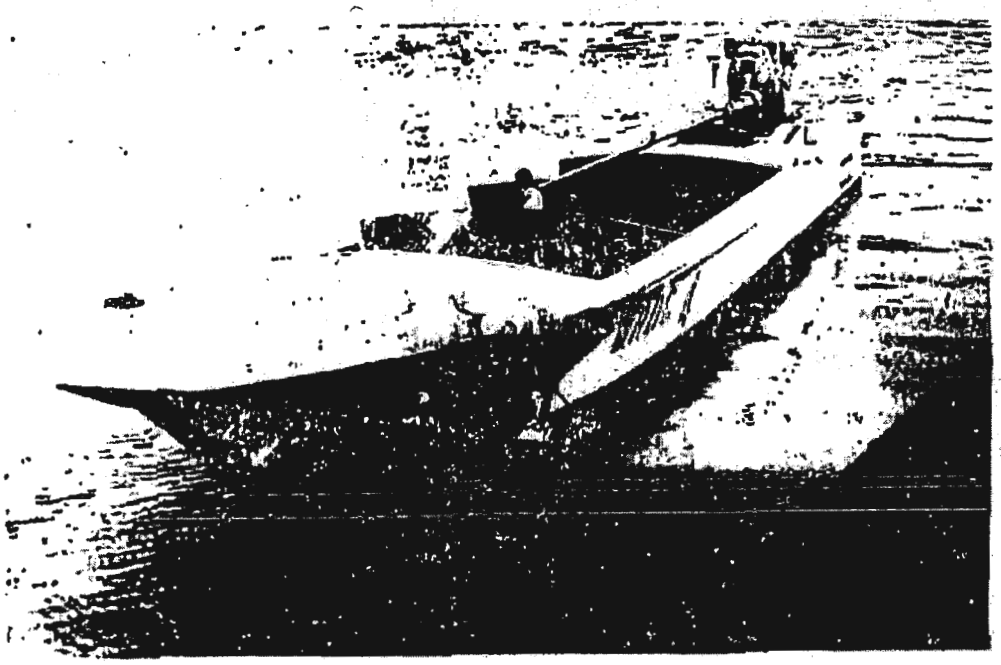
An additional boat is to be constructed at the Royal Thai Army Transportation boat shop to prove the adaptability of this design to local military construction and to establish a military source for further development of this water craft concept.



 # 4 Boat and trailer weight 1,000 lbs
boat weight 770 lbs



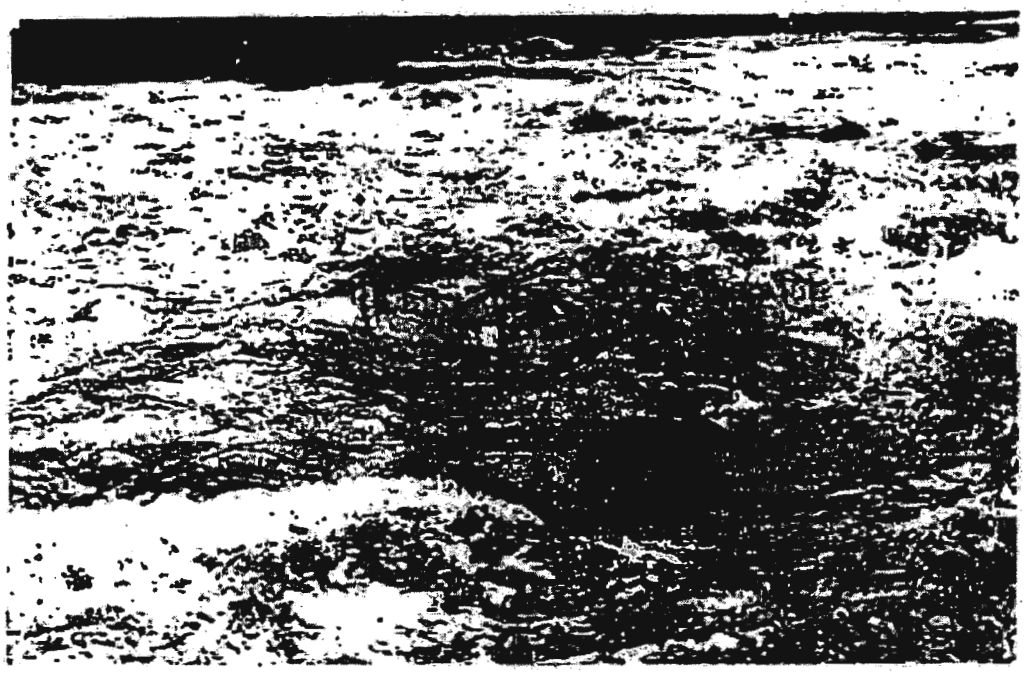
 # 4 Boat underway. Powered by 13.5 HP JLO aircooled engine



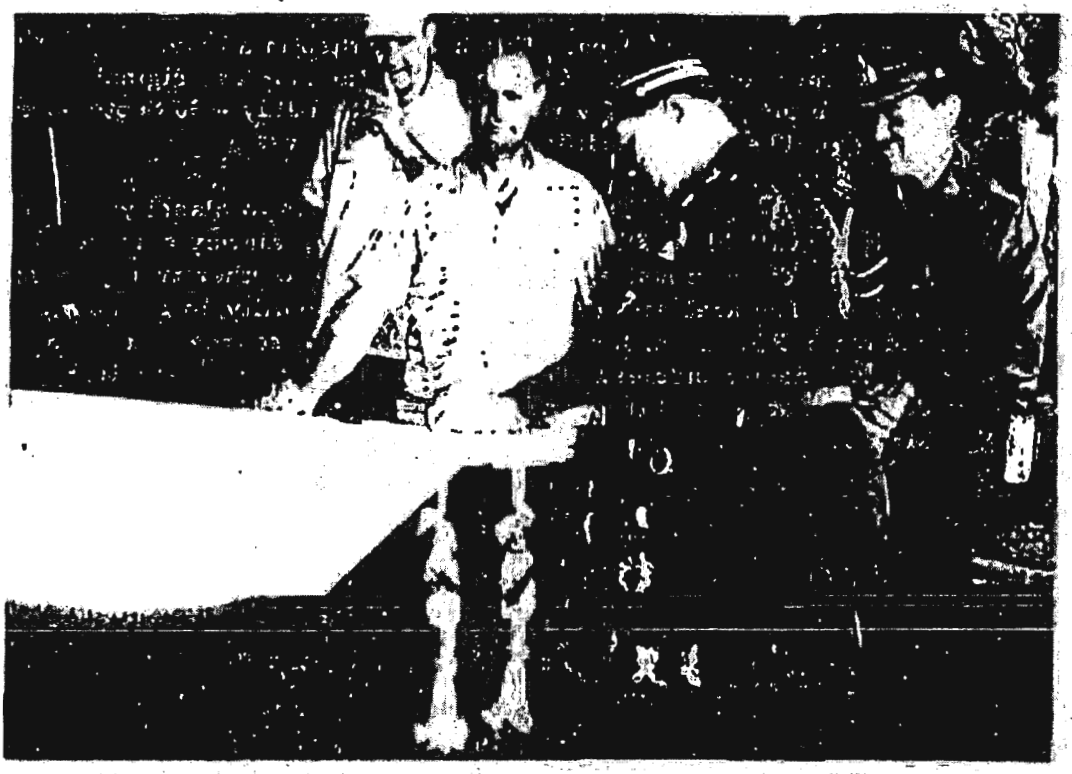
 # 4 Boat. Long shaft motor mounted.

 # 5 Boat. Outboard motor mounted

 # 4 Boat. Underway with 1650 lbs payload, at 19.8 MPH. Powered by 45 HP Mercury Outboard



Rapids on Saiburi River transitted by Boat # 1



Maj. Gen. Singchai Menasuta, Commanding General, MRDC.
Christening MRDC Boat # 5

Requirement: Mobility, Air

Task: Remote Area Airstrip

Sub-Task: Survey, Classification and Data Analysis of Airfields in Thailand

Data regarding the existence and location of airfields which was received from various agencies during the last reporting period have been assembled and recorded. Considerable effort was made to construct a form for recording and classifying all data at hand, and one which might also be useful in similar tasks elsewhere.

Having done this, the entire task was reviewed in the light of the data available with the purpose of redirection of effort, where required. This has resulted in a brief restatement of the task. Consequently, the task as originally drawn in the CDTC-T Quarterly Report for 1 July - 30 September 1963 (pp. 19 - 20) is modified to read as follows:

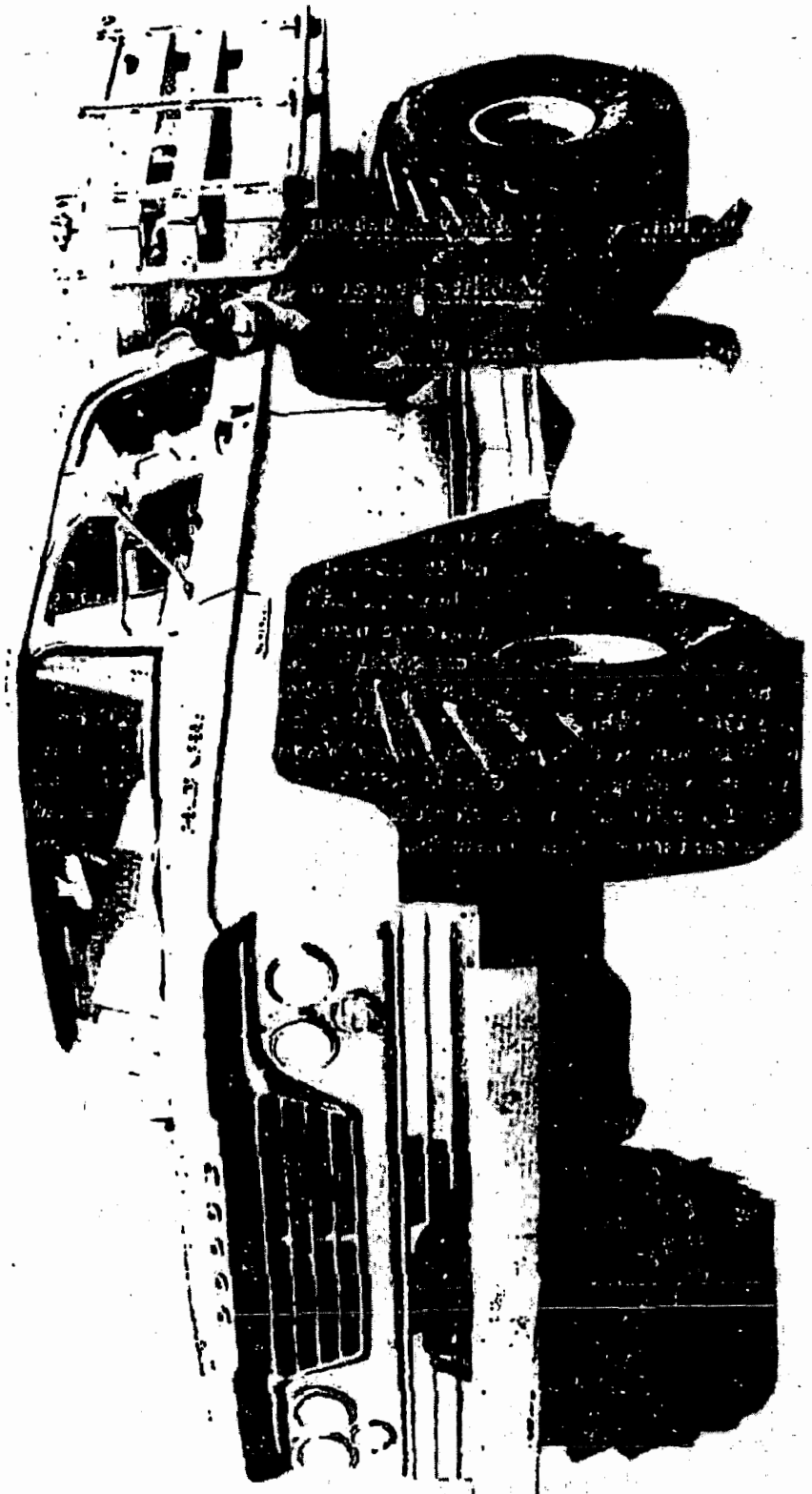
The purpose of the task is to classify and analyze available airfield data as to location, runway surface, soils and dimensions, and their relationship to other transportation modes. The analysis will benefit current mobility/logistics studies and other R&D uses: for example, it will be a source of data for aircraft design studies. Technical information on soils will be collected as part of the environmental studies conducted by the MRDC.

Requirement: Mobility Research

Task: Mobility Research and Testing (MORT)

Sub-Task: Power Wagon

Two 1 1/2 ton Power Wagons have been received for test and evaluation of this type of vehicle when equipped with very low pressure tires. The vehicles have installed 46 x 18--16R terra tires on the front and 46 x 24--16R terra tires on the rear. Power steering has been added to overcome turning forces imposed by the low ground pressure tires. The environmental test of the two vehicles will be conducted with the test of the XM-561 Test Rigs, which are scheduled to arrive in June 1964. In this way direct mobility comparison will be possible between the special Power Wagon and the XM-561. The intervening period of time will be utilized to acquire other data of particular interest on the Power Wagon, such as ride characteristics, fuel consumption, and tire heating on prolonged highway runs.



DODGE POWER WAGON

SUB-PROJECT IV

COMMUNICATIONS SYSTEMS

SUB-PROJECT IV

COMMUNICATIONS SYSTEMS

SUB-PROJECT OBJECTIVE:

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

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

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

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

In Thailand, communications research tasks are often referred to collectively as SEA CORE (South East Asia Communications REsearch Program).

Requirement: Remote Area Conflict Communications Research

Task: Operations Analysis (1A)

Sub-Task: Small Unit and Patrol Communications

One of the major objectives of the Communications Systems Sub-Project is to determine the desirable characteristics of military communications systems and equipments for Thai forces. Not only must the characteristics be feasible both technically and economically, they must also satisfy operational requirements. Accordingly, there is a need to study and analyze present and future systems and equipments, in order to obtain information on which to base a determination of necessary characteristics.

The purpose of this sub-task is to determine the need for research and development work to improve the communications capabilities of small Thai police and associated military units employed in border security missions. Emphasis is placed on forward communications and on units of patrol, squad, platoon, and company size. Seven Border Patrol Police platoons and two RTA platoons were visited in the course of a field trip to Northeast Thailand in October 1963. A similar trip to North Thailand was made in December 1963. A report on this phase of the sub-task is in preparation.

Other operations analysis sub-tasks are being formulated and planned. The SRI operations analysis group now numbers five Americans, one of whom is simultaneously the Senior SRI Representative in Thailand.

Requirement: Remote Area Conflict Communications Research

Task: Phenomenological Research (1B)

Sub-Task: Radio Propagation in Tropical Vegetation

A second major objective of SEA CORE is to obtain a systematic and comprehensive body of data on those factors of terrain, vegetation, and ionospheric behavior which affect electromagnetic wave propagation in Thailand. Such data are significant because they affect the utilization of available radio equipment and the design and development of new equipment.

It is the objective of this sub-task to measure and analyze the factors which influence the propagation of radio waves in areas of dense tropical vegetation. The SEA CORE contract with Jansky and Bailey places special emphasis on the influence of terrain and vegetation, at ranges up to 30 miles and at frequencies between 100 KC and 425 MC. In these frequency and distance ranges, the path loss will be measured over various types of terrain for all practical modes of propagation. Seasonal variations, the effects of polarization, and the effects of changing the transmitting and receiving antenna heights will be determined by measuring the path loss for the various modes.

The Jansky and Bailey permanent party of eleven is now complete. The measurement program got underway in late December. Thus far, data have been collected at several frequencies (including 6, 12, and 100 MC) at distances up to 8 miles.

Requirement: Remote Area Conflict Communications Research

Task: Phenomenological Research (1B)

Sub-Task: Vertical Incidence Ionospheric Sounding

It is the purpose of this sub-task to collect vertical incidence ionospheric sounding data for Thailand as a contribution to the world-wide ionospheric data system, with the long-term objective of improving the accuracy of frequency predictions for Southeast Asia.

The C-2 Vertical Sounder is in operation and data are being forwarded to the National Bureau of Standards through the U.S. Army Signal Radio Propagation Agency (USASRPA). Data are also being exchanged with stations in Manila and Singapore. Two enlisted men of USASRPA are now operating the Sounder 24 hours a day, 7 days a week. The rate of successful operation was 99% during each of the months of December, January, and February.

Requirement: **Remote Area Conflict Communications Research**

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

As a natural result of SEA CORE activities, the Thai military personnel associated with the Electronics Laboratory are gaining valuable experience which increases their abilities to contribute to the development of Thailand. The number of such Thai military personnel now totals 7 commissioned officers, and 4 warrant officers and non-commissioned technicians. An additional officer is associated with the Jansky and Bailey effort. All of the commissioned officers are educated to at least the bachelor degree level, and 3 of them are Ph.D.'s. The Communications Systems Sub-Project is operated as an integrated, combined Thai-U.S. effort.

Currently, Thai participation is mainly concentrated in Task ID.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

The major effort of the Electronics Laboratory in Thailand is currently focussed on the investigation of communications techniques. The purpose is to determine the utility of promising techniques in the geophysical environment of Thailand and Southeast Asia, with the objective of enhancing the communications capabilities of Thai forces. Initial emphasis of this effort is on radio, but all operationally useful means of communications are within its scope.

Certain of the sub-tasks listed in the pages which follow have a close relationship to other tasks, particularly 1B, of the Communications Systems Sub-Project. For contractual purposes, these primarily technical sub-tasks have been numbered consecutively in a single series. They are grouped under Task 1D in an effort to achieve clarity of presentation.

It should be recognized that some of the scientific efforts listed below are in their early stages. It is likely that some will be dropped and some redirected; others will be added as the work progresses.

Requirement:	**Remote Area Conflict Communications Research**
Task:	**Investigation of Communications Techniques and Devices (ID)**
Sub-Task 1:	**Test and Evaluation of Tactical Communications Devices.**

See Communications Tasks 2A and 2B which follow.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices

Sub-Task 2: Noise Measurements

It is the objective of this sub-task to determine mean atmospheric noise levels and their periodic variations in Thailand.

Noise measurements were conducted near the village of Sakatiem, using the NF 205 noise measurement equipment, on 200 KC, 2 MC, 10 MC, and 30 MC. In this area, which is relatively free of sources of man-made noise, meaningful results were obtained on three of the frequencies. Interference was too severe for the wide IF bandwidth of the NF 205 on 10 MC. The curves show a 10 to 20 db change in noise level in a period of one day, while the variation in level is less when comparing data from one day to another at the same time of day. As expected, very little noise was recorded on 30 MC. Experiments are being conducted at the laboratory to devise narrow-band noise measurement equipment.

Requirement:	**Remote Area Conflict Communications Research**
Task:	**Investigation of Communications Techniques and Devices (ID)**
Sub-Task 3:	**Antenna Orientation Effects**

In this sub-task it is intended to evaluate the advantages of North-South alignment of dipole antennas for short-range sky-wave communications in an area near the magnetic equator. Theoretical work suggests that there is an optimum orientation for horizontal, linearly polarized antennas used on short ionospheric paths near the geomagnetic equator, and that this optimum orientation is not necessarily broadside to a straight line from the transmitting station to the receiving station. Consideration of the magneto-ionic theory and its application to antenna-to-medium coupling problems indicate that aligning such antennas parallel to the earth's magnetic field will maximize signal strength and minimize polarization fading.

Four five-day CW tests were conducted in December and January between Bangkok and the vicinity of Ayuda (to the North) and the vicinity of Sakatiem (to the West). Analysis of the data obtained is about one-half complete.

A rotatable dipole is being used to investigate orientation effects for the vertical incidence (zero-range) case, with the C-2 Sounder transmitting into delta-matched dipoles being used for the signal source. Preparations are underway for pulse tests using the Bangkok-Ayudhya-Sakatiem geometry.

The project officer is Lt. Paibul Nacaskul, RTN.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

Sub-Task 4: Ground Constants

This sub-task seeks to determine the magnitudes of ground conductivity and dielectric constant at selected locations in Thailand. The work is now following two avenues:

a. Field-strength method for measurement of conductivity.

b. Wave-tilt method for measurement of dielectric constant.

A 130-watt transmitter has been built for use as a signal source in remote areas for the field-strength method measurements. Preliminary testing has been carried out by use of an R390 receiver (mounted in a Land Rover) as a detector of local broadcast station signals. The effects of nearby objects, trees, and buildings on the variations in observed signal strength have been noted. An RCA field strength meter will be briefly tested as a possibly more convenient detector.

Effort is continuing on the design and test of a small, portable detector-receiver for the wave-tilt method.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

Sub-Task 5: Earth Potential Measurements

MRDC has considered exploring the utility of earth potential measurements as indications of ionospheric and magnetic storms. At present, however, this sub-task is inactive and is being reconsidered to determine if the objective can be achieved as a by-product of other work.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

Sub-Task 6: Frequency Prediction

This sub-task is concerned with improving frequency predictions for Thailand. The flow of data from the C-2 Sounder into the world-wide ionospheric data system is expected, in the long term, to result in improved frequency predictions for Southeast Asia. It may be possible, however, to improve the frequency-prediction situation in the short term.

Accordingly, data from the Bangkok Sounder (see Task 1B, Sub-Task: Vertical Incidence Ionospheric Sounding) are being studied and analyzed locally. These data are considered in conjunction with the frequency predictions made by the Central Radio Propagation Laboratory and the U.S. Army Signal Radio Propagation Agency.

Frequency recommendations were prepared and furnished to JUSMAG for a Counter-Insurgency Field Training Exercise (KITTI 07), which was conducted by Thai forces early in 1964. In the process of preparing the predictions, an officer of the RTA Signal Department was familiarized with the techniques involved. Exercise results are being studied to evaluate the prediction effort.

Requirement: **Remote Area Conflict Communications Research**

Task: **Investigation of Communications Techniques and Devices (ID)**

Sub-Task 7: **Antenna Terrain Effects**

This sub-task is intended to investigate the effects of terrain in the immediate vicinity of field antennas on the performance of those antennas. It is not yet active.

Requirement:	**Remote Area Conflict Communications Research**
Task:	**Investigation of Communications Techniques and Devices (1D)**
Sub-Task 8:	**Flutter Fading**

This sub-task is concerned with the determination of the effect of equatorial flutter fading on field communications. It is not yet active.

Requirement:	**Remote Area Conflict Communications Research**
Task:	**Investigation of Communications Techniques and Devices (1D)**
Sub-Task 9:	**Vertical Incidence Ionospheric Measurements**

See Task 1B and Sub-Task: Vertical Incidence Ionospheric Sounding.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (ID)

Sub-Task 10: Oblique Incidence Ionospheric Measurements

Utilizing an oblique incidence sounder, it is planned to examine typical field communication paths and determine the nature and characteristics of the propagation modes and antenna effects, and the consequencies for tropical field communications. Technical planning is underway, and an ARPA decision on procurement of an oblique sounder is anticipated in the next quarter.

Requirement:	**Remote Area Conflict Communications Research**
Task:	**Investigation of Communications Techniques and Devices**
Sub-Task 11:	**Technical Assistance**

This sub-task is established to furnish technical advice and assistance as required and as approved. An informal report has been issued on a composite radio set RS-6A/GRC-87. Activity under this sub-task was at a generally low level during the current reporting period.

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

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

The test and evaluation of specific items of communications equipment, to determine the utility in Southeast Asia of these equipments or of some of their specific characteristics, is also within the scope of the SRI contract.

Bench tests have been done, a brief field trial has been accomplished, and a test plan is in preparation for the following items:

1. Motorola H-21-DCN (VHF-FM) This set is one of a number of commercially available, hand-held, voice-only transceivers using entirely transistorized circuitry. It weighs 33 ounces complete, and radiates 1.4 watts at frequencies between 24 and 54 MC.

2. PRC-35, Experimental (VHF-FM) This set was developed by RCA on contract to USAELRDL as a replacement for the AN/PRC-6, but it has not been standardized. It is transistorized and has a voice capability between 30 and 70 MC at a radiated power of about 1/3 watt.

3. AN/PRC-25 (VHF-FM) Covering a frequency range of 30-76 megacycles and weighing approximately 20 pounds, this set is beginning to replace the AN/PRC-8, -9, and -10 in the U.S. Army. It radiates 1.5 watts. Also on hand are experimental power amplifiers which can boost the power output of the AN/PRC-25 to 15 and 35 watts.

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

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

Distribution has been completed for SRI Research Memorandum 3, "Field Tests on Man-Pack Radios in a Tropical Environment."

SUB-PROJECT V

COMBAT SURVEILLANCE AND TARGET ACQUISITION SYSTEMS

SUB-PROJECT V

COMBAT SURVEILLANCE AND TARGET ACQUISITION SYSTEMS

SUB-PROJECT OBJECTIVES:

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

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

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

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

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

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

Requirement: Remote Area Conflict Surveillance Research

Task: Phenomenological Research (1B)

Sub-Task: Forest Canopy Obscuration

In QRT-1 there was described the method being employed to determine canopy obscuration and the results from one test site. This test site on the Kra Peninsula was measured again during January of this reporting period. The first measurement was at the start of the principal rainy season (July) and this measurement was early in the dry season. The average rainfall in millimeters at the nearest weather station 60 kilometers north of the site is:

January	-	32	July	-	97
February	-	42	August	-	90
March	-	48	September	-	111
April	-	81	October	-	253
May	-	114	November	-	172
June	-	92	December	-	31

The photographs are being analyzed and the results will be available for the next Quarterly Report.

The acquisition of forest canopy photography is continuing as part of the Vegetation Study (1A2) of Sub-Project VII, Technical Planning and Programming. Photographic data on two geographically

separated forests of the same botanical type have been obtained as has initial data covering another botanical type and a rubber plantation. The data is in the process of evaluation and analysis.

Requirement:	**Remote Area Conflict Surveillance Research**
Task:	**Phenomenological Research (1B)**
Sub-Task:	**Climatological Survey**

The proposal from the Royal Thai Department of Meteorology to perform a climatological survey has been received. This is in response to a request from this Unit for a climatological survey concerning rainfall, wind, temperature, relative humidity, clouds and obscuration. About one-fourth of the requested data has been compiled, analyzed and is available. The remainder is available as original station records, but has not been collated and analyzed. It is expected that an agreement will be reached during the next reporting period and as a result the remaining work will be performed.

Requirement: Investigation, Development and Evaluation of Techniques and Devices

Task: Airborne Infra-Red Systems (2A1)

Sub-Task: Reconnaissance Program

Activity in the cooking fire detection sub-task, described in MRDC QRT-1, is deferred pending arrival of a properly equipped aircraft. The latter is not expected before the end of calendar year 1964.

Requirement:	Investigation, Development and Evaluation of Techniques and Devices
Task:	Visual Surveillance and Low-Light-Level Amplification (2A4)
Sub-Task:	Airborne Visual Surveillance

Quarterly Report QRT-1 described the purpose of a proposal for a follow-on test of identification capabilities in visual searching for individual men in the Southeast Asia environment. First, it is to work from the results of the April, 1963 test which delineated quantities such as the maximum slant ranges at identification for narrow search strips and will attempt to find out the relationship between search strip width, aircraft velocity, and slant range at identification. Second, it is to provide a good opportunity to train three Thai officers in practical and proven methods of test and analysis by having them perform the entire program under guidance, since the methods were worked out last April. The Royal Thai Air Force has approved the participation of personnel and a helicopter at Ubon. It was requested that the date of the program be delayed from 12 February - 15 May to 1 April - 3 July so that the RAND Corporation representative conducting the program could participate in the Rural Security Pilot Study, which is discussed under the Technical Planning and Programming Sub-project. Guidance for training test observers in that specific task was requested from and provided by the U.S. Army Aviation Human Research Unit, Fort Rucker. That unit expressed interest in our published work and the proposed effort and recommended further contact.

Requirement: **Security and Protection Equipment**

Task: **Patrol and Outpost Intrusion Detectors**

Notification has been received that 35 improved break-wire detectors with instructions in the Thai language are scheduled for delivery. Arrangements have been initiated to obtain the assistance of the Thai Border Patrol Police in an operational test of these personnel intrusion detectors.

SUB-PROJECT VI

INDIVIDUAL AND SPECIAL PROJECTS

SUB-PROJECT VI

INDIVIDUAL AND SPECIAL PROJECTS

SUB-PROJECT OBJECTIVE

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

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

Requirement: Military Chemistry

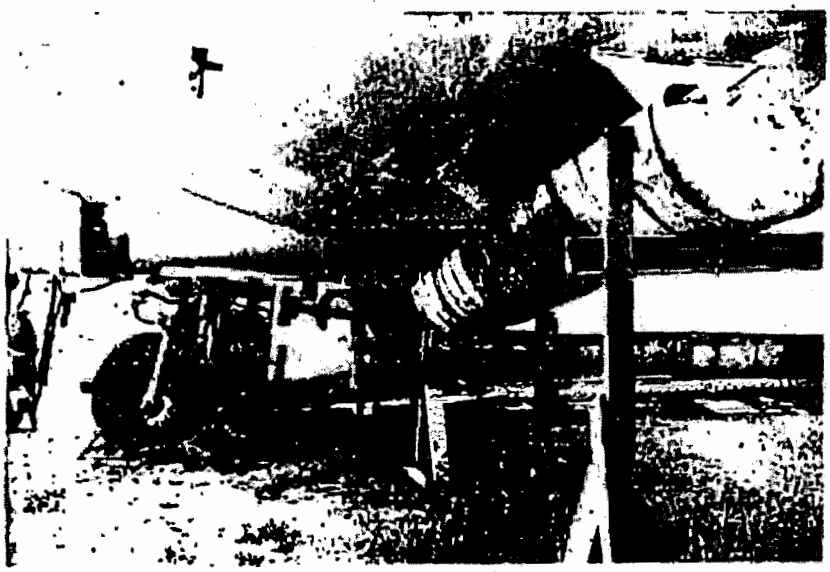
Task: Defoliation (1A)

Sub-Task: Thailand Defoliation Test Program

Activities

The Beechcraft Ten-Two airplane modified to include spray distribution equipment consisting of booms with 90 nozzle positions, air-driven pump, and 180-gallon stainless steel tank was delivered to Bangkok on 17 December. Static flow calibration tests with water and diesel fuel were made on the Beechcraft spray system from 1 - 10 January. A 20 hp stationary engine was used to activate the pump system. Flow tests were made in quadruplicate for a range of nozzle systems and pressures. The amount of delivered spray was measured from catchments in steel troughs installed under each boom.

Static flow calibration tests with "purple" and 2, 4, 5-T ester both singly and in mixtures with diesel fuel at ratios of 1:1 and 1:2 were made at the Hua Hin Airport operational headquarters from 13 January to 30 January. Flight calibration tests to determine effective swath width, spray deposition rates, and pattern and droplet size characteristics of diesel fuel and various chemical solutions were made at the Hua Hin location. Preliminary flight tests were conducted on a single east-west grid line using oil-sensitive dye cards at 10-ft. intervals on a 400 foot line to determine swath width and droplet patterns from diesel fuel sprays. An enlarged calibration grid was established at the Hua Hin Airport on 13 - 15 February to secure data from inwind flights on 8 radiating grid lines of 540 foot length. Deposit rates were determined by a colorimetric technique from diesel oil spray solution containing 0.1% DuPont oil red dye. White Kromekote cards were used in conjunction with 6 x 6 inch aluminum plates at each station interval for visual



Static calibration of Beechcraft boom delivery rates, using stationary engine attached to air-driven pump and metal troughs below booms.

Detail of troughs and catchment basins used in static boom delivery flow-rate calibration, with various nozzle configurations, spray pressures and soluents or chemicals.

Calibration grid lines with 6 x 6 plates and chromekote cards used to measure spray deposit at 10 foot intervals on 500-foot profile.

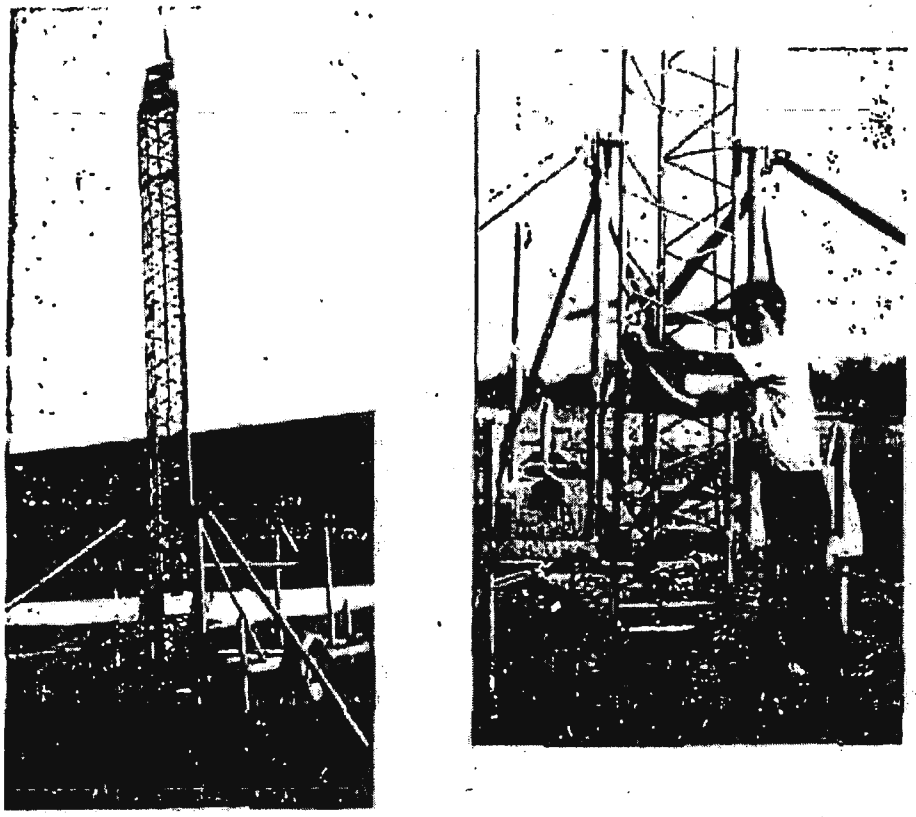
Aluminum plate and chromekote card with spray deposit.

check of spray deposit. The primary objective of the flight calibration tests was to evaluate nozzle configurations which would result in a uniform spray deposit over a known swath width.

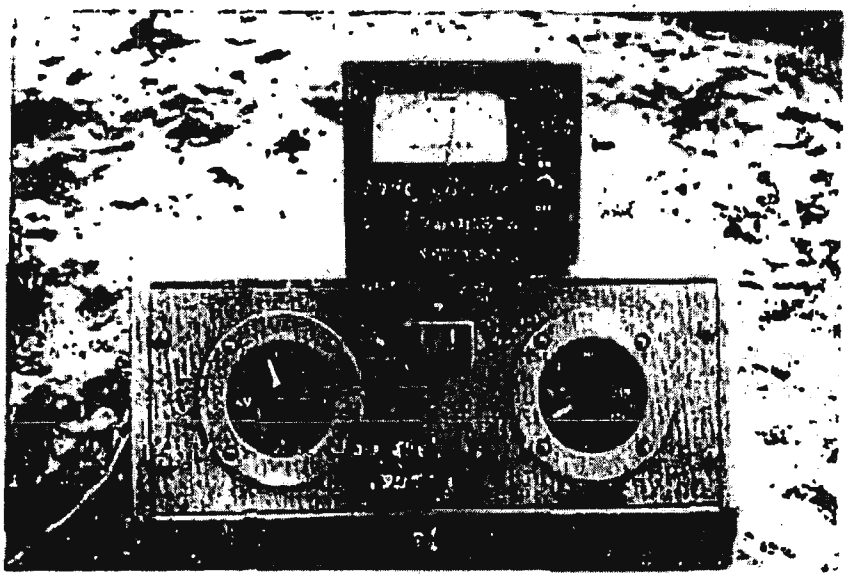
Calibration flight tests have been made on an additional grid area established on the Pranburi Military Reservation to determine swath width and spray deposit characteristics of "purple" and other chemicals included in the evaluation tests. Deposit patterns are measured colorimetrically with a Bausch & Lomb Model 20 spectrophotometer using a wet-plate acetone-wash technique with DuPont oil red dye or other suitable dye incorporated in the spray solution.

Meteorological conditions at flight altitude of 50 feet are obtained from instruments on a portable telescoping steel tower erected at the grid location. Wind direction and velocity to the nearest 0.1 mph are obtained on a Model L Belfort anemometer with a supplemental vernier velocity indicator calibrated to read velocities up to 10 mph. The wind direction and velocity transmitters are mounted at the top of the 50 foot tower; readings are taken prior to and at the time of each flight test on a console powered by a portable electric generator. Inversion conditions are determined by means of temperature readings taken on two maximum-minimum thermometers at ground level and 50 foot height, respectively. Temperatures are read immediately after each test.

Preparation of the test site for treatment applications was continued during the reporting period. Treatment plots 300' x 1500' were marked off on the small test site totaling 3,500 rai or 1,400 acres. Lanes on this site had been prepared during the previous quarter. A single swath of "purple" was sprayed on 19 February throughout the length of the small test site to serve as a reference grid line for treatment plot locations. Authorization was obtained from officials of the Pranburi Military Reservation and the Supreme Command Headquarters for extension of the small test site and relocation of the large test site providing for a total treatment



Portable telescoping tower used for securing Meteorological data at 50 feet height.



Wind direction and velocity indicator console with supplemental meter registering winds at 0-10 MPH at 50 feet height.

area of 5,000 rai (2,000 acres) and 3,500 rai (1,400 acres), respectively. Lane clearing operations were reactivated in March following surveys in the extension of the small test site and in the relocated large test site to determine suitable lane locations.

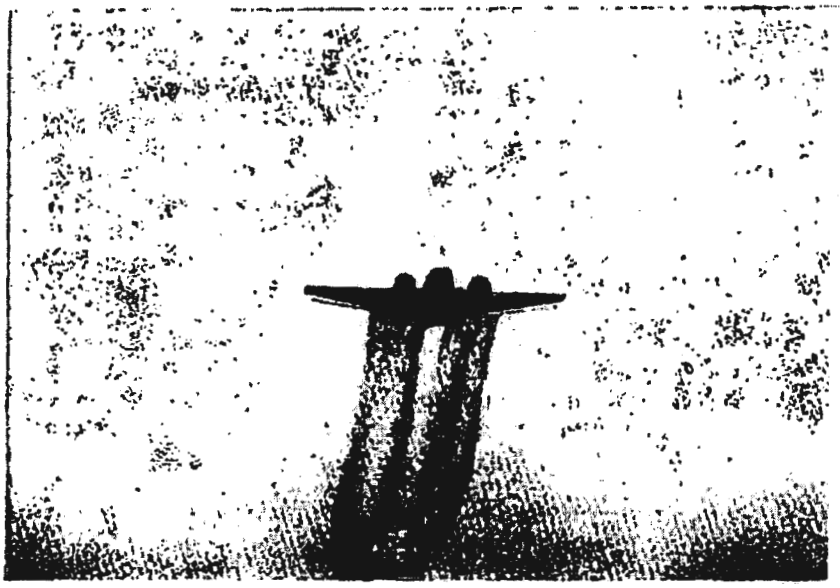
Vegetational study plots, each 10 x 40 meters in size, were established at 6 locations in the small test site. A complete census of woody vegetation and profile drawings were made at each location to characterize the vegetation. Photographic stations were established at 12 locations in the small test site at which one vertical and 4 horizontal photographs were taken to evaluate vertical and horizontal visibility and vegetation cover.

Additional vegetation inventory plots will be established in the extension of the small test site and in the relocated area after treatment plot locations have been established.

A photographic technique was developed for evaluation of changes in horizontal and vertical visibility caused by defoliation treatments. Six photographic stations will be established in each treatment plot prior to treatment. At each location, one vertical and 4 horizontal photographs will be taken with a Nikon F camera equipped with a 28 mm, wide-angle lens prior to treatment and at standard intervals subsequent to treatment. Percentage change in foliation due to treatment will be determined by photoelectric meter scanning of negatives subjected to standardized contrast development procedures. Corollary observations of defoliation will be made on tree species in vegetational transects at each photographic stations.

Test Results

Representative data obtained in static flow tests with various nozzle orifices, cones, and pressures are given



Calibration flight of Beechcraft to determine spray deposition pattern with 20 inboard nozzles per boom.

Calibration flight on grid at Hua Hin Airport. Note 50-foot telescoping meteorological tower to determine wind conditions at height of spray release.

in Table 1. Flow rate data are expressed in gallons per minute for a boom system consisting of a total of 40 nozzles (20 per boom).

These data can be converted to gallons per acre by the following formulas:

$$\text{Acres per minute} = \frac{2 \times \text{swath width (ft)} \times \text{airplane speed in mph}}{1{,}000}$$

$$\text{Gals per acre} = \frac{\text{gals per minute}}{\text{acres per minute}}$$

Thus, for example, assuming a swath width of 100 feet and a speed of 115 mph (100 knots), the number of acres sprayed per minute would be 23.0. A flow rate of 76.8 gals/min. such as for the mixture of 1:1 2, 4, 5-T diesel at 40 psi would be 3.3 gals/acre. The range of nozzle configurations for the data indicated show a range of flow delivery from 0.48 gals/acre (11.0 gals/min. for water with D6 - 25 nozzles at 20 psi) to 4.2 gals/acre (97.4 gals/min. for diesel fuel with D10 - 56 nozzles at 40 psi). Deliveries in excess of 4.2 gals/acre can be obtained by increasing the number of nozzles or by double applications.

General conclusions drawn from the data on delivery flow rates are:

a. Flow rates of diesel fuel are greater than those of water.

b. Flow rates of "purple", a fluid with specific density of 10.8 lbs/gal is appreciably less than that of diesel fuel with a density of 7.5 lbs/gal.

(1) DATA BASED ON D7-56 NOZZLES

TABLE 1. FLOW RATES (GALS/MIN) FOR BOOM SYSTEM WITH 40 NOZZLES FOR VARIOUS NOZZLES AND PRESSURES. BASED ON STATIC FLOW TESTS WITH BEECHCRAFT SYSTEM

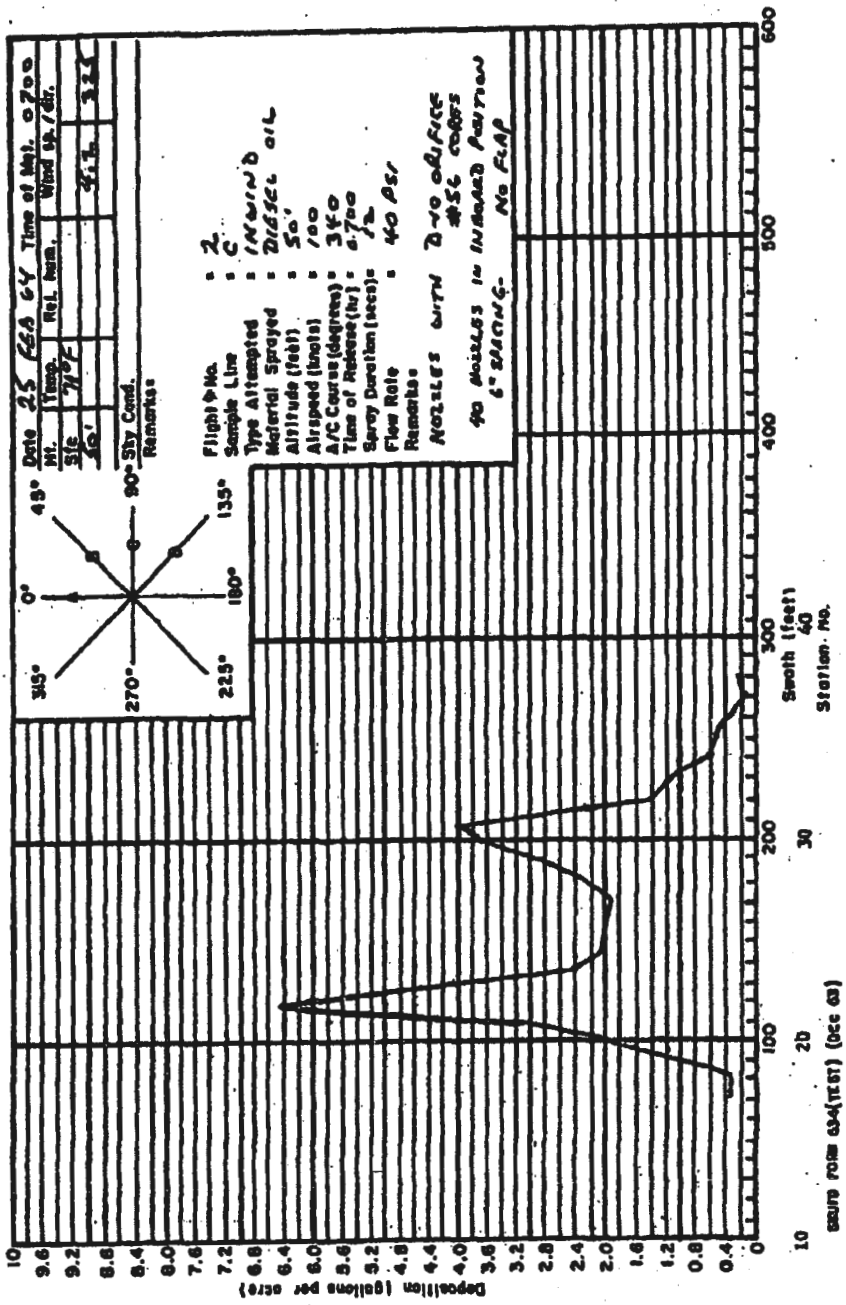
SPRAY SOLUTION	PSI	NOZZLE TYPE D6-25	D6-56	D8-25	D8-56	D10-56
WATER	20	11.0		16.4	53.7	64.4
	30	13.7		20.4	65.1	76.6
	40	15.4		23.7	77.8	92.2
DIESEL FUEL	20		42.0 (1)			
	30		52.0			81.5
	40		60.3			97.4
PURPLE	30	16.5	33.4		51.2	65.3
	40	18.4	38.3		62.0	76.3
PURPLE/ DIESEL 1:1 MIX	20	12.3		17.4	46.6	
	30	15.8		21.1	58.2	
	40	16.9		23.0	68.8	
PURPLE/ DIESEL 1:2 MIX	20		30.5		47.1	
	30		36.1		56.8	
	40		42.8			
2,4,5-T/ DIESEL 1:1 MIX	20	13.8	30.0	17.2	44.4	59.4
	30	15.5	34.0	20.0	54.2	68.3
	40	17.9	39.5	21.9	62.1	76.8
2,4,5-T/ DIESEL 1:2 MIX	20	13.4		16.6	45.9	
	30	15.7		20.0	56.8	
	40	18.7		22.7	67.3	

c. Flow rates of mixtures of "purple" or 2, 4, 5-T ester in ratios of 1:1 or 1:2 with diesel fuel do not differ significantly from that of diesel fuel.

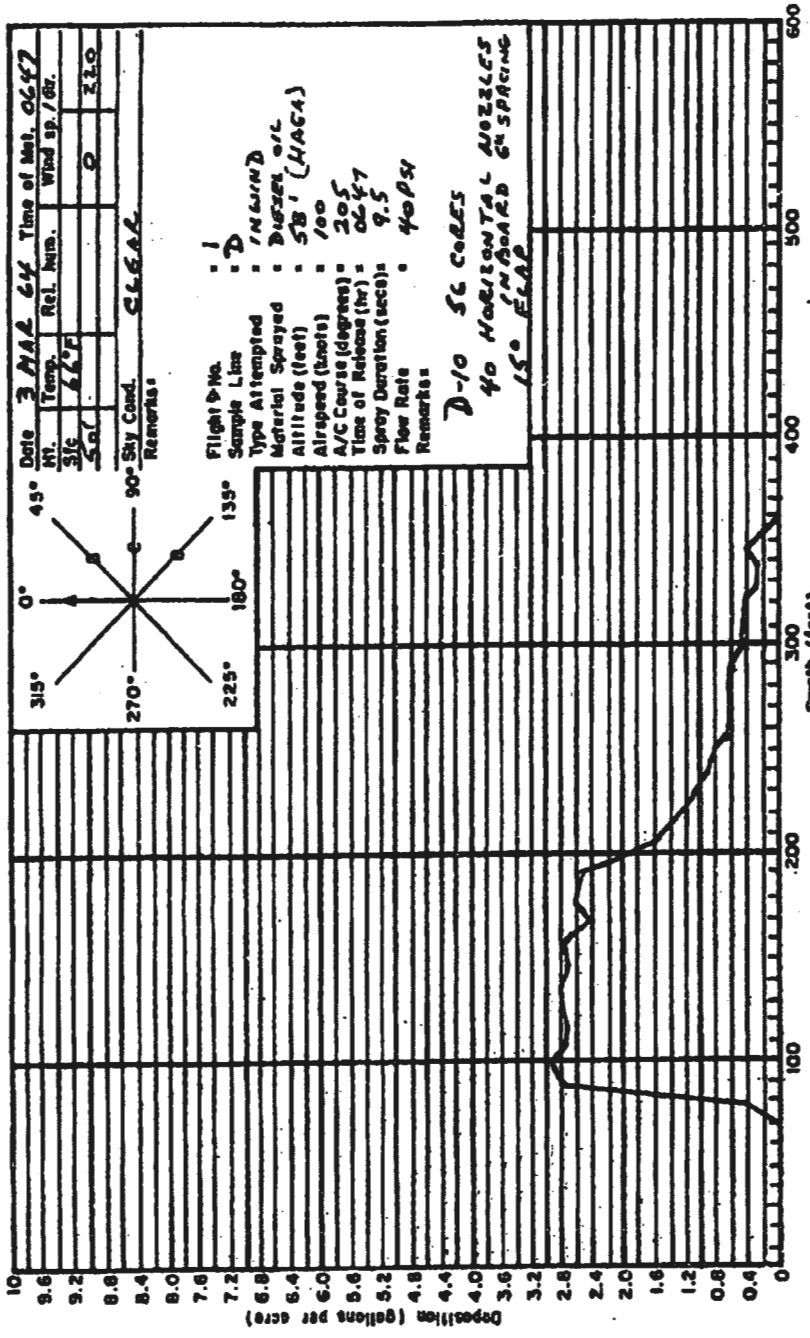
Preliminary spray deposit patterns obtained by the oil sensitive dye card technique on a single 400 foot grid line at the Hua Hin Airport, using diesel fuel spray, indicated that boom configurations with nozzles equally spaced for the length of the booms (wing span of 52 feet) produced a swath width in excess of 150 feet with a distinct bimodal pattern at flight altitudes of 50 to 75 feet. A total of 69 flight runs were made in a 6-day period using this technique.

A more comprehensive analysis of spray deposit patterns was made with the wet-plate method and Kromekote card technique on a grid with 8 grid lines permitting inwind flight runs from any direction. Effort in this phase of the calibration studies was directed toward modification of the boom and nozzle configuration to secure uniform spray deposit rates over a tentative swath width of 100 to 150 feet. Bimodal deposit patterns appeared to be influenced by the 2-engine configuration of the plane with a gap in nozzle placement corresponding to the fuselage and by the distinct wing-tip vortical action noted when nozzles were positioned to the wing tip. Restriction of nozzles to inboard positions behind the engine nacelles restricted the vortical deposit pattern and tended to give a more restricted swath width but the deposit pattern maintained a distinct bimodal aspect.

Trials conducted with flaps down at 10°, 15°, and 30° showed a tendency to minimize the bimodal deposit curve. Pertinent data from 46 test flights with various nozzle and boom configurations are presented in Table 2.



Spray deposit pattern of Beechcraft equipment using 20 nozzles per boom. Horizontally positioned, 6-inch spacing in inboard half of boom. Flight at 50-foot height with no flap. Note bimodal pattern of spray deposit with varying deposit rates.



Spray deposit pattern of Beechcraft equipment using 20 nozzles per boom, horizontally positioned, 6-inch spacing in inboard half of boom behind flaps. Flight at 50-foot height with 15° flap. Note uniform spray deposit; 100-120 foot swatch width with deposition of 20- to 30 gals/acre.

TABLE 2. SPRAY DEPOSIT CHARACTERISTICS OF VARIOUS NOZZLE AND BOOM CONFIGURATIONS TESTED IN FLIGHT CALIBRATIONS BY COLORIMETRIC-WET PLATE METHOD USING DIESEL FUEL AND DUPONT OIL RED DYE. ALL TESTS AT 40 PSI

Size	Nozzle No Boom	Spacing	Position	Degrees Flap	No. of Flight Tests	Swath Width (Ft.)	Range of Spray Deposit (Gals/Acre)	Character of Deposit Pattern
D6-56	20	12"	Horiz.	0	4	105-175	2.4 - 0.5	BIMODAL
D10-56	10	12"	Vert.	0	2	90-100	1.1 - 0.3	P. BIMODAL
D10-56	20	6"	Vert.	0	3	140-170	3.3 - 0.7	BIMODAL
D10-56	20	12"	Horiz.	0	4	125-175	4.1 - 0.7	BIMODAL
D10-56	10 10	12" 12"	Horiz. Vert.	0	6	95-140	3.6 - 1.7	VARIABLE
D10-56	20	6"	Horiz.	0	9	110-170	4.3 - 1.3	BIMODAL
D10-56	15	6"	Horiz.	0	4	90-160	2.7 - 0.7	BIMODAL
D10-56	20	6"	Horiz.	10	5	100-130	3.8 - 1.0	BIMODAL
D10-56	20	6"	Horiz.	15	5	100-110	4.3 - 1.7	2085 NOT BIMODAL
D10-56	20	6"	Horiz.	30	2	125-140	3.1 - 1.3	BIMODAL
D7-56	20	6"	Horiz.	10	2	90-130	1.3 - 0.3	1 of 2 NOT BIMODAL

UNCLASSIFIED U.S. Department of State Case No. F-2015-06622 Doc No. C05779368 Date: 06/02/2015

Results from flight calibration tests using diesel fuel sprays indicate that:

a. Horizontally positioned nozzles give droplets of larger mass median diameter than similar vertically positioned nozzles.

b. Restriction of nozzles to the inboard half of the boom with 20 horizontally-positioned nozzles at 6 inch spacings produces a well defined swath of less than 150 feet but with a distinct bimodal deposit pattern.

c. Use of 10 to 15° flaps during spray application minimizes the bimodal aspect of spray deposit and gives a suitable deposition pattern within a swath width of 100 to 120 feet.

Flight calibration tests with "purple", totaling 28 as of 15 March, indicate that the spray deposit patterns are slightly narrower in swath width and that droplets are of larger mass median diameter. The use of flaps gives a desirable deposition pattern.

Plans

Full scale treatment applications will be made on replicate 10-acre plots in both the small and large test site areas at the Pranburi Military Reservation. Bi-monthly applications will be made of basic rates of purple and 2, 4, 5-T ester, in coordination with specific rate and volume applications of 8 basic defoliants, desiccants, and herbicides. During the initial phases of treatment, calibration flights of all types of spray solutions will be made over a standard grid line to determine deposit rates under identical conditions as treatment. Deposit rates will be determined colorimetrically using either oil or water

soluble dye in the chemical solution. Meteorological conditions during the period of treatment will be measured at the test site and grid location.

Requirement: Psychological Warfare

Task: Psychological Warfare Equipment (2A)

Sub-Task: Audio-Visual Mobile Unit

MRDC is awaiting ARPA action in CONUS on recommended improvements based upon field test of the Willys Audio-Visual Mobile Units.

SUB-PROJECT VII

TECHNICAL PLANNING AND PROGRAMMING

SUB-PROJECT VII

TECHNICAL PLANNING AND PROGRAMMING

SUB-PROJECT OBJECTIVE

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

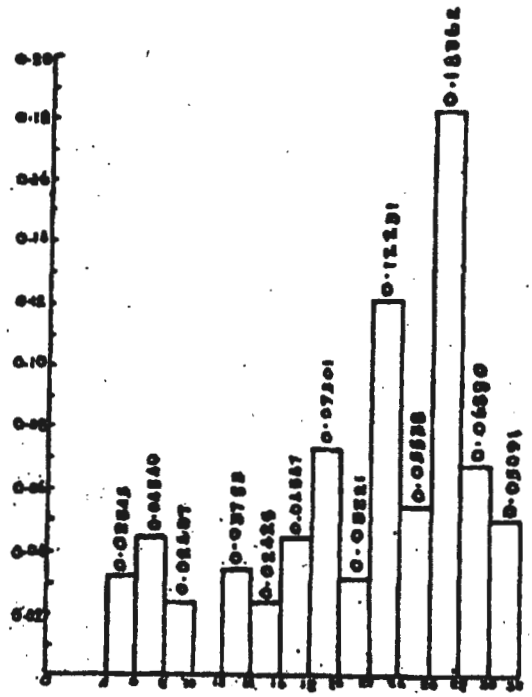
Requirement: **Data Collection and Analysis - Environmental**

Task: **Physical Environment Methodology (IAI)**

Sub-Task: **Water Resources**

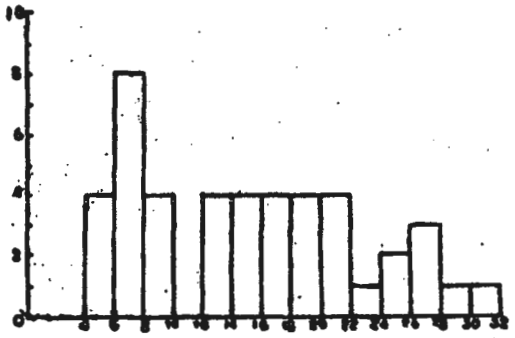
No further activity during the reporting period.

Vertical distribution of tree in plot V

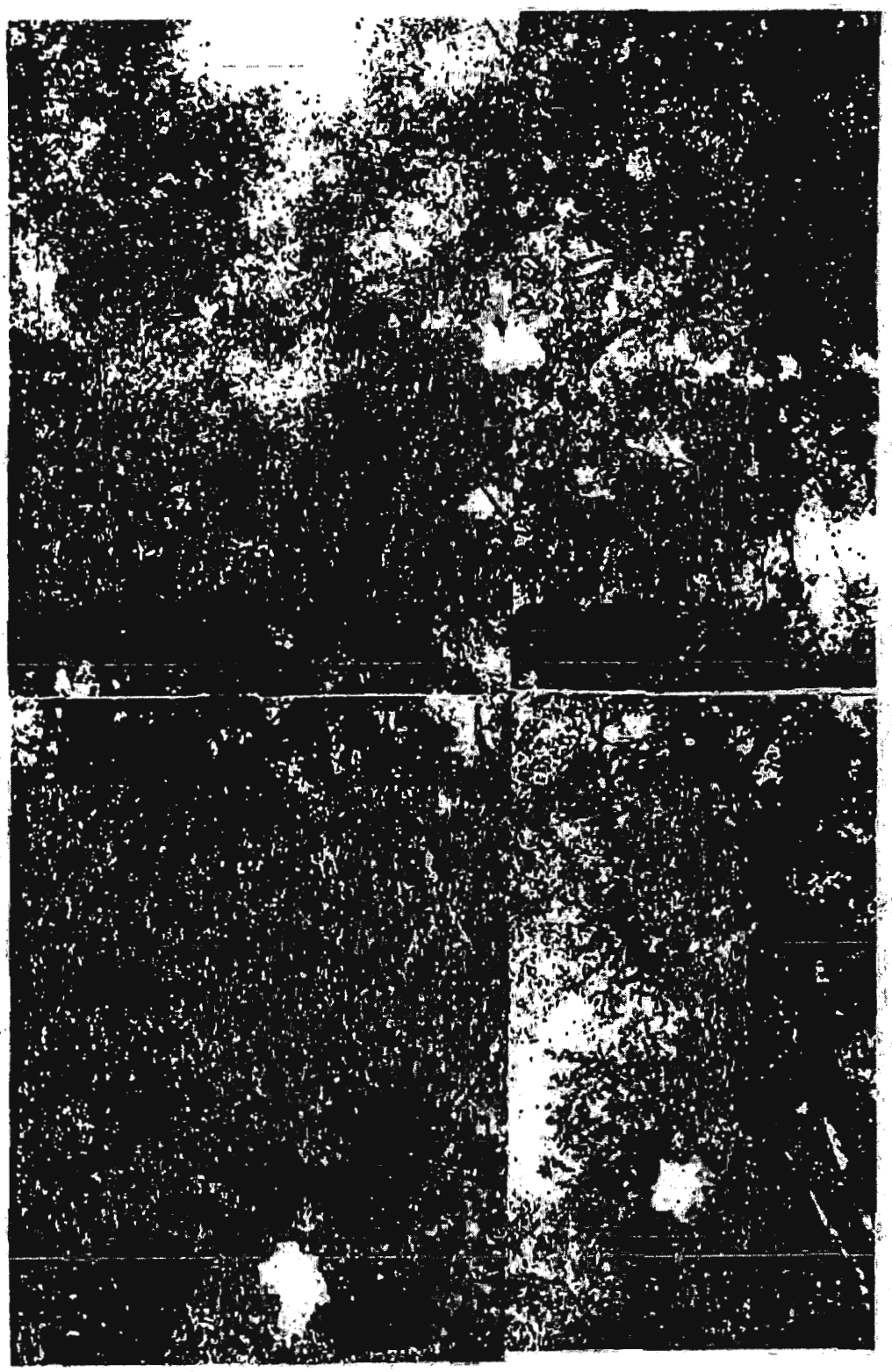


High - m

Frequency distribution of tree height of plot V



high - m.



Typic
lower

Vegetation Team in operation. Conducting a Floristic composition and structure of forest stands.

Soil Engineers conducting soil samples on site for use in Vegetation Studies and collection of soil data for MERS.

Requirement: Data Collection and Analysis - Environmental

Task: Vegetation Study (1A2)

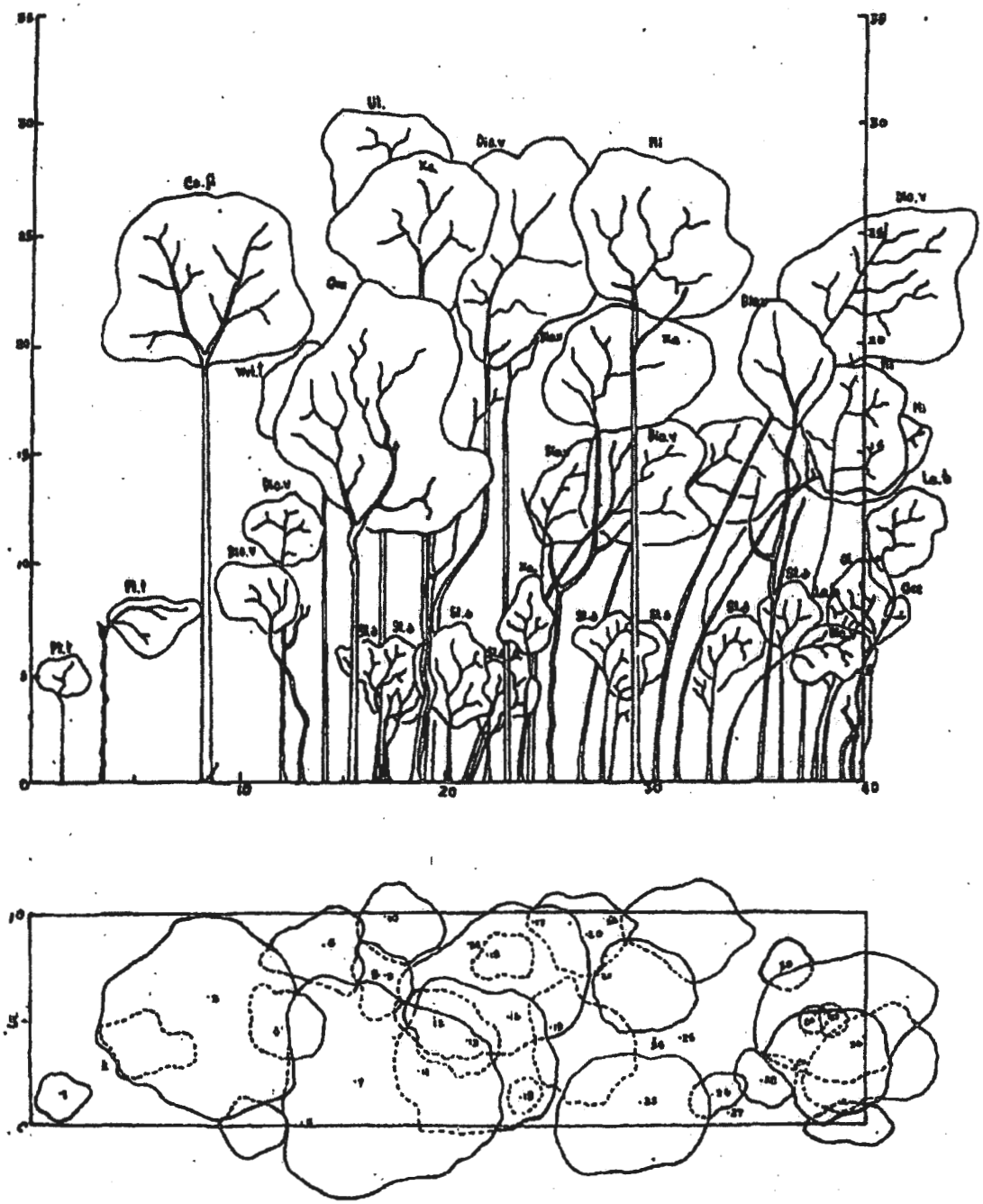
Thus far, 86 floristic composition profile plots have been completed to assist in identifying vegetation in Thailand. At the same time, canopy obscuration and forward visibility measurements of value to research in surveillance problems, and soil samples relevant to MRDC mobility research, are also taken. Approximately 200 canopy measurements, 390 forward visibility measurements, and 130 soil samples have been recorded by field research teams. Plates 1 and 2 show a vegetation team in the field. A team usually consists of a taxonomist, botanist, forester, plant collector, and soil engineer.

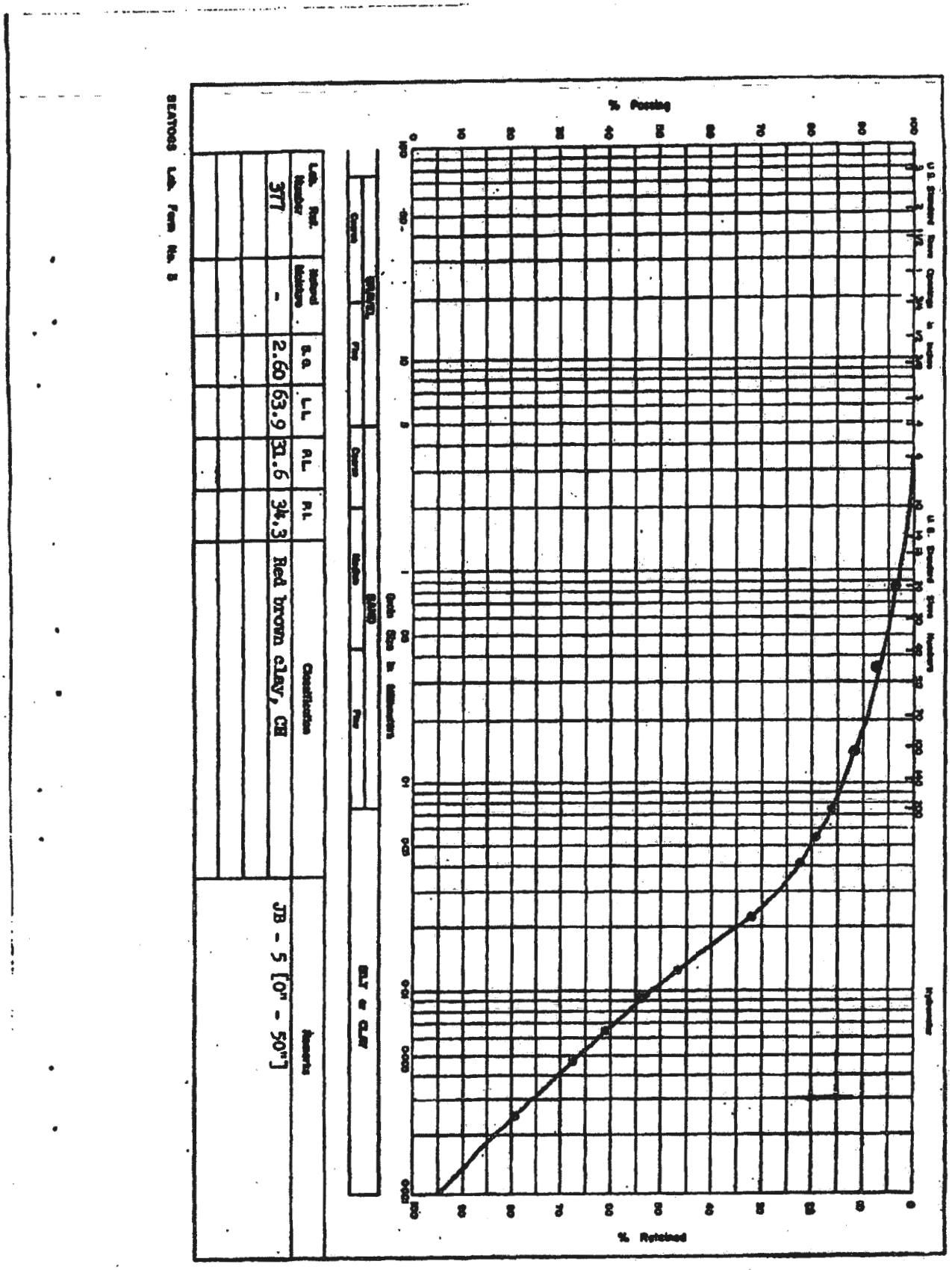
Plate 3 shows forest composition. The test plots are laid out in blocks 10 meters by 40 meters. The data collected is shown in Plates 4 and 5. From these data, leaf volume, wood volume, tree spacing and density, branch growth, heights, physical forest structure, and other measurements are obtained. Plate 6 shows soils data taken from a test plot.

Data are being collected on every forest type in Thailand and associated undergrowth. After collection is complete, an analysis is made and a written description prepared. Sample data sheets are attached in Appendix A for illustrative purposes. These data sheets can be modified at any time to include particular environmental data required for other MRDC tasks and sub-tasks.

While the vegetation surveys are in progress, notes are made on edible and poisonous plants for inclusion in a jungle survival handbook for the Royal Thai Army. The basic outline of the book is drawn from the Armed Forces Field Manuals, with additions covering such subjects as the nutritional food value and frequency of occurrence of edible forest plants.

Diagramatic profile and corresponding horizontal projection of dry evergreen forest on a 10 x 40 m strip through the sample plot. Alt. 360 m. January 6, 1964.




% Passing
% Retained
SILT or CLAY
Lab. Ref. Number
Natural Moisture
S.G.
L.L.
P.L.
P.I.
Classification
Remarks
377
-
2.60
63.9
31.6
34.3
Red brown clay, CH
JB - 5 [0" - 50"]

Requirement: Data Collection and Analysis-Sociological

Task: Studies of Northeast Thailand (IC1)

The Directory of The Social Science in Thailand was published in collaboration with Chulalongkorn University and distributed to interested parties during the reporting period. Work continues on the bibliography of uncatalogued and generally unknown reports and papers dealing with Thailand which are relevant to MRDC research activity.

RAC ELEMENT OF MRDC

RAC is developing a concept of conflict (such as might come about in Thailand if Communist-inspired insurgency develops) as an essential part of its task to accomplish operations research in logistics, mobility and ground operations under Sub-Project III; in addition the model concept is intended to provide all projects in MRDC with a common base or statement of potential conflicts that can be used or elaborated upon as the requirements for each study dictate.

During the reporting period a first draft of the concept was completed, briefed and circulated internally within the OSD/ARPA R&D Field Unit for critical comment. A second draft is scheduled for completion in April. This draft will be briefed to a wider US/Thai audience for comment on April 9 and will be submitted to a large number of people for detailed review before formal publication. The Northeast portion of Thailand was chosen as the setting for the situations and three examples of insurgency campaigns at varying levels of intensity have been developed.

The procedures used for situation development may have application in studies by other organizations within Thailand or in other areas of the world. These possibilities will be tested, both as to the adequacy of the procedure itself and the validity of the basic parameters already developed.

RAND ELEMENT OF MRDC

RAND effort during the reporting period was devoted primarily to continuation of the airfield data analysis and classification work discussed in Sub-Project III and participation in the planning and conduct of the village security pilot study described under Sub-Project VII. Plans were also laid for conducting the second airborne visual surveillance experiment as outlined under Sub-Project V, during the next quarter.

A professional economist was provided for 30 days, at the request of JUSMAG, to participate in a military cost analysis exercise.

Requirement: Data Collection and Analysis

Task: Village Security Pilot Study

This task was established during the reporting period. It is an attempt to explore ways and means to collect data of value for planning the security of villages in remote rural areas. Experience in Vietnam has shown the severe handicaps imposed when village studies are attempted while the conflict is in progress, and also the difficulty of planning security measures for people, villages, and locations about which very few facts are known. It was decided, therefore, that it would be wise to address the basic elements of the village security problem in Thailand now, in the event that actual village security programs were needed at some future date. It also appeared to the MRDC staff, on the basis of casual observation, that the villages in Thailand had certain special characteristics, some of which might have an affect on security planning.

This pilot study is aimed primarily at determining a methodology for acquiring useful data for village security purposes. As a first step, emphasis has been placed on the physical characteristics of rural villages which might be relevant to village security. For example: location, size, population density, external and internal village configurations, available natural resources (water, timber, bamboo, rock), man-made facilities, arable land, food storage, and food export/import ratios. A series of questions has been prepared to elicit information on these matters.

The questions are asked at five levels: central government, province, district, commune, and the village itself. This is done to determine how far one must go in order to obtain useful data and to identify the optimal combination of data sources, i.e., that combination which gives maximum essential information for the least effort.

Most of the field work for the pilot study was accomplished at the close of the reporting period. Two sample areas were selected in Udorn Province, 100 square miles and 25 square miles in size, respectively. Both lie west of the province capital of Udorn. They were selected on the basis of map studies and our general familiarity with northeast Thailand. About 50 villages are involved. Following completion of the research and analysis of the data, a report will be published.

SUB-PROJECT VIII

RESEARCH AND EXPLORATORY DEVELOPMENT

SUB-PROJECT VIII

RESEARCH AND EXPLORATORY DEVELOPMENT

SUB-PROJECT OBJECTIVE

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

Requirement: Clothing and Equipment

Task: Improved Individual Combat Equipment (1A)

Sub-Task: Individual Combat Clothing and Equipment

Clothing technicians from the US Army Natick Laboratories are due to return to Thailand in May 1964 to continue design work on Individual Combat Clothing and Equipment for the Royal Thai Armed Forces.

Various prototype items of clothing and equipment, designed by Natick technicians and fabricated by the RTA Boot and Clothing Factory during the last quarter of 1963, have been worn and used by soldiers from RTA Special Forces Units and 1st Division QM Company for several months. Data and information concerning the serviceability and utility of these items will be obtained by MRDC and Natick personnel. The design of the prototype items will be modified where necessary to correct reported deficiencies. Test items of modified design in sufficent numbers to conduct a valid field evaluation will be fabricated at the RTA Clothing and Boot Factory under supervision of Natick technicians. Extensive field tests will follow.

Requirement:	**Rations**
Task:	**Combat Rations**
Sub-Task:	**MRDC Evaluation of the CDTC-V Ranger Ration (A)**

A limited evaluation of the CDTC-V Ranger Ration was conducted in January 1964. The VN ration was fabricated for CDTC-V by the U.S. Army, Natick Laboratories, using U.S. and VN dehydrated foods. The purpose of the preliminary MRDC evaluation was to determine what changes should be made in the VN ration in order to make a similar combat ration suitable for Thai troops. The evaluation consisted of having two RTA soldiers subsist for three days on the VN ration, consuming two days of Type I and one day of Type 2 rations. In addition, one Type I ration (three meals) was sampled by a number of RTA QM and MRDC officers.

Generally speaking, the soldiers liked the VN Ranger ration and seemed to accept the dehydrated foods, preferring them to the present RTA canned combat ration. Some specific comments were:

a. The rice was acceptable; however, test subjects did not like the milk mixed with the rice in the Type 2 ration. Also the Type 2 ration did not provide enough rice.

b. Vegetable and meat bars were acceptable, but a wider variety of both should be offered.

c. Peanuts and sesame seeds were not acceptable.

d. Coffee and lemon powder were acceptable; tea was not. More coffee would be desirable.

e. Pepper slices were acceptable.

f. More sugar would be desirable.

g. A hot Thai curry powder and nam pla powder (dehydrated fish sauce) would be desirable in a Thai ration.

h. The packaging system was acceptable; however, a more compact package would be desirable.

i. The Type I ration was adequate for quantity; the Type 2 ration was not adequate.

As a consequence of this test, ARPA has been requested to contact the Natick Laboratories to fabricate 1000 rations (3000 meals) for MRDC evaluation. The following menus were proposed.

a. Breakfast (3 menus)

(1) Rice

(2) Meat bar (one-third each of fish, pork and shrimp)

(3) Coffee

(4) Sugar, cubes

b. Lunch (4 menus)

(1) Rice

(2) Meat

(3) Vegetable bar (any of the following, with as much variety as possible: cabbage, lettuce, spinach, Chinese mustard, collards, celery, or parsley.)

(4) Nam Pla powder

(5) Hot pepper powder or slices

(6) Garlic powder

(7) Lemon powder

(8) Salt

(9) Sugar, cubes

c. Dinner (4 menus)

(1) Rice

(2) Meat bar (same as lunch)

(3) Vegetable bar (same as lunch)

(4) Nam Pla powder

(5) Hot Thai curry powder

The following recommendations were made concerning the proposed MRDC test rations:

a. Food items be packaged in polyethelene bags similar to those used in the CDTC-V ration.

b. One ration (3 meals) should weigh not more than 2 1/2 pounds and should not be larger in bulk than the CDTC-V ration, and preferably smaller.

c. One ration should contain approximately 3500 calories.

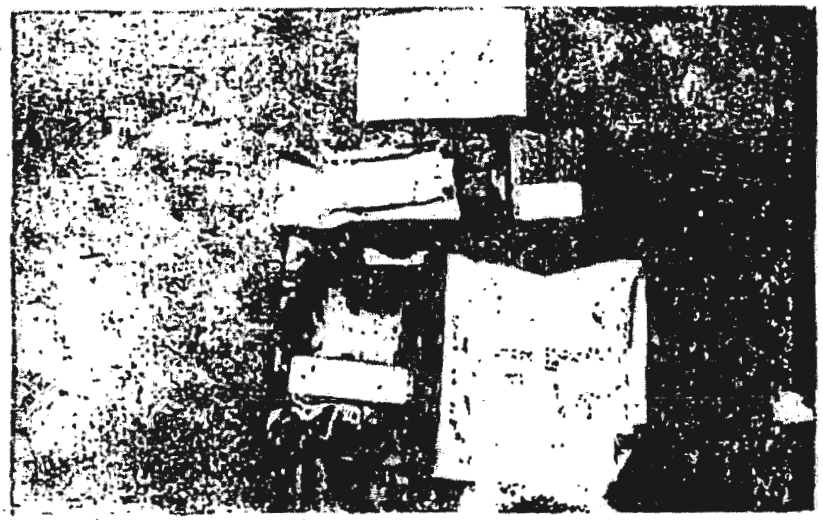
d. Food items should weigh approximately the following (dry processed weight):

(1)	Rice packet	300 grams
(2)	Vegetable bars	20 grams
(3)	Meat bars	50 grams
(4)	Coffee	5 grams
(5)	Lemon powder	5 grams
(6)	Salt	4 grams
*(7)	Nam pla powder	5 grams
*(8)	Thai curry powder	5 grams
(9)	Pepper slices or powder	5 grams
(10)	Sugar cubes	10 grams

e. Instructions for food preparation should be written in Thai on each food item. Each menu (packet) should be identified as breakfast, lunch, or dinner, along with the type meat and vegetable bar it contains. The mix of the various meat and vegetable bars of the menus should be in equal proportions. It is not known at this time which meat and vegetable bars should be in a particular menu.

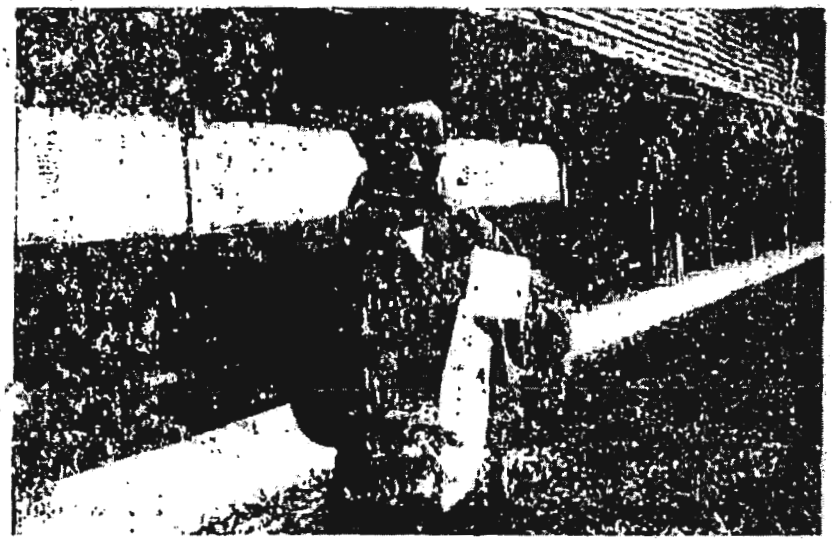
f. All items, except those indicated by an asterisk should be provided from U.S. sources. ARPA Field Unit, Bangkok, can forward the nam pla and curry powder (or any of the other items, if required) to the Natick Labs when notified of the amount and types required.

ARPA has been requested to arrange for a qualified food technician to come to Thailand during the test period in order to assist in evaluating the results of the test, as well as to recommend the composition of an operational ration. Should the RTA decide to adopt combat rations, the technician could further advise Thai authorities on equipment, plant, and materials required to produce a Thai ration.



The CDTC-V ration is relatively light-weight (2 pounds 9 ounces) and fairly compact when compared to the current canned RTA ration (4-1/2 pounds). Contains are dehydrated rice, vegetables (cabbage, spinch), meat (shrimp, fish, pork) condiments, (red pepper slices, garlic powder, salt), beverages (lemon drink, coffee, tea) and sugar cubes.

These rations have a long shelf life and can be produced from local produce.



A 10 ounce bag of dehydrated pre-cooked rice is a part of each meal. The rice is prepared by mixing one half canteen cup of hot water with the rice in its plastic container. The rice is ready to eat within 10 to 15 minutes. Thai soldiers liked the rice and preferred it to the canned rice used in the present RTA combat ration.

Requirement: Rations

Task: Combat Rations

Sub-Task: Food Packet, Indigenous, Combat Supplement Evaluation

An evaluation of the Food Packet, Indigenous, Combat Supplement was conducted in December 1963. The following background information is pertinent. The Food Packet, Indigenous Combat Supplement is being considered by the U.S. Army as a ration supplement which could be provided by U.S. Forces to Thai and other personnel in specialized combat operations. The ration was developed on the basis of existing technology by selecting simple components from U.S. military rations that were thought to have a good probability of being acceptable to people from different food cultures. The 9th Logistical Command located in Korat, Thailand, acting for USARYIS, requested MRDC, as the R&D agency of the Royal Thai Armed Forces, to conduct this evaluation as a part of the MRDC combat ration task.

The purposes of the evaluation were:

1. To determine the suitability of the food packet for use by Thai forces when conducting combat operations. The evaluation determined spoilage, suitability of cache feature, durability of bandoleers and individual packets during operations, and suitability for air drop.

2. To determine the acceptability of food components to Thai personnel.

3. To obtain information on the manner of its use as a supplement to other foods, either provided or found in nature, when conducting combat operations in Thailand.

4. To obtain information and data upon which to base improvements of components and packaging techniques of this or similar combat rations for use by Thai personnel.

The evaluation concluded that:

1. The ration, in its present form, is not entirely acceptable as a ration supplement for Thai personnel conducting combat operations. Until a more suitable ration is developed, this ration could be used as a supplement for short periods, provided that additional hot pepper and fish sauce powder were available. The RTA QM Subsistance Branch can supply both of these ingredients.

2. The plastic case is adequate as a container for the food packets; however, it would appear that all rations would not have to be packed in the expensive plastic case. Depending upon the tactical requirement, a percentage of rations could be packed in cheaper, waterproof cardboard cases, using the plastic cases only when rations are to be stored in a cache. The plastic case is suitable for air drop, but honeycomb should be used to protect cases that are free dropped.

3. The bandoleers are sturdy and are very effective as a carrier for the ration packets. The bandoleers can be conveniently carried by a soldier in a variety of ways which will save valuable space in an already overcrowded combat pack. The size and weight of the ration packets are particularly desirable.

4. The following food items are not entirely acceptable to the Thai palate and should be removed from the ration in order to make room for more acceptable items:

a. Cheese bar

b. Tea

c. Onion powder

d. Garlic powder

e. Sweet bars

5. The following items should be added to a portion of the food packets.

a. Small pack of cigarettes and matches

b. A variety of compressed vegetable bars

c. Sugar cubes

d. Powdered nam pla (fish sauce)

e. Hot Thai curry powder

6. The following items should be changed as indicated:

a. Dehydrated red pepper bar or powdered red pepper (very hot) should replace the relatively mild red pepper powder.

b. More coffee powder should be added to each packet containing coffee.

c. A variety of meat should be offered.

7. The ration packet is intended to supplement basic food items, either provided locally or found in nature. Basic food items (rice, vegetables, etc.) cannot always be found in sufficient quantities in nature or locally in remote areas of Thailand to sustain even small numbers of troops. The ration supplement, because of its concentrated nature, could be used as a sole food source by Thai troops for only a few days and still have the troops maintain their combat effectiveness. Provision should therefore be

made to supply troops with basic food stuffs, such as dehydrated rice, in those instances where basic foods are not available in the area of operations. Two varieties of dehydrated pre-cooked rice which is ready to eat within 15 to 20 minutes after cold water is added will soon be evaluated by MRDC for use in a Thai combat ration. Dehydration reduces the weight as well as the bulk of the rice. Another advantage is that the rice is pre-cocked, eliminating the necessity for elaborate cooking preparations.

7. A ration of this type should be fed to Thai troops during training so they can learn to prepare the food and acquire a taste for some of the food items which are strange to them.

As a result of the test, the following recommendations were made:

1. The Food Packet, Indigenous, Combat Supplement, in its present form, not be standardized as a combat ration supplement for use by Thai personnel engaged in combat operations. Until a better ration is developed, the present ration supplement can be used for short periods of time, providing it is supplemented with additional hot powder and fish sauce powder.

2. The plastic food packet container case be used for rations that are to be stored in a cache or improvised field storage for long periods before being consumed. Less expensive cases should be used for rations that are to be consumed soon after delivery to the area of operations.

3. The cloth bandoleer and the foil food packet wrapper are acceptable for combat rations of this type. The weight and size of the food packets are particularly desirable.

4. ARPA arrange for an appropriate agency to fabricate a dehydrated type ration of approximately the same size and weight, using a similar packaging technique as used in the test ration and containing essentially the following food items arranged in the following menus:

a. Breakfast (Three menus)

Meat bar, one of either fish, pork, or shrimp

Cereal bar

Coffee

Sugar, Cube

Small package of cigarettes and matches

b. Lunch (Four menus)

Meat bar, one of either fish, pork, shrimp or beef

Vegetable bar, one of either cabbage, lettuce, spinach, Chinese mustard, collards or celery

Nam pla powder

Salt packet

Lemon powder packet

Packet of hot pepper powder or slices

Packet of sugar cubes

c. Dinner (Four menus)

Meat bar, one of either pork, shrimp, fish or beef

Vegetable bar, one of either cabbage, lettuce, spinach, Chinese mustard, collards or celery

Nam pla powder

Packet of hot Thai curry powder

d. Food items in these menus should weigh approximately the following (dry-prepared weight)

Vegetable bars	20 grams
Meat bars	50 grams
Coffee	5 grams
Lemon powder	5 grams
Salt	4 grams
Nam pla powder	5 grams
Thai curry powder	5 grams
Pepper slices or powder (hot)	5 grams
Sugar, cubes	10 grams

e. Food preparation instructions should be printed in Thai on each packet. Each meal (packet) should be identified as breakfast, lunch, or dinner, along with the type meat and vegetable bar it contains. Various types of meat and vegetable bars should be equally distributed throughout the rations. It is not known at this time which meat and vegetable bar combinations are best.

f. That approximately 3,000 of the above packets (1,000 rations) be evaluated by MRDC to determine their suitability as a combat ration supplement for Thai troops.

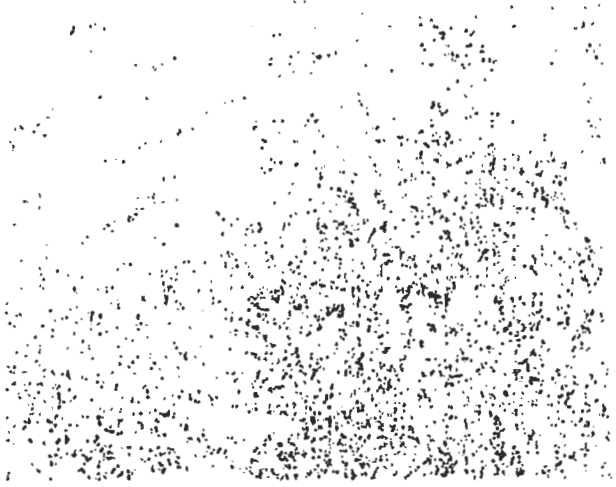
g. That provisions be made to provide Thai troops engaged in combat operations in remote areas of Thailand basic food items such as dehydrated rice packets along with ration supplements when basic items are not available in the area of operations.

h. That combat rations of this type be fed to Thai troops in training so they can acquire a taste for the food items as well as learn to prepare them.

The small size and light weight of the ration packet permits this RTA soldier to carry a six day supply of ration supplements. Test subjects wore the bandoleers for three days during vigorous training exercises. The bandoleers were convenient to carry, withstood the rough handling and did not interfere with the soldiers' body movement. Because of the heavy weight and bulk, an RTA soldier can carry only one day of combat rations currently used by the RTA, along with other essential combat equipment.

Test subjects lost an average of three kilos (6.6 lbs) during the three days in which they ate the ration supplements. Some men lost as much as 4 and 5 kilos (approximately 10 lbs). Men ate 600 grams of rice per day, supplemented by three ration packets. RTA soldiers normally eat 1,000 grams of rice per day in addition to meat and vegetables.

APPENDIX A



APPENDIX A

FIELD TABLE A.

TABLE OF DESCRIPTION OF SAMPLE FOREST STANDS

Date: January 6, 1964 Examiners: Pong & Anan

Examination or plot No. 5

Locality and site 8.23 miles from the base camp of Jansky and Bailey at Khao Yai.

Latitude 14° 32' 14.88" N Longitude 101° 37' 4.76" E

Vegetation Type. Dry Evergreen Forest

Sample shape. Rectangle Sample area 10 x 40 sq.m.

Physiognomy: Structure, life form. This is a two-story forest structure. The upper story from 10-30 meters is composed of Diospyros variegata, Mitrephora sp., and other species. The lower story up to 10 meters is composed of Streblus taxoides, almost pure stand.

Habitat.

Elevation 360 m. Exposure N 40 E Aspect N Slope 10°

Precipitation

Drainage: - Rapid Moderate x Poor

Solar radiation open 220

Vertical 25 N: N 30 E 10.1 N 60 E 16 E: S 60 E 40 S 30 E 50
S: S 30 W 25 S 60 W 40 W: N 60 W 20 N 30 W 13

Time 0940 **Weather condition** clear.

Parent Rock Lime stone

Nature of soil: - **Depth** 50" **pH** 0 - 25" = 6.5
25- 50" = 5.5 **Color** Red brown clay

Texture fine **Consistency** soft.

Surface litter: **Depth** **Bare** **Scatter** x

Edible plant:

Hazardous plant: Thorny shrubs (Streblus taxoides)

Nota bene: Tree leanings indicate strong winds from the East.

FIELD TABLE B.

FLORISTIC COMPOSITION AND CENSUS OF TREES (MORE THAN 5CM. DBH)

Stand No. V **Stand name** Dry evergreen forest

Date: January 6, 1964 **Local name** J&B site, Khao Yai

Area 40 x 10 sq. m.

Vegetation Species in the profile

Tree: Pterocymbium tintorium, Colona flagrocarpa, Diospyros variegata, Writia tomentosa, Grewia sp., Ulmus sp., Xanthophyllum sp., Mitrephora sp., Lagerstroemia balansae, Olea sp.

Shrub: Streblus taxoides, Excoecaria sp., Mellotus sp., Psychoria sp., Micromelum.

Herb: Tetrastigma sp., Linostoma sp., Uvaria sp., Veppis sp., Gnetum sp., Ancistroclaudus sp., Hymenopyramis sp., Jasminum sp., Toxocarpus sp., Ventilago sp., Pteroloma sp.

Climbers: Dia.....2-5.....cm
Bauhinia sp.

Saprophytes:

Parasites:

Diameter of Branches 5-20 cm.

Undergrowth high: 1-3 m. **Composed of** Streblus taxoides, Vines, seedlings and saplings.

Penetrability Fair _____ Poor x

Visibility N 22 E 15 S 12 W 17 (ave. 16.5 m.)

No. of Pictures: Roll II Vert. 4 N 5 E 6 S 7 W 8

FIELD TABLE C.

Stand no. 5 Date. January 6, 1964

Forest Type. Dry Evergreen Forest

No. of Trees	Tree Species	Dia. cm.	B.A. sq.m.	Height m.	Position of Tree m. Base Line	From Base Line
1	Pterocymbium tinctorium	38	011487	6	1.5	1.40
2	Pterocymbium tinctorium	39	012100	8	3.5	3.0
3	Colona flagrocarpa	110	096250	28	8.0	6.0
4	Diospyros variegata	60	028638	13	12.0	4.5
5	Diospyros variegata	34	009196	10	13.0	10.0
6	Wrightia tomentosa	77	047165	20	14.0	8.5
7	Grewia sp.	124	12231	24	15.5	2.0
8	Streblus taxoides	35	009745	6	16.5	7.0
9	Streblus taxoides	31	007645	6	17.0	7.0
10	Ulmus sp.	80	050912	31	17.0	9.8
11	Xanthophyllum sp.	78	048398	28	18.3	2.5
12	Diospyros variegata	93	068803	29	19.0	5.0
13	Streblus taxoides	30	007160	7	20.0	4.0
14	Diospyros variegata	45	016109	16	21.0	8.5
15	Streblus taxoides	24	004582	5	22.0	8.0
16	Diospyros variegata	59	027691	25	23.0	5.0
17	Diospyros variegata	32	008146	16	24.0	9.5
18	Xanthophyllum sp.	20	003182	9	24.5	1.5
19	Xanthophyllum sp.	45	016109	22	25.0	4.5

No. of Trees	Tree Species	Dia. cm.	B.A. sq.m.	Height m.	Position of Tree m.	
					Base Line	From Base Line
20	Diospyros variegata	46	016833	17	26.5	9.0
21	Streblus taxoides	20	003182	7	27.8	7.0
22	Streblus taxoides	24	004582	7	28.0	9.8
23	Mitrephora sp.	70	038980	28	29.0	1.0
24	Diospyros variegata	59	027691	26	30.0	4.0
25	Mitrephora sp.	60	028638	17	31.0	4.0
26	Streblus taxoides	35	009745	7	32.5	1.5
27	Diospyros variegata	18	002577	7	33.5	3.5
28	Diospyros variegata	45	016109	22	35.0	2.0
29	Streblus taxoides	32	008146	9	36.0	7.0
30	Mitrephora sp.	57	025846	19	37.0	3.0
31	Lagerstroemia Balansae	19	002872	8	38.0	5.0
32	Grewia sp.	20	003182	8	38.5	5.0
33	Lagerstroemai balansae	34	009196	14	39.0	1.0
34	Olea sp.	22	003850	10	40.0	4.0

PLOT V DRY EVERGREEN FOREST
KHAO YAI NATIONAL PARK, SOUTH OF J & B

---

1. Pt.t Pterocymbium tinctorium
2. Co.fl Colona flagrocarpa
3. Dio.v Diospyros variegata
4. Wri.t Wrightia tomentosa

5.	Gre	Grewia sp.
6.	St.t	Streblus taxoids
7.	Ul	Ulmus sp.
8.	Xa.	Xanthophyllum sp.
9.	Mi	Mitrephora sp.
10.	La.b	Lagerstroemia balansae
11.	Ol	Olea sp.

Type of Forest	No. of Measure-ment	Visibility in %				
		20⁻ m	20-30m	30-40m	40-50m	50⁺m
Mixed Deciduous (Teak forest) Maehongsorn	36	2.8	27.8	22.2	19.4	27.8
		40⁻	40-60	60-80	80⁺	-
Dry Dipterocarp km 109, Ban Kurugu Nakorn Phanom	12	20.0	33.3	40.0	6.7	-
Dry Dipterocarp km Banphai Borabue	8	-	37.5	25.0	37.5	-
Dry Dipterocarp (mixed with teak) Obluang, Hod	12	66.7	33.3	-	-	-
		80⁻	80-100	100-120	120-140	140⁺
Dry Dipterocarp (mixed with pine) Doi Boluang, Hod	32	25.0	22.1	21.9	12.5	12.5

		20"	20-40	40-60	60+	-
Dry Dipterocarp Mae Hongsorn	24	8.3	66.7	16.7	8.3	-

GROUND VISIBILITY

Type of Forest	No. of Measure-ment	Visibility in %				
		10⁻m	10-20m	20-30m	30-40m	40⁺meters
Dry Evergreen Dong Bang-ei Mukdaharn	36	8.3	36.1	19.5	16.7	19.4
Dry Evergreen Pupan National Forest	12	-	41.7	25.0	16.7	16.6
Dry Evergreen Pakthongchi, Korat	28	-	46.4	42.9	10.7	-
Dry Evergreen Kabinburi	57	7.0	28.2	33.3	17.5	14.0
Dry Evergreen Pranburi	96	-	31.3	51.0	15.6	2.1
Dry Evergreen J&B Site, Pakchong	40	-	67.5	22.5	2.5	7.5
Moist Mixed Deciduous	18	11.1	38.9	22.2	16.7	11.1

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MILITARY RESEARCH AND DEVELOPMENT CENTER

QUARTERLY REPORT
1 January - 31 March 1964
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T. W. Brundage
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Atch 3

MILITARY RESEARCH AND
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QUARTERLY REPORT
1 January - 31 March 1964
QRT-2

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01293

Joint Thai-US Combat Development and Test Center

Bangkok, Thailand

CONTENTS

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INTRODUCTION

UNCLASSIFIED

MRDC MISSION

The Military Research and Development Center, Thailand (MRDC) is a joint Thai-U.S. organization established to undertake research, development, test and evaluation activities in support of the Royal Thai Armed Forces, with special emphasis on strengthening Thai counterinsurgency capabilities.

MRDC is established within the Thai Ministry of Defense Supreme Command Headquarters under the leadership of Major General Singchai Menasuta, Director, and Mr. Thomas W. Brundage, Deputy Director. It is staffed jointly, and its work is conducted jointly, by officers of the Royal Thai Armed Forces and officers and civilians assigned from the U. S. Department of Defense. Representation from the United Kingdom Ministry of Defence has also been provided. Scientific, technical, and military operations experience are represented on the staff. The U. S. component of the MRDC, called the Research and Development Field Unit (RDFU), and requisite financial and materiel support, are provided through the Advanced Research Projects Agency, Office of the Secretary of Defense as part of ARPA's program of research in Remote Area Conflict (Project AGILE).

Primary emphasis in Thailand is placed on research and development effort of a long term nature in fields such as communications, surveillance, mobility, and operations research. Much of the work is theoretical and experimental, and for the time being, is mainly non-hardware oriented. It is felt that fundamental studies in fields such as the foregoing will provide the basis for and eventually lead to specific improvements in the capabilities of Thai forces, and that the basic information acquired in Thailand can often be applied to similar problems facing other U. S. allies.

FORMAT

Insofar as is possible, the format and nomenclature used in this Quarterly Report follows that used in the ARPA Project AGILE Quarterly Report series. Readers are reminded that the ARPA Quarterly Report contains summaries of Project AGILE research tasks conducted in CONUS and South Vietnam as well as in Thailand. The MRDC Quarterly Report is concerned with field tasks conducted in Thailand only.

As announced in previous Quarterly Reports in recognition of the long-term nature of MRDC research tasks, it has been decided that the Monthly Letter Report previously sent by MRDC to OSD/ARPA will be discontinued. Henceforth, the primary periodic reporting document for MRDC will be the Quarterly Report. MRDC Quarterly Reports will be serialized and numbered for ease of reference. This Report is identified as QRT-2.

GENERAL INFORMATION

During the first three months of 1964, the MRDC was pleased to host several distinguished visitors. All were briefed in detail upon AGILE Sub-projects by the MRDC Program Managers. Where time and opportunity permitted, they visited some of our test sites, and Mr. Deitchman and Brig. Gen. Boles were able to visit with the Village Security Pilot Study team for an on-the-spot view of some of their work in northeast Thailand. The visitors were:

DR. R. L. SPROULL, DIRECTOR, ARPA
DR. D. CAWOOD, CHIEF SCIENTIST, WAR OFFICE, LONDON
DR. D. H. SCHWEBS, OASD (Comptroller)
MR. S. J. DEITCHMAN, SPECIAL ASSISTANT FOR COUNTER-INSURGENCY, ODDRE
BRIG. GEN. JOHN K. BOLES, JR., USA, DIRECTOR, OSD/ARPA RDFU-V and JOEG-V
COL. G. CLEVEN, USAF, Chief, OSD/ARPA RDFU-V
MR. WARREN STARK, OSD/ARPA STAFF

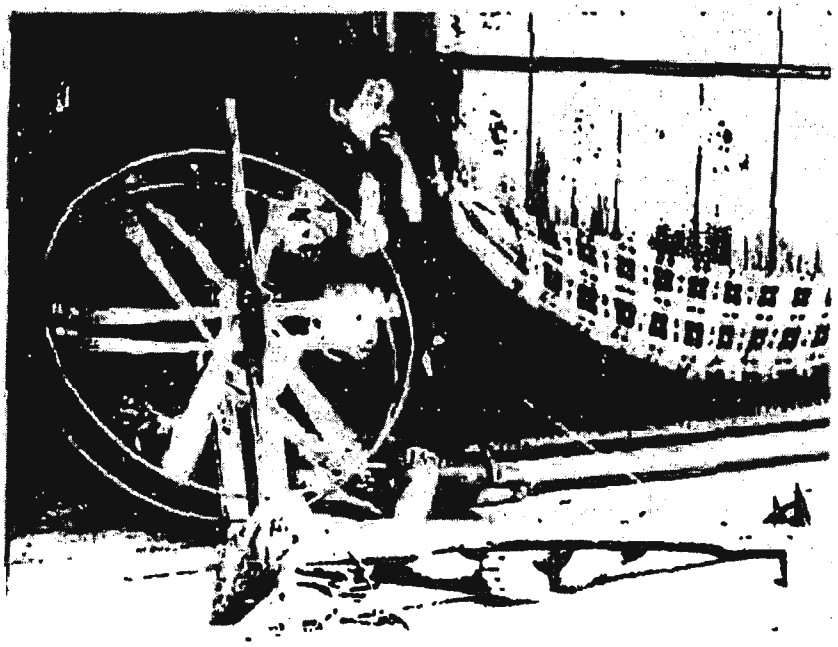
Three Vietnamese members of CDTC-V, CAPTAINS HO and TON and ASPIRANT TUY, spent several days here in January. On 18 - 19 March, Major JOHN MAXWELL, Australian Liaison Officer, FARELF, was apprised of MRDC functions of interest to the Australian Armed Forces. Other visitors for brief periods included DR. LYLE LANIER, VICE-PRESIDENT and PROVOST, University of Illinois; Messrs THOMAS H. MORRIN and GORDON W. WILEY of Stanford Research Institute, DR. G. J. ZISSIS, IDA and Mr. F. W. WOLCOTT and M/Gen G. J. HIGGINS (Ret), Research Analysis Corporation.

A series of seminars and technical reports was launched in March for all members of MRDC. Thirteen weekly sessions are now scheduled through May 1964. They cover most

of the major work underway in MRDC. It is planned that new subjects will be added when appropriate. The series is given informally by MRDC personnel and is intended to inform the audience of the status of work underway and planned throughout the organization. Discussion and suggestions for improvements in the pertinence and quality of work performed by the MRDC are invited. In some instances, exploratory concepts will be presented in order to expose them to critical review prior to implementation.

In the interest of improving mutual understanding, the standard MRDC briefing concerning Mission, Organization and Sub-Projects was given to the JUSMAG staff and later to the US Army advisors in Thailand. The briefing was well received, and will be given wherever and whenever possible to interested agencies. The Thai component of the MRDC is drawing up a similar briefing designed for presentation to Royal Thai Armed Forces organizations.

Manufacture of salt from local soil for home consumption is explained by Captain Sommart, RTMC, (right) to Brigadier General Boles, Dr. Huff and Mr. Dietchman.



Spinning cotton thread to be woven into cloth for the family. Typical finished product is in the background.

Water resources and supply are a problem in Northeast Thailand

Colonel Lua, Mr. Brundage, Captain Sommart, Mr. Dietchman. Representative fences around family plots appear in the background.

MAP


BURMA
LAOS
GULF OF TONKIN
MAE NAM CHAO PHRAYA
KHORAT PLATEAU
LAOS
CAMBODIA
GULF OF SIAM
MALAYA
INDONESIA
THAILAND

SUB-PROJECT I

TACTICAL UNIT WEAPONS SYSTEMS

SUB-PROJECT I

TACTICAL UNIT WEAPONS SYSTEMS

SUB-PROJECT OBJECTIVE:

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

All activity in this Sub-Project is presently conducted in CONUS and CDTC-V.

SUB-PROJECT II

AREA FIRE WEAPONS SYSTEMS

SUB-PROJECT II

AREA FIRE WEAPONS SYSTEMS

SUB-PROJECT OBJECTIVE:

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

Requirement: **Aircraft and Air-Ground Armament and Munition Systems**

Task: **Counterinsurgency Aircraft**

Sub-Task (Proposed): **Environmental Effects on Aircraft Reliability**

This proposed sub-task was withdrawn during the reporting period.

SUB-PROJECT III

REMOTE AREA MOBILITY AND LOGISTICS SYSTEMS

Requirement: Mobility Research

Task: Mobility Environmental Research (MERS)

1. Mr. E. E. Garrett arrived in Bangkok on 26 December 1963 from U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. This completed the DA civilian staffing of the MERS Detachment in Thailand.

2. Lt Colonel Arthur R. Simpson, Corps of Engineer, arrived in Bangkok on 15 February to command the MERS Detachment.

3. Discussions were initiated during February and March with the Thai Meteorological Department, SEATO Graduate School of Engineering, Royal Thai Army and Kasetsart University to coordinate MERS activities and requirements.

4. Selection and hiring of Thai administrative and engineering staff members for the MERS Detachment was initiated and completed during the report period. Training of Thai personnel was started.

5. Two field trips for the acquisition of undisturbed and moisture content soils samples were made to the Lopburi area.

Requirement: Mobility Research

Task: Mobility Research and Testing (MORT)

Sub-Task: Canadian Jiger

1. During the first week of January, the Jiger was tested on the Mae Khlong River at Ban Pong, Changwad Rajburi, to determine its capabilities in typical Southeast Asia rivers. The river is 150 meters wide at this point, and has a current of about 5 miles per hour. Various bank configurations were used to assess entrance and egress capabilities. The Jiger had little difficulty with the banks up to 60 per cent. Water performance was unsatisfactory because it is too slow. During the last half of January, the Jiger was tested in rice paddies at Lopburi, on slopes at Koke Kathiem, and on a jungle trail near Pakchong.

a. In paddies, the Jiger sucessfully negotiated bunds up to 24 inches in height. Operating in flooded paddies and over packed bunds, it attained an average speed of 5 kilometers per hour (about 3 miles per hour), or slightly faster than a man could walk.

b. The vehicle climbed the natural slopes at Koke Kathiem up to about 30 per cent with the crew's dismounting. It showed an alarming tendency to overturn at every small surface irregularity, however. When the crew dismounted to walk the vehicle up, higher slopes could be climbed, but only at the cost of exhausting the men.

c. The Jiger performed quite well on the Pakchong trail, since it is sufficiently small to by-pass the worst ruts and obstacles. Its average speed was approximately 15 kilometers per hour on this march. One engine froze from overheating, after about 3 hours' operation.

2. The remainder of the quarter has been devoted to data reduction and preparation of the report. The first draft of the report is approximately 60 per cent complete and will be finished during March. Distribution will be made during the next quarter.

Requirement: Mobility Research

Task: Mobility Research and Testing (MORT)

Sub-Task: Tote Gote

Test and environmental evaluation of the Tote Gote has been completed. The final report has been completed in draft form and will be reviewed, edited, published, and distributed within the next quarter.

Requirement: Mobility Research

Task: Ground Mobility/Logistics Analysis

Collection of data for the RAC mobility/logistics analysis continued during the reporting period.

A study of the Thai Highway System is being completed. This will present an overview of the Royal Thai Highway Department organization, the location and condition of the existing road network, the status of highway construction projects currently underway and long range highway development programs. Traffic volume and pattern data are being developed and will be contrasted with accepted civilian and military methods for evaluation of maximum traffic density in order to estimate potential highway traffic capacity available for military operations. Emphasis will be devoted to detailed presentation and analysis of highway capability in Northeast Thailand. This study will provide the road and highway data base requisite for analysis in detail of Thai logistic and mobility capability under conditions of counter-insurgency in Thailand.

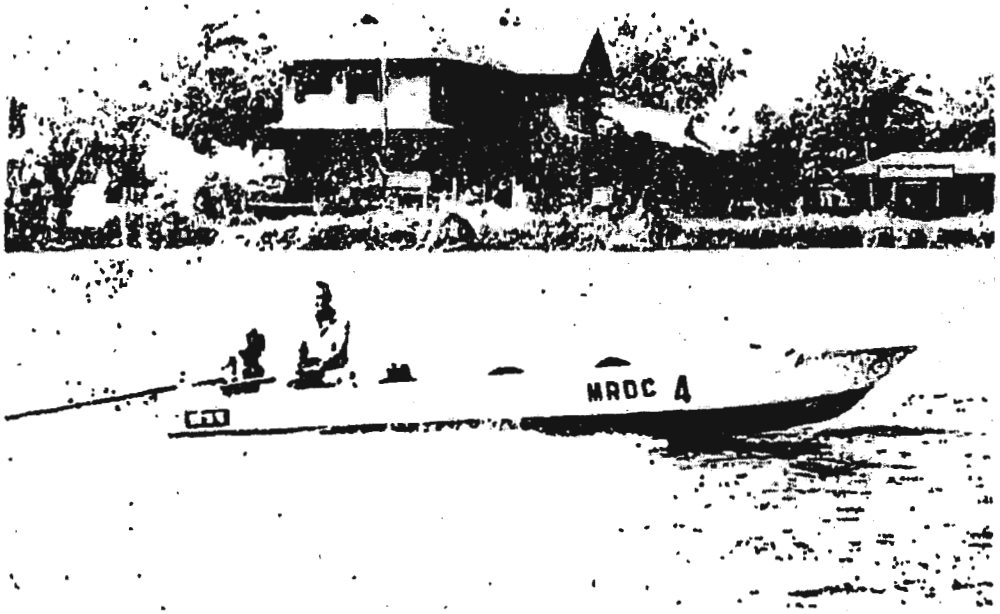
The study of the probable capabilities, limitations, and gaps in the Thai mobility/logistics potential for CI conflict has been initiated. This study, currently in the planning phase, will integrate real environments, available transport, force dispositions, response modes and techniques. Trade-offs among these factors are to be studied to determine preferred equipment and systems operation and to attempt to uncover elements which R&D effort might improve.

Requirement: Mobility, Ground and Water

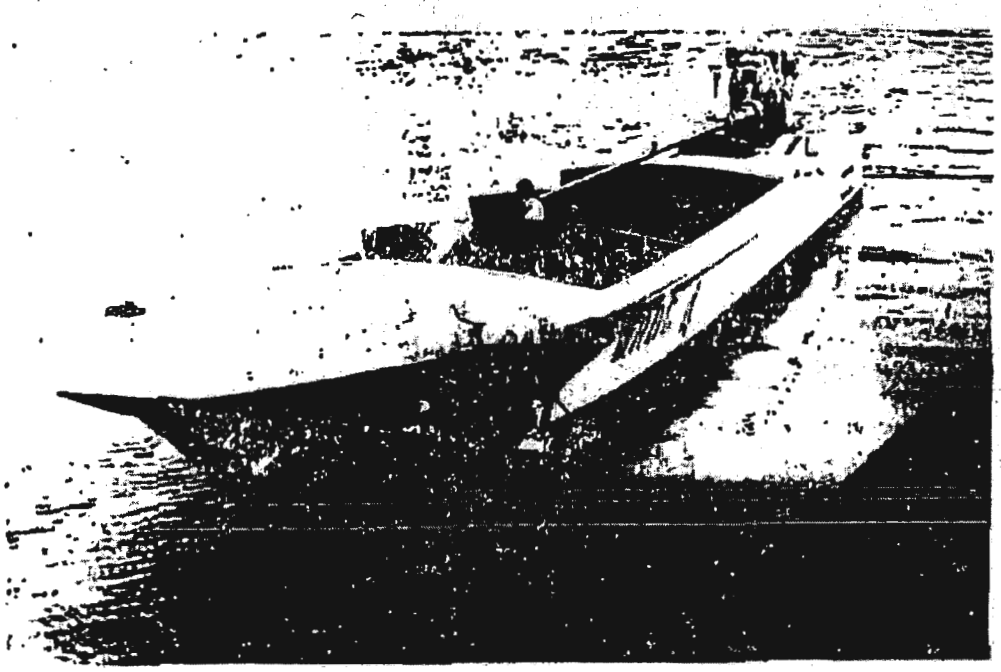
Task: Delta Mobility - Small Craft

The MRDC modified Thai klong boat was discussed and illustrated in MRDC QRT-1 (P. 25). During the reporting period, three boats were completed. One was sent to CDTC-V for evaluation in South Vietnam. The other two are undergoing trials in Thailand. Hull tests with weights up to 950 kg. are being made with two power units: (1) a 45 hpr Mercury engine with an 11 inch prop and (2) a 13 1/2 hpr JLO long-shaft motor. Results to date show that stability of the hull is excellent, and under normal operation in a river the boat is dry. There is no tendency to porpoise.

An additional boat is to be constructed at the Royal Thai Army Transportation boat shop to prove the adaptability of this design to local military construction and to establish a military source for further development of this water craft concept.



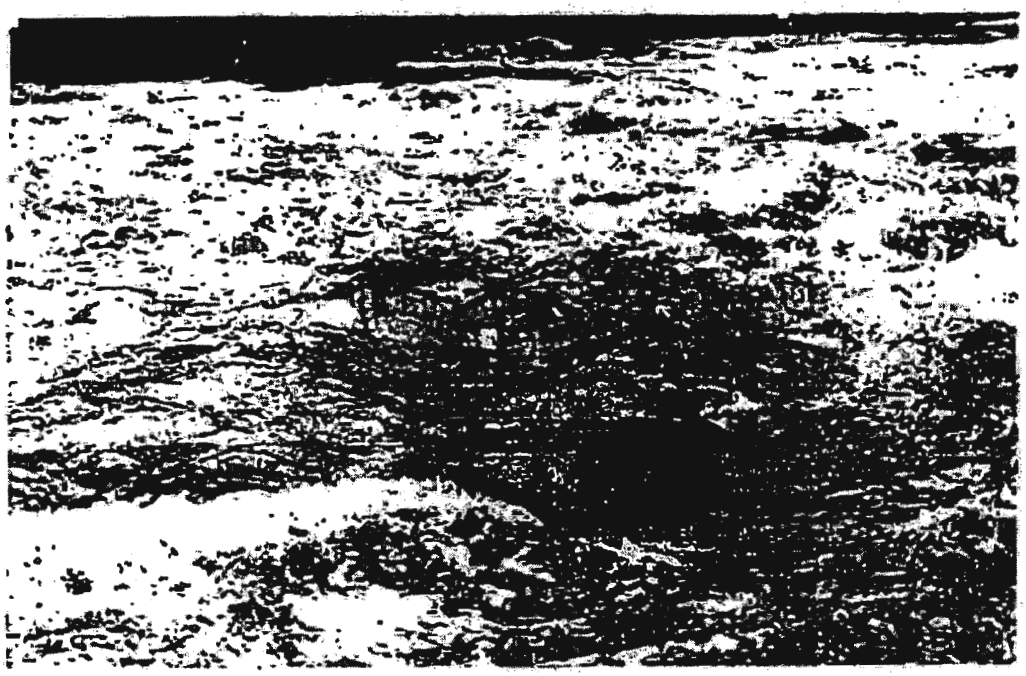
 # 4 Boat underway. Powered by 13.5 HP JLO aircooled engine



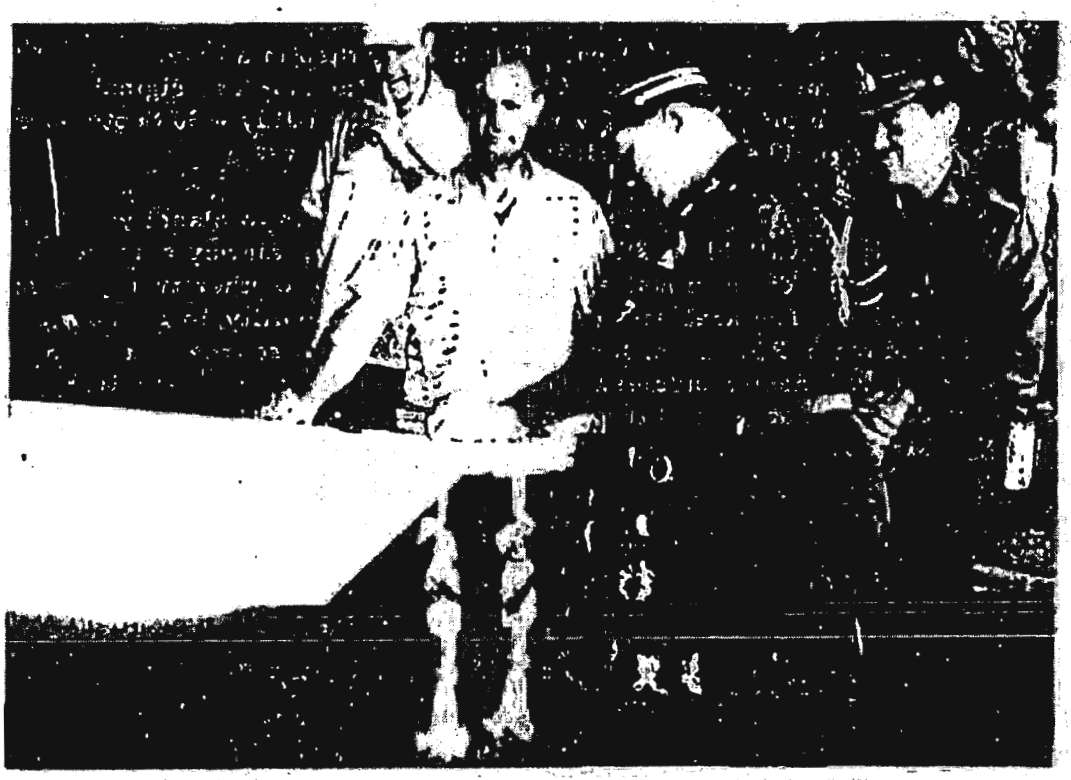
 # 4 Boat. Long shaft motor mounted.

 # 5 Boat. Outboard motor mounted

 # 4 Boat. Underway with 1650 lbs payload, at 19.8 MPH. Powered by 45 HP Mercury Outboard



Rapids on Saiburi River transitted by Boat # 1



Maj. Gen. Singchai Menasuta, Commanding General, MRDC.
Christening MRDC Boat # 5

Requirement: Mobility, Air

Task: Remote Area Airstrip

Sub-Task: Survey, Classification and Data Analysis of Airfields in Thailand

Data regarding the existence and location of airfields which was received from various agencies during the last reporting period have been assembled and recorded. Considerable effort was made to construct a form for recording and classifying all data at hand, and one which might also be useful in similar tasks elsewhere.

Having done this, the entire task was reviewed in the light of the data available with the purpose of redirection of effort, where required. This has resulted in a brief restatement of the task. Consequently, the task as originally drawn in the CDTC-T Quarterly Report for 1 July - 30 September 1963 (pp. 19 - 20) is modified to read as follows:

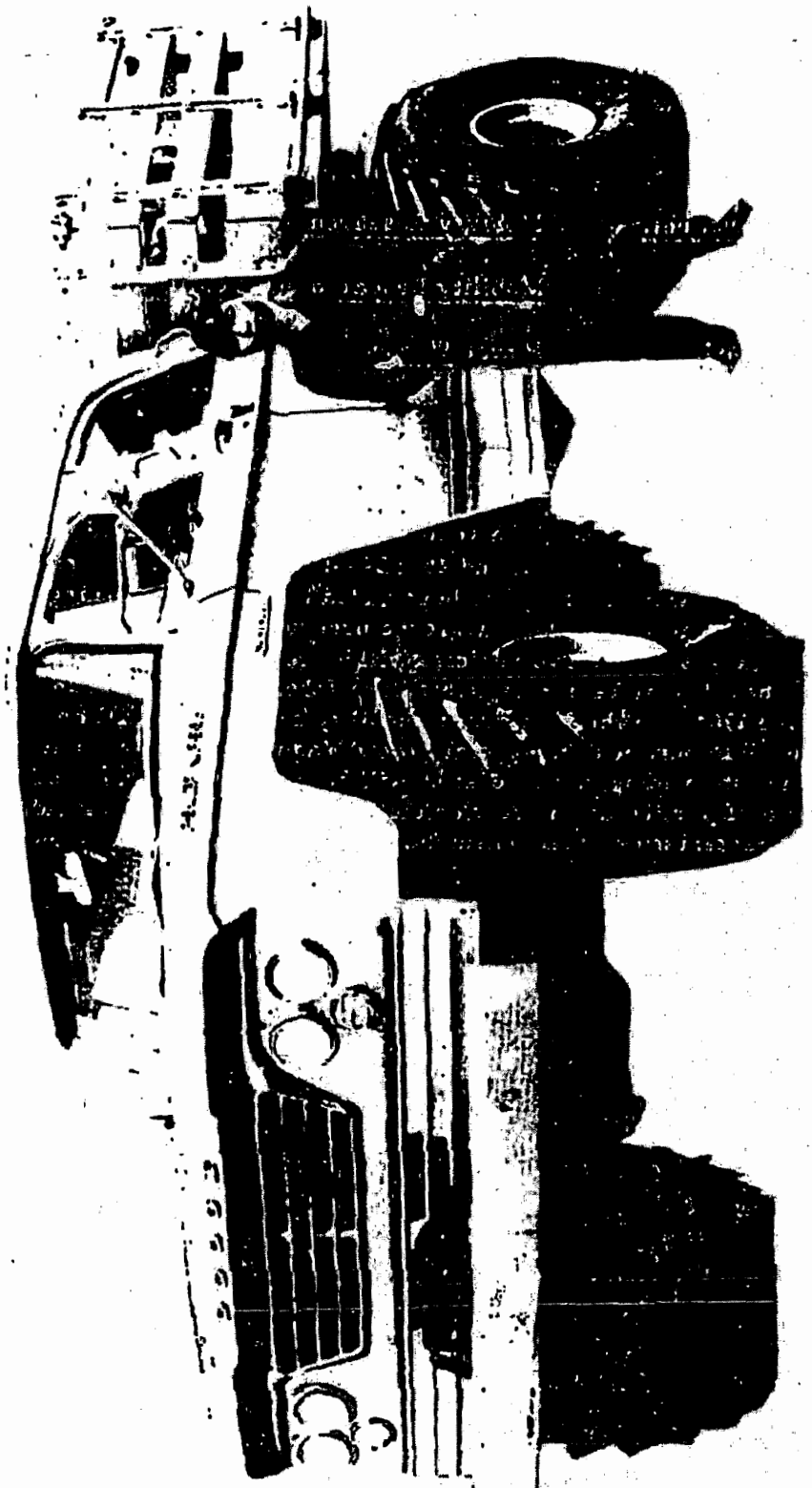
The purpose of the task is to classify and analyze available airfield data as to location, runway surface, soils and dimensions, and their relationship to other transportation modes. The analysis will benefit current mobility/logistics studies and other R&D uses: for example, it will be a source of data for aircraft design studies. Technical information on soils will be collected as part of the environmental studies conducted by the MRDC.

Requirement: Mobility Research

Task: Mobility Research and Testing (MORT)

Sub-Task: Power Wagon

Two 1 1/2 ton Power Wagons have been received for test and evaluation of this type of vehicle when equipped with very low pressure tires. The vehicles have installed 46 x 18--16R terra tires on the front and 46 x 24--16R terra tires on the rear. Power steering has been added to overcome turning forces imposed by the low ground pressure tires. The environmental test of the two vehicles will be conducted with the test of the XM-561 Test Rigs, which are scheduled to arrive in June 1964. In this way direct mobility comparison will be possible between the special Power Wagon and the XM-561. The intervening period of time will be utilized to acquire other data of particular interest on the Power Wagon, such as ride characteristics, fuel consumption, and tire heating on prolonged highway runs.



DODGE POWER WAGON

SUB-PROJECT 1V

COMMUNICATIONS SYSTEMS

SUB-PROJECT IV

COMMUNICATIONS SYSTEMS

SUB-PROJECT OBJECTIVE:

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

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

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

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

In Thailand, communications research tasks are often referred to collectively as SEA CORE (South East Asia Communications REsearch Program).

Requirement: Remote Area Conflict Communications Research

Task: Operations Analysis (1A)

Sub-Task: Small Unit and Patrol Communications

One of the major objectives of the Communications Systems Sub-Project is to determine the desirable characteristics of military communications systems and equipments for Thai forces. Not only must the characteristics be feasible both technically and economically, they must also satisfy operational requirements. Accordingly, there is a need to study and analyze present and future systems and equipments, in order to obtain information on which to base a determination of necessary characteristics.

The purpose of this sub-task is to determine the need for research and development work to improve the communications capabilities of small Thai police and associated military units employed in border security missions. Emphasis is placed on forward communications and on units of patrol, squad, platoon, and company size. Seven Border Patrol Police platoons and two RTA platoons were visited in the course of a field trip to Northeast Thailand in October 1963. A similar trip to North Thailand was made in December 1963. A report on this phase of the sub-task is in preparation.

Other operations analysis sub-tasks are being formulated and planned. The SRI operations analysis group now numbers five Americans, one of whom is simultaneously the Senior SRI Representative in Thailand.

Requirement: Remote Area Conflict Communications Research

Task: Phenomenological Research (1B)

Sub-Task: Radio Propagation in Tropical Vegetation

A second major objective of SEA CORE is to obtain a systematic and comprehensive body of data on those factors of terrain, vegetation, and ionospheric behavior which affect electromagnetic wave propagation in Thailand. Such data are significant because they affect the utilization of available radio equipment and the design and development of new equipment.

It is the objective of this sub-task to measure and analyze the factors which influence the propagation of radio waves in areas of dense tropical vegetation. The SEA CORE contract with Jansky and Bailey places special emphasis on the influence of terrain and vegetation, at ranges up to 30 miles and at frequencies between 100 KC and 425 MC. In these frequency and distance ranges, the path loss will be measured over various types of terrain for all practical modes of propagation. Seasonal variations, the effects of polarization, and the effects of changing the transmitting and receiving antenna heights will be determined by measuring the path loss for the various modes.

The Jansky and Bailey permanent party of eleven is now complete. The measurement program got underway in late December. Thus far, data have been collected at several frequencies (including 6, 12, and 100 MC) at distances up to 8 miles.

Requirement: Remote Area Conflict Communications Research

Task: Phenomenological Research (1B)

Sub-Task: Vertical Incidence Ionospheric Sounding

It is the purpose of this sub-task to collect vertical incidence ionospheric sounding data for Thailand as a contribution to the world-wide ionospheric data system, with the long-term objective of improving the accuracy of frequency predictions for Southeast Asia.

The C-2 Vertical Sounder is in operation and data are being forwarded to the National Bureau of Standards through the U.S. Army Signal Radio Propagation Agency (USASRPA). Data are also being exchanged with stations in Manila and Singapore. Two enlisted men of USASRPA are now operating the Sounder 24 hours a day, 7 days a week. The rate of successful operation was 99% during each of the months of December, January, and February.

Requirement: **Remote Area Conflict Communications Research**

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

As a natural result of SEA CORE activities, the Thai military personnel associated with the Electronics Laboratory are gaining valuable experience which increases their abilities to contribute to the development of Thailand. The number of such Thai military personnel now totals 7 commissioned officers, and 4 warrant officers and non-commissioned technicians. An additional officer is associated with the Jansky and Bailey effort. All of the commissioned officers are educated to at least the bachelor degree level, and 3 of them are Ph.D.'s. The Communications Systems Sub-Project is operated as an integrated, combined Thai-U.S. effort.

Currently, Thai participation is mainly concentrated in Task 1D.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

The major effort of the Electronics Laboratory in Thailand is currently focussed on the investigation of communications techniques. The purpose is to determine the utility of promising techniques in the geophysical environment of Thailand and Southeast Asia, with the objective of enhancing the communications capabilities of Thai forces. Initial emphasis of this effort is on radio, but all operationally useful means of communications are within its scope.

Certain of the sub-tasks listed in the pages which follow have a close relationship to other tasks, particularly 1B, of the Communications Systems Sub-Project. For contractual purposes, these primarily technical sub-tasks have been numbered consecutively in a single series. They are grouped under Task 1D in an effort to achieve clarity of presentation.

It should be recognized that some of the scientific efforts listed below are in their early stages. It is likely that some will be dropped and some redirected; others will be added as the work progresses.

Requirement: **Remote Area Conflict Communications Research**

Task: **Investigation of Communications Techniques and Devices (ID)**

Sub-Task 1: **Test and Evaluation of Tactical Communications Devices.**

See Communications Tasks 2A and 2B which follow.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices

Sub-Task 2: Noise Measurements

It is the objective of this sub-task to determine mean atmospheric noise levels and their periodic variations in Thailand.

Noise measurements were conducted near the village of Sakatiem, using the NF 205 noise measurement equipment, on 200 KC, 2 MC, 10 MC, and 30 MC. In this area, which is relatively free of sources of man-made noise, meaningful results were obtained on three of the frequencies. Interference was too severe for the wide IF bandwidth of the NF 205 on 10 MC. The curves show a 10 to 20 db change in noise level in a period of one day, while the variation in level is less when comparing data from one day to another at the same time of day. As expected, very little noise was recorded on 30 MC. Experiments are being conducted at the laboratory to devise narrow-band noise measurement equipment.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

Sub-Task 3: Antenna Orientation Effects

In this sub-task it is intended to evaluate the advantages of North-South alignment of dipole antennas for short-range sky-wave communications in an area near the magnetic equator. Theoretical work suggests that there is an optimum orientation for horizontal, linearly polarized antennas used on short ionospheric paths near the geomagnetic equator, and that this optimum orientation is not necessarily broadside to a straight line from the transmitting station to the receiving station. Consideration of the magneto-ionic theory and its application to antenna-to-medium coupling problems indicate that aligning such antennas parallel to the earth's magnetic field will maximize signal strength and minimize polarization fading.

Four five-day CW tests were conducted in December and January between Bangkok and the vicinity of Ayuda (to the North) and the vicinity of Sakatiem (to the West). Analysis of the data obtained is about one-half complete.

A rotatable dipole is being used to investigate orientation effects for the vertical incidence (zero-range) case, with the C-2 Sounder transmitting into delta-matched dipoles being used for the signal source. Preparations are underway for pulse tests using the Bangkok-Ayudhya-Sakatiem geometry.

The project officer is Lt. Paibul Nacaskul, RTN.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

Sub-Task 4: Ground Constants

This sub-task seeks to determine the magnitudes of ground conductivity and dielectric constant at selected locations in Thailand. The work is now following two avenues:

a. Field-strength method for measurement of conductivity.

b. Wave-tilt method for measurement of dielectric constant.

A 130-watt transmitter has been built for use as a signal source in remote areas for the field-strength method measurements. Preliminary testing has been carried out by use of an R390 receiver (mounted in a Land Rover) as a detector of local broadcast station signals. The effects of nearby objects, trees, and buildings on the variations in observed signal strength have been noted. An RCA field strength meter will be briefly tested as a possibly more convenient detector.

Effort is continuing on the design and test of a small, portable detector-receiver for the wave-tilt method.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

Sub-Task 5: Earth Potential Measurements

MRDC has considered exploring the utility of earth potential measurements as indications of ionospheric and magnetic storms. At present, however, this sub-task is inactive and is being reconsidered to determine if the objective can be achieved as a by-product of other work.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

Sub-Task 6: Frequency Prediction

This sub-task is concerned with improving frequency predictions for Thailand. The flow of data from the C-2 Sounder into the world-wide ionospheric data system is expected, in the long term, to result in improved frequency predictions for Southeast Asia. It may be possible, however, to improve the frequency-prediction situation in the short term.

Accordingly, data from the Bangkok Sounder (see Task 1B, Sub-Task: Vertical Incidence Ionospheric Sounding) are being studied and analyzed locally. These data are considered in conjunction with the frequency predictions made by the Central Radio Propagation Laboratory and the U.S. Army Signal Radio Propagation Agency.

Frequency recommendations were prepared and furnished to JUSMAG for a Counter-Insurgency Field Training Exercise (KITTI 07), which was conducted by Thai forces early in 1964. In the process of preparing the predictions, an officer of the RTA Signal Department was familiarized with the techniques involved. Exercise results are being studied to evaluate the prediction effort.

Requirement: **Remote Area Conflict Communications Research**

Task: **Investigation of Communications Techniques and Devices (ID)**

Sub-Task 7: **Antenna Terrain Effects**

This sub-task is intended to investigate the effects of terrain in the immediate vicinity of field antennas on the performance of those antennas. It is not yet active.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (1D)

Sub-Task 8: Flutter Fading

This sub-task is concerned with the determination of the effect of equatorial flutter fading on field communications. It is not yet active.

Requirement: **Remote Area Conflict Communications Research**

Task: **Investigation of Communications Techniques and Devices (1D)**

Sub-Task 9: **Vertical Incidence Ionospheric Measurements**

See Task 1B and Sub-Task: Vertical Incidence Ionospheric Sounding.

Requirement: Remote Area Conflict Communications Research

Task: Investigation of Communications Techniques and Devices (ID)

Sub-Task 10: Oblique Incidence Ionospheric Measurements

Utilizing an oblique incidence sounder, it is planned to examine typical field communication paths and determine the nature and characteristics of the propagation modes and antenna effects, and the consequencies for tropical field communications. Technical planning is underway, and an ARPA decision on procurement of an oblique sounder is anticipated in the next quarter.

Requirement: **Remote Area Conflict Communications Research**

Task: **Investigation of Communications Techniques and Devices**

Sub-Task 11: **Technical Assistance**

This sub-task is established to furnish technical advice and assistance as required and as approved. An informal report has been issued on a composite radio set RS-6A/GRC-87. Activity under this sub-task was at a generally low level during the current reporting period.

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

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

The test and evaluation of specific items of communications equipment, to determine the utility in Southeast Asia of these equipments or of some of their specific characteristics, is also within the scope of the SRI contract.

Bench tests have been done, a brief field trial has been accomplished, and a test plan is in preparation for the following items:

1. Motorola H-21-DCN (VHF-FM) This set is one of a number of commercially available, hand-held, voice-only transceivers using entirely transistorized circuitry. It weighs 33 ounces complete, and radiates 1.4 watts at frequencies between 24 and 54 MC.

2. PRC-35, Experimental (VHF-FM) This set was developed by RCA on contract to USAELRDL as a replacement for the AN/PRC-6, but it has not been standardized. It is transistorized and has a voice capability between 30 and 70 MC at a radiated power of about 1/3 watt.

3. AN/PRC-25 (VHF-FM) Covering a frequency range of 30-76 megacycles and weighing approximately 20 pounds, this set is beginning to replace the AN/PRC-8, -9, and -10 in the U.S. Army. It radiates 1.5 watts. Also on hand are experimental power amplifiers which can boost the power output of the AN/PRC-25 to 15 and 35 watts.

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

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

Distribution has been completed for SRI Research Memorandum 3, "Field Tests on Man-Pack Radios in a Tropical Environment."

SUB-PROJECT V

COMBAT SURVEILLANCE AND TARGET ACQUISITION SYSTEMS

SUB-PROJECT V

COMBAT SURVEILLANCE AND TARGET ACQUISITION SYSTEMS

SUB-PROJECT OBJECTIVES:

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

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

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

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

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

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

Requirement: Remote Area Conflict Surveillance Research.

Task: Phenomenological Research (1B)

Sub-Task: Forest Canopy Obscuration

In QRT-1 there was described the method being employed to determine canopy obscuration and the results from one test site. This test site on the Kra Peninsula was measured again during January of this reporting period. The first measurement was at the start of the principal rainy season (July) and this measurement was early in the dry season. The average rainfall in millimeters at the nearest weather station 60 kilometers north of the site is:

January	-	32	July	-	97
February	-	42	August	-	90
March	-	48	September	-	111
April	-	81	October	-	253
May	-	114	November	-	172
June	-	92	December	-	31

The photographs are being analyzed and the results will be available for the next Quarterly Report.

The acquisition of forest canopy photography is continuing as part of the Vegetation Study (1A2) of Sub-Project VII, Technical Planning and Programming. Photographic data on two geographically

separated forests of the same botanical type have been obtained as has initial data covering another botanical type and a rubber plantation. The data is in the process of evaluation and analysis.

Requirement: Remote Area Conflict Surveillance Research

Task: Phenomenological Research (1B)

Sub-Task: Climatological Survey

The proposal from the Royal Thai Department of Meteorology to perform a climatological survey has been received. This is in response to a request from this Unit for a climatological survey concerning rainfall, wind, temperature, relative humidity, clouds and obscuration. About one-fourth of the requested data has been compiled, analyzed and is available. The remainder is available as original station records, but has not been collated and analyzed. It is expected that an agreement will be reached during the next reporting period and as a result the remaining work will be performed.

Requirement: Investigation, Development and Evaluation of Techniques and Devices

Task: Airborne Infra-Red Systems (2A1)

Sub-Task: Reconnaissance Program

Activity in the cooking fire detection sub-task, described in MRDC QRT-1, is deferred pending arrival of a properly equipped aircraft. The latter is not expected before the end of calendar year 1964.

Requirement:	Investigation, Development and Evaluation of Techniques and Devices
Task:	Visual Surveillance and Low-Light-Level Amplification (2A4)
Sub-Task:	Airborne Visual Surveillance

Quarterly Report QRT-1 described the purpose of a proposal for a follow-on test of identification capabilities in visual searching for individual men in the Southeast Asia environment. First, it is to work from the results of the April, 1963 test which delineated quantities such as the maximum slant ranges at identification for narrow search strips and will attempt to find out the relationship between search strip width, aircraft velocity, and slant range at identification. Second, it is to provide a good opportunity to train three Thai officers in practical and proven methods of test and analysis by having them perform the entire program under guidance, since the methods were worked out last April. The Royal Thai Air Force has approved the participation of personnel and a helicopter at Ubon. It was requested that the date of the program be delayed from 12 February - 15 May to 1 April - 3 July so that the RAND Corporation representative conducting the program could participate in the Rural Security Pilot Study, which is discussed under the Technical Planning and Programming Sub-project. Guidance for training test observers in that specific task was requested from and provided by the U.S. Army Aviation Human Research Unit, Fort Rucker. That unit expressed interest in our published work and the proposed effort and recommended further contact.

Requirement: **Security and Protection Equipment**

Task: **Patrol and Outpost Intrusion Detectors**

Notification has been received that 35 improved break-wire detectors with instructions in the Thai language are scheduled for delivery. Arrangements have been initiated to obtain the assistance of the Thai Border Patrol Police in an operational test of these personnel intrusion detectors.

SUB-PROJECT VI

INDIVIDUAL AND SPECIAL PROJECTS

SUB-PROJECT VI

INDIVIDUAL AND SPECIAL PROJECTS

SUB-PROJECT OBJECTIVE

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

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

Requirement: Military Chemistry

Task: Defoliation (1A)

Sub-Task: Thailand Defoliation Test Program

Activities

The Beechcraft Ten-Two airplane modified to include spray distribution equipment consisting of booms with 90 nozzle positions, air-driven pump, and 180-gallon stainless steel tank was delivered to Bangkok on 17 December. Static flow calibration tests with water and diesel fuel were made on the Beechcraft spray system from 1 - 10 January. A 20 hp stationary engine was used to activate the pump system. Flow tests were made in quadruplicate for a range of nozzle systems and pressures. The amount of delivered spray was measured from catchments in steel troughs installed under each boom.

Static flow calibration tests with "purple" and 2, 4, 5-T ester both singly and in mixtures with diesel fuel at ratios of 1:1 and 1:2 were made at the Hua Hin Airport operational headquarters from 13 January to 30 January. Flight calibration tests to determine effective swath width, spray deposition rates, and pattern and droplet size characteristics of diesel fuel and various chemical solutions were made at the Hua Hin location. Preliminary flight tests were conducted on a single east-west grid line using oil-sensitive dye cards at 10-ft. intervals on a 400 foot line to determine swath width and droplet patterns from diesel fuel sprays. An enlarged calibration grid was established at the Hua Hin Airport on 13 - 15 February to secure data from inwind flights on 8 radiating grid lines of 540 foot length. Deposit rates were determined by a colorimetric technique from diesel oil spray solution containing 0.1% DuPont oil red dye. White Kromekote cards were used in conjunction with 6 x 6 inch aluminum plates at each station interval for visual

Static calibration of Beechcraft boom delivery rates, using stationary engine attached to air-driven pump and metal troughs below booms.

Detail of troughs and catchment basins used in static boom delivery flow-rate calibration, with various nozzle configurations, spray pressures and soluents or chemicals.

Calibration grid lines with 6 x 6 plates and chromekote cards used to measure spray deposit at 10 foot intervals on 500-foot profile.

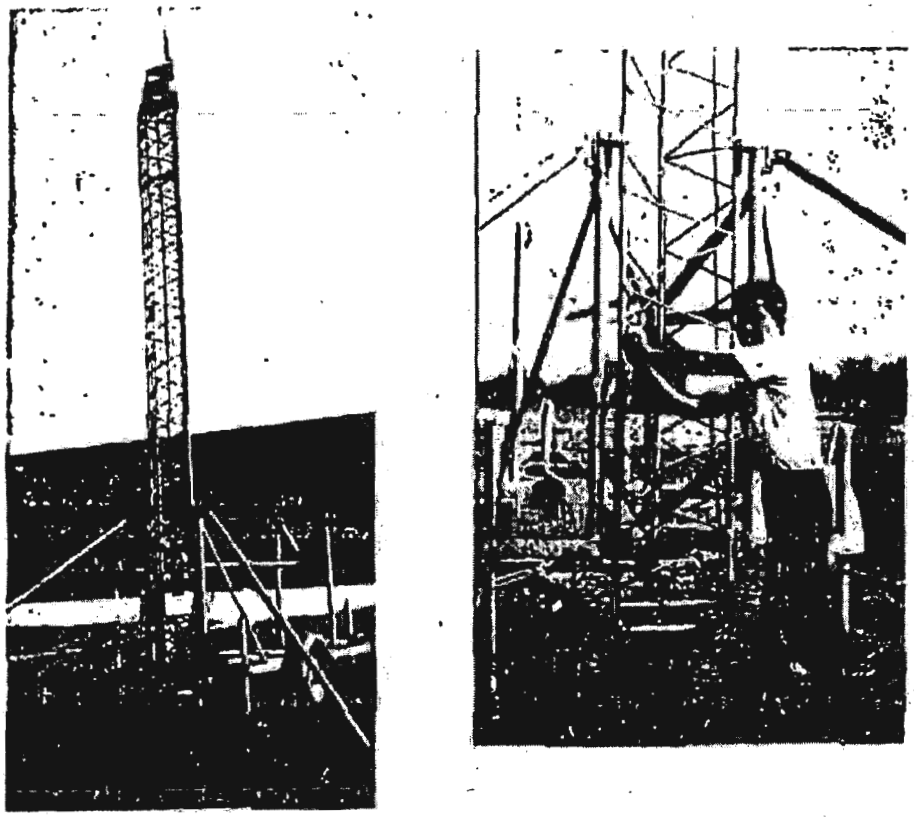
Aluminum plate and chromekote card with spray deposit.

check of spray deposit. The primary objective of the flight calibration tests was to evaluate nozzle configurations which would result in a uniform spray deposit over a known swath width.

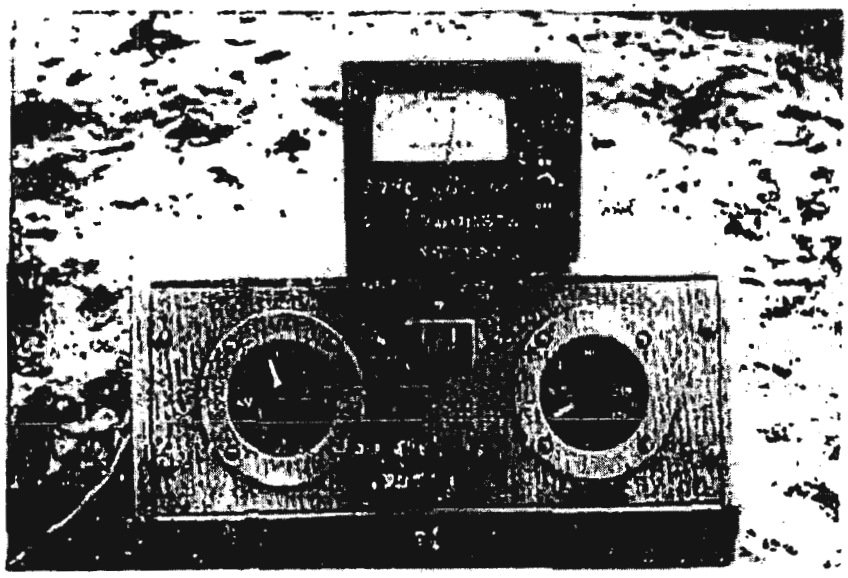
Calibration flight tests have been made on an additional grid area established on the Pranburi Military Reservation to determine swath width and spray deposit characteristics of "purple" and other chemicals included in the evaluation tests. Deposit patterns are measured colorimetrically with a Bausch & Lomb Model 20 spectrophotometer using a wet-plate acetone-wash technique with DuPont oil red dye or other suitable dye incorporated in the spray solution.

Meteorological conditions at flight altitude of 50 feet are obtained from instruments on a portable telescoping steel tower erected at the grid location. Wind direction and velocity to the nearest 0.1 mph are obtained on a Model L Belfort anemometer with a supplemental vernier velocity indicator calibrated to read velocities up to 10 mph. The wind direction and velocity transmitters are mounted at the top of the 50 foot tower; readings are taken prior to and at the time of each flight test on a console powered by a portable electric generator. Inversion conditions are determined by means of temperature readings taken on two maximum-minimum thermometers at ground level and 50 foot height, respectively. Temperatures are read immediately after each test.

Preparation of the test site for treatment applications was continued during the reporting period. Treatment plots 300' x 1500' were marked off on the small test site totaling 3,500 rai or 1,400 acres. Lanes on this site had been prepared during the previous quarter. A single swath of "purple" was sprayed on 19 February throughout the length of the small test site to serve as a reference grid line for treatment plot locations. Authorization was obtained from officials of the Pranburi Military Reservation and the Supreme Command Headquarters for extension of the small test site and relocation of the large test site providing for a total treatment



Portable telescoping tower used for securing Meteorological data at 50 feet height.



Wind direction and velocity indicator console with supplemental meter registering winds at 0-10 MPH at 50 feet height.

area of 5,000 rai (2,000 acres) and 3,500 rai (1,400 acres), respectively. Lane clearing operations were reactivated in March following surveys in the extension of the small test site and in the relocated large test site to determine suitable lane locations.

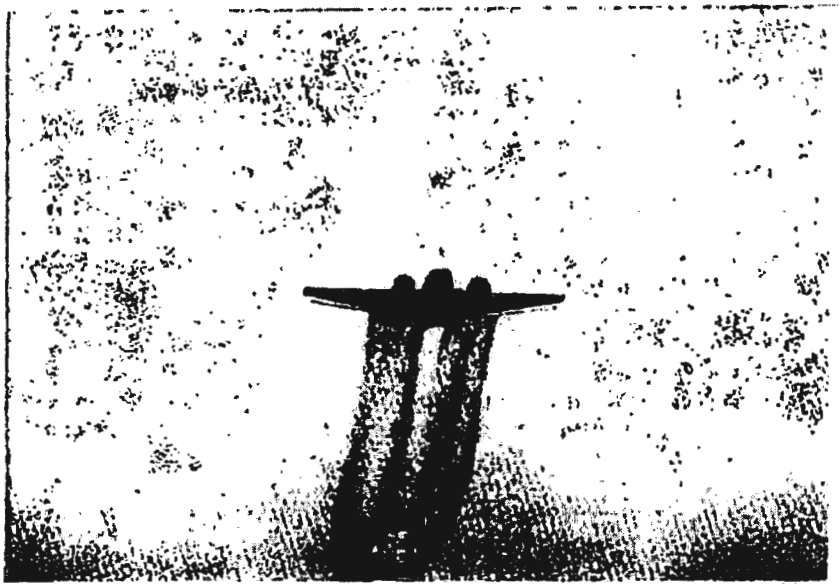
Vegetational study plots, each 10 x 40 meters in size, were established at 6 locations in the small test site. A complete census of woody vegetation and profile drawings were made at each location to characterize the vegetation. Photographic stations were established at 12 locations in the small test site at which one vertical and 4 horizontal photographs were taken to evaluate vertical and horizontal visibility and vegetation cover.

Additional vegetation inventory plots will be established in the extension of the small test site and in the relocated area after treatment plot locations have been established.

A photographic technique was developed for evaluation of changes in horizontal and vertical visibility caused by defoliation treatments. Six photographic stations will be established in each treatment plot prior to treatment. At each location, one vertical and 4 horizontal photographs will be taken with a Nikon F camera equipped with a 28 mm, wide-angle lens prior to treatment and at standard intervals subsequent to treatment. Percentage change in foliation due to treatment will be determined by photoelectric meter scanning of negatives subjected to standardized contrast development procedures. Corollary observations of defoliation will be made on tree species in vegetational transects at each photographic stations.

Test Results

Representative data obtained in static flow tests with various nozzle orifices, cones, and pressures are given



Calibration flight of Beechcraft to determine spray deposition pattern with 20 inboard nozzles per boom.

Calibration flight on grid at Hua Hin Airport. Note 50-foot telescoping meteorological tower to determine wind conditions at height of spray release.

in Table 1. Flow rate data are expressed in gallons per minute for a boom system consisting of a total of 40 nozzles (20 per boom).

These data can be converted to gallons per acre by the following formulas:

$$\text{Acres per minute} = \frac{2 \times \text{swath width (ft)} \times \text{airplane speed in mph}}{1{,}000}$$

$$\text{Gals per acre} = \frac{\text{gals per minute}}{\text{acres per minute}}$$

Thus, for example, assuming a swath width of 100 feet and a speed of 115 mph (100 knots), the number of acres sprayed per minute would be 23.0. A flow rate of 76.8 gals/min. such as for the mixture of 1:1 2, 4, 5-T diesel at 40 psi would be 3.3 gals/acre. The range of nozzle configurations for the data indicated show a range of flow delivery from 0.48 gals/acre (11.0 gals/min. for water with D6 - 25 nozzles at 20 psi) to 4.2 gals/acre (97.4 gals/min. for diesel fuel with D10 - 56 nozzles at 40 psi). Deliveries in excess of 4.2 gals/acre can be obtained by increasing the number of nozzles or by double applications.

General conclusions drawn from the data on delivery flow rates are:

a. Flow rates of diesel fuel are greater than those of water.

b. Flow rates of "purple", a fluid with specific density of 10.8 lbs/gal is appreciably less than that of diesel fuel with a density of 7.5 lbs/gal.

(1) DATA BASED ON D7-56 NOZZLES

TABLE 1. FLOW RATES (GALS/MIN) FOR BOOM SYSTEM WITH 40 NOZZLES FOR VARIOUS NOZZLES AND PRESSURES. BASED ON STATIC FLOW TESTS WITH BEECHCRAFT SYSTEM

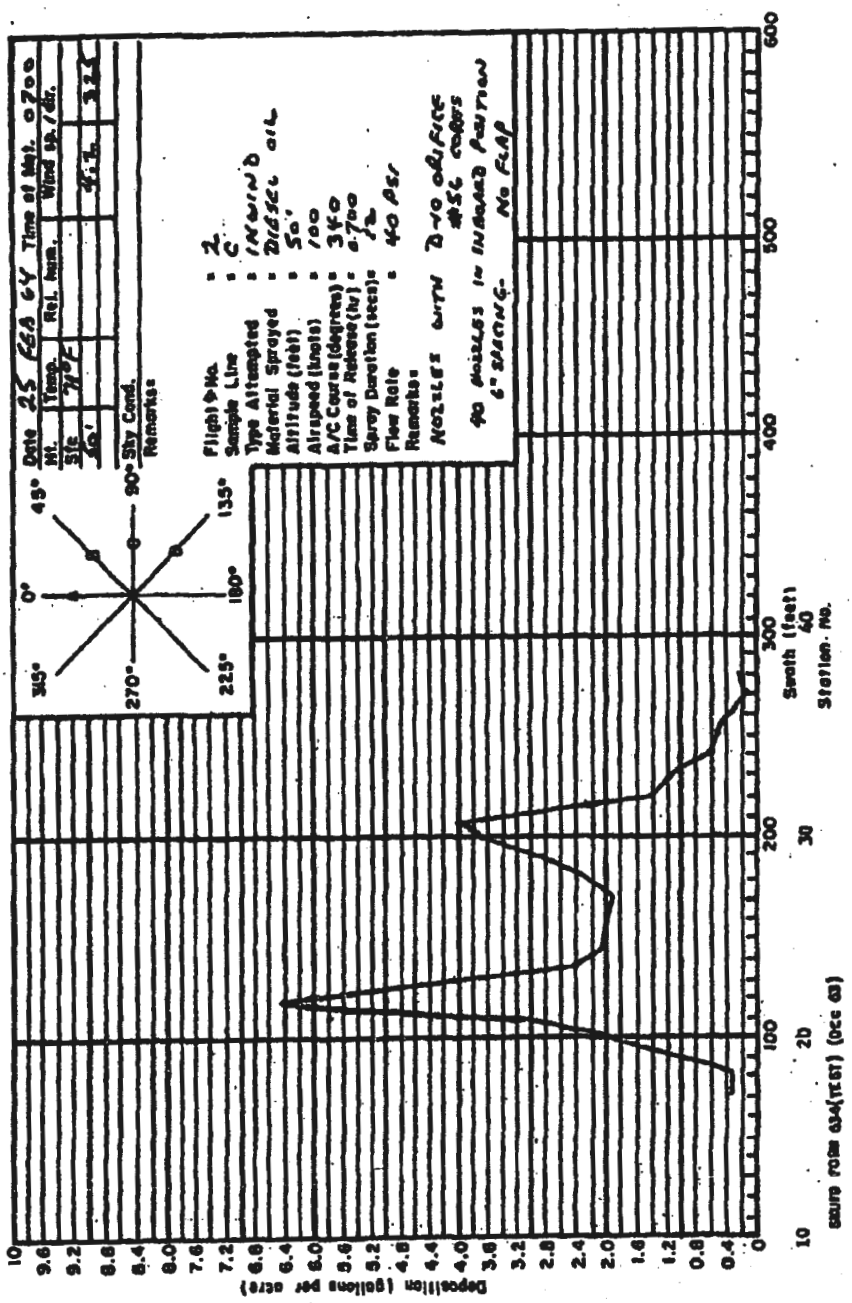
SPRAY SOLUTION	PSI	NOZZLE TYPE D6-25	D6-56	D8-25	D8-56	D10-56
WATER						
	20	11.0		16.4	53.7	64.4
	30	13.7		20.4	65.1	76.6
	40	15.4		23.7	77.8	92.2
DIESEL FUEL			(1)			
	20		42.0			
	30		52.0			81.5
	40		60.3			97.4
PURPLE						
	30	16.5	33.4		51.2	65.3
	40	18.4	38.3		62.0	76.3
PURPLE/ DIESEL 1:1 MIX	20	12.3		17.4	46.6	
	30	15.8		21.1	58.2	
	40	16.9		23.0	68.8	
PURPLE/ DIESEL 1:2 MIX	20		30.5		47.1	
	30		36.1		56.8	
	40		42.8			
2,4,5-T/ DIESEL 1:1 MIX	20	13.8	30.0	17.2	44.4	59.4
	30	15.5	34.0	20.0	54.2	68.3
	40	17.9	39.5	21.9	62.1	76.8
2,4,5-T/ DIESEL 1:2 MIX	20	13.4		16.6	45.9	
	30	15.7		20.0	56.8	
	40	18.7		22.7	67.3	

c. Flow rates of mixtures of "purple" or 2, 4, 5-T ester in ratios of 1:1 or 1:2 with diesel fuel do not differ significantly from that of diesel fuel.

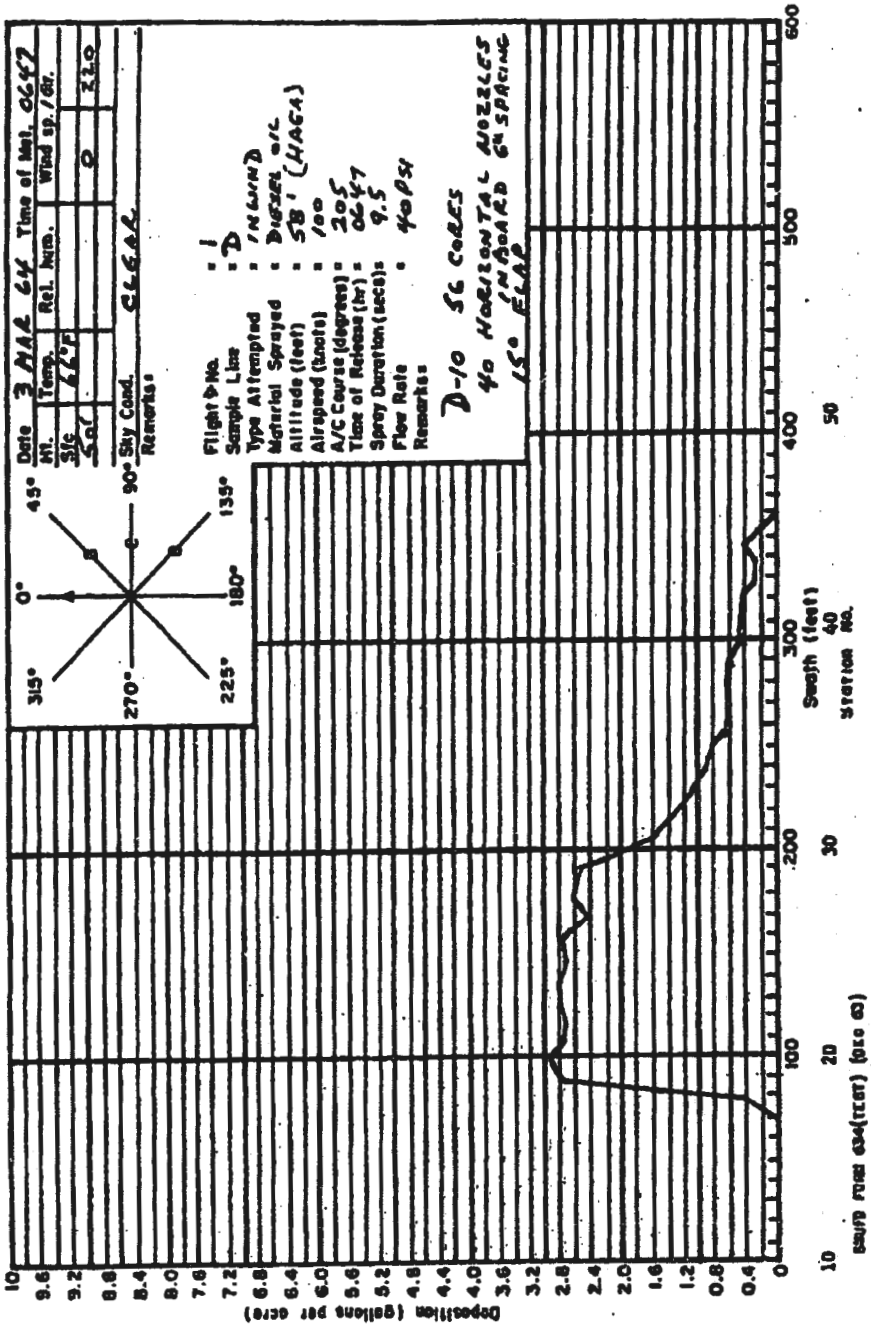
Preliminary spray deposit patterns obtained by the oil sensitive dye card technique on a single 400 foot grid line at the Hua Hin Airport, using diesel fuel spray, indicated that boom configurations with nozzles equally spaced for the length of the booms (wing span of 52 feet) produced a swath width in excess of 150 feet with a distinct bimodal pattern at flight altitudes of 50 to 75 feet. A total of 69 flight runs were made in a 6-day period using this technique.

A more comprehensive analysis of spray deposit patterns was made with the wet-plate method and Kromekote card technique on a grid with 8 grid lines permitting inwind flight runs from any direction. Effort in this phase of the calibration studies was directed toward modification of the boom and nozzle configuration to secure uniform spray deposit rates over a tentative swath width of 100 to 150 feet. Bimodal deposit patterns appeared to be influenced by the 2-engine configuration of the plane with a gap in nozzle placement corresponding to the fuselage and by the distinct wing-tip vortical action noted when nozzles were positioned to the wing tip. Restriction of nozzles to inboard positions behind the engine nacelles restricted the vortical deposit pattern and tended to give a more restricted swath width but the deposit pattern maintained a distinct bimodal aspect.

Trials conducted with flaps down at 10°, 15°, and 30° showed a tendency to minimize the bimodal deposit curve. Pertinent data from 46 test flights with various nozzle and boom configurations are presented in Table 2.



Spray deposit pattern of Beechcraft equipment using 20 nozzles per boom. Horizontally positioned, 6-inch spacing in inboard half of boom. Flight at 50-foot height with no flap. Note bimodal pattern of spray deposit with varying deposit rates.



Spray deposit pattern of Beechcraft equipment using 20 nozzles per boom, horizontally positioned, 6-inch spacing in inboard half-of boom behind flaps. Flight at 50-foot height with 15° flap. Note uniform spray deposit; 100-120 foot swatch width with deposition of 20-to 30 gals/acre.

TABLE 2. SPRAY DEPOSIT CHARACTERISTICS OF VARIOUS NOZZLE AND BOOM CONFIGURATIONS TESTED IN FLIGHT CALIBRATIONS BY COLORIMETRIC-WET PLATE METHOD USING DIESEL FUEL AND DUPONT OIL RED DYE. ALL TESTS AT 40 PSI

Size	Nozzle No Boom	Spacing	Position	Degrees Flap	No. of Flight Tests	Swath Width (Ft.)	Range of Spray Deposit (Gals/Acre)	Character of Deposit Pattern
D6-56	20	12"	Horiz.	0	4	105-175	2.4 - 0.5	BIMODAL
D10-56	10	12"	Vert.	0	2	90-100	1.1 - 0.3	P. BIMODAL
D10-56	20	6"	Vert.	0	3	140-170	3.3 - 0.7	BIMODAL
D10-56	20	12"	Horiz.	0	4	125-175	4.1 - 0.7	BIMODAL
D10-56	10 10	12" 12"	Horiz. Vert.	0	6	95-140	3.6 - 1.7	VARIABLE
D10-56	20	6"	Horiz.	0	9	110-170	4.3 - 1.3	BIMODAL
D10-56	15	6"	Horiz.	0	4	90-160	2.7 - 0.7	BIMODAL
D10-56	20	6"	Horiz.	10	5	100-130	3.8 - 1.0	BIMODAL
D10-56	20	6"	Horiz.	15	5	100-110	4.3 - 1.7	2085 NOT BIMODAL
D10-56	20	6"	Horiz.	30	2	125-140	3.1 - 1.3	BIMODAL
D7-56	20	6"	Horiz.	10	2	90-130	1.3 - 0.3	1 of 2 NOT BIMODAL

UNCLASSIFIED U.S. Department of State Case No. F-2015-06622 Doc No. C05779368 Date: 06/02/2015

Results from flight calibration tests using diesel fuel sprays indicate that:

a. Horizontally positioned nozzles give droplets of larger mass median diameter than similar vertically positioned nozzles.

b. Restriction of nozzles to the inboard half of the boom with 20 horizontally-positioned nozzles at 6 inch spacings produces a well defined swath of less than 150 feet but with a distinct bimodal deposit pattern.

c. Use of 10 to 15° flaps during spray application minimizes the bimodal aspect of spray deposit and gives a suitable deposition pattern within a swath width of 100 to 120 feet.

Flight calibration tests with "purple", totaling 28 as of 15 March, indicate that the spray deposit patterns are slightly narrower in swath width and that droplets are of larger mass median diameter. The use of flaps gives a desirable deposition pattern.

Plans

Full scale treatment applications will be made on replicate 10-acre plots in both the small and large test site areas at the Pranburi Military Reservation. Bi-monthly applications will be made of basic rates of purple and 2, 4, 5-T ester, in coordination with specific rate and volume applications of 8 basic defoliants, desiccants, and herbicides. During the initial phases of treatment, calibration flights of all types of spray solutions will be made over a standard grid line to determine deposit rates under identical conditions as treatment. Deposit rates will be determined colorimetrically using either oil or water

soluble dye in the chemical solution. Meteorological conditions during the period of treatment will be measured at the test site and grid location.

Requirement: Psychological Warfare

Task: Psychological Warfare Equipment (2A)

Sub-Task: Audio-Visual Mobile Unit

MRDC is awaiting ARPA action in CONUS on recommended improvements based upon field test of the Willys Audio-Visual Mobile Units.

SUB-PROJECT VII

TECHNICAL PLANNING AND PROGRAMMING

SUB-PROJECT VII

TECHNICAL PLANNING AND PROGRAMMING

SUB-PROJECT OBJECTIVE

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

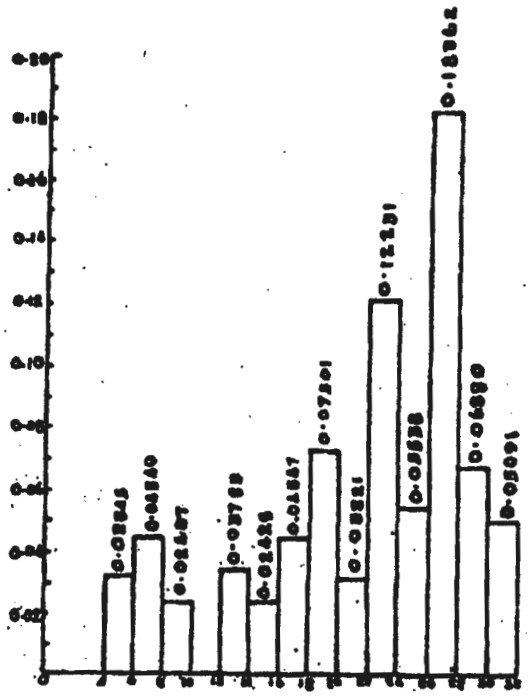
Requirement: **Data Collection and Analysis - Environmental**

Task: **Physical Environment Methodology (IAI)**

Sub-Task: **Water Resources**

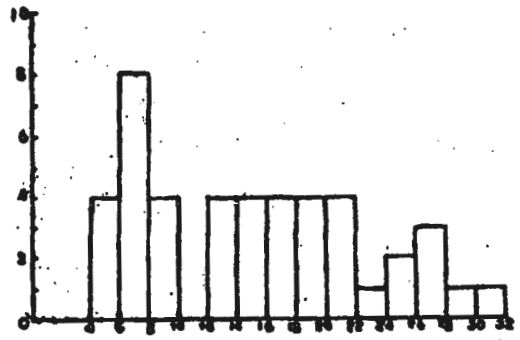
No further activity during the reporting period.

Vertical distribution of tree in plot V

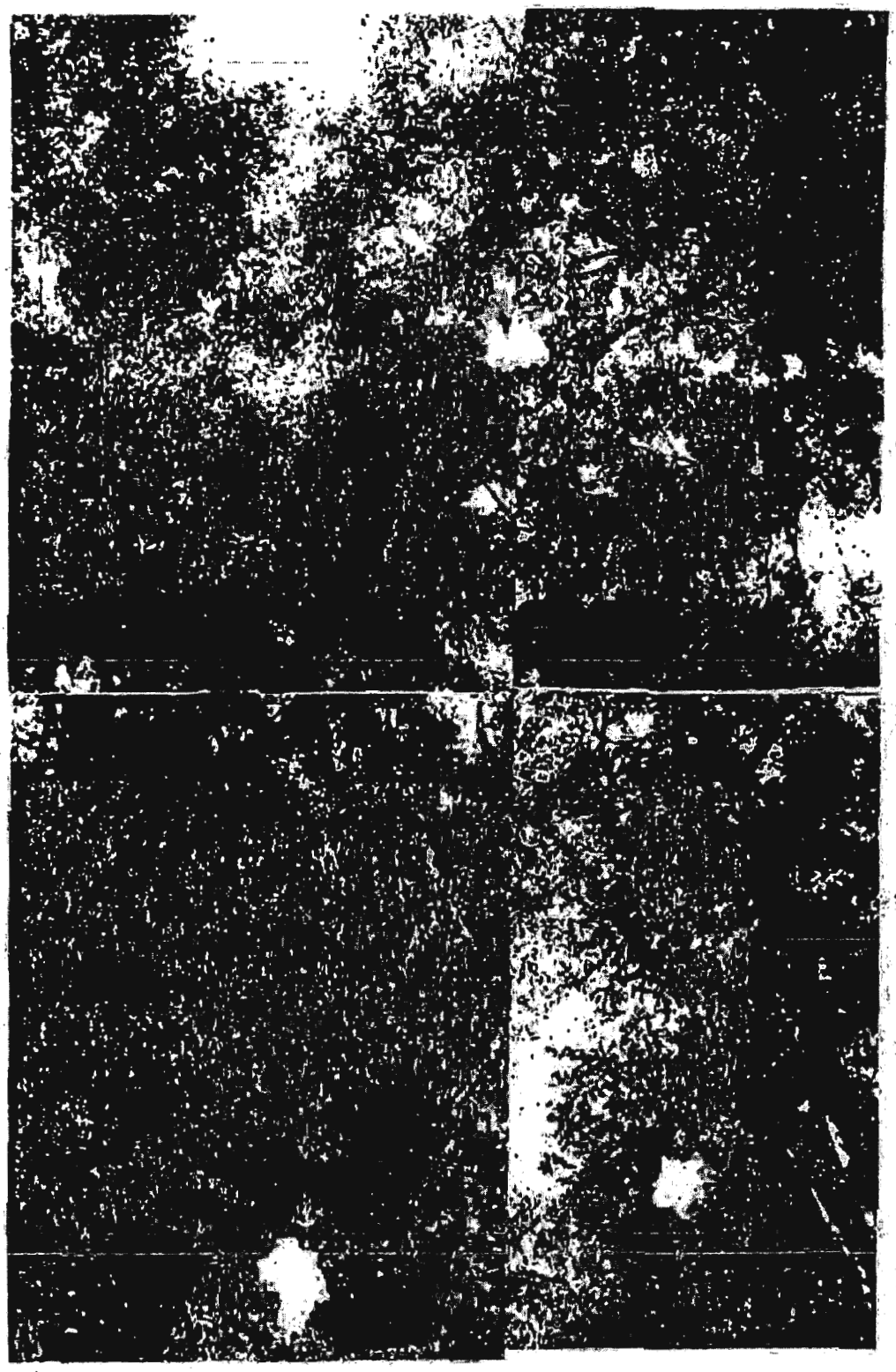


High - m

Frequency distribution of tree height of plot V



high - m.



Typic
lower

Vegetation Team in operation. Conducting a Floristic composition and structure of forest stands.

Soil Engineers conducting soil samples on site for use in Vegetation Studies and collection of soil data for MERS.

Requirement: Data Collection and Analysis - Environmental

Task: Vegetation Study (1A2)

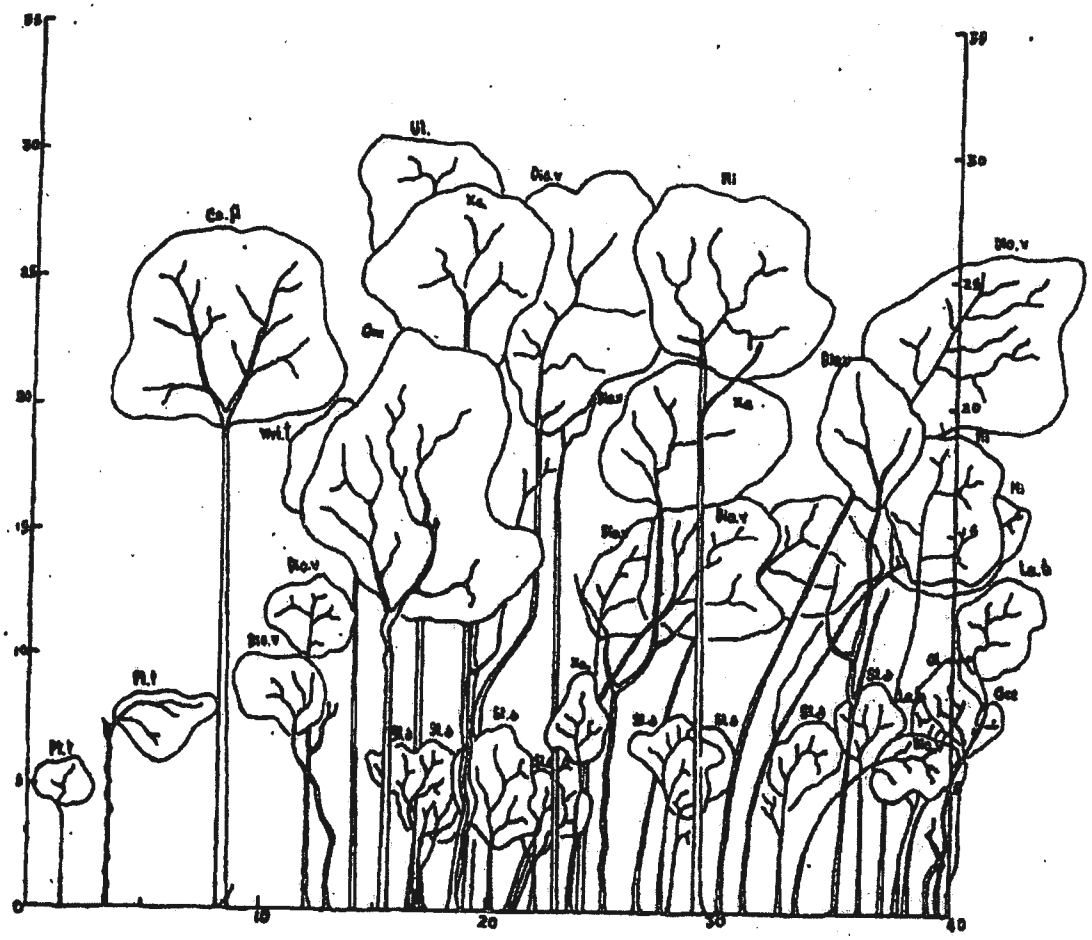
Thus far, 86 floristic composition profile plots have been completed to assist in identifying vegetation in Thailand. At the same time, canopy obscuration and forward visibility measurements of value to research in surveillance problems, and soil samples relevant to MRDC mobility research, are also taken. Approximately 200 canopy measurements, 390 forward visibility measurements, and 130 soil samples have been recorded by field research teams. Plates 1 and 2 show a vegetation team in the field. A team usually consists of a taxonomist, botanist, forester, plant collector, and soil engineer.

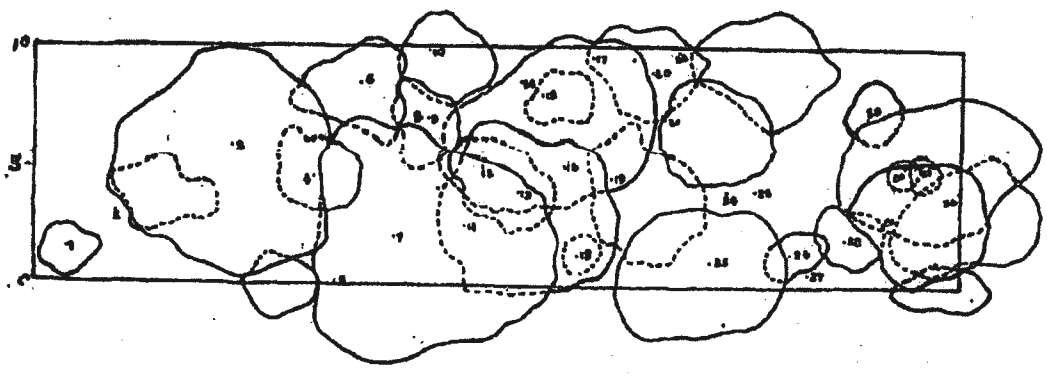
Plate 3 shows forest composition. The test plots are laid out in blocks 10 meters by 40 meters. The data collected is shown in Plates 4 and 5. From these data, leaf volume, wood volume, tree spacing and density, branch growth, heights, physical forest structure, and other measurements are obtained. Plate 6 shows soils data taken from a test plot.

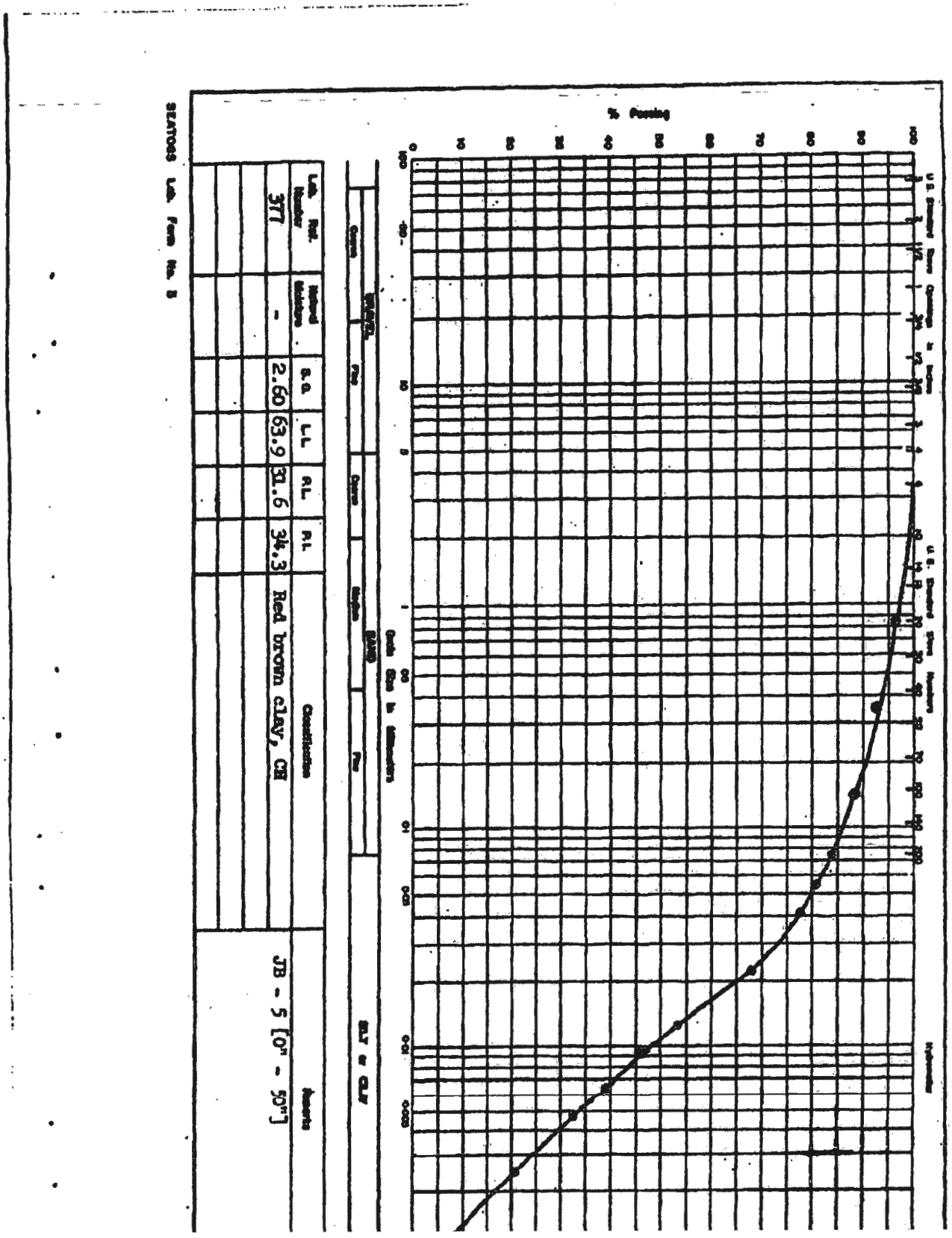
Data are being collected on every forest type in Thailand and associated undergrowth. After collection is complete, an analysis is made and a written description prepared. Sample data sheets are attached in Appendix A for illustrative purposes. These data sheets can be modified at any time to include particular environmental data required for other MRDC tasks and sub-tasks.

While the vegetation surveys are in progress, notes are made on edible and poisonous plants for inclusion in a jungle survival handbook for the Royal Thai Army. The basic outline of the book is drawn from the Armed Forces Field Manuals, with additions covering such subjects as the nutritional food value and frequency of occurrence of edible forest plants.

Diagramatic profile and corresponding horizontal projection of dry evergreen forest on a 10 x 40 m strip through the sample plot. Alt. 360 m. January 6, 1964.







Requirement: Data Collection and Analysis-Sociological

Task: Studies of Northeast Thailand (IC1)

The Directory of The Social Science in Thailand was published in collaboration with Chulalongkorn University and distributed to interested parties during the reporting period. Work continues on the bibliography of uncatalogued and generally unknown reports and papers dealing with Thailand which are relevant to MRDC research activity.

RAC ELEMENT OF MRDC

RAC is developing a concept of conflict (such as might come about in Thailand if Communist-inspired insurgency develops) as an essential part of its task to accomplish operations research in logistics, mobility and ground operations under Sub-Project III; in addition the model concept is intended to provide all projects in MRDC with a common base or statement of potential conflicts that can be used or elaborated upon as the requirements for each study dictate.

During the reporting period a first draft of the concept was completed, briefed and circulated internally within the OSD/ARPA R&D Field Unit for critical comment. A second draft is scheduled for completion in April. This draft will be briefed to a wider US/Thai audience for comment on April 9 and will be submitted to a large number of people for detailed review before formal publication. The Northeast portion of Thailand was chosen as the setting for the situations and three examples of insurgency campaigns at varying levels of intensity have been developed.

The procedures used for situation development may have application in studies by other organizations within Thailand or in other areas of the world. These possibilities will be tested, both as to the adequacy of the procedure itself and the validity of the basic parameters already developed.

SUB-PROJECT VIII

RESEARCH AND EXPLORATORY DEVELOPMENT

SUB-PROJECT OBJECTIVE

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

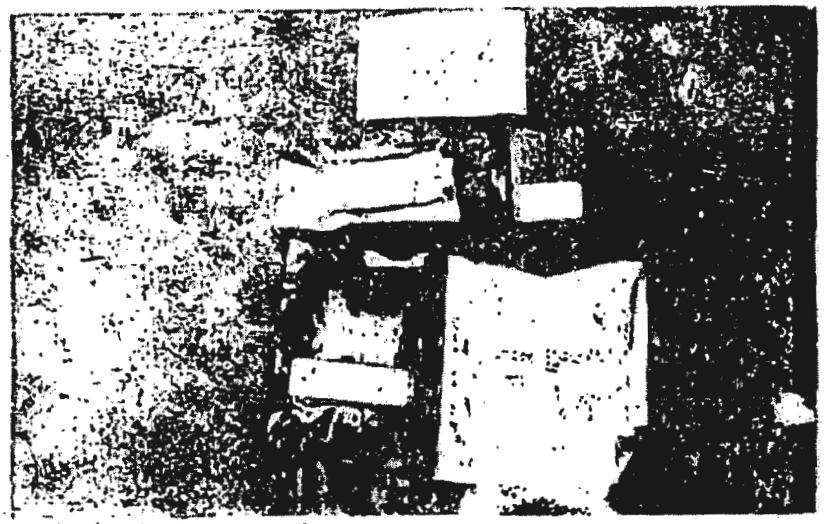
d. Food items should weigh approximately the following (dry processed weight):

(1)	Rice packet	300 grams
(2)	Vegetable bars	20 grams
(3)	Meat bars	50 grams
(4)	Coffee	5 grams
(5)	Lemon powder	5 grams
(6)	Salt	4 grams
*(7)	Nam pla powder	5 grams
*(8)	Thai curry powder	5 grams
(9)	Pepper slices or powder	5 grams
(10)	Sugar cubes	10 grams

e. Instructions for food preparation should be written in Thai on each food item. Each menu (packet) should be identified as breakfast, lunch, or dinner, along with the type meat and vegetable bar it contains. The mix of the various meat and vegetable bars of the menus should be in equal proportions. It is not known at this time which meat and vegetable bars should be in a particular menu.

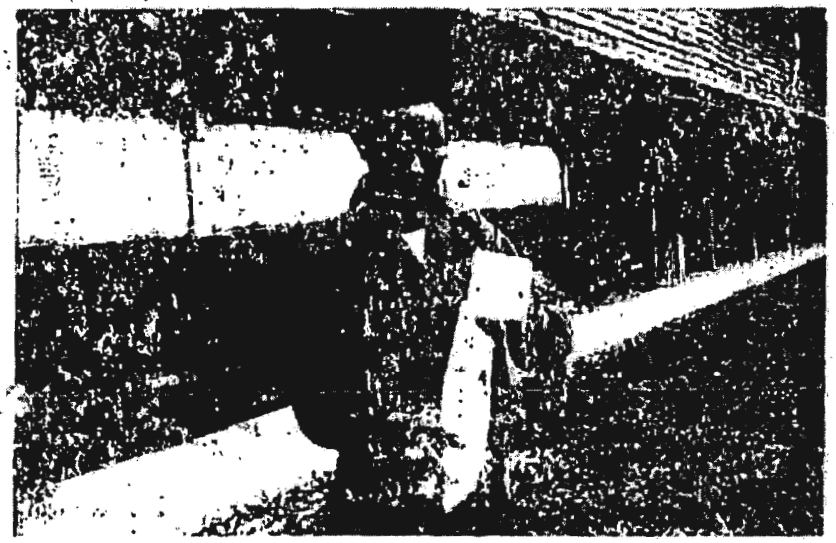
f. All items, except those indicated by an asterisk should be provided from U.S. sources. ARPA Field Unit, Bangkok, can forward the nam pla and curry powder (or any of the other items, if required) to the Natick Labs when notified of the amount and types required.

ARPA has been requested to arrange for a qualified food technician to come to Thailand during the test period in order to assist in evaluating the results of the test, as well as to recommend the composition of an operational ration. Should the RTA decide to adopt combat rations, the technician could further advise Thai authorities on equipment, plant, and materials required to produce a Thai ration.



The CDTC-V ration is relatively light-weight (2 pounds 9 ounces) and fairly compact when compared to the current canned RTA ration (4-1/2 pounds). Contains are dehydrated rice, vegetables (cabbage, spinch), meat (shrimp, fish, pork) condiments, (red pepper slices, garlic powder, salt), beverages (lemon drink, coffee, tea) and sugar cubes.

These rations have a long shelf life and can be produced from local produce.



A 10 ounce bag of dehydrated pre-cooked rice is a part of each meal. The rice is prepared by mixing one half canteen cup of hot water with the rice in its plastic container. The rice is ready to eat within 10 to 15 minutes. Thai soldiers liked the rice and preferred it to the canned rice used in the present RTA combat ration.

Requirement:	**Rations**
Task:	**Combat Rations**
Sub-Task:	**Food Packet, Indigenous, Combat Supplement Evaluation**

An evaluation of the Food Packet, Indigenous, Combat Supplement was conducted in December 1963. The following background information is pertinent. The Food Packet, Indigenous Combat Supplement is being considered by the U.S. Army as a ration supplement which could be provided by U.S. Forces to Thai and other personnel in specialized combat operations. The ration was developed on the basis of existing technology by selecting simple components from U.S. military rations that were thought to have a good probability of being acceptable to people from different food cultures. The 9th Logistical Command located in Korat, Thailand, acting for USARYIS, requested MRDC, as the R&D agency of the Royal Thai Armed Forces, to conduct this evaluation as a part of the MRDC combat ration task.

The purposes of the evaluation were:

1. To determine the suitability of the food packet for use by Thai forces when conducting combat operations. The evaluation determined spoilage, suitability of cache feature, durability of bandoleers and individual packets during operations, and suitability for air drop.

2. To determine the acceptability of food components to Thai personnel.

3. To obtain information on the manner of its use as a supplement to other foods, either provided or found in nature, when conducting combat operations in Thailand.

4. To obtain information and data upon which to base improvements of components and packaging techniques of this or similar combat rations for use by Thai personnel.

The evaluation concluded that:

1. The ration, in its present form, is not entirely acceptable as a ration supplement for Thai personnel conducting combat operations. Until a more suitable ration is developed, this ration could be used as a supplement for short periods, provided that additional hot pepper and fish sauce powder were available. The RTA QM Subsistance Branch can supply both of these ingredients.

2. The plastic case is adequate as a container for the food packets; however, it would appear that all rations would not have to be packed in the expensive plastic case. Depending upon the tactical requirement, a percentage of rations could be packed in cheaper, waterproof cardboard cases, using the plastic cases only when rations are to be stored in a cache. The plastic case is suitable for air drop, but honeycomb should be used to protect cases that are free dropped.

3. The bandoleers are sturdy and are very effective as a carrier for the ration packets. The bandoleers can be conveniently carried by a soldier in a variety of ways which will save valuable space in an already overcrowded combat pack. The size and weight of the ration packets are particularly desirable.

4. The following food items are not entirely acceptable to the Thai palate and should be removed from the ration in order to make room for more acceptable items:

a. Cheese bar

b. Tea

c. Onion powder

d. Garlic powder

e. Sweet bars

5. The following items should be added to a portion of the food packets.

a. Small pack of cigarettes and matches

b. A variety of compressed vegetable bars

c. Sugar cubes

d. Powdered nam pla (fish sauce)

e. Hot Thai curry powder

6. The following items should be changed as indicated:

a. Dehydrated red pepper bar or powdered red pepper (very hot) should replace the relatively mild red pepper powder.

b. More coffee powder should be added to each packet containing coffee.

c. A variety of meat should be offered.

7. The ration packet is intended to supplement basic food items, either provided locally or found in nature. Basic food items (rice, vegetables, etc.) cannot always be found in sufficient quantities in nature or locally in remote areas of Thailand to sustain even small numbers of troops. The ration supplement, because of its concentrated nature, could be used as a sole food source by Thai troops for only a few days and still have the troops maintain their combat effectiveness. Provision should therefore be

made to supply troops with basic food stuffs, such as dehydrated rice, in those instances where basic foods are not available in the area of operations. Two varieties of dehydrated pre-cooked rice which is ready to eat within 15 to 20 minutes after cold water is added will soon be evaluated by MRDC for use in a Thai combat ration. Dehydration reduces the weight as well as the bulk of the rice. Another advantage is that the rice is pre-cocked, eliminating the necessity for elaborate cooking preparations.

7. A ration of this type should be fed to Thai troops during training so they can learn to prepare the food and acquire a taste for some of the food items which are strange to them.

As a result of the test, the following recommendations were made:

1. The Food Packet, Indigenous, Combat Supplement, in its present form, not be standardized as a combat ration supplement for use by Thai personnel engaged in combat operations. Until a better ration is developed, the present ration supplement can be used for short periods of time, providing it is supplemented with additional hot powder and fish sauce powder.

2. The plastic food packet container case be used for rations that are to be stored in a cache or improvised field storage for long periods before being consumed. Less expensive cases should be used for rations that are to be consumed soon after delivery to the area of operations.

3. The cloth bandoleer and the foil food packet wrapper are acceptable for combat rations of this type. The weight and size of the food packets are particularly desirable.

4. ARPA arrange for an appropriate agency to fabricate a dehydrated type ration of approximately the same size and weight, using a similar packaging technique as used in the test ration and containing essentially the following food items arranged in the following menus:

a. Breakfast (Three menus)

Meat bar, one of either fish, pork, or shrimp

Cereal bar

Coffee

Sugar, Cube

Small package of cigarettes and matches

b. Lunch (Four menus)

Meat bar, one of either fish, pork, shrimp or beef

Vegetable bar, one of either cabbage, lettuce, spinach, Chinese mustard, collards or celery

Nam pla powder

Salt packet

Lemon powder packet

Packet of hot pepper powder or slices

Packet of sugar cubes

c. Dinner (Four menus)

Meat bar, one of either pork, shrimp, fish or beef

Vegetable bar, one of either cabbage, lettuce, spinach, Chinese mustard, collards or celery

Nam pla powder

Packet of hot Thai curry powder

d. Food items in these menus should weigh approximately the following (dry-prepared weight)

Vegetable bars	20 grams
Meat bars	50 grams
Coffee	5 grams
Lemon powder	5 grams
Salt	4 grams
Nam pla powder	5 grams
Thai curry powder	5 grams
Pepper slices or powder (hot)	5 grams
Sugar, cubes	10 grams

e. Food preparation instructions should be printed in Thai on each packet. Each meal (packet) should be identified as breakfast, lunch, or dinner, along with the type meat and vegetable bar it contains. Various types of meat and vegetable bars should be equally distributed throughout the rations. It is not known at this time which meat and vegetable bar combinations are best.

f. That approximately 3,000 of the above packets (1,000 rations) be evaluated by MRDC to determine their suitability as a combat ration supplement for Thai troops.

g. That provisions be made to provide Thai troops engaged in combat operations in remote areas of Thailand basic food items such as dehydrated rice packets along with ration supplements when basic items are not available in the area of operations.

h. That combat rations of this type be fed to Thai troops in training so they can acquire a taste for the food items as well as learn to prepare them.

The small size and light weight of the ration packet permits this RTA soldier to carry a six day supply of ration supplements. Test subjects wore the bandoleers for three days during vigorous training exercises. The bandoleers were convenient to carry, withstood the rough handling and did not interfere with the soldiers' body movement. Because of the heavy weight and bulk, an RTA soldier can carry only one day of combat rations currently used by the RTA, along with other essential combat equipment.

Test subjects lost an average of three kilos (6.6 lbs) during the three days in which they ate the ration supplements. Some men lost as much as 4 and 5 kilos (approximately 10 lbs). Men ate 600 grams of rice per day, supplemented by three ration packets. RTA soldiers normally eat 1,000 grams of rice per day in addition to meat and vegetables.

APPENDIX A

APPENDIX A

FIELD TABLE A.

TABLE OF DESCRIPTION OF SAMPLE FOREST STANDS

Date: January 6, 1964 Examiners: Pong & Anan

Examination or plot No. 5

Locality and site 8.23 miles from the base camp of Jansky and Bailey at Khao Yai.

Latitude 14° 32' 14.88" N Longitude 101° 37' 4.76" E

Vegetation Type. Dry Evergreen Forest

Sample shape. Rectangle Sample area 10 x 40 sq.m.

Physiognomy: Structure, life form. This is a two-story forest structure. The upper story from 10-30 meters is composed of Diospyros variegata, Mitrephora sp., and other species. The lower story up to 10 meters is composed of Streblus taxoides, almost pure stand.

Habitat.

Elevation 360 m. Exposure N 40 E Aspect N Slope 10°

Precipitation

Drainage: - Rapid Moderate x Poor

Solar radiation open 220

Vertical 25 N: N 30 E 10.1 N 60 E 16 E: S 60 E 40 S 30 E 50
S: S 30 W 25 S 60 W 40 W: N 60 W 20 N 30 W 13

Time 0940 **Weather condition** clear.

Parent Rock Lime stone

Nature of soil: - **Depth** 50" **pH** 0 - 25" = 6.5
25- 50" = 5.5 **Color** Red brown clay

Texture fine **Consistency** soft.

Surface litter: **Depth** **Bare** **Scatter** x

Edible plant:

Hazardous plant: Thorny shrubs (Streblus taxoides)

Nota bene: Tree leanings indicate strong winds from the East.

FIELD TABLE B.

FLORISTIC COMPOSITION AND CENSUS OF TREES (MORE THAN 5CM. DBH)

Stand No. V **Stand name** Dry evergreen forest

Date: January 6, 1964 **Local name** J&B site, Khao Yai

Area 40 x 10 sq. m.

Vegetation Species in the profile

Tree: Pterocymbium tintorium, Colona flagrocarpa, Diospyros variegata, Writia tomentosa, Grewia sp., Ulmus sp., Xanthophyllum sp., Mitrephora sp., Lagerstroemia balansae, Olea sp.

Shrub: Streblus taxoides, Excoecaria sp., Mellotus sp., Psychoria sp., Micromelum.

Herb: Tetrastigma sp., Linostoma sp., Uvaria sp., Veppis sp., Gnetum sp., Ancistroclaudus sp., Hymenopyramis sp., Jasminum sp., Toxocarpus sp., Ventilago sp., Pteroloma sp.

Climbers: Dia.....2-5.....cm
Bauhinia sp.

Saprophytes:

Parasites:

Diameter of Branches 5-20 cm.

Undergrowth high: 1-3 m. **Composed of** Streblus taxoides, Vines, seedlings and saplings.

Penetrability Fair _____ Poor x

Visibility N 22 E 15 S 12 W 17 (ave. 16.5 m.)

No. of Pictures: Roll II Vert. 4 N 5 E 6 S 7 W 8

FIELD TABLE C.

Stand no. 5 Date. January 6, 1964

Forest Type. Dry Evergreen Forest

No. of Trees	Tree Species	Dia. cm.	B.A. sq.m.	Height m.	Position of Tree m. Base Line	Position of Tree m. From Base Line
1	Pterocymbium tinctorium	38	011487	6	1.5	1.40
2	Pterocymbium tinctorium	39	012100	8	3.5	3.0
3	Colona flagrocarpa	110	096250	28	8.0	6.0
4	Diospyros variegata	60	028638	13	12.0	4.5
5	Diospyros variegata	34	009196	10	13.0	10.0
6	Wrightia tomentosa	77	047165	20	14.0	8.5
7	Grewia sp.	124	12231	24	15.5	2.0
8	Streblus taxoides	35	009745	6	16.5	7.0
9	Streblus taxoides	31	007645	6	17.0	7.0
10	Ulmus sp.	80	050912	31	17.0	9.8
11	Xanthophyllum sp.	78	048398	28	18.3	2.5
12	Diospyros variegata	93	068803	29	19.0	5.0
13	Streblus taxoides	30	007160	7	20.0	4.0
14	Diospyros variegata	45	016109	16	21.0	8.5
15	Streblus taxoides	24	004582	5	22.0	8.0
16	Diospyros variegata	59	027691	25	23.0	5.0
17	Diospyros variegata	32	008146	16	24.0	9.5
18	Xanthophyllum sp.	20	003182	9	24.5	1.5
19	Xanthophyllum sp.	45	016109	22	25.0	4.5

No. of Trees	Tree Species	Dia. cm.	B.A. sq.m.	Height m.	Position of Tree m. Base Line	From Base Line
20	Diospyros variegata	46	016833	17	26.5	9.0
21	Streblus taxoides	20	003182	7	27.8	7.0
22	Streblus taxoides	24	004582	7	28.0	9.8
23	Mitrephora sp.	70	038980	28	29.0	1.0
24	Diospyros variegata	59	027691	26	30.0	4.0
25	Mitrephora sp.	60	028638	17	31.0	4.0
26	Streblus taxoides	35	009745	7	32.5	1.5
27	Diospyros variegata	18	002577	7	33.5	3.5
28	Diospyros variegata	45	016109	22	35.0	2.0
29	Streblus taxoides	32	008146	9	36.0	7.0
30	Mitrephora sp.	57	025846	19	37.0	3.0
31	Lagerstroemia Balansae	19	002872	8	38.0	5.0
32	Grewia sp.	20	003182	8	38.5	5.0
33	Lagerstroemai balansae	34	009196	14	39.0	1.0
34	Olea sp.	22	003850	10	40.0	4.0

PLOT V DRY EVERGREEN FOREST
KHAO YAI NATIONAL PARK, SOUTH OF J & B

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1. Pt.t Pterocymbium tinctorium
2. Co.fl Colona flagrocarpa
3. Dio.v Diospyros variegata
4. Wri.t Wrightia tomentosa

5.	Gre	Grewia sp.
6.	St.t	Streblus taxoids
7.	Ul	Ulmus sp.
8.	Xa.	Xanthophyllum sp.
9.	Mi	Mitrephora sp.
10.	La.b	Lagerstroemia balansae
11.	Ol	Olea sp.

Type of Forest	No. of Measure-ment	Visibility in %				
		20 m	20-30m	30-40m	40-50m	50+m
Mixed Deciduous (Teak forest) Maehongsorn	36	2.8	27.8	22.2	19.4	27.8
		40-	40-60	60-80	80+	-
Dry Dipterocarp km 109, Ban Kurugu Nakorn Phanom	12	20.0	33.3	40.0	6.7	-
Dry Dipterocarp km Banphai Borabue	8	-	37.5	25.0	37.5	-
Dry Dipterocarp (mixed with teak) Obluang, Hod	12	66.7	33.3	-	-	-
		80-	80-100	100-120	120-140	140+
Dry Dipterocarp (mixed with pine) Doi Boluang, Hod	32	25.0	22.1	21.9	12.5	12.5

		20"	20-40	40-60	60+	-
Dry Dipterocarp Mae Hongsorn	24	8.3	66.7	16.7	8.3	-

GROUND VISIBILITY

Type of Forest	No. of Measure-ment	Visibility in %				
		10⁻m	10-20m	20-30m	30-40m	40⁺meters
Dry Evergreen Dong Bang-ei Mukdaharn	36	8.3	36.1	19.5	16.7	19.4
Dry Evergreen Pupan National Forest	12	-	41.7	25.0	16.7	16.6
Dry Evergreen Pakthongchi, Korat	28	-	46.4	42.9	10.7	-
Dry Evergreen Kabinburi	57	7.0	28.2	33.3	17.5	14.0
Dry Evergreen Pranburi	96	-	31.3	51.0	15.6	2.1
Dry Evergreen J&B Site, Pakchong	40	-	67.5	22.5	2.5	7.5
Moist Mixed Deciduous	18	11.1	38.9	22.2	16.7	11.1

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