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CONTROLLABILITY

of PENTANA-TYPE COMPANIES in MOBILE OPERATIONS

VOLUME II

LOGISTICS

U. S. ARMY
COMBAT DEVELOPMENT
EXPERIMENTATION CENTER
FORT ORD, CALIFORNIA

FINAL REPORT

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58-1111

ERRATA SHEET

1. Page 23, paragraph 7b(3) change nedical to medical.
2. Page 30, paragraph 5b(7) change Tacometer to Tachometer.
3. Page 33, paragraph 7e change attenpting to attempting.

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See 1473

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VOLUME II

LOGISTICS

LOGISTICS

PREFACE

(FOR OFFICIAL USE ONLY)

A brief resume of the conditions, environment and limitations of the Controllability Experiment is given in the preface to Volume I of this report and the statements therein should be reviewed prior to the study of Volume II.

The Plan of the Experiment provided for three logistical objectives which were stated as follows:

1. "To determine the logistical support requirements generated by the Rifle Company." (Referred to as objective 6 in Volume I)

2. "To investigate techniques of aerial resupply of and maintenance of the Rifle Company." (Referred to as objective 7 in Volume I)

3. "To determine the logistical support requirements generated by the Combat Group Artillery Battery." (Referred to as objective 3, Artillery Support, in Volumes I and III)

However, in the conduct of the experiment it was impossible to isolate the Class I and Class III support requirements generated by the Rifle Company from those generated by the Artillery Battery.

For this reason the first and third of the above listed objectives have been combined for the purpose of this logistical report into one objective as follows:

> "To determine the logistical support requirements generated by the Rifle Company and the Artillery Battery."

The logistic experiment was conducted within the framework of the "Controllability of PENTANA-Type Companies in Mobile Operations" experiment. The logistical experimentation followed the same experimental design as the tactical experiment and consisted primarily of collecting logistical data in the field. Data pertaining to Class I, III, and V supply was furnished by the S4, 1st Battle Group.

The data pertaining to POL requirements requires further experimentation which will separate those requirements generated solely to power non-tactical radios carried in the vehicles from overall operational requirements. The data pertaining to ammunition requirements indicates a need for further experimentation under conditions of controlled or limited use of nuclear weapons. Vehicle maintenance data requires further investigation under conditions of adequate first echelon maintenance.

The aerial techniques used in Night Aerial resupply of isolated platoons, and the techniques used in vehicle repair and radio repair were repeatedly employed. These merit further study.

CONTENTS

CONTENTS (continued)

ABSTRACT

1. (U) General:

The Logistics Report (Volume II of the Controllability of PENTANA-Type Companies in Mobile Operations Report) is in two sections. Section I presents the logistical requirements generated by the two PENTANA-Type companies in the Controllability, Artillery, Experiment conducted at HLMR from 6 May to 18 July 1958. Section II outlines Aerial Techniques developed for Aerial resupply and aerial maintenance of vehicles and radios during this same experiment.

2. (OFLUSE) Purpose:

The purpose of this experimentation was to establish the logistical requirements generated by PENTANA-Type companies under the concepts of mobility and dispersion on a nuclear battlefield and the development of techniques to support such units by the use of the H21C helicopter.

3. (C-NEA) Conclusions and Recommendations:

a. Objective 1:

To determine the logistical support requirements generated by the integrated rifle company.

Conclusions:

(1) Logistics support requirements for a PENTANA-Type Rifle Company as developed in this experiment are valid only for rations and water consumption. The requirements for water and rations are shown on page 7.

(2) Validity of requirements for POL should be established by further experimentation which will separate those requirements generated solely to power non-tactical radios carried in vehicles. The POL requirements are depicted on page 8.

(3) The expenditure rates of ammunition indicate need for further experimentation under conditions of controlled or limited use of nuclear weapons. An average day of fire is shown on page 10.

Supplementary Conclusions:

(1) First echelon (driver) maintenance of vehicles is less efficient when vehicles and drivers are attached than when they are organic to a unit.

(2) Component replacement system of maintenance for vehicles and radios, from a central source, can restore equipment to operable status quicker than present system of spare parts and organic unit maintenance.

(3) Personnel casualties within an ICG from unrestricted nuclear weapon use are beyond the capability of organic medical personnel to handle.

(4) In comparison of ton/miles aerial and surface resupply the experiment indicated that 3.5 H21C helicopters can move the equivalent tonnage carried by 1, 2½ ton truck in 1/6 the time. Additionally the experiment indicated that palletized loads can be picked-up and delivered by helicopter more rapidly than by ground vehicle.

b. Objective 2:

To investigate techniques of aerial resupply and maintenance of the Rifle Company.

Conclusions:

(1) Aerial resupply is tactically sound, avoids partisan activity and becomes more economical of time the longer the distance travelled.

(2) Vehicular resupply permits multiple missions due to greater lift capacity and is far more economical in gasoline consumption.

(3) Homing and Night Lighting System: The system is a good one for guiding aircraft to a rendezvous point and activating lights on the ground for landing during night flights. It can be used for either rotary wing or fixed wing aircraft. The device can eliminate the separate need for "PATHFINDERS" for resupply purposes. It is a device that could be used by isolated units and Aid Stations at night.

(4) The Aircraft Homing and Night Lighting System is a good system for use at night in conjunction with supply delivery in forward areas.

(5) The ½ Ton M-274 "Mule" is an acceptable mobile platform for air lifts.

(6) The Roller Fluid Transporter is an acceptable fuel cell for air lift.

(7) Aerial resupply of isolated units operating both day and night appears feasible under the environmental conditions of the experiment.

SECTION I

LOGISTICAL SUPPORT REQUIREMENTS OF THE RIFLE COMPANY

1. (OFLUSE) Objective:

To determine the logistical support requirements generated by the PENTAMA-Type experimental rifle company and the artillery battery.

2. (U) General:

The logistical data presented in this annex depicts the complete logistical requirements generated by two PENTAMA-Type Experimental Companies. This data has not been correlated with other collected scientific data.

3. (U) Authority:

Letter ATSWD-P 322/71 (CDEC) (14 Oct 57), Hq USCOMARC, 14 October 1957, subject: "Directive for CDEC Experimentation Program."

4. (OFLUSE) Sources of Logistical Data:

a. Scientific Personnel:

Vehicular Casualties both friendly and enemy, to include the causative agent, the number of simulated rounds fired and the location of the actions as they occurred in time sequence during the conduct of the experiments.

b. Controller Group:

The narrative account of actions and incidents as they occurred in the course of each experimental run.

c. Supply Section, 1st Battle Group:

(1) Number of rations issued daily to each experimental company and the method of delivery.

(2) Number of gallons of water issued to each experimental company and the method of delivery.

(3) Amounts of POL consumed by each experimental company and the method of delivery.

(4) Number of rounds of ammunition by type expended by each experimental company.

(5) Number of Radio breakdowns in each experimental run.

d. The 554th Ordnance Company:

Vehicular Maintenance data.

e. The Signal Section, 1st Battle Group:

Radio Maintenance data.

f. The 33rd Helicopter Transportation Company:

Flight Mission data, Troop Movement, Aerial Resupply, Aerial Vehicular and Radio Maintenance.

g. Logistics Experimentation Branch:

Personnel Casualty Assessment.

5. (C) Logistical Support Requirements:

a. Supply:

(1) Rations: The standard "C" ration presently used by the U. S. Army was employed in this study as a standard of measurement. During the first two weeks of experimental runs the ration was actually fed to the troops. (Appendix I to Section I)

(a) Company Daily Requirements - Rations

STRENGTH	CASES OF RATIONS/DAY	WEIGHT	MEASUREMENT
279	47	1786 lbs	56.4 cu ft

(b) Combat Group Daily Requirement - Rations

STRENGTH	CASES OF RATIONS	WEIGHT	MEASUREMENT
1279	214	8132 lbs	256.8 cu ft

(2) Water: Dispersed mobile units require water for drinking, bathing, laundry, food preparation and for the cooling system of their vehicles. The impact of the water requirement on the available transportation system can be excessive. In World War II the water allowance per man varied from 1 gallon to 10 gallons a day. Since all water used by troops must be chlorinated and protected from contamination, water is procured at central points and transported to the troops. The water allowance per man in the Experimental Companies was arbitrarily set at 3 gallons per man per day. This water was delivered in either 5 gallon water cans or in 250 gallon water trailers. (Appendix II to Section I)

(a) Company Daily Requirements - Water

STRENGTH	GALLONS	5 GAL CANS	WEIGHT	250 GAL TRAILER
279	837	168	8400 lbs	3 ⁄

(b) Combat Group Daily Requirement - Water

STRENGTH	5 GAL CANS	WEIGHT	250 GAL TRAILER LOADS
1279	768	39,400 lbs	16

(3) POL: The data on POL consumption is taken from the operations individual daily trip tickets. Normally each vehicle of an experimental company was filled to capacity with gasoline and oil prior to the initial jump-off from Tule Bivouac at the beginning of the two day experimental run. Resupply was effected at the administrative breaks between situations. A 3000 gallon tanker truck was used for this purpose. Emergency requests for POL were filled administratively. However, during "Controllability" on several occasions POL was delivered by H21 helicopter, tactically, using either 5 gallon cans or the Roller Fluid Transporter. These deliveries will be discussed subsequently in "Aerial Resupply." The POL consumption data, per type vehicle presented, is in wide variance to both manufacturers specifications and the consumption factor previously evaluated in the "Mobility Experiment." In "Controllability," radios in vehicles were not only in greater quantity than normally used but were required to be continuously in operation. This factor necessitated the constant operation of vehicle motors. (Appendix III to Section I)

(a) POL Requirements Experimental Company:

Total requirement per 100 miles, 9646 gallons of gas and 34 quarts of oil.

(b) POL Requirements per ICG:

38,584 gallons of gasoline. 136 quarts of oil.

(4) Materiel Replacement:

(a) Vehicles:

(1) In this study a "Total Kill" assessment by the umpires and evaluators meant the total loss of the vehicle, its weapons and its radios. "Mobile Kill" meant a damaged, recoverable and repairable vehicle, with no loss of personnel, weapons or radios. A "Hit" was disregarded in the compilation of logistical data. (Appendix VI and Appendix VII to Section I)

(2) Average Daily Vehicle Replacement Integrated Combat Group:

¼ TON TRUCK	M52 SELF PROPELLED	APC	TANK
22	.5	88	9

(b) Weapons:

In this study a killed vehicle was interpreted as the total loss of the weapons mounted on those vehicles regardless of the possibility of recovery. The weapon replacement requirement was of primary importance, the loss of firepower was only of secondary importance. The losses of personnel and the losses of vehicles have already accounted for the loss of firepower.

Replacement Requirement - Per Day

WEAPON	105 SP	DART	MG 30CAL	90mm TANK	106 RECOIL	3.5 RL	NUCLEAR LAUNCHER	4.2 MORTAR
COMPANY	1.35	1.35	61.1	4.8	14.7	27.9	2.25	6.05
ICG	5	5	244	19	59	112	9	24

(c) Radio Equipment:

The multiplicity of radios, required for umpires as well as for tactical use, mounted in vehicles of all types staggeringly increased the radio replacement factor. If a single type radio was carried in each vehicle the requirement would be more realistic.

A "Total Kill" on a vehicle meant the "Total Kill" of all radios carried in the killed vehicle. Daily average:

RADIO TYPE	AN / GRC 19	AN / GRC 8	VRC 10	PRC 6
COMPANY	9	88.5	22	109
ICG	36	354	88	436

(5) Ammunition: The ammunition requirements were derived from two sources. The 1st Battle Group S4 based ammunition expenditures on the number of blank rounds used and the number of simulators used. The Controller based their data on Missions requested and delivered. (Appendix VIII and Appendix IX, Section I)

(a) Average day of fire per Company - Conventional

	RIFLE	MG 30CAL	90mm TANK	MORITZER	4.2 MORTAR	106	DART	3.5 RL
ROUNDS	2088	5780	14	884	18	22	9	22
WEIGHT	115#	377#	833#	18,564#	1260#	1309#	595#	1309#

The average daily weight of Conventional ammunition was:

Infantry Company	5,768 lbs
Artillery Battery	18,564 lbs
	24,362 lbs

(b) Average day of fire per Company - Nuclear Weapons

	MINES	LIGHT WEAPON DC A	HEAVY WEAPON DC B	OTHER NUCLEAR
NUMBER	0.5	6	7	15

(c) Average day of fire per ICG Conventional Ammunition

	RIFLE	MG 30CAL	90mm TANK	MORITZER	4.2 MORTAR	106	DART	3.5 RL
ROUNDS NUMBER	8,352	23,120	56	3,536	72	88	36	88
WEIGHT	520#	1,392#	3,332#	74,256#	5,040#	5,236#	2380#	1590

(d) Average day of fire per ICG - Nuclear Weapons

	MINES	LIGHT WEAPONS	HEAVY WEAPONS	OTHER NUCLEAR
NUMBER	2	24	28	60

(e) Daily tonnages Ammunition Resupply ICG

Infantry Companies		Artillery Batteries
11.5 tons	Conventional	37.25 tons

b. Maintenance:

(1) Vehicle Maintenance:

(a) General: The data collected and presented on Vehicle Maintenance was taken from the daily reports of the S4, 1st Battle Group

and the records of the 554th Ordnance Company. Minor repairs to vehicles were effected by crews of mechanics dispatched from Tule Bivouac to the distressed vehicle. Where practicable repairs were effected at the site. Vehicles requiring major shop-type repairs were evacuated either by wrecker or tank retriever, depending on the size and weight of the vehicle, to the 554th Ordnance Company at Tule Bivouac. Maintenance and recovery were effected administratively. Ordnance Corps precepts and procedures were followed. Maintenance of vehicles effected by air will be discussed in Part II of this report. (Appendix X to Section I)

(b) Vehicle Operations:

(1) Wheeled Vehicles were organic to the unit. Assigned drivers, members of the experimental companies operated and maintained these vehicles with Command Supervision.

(2) M-59 Armored Personnel Carriers were attached to the experimental companies. The vehicles and drivers were from the Mortar Company. Experimental Company Commanders exercised little supervision over these attached personnel with the result that normal first echelon maintenance was neglected. This resulted in numerous breakdowns.

(3) The M-52 Self Propelled tracked gun-carriers were the organic property of the Artillery Battery Command. Supervision of maintenance was excellent.

(4) The M-48 Tanks were the organic property of the aggressor force. The drivers were members of the aggressor force. Command Supervision of maintenance was excellent.

(c) Vehicle Breakdowns by Echelon of Maintenance

UNIT	DATES	M59	M52	M48	¼ton	3/4ton	MAINT ECHELON 1	2	3
A	6-7 May	27					6	6	15
B	8-9 May	17				1	3	2	12
A	20-21 May	15	2				2	1	14
B	22-23 May	10					6	1	3
B	3-4 Jun	15					4	2	9
A	5-6 Jun	26			4		7	1	22
B	30Jun-1Jul	16			1		6	1	10
A	2-3 Jul	18	1				2	2	15
A	15-16 Jul	26	1		1		4	4	20
B	17-18 Jul	10					1	1	8

(d) Nature of Breakdowns: (See Appendix X to Section I)

(e) Time Requirement: Evacuation and repairs of vehicles. (See Appendix IV to Section II)

(2) Radio Maintenance:

(a) General: Radio repair was effected by air. Radio repair men were flown by H21C to vehicles when notified of a radio failure. Radios were exchanged. The average time for such exchange was ten (10) minutes. The evacuated radios were delivered to the radio repair shop. Repaired radios were then returned to a radio pool for subsequent exchange.

(b) Radio Exchange and Repair:

UNIT	DATES	RT67	RT68	RT70	PP112
A	7 May	1			
B	8 May	1			
A	20 May		1		
B	22 May		1	1	
B	3-4 Jun		7		
A	5-6 Jun		6		2
B	30Jun-1Jul		4	1	
A	2-3 Jul		2		
A	15-16 Jul		5	1	2
B	17-18 Jul		2		

c. Personnel Casualties and Evacuation Requirements:

(1) General: In the Controllability Experiment the Armored Personnel Carrier was considered as a "Mobile Foxhole." Men fought from vehicles and only rarely dismounted. The Armored Vehicle was considered relatively immune to the shell fragmentation of indirect fire. A template evaluation was used to assess nuclear weapons casualties. Personnel enclosed in Armored Vehicles at prescribed distances from the Epicenter had relative immunity to the thermal, blast and radiation effects of nuclear weapons. A vehicle kill was presumed to mean injury to all occupants of the vehicle. (Appendix IV and Appendix V to Section I)

(2) Casualty Assessment factors:

(a) Conventional weapons from FM 101-10

Dead 25%

Immediate Evacuation 25%

Delayed Evacuation 25%

Return to duty 25%

(b) Nuclear weapons Casualties: Surgeon General's Office

Dead or dying 36%

Immediate Evacuation 16%

Delayed Evacuation 26%

Return to duty 22%

(3) Average Casualties per Company per Day:

NUCLEAR	CONVENTIONAL	TOTAL	IMM EVAC	DELAYED EVAC
156	155	311	59	75

(4) Integrated Combat Group Casualty Expectancy and Evacuation Requirements. Average per Day.

NUCLEAR	CONVENTIONAL	TOTAL	IMM EVAC	DELAYED EVAC
692	698	1390	285	354

d. Comparison Aerial Resupply and Conventional Surface Resupply:

A comparison in terms of ton-miles between aerial resupply and conventional surface resupply was made from the data collected during the experiment.

(1) Integrated Combat Company requires per day:

(a)	Class I, Food and Water	11,186 lbs
	Class III, Gasoline in 5 gallon cans	81,060 lbs
	Class V, Ammunition, all types	24,374 lbs
	Total Tons	57.81

(b) Other Factors:

(1) Distance FIDO to Combat Group Supply Point.

Ground - 16 miles

Air - 6.2 miles

(2) Miles per hour.

Ground - 25 mph

Air - 60 mph

(3) Load Capacity.

Ground, 2½ ton truck load 5 tons

Air, H21C helicopter 2500 lbs palletized external load

(2) Comparison in tons and miles:

METHOD	TONS/ MILES	VEHICLES or MISSIONS	TIME REQUIRED PER VEHICLE
GROUND	57.81/16	12, 2½ ton trucks	38 min, 21 seconds
AIR	57.81/16	42, H21C missions	6 min, 12 seconds

(3) Conceivably 6 H21C helicopters could, making 7 trips each, move the same number of tons to the same destination in the same time. The advantage of airlift is not only shortened mileage and time but in the rapidity with which palletized loads can be picked up at FIDO and deposited at the Combat Group Supply point with a minimal personnel requirement; i.e., trucks do not have to be loaded and then unloaded.

e. <u>The Logistical Impact of the Automatic Resupply System</u>:

A determination in terms of ton-miles, vehicle and POL requirements and the logistical impact generated by the automatic resupply system from FIDO to the Supply Point of the Combat Group was made from the data collected in the experiment.

(1) If, as calculated in paragraph 6, the Integrated Combat Company requirement is 57.81 tons per day to be moved by 2½ ton trucks an average of 16 miles per vehicle then, twelve 2½ ton trucks will move 57.81 tons 16 miles.

(2) POL gasoline requirement. The 2½ ton truck requires 1 gallon of gasoline for every 3 miles travelled. The mileage from FIDO to Combat Group Supply Point and return to FIDO is 32 miles. Hence, 12 trucks x 32 miles ÷ 3 miles per gallon of gasoline equals 128 gallons of gasoline required.

(3) Additional Logistical Impact:

(a) The time of travel and the gasoline required has minimal logistical impact when one company is considered. The entire Integrated Combat Group would require 234.57 tons/16 miles. This requirement would require 47 - 2½ ton trucks x 32 ÷ 3 miles/gallon or 1504 gallons of gasoline.

(b) Conceivably the twelve 2½ ton trucks could make four round trips. However, these trips would be at wide-spread intervals in time due to the time required for loading and unloading. The handling of 234.57 tons of supply would require a number of personnel both at FIDO and at the Integrated Combat Group Supply Point.

6. (C) Discussion:

a. General:

The concept of "Mobility and Firepower" plus the dimensions of a nuclear battlefield radically change the logistical concepts and requirements from the conventional warfare of World War II and Korea.

b. Logistical Requirements:

(1) Rations: Rations of necessity will have to be standardized, light in weight and easy to prepare. Such rations will require no refrigeration. If they are to be air dropped, economically they must require less aircraft, be packaged to eliminate breakage and accurately dropped to minimize losses.

In this study conventional QM "C" ration was used. The new QM irradiated dehydrated ration will be lighter, less bulky and easier to prepare.

(2) Water: Water can be a tremendous bulk and weight and impose a considerable strain on transportation requirements. The 3 gallons per man per day used in this study is a minimal requirement. It permits no washing of clothes, little bathing and a minimum for water-cooled vehicles.

(3) POL Requirements: The daily POL requirement for either a company or a Combat Group using tracked vehicles is staggering. Movement of 100 miles per day per vehicle with radios operational 24 hours a day as depicted in the Controllability Experiment, using gasoline as a propellant would require fleets of either ground tankers or aerial tankers per division per day.

(4) Vehicle Maintenance: From a maintenance viewpoint the attached vehicles to the Experimental Companies, the M59 and M84 Armored Personnel Carriers suffer severely in comparison to the wheeled vehicles, tracked self-propelled artillery and tanks which were organic to units and had close Command Supervision.

The drivers of the attached M59's and M84's ignored first echelon maintenance. They received no aid from vehicle crews in effecting first echelon repairs. As a result the demands for Ordnance Support were considerably greater than they should have been. Neglected first echelon driver maintenance resulted frequently in the need for second, third and fourth echelon maintenance that could have been minimal.

At the Integrated Combat Group level, Ordnance Support should be organized on a Components System rather than on a Spare Parts System. Components, such as carburators, fuel pumps and entire motors with harness in this study were more rapidly exchanged than the replacement of individual spare parts. When aerial maintenance of ground vehicles was used, vehicles disabled in the field were returned to action far more rapidly than under the present system of using spare parts.

Cannabilization for components of vehicles rendered unserviceable by either breakdowns or enemy action will be a necessity if maintenance requirements are to be met. Such cannabilization is feasible using teams of mechanics transported by helicopter. Damaged components should be evacuated and replaced by intact components.

(5) Radio Maintenance: A similar components system should be in effect for malfunctioning or damaged electronics equipment. In this study the average exchange time for radios was ten minutes. Travel time for repair crew was drastically shortened by the use of the H21C.

(6) Personnel Casualties and Evacuation: The number of medical personnel, 2 Medical Corps Officers and 40 enlisted personnel assigned to the Integrated Combat Group is most unrealistic.

Twenty-three company aid men would have 1251 casualties to find, tag, dress and collect in 24 hours in a rapidly moving situation over a large area, a sheer impossibility.

Five ambulances and ten men would have to move a minimum of 316 conventional weapons casualties and 242 nuclear weapons casualties requiring separate handling and special handling. The distances to air evacuation points would be long. This is another impossible task.

Two Medical Corps Officers and seven enlisted men would have 316 conventional weapons casualties and 242 nuclear weapons casualties requiring separate handling, plus numerous men or injuries and illnesses to treat, dress, administer, administrate, feed and load on aircraft.

(7) Vehicle Losses:

(a) The Blue Force vehicle losses seem extraordinarily high. A comparison of losses to conventional weapons and to nuclear weapons is of no great significance.

(b) The daily vehicle replacement requirement indicated by losses assessed in this experiment per Combat Group are so tremendous, particularly as pertains to Armored Personnel Carriers, that our national economy could not keep up with the demand.

(c) In a comparison of vehicle losses and enemy vehicle kills of Company A with a captain commanding and Company B with a major plus a staff for additional control, losses were about even, enemy kills were in favor of B type companies.

(d) Vehicle kills in the Controllability Experimen are extraordinarily high. Troops mounted in Armored vehicles are less vulnerable to nuclear weapons.

(e) The Armored Personnel Carrier, because of high silhouette and thin armor, is not a good mount for direct fire weapons. It should be regarded as a "Mobile Foxhole" and not as an offensive combat vehicle.

(8) Weapons Losses: In this study a "Total Kill" assessment on a vehicle meant the loss of the weapons mounted on or carried in the vehicle. The weapons mounted on or carried in the Armored Personnel Carrier suffered the greatest losses and required the greatest number of replacements. These were the Machine Gun, Cal .30, the 106 Recoilless Rifle and the 3.5 Rocket Launcher. Indirect fire weapons had few losses. Losses of Tank 90mm weapons were considerably less than the Armored Personnel Carrier mounted weapons.

(9) Ammunition Expenditure:

(a) In the first half of the Experimental Runs the Experimental Company Commanders stressed the use of conventional weapons to the neglect of nuclear weapons. They discovered that in Casualty Assessment armored vehicles were immune to small arms fire and indirect fire. Direct fire weapons were used increasingly and numerous direct fire nuclear weapons were used from then to the last experimental run. The use of indirect fire and small arms fire, particularly those of the experimental rifle companies, decreased. The use of artillery fire was minimal.

(b) If troops are to regard the Armored Personnel Carriers as "Mobile Foxholes" from which they will fight, then some thought should be given to a change in our weapons system. Fewer different classes of weapon at the Combat level would mean fewer types of ammunition to be stocked and shipped.

(c) Nuclear ammunition regardless of size will require special handling and shipping particularly at the Integrated Combat Group level. Transportation carriers must be devised for these weapons.

7. (C-MHA) Conclusions:

a. Logistic Support Requirements:

(1) Logistical support requirements for a PENTANA-Type Rifle Company as developed in this experiment are valid only for rations and water consumption.

(2) Validity of requirements for POL should be established by further experimentation which will separate those requirements generated solely to power non-tactical radios carried in vehicles.

(3) The expenditure rates of ammunition indicate need for further experimentation under conditions of controlled or limited use of nuclear weapons.

b. Supplementary Conclusions:

(1) First echelon (driver) maintenance of vehicles is less efficient when vehicles and drivers are attached than when they are organic to a unit.

(2) Component replacement system of maintenance for vehicles and radios, from a central source, can restore equipment to operable status quicker than present system of spare parts and organic unit maintenance.

(3) Personnel casualties within an ICG from unrestricted nuclear weapon use are beyond the capability of organic medical personnel to handle.

(4) In comparison of ton/miles aerial and surface resupply the experiment indicated that 3.5 H21C helicopters can move the equivalent tonnage carried by one 2½ ton truck in 1/6 the time. Additionally the experiment indicated that palletized loads can be picked-up and delivered by helicopter more rapidly than by ground vehicle.

SECTION II
(CONFIDENTIAL-MODIFIED HANDLING AUTHORIZED)

AERIAL RESUPPLY AND MAINTENANCE

1. Objective:

To investigate techniques of aerial resupply and maintenance of the Rifle Company.

2. General:

a. The employment of small fully mobile forces moving rapidly over wide areas of terrain, in dispersed positions on a nuclear battlefield, poses considerable problems for those responsible for logistical support.

b. The PENTANA-concept of logistical support provides a minimum of technical service personnel to perform the support mission required. A secure MSR (Main Supply Route) will not exist. Enemy troops will be able to operate between and behind friendly forces. If conventional ground support is used land trains will require security forces sufficient in size to fight their way to combat units.

c. Aerial delivery of supplies, evacuation of casualties and maintenance of all types should provide rapid support and require less personnel than surface means.

3. Operational Concepts and Techniques:

a. Night Aerial Resupply:

One platoon of each experimental company was automatically resupplied with rations, water, ammunition and POL, at night between the 4th and 5th situations of each experimental run. Night delivery is tactically secure.

b. Night Homing and Lighting System:

A night homing and lighting system was designed and fabricated to enable the platoon to act as its own pathfinder team and to enable the helicopter pilots to deliver required supply at night to exact locations at specific times with a maximum of safety. This apparatus is described in Section II, Appendix I.

c. Mobile Platform:

The Mechanical Mule M-274, was used as a mobile platform for the delivery of rations, water, ammunition and heavy maintenance parts and tools. The use of a mobile platform reduces the number of supply personnel required. At the supply point the loaded mule is picked up by the helicopter. At the platoon delivery point one man mounts the mule and drives it away. The loads do not require transfer or handling. After the delivery of a loaded mule the helicopter picks up an unloaded mule in exchange. (Appendix II to Section II)

d. Roller Fluid Transporter:

The Roller Fluid Transporter with a 500 gallon capacity was used as a Mobile POL cell. The H21C helicopter can carry it as a sling load when it contains a maximum of 300 gallons of gasoline. This amount is usually sufficient to resupply one platoon with POL. One vehicle and two men can handle it. Its pumping equipment using the exhaust of the towing vehicle can readily and rapidly force gasoline into the vehicle to be resupplied. (Appendix III to Section II)

e. Aerial Resupply:

(1) A single rifle platoon was supplied with rations, water and gasoline during the hours of darkness twice weekly using the helicopter H21C. Rations and water were loaded on the ½ Ton Mule M124. Gasoline was carried in the Roller Fluid Transporter. These were external loads carried in slings.

(2) Strength of Platoon: 28 Personnel, 5 Armored Personnel Carriers.

4. Comparison Aerial Delivery vs Ground Delivery:

In each run 196 lbs of rations, 935 lbs of water and 2175 lbs of gasoline were carried.

Platoon 1-Aerial Delivery				Platoon 2-Ground Delivery			
VEHICLES	TOTAL MILES	TOTAL MIN	POL CONSUMED	VEHICLES	TOTAL MILES	TOTAL MIN	POL CONSUMED
2 H21	30	40	110 Gal	2½ Ton Truck & Gas Tanker	36	108	10.32
"	30	60	134 "	"	35	108	10.32
"	35	70	150 "	"	38	114	10.91
"	20	60	150 "	"	22	66	6.31
"	30	60	120 "	"	36	108	10.32
"	20	65	155 "	"	22	66	6.31
"	20	60	200 "	"	22	66	6.31
"	28	60	135 "	"	32	96	9.31
"	30	60	135 "	"	36	108	10.32

Emergency POL Delivery: Several air missions carrying emergency replenishment of gasoline and oil were made and several such missions were made on the ground. In these missions the time advantage because of speed of travel was definitely in favor of air by a considerable margin.

5. Aerial Vehicular Maintenance in Comparison to Conventional Vehicular Maintenance:

a. Procedure:

The Battle Group S4, when notified by the Experimental Company Executive Officer of a vehicle breakdown, dispatched when available an H21C helicopter to the scene. The helicopter carried the necessary mechanics, component parts and tools to effect the indicated repair.

When the helicopter approached the area of the distressed vehicle, the operator threw out an ignited green smoke grenade to attract the pilot and to indicate the direction of the wind.

If aerial service was not available, the 554th Ordnance Company dispatched mechanics, tools and a wrecker. Invariably, other than simple repairs resulted in the evacuation of the vehicle to the field shop of the 554th Ordnance Company or to Fort Ord.

b. Motor Vehicle Maintenance Time, Air vs Ground, Component Replacement vs Parts Replacement: (Appendix IV to Section II)

(1) Fuel Pump Repair or Replacement:

AIR		
TRAVEL TIME	MAINT TIME	TOTAL TIME
15 min	1 hr	1 hr 15 min
28 min	45 min	1 hr 13 min
41 min	1 hr	1 hr 45 min
15 min	1 hr 30 min	1 hr 45 min

GROUND		
TRAVEL TIME	MAINT TIME	TOTAL TIME
2 hrs 10 min	2 hrs 30 min	4 hrs 40 min
3 hrs	1 hr	4 hrs
2 hrs 45 min	1 hr 20 min	4 hrs 5 min
1 hr 12 min	1 hr	2 hrs 12 min

(2) Replace Battery:

AIR		
TRAVEL TIME	MAINT TIME	TOTAL TIME
15 min	5 min	20 min
15 min	10 min	25 min

GROUND		
TRAVEL TIME	MAINT TIME	TOTAL TIME
30 min	5 min	35 min
1 hr 15 min	10 min	1 hr 25 min

(3) Replace Engine:

AIR			GROUND		
TRAVEL TIME	MAINT TIME	TOTAL TIME	TRAVEL TIME	MAINT TIME	TOTAL TIME
10 min	57 min	1 hr 7 min	2 hrs 8 min	38 hrs 30 min	40 hrs 38 min
10 min	52 min 17 sec	1 hr 2 min17sec	2 hrs 30 min	38 hrs 30 min	41 hrs
10 min	44 min 47 sec	54 min 47 sec	1 hr 10 min	38 hrs	38 hrs 10 min

(4) Replace Road Wheel:

AIR			GROUND		
TRAVEL TIME	MAINT TIME	TOTAL TIME	TRAVEL TIME	MAINT TIME	TOTAL TIME
15 min	15 min	30 min	40 min	60 min	1 hr 40 min
54 min	1 hr 26 min	2 hrs 20 min	50 min	20 min	1 hr 10 min
15 min	15 min	30 min			

(5) Replace Fuel Line:

AIR			GROUND		
TRAVEL TIME	MAINT TIME	TOTAL TIME	TRAVEL TIME	MAINT TIME	TOTAL TIME
20 min	1 hr	1 hr 20 min	1 hr 30 min	45 min	2 hrs 15 min

(6) Replace Water Hose

AIR			GROUND		
TRAVEL TIME	MAINT TIME	TOTAL TIME	TRAVEL TIME	MAINT TIME	TOTAL TIME
20 min	1 hr	1 hr 20 min	1 hr 30 min	20 min	1 hr 50 min

(7) Broken Tacometer:

TRAVEL TIME	MAINT TIME	TOTAL TIME
20 min	55 min	1 hr 15 min

TRAVEL TIME	MAINT TIME	TOTAL TIME
40 min	2 hrs	2 hrs 40 min

6. Aerial Radio Maintenance in Comparison to Ground Radio Maintenance:

General: Aerial Radio Maintenance using the helicopter H21C was employed whenever aircraft was available. In this type of maintenance like radios were exchanged. During the periods when airlift was not available radio repair crews travelled along the ground. In some cases radios were exchanged; in others the radio was evacuated to the Signal repair shop, repaired and returned.

AIR

TYPE RADIO	TRAVEL TIME	MAINT TIME	TOTAL TIME	REMARKS
RT 70	10 min	5 min	15 min	25 miles
RT 68	15 min	5 min	20 min	17 miles
RT 70	18 min	12 min	30 min	15 miles
RT 68	72 min	18 min	90 min	25 miles Wrong Direction

GROUND

TYPE RADIO	TRAVEL TIME	MAINT TIME	TOTAL TIME	REMARKS
RT 68	60 min	15 min	75 min	25 miles
RT 68	51 min	10 min	6 hrs 29 min	17 miles -6 hrs 29 min repair
RT 68	51 min	5 min	6 hrs 44 min	17 miles repair
RT 68	65 min	5 min	70 min	27 miles
RT 68	200 min	5 min	205 min	25 miles Wrong Location

7. Discussion:

a. <u>The Aircraft Homing and Night Lighting System:</u>

(1) This system designed by CDEC's Logistical Experimentation Branch of Field Operations and fabricated by the Fort Ord Signal Repair Shop, performed its intended mission in a successful manner. It was used at night in ten (10) experimental runs to deliver food, water and POL for one platoon of the Experimental Company. The designated platoons and their locations and distances from the Battle Group Supply point were varied. (Appendix I to Section II)

(2) The ARC-44 Radio in the aircraft, tuned to the same frequency as the AN/PRC-10 Radio on the ground with the platoon to be supplied, was accurate at a range of 13 miles and an elevation of 2500 feet. The Homer was activated and deactivated regularly without difficulty. The lights on the ground were activated and deactivated without difficulty.

(3) The System as presently fabricated is fragile. The coils of cables used from the control box to the ground lights give the system too much bulk and too much weight. When too many radios are in use on bands close to those being used for the Homer and the Night Lighting System, these radios when transmitting activate and deactivate the system.

b. <u>Mobile Pallet Concept:</u>

(1) The concept of a mobile pallet is a good one. The preloaded pallets as slingloads can be readily lifted by the H21C helicopter if Pallet and load do not exceed 2500 lbs and the air density is not rendered too thin by temperatures in excess of 90° F. The loads are landed with ease and without breakage at the exact

location designated. The loads once made up are delivered to the consumer without multiple handling, with an economy of manpower. Loaded Pallets can be readily driven or towed away.

(2) The ½ Ton Vehicle, M-274 "Mule": This vehicle weighing approximately 900 lbs is a good platform and can carry 1900 lbs. The H21C repeatedly lifted and delivered the "Mule" plus cargo with a gross weight of 2300 lbs. The M-274 Mule is a difficult vehicle to start. When the vehicles were carried with the motor going and the gear shift locked in place there was no difficulty. A four point suspension system would give the vehicle more stability on take off, in flight and in landing than the present 3 point suspension system.

(3) The Roller Fluid Transporter: The Roller Fluid Transporter with its built-in pumping system which uses the carbon monoxide exhaust of another vehicle is a useful POL cell. It is readily air transportable by sling and it is stable in flight. The H21C helicopter repeatedly lifted and transported this cell when the weight lift capacity of the helicopter was not exceeded. The "Transporter" is easily towed. The pumping system is highly efficient.

Its use in conjunction with the helicopter provided a rapid refueling system which was economic of personnel.

c. <u>Aerial Resupply to Isolated Units Using the H21C Helicopter:</u>

The H21C helicopter is a good cargo-carrier using either internal or external loads. It can be used to supply troops either by day or night. Units are rapidly supplied. It can serve units at a distance, five times more rapidly than can ground vehicles. It has a limited lift capacity and consumes gasoline in great quantities.

d. Vehicular Maintenance by Air:

The H21C helicopter, by rapidity of travel, considerably speeds up vehicular maintenance time. The use of components, (i.e. fuel pumps, carburetors, entire motors with harness) permits vehicular maintenance at the Integrated Combat Group level in comparatively short times and with an economy of personnel. A far shorter time is required for the replacement of components in the field than by the replacement of spare parts. It is feasible in field maintenance to evacuate components to a higher echelon of maintenance for time-consuming repairs and rehabilitation and then send these components forward as replacements.

e. Radio Maintenance by Air:

The H21C helicopter, by rapidity of travel, considerably speeds up radio maintenance. The exchange of radios can be effected with considerable saving of time over attempting to repair radios in the field. Radios can be evacuated to Signal Maintenance shops in the rear where they can be repaired and then shipped forward to Combat Group Signal Supply Points.

8. Conclusions:

a. Aerial resupply is tactically sound, avoids partisan activity and becomes more economical of time the longer the distance travelled.

b. Vehicular resupply permits multiple missions due to greater lift capacity and is far more economical in gasoline consumption.

c. Homing and Night Lighting System: The system is a good one for guiding aircraft to a rendevous point and activating lights on the ground for landing during night flights. It can be used for either rotary wing or fixed wing aircraft. The device can eliminate "Pathfinders." It is a device that could be used by isolated units and Aid Stations at night.

d. The Aircraft Homing and Night Lighting System is a good system for use at night in conjunction with supply delivery in forward areas.

e. The ½ Ton M-274 "Mule" is a good mobile platform for air lifts.

f. The Roller Fluid Transporter is a good fuel cell for air lift.

g. Aerial resupply of isolated units operating both day and night is feasible.

h. Considerable time can be saved in effecting the repair of vehicles during combat simulated conditions when maintenance crews and vehicular components are delivered to the disabled vehicle by H21C helicopter.

i. A vehicular component replacement system considerably speeds up repair time at the Integrated Combat Group level.

9. Recommendations:

a. Aircraft Homing and Night Lighting System:

(1) The system should be reconstituted so as to be impervious to jarring.

(2) The cables should be eliminated by using a small radio system in the control box attached to each light.

(3) The lights should be columned to limit visibility at a distance.

(4) Radio bands one or more bands away from other radios in the vicinity, should be used.

b. The Mobile Pallet concept of Aerial resupply merits further study with a view to extending its employment.

c. The ½ Ton Vehicle M-274 "Mule" needs a starting device. A four point suspension system would give the vehicle more stability during air lifts.

d. A helicopter more economical in fuel consumption and with a greater lift capacity would make a better cargo carrier than the H21C and should be developed.

e. Helicopters, with vehicular mechanics, should be used on the battlefield to repair disabled vehicles and cannabilize damaged vehicles.

f. Serious consideration should be given by Ordnance for a Components replacement system rather than a spare parts system in battlefield vehicular maintenance.

g. Serious thought should be given to use of helicopter for the transportation of radio repairmen and radios to forward points on the battlefield by the Signal Corps.

h. The adaptation of a radio replacement system rather than a spare parts system should be used in effecting signal repair for forward combat units.

APPENDIXES TO SECTION I

APPENDIX I TO SECTION I
RATIONS
(CONFIDENTIAL)

Calculations

QM - Ration C

1 ration feeds 1 man per day

1 case equals 6 rations

1 case weighs 38 lbs.

1 case measures 1.2 cu. ft.

COMPANY DAILY REQUIREMENTS - RATIONS

CO	WEEK	STRENGTH	CASES OF RATIONS/DAY	WEIGHT	MEASUREMENT
A	1st	265	45	1710 lbs	54 cu.ft.
A	2nd	263	44	1672 lbs	52.8 cu.ft.
A	3rd	276	46	1748 lbs	52.2 cu.ft.
A	4th	279	47	1786 lbs	56.4 cu.ft.
A	5th	292	49	1862 lbs	58.8 cu.ft.
B	1st	289	49	1862 lbs	58.8 cu.ft.
B	2nd	288	48	1824 lbs	57.6 cu.ft.
B	3rd	262	44	1672 lbs	52.8 cu.ft.
B	4th	279	47	1786 lbs	56.4 cu.ft.

COMBAT GROUP DAILY REQUIREMENT

PERIOD	STRENGTH	CASES OF RATIONS	WEIGHT	MEASUREMENT
DAY	1279	214	8132 lbs	256.8 cu.ft.
WEEK	8953	1493	56734 lbs	1791.6 cu.ft.

APPENDIX II TO SECTION I
WATER
(CONFIDENTIAL)

Calculations

Allowance 3 gallons per man per day

5 gallon can of water equals 50 lbs

COMPANY DAILY REQUIREMENTS

CO	WEEK	STRENGTH	GALLONS	5 GAL CANS	WEIGHT	250 GAL TRAILER
A	1st	265	795	159	7950 lbs	3+
A	2nd	263	789	158	7900 lbs	3+
A	3rd	276	828	166	8300 lbs	3+
A	4th	279	837	168	8400 lbs	3+
A	5th	292	876	175	8800 lbs	3+
B	1st	289	867	174	8700 lbs	3+
B	2nd	288	864	173	8650 lbs	3+
B	3rd	262	786	158	7900 lbs	3+
B	4th	279	837	168	8400 lbs	3+
B	5th	291	873	175	8750 lbs	3+

COMBAT GROUP DAILY REQUIREMENT

PERIOD	STRENGTH	5 GAL CANS	WEIGHT	250 GAL TRAILER LOADS
DAY	1279	768	39,400 lbs	16
WEEK	8953	5372	268,600 lbs	108

APPENDIX III TO SECTION I

POL

(CONFIDENTIAL-MODIFIED HANDLING AUTHORIZED)

Total Vehicle Use

Experimental Companies

Type	Number	Mileage	Gas	Mi/gal	Qts Oil
¼ Ton	292	19,941	6,189	3.22	46
M59 APC	601	27,781	37,614	0.738	491
M84 APC	160	8,046	10,950	0.734	66
M52 SP	80	2,131	6,566	0.324	22
M48 Tank	98	3,307	12,522	0.264	3

Total Vehicle Use

Support Group

Type	Number	Mileage	Gas	Mi/gal	Qts Oil
¼ Ton	55	3,176	536	5.94	14
2½ Ton	110	7,262	2,675	2.71	16
3/4 Ton	40	2,394	672	3.56	5
2000 gal Tanker	35	5,066	1,031	4.89	4
6 ton Retriever	2	64	121	0.537	0

Under the term number is listed the total number of vehicle missions for the entire experiment.

POL Daily Requirements Experimental Co.

Type	Number	Mileage	Gas	Mi/gal	Qts Oil
¼ Ton	15	100	465	3.22	3
M59 APC	35	100	4800	0.73	22
M84 APC	8	100	1041	0.73	2
M52 SP	4	100	1238	0.325	2
M48 Tank	5	100	1852	0.27	3

APPENDIX IV TO SECTION I

(CONFIDENTIAL)

APPENDIX IV TO SECTION I

PERSONNEL CASUALTY ASSESSMENT BY WEAPONS

Blue versus Red. Blue evacuation requirements

Strengths:	Co A	269
	Co B	285

CO A, 6 & 7 MAY 1958

	BLUE					RED		
SIT	NUCL	CONV	TOTAL	IMM EVAC	DEL EVAC	NUCL	CONV	TOTAL
1		41	41	10	10	42	27	69
2	21	13	34	6	8	32	22	54
3	22	42	64	15	16		10	10
4								
5	22		22	3	6	10	10	20
6	73	17	90	16	23	24	8	33
7	2	34	36	10	8	2	80	82
TOT:	140	147	287	60	71	110	158	268

CO B, 8 & 9 MAY 1958

1	13	44	57	13	14	33	5	38
2	31	29	60	12	15	35	55	90
3	42	79	121	27	31	23	60	83
4								
5	32	14	46	9	12		41	41
6	9	65	74	18	18	98	18	116
7	45	37	82	16	21	84	53	137
TOT:	172	268	440	95	111	273	232	505

CO A, 20 & 21 MAY 1958

1	64	88	152	32	39	88	8	96
2	20	74	94	22	24	15	30	45
3	90	20	110	19	12	3	57	60
4								
5	34	24	58	12	15	114	46	160
6	85	100	185	40	47	81	2	83
7	64	33	97	18	25	24	27	51
TOT:	357	339	696	143	162	325	170	495

CO B, 22 & 23 MAY 1958

				BLUE			RED	
SIT	NUCL	CONV	TOTAL	IMM EVAC	DEL EVAC	NUCL	CONV	TOTAL
1	102	104	206	42	53	38	54	92
2	28	74	102	23	26	31	96	127
3	14	36	50	11	13	57	149	206
4								
5	34	24	58	11	15	102	161	263
6	118	87	205	29	53	66	66	132
7	28	6	34	6	9	59	58	117
TOT:	324	331	655	122	169	353	584	937

CO B, 3 & 4 JUNE 1958

1	57	59	116	23	30	59	11	70
2	50	41	91	18	23	89	60	149
3	8	119	127	30	32	6	101	107
4								
5	61	86	147	19	25	35	75	110
6	107	46	153	28	39	74	5	79
7	18	12	30	6	8	138	18	156
TOT:	301	363	664	124	157	401	270	671

CO A, 5 & 6 JUNE 1958

1	6	83	89	22	23	93	2	95
2	55	25	80	15	20	74	6	80
3	19	95	114	27	29	61	54	115
4								
5	47	24	71	14	18	44	44	88
6	35	93	128	29	32	79	5	84
7	3	6	9	3	2	77	69	146
TOT:	165	326	491	110	124	428	180	608

CO B, 30 JUNE & 1 JULY 1958

	BLUE					RED		
SIT	NUCL	CONV	TOTAL	IMM EVAC	DEL EVAC	NUCL	CONV	TOTAL
1	44	52	96	20	24	113		113
2	58	68	126	26	32	80	85	165
3	60	52	112	23	29	150	18	168
4								
5	55	42	97	20	25	67	74	141
6	101	60	161	31	41	49	22	71
7	89	14	103	28	27	91	50	141
TOT:	407	288	695	148	178	550	249	799

CO A, 2 & 3 JULY 1958

1	78	34	112	21	29	102	18	120
2	62	58	120	24	31	122	24	146
3	123	87	210	42	54	101	12	113
4								
5	89	14	103	18	27	130	13	143
6	77	101	178	26	45	138	16	154
7	111	44	155	28	40	63	69	132
TOT:	540	338	878	159	226	656	152	808

CO A, 15 & 16 JULY 1958

1	72	70	142	29	36	96	18	114
2	36	56	92	20	23	20	124	144
3	94	72	166	31	41	45	105	150
4								
5	44	29	73	14	19	18	78	96
6	82	123	205	44	52	122	5	127
7		22	22	5	5	66	74	140
TOT:	328	372	700	143	176	367	404	771

CO B, 17 & 18 JULY 1958

	BLUE					RED		
SIT	NUCL	CONV	TOTAL	IMM EVAC	DEL EVAC	NUCL	CONV	TOTAL
1	116	86	202	40	31	76		76
2	92	38	130	25	34	122	35	157
3	22	118	140	33	44	55	26	81
4								
5	55	24	79	15	20	97	70	167
6	83	120	203	43	52	126	3	129
7	25	26	51	11	13	62	93	155
TOT:	393	412	805	167	194	538	227	765

d. Total Casualty and Evacuation Requirements:

	BLUE					RED		
	NUCL	CONV	TOTAL	IMM EVAC	DEL EVAC	NUCL	CONV	TOTAL
A	140	147	287	60	71	110	158	268
B	172	268	440	95	111	273	232	505
A	357	339	696	143	162	325	170	495
B	324	331	655	122	169	353	584	937
B	301	363	664	124	157	401	270	671
A	165	326	491	110	124	428	180	608
B	407	288	695	148	178	550	249	799
A	540	338	878	159	226	656	152	808
A	328	372	700	143	176	367	404	771
B	393	412	805	167	194	538	227	765
TOT:	3127	3184	6311	1271	1568	4001	2626	6627

APPENDIX V TO SECTION I
(CONFIDENTIAL)

1. The Integrated Combat Group has a strength of 1279 using the factors for Casualty assessment outlined in Section I, Page 7 & 8, par (2)(a) and (b), thus of 1390 casualties:

(a) Conventional weapons casualties:

Dead or dying	175
Immediate evacuation	174
Delayed evacuation	174
Returned to duty	175

(b) Nuclear weapons casualties:

Dead or dying	249
Immediate evacuation	111
Delayed evacuation	180
Returned to duty	152

2. The Integrated Combat Group has an assigned Medical Platoon with a strength of 2 Medical Corps Officers and 40 enlisted men.

3. The air evacuation requirements of 285 patients for immediate evacuation and 354 patients for delayed evacuation are prodigious.

APPENDIX VI TO SECTION E
(CONFIDENTIAL)

Comparison in Vehicle Losses Blue and Aggressor Forces, Conventional and Nuclear Fire

		BLUE FORCES				AGGRESSOR FORCE			
UNIT	DATE	¼TON	M52SP	APC	TANK	¼TON	2½TON	APC	TANK
A	6-7 May	1		20	3	3		13	10
B	8-9 May	6		39	11	4		29	17
A	20-21 May	7	4	49	6	24		29	15
B	22-23 May	4		50	1	27		55	30
B	3-4 June	9	2	42	5	10	1	29	12
A	5-6 June	12		41	6	45	1	69	21
B	30 June 1 July	9	3	56		15		22	15
A	2-3 July	9	1	49	6	8		12	10
A	15-16 July	9		55	8	21		37	22
B	17-18 July	17		63		15		19	15
TOTAL:		83	10	464	46	172	2	314	167

APPENDIX VI TO SECTION I (CONT)
(CONFIDENTIAL)
NUCLEAR WEAPONS

		BLUE FORCES				AGGRESSOR FORCE			
UNIT	DATE	¼TON	M52SP	APC	TANK	¼TON	2½TON	APC	TANK
A	6-7 May	7		20	5	4		11	2
B	8-9 May			34	1	5		25	18
A	20-21 May	21		50	5	25	1	44	31
B	22-23 May	16		45	2	17		33	17
B	3-4 June	9		30	5	24		40	20
A	5-6 June	12	4	27	3	38	1	54	6
B	30 June 1 July	19		56	7	25	1	55	15
A	2-3 July	24	3	77	6	37	1	64	23
A	15-16 July	12	4	36	4	16		42	19
B	17-18 July	12	2	54	9	29	1	53	18
TOTAL:		132	13	429	47	220	5	421	169

APPENDIX VII TO SECTION I
(CONFIDENTIAL)

Comparison of Experimental Companies

1. Co A - Captain Commanding

2. Co B - Major Commanding with 1 Staff Officer

CO A VEHICLE LOSSES				
VEHICLE	¼TON	M52	APC	TANK
Conventional	38	5	214	29
Nuclear	76	11	210	23
TOTAL:	114	16	424	52

ENEMY VEHICLE KILLS			
¼TON	2½TON	APC	TANK
101	1	160	78
120	3	215	81
221	4	375	159

CO B VEHICLE LOSSES				
VEHICLE	¼TON	M52	APC	TANK
Conventional	45	5	250	17
Nuclear	56	2	219	24
TOTAL:	101	7	469	41

ENEMY VEHICLE KILLS			
¼TON	2½TON	APC	TANK
71	1	154	89
100	2	206	88
171	3	360	177

APPENDIX VIII TO SECTION I
(CONFIDENTIAL-MODIFIED HANDLING AUTHORIZED)

Ammunition Expenditure

UNIT	DATE	RIFLE	MG 30 Cal	TANK 90mm	MORTIZER	MORTAR	106	DART	3.5 RL
A	6-7 May	1900	30,000	8	2588	280	13	24	216
B	8-9 May	9620	10,000	48	1088		34	10	76
A	20-21 May	9600	19,000	1	1528	48	15	46	7
B	22-23 May	500	16,000	50	666	40	39	19	14
B	3-4 June	5000	1,600	18	232		41	26	19
A	5-6 June	5000	10,000	33	1180		21	16	22
B	30Jun 1July	550	10,000	38	142		80	9	10
A	2-3 July	9600	19,000	6	998		30	12	22
A	15-16 July			43	1143		49	11	43
B	17-18 July			32	108		66	10	16
TOTAL:		41,770	115,600	277	9,673	368	388	183	447
WT IN LBS:		2,309	7,540	16,541	203,196	25,760	23086	10948	7897

APPENDIX IX TO SECTION I
(CONFIDENTIAL)

Three day basic load per ICG - Conventional Ammunition

	RIFLE	30 Cal MG	90mm TANK	MORTIZER	MORTAR 4.2	106	DART	3.5 RL
ROUNDS	24,156	69,360	168	10,608	216	264	108	264
WEIGHT IN LBS	1,365	4,060	9,996	222,768	15,120	15,708	7,140	4,770

APPENDIX X TO SECTION I

(CONFIDENTIAL-MODIFIED HANDLING AUTHORIZED)

Co A, 6-7 May 58

Breakdown	M-59 -84	M-52	M-48	¼ Ton	Ech Maint	Breakdowns	M-59 -84	Ech Maint
Carburetor	1				3	Dead Battery	1	1
Leaky Radiator	1				3	Broken Track	1	3
Oil Leak	1				3	Rear Main Bearing	1	3
Fuel Pump	1				2	Dead Battery	1	1
Motor,Mount Broken	1				3	Thrown Track	1	1
Engine Idler	1				3	Broken Gas Line	1	3
Engine Exchange	1				3	Broken Pulley Fan Belt	1	1
Thrown Track	1				1	Fuel Pump	1	1
Dirty Fuel Filter	1				1	Replace Engine	1	3
Manifold Broken	1				3	Gen. Bearing	1	3
Frozen Shocks	1				3	Ech. Maint		

TOTAL VEHICLES:	27 APC's		
Ech. Maint:	1st	2nd	3rd
	6	6	15

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co B, 8-9 May 58

Breakdown	M-59 -84	M-52	3/4 Ton	M-48	Ech Maint	Breakdown	M-59 -84	$\frac{1}{4}$ Ton Ech Maint
Voltage Reg.			1		3	Hydo Lock	1	3
Dead Battery	1				1	Thrown Track	1	1
Thrown Track	1				1	Gen Out	1	3
Replace Engine	1				3	Gen Out	1	3
Fuel Pump	1				2			
Engine Trouble	1				3			
Broken Water Hose	1				3			
2 Batt-1 Voltage Reg Points	1				3			
Right Engine Out	1				3			
Left comp Idler	1				3			
Final Dr.Malfunction	1				3			
Battery	1				1			
Left, Spindle	1				3			
Fuel Pump	1				2			

TOTAL VEHICLES: 1 - 3/4 Ton
17 - APC's

Ech. Maint:	1st	2nd	3rd
	3	2	12

APPENDIX X TO SECTION I (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co A, 20 - 21 May 58

Breakdown	M-59-84	M-52	3/4 Ton	M-48	Ech Maint	
Fuel Pump	1				2	
Frozen Drive	1				3	
Broken Track	1				3	
Thrown Spindle	1				3	
Broken Track Wheel	1				3	
Right Engine	1				3	
Engine Overheated	1				3	
Both Tracks Off	1				1	
Rtn to Ord-Engine	1				3	
Broken Fan Belt	1				1	
Left Engine Missing	1				3	
To be Towed in (Unk)	1				3	
Left Engine Heat	1				3	
Road Wheel	1	1			3	
Steering Control	1	1			3	

TOTAL VEHICLES: 15 - APC's
2 - M-52

Ech. Maint:	1st	2nd	3rd
	2	1	12

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co B, 22 - 23 May 58

Breakdown	M-59-84	M-52	3/4 Ton	M-48	Ech Maint	
Dead Battery	1				1	
Engine Trouble	1				3	
Engine Trouble	1				3	
Thrown Tracks	1				1	
Lost Road Wheel	1				1	
Fuel Pump	1				2	
Thrown Track	1				1	
Water Hose	1				1	
Control Differential	1				3	
Stuck Track Off	1				1	

TOTAL VEHICLES: 10 APC's

Ech. Maint:	1st	2nd	3rd
	6	1	3

APPENDIX X TO SECTION I (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co B, 3-4 June 58

Breakdown	M-59-84	M-52	3/4 Ton	M-48	Ech Maint	
Both Engines	1				3	
Broken Rod	1				3	
One Engine Out	1				3	
Dead Battery	1				1	
Will Not Start	1				3	
Fuel Pump	1				2	
Unk, In Accident	1				3	
Unk, In Accident	1				3	
Motor Out	1				3	
Dead Battery	1				1	
Fuel Pump	1				2	
Carburetor	1				3	
Overheated	1				3	
Thrown Tracks	1				1	
Thrown Tracks	1				1	

TOTAL VEHICLES: 15 - APC's

Ech. Maint:	1st	2nd	3rd
	4	2	9

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co A, 5-6 June 58

Breakdown	M-59 -84	M-52	¼ Ton	M-48	Ech Maint	Breakdown	M-59 - ¼ Ton	Ech Maint
Transmission Trouble	1				3	Spark Plug	1	3
Stopped up Fuel Line	1				3	Spark Plug	1	3
Driver Trouble	1				3	Engine Stopped	1	3
Unknown	1				3	Engine Stopped	1	3
Joint of Final Drive	1				3	Thrown Track	1	1
Thrown Track - Bad Engine	1				3	Dead Battery	1	1
Need Oil-To be moved	1				3	Fuel Pump	1	2
Thrown Track	1				1	Engine Trouble	1	3
Generator	1				3	Thrown Track	1	1
Thrown Track	1				1	Broken Rd Wheel	1	1
Sleeve Cable Dead Battery	1				3	Left Eng Trouble	1	3
Engine	1				3	Dead Battery	1	1
Generator	1				3	Broken Down	1	3

(Continued on next page)

APPENDIX X TO SECTION I (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co A, 5-6 June 58 (Continued)

Breakdown	M-59 -84	M-52	¼ Ton	M-48	Ech Maint	Breakdown	M-59 - ¼ Ton	Ech Maint
Compensator Idler	1				3	Broken Down	1	3
Spark Plug			1		3	Spark Plug	1	3

TOTAL VEHICLES:	26 - APC's 4 - ¼ Ton		
Ech Maint:	1st	2nd	3rd
	7	1	22

TOTAL VEH. 26 APC's, 4 - ¼ Ton. ECH. MAINTENANCE = 1st 7, 2nd, 1, 3rd - 22.

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co B, 30 Jun - 1 Jul 58

Breakdown	M-59 -84	M-52	¼ Ton	M-48	Ech Maint	Breakdown	M-59 - 84	Ech Maint
Tachometor	1				3	Fan Belt	1	1
Cracked Oil Pan	1				3	Water Hose	1	1
3 Nuts for Idler Plug for Rd Wheel	1				3			
Thrown Tracks	1				1			
Thrown Tracks	1				1			
Gasket Fuel Filter	1				3			
Fuel Pump	1				2			
Points			1		3			
Bad Track Connections	1				1			
Gas Leak	1				3			
Broken Fuel Line	1				3			
Broken Water Hose	1				1			
Fuel Gasket	1				3			
Loss 2 Screws	1				3			
Breather Pipe	1				3			

TOTAL VEHICLES:	16 - APC's 1 - ¼ Ton		
Ech Maint:	1st	2nd	3rd
	6	1	10

APPENDIX X TO SECTION I (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co A, 2 - 3 July 58

Breakdown	M-59 -84	M-52	3/4 T	M-48	Ech Maint	Breakdown	M-52 - 59	Ech Maint
Broken Tachometor	1				3	Overheating	1	3
Won't Start	1				3	Rep Cooler Assy	1	3
Dirt in Fuel Line	1				3	Oil Line Broken	1	3
Right Engine	1				3	Rocker Arm	1	3
Leak in Carburetor	1				3			
Broken Gear Shift	1				3			
Engine Trouble	1				3			
Fuel Pump	1				2			
Fuel Pump	1				2			
Engine	1				3			
Engine Trouble	1				3			
Gear Shift	1				3			
Road Wheel	1				1			
Broken Gear	1				3			
Broken Water Hose	1				1			

TOTAL VEHICLES:	18 - APC's 1 - M-52		
Ech Maint:	1st	2nd	3rd
	2	2	15

APPENDIX X TO SECTION I (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co A, 15 - 16 July 58

Breakdown	M-59 -84	M-52	3/4 T	M-48	Ech Maint
Rod Going Out	1				3
Thrown Rod	1				3
Leak Trouble	1				3
Differential Trouble	1				3
Gen. Engine Trouble	1				3
Gen. Trouble	1				3
Idler Wheel Link	1				3
Idler Comp Leak	1				3
Dead Battery	1				1
Fuel Pump	1				2
Gear Shift Lever	1				3
Rock in Road Wheel	1				1
Rt Eng Throwing Oil	1				3
Engine Trouble	1				3
Gen. Trouble	1				3

Breakdown	M-52, 59	¼T	Ech Maint
Gas Tank Leakage		1	3
Battery boiled over	1		3
Spark Plugs Right Engine Out	1		3
Spinning Cable R.P.M. Gauge	1		3
Both Engs heating	1		3
Fuel Pumps	1		2
Gasket for fuel pump	1		2
Unknown	1		3
Tire off wheel disk	1		3
Fuel Pump Failure	1		2
Thrown Track	1		1
Fuel Line Trouble	1		3
Dead Battery	1		1

TOTAL VEHICLES: 26 - APC's
1 - M-52
1 - ¼ Ton

Ech Maint:	1st	2nd	3rd
	4	4	20

APPENDIX X TO SECTION I (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co B, 17 - 18 July 58

Breakdown	M-59	M-52	3/4 T	M-48	Ech Maint
Distributor Trouble	1				3
Engine Out	1				3
Dead Battery	1				1
Unk, Must be recovered	1				3
Carb. Trouble	1				3
Eng. bad-throwing oil	1				3
Breather Trouble	1				3
Mech. Trouble	1				3
Fuel Pump	1				2
Unk, must be recovered	1				3

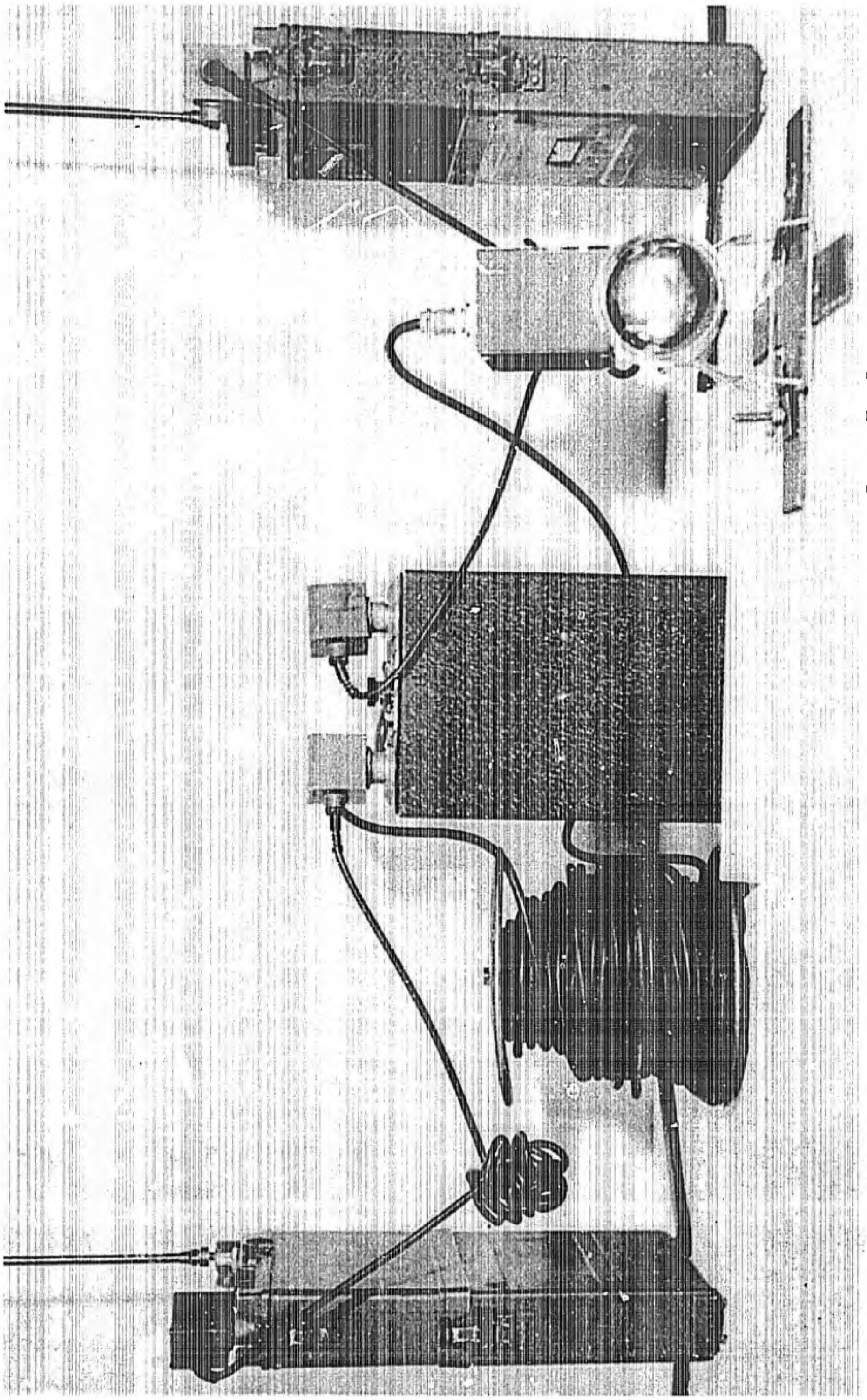
TOTAL VEHICLES: 10 - APC's

Ech Maint:	1st	2nd	3rd
	1	1	8

APPENDIX X TO SECTION I (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

APPENDIXES TO SECTION II



APPENDIX I TO SECTION II
(CONFIDENTIAL-MODIFIED HANDLING AUTHORIZED)

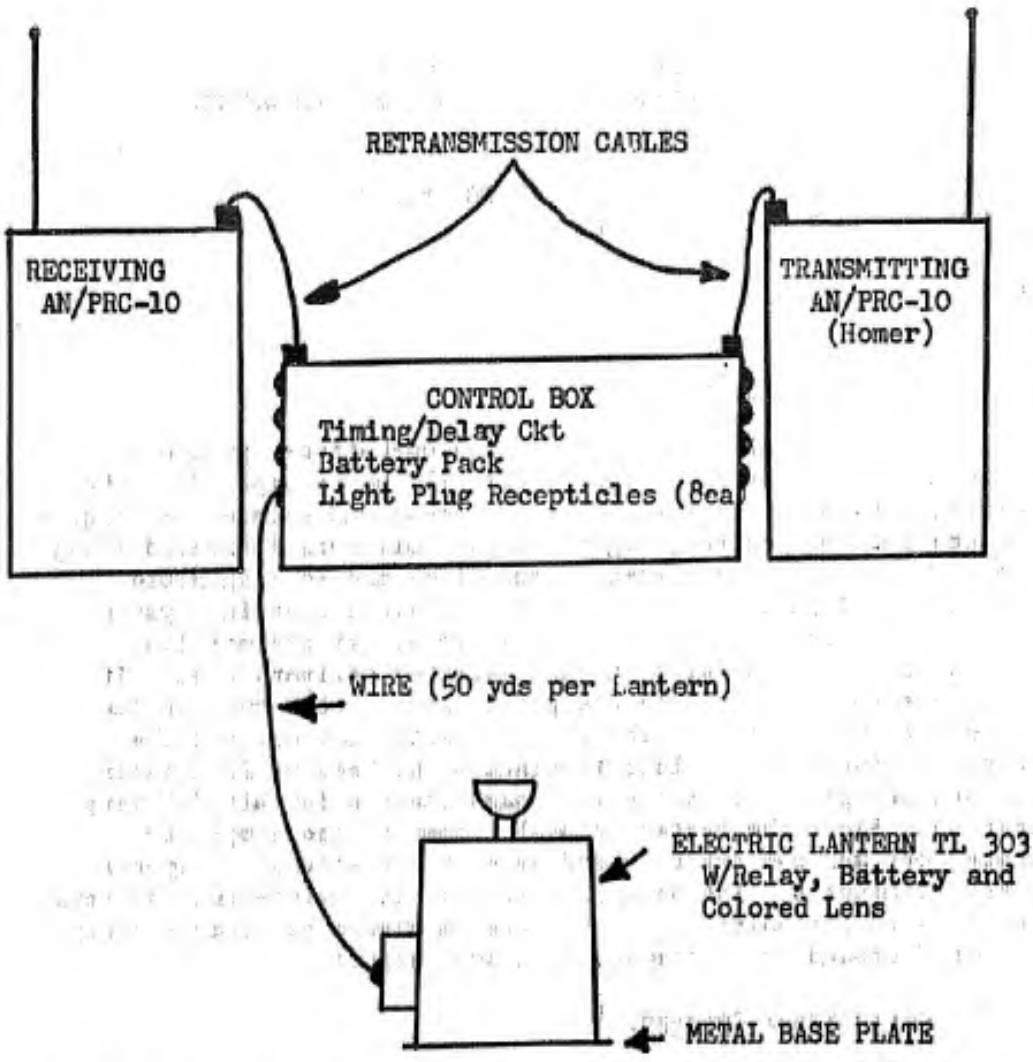
AIRCRAFT HOMING AND NIGHT LIGHTING SYSTEM
FOR USE IN FIELD OPERATIONS

1. Statement of Requirement:

It is visualized that in future operations, ground units down to and including squad size units will be resupplied on the battlefield by air. In testing this concept and related techniques using the H21C Helicopter, night resupply missions delivered sling loaded "Mules" (rations, water, ammunition) and Rolking Fluid Transporters of gasoline. The Homing and Night Lighting System was designed, constructed and utilized to assist the mission. This system guides the pilot to the selected delivery area. It enables him to activate both the ground lights that outline the selected delivery area and the ground lights that outline the selected delivery spot. This eliminates the need of Pathfinder personnel and ground-to-air voice communication for air delivery operation. Since the system is small, compact and simple to operate, one man can erect it and have it operational in approximately 10 minutes. The design, operation and maintenance aspects were based on the opinion that the system should be organic equipment for a ground unit (company size and larger).

2. Operational Concept:

The Homing and Lighting System consists of two (2) AN/PRC 10 radios with retransmission cables, one (1) control box, and eight (8) TL-303 electric lanterns with spools of wire to connect to control box outlets. (Figure 1) Upon selection of the delivery area, the lights are set out and connected to the control box, as are the two radios. The individual who does this may depart after turning the two radio and control box switches to the "on" position, since the pilot will control the system from the aircraft until mission is completed. The two (2) AN/PRC-10 radios, being adjusted to different frequencies, receiving and homing, must be connected to the control box correctly. Proper connection is indicated on the box by letters "R" and "T." The control box has



SYSTEM COMPONENTS AS IN USE NOW:

1. AN/PRC-10 Radios - 2 ea
2. Control Box - 1 ea
3. Electric Lantern - 8 ea
4. Lantern Cords - 8 ea

FIGURE I

a time delay dial that can be set from 1 to 25 seconds adjustment. This time delay system prevents other radio signals of the same frequency from accidently activating the system. The pilot, knowing the two radio frequencies and general location of delivery area, departs from supply point. When within radio operating range, he tunes the aircraft radio (ARC/44) to the frequency of the receiving AN/PRC-10 radio in the system (example: 38.9 m.c.), and presses the microphone button for 25 seconds. This carrier signal from the helicopter is picked up by the receiving AN/PRC-10 radio and passed to the control box, via retransmission cable, which through the second retransmission cable activates the "Homer" AN/PRC-10 radio on its frequency (example: 45.7 m.c.). The pilot retunes the aircraft radio (ARC-44) to the frequency of the "Homer" AN/PRC-10 (i.e. 45.7 m.c.) and turns the ARA/31 keyer on. (This is part of the ARC/44 radio system.) The keyer has now taken the silent carrier signal and converted it into an aural one, which the pilot hears, orients himself, and follows to the delivery area. Over the area, the pilot retunes his radio to the receiving AN/PRC-10 radio (38.9 m.c.) and presses his microphone button for 25 seconds. This will turn off the Homer radio. Pressing the microphone button again will turn the ground lights on (if needed). After delivery is made and aircraft departs area, the pilot presses his microphone button to turn ground lights off. The entire operation has been without voice or signal that could be detected by enemy countermeasure.

3. Equipment:

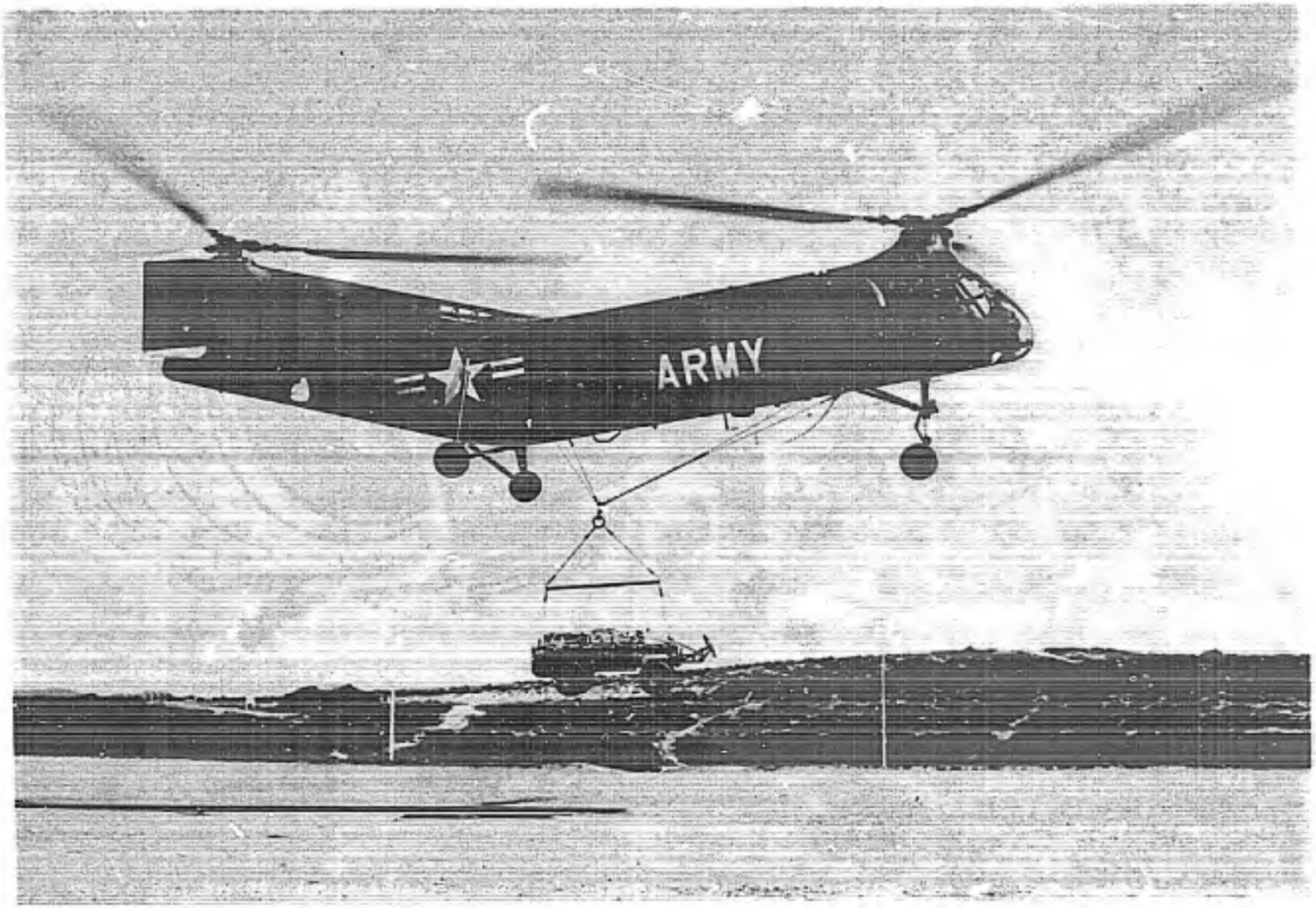
The two (2) AN/PRC-10 radios are as manufactured and have not been modified. The control box was manufactured locally and uses five (5) BA-200 dry cell batteries in series to operate the electric lantern relays and two (2) BA-270 dry cell batteries to activate the ratchet relay. The eight (8) TL-303 electric lanterns have been modified with a relay switch, but are otherwise unchanged. The bulbs of the lanterns are colored to give the pilot landing instructions by their arrangement on the ground. There are two (2) red, three (3) green, one (1) amber, and two (2) blue lanterns. Arrangement of the lights on the ground with the green at one end, red at opposite end, amber in center and forward of red, and blue on each side renders the zone color-marked. The pilot makes his approach over green light toward amber and terminates in front of amber. He releases load, does a hovering 180°

turn and departs from area over green lights. The lights are not for illumination to aid the pilot in seeing the ground, but to indicate the delivery site. It has been found that the blue lights, intended to denote width of delivery zone, can be taken out of the system since the arrangement of the red and green lights in a line can accomplish this.

4. Organizational Concept:

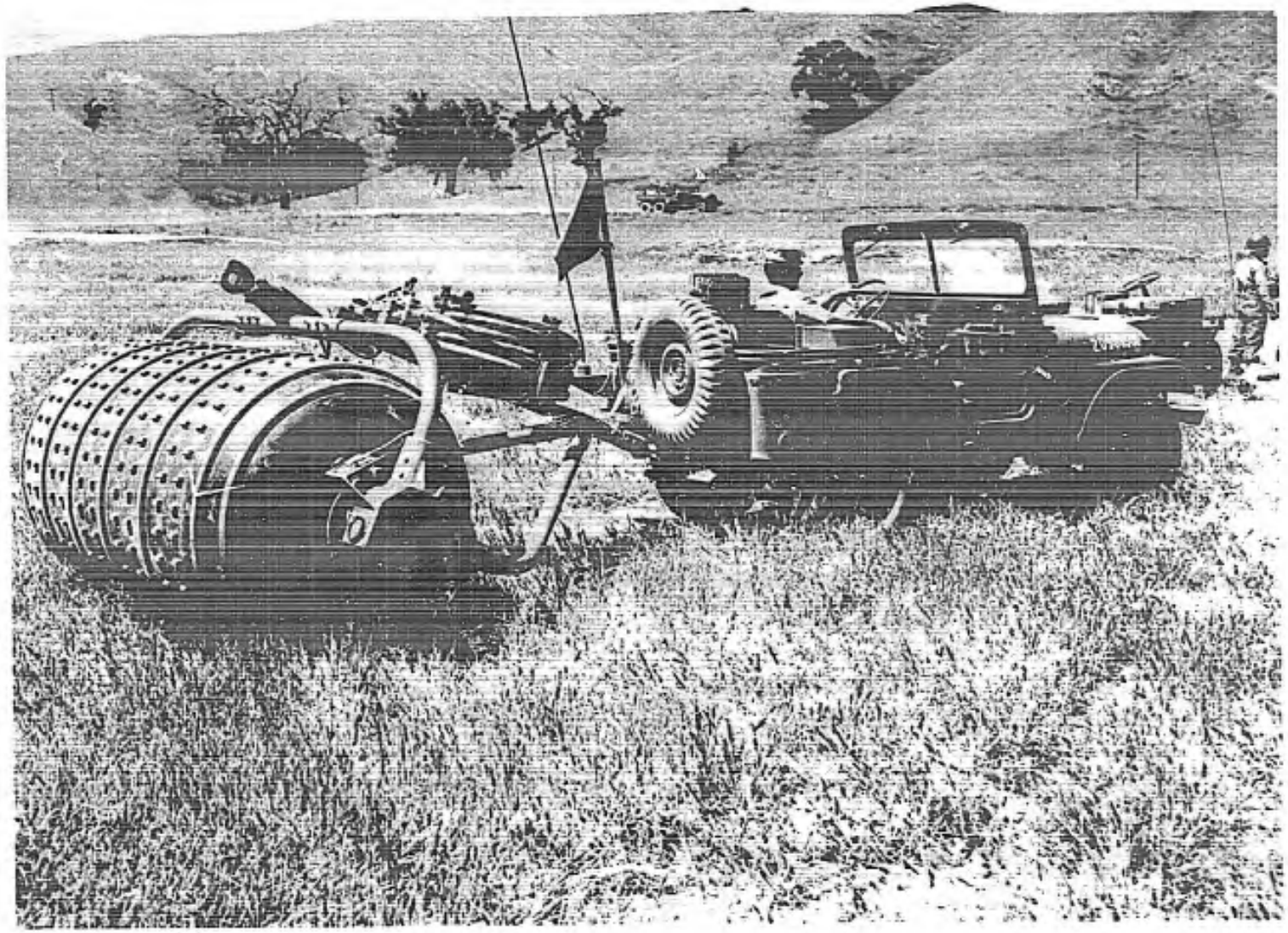
The Homing and Night Lighting System was designed to be organic equipment for the ground unit (company size and larger). It is visualized that the system can be used in many ways--by Medical Corps at battlefield aid station in evacuating wounded by air; by ground units for resupply; by air sections for Heliport operation and at supply points, to mention a few.

APPENDIX II TO SECTION I



Mobile Platform ("Mule")

APPENDIX III TO SECTION I



Fluid Roller Transport

APPENDIX IV TO SECTION II

(CONFIDENTIAL-MODIFIED HANDLING AUTHORIZED)

6 - 7 May 58

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
30	Carburetor	1135	1325		1 Hr 5 Min	45 Min		1 Hr 50 Min	2.4	
40	Leaky Radiator	1135	1322		1 Hr 5 Min	45 Min		1 Hr 50 Min	20	
36	Oil Leak	1135	1355		50 Min	1 Hr 30 Min		2 Hr 20 Min	20	
4	Fuel Pump	1225	1705		2 Hr 10 Min	2 Hr 30 Min		4 Hr 40 Min	18	
18	Motormount Broken Eng	1525	1825		Wrecker	1 Hr		4 Hr	30.5	3 hr wait for wrecker.
16	Eng. Idler	1520	1750		1 Hr 40 Min	50 Min		2 Hr 30 Min	21	
28	Engine Out	1720	1950		2 Hr 30 Min	38 Hr 30 Min		Towed to Tule 41hr	27	Engine Exchange
37	Thrown Track	1720	1945		1 Hr 55 Min	30 Min		2 Hr 25 Min	21	
11	Dirty Fuel Filter	2010	2315		2 Hr 5 Min	1 Hr		3 Hr 5 Min	20	
16	Manifold	2010	1100		1 Hr 45 Min	60 Min		13 Hr 55 Min	22	Awaiting Parts
47	Frozen Shocks	2040	2245		1 Hr 5 Min	1 Hr		2 Hr 5 Min	29	
5	Voltage Reg.	0845	0950	50 Min		15 Min	1 Hr 5 Min		18	Fan Belt Off
42	Dead Battery	0800	0820	15 Min		5 Min	20 Min		20	
15	Fuel Pump	0845	1000	15 Min		1 Hr	1 Hr 15 Min		16.5	

APPENDIX IV TO SECTION II

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

6 - 7 May 58 (Cont'd)

MAINTENANCE TIME AIR vs GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
45	Fuel Pump	0845	0958	28 Min		45 Min	1 Hr 13 Min		34	
33	Dead Battery	0935	0950	10 Min		5 Min	15 Min		16	
6	Broken Track	0935	1110		1 Hr 5 Min	30 Min		1 Hr 35 Min	33	
39	Rear Bearing Main	0953	1200					2 Hr 7 Min	14	
35	Dead Battery	1240	1305	15 Min		10 Min	25 Min		16	
36	Thrown Track	1240	1334		1 Hr 36 Min	30 Min		2 Hr 6 Min	32	
	Man Injured	1435	1444	9 Min	Air evacuation of casualty					
7	Broken Gas Line	1753	1930		1 Hr 17 Min	20 Min		1 Hr 37 Min	25.5	
1	Broken Pulley Fan Belt	1840	1855	15 Min		30 Min	45 Min		20	
15	Fuel Pump	1940	2340		3 Hr	1 Hr		4 Hr	30	3 Hrs to Locate
34	Carburetor	1945	2245					3 Hr	31	
45	Fuel Pump	1945	2350		2 Hr 45 Min	1 Hr 20 Min		4 Hr 5 Min	28	
17	Replace Eng	2018			2 Hr 8 Min	38 Hr 30 Min		40 Hr 38 Min	32	Rep Deadline 12-5-58

On level Grd - 30 Min to replace thrown track - information rec from 554 Ord
Fuel Pumps - 1 Hr
Idler - 6 Hrs

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

6 - 7 May 58 (Cont'd)

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
33	Gen Bearing	1830	2400 1130		2 Hr 12 Min	2 Hr		4 Hr 12 Min	33	Deadline 11 Hr, 30 Min
20	Stuck	1425	1640					2 Hr 15 Min	33	
6	Stuck	2040	2245					2 Hr 5 Min	36	
42	Request Gas	0705	0828		1 Hr 10 Min			1 Hr 33 Min	17	
7	Stuck	0937	1150					2 Hr 10 Min	25	
H21	Logistic Resupply	0530 0545	III I	20 Min 20 Min				for rifle plt	17	POL 200 Gal Water, Rat
Tanker Resupply		1815						2 Hrs 30 Min	17	3000 Gal POL

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

8 - 9 May 58

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
3/4T	Bat. Distr Volt Reg.	0840	1010		None	1 Hr 30 Min		1 Hr 30 Min	0	To Tule Biv.
29	Dead Battery	1050	1140		30 Min	5 Min		35 Min	7.5	
10	Thrown Track	1122	1352		2 Hr	30 Min		2 Hr 30 Min	19.5	
17	Eng Trouble	1210			2 Hr 30 Min	38 Hr 30 Min		Evac 41 Hr		Replaced Engine
15	Fuel Pump	1619	1700	41 Min		1 Hr			29	Couldn't Locate
3	Eng Trouble	1610	1700	40 Min		10 Min	50 Min		28	
3	Broken Water Hose	1908	2040		2 Hr 24 Min	20 Min		2 Hr 44 Min	21	
¼T	2 Bal 1 Volt Reg Points	2040	2130					Evac 50 Min	18	No Parts
24	Rt Eng Out need rep veh	2140	2210		1 Hr 10 Min	38 Hr		38 Hr 10 Min	17	APC was replaced
51	Left Comp Idler	2320			2 Hr	6 Hr		8 Hr	19	Ord Evac 9/5/58
6	Malfunction Final Dr.	1700	2320		2 Hr 30 Min	3 Gr 50 Min		6 Hr 20 Min	27	Evac
42	Need Gas 2 Batt	1030	1115		35 Min	10 Min		45 Min	8	
10	Left Spindle	1143	1800		1 Hr 42 Min	4 Hr 25 Min		6 Hr 17 Min	17	Grd Evac Retriever

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

8 - 9 May 58 (Cont'd)

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
23	Needs Replacement	1530		Replaced				2 Hr	18.5	Gas
13	Needs gas Fuel Pump	1145	1205		20 Min	need gas RT-68			26	Trk couldn't Locate
20	Hydo Lock	1635	1835		90 Min	30 Min		2 Hr	30	Grd Evac Retriever
6	Thrown Track	1630	1810		2 Hr	30 Min		2 Hr 30 Min	31	
2	Gen went out	1310	1545		1 Hr	2 Hr 35 Min		3 Hr 35 Min	20	A Battery APC Evac
Unk	Gen went out	1400	1730		1 Hr	3 Hr 30 Min		4 Hr 30 Min	20	A Battery APC Evac
2	Stuck	1050	1125		20 Min	15 Min		35 Min	9.5	
24	Stuck	1050	1125		20 Min	15 Min		35 Min	8.5	
Unk	Stuck	1050	1125		20 Min	15 Min		35 Min	8.5	
32	Stuck	1020	1230		1 Hr 55 Min	15 Min		2 Hr 10 Min	7	
20	Stuck	1455	1630		1 Hr 20 Min	15 Min		1 Hr 35 Min	19.5	
LT	Stuck	1615	1750		1 Hr 20 Min	15 Min		1 Hr 35 Min	17	
33	Stuck	1630	1810		1 Hr 25 Min	15 Min		1 Hr 40 Min	31	
2	Need Oil	1128	1145	17 Min		10 Min		27 Min	25	

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

8 - 9 May 58 (Cont'd)

MAINTENANCE TIME AIR vs GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
56	RT-67	2020	2105		40 Min	5 Min		45 Min	17	
23	Request 4 Qts Oil	0655	0740		20 Min	20 Min		40 Min	18.5	Arr at Veh 0705
23	Request 6 Qts Oil	1040	1110		20 Min	10 Min		30 Min	17	
3	Out of Gas	2000			1 Hr 35 Min	20 Min			20	Filled by same Rolligan
9	Out of Gas				1 Hr 35 Min	20 Min			20	
10	Out of Gas		2230		1 Hr 30 Min	20 Min		2 Hr 30 Min	19	
13	Out of Gas				1 Hr 27 Min	20 Min			18.5	
11	Out of Gas				1 Hr 27 Min	20 Min			18.5	
3	Out of Gas	0735	0745		1 Hr 27 Min	10 Min			18.5	
4	Out of Gas	Resupply made by H-21					10 Min		18.5	
2½T	Out of Gas	By Rolligan							18.5	
13	Out of Gas	2022	2140		1 Hr 58 Min	20 Min		2 Hr 18 Min	26	

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

20 - 21 May 58

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
37	Fuel Pump	0740	0952		1 Hr 12 Min	1 Hr		2 Hr 12 Min	9	
9	Frozen Line	0920	1500	20 Min		6 Hr 20 Min			7	#9 Repl by APC 15
18	Broken Track	1040	1110	10 Min		20 Min	30 Min		3	
46	Thrown Spindle	1755	1900		35 Min	30 Min		1 Hr 5 Min	5	
32	Broken Track Wheel	1810	1900		21 Min	29 Min		50 Min	8	
68	Rt Engine	2045	2240		35 Min	1 Hr 20 Min		1 Hr 55 Min	11	
37	Eng Overheat Broken Down	0745	1600		1 Hr 15 Min	7 Hr		8 Hr 15 Min	21	
16	Both Tracks Off	0810	1000		1 Hr	50 Min		1 Hr 50 Min	19	
37	Rtn to Ord (Engine)	1215	1600	40 Min		3 Hr 5 Min			23	
79	Broken Fan Belt	1300	1420	20 Min		1 Hr		1 Hr 20 Min	20	
76	Left Eng Missing	1220	1410	10 Min		1 Hr 40 Min		1 Hr 50 Min	13	
61	(Unk) To be Towed In	1735			30 Min	38 Hr 30 Min		39 Hr	13	Evac by Retriever
38	Left Eng. Heating	1140	2328		5 Min	11 Hr 58 Min		12 Hr 3 Min	2	Brkdn on way to Tule

APPENDIX IV TO SECTION II (CONT'D)

20 - 21 May 58 (Cont'd)

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
12G933 (M-52)	Road Wheel	1810	1900		40 Min	1 Hr	1 Hr 40 Min	1 Hr 40 Min	13	Repaired by A-Battery
(M-52) 3	Steering Control				40 Min	30 Min	1 Hr 10 Min	1 Hr 10 Min	13	Repaired by A-Battery
¼T	Stuck	0810	0930		1 Hr 10 Min	waiting 10 Min	wrecker	1 Hr 20 Min	3	Mtr bat at shower point
¼T	Stuck	0945	1055		40 Min 20 Min	waiting 10 Min		1 Hr 10 Min	7	
79	Stuck	1030	0500		Waiting 50 Min	Ret 3 Hr 1 Hr	40 Min	5 Hr 30 Min	17	
44	Stuck	0030	0515		3 Hr 25 Min 50 Min	waiting 30 Min		4 Hr 45 Min	17	
17	Stuck	1453	1635		22 Min	1 Hr 20 Min		1 Hr 42 Min	12	
11	RT-67 (Radio) Broken	1115	1135		15 Min	5 Min		20 Min	3	
45	No Commo	0810			15 Min	5 Min		20 Min		Repaired before Situation Started

APPENDIX IV TO SECTION II (CONT'D)

22 - 23 May 58

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
21	Need RT-68	0715	0830		1 Hr	15 Min		1 Hr 15 Min	25	
30	Need RT-70	0825	0840	10 Min		5 Min	15 Min	30 Min	25	
58	Stuck	0920	1035		55 Min	20 Min		1 Hr 15 Min	18	
59	Stuck	1206	1415		1 Hr 9 Min	20 Min		2 Hr 9 Min	24	40 Min waiting
51	Stuck Track Off	1010	1318		1 Hr 8 Min	1 Hr 20 Min		3 Hr 7 Min	22	50 Min waiting
74	Stuck	1822	2030		1 Hr	20 Min		2 Hr 8 Min	21	48 Min wait Retriever
73	Stuck	1128	1400		12 Min	20 Min		2 Hr 32 Min	4	2 Hr wait Retriever
30	Need 30 wt Oil	1515	1538	20 Min		3 Min	23 Min		28	
75	Need 50 wt Oil	1503	1530	20 Min		7 Min	27 Min		37	
14	Need Gas	1510	1714		1 Hr 54 Min	10 Min		2 Hr 4 Min	37.5	Tanker
28	Needs Oil Trans	1825	1940		20 Min	10 Min		1 Hr 15 Min	6.5	45 Min wait Replaced

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL - MODIFIED HANDLING AUTHORIZED

22 - 23 May 58 (Cont'd)

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
4	Dead Battery	0705	0830		1 Hr 15 Min	10 Min		1 Hr 25 Min	25	
43	Eng. Trbl	0805	0840	20 Min		15 Min	35 Min		13.5	
12	Eng. Trbl	0905	1108		1 Hr 6 Min	57 Min		2 Hr 3 Min	21.5	
36	Thrown Track	1445	1615	20 Min		1 Hr 10 Min	1 Hr 30 Min		19	
31	Lost Road Wheel	1440	1700	54 Min		1 Hr 26 Min	2 Hr 20 Min		37	
12	Fuel Pump	1125	1328		1 Hr 3 Min	1 Hr		2 Hr 3 Min	21	
		21 May								
34	Thrown Track	0630	0740	1 Hr 10 Min				1 Hr 10 Min	Tule	Reported on 22 May
41	Water Hose	1128	1155		5 Min	22 Min		27 Min	1	
57	Control Differential	1128	1430		5 Min	2 Hr 57 Min		3 Hr 2 Min	1	
57	Replaced by 66									
28	Replaced by 14									
12, 43, 51 replaced by 74, 32, 15										

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

3 - 4 June 58

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
57	Both timing Engines	2100	2210		45 Min	25 Min		1 Hr 10 Min	15	
94	Broken Rod	1020	1130						17	Replaced by APC 28
41	One Engine	1230			1630				17	4 Hr wait-to be replaced
29	Dead Battery	1630	1752		1 Hr 12 Min	10 Min		1 Hr 22 Min	24	
89	Dead Battery	1221	1436		1 Hr 15 Min	1 Hr		2 Hr 15 Min	25	
73	Will not Start	1820	2000		40 Min	1 Hr		1 Hr 40 Min	19	
56	Fuel Pump	2000	2415		1 Hr 15 Min	3 Hr		4 Hr 15 Min	25	
27	In Accident	0055	0652		1 Hr 27 Min	4 Hr 30 Min		5 Hr 57 Min	28.5	Evac to Ord
44	In Accident	0055	0652		1 Hr 27 Min	4 Hr 30 Min		5 Hr 57 Min	28.5	Evac to Ord
57	Motor Out	0055			1 Hr 30 Min	38 Hr 30 Min		40 Hr	28.5	Prepared 5-6 Jun
99	Needs Replacement	0055			24 Min				16	Replaced by APC 31
25	Dead Battery	0645	0745		54 Min	10 Min		1 Hr 4 Min	17.5	
56	(Unk) Replaced	0715	2300		54 Min	14 Hr 51 Min		15 Hr 45 Min	17.5	
57	(Unk) Replaced	0715	2300		54 Min	14 Hr 51 Min		15 Hr 45 Min	17.5	

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

3 - 4 June 58 (Cont'd)

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
51	Fuel Pump	1030	1324		54 Min	2 Hr		2 Hr 54 Min	17.5	
47	Carburetor					1 Hr				Repaired at Tule, 5-6 Jun
75	Overheated	1325	1440		60 Min	15 Min		1 Hr 15 Min	20.5	Water Hose 5-6 June
95	Thrown Track	1430	1557		57 Min	30 Min		1 Hr 27 Min	19	
63	Thrown Track	1445	1627		1 Hr 12 Min	30 Min		1 Hr 42 Min	24	
99	Out of Oil	1230	1337		57 Min	10 Min		1 Hr 7 Min	19	
27	Need Oil	1325	1456		1 Hr 21 Min	10 Min		1 Hr 31 Min	27	
28	VRC9 Radio	2030	0500		51 Min	5 Min		8 Hr 30 Min	17	7 Hr 34 Min Wait
38	2RT68 Radio	2130	0500		51 Min	10 Min		7 Hr 30 Min	17	6 Hr 29 Min Wait
40	RT68 Radio	2120	0500		51 Min	5 Min		7 Hr 40 Min		6 Hr 44 Min Wait

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

5 - 6 June 58

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
33	Trans Trbl	0615	0800		8 Min	1 Hr 57 Min		1 Hr 45 Min	8	
26	Plugged Fuel Line	0710	0930		42 Min	1 Hr 38 Min		2 hrs 20 Min	12.5	
68	Driver Trouble	0710	0930		51 Min	1 Hr 29 Min			17	
30	Unk	0828	1300		1 Hr	3 Hr 32 Min		4 Hr 32 Min	20	
66	Joint of Final Dr.	0950	1200		1 Hr 10 Min	1 Hr		2 Hr 10 Min	24	
43	Thrown Track Bad Engine	1200	1400		1 Hr 12 Min	48 Min		2 Hr	24	
58	Need Oil To be moved	1235	1000		1 Hr 6 Min	4 Hr 19 Min		5 Hr 25 Min	22	
88	Thrown Track	1323	1545		1 Hr 31 Min	51 Min		2 Hr 22 Min	21	
23	Generator	1500	1620		1 Hr 20 Min	35 Min		1 Hr 50 Min	24.5	Evac - Rtn to Tule
46	Thrown Track	1142	1300		48 Min	30 Min		1 Hr 18 Min	16	
48	Sleeve Cable Dead Batt.	1430	1515	15 Min		30 Min	45 Min		19	
60	Engine	1655	1730	15 Min		20 Min	35 Min		24	
85	Generator	1505	1735		1 Hr 6 Min	1 Hr 24 Min		2 Hr 30 Min	22	
43	Compensator Idler	1545			40 Min	6 Hr 5 Min		6 Hr 45 Min	13	

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

5 - 6 June 58 (Cont'd)

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
¼T	Sparkplug	2100	0640		40 Min	10 Min		9 Hr 40 Min	13	8 Hr 50 Min Waiting Mech
¼T	Sparkplug	1730	0640		40 Min	10 Min		13 Hr 22 Min	10	12 Hr 32 Min to Locate
¼T	Sparkplug	2100	0640		1 Hr 5 Min	10 Min		9 Hr 40 Min	21	8 Hr 35 Min to Locate
37	Engine Stopped	2215	0900		1 Hr 50 Min	8 Hr 35 Min		10 Hr 45 Min	22	
40	Engine Stopped	2 5	0900		1 Hr 50 Min	8 Hr 35 Min		10 Hr 45 Min	22	
33	Track Thrown	2250	1630		1 Hr 50 Min	15 Min		2 Hr 5 Min	23	
48	Dead Battery	0548	0630		42 Min	10 Min		52 Min	16	
85	Fuel Pump	0555	0750		48 Min	1 Hr 7 Min		1 Hr 55 Min	16	
52	Engine Trouble	0722	0950		50 Min	1 Hr 38 Min		2 Hr 28 Min	16.5	
34	Thrown Track	1010	1300		1 Hr 50 Min	1 Hr		2 Hr 50 Min	13	Most of time to Locate
48	Broken Road Wheel	1700	1730	15 Min		15 Min	30 Min		24	
5	Left Engine Trouble	1758	1944	22 Min		1 Hr 24 Min	1 Hr 46 Min		16	
77	Dead Battery	1905	2100		1 Hr 45 Min	10 Min		1 Hr 55 Min	19	

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

5 - 6 June 58 (Cont'd)

MAINTENANCE TIME - AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
17	Broken Down	2020	2140		1 Hr	20 Min		1 Hr 20 Min	24	
72	Broken Down	2025	2150		1 Hr	30 Min		1 Hr 30 Min	24	
1T	Sparkplug	2100	0640		30 Min	10 Min		9 Hr 40 Min	12	9 Hrs trying to Locate

30 Jun - 1 Jul 58

MAINTENANCE TIME AIR vs GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
31	Tachometer	0705	0945		40 Min	2 Hr		2 Hr 40 Min	27	
91	Cracked Oil Pan	0943	1200	17 Min		16 Hr	18 Hr 34 Min		15	Recovered by Trailer
52	3 nuts-Idler & Plug RdWhl	1040	1110	10 Min		20 Min	30 Min		17	
22	Thrown Track	1545	2000		1 Hr 20 Min	3 Hr 55 Min		5 Hr 15 Min	26.5	
37	Thrown Track	1510	1700		1 Hr 20 Min	30 Min		1 Hr 50 Min	17	
57	Fuel Gasket Filter	1533	1705	52 Min		40 Min	1 Hr 32 Min		15.5	Had trbl Locating
98	Fuel Pump	1545	1730	15 Min		1 Hr 30 Min	1 Hr 45 Min		24	
34	Thrown Track	1800	1900		30 Min	30 Min		1 Hr	19	
1T	Points	1903	2030		36 Min	51 Min		1 Hr 27 Min	12	
37	Bad Track Connections	1940	2100		1 Hr 10 Min			1 Hr 20 Min	31	Returning to Ord.
28	Gas Leak	0950	1015	20 Min		5 Min	25 Min		24.5	
41	Broken Fuel Line	1300	1625	20 Min		1 Hr	1 Hr 20 Min		22	Deadline 3 Hr 25 Min
81	Broken Water Hose	1300	1420	20 Min		1 Hr	1 Hr 20 Min		24	
57	Fuel Gasket	1345	1420	15 Min		20 Min	35 Min		15	

APPENDIX IV TO SECTION II (CONT'D)

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

30 Jun - 1 Jul 58 (Cont)

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
42	Lost 2 Screws	2105	2300		1 Hr 25 Min	30 Min		1 Hr 55 Min	12	
45	Breather Pipe	1815	1855	15 Min		25 Min	40 Min		29	
±T	1 - RT 68 1 - MG	0740	0810		1 Hr 5 Min	5 Min		1 Hr 10 Min	27	"B" Mess
35	1 RT 70,1-R 10 1Qt,10wt Oil	1040	1110	18 Min		12 Min	30 Min		15	
28	1 RT 68	1240	1330	15 Min		5 Min	20 Min	30 Min HLMR	17	Time lapse Hel.at HLMR
28	1 RT 68	1510	1640	1 Hr 12 Min		18 Min	1 Hr 30 Min		25	Wrong Location
94	1 RT 68	1300	1625		3 Hr 20 Min	5 Min		3 Hr 25 Min	21	Wrong Location
45	1 RT 68	2120	2200		30 Min	10 Min		40 Min	4	At Assembly Area
25	Stuck	1505	1630		54 Min	31 Min		1 Hr 25 Min	18	
56	5 Qts 30 wt Oil	0915	0935	15 Min		5 Min	30 Min		19.5	
21	4 Qts 30 wt Oil	1510	1640	10 Min		5 Min	15 Min		24	1 Hr 15 Min Searching
	POL Request	2200	0600		50 Min	8 Hrs			17	S-4
	Air Resupply	2330	2335	5 Min	Mule	W/Rat.	& Rolligon		12	

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

30 Jun - 1 Jul 58 (Cont'd)

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
97	4 Qts Oil	1210	1230	10 Min		10 Min	20 Min		23	
	Request Tanker	1508	1700		1 Hr	52 Min		1 Hr 52 Min	19.5	
21	Left Rear Sprocket	1900	1940	40 Min	1 Hr	3 Hr		4 Hr	22	Rtn & Repl by M-26
41	Broken Fan Belt	2025	2040	10 Min		5 Min	15 Min		22	
110	Fan Belt	0845	0945			15 Min				Tule Biv.
104	Water Hose	1030	1400		1 Hr 30 Min	20 Min		1 Hr 30 Min	30	1 Hr 10 Min Waiting

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
87	Broken Tachometer	0940	1100	20 Min		55 Min	1 Hr 15 Min		29	DL Time 5 Hr 15 Min
95	Won't Start	0540		20 Min		30 Min	50 Min		29	D.L. Time 1 Hr 30 Min
37	Dirt in Fuel Line	0940	1230	15 Min	1 Hr 30 Min	45 Min	1 Hr	2 Hr 15 Min	22	D.L. Time 0930 to 1230
96	Right Eng.	1315 1425	1320 1440	50 Min		2 Hr 40 Min	3 Hr 30 Min		26	Needed Oil DL fr 1100
66	Leak in Carburetor	1200	1245	10 Min		30 Min	45 Min		21	Checked later 1½ Hr
92	Broken Gear Shift	1430	1520	1 Hr 25 Min	1 Hr 30 Min	30 Min	1 Hr 55 Min	2 Hr	24.5	Had been Evac.
73	Engine Trouble	2050	2130		25 Min	15 Min		40 Min	5	
90	Fuel Pump	2235	0900		40 Min	3 Hr		3 Hr 40 Min	13	D.L. Time 10 Hr 25 Min
66	Fuel Pump	0700	0900		1 Hr 30 Min	30 Min		2 Hr	20	
95	Engine	0935	1050	15 Min		1 Hr	1 Hr 15 Min		20	
94	Engine Trbl	0935	1050	20 Min		1 Hr	1 Hr 20 Min		28	
67	Gear Shift	1030	1050	20 Min		30 Min		2 Hr 20 Min	21	Both Jeep & Air used
38	Road Wheel	1320	1430		50 Min	20 Min		1 Hr 10 Min	10	
67	Broken Gear	1415	1745		2 Hr	30 Min		2 Hr 30 Min	25	Ret to Tule

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

2 - 3 July 58 (Cont'd)

MAINTENANCE TIME - AIR vs GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
60	Broken Water Hose	1420	1640	20 Min		2 Hr	2 Hr 20 Min		23	
59	Over-heating	1605	1630	10 Min		15 Min	25 Min		13.5	
111	Repair Cooler Assy	1000	1800		2 Hr	6 Hr		8 Hr	24	See Brkdn Sheet
1	Oil Line Broken	1150	1450			3 Hr		4 Hr 50 Min	22	A-Battery Maint Sect
68	Rocker Arm	1250	1415		25 Min	2 Hr		2 Hr 25 Min	5	See Veh Maint Chart

3 Airflights to APC 96

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co A 15 - 16 July 58

MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
92	Rod Going Out	0600	0900		1 Hr	2 Hr		3 Hr	12	Rtn to Tule M-26
97	Thrown Rod	1145	1315		1 Hr 20 Min	2 Hr		3 Hr [illegible] Min	21	Rtn to Tule
96	Brake Trbl	1330	1545		45 Min	1 Hr 30 Min		2 Hr 15 Min	19	Rept 554 Ord
89	Differential Trouble	1900	2100		1 Hr	1 Hr		2 Hr	22	Rept to 554 Ord
25	Generator Eng Trouble	1900	2320		1 Hr	1 Hr		2 Hr	20	Ret 2 Hr 20 Min Wait
55	Gen Trouble	1920	2245		2 Hr 20 Min	2 Hr		4 Hr 20 Min	20	Ret Rept to 554
83	Idle R. Wheel Link	1920	2245		1 Hr 25 Min	2 Hr		3 Hr 25 Min	20	Ret Rept to 554
84	Idler Comp Leak	1920	2315		55 Min	3 Hr		3 Hr 55 Min	20	Ret Rept to 554
36	Dead Battery	1935	2035		40 Min	20 Min		1 Hr	36.5	Ret Rept to 554/to APC24
24	Fuel Pump	1935	2147		43 Min	1 Hr 30 Min		2 Hr 13 Min	22	Ret Rept to 554
40	Gear Shift Lever	1235	1430	55 Min		1 Hr	1 Hr 55 Min		17	Couldn't find Rept 554
74	Rock in Road Wheel	2000	2015			15 Min	Repaired	by crew	20	Compt by Crew
80	Right Eng. Throwing Oil	2215	2348		33 Min	1 Hr		1 Hr 33 Min	10.5	Rept 554 Ret
96	Engine Trouble	2230	2330		30 Min	30 Min		1 Hr	24	Rept 554 Ret

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co A 15 - 16 July 58 (Cont'd) MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
100	Gen. Trbl	2230	2330		30 Min	30 Min		1 Hr	20	Rept 554 Ret
1T	Leaky Gas Tank	0955	1130		1 Hr	35 Min		1 Hr 35 Min	19.5	1st Bat Gp Maint
110	Battery Boiled Over				1 Hr	30 Min		1 Hr 30 Min	20	
30	Sparkplugs R.Eng. Out	0720	1430		1 Hr 12 Min	3 Hr		4 Hr 12 Min	24	Rept 554 Ret 16 Hrs
51	Bkn Spin. CableRPM Ga.	0900	1500		1 Hr	45 Min		1 Hr 45 Min	21	4 Hr 15 Min Wait
44	Engines Overheat	0935	1235		48 Min	30 Min		1 Hr 18 Min	16	1 Hr 42 Min Wait
53	Fuel Pump	1235	1405	30 Min		3 Hr 30 Min	4 Hr		25	Rept 554
57	Gasket for Fuel Pump	1420	1700		1 Hr 15 Min	55 Min		2 Hr 15 Min	12	Ret to Tule 5 Min Wait
42	Resting on Tree	1100	1800						20	Rept 554
5	Rubber Tire off Wheel Disk				1 Hr	45 Min		1 Hr 45 Min	20	
106	Fuel Pump				1 Hr	1 Hr 30 Min			20	
42	Thrown Track	15Jul 1855	16Jul 1540	16Jul 15 Min		1 Hr	1 Hr 15 Min	10 Hr 45 Min	28	Rept to 554
28	Need 30 wt Oil	1335	1400	20 Min		5 Min	25 Min		17.5	
42	Out of Oil	1855	16Jul 1540		1 Hr 24 Min	15 Min		10 Hr 45 Min	28	Rept to 554

APPENDIX IV TO SECTION II (CONT'D)

Co A 15 - 16 July 58 (Cont'd) MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint. Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
71	Fuel Line Trouble	2130	2250		1 Hr 10 Min	20 Min		1 Hr 30 Min		
81	Dead Battery	2130	2250		1 Hr 10 Min	20 Min		1 Hr 30 Min	20	

APC 40 - 2 Roundtrip Airflights were made

APC 57 - 2 Roundtrip Airflights

CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED

Co B 17 - 18 July 58 MAINTENANCE TIME AIR vs. GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
4-12	Distributor Trouble	1115	1300		45 Min	1 Hr		1 Hr 45 Min	20.7	Rept 1st Bt Gp Maint
57	Engine Out	1240	1415		1 Hr 45 Min			1 Hr 45 Min	20	Evac - Could not repair
81	Dead Battery	1305	1400		45 Min	15 Min		1 Hr	25.5	Rept 554
85	Must be Recovered	1530	1625		55 Min	3 Hr 30 Min		4 Hr 25 Min	21	Rep Ord-Sent Repl 1625
95	Carburetor Trouble	1740	1820	20 Min		20 Min	40 Min		33	554th
100	Engine Bad Throw. Oil	2105	2250		1 Hr 30 Min	15 Min		55 Min	30	554th
71	Breather Trouble	0600	0745		1 Hr 30 Min	15 Min		1 Hr 45 Min	22	554th
21	Mechanical Trouble	0700	0900		1 Hr 10 Min	50 Min		2 Hr	22	554th
86	Replaced #42								21.5	M.B.Notified at 0930
55	Fuel Pump	1250	1400		10 Min	1 Hr		1 Hr 10 Min	10	554th
56	Must be Recovered					2 Hr			20	9 Hrs Deadline
100	Needs 6 Qts Oil	0630	0730		30 Min	30 Min		1 Hr	13	1st Bat Gp Maint
53	Needs 4 Qts Oil	0630	0730		30 Min	30 Min		1 Hr	13	1st Bat Gp Maint
86	Need 12 Qts Oil	1845	1950	20 Min		40 Min	1 Hr		20	Maint

APPENDIX IV TO SECTION II (CONT'D)

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Co B 17 - 18 July 58 (Cont'd) MAINTENANCE TIME AIR vs GRD

APC	Nature of Breakdown	Time Disp	Time Comp	Total Air Travel	Total Grd Travel	Maint Time	Total Air Tvl & Maint	Total Grd Tvl & Maint	Roundtrip Distances (Miles)	Remarks
34	Needs 8 Qts Oil	1045	1120	15 Min		20 Min	35 Min		24	1st Bat Gp Maint
11	Flat Tire	1555	1850		2 Hr	55 Min		2 Hr 55 Min	16	1st Bat Gp Tanker-Maint.

APPENDIX V TO SECTION II

(CONFIDENTIAL-MODIFIED HANDLING AUTHORIZED)

APPENDIX V TO SECTION II

FLIGHT MISSION DATA

1. Missions:

DATE	UNIT	TYPE ACFT	FLTS	MISSION	INTERNAL	EXTERNAL	WEIGHT	MILES	HOURS FLIGHT	OIL USED (GALS)	GAS USED (GALS)
7-8 May	Co A	H-21C	6	Troop Lift	51		10,440	15	3.05	3	225
		H-21C	2	¼ Ton Veh Lift		2	5,400	15	1.50	3	150
		H-21C	2	Resupply (Rolligon & Mule) (Night)		2	4,300	15	.40		110
8-9 May	Co B	H-21C	5	Troop Lift	41		8,120	10	2.05	4.5	180
		H-21C	2	Veh Lift ¼ Ton		2	5,400	10	.50	1.5	92
		H-21C	2	Resupply (Rolligon & Mule)		2	4,600	15	1.00		134
20-21 May	Co A	H-21C	4	Troop Lift	23		4,500	25	2.55	7	250
		H-21C	1	Veh Lift ¼ Ton		1	2,800	15	.25	1	75
		H-21C	1	Resupply (Mule) (Night)		1	1,500	20	.40	1	100

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FLIGHT MISSION DATA (CONT'D)

DATE	UNIT	TYPE ACFT	FLTS	MISSION	INTERNAL	EXTERNAL	WEIGHT	MILES	HOURS FLIGHT	OIL USED (GALS)	GAS USED (GALS)
20-21 May (Continued)	Co A	H-21C	1	Resupply (Rolligon) (Day)		1	2,750	15	.30	1	50
		H-21C	6	Maint (Mech & Equip)Veh			4,800	20	5.30	3	407
3-4 June	Co B	H-21C	6	Troop Lift	40		8,120	10	4.25	4.5	358
		H-21C	2	Resupply (Rolligon & Mule)		2	4,046	10	1.00	1	150
		H-21C	2	Veh Lift ¼ Ton		2	5,400	10	1.00		150
5-6 June	Co A	H-21C	6	Troop Lift	51		10,200	15	2.55	4	355
		H-21C	2	Veh Lift		2	5,400	15	1.00	1	150
		H-21C	2	Resupply (Rolligon & Mule)		2	4,160	15	1.00	.5	120
30 Jun 1-Jul	Co B	H-21C	3	¼ Ton Veh Lift		3	8,100	10	1.30	1.5	150
		H-21C	2	Resupply (Rolligon & Mule)		2	3,830	10	1.05	1	155

APPENDIX V TO SECTION II (CONT'D)

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FLIGHT MISSION DATA (CONT'D)

DATE	UNIT	TYPE ACFT	FLTS	MISSION	INTERNAL	EXTERNAL	WEIGHT	MILES	HOURS FLIGHT	OIL USED (GALS)	GAS USED (GALS)
30 Jun 1 Jul (Continued)	Co B	H-21C	15	Maint					10.10	5	744
2-3 July	Co A	H-21C	4	Troop Lift	51		10,200	10	1.45	2.5	220
		H-21C	3	Veh Lift (¼ Ton)		3	7,900	10	1.10	4.5	167
		H-21C	2	Resupply (Rolligon & Mule)		2	2,800	10	1.00	1	200
		H-21C	8	Maint					2.55	2	280
15-16 July	Co A	H-21C	6	Troop Lift	68		13,525	15	2.30	5	334
		H-21C	4	Veh Lift (¼ Ton)		4	11,400	15	1.45	4	200
		H-21C	2	Resupply (Rolligon & Mule)		2	4,000	14	1.00	1	134
		H-21C	8	Maint					4.05	3	410
17-18 July	Co B	H-21C	6	Troop Lift	40		8,000	15	3.00	3	270
		H-21C	2	Veh Lift (¼ Ton)		2	5,600	15	1.00	1	120

FLIGHT MISSION DATA (CONT'D)

DATE	UNIT	TYPE ACFT	FLTS	MISSION	INTERNAL	EXTERNAL	WEIGHT	MILES	HOURS FLIGHT	OIL USED (GALS)	GAS USED (GALS)
17-18 July (Continued)	Co B	H-21C	2	Resupply (Rolligon & Mule)		2	4,000	15	1.00	1.5	135
		H-21C	10	Maint					4.00	5	360

2. Summary of Missions: Number of Flight Missions H-21C - Summary

UNIT	DATES	TROOP LIFT	VEHICLE LIFT	RATION LIFT	VEHICLE MAINT	RADIO MAINT	POL LIFT
A	7-8 May	6	2	1		2	1
B	8-9 May	5	2	1		1	1
A	20-21 May	4	1	1	6	3	1
B	3-4 June	6	2	1		7	1
A	5-6 June	6	2	1		6	1
B	30 Jun-1 Jul	4	3	1	15	5	1
A	2-3 July	4	3	1	8	2	1
A	15-16 July	6	4	1	8	8	1

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FLIGHT MISSION DATA - Summary of Missions (Cont'd)

UNIT	DATES	TROOP LIFT	VEHICLE LIFT	RATION LIFT	VEHICLE MAINT	RADIO MAINT	POL LIFT
B	17-18 July	6	2	1	10	2	1
TOTALS		47	21	9	47	36	9

The Resupply Missions, POL and Rations, were flown at night.

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This volume covers logistical aspects of operations by a PENTANA-type rifle company against a mechanized Aggressor task force, as examined in the subject experiment. Conclusions are drawn regarding logistical support requirements of the rifle company, including supply, maintenance, medical evacuation, and support of the artillery battery. Also evaluated are techniques of aerial resupply.

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