CARMONETTE. VOLUME II. DATA PREPARATION AND OUTPUT GUIDE

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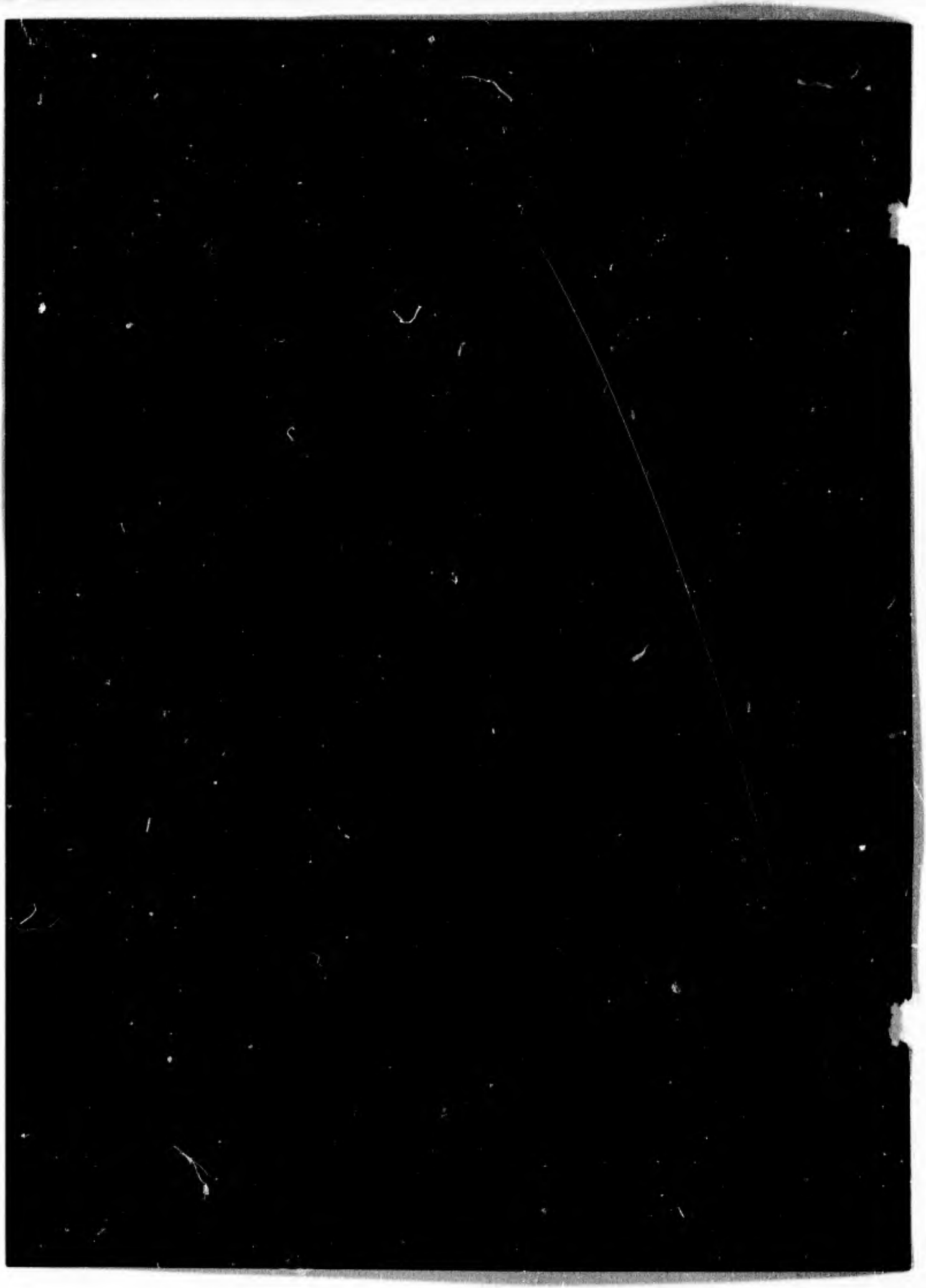

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A gamer's manual that describes the sources and handling of data required by the simulation; the interpretation of preprocessor outputs; the operation of the battle model; and the interpretation of game outputs.

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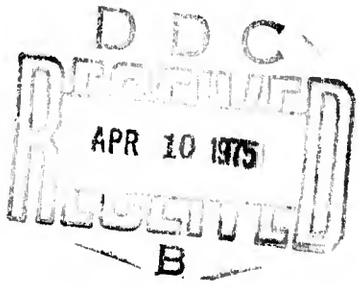

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CONTENTS

Figures

Figures cont'd

Figures cont'd

Tables

Part I

OVERVIEW

INTRODUCTION

This volume of the CARMONETTE documentation is a user's guide to the preparation of input and a description of the output. It is assumed that the personnel who are responsible for data preparation fully understand the material in Vol I. Because of the complex interactions of various elements of the data, the data forms must be filled out with utmost care. A strong point is made of the need for detailed planning of the experiments. The temptation to start filling out forms and making runs on the computer is overwhelming but must be resisted if meaningful results are to be obtained. CARMONETTE, like many complex simulations, is a voracious consumer of computer time, and if incorrectly or mistakenly used will produce meaningless results. The jargon of the computer world "garbage in, garbage out" (GIGO) applies.

This volume is organized to assist the analyst in data preparation. The body contains a survey of the concepts and interactions of the various elements of data. If only a brief review of the body precedes the execution of any of the forms, confusion is almost guaranteed. Detailed study of these concepts and interactions is recommended before forms are even consulted.

Part II contains detailed information on filling out each input form and uses a sample game as a vehicle. The forms to be used have certain items preprinted and are in the standard 80-column card format.

Part III describes the data diagnostics produced by the preprocessors, and the battle model and post processor outputs.

Appendix A is a listing of game inputs.

Appendix B discusses considerations relating to the number of iterations required for a single treatment.

Appendix C is a glossary of terms, which attempts to relate the short phrases used to describe some of the data to the military vocabulary assumed of the user. It also indicates where the term is discussed in Part II and on which input forms it is used.

Before beginning to fill out any of the forms used to input data to the simulation, several preliminary steps should be completed. The user should analyze the problem, isolate the important variables, decide on the measure of effectiveness, and, in short, develop a rational foundation for the data needs. Much care should be taken on these points because many data items will require judgment that must be tempered in equal measure by the military reality being simulated and the scientific problem being solved.

The first thing to do before filling out the forms is to design the experiment. The design of the experiment must specify the various terrains to be used, the task organizations, the equipment variations, the tactical situations, posture of the forces, time of day, weather, and the specification of the output desired. The experimental design is not complete until the method of analysis has been completely specified. The method of analysis, the number of variables, the number of levels of each variable, and the acceptable tolerance of error together with estimates of variance of the results are required to determine the number of replications of each treatment to be run.

There are a number of game parameters used in the simulation that have no analogy in real combat. These data are needed as a means of bookkeeping and of ensuring continuity of action and will be discussed in detail in Part II.

PRIMARY ACTIVITIES

Since CARMONETTE is a simulation of ground combat, it is primarily concerned with movement, target acquisition, and the firing of weapons

and assessment of their effects. The input data required can be categorized under five general headings: terrain, weapons, sensors, mobility, and units.

Terrain

The properties of terrain on which the battle is played are described explicitly in terms of:

(a) Elevation
(b) Height of vegetation
(c) Trafficability of roads
(d) Cross-country trafficability
(e) Cover
(f) Concealment

The average elevation is used in determining slopes and lines of sight. The average height of vegetation is added to the elevation of the intervening terrain to determine intervisibility.

Trafficability is combined with the slope to give the maximum movement rate for units. Cross-country trafficability depends on the condition of the soil and any trees or brush that might hinder movement. Trafficability of roads depends on the quality of the road.

Cover and concealment are used to indicate the exposed area of an element. Tables are used to convert target size to exposed area for the varying degrees of cover or concealment.

CARMONETTE defines net cover as the capability of dismounted troops to find protection against fragments from exploding rounds. Net cover is differentiated from cover by the fact that cover gives protection from flat trajectory non-fragmenting ammunition, whereas net cover gives protection from overhead artillery bursts and flat trajectory fragmenting ammunition. The probability of killing dismounted troops, given a hit in the unit's area by a fragmenting round, depends on the weapon type, ammunition type, the reaction to fire of the troops (if any), and the net cover.

Weapons

A total of 56 weapon types may be played in CARMONETTE. These weapons are classified into three general groups: 12 may be artillery and mortars; 22 direct fire, fragmenting; and 22 direct fire, non-fragmenting. Each weapon may have two ammunition types.

For each type of weapon to be simulated, the following data are required:

(a) The minimum and maximum effective range (in meters),

(b) The minimum number of men required to serve the weapon,

(c) The mean and standard deviation (in minutes) of the time to aim the weapon initially,

(d) The mean and standard deviation (in minutes) of the time required to reaim the weapon at the same target after the weapon has been fired,

(e) The mean and standard deviation (in minutes) of the time required to reload the weapon after firing,

(f) The velocity of a round in meters per second. This should not be the muzzle velocity but the average velocity of a round over its anticipated range of employment during the game.

A measure of the impact area is required for the artillery and mortars. This area is the average area covered by a volley of one round from each piece in the firing unit.

The number of rounds that are fired each time one of the weapon types is fired is referred to as "rounds per trigger pull." In most cases this number is one. In the event that the normal mode of fire for a weapon is burst fire, then the number of rounds per trigger pull is indicated. The neutralization weight of each round fired is also indicated; see Vol I for a detailed discussion of neutralization.

In order to simulate the accuracy of each weapon, CARMONETTE considers the total tactical standard deviation (SD) as a function of range and the following factors: weapon type, first or subsequent round at same target, previous round hit or miss, firer moving or stationary, target moving or stationary, whether or not the firer is partially suppressed by hostile fire, and ammunition type.

Kill probabilities given a hit, and target priorities are also input for each weapon.

Sensors

A total of 36 sensors may be used by the simulated forces. The sensors are subdivided into six classes of six types each. Three special classes represent unaided eyes and binoculars (Class 1), passive night vision devices (Class 2), and radars (Class 4); and three classes can be used for any sensor. The model represents information about non-firing targets as being in one of four states:

(1) Target's location unknown,

(2) Target known to be located in a certain area,

(3) Target erroneously pinpointed within an area,

(4) Target correctly pinpointed.

Inputs required for each sensor to be used are:

(a) Range,

(b) Probability of completely losing target information, given that line of sight is lost,

(c) Probabilities of improving information state,

(d) Probabilities of losing information state.

Information concerning firing targets does not include State 2 and does not require probabilities of losing information state.

Mobility

In addition to dismounted infantry, CARMONETTE plays four types of ground vehicles and three types of helicopters. Input data includes:

(a) Doctrines that describe how a unit will act under varying conditions of cover and target availability,

(b) Rates at which ground and air units move,

(c) The time required for infantry units to dismount and remount from ground or air personnel carriers,

(d) Altitudes at which aircraft operate.

Units

CARMONETTE forces are divided into not more than 48 units on each side. A unit may have a maximum of 63 killable elements. These elements can be destroyed one by one. The elements of each unit must have the same mobility, vulnerability, location, and target detection capability. When a unit moves, all its elements move together. When a unit is fired on, all its elements are equally vulnerable. When a single element of any unit is detected, the entire unit is considered to be detected. Also, when one element of a unit detects an enemy unit, all other elements are considered to have detected this enemy.

A unit may be assigned up to four groups of weapons. For example, a tank may have a main gun, an air defense machine gun, and a coaxial machine gun; a rifle squad may have two light antitank weapons, one machine gun, one grenade launcher, and five rifles.

Two units are required to describe the characteristics of troops mounted in carriers. The carrier is one unit, and the infantry squad is a second unit. The carrier unit retains the number of men designated as drivers and its weapons when the troop unit dismounts.

Such characteristics as the area occupied may depend on whether the troop unit is mounted in the carrier unit. The horizontal area that a unit occupies when it is deployed is used to compute hit probabilities for fragmenting munitions.

The visible area of the largest element of the unit is used for detection calculations. The height of the unit's sensors above the ground is used for line of sight calculations.

Certain units may be ordered to hold fire until they are quite close to the enemy or until fired on. If a unit is given such orders, once it opens fire it will continue to search for and fire at targets, even though all targets withdraw beyond the hold-fire range.

Each unit is described by indexes for target class, vulnerability class, element-size class, mobility class, fire-response class, and sensor class. These indexes are some of the data that are required by the

simulation to provide for the bookkeeping and for representing the combat in a realistic manner; they have no analogue in actual combat. Although the number of indexes available in the simulation for each of the above classes is fixed, it is not necessary that all be used.

Target Class. Each unit in the battle presents a target of certain value to opposing forces. The target-class index is used in the target list as the basis of selection of units as targets for different weapon types and in the danger-state table to be discussed in the section on vulnerability class.

The two factors associated with the assignment of a unit to a target class are the unit's vulnerability to the various weapons and the firepower possessed by the unit. For example, an armored personnel carrier mounting an antitank guided missile would be a more desirable target than a similar carrier without the missile. Both carriers have the same vulnerability to the tank gun, but the one with the missile is a greater threat to the tank; therefore the carriers should be assigned to different target classes.

Each non-artillery weapon type on each side in the battle is assigned one, two, or three target lists. A unit's orders indicate which list to use during different phases of the battle. When a unit's orders indicate targets of opportunity, it looks for targets indicated on the list specified in its current order. Artillery units firing scheduled fires are not controlled by target lists. When artillery units fire "on call," they follow the priority indicated for their command unit. There are sixteen target classes in CARMONETTE.

Vulnerability Class. The probability of kill given a hit on a target is a function of the vulnerability of the target and of the firer's ammunition and weapon type. Whenever several units have identical or similar vulnerabilities, they are grouped into classes, and the vulnerability class index is used to determine the probability of kill by each weapon and ammunition. The vulnerability class index is also used to indicate the preferred ammunition type for each weapon type against each

unit. Hence, if two units are composed of tanks with different armor, they would be placed in different vulnerability classes as are armored personnel carriers and tanks.

The danger-state table relates the characteristics of target class and vulnerability class for each of three range intervals. Two critical ranges, R1 and R2 serve to divide the targets available to a given unit into three separate groups: those closer than R1, those between R1 and R2, and those farther away than R2. In each of these range intervals a unit can place a different weight on its own vulnerability to the weapons of each target class. For example, if R1 is 300 m and R2 is 1000m, a 90mm recoilless rifle unit might be seriously vulnerable to an infantry platoon in the 0-300 m range, moderately vulnerable in the 300-1000 m range, and relatively invulnerable for ranges beyond 1000 m. Twelve vulnerability classes are provided.

Element-Size Class. Each unit is classified according to the size of its principle element(s). The element-size class is used to determine the probability of detection and the probability of hitting the element. The element-size class of a unit is determined by two criteria: (a) the largest visible area that any element presents to a sensor, and (b) the greatest vulnerable area that any element presents to a direct-fire weapon.

The element-size class is used with the concealment available to determine the exposed visible area of an element of a target unit for determining the probability of detection. The concealment is determined by estimating the fraction of an element of each element-size class that would be hidden by trees, brush, ditches, etc. The exposed visible area of a target thus determined is then used in detection calculations.

The element-size class is also used with the cover available to determine the exposed vulnerable area of an element of a target unit for determining the probability of hit by a direct-fire weapon. The cover available is found by estimating the fraction of an element of each element-size class that would be covered from direct-fire weapons. The

resultant exposed vulnerable area is used in the calculation of hit probability as described previously under weapon accuracy. CARMONETTE has ten element-size indices.

Mobility Class. The mobility class index is used to describe a unit's rate of movement in terrain of various trafficability and road conditions for ground units or climb and dive angle for air units. Two units with similar mobility characteristics should be assigned to the same mobility class. It must be remembered that all elements of the same unit must have the same mobility characteristics, since a unit does not separate. Terrain trafficability is determined by the slope of a hill, either up or down, and the condition of the soil or road connecting the two grid squares to be crossed.

In addition to dismounted infantry, there are four ground and three air mobility classes.

Fire-Response Class. The fire-response class is used to describe a unit's reaction to hostile fire. Thresholds are used to indicate the response of each of these classes to fire. All classes may be partially suppressed by direct or by indirect fire; dismounted infantry and unarmored vehicles may be pinned down by either direct or indirect fire or both. Helicopters react only to direct fire and take evasive action by dropping to treetop level. If the helicopter is guiding a missile to a target, it will not drop to treetop level until after the missile impacts.

When a unit is partially suppressed, its aim and reaim time are increased, its movement rate is decreased, and the accuracy of its weapons and sensors is reduced. A pinned-down unit does not move, conduct surveillance, or fire its weapon.

The neutralization interval is the period of time over which incoming rounds will be considered to affect the behavior of a unit. The reaction of a unit to hostile fire will be determined by comparing the thresholds for response with the actual number of rounds (adjusted by the neutrlaization weighting factors) fired during the neutralization interval into the area occupied by the unit.

The fire-response class is also used to determine whether the unit is infantry or a soft vehicle, and if so, the model uses different kill probabilities for determining probability of kill, if given a hit, by fragmenting ammunition.

The fire-response classes represented in CARMONETTE are: dismounted infantry, open vehicles, light armor, heavy armor, and helicopters.

Sensor Class. Sensor class indexes are assigned to differentiate the unit's ability to detect targets under similar conditions. The sensor class index is used together with the size of the target, the unit's response to fire (if any), the unit's current level of information about the target, and the target motion (if any), to determine the probability of gain or loss of target information. A unit that can call artillery can do so if it knows a target is located in a certain grid square. A unit can engage by direct fire only those targets whose locations have been pinpointed, whether correctly or not. There are six sensor classes in CARMONETTE.

Orders. Each unit must be given detailed orders that will control its actions throughout the simulated battle. When a unit is killed, it simply stops following its orders. Each unit must be directed to move, stay, or fire by means of a preprogrammed set of instructions. The basic set of orders is listed in Table 1. There are three fundamental types of orders: move, stay, and skip. Fire orders are combined with move and stay orders.

Table 1

CARMONETTE COMMANDS

Narrative order[a]	Order	Qual[b] 1	No 1	Qual 2	No 2	Qual 3	No 3	Qual 4	No 4	Qual 5	No 5
move NoSToPping at RATE r to SQuaRE xx yy with KIND of fire k PRiORity p[c]	NSTP	RATE	r	SQRE	xxyy	KIND	k	PROR	p	ALT	a
MOVE under DOCTrine m at RATE r to SQuaRE xx yy with KIND of fire k PRiORity p	MOVE	DOCT	m	RATE	r	SQRE	xxyy	KIND	k	PROR	p
STAY and FIRE s shots at SQuaRE xx yy with KIND of fire k PRiORity p	STAY	FIRE	s	SQRE	xxyy	KIND	k	PROR	p		
STAY until TIME tt.tt or FIRE s shots with KIND of fire k PRiORity p	STAY	TIME	tt.tt	FIRE	s	KIND	k	PROR	p		
STAY for INTerval tt.tt or FIRE s shots with KIND of fire k PRiORity p	STAY	INTL	tt.tt	FIRE	s	KIND	k	PROR	p		
DISMount in present location	DISM										
REMOunt in present location	REMO										
CHange ALtitude to get LOS	CHAL	LOS									
CHange ALtitude to TReeToP	CHAL	TRTP									
CHange ALtitude to LAND	CHAL	LAND									
SKIP FORWard SKIP BACKward nn orders UNConDitionally	SKIP	FORW BACK	nn nn	UNCD UNCD							
if current TIME ≤ tt.tt				TIME	tt.tt						
if dead FRiendly UNits ≥ uu				FRUN	uu						
if dead ENemy UNits ≥ uu				ENUN	uu						
UNTiL friendly unit uu is in SQuaRE xx yy, if uu dies STAY 63.99				UNTL	uu	SQRE	xxyy	STAY			
UNTiL friendly unit uu is in SQuaRE xx yy, if uu dies SKiP 1 order				UNTL	uu	SQRE	xxyy	SKP1			
UNTiL friendly unit uu is in SQuaRE xx yy if uu dies go to EXIT pt				UNTL	uu	SQRE	xxyy	EXIT			
if FRiendly CAsualties ≥ nnnn				FRCA	nnnn						
if ENemy CAsualties ≥ nnnn				ENCA	nnnn						
if ENemy UNits ≥ uu are closer then RaNGE nnnn meters				ENUN	uu	RNGE	nnnn				
if FRiendly UNIT CAsualties ≥ uu for vul class TYPE vv				FRCA	uu	TYPE	vv				

[a] r:1-7 a:1-7 xx:1-60 vv:1-12
k:0-7 m:1-4 yy:1-63 nnn:1-4095
p:1-7 s:1-7 nn:1-63 tt.tt:1-63.99
uu:1-48

[b] Qual is left justified

[c] ... at ALTitude a (if unit is helicopter)

Part II

INPUT FORMS AND DETAILED PREPARATION INSTRUCTIONS

INTRODUCTION

This part of Volume II could well be titled, "The CARMONETTE Cook Book." It contains a step-by-step procedure for preparing the input data, using a hypothetical illustrative battle. All input numbers used describe artificial vehicles, weapons, and rates to keep this part unclassified. The input forms need not be filled out in the sequence presented, however a conscious effort has been made to discuss them in a logical sequence.

GENERAL DESCRIPTION OF THE ILLUSTRATIVE BATTLE

The illustrative problem is one of a set of simulations conducted to evaluate the combat potential of two proposed antiarmor mixes within a mechanized battalion. The general tactical situation is as follows: Red forces crossed the East-West German border in early summer, with the mission of securing crossing sites over the Rhine River. Blue forces are conducting a delaying action and are presently deployed along LINE BRAVO, see Figure 1. The area to be used in the illustrative problem is shown in the inset and is also shown in more detail in Fig. 2.

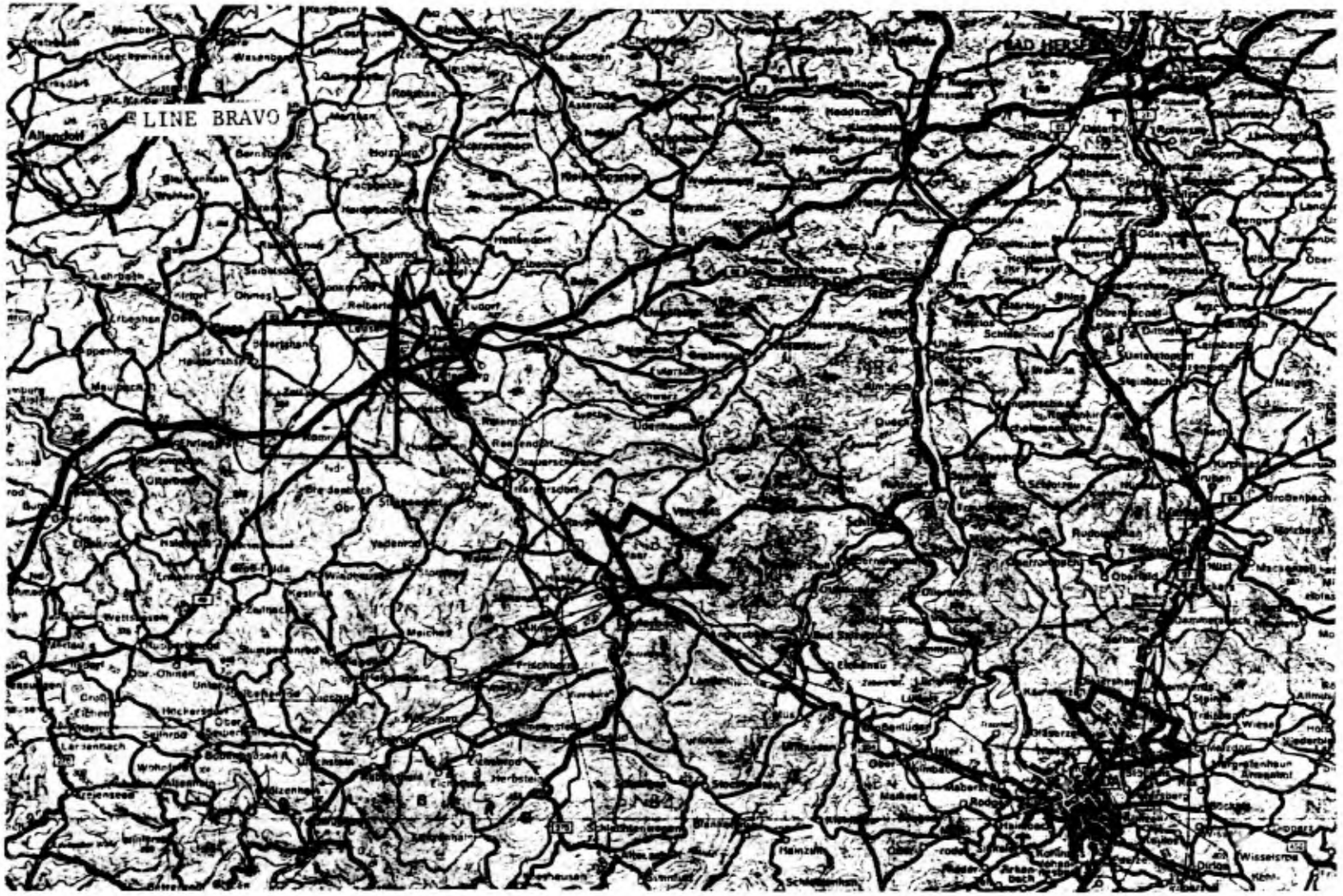

Fig. 1 — General Situation

Fig. 2 — Special Situation

STEP 1 - DESIGN OF THE EXPERIMENT

As previously stated, the purpose of the experiment is to evaluate the combat potential of two proposed antiarmor mixes within a mechanized battalion. The measure of effectiveness is a comparison of losses suffered by Blue and by Red when the Red forces have lost 30, 50, and 70% of its vehicles. The treatments (combination of levels of factors) must now be defined. Intelligence predictions show that the Red force may be equipped with either of two types of armored personnel carriers. An inspection of maps of the area of interest shows that there are three general types of terrain over which the battle may be fought. The variables are described in the accompanying tabulation by the factor and their levels.

Factor	Level
Blue force	2
Red force	2
Terrain	3

A complete factorial experiment is to be performed, therefore 12 ($2 \times 2 \times 3$) treatments are required to permit all main factors and interactions to be analyzed for significant effects. Any of several statistical techniques may be used to determine if a sufficient number of replications of the experiment exist to provide the desired level of confidence.

STEP 2 - PRELIMINARY CONSIDERATIONS

Worksheets

A series of work sheets, which are developed from a study of the forces to be gamed, is very helpful in developing a rational foundation for the data needs. These work sheets are also useful when filling out the input forms. The organization of one of the Blue companies to be evaluated is shown in Fig. 3. The organization of the other Blue company is similar, however it does not have a weapons squad in the rifle platoons. Each rifle squad has a medium antitank weapon (MAW) in addition to its two light antitank weapons (LAW), and the two AT squads in the weapons platoon are armed with different heavy antitank weapons (HAW). The supporting weapons received from higher headquarters are identical. They are: 2 HAWs, 5 tanks, and 2 attack helicopters. One heavy mortar platoon, 2 batteries of medium howitzers, and one battery of heavy howitzers are available to provide fire support. This same type of information should also be collected for the two Red forces, and then all the data is combined into the following work sheets:

1. Weapons list
2. Organization lists
3. Unit classification list

As stated previously, there are 56 weapon types available in CARMONETTE. The weapons to be played in this investigation are assigned as shown in Table 2.

Two of the four organization lists are shown in Tables 3 and 4.

The Unit Classification List is shown in Table 5.

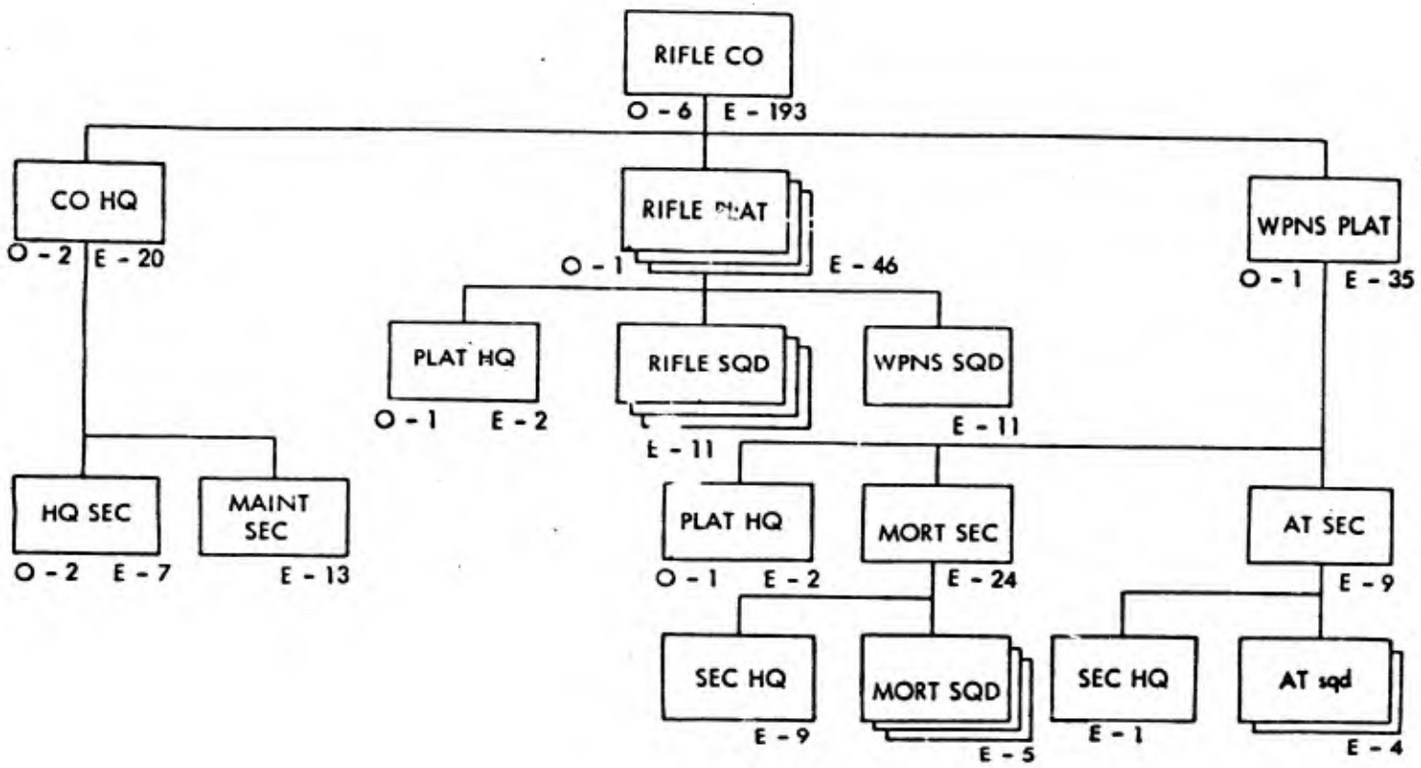

Fig. 3 — Organization for Blue 1

Table 2

WEAPONS LIST

Artillery and mortars

1. Blue medium mortar
2. Blue heavy mortar
3. Red heavy mortar
4. Red light howitzer
5. Red heavy howitzer
6. Blue medium howitzer
7. Blue heavy howitzer
8.
9.
10.
11.
12.

Direct fire fragmentation

13. Blue tank gun
14. Red tank gun
15. Red APC gun
16. Red AD vs helo
17. Red AD vs ground
18. Blue helo G/L
19. Blue helo auto cannon
20.
21.
22.
23.
24.
25.
26.
27.
28.
29.
30.
31.
32.
33.
34.

Direct fire Nonfragmentation

35. Blue HAW 1
36. Blue helo HAW
37. Red ground HAW
38. Red APC HAW
39. Red HAW
40. Blue HAW 2
41. Blue MAW
42. Blue LAW
43. Red LAW
44. Blue APC HMG
45. Blue tank HMG
46. Red APC HMG
47. Red tank HMG
48. Both tank LMG
49. Red APC LMG
50. Both ground LMG
51. Blue helo minigun
52. Both rifle
53. Red shoulder fired AD missile
54.
55.
56.

Table 3

ORGANIZATION LIST, BLUE 1

1. Squad APC
2. Rifle squad
3. Squad APC
4. Rifle squad
5. Squad APC
6. Rifle squad
7. MAW team
8. MAW team

9. Squad APC
10. Rifle squad
11. Squad APC
12. Rifle squad
13. Squad APC
14. Rifle squad
15. MAW team
16. MAW team

17. Squad APC
18. Rifle squad
19. Squad APC
20. Rifle squad
21. Squad APC
22. Rifle squad
23. MAW team
24. MAW team

25. HAW
26. HAW
27. HAW
28. HAW

29. Tank
30. Tank
31. Tank
32. Tank
33. Tank

34. Atk helo
35. Atk helo

36. Hv How Btry (4)
37. Med How Btry (6)
38. Med How Btry (6)
39. Hv Mort Plt (4)
40. Med Mort Sec (3)
41.
42.
43.
44.
45.
46.
47.
48.

Table 4

ORGANIZATION LIST, RED 1

1.	4 APC	25.	Gnd HAW
2.	Rifle Plt* & Co HW	26.	Gnd HAW
3.	3 APC		
4.	Rifle Plt	27.	AD (SP)
5.	3 APC	28.	AD (SP)
6.	Rifle Plt	29.	AD (SP)
		30.	AD (SP)
7.	4 APC		
8.	Rifle Plt & Co HQ	31.	AD msl
9.	3 APC	32.	AD msl
10.	Rifle Plt	33.	AD msl
11.	3 APC	34.	AD msl
12.	Rifle Plt	35.	AD msl
		36.	AD msl
13.	4 APC	37.	AD msl
14.	Rifle Plt & Co HQ	38.	AD msl
15.	3 APC	39.	AD msl
16.	Rifle Plt		
17.	3 APC	40.	Hv How Btry (6)
18.	Rifle Plt	41.	Lt How Btry (6)
		42.	Lt How Btry (6)
19.	3 Tanks	43.	Lt How Btry (6)
20.	4 Tanks	44.	Hv Mort Btry (6)
21.	3 Tanks		
		45.	
22.	HAW	46.	
23.	HAW	47.	
24.	HAW	48.	

*3 LAW, 4 LMG, 17 Rifles

Table 5

UNIT CLASSIFICATION LIST

	BLUE	RED
	Target Class	
1	Tank	Tank
2	APC	APC 1
3		APC 2
4	HAW 1	HAW
5		HAW-Ground mount
6	HAW 2	
7	MAW	
8	Rifle squad	Rifle squad
9		
10	Attack helo	
11		AD missile— shoulder fired
12		AD (SP)
13		
14		
15		
16	Arty	Arty
	Vulnerability Class	
1	Tank	Tank
2		APC 2
3	APC	APC 1
4	Arty	AD(SP), HAW
5	HAW 1	
6	HAW 2, MAW	Arty, HAW-Ground, msl
7	Rifle squad	Rifle squad
8		
9		
10	Attack helo	
11		
12	Survivability of troops from an APC which is killed	

Table 5 cont'd

			BLUE	RED
			Element Size	
	M^2	R		
0	11.5	1.9	Tank	
1	10.0	1.8	Arty	APC 2
2	8.5	1.6		Tank
3	7.5	1.5		APC 1, AD(SP)
4	6.0	1.4	APC, HAW 1	HAW, Arty
5	5.2	1.3	7½ × 7½-ft tgt, attack helo	
6				
7				
8	1.0	0.6	HAW 2, MAW	AD msl, ground HAW
9	0.5	0.4	Fully exposed man	Fully exposed man
			Mobility Class	
0	Dismtd trps		Rifle squad	Rifle squad
1	Tracked vehs		Tank, APC, HAW 1 & 2, MAW, Arty	Tank, APC 1 & 2, AD(SP), msl
2	Wheeled vehs			HAW, HAW-Ground, Arty
3				
4				
5	Attack helos			
6				
7				
			Fire Response Class	
1	Dismtd trps		Rifle squad	Rifle squad
2	Soft vehs		HAW 2, MAW	HAW-Ground, AD msl, Arty
3	Lt armor		APC, HAW 1, Arty	APC 1 & 2, HAW, AD(SP)
4	Hv armor		Tank	Tank
5	Helos		Atk helo	
			Sensors	
51	Eyeballs			
52	Binoculars			
53	Attack helos			
54	AD(SP)			
55				
56				

Game Parameters

Several of the parameters used by the model for bookkeeping purposes and to ensure continuity of action are entered on the first data card. These parameters are discussed below and are entered as shown in Fig. 4.

Grid Size. There is no definite way of determining the proper grid size for a CARMONETTE simulation of combat. Some guidelines can be presented and the user advised as to the restrictions that are placed on a free choice of grid size. As a guide the grid size should be as small as practicable. However, the grid size must be large enough to contain the battle being simulated. The design of the simulation permits a battlefield size that is a maximum of 60 by 63 grid squares. In addition the restriction on the number of units on a side requires that each force being simulated be divided into no more than 48 weapon units. The simulation does not restrict the number of units that may be in a grid square at one time, however it is unusual for more than two or three units to be in a square at the same time. Following the above reasoning, Table 6 shows the relationship between grid size, unit size, force size, and zone of action. This table is only a rough guide and does not preclude other grid, unit, or force sizes if they satisfy the needs of the problem. A grid size of 100 meters is appropriate for this investigation. The grid size in meters is entered in columns 6 through 9 of the GAME card, therefore 100 is entered in columns 7, 8, and 9. If no grid size is entered, the program will set it equal to 100 meters.

Suppressive Fire Area. If a unit is ordered to fire into a specific grid square (see the third command in Table 1), the area from which it selects targets can be increased to include adjacent grid squares. This increase is accomplished by use of the "suppressive fire area," which in effect is the distance from the selected grid square that he may look for targets. The model converts the input, which is in meters, to grid squares and permits the unit to search for targets in the expanded area. Since the grid size in this investigation is 100 meters, a suppressive fire area of 100 meters will permit units to search the eight

CARMONETTE
GAME PARAMETERS

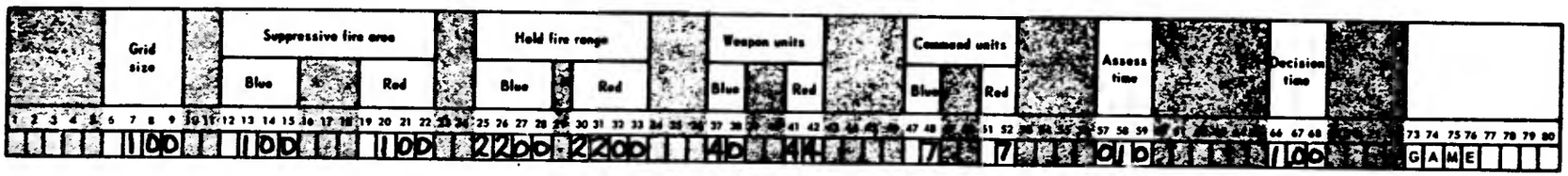

Fig. 4 — GAME Entries

Table 6

RELATION BETWEEN GRID SIZE, UNIT SIZE, FORCE SIZE, AND ZONE OF ACTION

Grid size (m)	Approximate unit size				Maximum force size		Maximum zone of action	
	Infantry	Mechanized infantry	Artillery	Aviation, aircraft	Infantry	Mechanized infantry	Width (m)	Depth (m)
10	1 Man	n/a	1 tube	n/a	2 Plts	n/a	600	630
25	2 Men	1 Veh	2 tubes	1	1 Co	1 Co	1500	1575
50	½ Sqd	2 Vehs	4 tubes	1	1 Bn	1 Bn	3000	3150
100	1 Sqd	3 Vehs	6 tubes	2	2 Bns	2 Bns	6000	6300
250	1 Plt	7 Vehs	12 tubes	4	4 Bns	4 Bns	15000	15750

grid squares adjacent to the selected square. A suppressive fire area of 100 meters is desired for this investigation, therefore 100 is entered in columns 13-15 and 20-22. No entry is required.

Hold-Fire Range. There are situations in which it is not desirable to engage targets at the maximum range of a weapon. If the gamer wishes to limit the range at which a unit will initiate a fire fight, the unit is designated a "Hold Fire" unit, and the desired range is entered in columns 25-28 for Blue and columns 30-33 for Red. In this game the hold-fire range for both sides was set at 2200 meters and entered as shown. No entry is required if no units are told to hold fire.

Weapons Units. The number of weapons units is determined from the Organization Lists in Tables 3 and 4, and are entered in columns 37, 38, 41, and 42 as shown.

Command Units. The number of command units is determined after the Task Organization is decided upon and will be discussed under STEP 7.

Assess Time. There is a finite time between the instant that a round impacts and the time that a firer is able to assess the effects of his fire. This is called Assess Time and is entered in columns 57-59. In this game the assess time was set at 0.10 minutes. If no entry is made, the model will assume the assess time equals zero.

Decision Time. During the course of a CARMONETTE battle, decisions are made whenever a unit fires or reaches the center of a grid square. However, if a unit is neither firing nor moving, it must reevaluate its situation periodically. The time interval at which this reevaluation is made is called the decision time and is entered in columns 66-68; in this game it was set at 1.00 minute. A decision time must always be entered.

STEP 3 - TERRAIN DATA

Two types of information on terrain are input to CARMONETTE. The properties of terrain are characterized by elevation, height of vegetation, trafficability of roads, cross-country trafficability, cover and concealment. These properties are input using Form TERRAIN 1. The cover offered by terrain has the effect of reducing the vulnerable area a target presents to firers; similarly, concealment reduces the visible area presented to observers. These effects are input using Form TERRAIN 2. Preparation of these forms is described below.

TERRAIN 1

A reference grid as described under Preliminary Considerations is superimposed over the simulated battlefield as shown in Fig. 5.

Each grid is then assigned a separate index for each of the six terrain properties using Form TERRAIN 1. CARMONETTE has two features which reduce the effort required by terrain coding. First, it is not necessary to code areas covered by the grid that are now within the area of interest. Second, the program will continue to assign the last index read to subsequent squares until a new index and square are identified.

Elevation. The average elevation of any grid must be between 0-4095 feet or 0-1248 meters. Negative elevations are prohibited. For cases that violate these limits, a constant can be added to or subtracted from all elevations. Since US maps show elevations in feet and most other countries present them in meters, the option of entering the average elevation in feet or meters is allowed. However, the data are converted and stored in the computer as feet.

Average elevation of each grid (specified to the nearest meter or foot) is listed beginning in row 1, col 1 of the battlefield (60 columns by 63 rows). See Fig. 6 to determine the format. The letters "ELE" are entered in cols 73-75 of each data card in the elevation deck. The first card is called a header card and the type of measurement is entered in cols 77-80 as "FEET" or "MTRS" of the header card. The entry "FEET" or

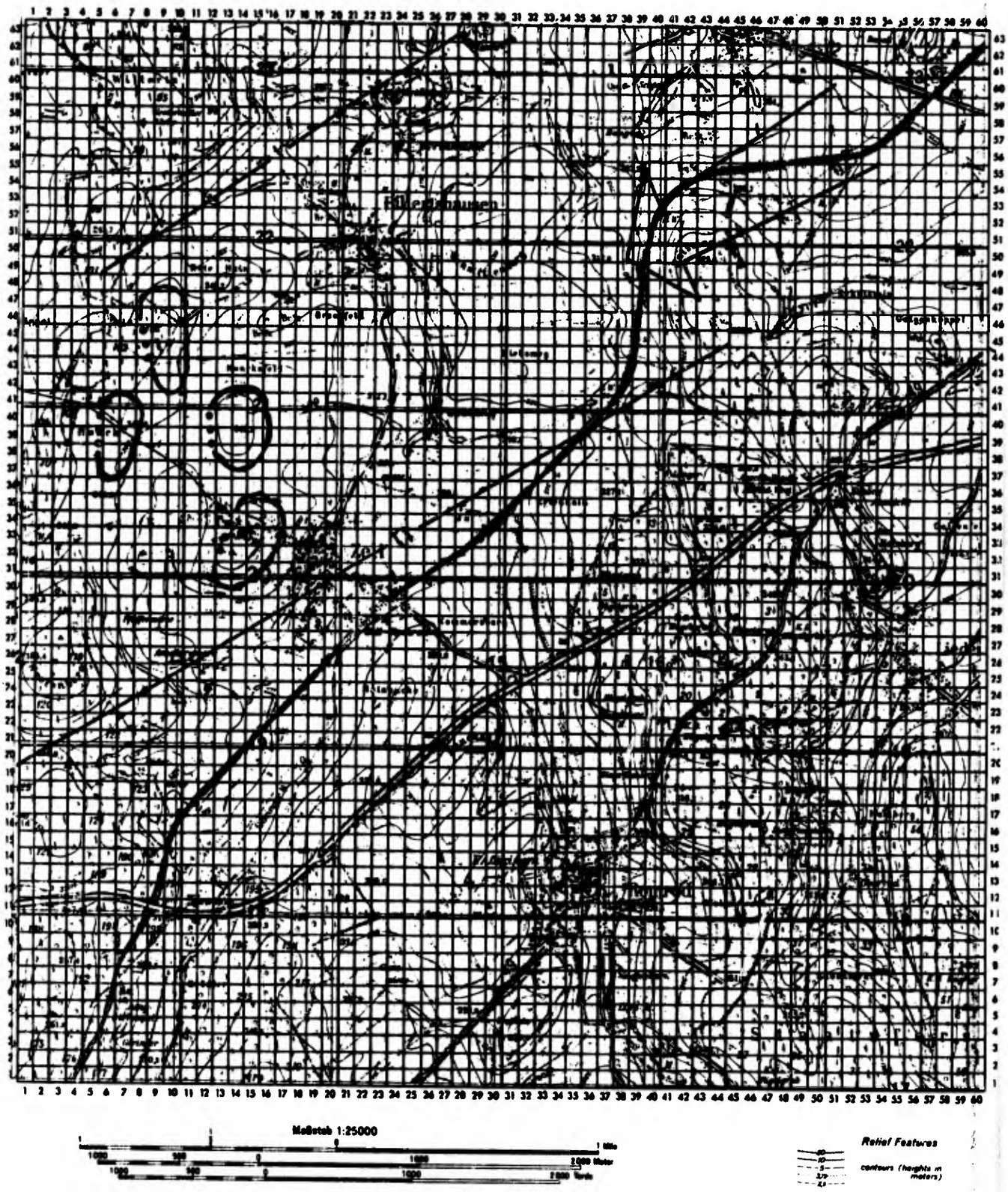

Fig. 5 - CARMONETTE Battlefield

"MTRS" is not repeated, and these columns may be used to record sequence numbers. For each terrain grid for which values are to be filled out enter the "X" and "Y" coordinates of the grid, and the value of the elevation of that grid in the designated columns of the form. The numbers entered in these fields must be right adjusted. The order of the grid coordinates is to increment the "X" coordinate through its range, then increment the "Y" coordinate, and increment the "X" coordinate through its range again. Thus, the "X" coordinate must always be increasing from 1 to 60, and the "Y" coordinate increasing from 1 to 63. Only grids whose average elevation changes from the previously entered value, need be entered on the form. The program will continue to assign to the intervening squares the last average elevation read. After the last entry for elevation, 999 must be entered in the next three columns.

Vegetation. Average height of vegetation for each grid is used in the battle model as a factor affecting intervisibility. The format to be used in completing the vegetation data is similar to the elevation format except the ID for cols 73-75 is the letters "VEG." The first card of the vegetation data must be the header card, the unit of measure is included as it was for elevation, followed by the data cards. The closing entry of 999 must be made as for elevation.

The average height of vegetation of any grid must be between 0-63 feet or 0-19 meters. The data is stored in the computer as feet.

Trafficability of Roads. The trafficability of roads is one of the factors (mobility class and slope between grids are the others) used in determining the rates at which units move over the roads in CARMONETTE.

A grid with an index of 0 has no road through it. Each road on the map is designated by an index of 1 (main highway), 2 (secondary road) or 3 (unpaved road). CARMONETTE assumes there is a road between two adjoining grids only if the road trafficability index of both grids is identical. If there are not, then movement must be cross-country. If there is more than one road in a grid, assign the index of the best road. If two roads of the same index occur in adjacent grid squares but do not actually

connect, they must be relocated with a road-vacant grid between them so that phantom connecting roads will not be simulated. If roads are traverse to the axis of advance, they are of no value to the unit's movement through the grid.

The format for entering the trafficability of roads is similar to that of elevation except that the ID for cols 73-75 is the letters "RDS." The closing entry of 999 is required.

Cross-Country Trafficability. The cross-country trafficability is similar to trafficability of roads and is used as a factor in determining the movement rates of various kinds of vehicles and dismounted infantry. The entries are either 1, 2, or 3.

Generally, one might classify the terrain so that movement rates would reflect that the grid with trafficability index 1 does not hinder the movement of units, terrain with trafficability index 2 provides some hindrance, and terrain with trafficability index 3 provides the most hindrance and may be impassable to some units with certain type of vehicles.

The format for entering the cross-country trafficability of a grid is similar to that of elevation except that the ID for cols 73-75 is the letters "TRF." The closing entry of 999 is required.

Cover. The average cover to direct fire provided by a grid in respect to other grids is described by 1 of 15 indexes. Index 1, for example, might be designated complete exposure for elements of units that are within that grid, while an index 15 might designate impregnable cover. Not all 15 indexes must be used.

The format for entering the average cover of a grid is similar to that of elevation except that the ID for cols 73-75 is the letters "COV." The limits of the cover index are 1 through 15. The closing entry of 999 is required.

Concealment. The concealment for a non-firing unit is also described in terms of 15 concealment index values. An index value defines the average amount of protection a unit has against hostile detection in a terrain

grid. Thus, during battle, as a unit moves from grid to grid, its average concealment can change depending on the concealment index number assigned to the terrain grid the unit is presently within. Not all 15 indexes need be used.

The format for entering the average concealment of a grid is similar to that of elevation except that the ID for cols 73-75 is the letters "CON." The limits of the concealment index are 1 through 15. The closing entry of 999 is required.

Examples of TERRAIN 1 entries are shown in Fig. 6

CARMONETTE

TERRAIN 1

TERRAIN CHARACTERISTICS

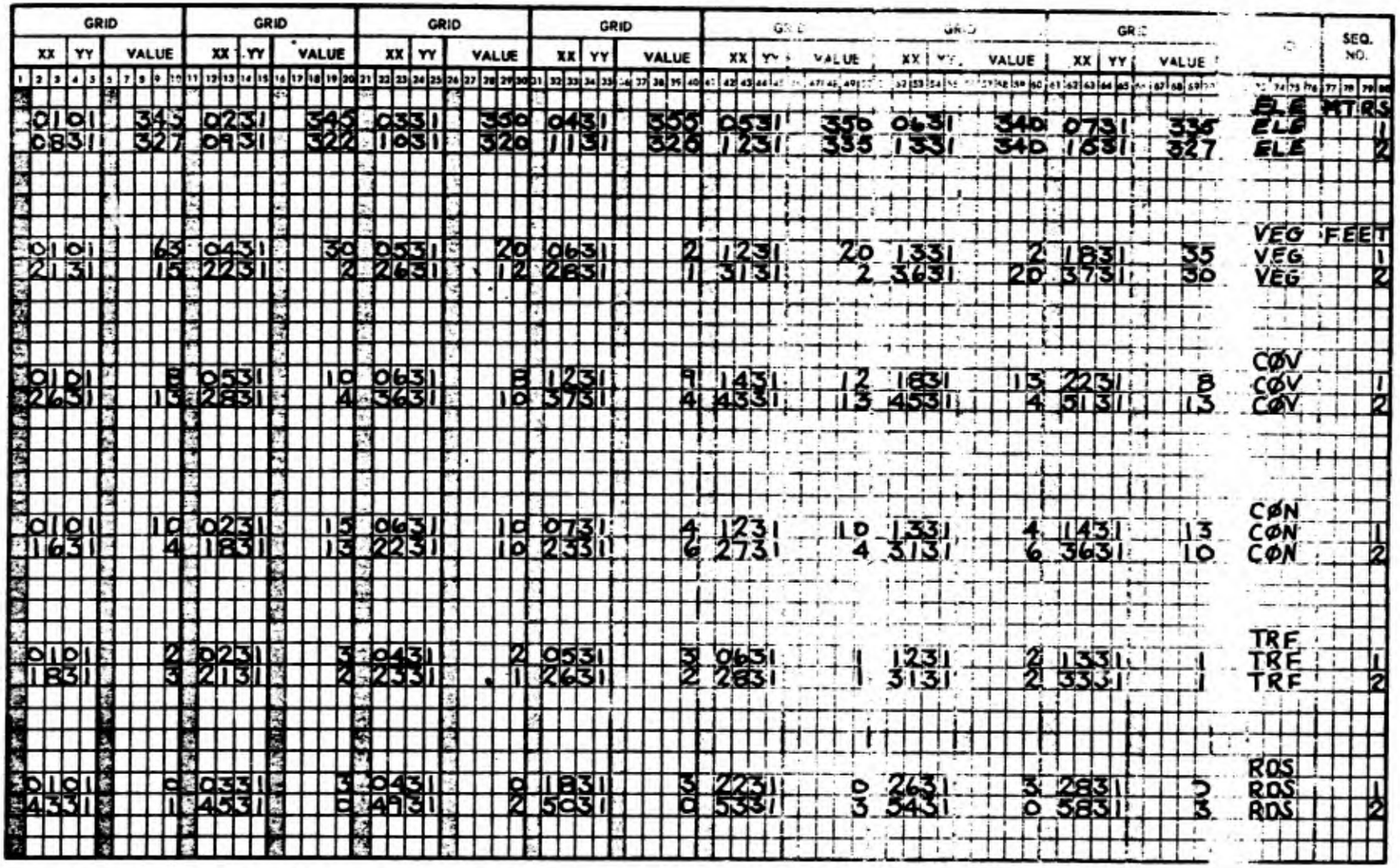

Fig. 6 - TERRAIN 1 Entries

TERRAIN 2

The effects of cover and concealment are simulated in CARMONETTE by reducing the size of the target that is presented to weapons and sensors. The size reduction is not fixed by the program; it is done by inputting the presented vulnerable and visible areas using form TERRAIN 2, Fig. 7. The columns on this form represent the element size indexes identified on the Unit Classification List that was prepared earlier, and the rows represent the cover indexes assigned on form TERRAIN 1. It is not necessary that all element sizes and cover states be used; only those of interest in the situation being gamed are required. It is also possible that the vulnerable and visible area may be different.

Information on vulnerable and visible areas is available in technical manuals, design specifications, or through Army Materiel Command agencies. The data shown below is for a Blue tank and is in a typical format.

Dimensions of a Fully Exposed Blue Tank

0^{o} (Front)				90^{o} (Side)			
Bottom Rectangle		Top Rectangle		Bottom Rectangle		Top Rectangle	
W(m)	H(m)	W(m)	H(m)	W(m)	H(m)	W(m)	H(m)
3.5	1.4	3.1	1.0	7.0	1.4	5.2	1.0

Given this information, form TERRAIN 2 is completed as follows and as shown in Fig. 7.

Since the only information given pertains to visible area, and no factors were given to convert it to vulnerable area, the two areas will be considered equal for this game. It is also necessary to decide how to combine the front and side areas since the model does not consider target orientation except in the case of helicopters. (The model sets the side area of a helicopter equal to five times its front area.) In this game it was decided to use the mean of the two areas. Table 7 shows two options for computing the areas to be input. Under either option, Cover State 1 represents a fully exposed target, and the area is calculated as shown below.

CARMONETTE
TERRAIN 2
COVER AND CONCEALMENT

	COVER CONVERSION TABLE PRESENTED VULNERABLE AREA (METER²) < 64.0										CONCEALMENT CONVERSION TABLE PRESENTED VISIBLE AREA (METER²) < 64.0										NET COVER (1, 2, or 3)											
Cover state	Element size index										Element size index										Element size index									Identification	
	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	ID	Seq. no.
1	111.5	100	85	75	60	52			110	105	111.5	100	85	75	60	52			110	105	3	3	3	3	3	3			3	3	T E R 2	1
2	107										107										3										T E R 2	2
3	99										99										3										T E R 2	3
4	90										90										2										T E R 2	4
5	82										82										2										T E R 2	5
6	74										74										2										T E R 2	6
7	66										66										2										T E R 2	7
8	58										58										2										T E R 2	8
9	49										49										2										T E R 2	9
10	41										41										2										T E R 2	10
11	33										33										2										T E R 2	11
12	25										25										2										T E R 2	12
13	16										16										2										T E R 2	13
14	08										08										2										T E R 2	14
15	00										00										2										T E R 2	15

Fig. 7 - TERRAIN 2 Entries

Table 7

WORKING TABLE FOR COVER AND CONCEALMENT COMPUTATIONS

OPTION 1		OPTION 2
Fraction of total area	Cover State	Condition
1	1	Fully exposed
13/14	2	In the open
6/7	3	
11/14	4	
5/7	5	At dismount points
9/14	6	
4/7	7	
1/2	8	Hasty positions
3/7	9	
5/14	10	
2/7	11	Deliberate positions
3/14	12	
1/7	13	
1/14	14	Fully covered and/or concealed
0	15	

$$\text{Area} = \frac{\text{Front Area} + \text{Side Area}}{2}$$

$$= \frac{[(3.5 \times 1.4) + (3.1 \times 1.0)] + [(7.0 \times 1.4) + (5.2 \times 1.0)]}{2}$$

$$= \frac{4.9 + 3.1 + 9.8 + 5.2}{2}$$

$$= 11.5 \text{ m}^2$$

This area is entered in columns 3, 4, 5 and 33, 34, 35 of line 1. Under Option 1, this area is multiplied by the appropriate fraction and the product entered as shown. Under Option 2 the gamer must decide how much of the total area is covered and/or concealed under the condition described. The gamer could decide that a tank traveling in the open would have ¼ of its hull covered; at dismount points ½ of the hull would be covered; in hasty positions 2/3 of hull would be covered; and in deliberate positions only the top rectangle would be exposed. He would then recompute the areas and enter them in the appropriate places on form TERRAIN 2.

The total cover for a unit depends on the cover provided by the square and the size of the elements of the unit. The net-cover table provides a measure of the cover of a unit as a function of the element-size index and the cover index of the grid square by assigning to each terrain-cover index and to each element-size index a net-cover index. In effect the net-cover table is a summary of the cover conversion table with only indexing values 1, 2, or 3. Net-cover index 1 is such that a unit of dismounted infantry has good protection against a fragmentation burst. Net-cover index 2 implies fair protection for dismounted infantry against a fragmentation burst. Net-cover index 3 implies poor protection for dismounted infantry against a fragmentation burst. The net-cover index is also used to characterize the cover available in a grid square when a decision to move or fire is to be made and the unit cannot fire while moving. The net-cover index 3 implies no cover for this tactical situation. A net-cover index is assigned to each combination of element-

size index and cover index. When dismounted infantry or open vehicles are pinned down, the program sets their net-cover index to 1 automatically.

STEP 4 - WEAPONS DATA

Weapons simulated in CARMONETTE are described by their characteristics, accuracies, kill probabilities and target priorities. This information is input to the model using five WEAPON forms.

WEAPON 1

The characteristics of a weapon includes its minimum and maximum range; minimum crew size; reaim and reload times; round velocity; impact area for indirect fire weapons; firing signature for direct fire weapons; guidance; and ammunition types. These data are available in technical manuals, tables of organization and equipment, firing tables, test reports, project managers, and similar DA and AMC publications. They are input to CARMONETTE using form WEAPON 1 which is described below and shown in Fig. 8.

Column	Characteristic
3-6	Minimum effective range of weapon in meters. Minimum value is zero.
7-11	Maximum effective range of weapon in meters. Maximum value of 32767 results from storage allocated by program and is not a problem for weapons likely to be used in a CARMONETTE game.
12-13	Minimum number of men required to serve weapon. Minimum: 1, maximum: 63.
14-17	Average aim time of weapon, in minutes.[1]
18-19	SD of aim time, in minutes.[2]
20-23	Average reaim time after weapon has been fired, in minutes.[1]
24-25	SD of reaim time, in minutes.[2]
26-29	Average time to load weapon, in minutes.[1] — The model assumes the proper ammunition is loaded prior to initial engagement, hence these inputs are not currently used.
30-31	SD of load time, in minutes.[2] — The model assumes the proper ammunition is loaded prior to initial engagement, hence these inputs are not currently used.
32-35	Average time to reload weapon after firing, in minutes.[1]

Column	Characteristic
36-37	SD of reload time, in minutes.[2]
38-42	Average round velocity, in meters per second. This velocity is taken over the range expected to be most used in the simulated battle. Minimum: 2, maximum: 32767.
43-50	For artillery and mortars, weapons 01 to 12, enter the length and width of the impact area in meters. The length is measured parallel to the direction of fire, the width perpendicular to it. The program will compare these dimensions with the grid size and store the impact area as one of four sizes: 1 by 1, 1 by 3, 3 by 1, or 3 by 3 grid squares.
53	For the 1 by 3 and 3 by 1 artillery and mortar impact areas described above the orientation is indicated as follows: Direction 0 implies that the direction of fire is parallel to the X axis. Direction 1 implies that the direction of fire is perpendicular to the X axis. Direction 2 implies that the direction of fire is 45(225) degrees to the X axis. Direction 3 implies that the direction of fire is 135(315) degrees to the X axis.
51-53	For all other weapons the approximate firing signature (flash, smoke, dust, etc.), in square meters to nearest tenth. Minimum: 0.1, maximum: 63.9.
54	Enter x if weapon is guided missile.
55	Enter x if weapon cannot be reloaded until impact occurs (e.g., wire-guided missile).
56	Enter x if weapon is to fire at farthest of two equally desirable targets (otherwise nearest target will be chosen).
57-60 62-65	Can be used to record ammunition types used by weapon, e.g., high-explosive antitank (HEAT), high explosive (HE). These names are for identification only.
61,66	Enter x if ammunition has multiple-kill capability (fragmentation ammunition).
67-68	Number of rounds per trigger pull normal mode of fire. Minimum: 1, maximum: 63.

Column	Characteristic
69-70	Neutralization weight per round. Minimum: 1, maximum: 63.

[1]Minimum value: 0.002, maximum value: 7.999. If a standard deviation (SD) is to be used, this value must be at least 3.4 times the value of the standard deviation.

[2]An entry is not required, however if a standard deviation is used, its minimum value is 0.02 and maximum value is 0.99.

Examples

The following is a discussion of the WEAPON 1 entries shown in Fig. 8. Columns 1 and 2 contain weapon numbers corresponding to those assigned on the Weapons List prepared during STEP 2.

Weapon 01 is the Blue medium mortar. The field manual describing this weapon gives the following data.

Ammunition: HE, WP, Illuminating

Range: Minimum - 100 meters
Maximum - 4700 meters

Bursting Area: 30 meter diameter

Rate of Fire: 5 rounds/minutes, sustained.

The organization chart in Fig. 3 shows a crew size of 5. A technical memorandum prepared by the Army Materiel Systems Analysis Agency adds:

Time to fire 1st round: 15 seconds

Probable Error: Range - 50 meters
Deflection - 15 meters

Lethal Area, HE round: Personnel, standing - 798 m^2
Personnel, prone - 596 m^2

A map inspection indicates that this mortar will generally engage targets at ranges from 3000 to 4000 meters. The appropriate firing table shows the time of flight to 3500 meters is 32 seconds.

CARMONETTE

WEAPON 1

WEAPONS CHARACTERISTICS (Weapons 1 to 34)

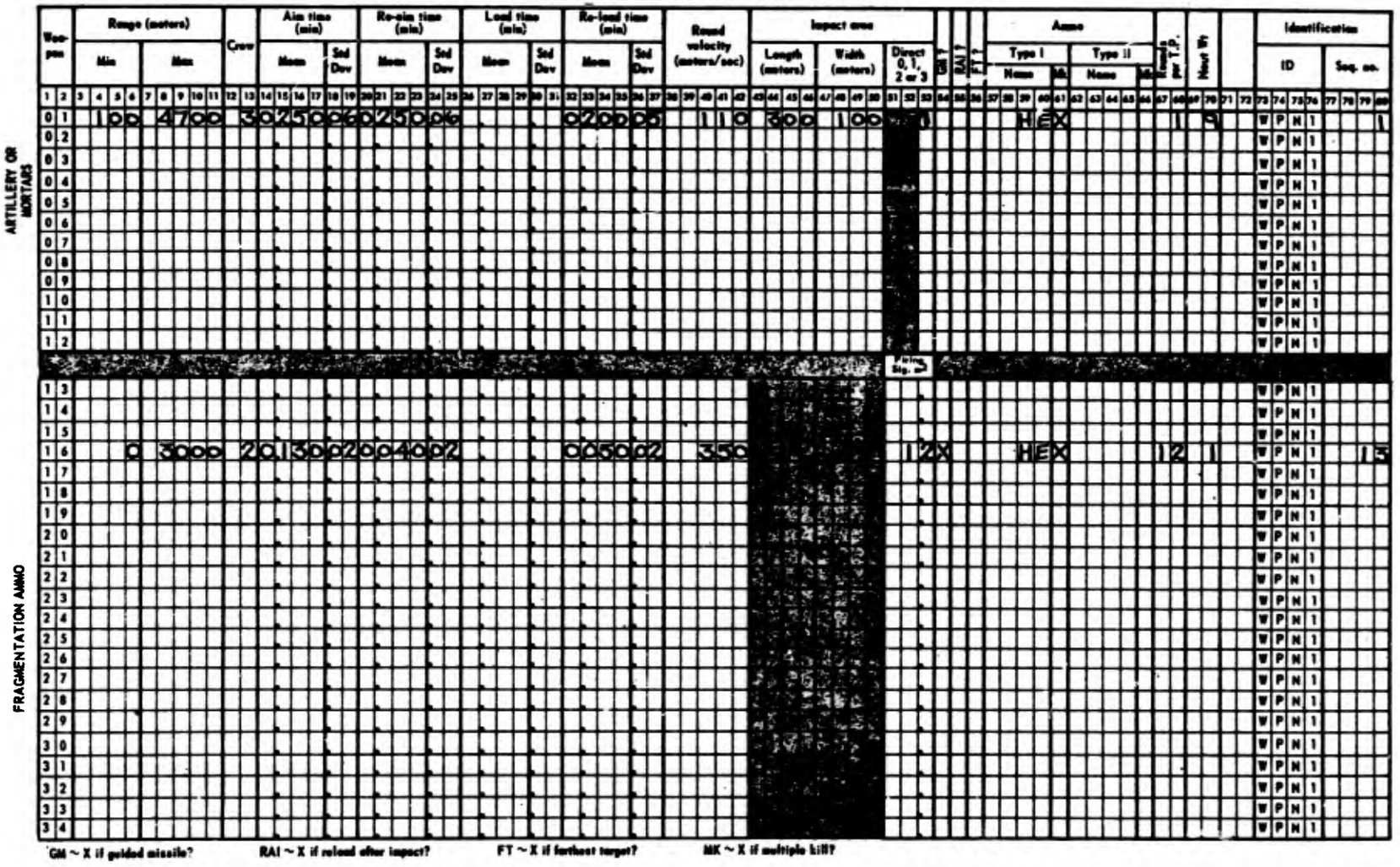

Fig. 8 - WEAPON 1 Entries

CARMONETTE

WEAPON 1

WEAPONS CHARACTERISTICS (Weapons 35 to 56)

NONFRAGMENTATION AMMO

Weapon	Range (meters) Min	Range (meters) Max	Crew	Aim time (min) Mean	Aim time (min) Std Dev	Re-aim time (min) Mean	Re-aim time (min) Std Dev	Load time (min) Mean	Load time (min) Std Dev	Re-load time (min) Mean	Re-load time (min) Std Dev	Round velocity (meters/sec)	Target area Length (meters)	Target area Width (meters)	Firing Sig. m^2	GM ?	RAI ?	FT ?	Ammo Type I Name	Ammo Type I No.	Ammo Type II Name	Ammo Type II No.	Rounds per T.P.	Next Wt		Identification ID	Identification Seq. no.
1 2	3 4 5 6	7 8 9 10 11	12 13	14 15 16 17	18 19	20 21 22 23	24 25	26 27 28 29	30 31	32 33 34 35	36 37	38 39 40 41 42	43 44 45 46	47 48 49 50	51 52 53	54	55	56	57 58 59 60	61	62 63 64 65	66	67	68 69	70	71 72	73 74 75 76	77 78 79 80
35																											WPN1	
36																											WPN1	
37																											WPN1	
38																											WPN1	
39																											WPN1	
40																											WPN1	
41	50	1000	10	12	00	30	22	00	05	22	00	05	89			15	XX		HEAT				110				WPN1	21
42																											WPN1	
43																											WPN1	
44																											WPN1	
45																											WPN1	
46																											WPN1	
47																											WPN1	
48																											WPN1	
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52																											WPN1	
53																											WPN1	
54																											WPN1	
55																											WPN1	
56																											WPN1	

GM ~ X if guided missile? RAI ~ X if reload after impact? FT ~ X if farthest target? MK ~ X if multiple kill?

Fig. 8 - WEAPON 1 Entries continued

The above data is entered on WEAPON 1 using the following reasoning:

Range:	Enter directly
Crew:	Although 5 men are assigned, 3 can operate the weapon. If the number of men serving the weapon falls below 3 during the simulated battle, the weapon will cease firing.
Aim Time:	15 secs = 0.250 minutes. No standard deviation is given, therefore it is estimated to be ¼ the aim time and equals 0.06 minutes.
Reaim Time:	Artillery and mortars do not reaim during a single mission, therefore the entrys used for aim time are used.
Load Time:	This value is not used by program, hence it is left blank.
Reload Time:	5 rounds per minute is equivalent to 0.20 minutes reload time. Again the standard deviation is approximated by ¼ the basic entry.
Round Velocity:	$\frac{3500 \text{ meters}}{32 \text{ seconds}}$ = 110 meters/second
Impact Area:	Of the four impact area configurations available, the 3 by 1 most closely approximates that of the 3 tube mortar section, therefore enter 300 × 100.
Direction:	The direction of fire of the mortars parallels the X axis so enter 0.
GM?, RAI?, FT?:	None of these apply, therefore no entry.
Ammo:	Only high explosive (HE) will be used in these games, and it is a multi-kill munition.
Rounds per TP:	The weapon fires a single round per trigger pull.
Neut Wt:	This is a judgmental input and is estimated to be 9.

Weapon 16 is a Red air defense multi-barreled machine gun employed in its primary role. Since the characteristics of this weapon when employed against ground targets are quite different from those in the AD role data must be entered for the system in both roles. Data on "threat weapons" is available through the Intelligence Threat Analysis Detachment (ITAD) of ACSI and AMSSA. The same sort of reasoning as was used for the Blue mortar is used in entering this weapon on the form, therefore only those entries that have a different basis will be discussed below. This discussion pertains to the AD role.

Standard Deviations for Reaim and Reload Times: The minimum non-zero input, 0.02, is used to indicate that a standard deviation is desired. When the program determines that the standard deviation is not less than the basic entry divided by 3.4, it will compute and store the remaining reload (Reaim or Reload Time)/3.4 rather than the 0.2 which was input.

Firing Signature: This is a judgmental input scaled to the signature of a rifle which is set at 0.1.

GM?: Although the weapon is not a guided missile, an X in this column causes the program to confirm that line of sight between the AD gun and the helicopter still exists at the time of impact. If the helicopter has remasked LOS does not exist, and the rounds from the AD gun do not impact.

Rounds per TP: See discussion pertaining to this weapon under form WEAPON ?.

Weapon 41 is a Blue medium antitank weapon that fires non-fragmenting ammunition, therefore there is no option to indicate multiple kill under ammunition.

WEAPON 2

In addition to the range to a target, the accuracy of a direct-fire weapon is a function of the following:

Volley History:	Is this a first or a subsequent round? Did the first round hit or miss the target?
Firer Activity:	Is the firer stationary or moving? Is the firer partially suppressed by incoming rounds?
Target Activity:	Is the target stationary or moving?

CARMONETTE uses the distance a round is expected to miss a target under appropriate combinations of the above factors to calculate hit probabilities. These expected miss distances are recorded on WEAPON 2. Three data cards are provided for each direct-fire weapon. They are the miss distance at maximum effective range (card 1), at 0.707 maximum effective range (card 2), and at zero range (card 3). The computer program will fit a quadratic curve to these three points to derive the miss distance for any range. It is important that the value for zero range be obtained by backward quadratic extrapolation from the minimum effective range of the weapon. This data should be provided by AMSAA or other AMC laboratories. Occasionally the data will be provided in the format required but usually comes in the form of tables or curves which use a $7\frac{1}{2} \times 7\frac{1}{2}$-ft target and give the probability of a hit given a shot ($P_{H|S}$) and the probability of a kill given a hit ($P_{K|H}$). The probability of a kill given a hit will be discussed in conjunction with WEAPON 3. Table 8 lists miss distances that correspond to hit probabilitites against a $7\frac{1}{2} \times 7\frac{1}{2}$-ft target; appropriate miss distances are entered on WEAPON 2. The preprocessor calculates selected hit probabilities based on these inputs. These values are compared with the $P_{H|S}$ curves and/or tables, and the miss distances are adjusted until the values from the preprocessor match the curves.

WEAPON 2 is completed by recording the known or estimated values of miss distance on three cards for each weapon type as shown in the accompanying explanation.

Table 8

PROBABILITY OF HITTING A STATIONARY 7½ BY 7½-FT TARGET CORRESPONDING TO A GIVEN MISS DISTANCE MEASURED IN METERS

Miss distance	Probability of hit	Miss distance	Probability of hit
0.4	1.00	2.0	.16
0.5	0.95	2.1	.15
0.6	0.92	2.2	.14
0.7	0.88	2.3	.13
0.8	0.75	2.4	.12
0.9	0.64	2.5	.11
1.0	0.53	2.7	.09
1.1	0.48	2.8	.07
1.2	0.45	2.9	.08
1.3	0.38	3.1	.06
1.4	0.31	3.5	.05
1.5	0.29	3.8	.04
1.6	0.28	4.3-4.7	.03
1.7	0.23	4.9-6.7	.02
1.8	0.20	7.0	.00
1.9	0.17		

Column	Characteristic
Left margin	Enter weapon name for identification.
4-6	First round miss distance (to nearest 0.1 meter accuracy), firer moving, stationary target, weapon normal (not suppressed), ammunition type I.
7-9	Same as above for ammunition type II.
10-12	First round miss distance (to nearest 0.1 meter accuracy), firer moving, stationary target, weapon partially suppressed, ammunition type I.
13-15	Same as above for ammunition type II.
16-18	First round miss distance (to nearest 0.1 meter accuracy), firer moving, moving target, weapon normal, ammunition type I.
19-21	Same as above for ammunition type II.
22-24	First round miss distance (to nearest 0.1 meter accuracy), firer moving, moving target, weapon partially suppressed, ammunition type I.
25-27	Same as above for ammunition type II.
28-51	First round miss distance (to nearest 0.1 meter accuracy), firer stationary, etc.
52-63	Subsequent round miss distance (to nearest 0.1 meter accuracy), given first round hit, etc.
64-75	Subsequent round miss distance (to nearest 0.1 meter accuracy), given first round miss, etc.
NOTE:	In all cases the minimum entry is 00.0 and the maximum is 99.9.

Examples

Weapon 13 is the main gun on the Blue tank. Accuracy data similar to that provided by AMSAA is shown in Tables 9 and 10.

CARMONETTE uses a single value for probability of a kill given a hit, therefore it is necessary to combine the two probabilities given above into a single probability of a kill given a shot, decide upon a representative probability of a kill given a hit, and then modify the probability of a hit table. This modified table is shown in Table 11.

Table 9

HIT PROBABILITY ESTIMATES FOR MAIN GUN FIRED FROM A MOVING BLUE TANK AT A STATIONARY, VERTICAL, 7½ × 7½-FT TARGET, APDS ROUND

Range	Probability of a hit
250	0.92
500	0.90
1000	0.77
1500	0.55
2000	0.35
2500	0.21
3000	0.12

Table 10

PROBABILITY OF A KILL (M or F) GIVEN A HIT VS RED TANK, EXPOSED (AVERAGED OVER ATTACK ANGLES), APDS ROUND

Range	Probability of a kill
500	0.77
1000	0.67
1500	0.61
2000	0.48
2500	0.40
3000	0.31

Table 11

WORKING TABLE, HIT AND KILL PROBABILITIES,
WEAPON NUMBER 13, 1st ROUND, FIRER MOVING,
TARGET STATIONARY, FIRER NORMAL

Range	$P_{K\|S}$	Effective $P_{H\|S}$ ($P_{K\|S}/0.59$)
250	0.75	1.00
500	0.69	1.00
1000	0.52	0.88
1500	0.34	0.58
2000	0.17	0.29
2500	0.08	0.14
3000	0.04	0.07

Inspection of the map of the game area shows that most Red tanks engaged by the Blue tanks will be at ranges from 1000 to 2000 meters. The average of the $P_{K|H}$ over these ranges is 0.59, therefore this value is selected as the representative $P_{K|H}$. The $P_{K|S}$ values are now divided by 0.59 to give the accuracy data to be input on WEAPON 2 as shown in Fig. 9. Range Card 2 pertains to accuracies at 0.707 of the maximum range, in this case 2121 meters. The working table (Table 11) shows the P_H to be approximately 0.28, and according to Table 8 a miss distance of 1.6 meters will result in a P_H of 0.28. Enter 1.6 in cols 5 and 6 of Card 2 of Weapon Number 13. A similar process is followed for the other Firer/Target/Round Number/Ammunition combinations. Table 12 is an example of the preprocessor output; a 7½ × 7½-ft target has an equivalent radius of 1.3 meters.

Data on the Red air defense weapon, Weapon 16, is provided in a format similar to that for Weapon 13. Since the probability of a hit with a single round is 0.0013 at 3000 meters, and the smallest P_H used in the model is 0.02, it becomes necessary to create an artificial round that will accurately represent a burst of fire from this weapon. This is done in the following manner.

The probability of at least one hit ($P_{H/n}$) from a burst of "n" rounds is given by:

$$P_{H/n} = 1-(1-P_{H/1})^n$$

Since both $P_{H/n}$ (0.02) and $P_{H/1}$ (0.0013) are known, this expression is solved for "n"

$$n = \frac{\ln(1-P_{H/n})}{\ln(1-P_{H/1})} = \frac{0.0202}{0.0017} = 11.88 \approx 12$$

The weapon normally fires a 144 round burst. Since 12 real rounds are represented by one of our artificial rounds, the number 12 is entered in cols 67 and 68 of WEAPON 1 for Weapon 16. WEAPON 2 is then completed in the manner described above.

The Blue MAW, Weapon 41, cannot fire on the move, therefore no entries are necessary in cols 4 through 27. Unless the crew is partially suppressed, the accuracy of this weapon is not dependent upon range; so the miss distance is the same on all three cards.

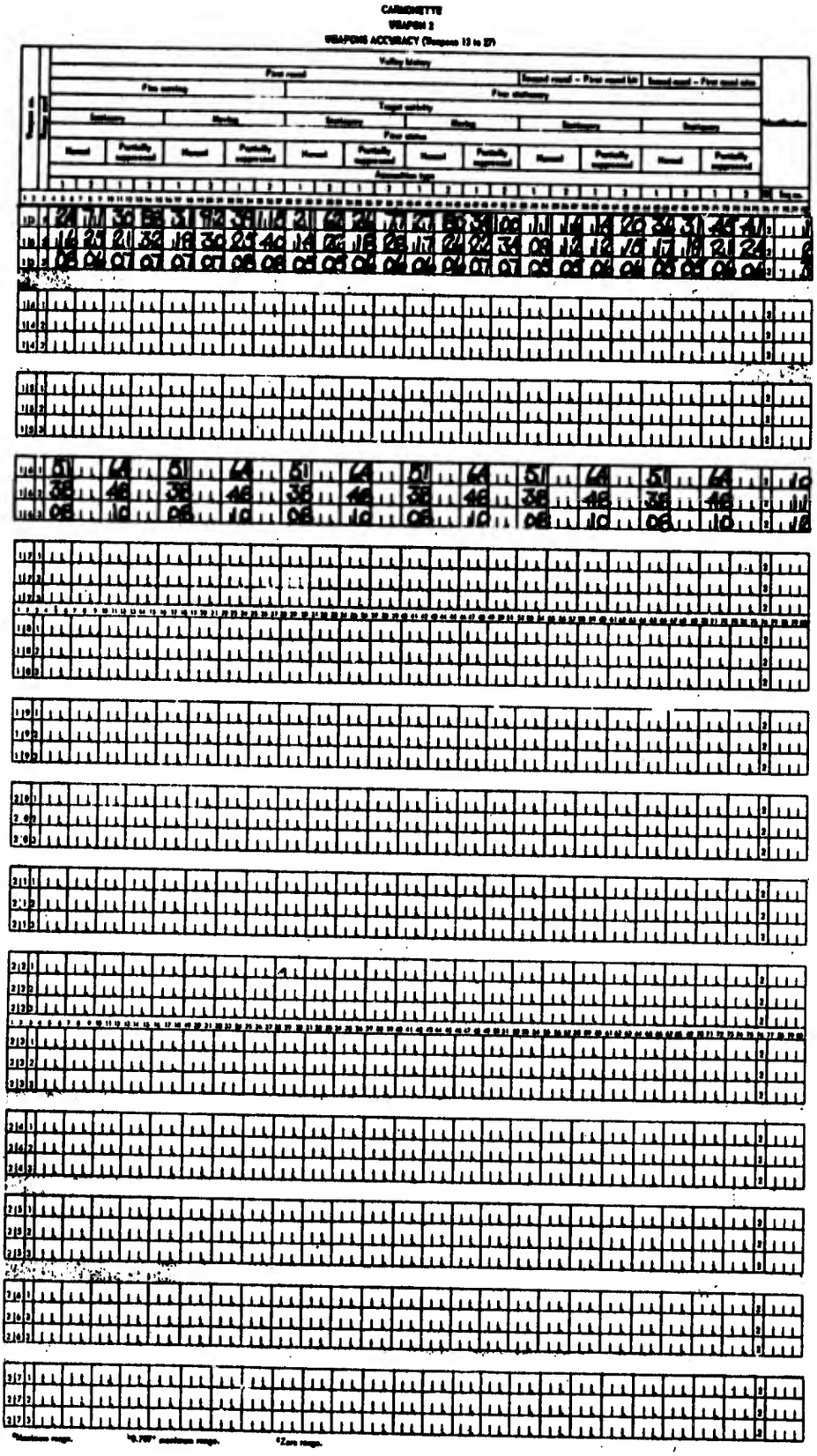


Fig. 9 - WEAPON 2 Entries

CARBINETTE
WEAPON 2
WEAPONS ACCURACY (Weapons 20 to 42)

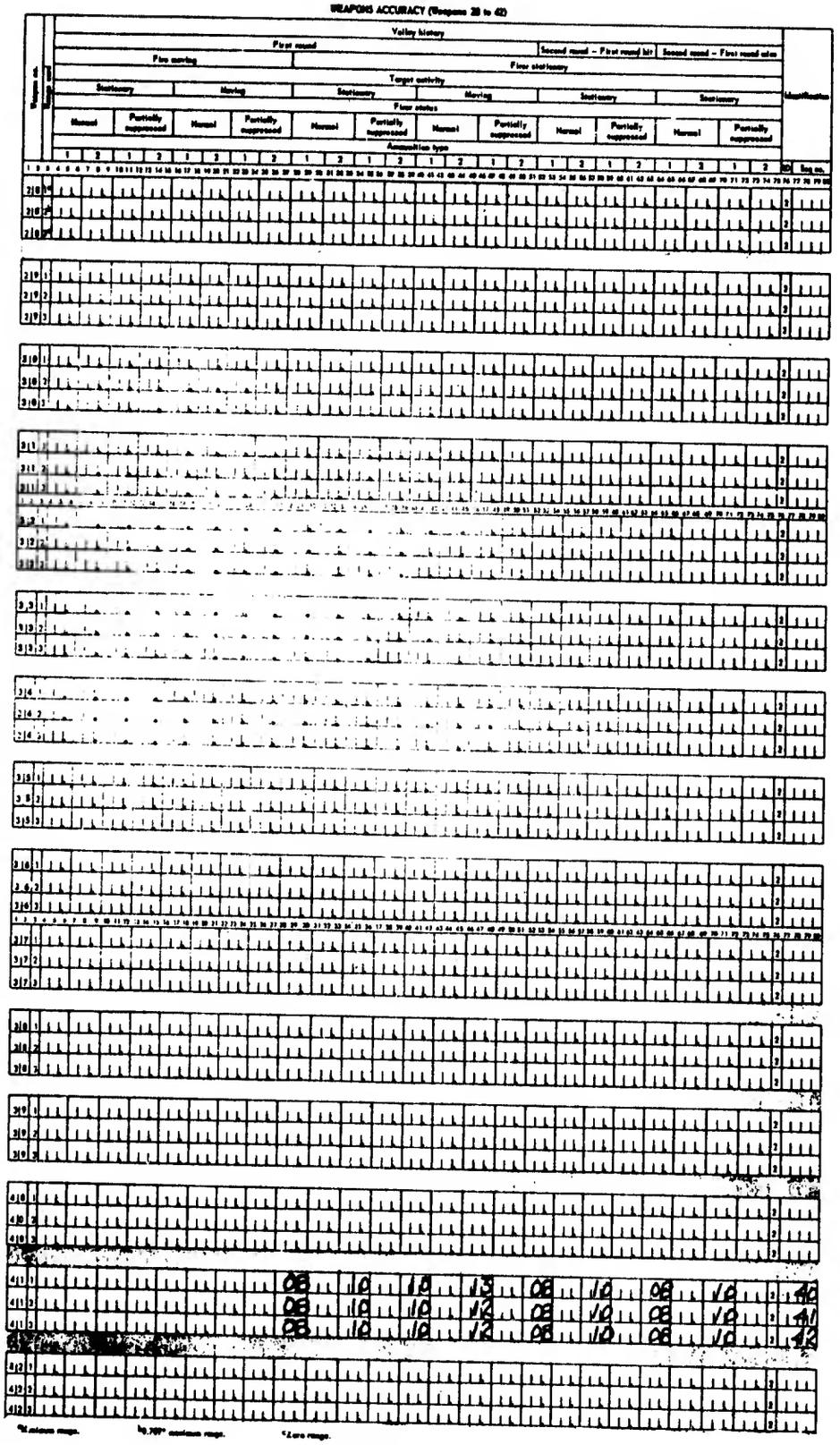


Fig. 9 - WEAPON 2 Cont'd

Table 12

PROBABILITY OF HIT VS RANGE, WEAPON TYPE 13, AMMUNITION TYPE I
TARGET RADIUS 1.3

WEAPON TYPE	AMMO TYPE	TARGET RADIUS	RANGE	PROBABILITY OF HIT VS. RANGE											
				TARGET MOVING (FIRER MOVING) NEUTRALIZED		TARGET MOVING (FIRER NOT MOVING) NEUTRALIZED		TARGET NOT MOVING (FIRER MOVING) NEUTRALIZED		TARGET NOT MOVING (FIRER NOT MOVING) NEUTRALIZED			NOT NEUTRALIZED		
				YES	NO	YES	NO	YES	NO	1ST	2/M	2/M	1ST	2/M	2/M
13	1	1.9	0.	.92	1.00	1.00	1.00	1.00	.92	1.00	1.00	1.00	1.00	1.00	1.00
			750.	.84	.92	.91	1.00	.91	.91	.97	1.00	.94	1.00	1.00	1.00
			1500.	.45	.67	.58	.78	.61	.77	.72	.91	.55	.86	.94	.86
			2250.	.19	.33	.27	.41	.30	.48	.38	.72	.20	.55	.89	.39
			3000.	.09	.16	.13	.20	.16	.25	.22	.59	.09	.33	.84	.11
13	1	1.7	0.	.92	.98	.98	1.00	.98	.92	1.00	1.00	1.00	1.00	1.00	1.00
			750.	.80	.91	.89	.95	.89	.89	.94	1.00	.92	.98	1.00	1.00
			1500.	.41	.61	.53	.73	.55	.72	.66	.88	.50	.81	.92	.81
			2250.	.17	.28	.23	.38	.27	.42	.33	.67	.19	.50	.84	.34
			3000.	.08	.14	.11	.17	.14	.22	.19	.55	.08	.30	.80	.09
13	1	1.6	0.	.91	.94	.94	1.00	.94	.91	1.00	1.00	1.00	1.00	1.00	1.00
			750.	.75	.89	.86	.94	.88	.86	.92	.95	.91	.94	1.00	.95
			1500.	.36	.55	.47	.67	.50	.66	.59	.84	.44	.77	.91	.77
			2250.	.14	.25	.20	.33	.22	.38	.30	.61	.16	.44	.81	.31
			3000.	.06	.13	.09	.16	.13	.19	.17	.48	.06	.25	.73	.08
13	1	1.5	0.	.88	.92	.92	1.00	.92	.88	1.00	1.00	1.00	1.00	1.00	1.00
			750.	.69	.84	.81	.92	.83	.81	.91	.92	.88	.92	.95	.92
			1500.	.31	.48	.41	.61	.44	.59	.53	.80	.39	.70	.89	.70
			2250.	.13	.22	.17	.28	.19	.33	.25	.55	.14	.39	.75	.27
			3000.	.06	.09	.08	.13	.09	.16	.14	.42	.05	.22	.67	.08
13	1	1.4	0.	.83	.91	.91	.97	.91	.83	.97	.97	.97	.97	.97	.97
			750.	.61	.80	.75	.89	.77	.75	.88	.92	.83	.91	.92	.91
			1500.	.27	.42	.36	.55	.38	.52	.47	.72	.33	.63	.84	.63
			2250.	.11	.19	.14	.23	.17	.28	.22	.48	.11	.33	.69	.22
			3000.	.05	.08	.06	.11	.08	.14	.13	.38	.05	.19	.61	.06
13	1	1.3	0.	.75	.88	.88	.92	.88	.75	.92	.92	.92	.92	.92	.92
			750.	.53	.72	.69	.86	.69	.67	.83	.89	.77	.88	.91	.89
			1500.	.22	.36	.30	.47	.33	.45	.41	.66	.28	.55	.78	.55
			2250.	.08	.16	.13	.20	.14	.23	.17	.41	.09	.28	.61	.19
			3000.	.03	.06	.05	.09	.06	.11	.09	.31	.03	.14	.53	.05

WEAPON 3 AND WEAPON 4

After a direct-fire round has hit its target or an indirect-fire round has impacted in the desired area, the model determines if the hit has caused a kill. The probability of a kill given a hit used in CARMONETTE depends upon whether or not the target is a vehicle, and if the target is a vehicle, whether or not it is a soft vehicle (Fire Response Class 2). WEAPON 3 contains the probability of kill given a hit by direct-fire rounds that have not fragmented; WEAPON 4 contains the probability of kill given a hit by rounds that have fragmented. The logic employed by the model in determining the probability of a kill given a hit is shown in Fig. 10.

An X in column 61 or 66 of form WEAPON 1 identifies fragmenting ammunition. If the round being considered is not fragmenting, the probability of a kill given a hit is determined from WEAPON 3. If the round is fragmenting, the target is identified as a vehicle or not. If the target is not a vehicle, it is infantry, and the probability is taken from WEAPON 4. If the target is a vehicle, it is identified as being "soft" (Fire Response Class 2) or "hard" (Fire Response Classes 3 and 4). If the target is "hard", the kill probability is taken from WEAPON 4. If the target is "soft", WEAPON 3 is consulted to determine if the round kills the vehicle before fragmenting; if it does all crew members die with the vehicle. If the round does not kill the "soft" vehicle, the probability of killing individual crew member is determined from WEAPON 4.

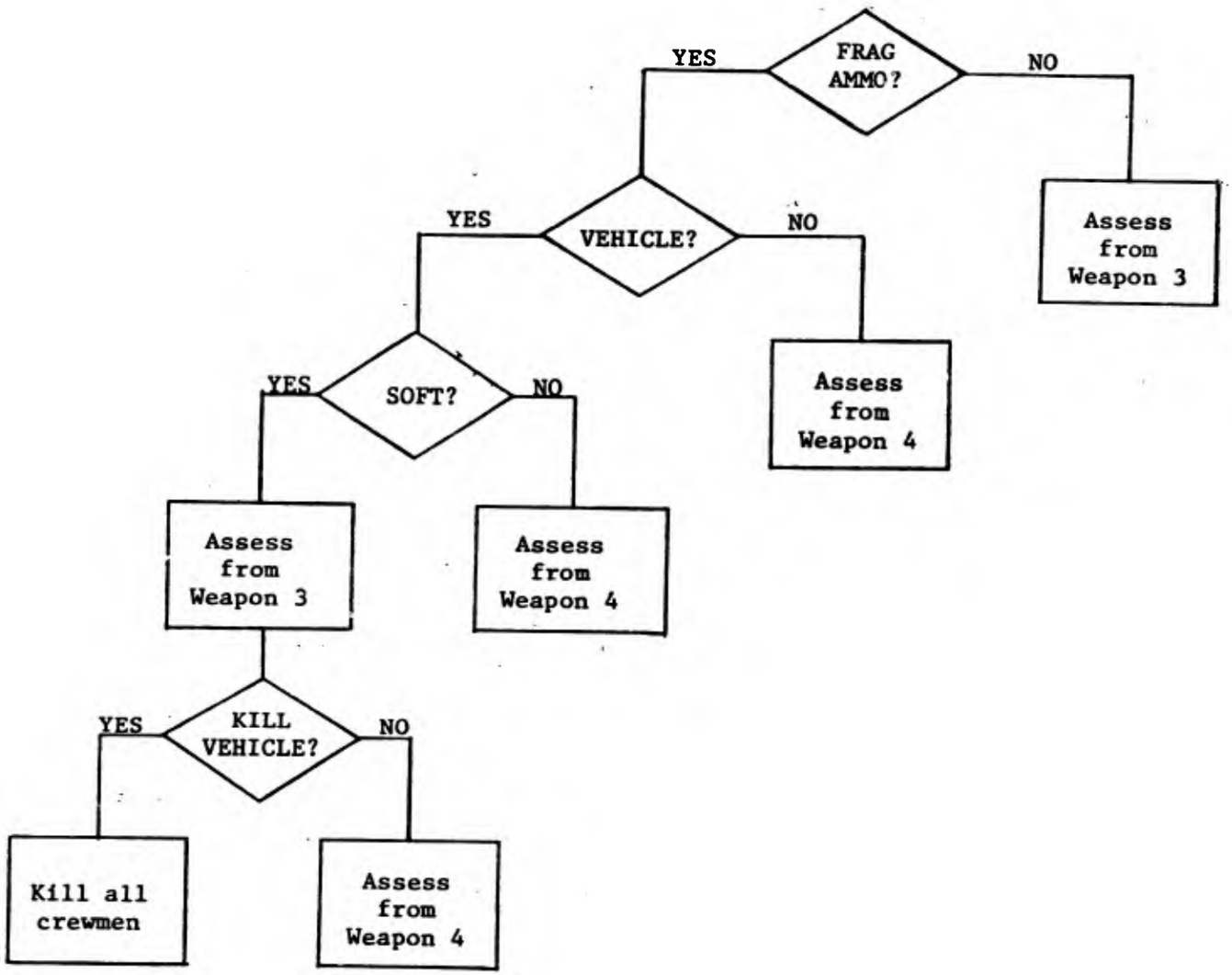


Fig. 10 - Logic for Determining Probability of a Kill Given a Hit

WEAPON 3

The probability of a kill given a hit for direct-fire weapons and the type of ammunition to be used against each vulnerability class for all weapons are entered on WEAPON 3 as explained below and shown in Fig. 11. The numbers across the top of the form indicate the weapon number; those along the left edge identify vulnerability class.

Column	Characteristic
Left & top margin	Enter vulnerability class and weapon name for identification.
5, 8, 11, 14, ...68	Enter x to indicate the ammunition type each weapon type prefers to use against each vulnerability index.
6&7, 9&10, ..., 69&70	Enter kill probabilities given a hit of each vulnerability index by each ammunition and weapon type for each direct-fire weapon. Limits: 0.00 to .99.

The probability of survival of troops who are not crew members inside troop carriers when the carrier is destroyed is entered as vulnerability class 12; this probability is usually provided by AMSAA. All crew members are killed with the carrier.

Examples

Since Weapon 1, the Blue medium mortar, has only one ammunition type no entries are required.

Weapon 6 is the Blue medium howitzer with dual purpose ammunition for type I and high explosive ammunition for type II. Type I is selected for vulnerability classes 1, 2, 3, 4, and 5; type II is selected for vulnerability classes 6 and 7 and troops riding inside of armored personnel carriers destroyed by type I ammunition have a 0.95 probability of survival.

The Blue tank gun (Weapon 13) has both armor piercing, disposable sabot (type I) and high explosive antitank (type II) ammunition. As shown

in Fig. 11, type I is preferred against the Red tank and type II against other targets.

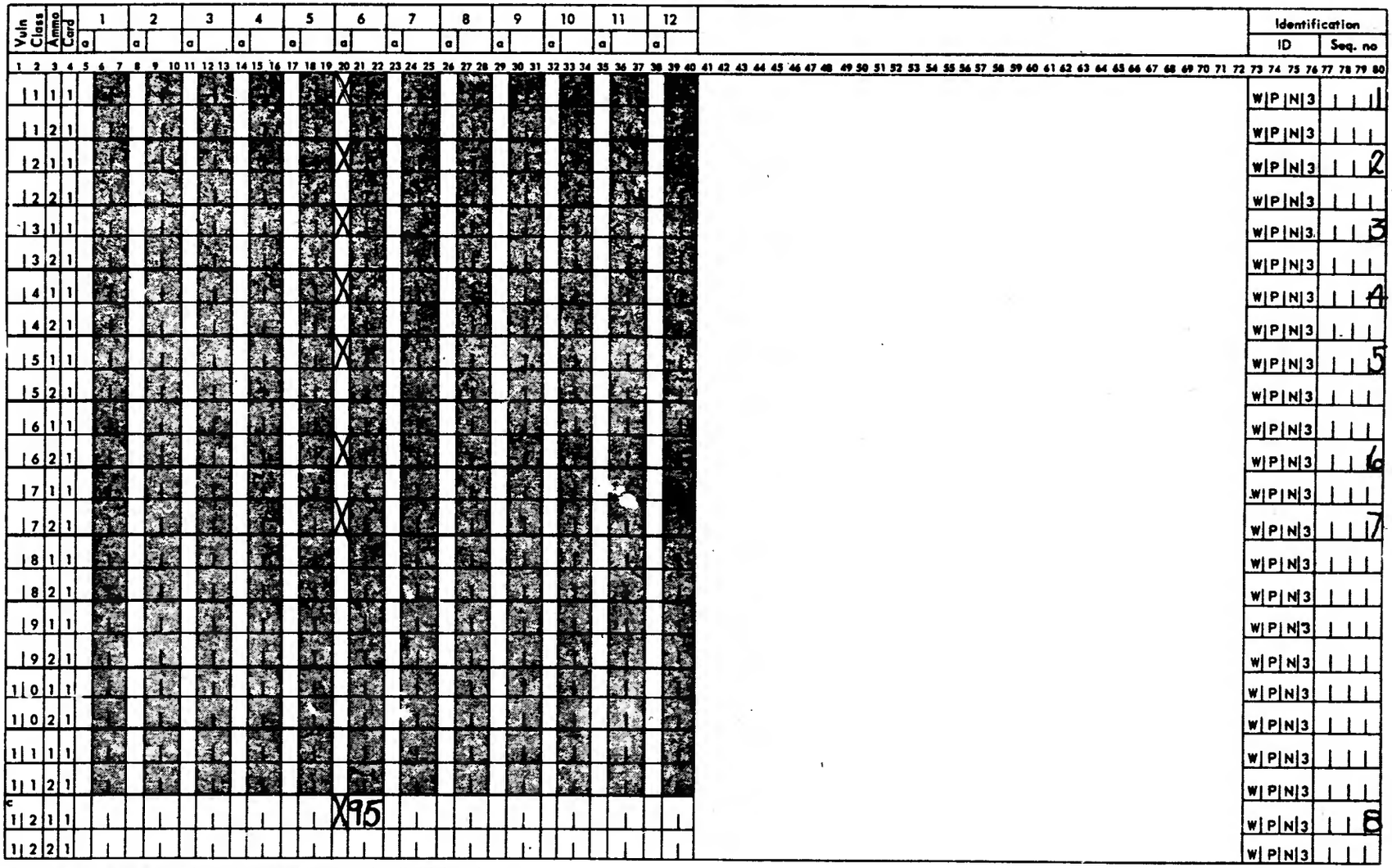
Since the Blue MAW, Weapon 41, only has one type of ammunition, there is no need to mark an ammunition selection. The probabilities of killing the various type targets are as shown in Fig. 11.

CARMONETTE

WEAPON 3

KILL PROBABILITY AND AMMUNITION SELECTION

(Weapons 1 to 12)



a – X if preferred ammo type for each weapon against each vulnerability class.

c – Entries for Vuln Class 12 are probabilities of survival of passengers in troop carriers.

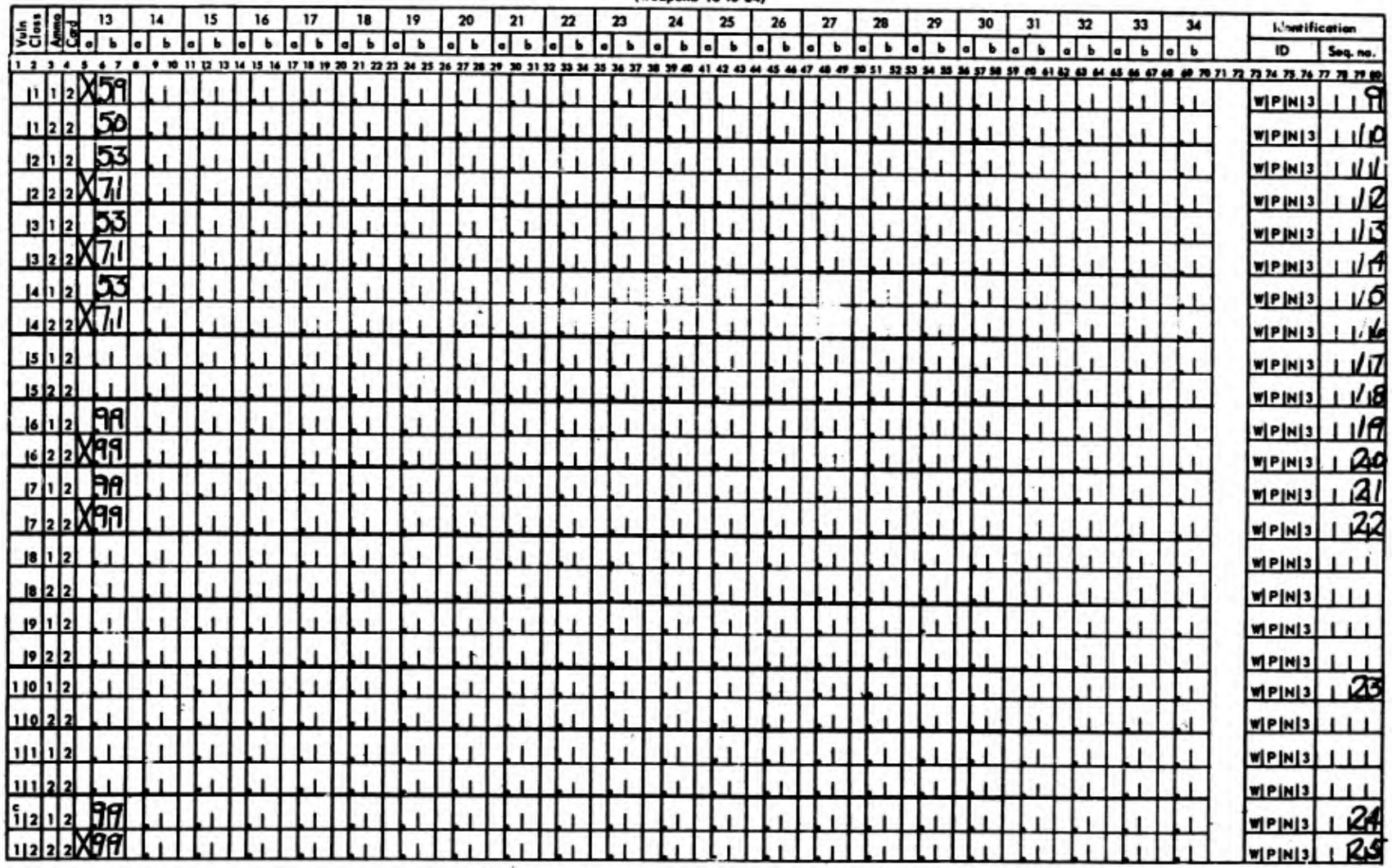
Fig. 11 - WEAPON 3 Entries

CARMONETTE

WEAPON 3

KILL PROBABILITY AND AMMUNITION SELECTION

(Weapons 13 to 34)



a – X if preferred ammo type for each weapon against each vulnerability class.
b – probability of kill.
c – Entries for Vuln Class 12 are probabilities of survival of passengers in troop carriers.

Fig. 11 – WEAPON 3 Entries continued

CARMONETTE

WEAPON 3

KILL PROBABILITY AND AMMUNITION SELECTION

(Weapons 35 to 56)

Vuln Class	Ammo Card	35 a	35 b	36 a	36 b	37 a	37 b	38 a	38 b	39 a	39 b	40 a	40 b	41 a	41 b	42 a	42 b	43 a	43 b	44 a	44 b	45 a	45 b	46 a	46 b	47 a	47 b	48 a	48 b	49 a	49 b	50 a	50 b	51 a	51 b	52 a	52 b	53 a	53 b	54 a	54 b	55 a	55 b	56 a	56 b	Identification ID	Identification Seq. no.
1	1 3		38																																										W|P|N|3	26
1	2 3																																														W|P|N|3	
2	1 3		33																																												W|P|N|3	27
2	2 3																																														W|P|N|3	
3	1 3		58																																												W|P|N|3	28
3	2 3																																														W|P|N|3	
4	1 3		58																																												W|P|N|3	29
4	2 3																																														W|P|N|3	
5	1 3																																														W|P|N|3	30
5	2 3																																														W|P|N|3	
6	1 3		99																																												W|P|N|3	31
6	2 3																																														W|P|N|3	
7	1 3																																														W|P|N|3	32
7	2 3																																														W|P|N|3	
8	1 3																																														W|P|N|3	
8	2 3																																														W|P|N|3	
9	1 3																																														W|P|N|3	
9	2 3																																														W|P|N|3	
10	1 3																																														W|P|N|3	33
10	2 3																																														W|P|N|3	
11	1 3																																														W|P|N|3	
11	2 3																																														W|P|N|3	
c 12	1 3		99																																												W|P|N|3	34
12	2 3																																														W|P|N|3	

a – X if preferred ammo type for each weapon against each vulnerability class.
b – probability of kill.
c – Entries for Vuln Class 12 are probabilities of survival of passengers in troop carriers.

Fig. 11 – WEAPON 3 Entries continued

WEAPON 4

The probability of killing infantry in various net-cover indexes by weapon and ammunition types is entered on WEAPON 4. The probability of killing infantry is equivalent to the lethal area of the number of rounds fired per trigger pull divided by the total impact area. For artillery and mortars the length and width of the impact area are entered in cols 43 to 50 on WEAPON 1. For other fragmenting rounds the impact area is the area occupied by the target unit (deployment area).

The kill probability of dual purpose munitions against vehicles is also entered on WEAPON 4. It should be noted that this kill probability is entered as a four-digit decimal fraction (.0000 to .9999). The type vehicle target is identified by "vulnerability class." If any type of weapon or type of ammunition is not effective against a particular type vehicle, no entry is made at this point. This kill probability is:

$$P_k = \frac{\text{vulnerable area of vehicle}}{\text{impact area}} \times \text{number of submissiles} \times \text{probability of kill given a hit by a submissile}$$

WEAPON 4 is shown in Fig. 12 and is completed as follows. The data on Weapon 1, the Blue medium mortar, shows the lethal areas against personnel as: standing— 798 m^2; prone— 596 m^2. Standing is equated to "Not responding to hostile fire." Net Cover State 2 is considered to represent typical conditions. Using the equation, $P_k = \frac{\text{Lethal Area}}{\text{Impact Area}}$, the probability of killing infantry responding to hostile fire and in Net Cover State 2 is $P_k = \frac{596}{300\times100} = 1.99\times10^{-2} \approx 0.02$. This probability when the infantry is not responding to hostile fire is, $P_k = \frac{798}{300\times100} = 2.66\times10^{-2} \approx 0.03$. These values are entered on the form as shown. The probability is lower for Net Cover State 1 and higher for Net Cover State 3, but 0.02 is the minimum entry for infantry; so it is entered for Net Cover State 1. For Net Cover State 3 the probability is increased by 0.01. Weapon 1 has no capability against vehicles, therefor there are no entries under Vehicles.

The probability of killing infantry with the Blue medium howitzer, Weapon 6, is calculated as above. This weapon also has a dual purpose round; the probability of killing a tank with this type of ammunition is shown below. The size of the vulnerable area should be provided by ITAD or other intelligence agencies. In this case it is 15 m^2. The impact area is input on WEAPON 1 and is 9×10^4 m^2. AMSAA provides information on the number of submissiles and $P_{K|H} = 0.25$.

$$P_k = \frac{15}{9 \times 10^4} \times 90 \times 0.25 = 0.0038$$

This value is entered in cols 16 through 19 for Weapon 6. The probability of killing vulnerability classes 2, 3, and 4 is computed in the same manner. NOTE THAT ONLY VULNERABILITY CLASSES 1 THROUGH 4 CAN BE KILLED BY FRAGMENTING AMMUNITION.

CARMONETTE

WEAPON 4

PROBABILITY OF KILLING INFANTRY AND VEHICLES
WITH FRAGMENTING AND DUAL PURPOSE MUNITIONS

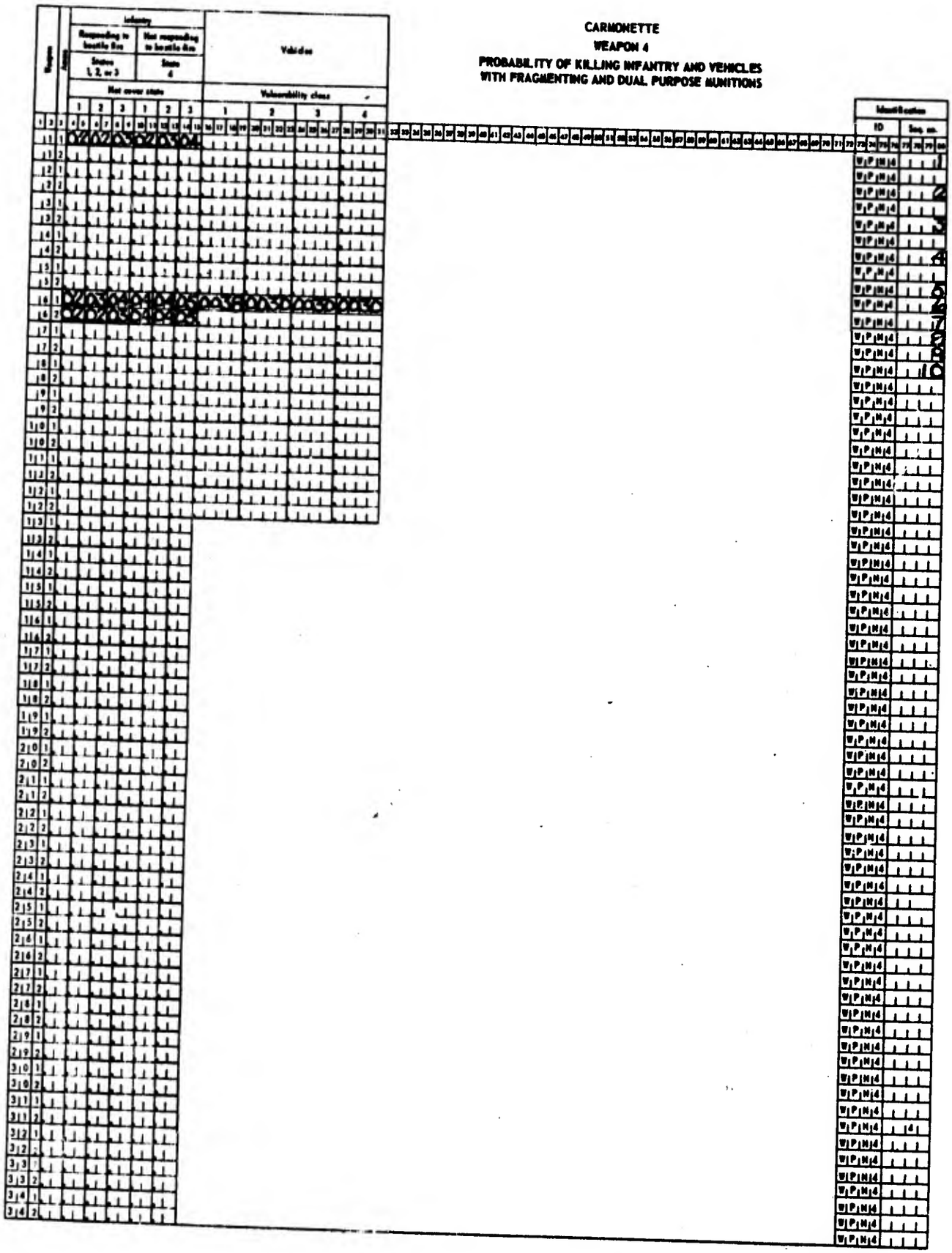


Fig. 12 - WEAPON 4 Entries

WEAPON 5

Targets are not of equal value to all firers, and all weapons are not capable of killing all targets, therefore each weapon has specific target preferences. These preferences, Target Lists, are input to CARMONETTE using WEAPON 5. There are separate target lists for each side. The form provides for three separate target lists for each weapon. At each point of the battle, each unit will be told in its orders which target list its active weapon should follow. This form consists of two pages for each side. Page one pertains to direct-fire weapons (13-34) with fragmenting ammunition. Page two is for direct-fire weapons (35-56) with solid projectile ammunition. The ordering of target classes within a list does not determine the priority in which targets will be selected. The decision as to which target should be engaged is based on the threat targets represent to the firer and upon their proximity to the firer.

The ordering within the lists does influence the manner in which a unit conducts surveillance however. The model restricts a unit's surveillance to an area surrounding targets that are first on each of the three lists. This restriction is accomplished in the following manner. A unit conducts surveillance over the entire battlefield until it determines the general location on a target that is first on one of the three lists. The unit then restricts the area over which it is conducting surveillance to the square occupied by the target and the eight squares surrounding it. In the event that an observer knows the general location of more than one target that meets the above criteria, surveillance is restricted to the closest target. If more than one target are at the same distance from the observer, surveillance is restricted to all of them. If target information is lost, the process is repeated. The form is shown in Fig. 13, and is completed as follows.

Example

Appropriate targets for the main gun, Weapon 13, on the Blue tank are other tanks, APCs, HAWs, and self-propelled air defense weapons. The target classes representing these targets are recorded on the form. The

coaxial machine gun, Weapon 48, should engage infantry squads, AD shoulder fired missile gunners and the ground mount HAW when it is in range.

The Blue helo, Weapon 36, will engage targets in the same priority as the tank except that it will always engage air defense weapons first.

The Red self-propelled air defense gun, Weapon 16, and shoulder-fired missile, Weapon 53, will only engage helicopters.

CARMONETTE

WEAPON 5 - BLUE

TARGET LISTS (Weapons 13 to 34)

Side	Weapon	List 1						List 2						List 3						Identification	
		Target class preference																		ID	Seq. no.
		1[a]	2	3	4	5	6	1[a]	2	3	4	5	6	1[a]	2	3	4	5	6		
B	13	1	2	4	5	12		4	5	2	11	12		2	5	1	4	12		W P N 5	1 1
B	14																			W P N 5	
B	15																			W P N 5	
B	16																			W P N 5	
B	17																			W P N 5	
B	18																			W P N 5	
B	19																			W P N 5	
B	20																			W P N 5	
B	21																			W P N 5	
B	22																			W P N 5	
B	23																			W P N 5	
B	24																			W P N 5	
B	25																			W P N 5	
B	26																			W P N 5	
B	27																			W P N 5	
B	28																			W P N 5	
B	29																			W P N 5	
B	30																			W P N 5	
B	31																			W P N 5	
B	32																			W P N 5	
B	33																			W P N 5	
B	34																			W P N 5	

[a]First preference.

Fig. 13 - WEAPON 5 Entries (Blue)

CARMONETTE

WEAPON 5 - BLUE

TARGET LISTS (Weapons 35 to 56)

Side	Weapon	List 1						List 2						List 3						Identification	
		Target class preference																		ID	Seq. no.
		1*	2	3	4	5	6	1*	2	3	4	5	6	1*	2	3	4	5	6		
B	35																			W P N 5	
B	36	12	11	12	4	5		12	4	5	2	11		12	2	5	11	4		W P N 5	11
B	37																			W P N 5	
B	38																			W P N 5	
B	39																			W P N 5	
B	40																			W P N 5	
B	41																			W P N 5	
B	42																			W P N 5	
B	43																			N 5	
B	44																			W P N 5	
B	45																			W P N 5	
B	46																			W P N 5	
B	47																			W P N 5	
B	48	8	7	6	4			7	6	4	8			6	4	8	7			W P N 5	25
B	49																			W P N 5	
B	50																			W P N 5	
B	51																			W P N 5	
B	52																			W P N 5	
B	53																			W P N 5	
B	54																			W P N 5	
B	55																			W P N 5	
B	56																			W P N 5	

*First preference.

Fig. 13 - WEAPON 5 Entries (Blue) continued

CARMONETTE

WEAPON 5 - RED

TARGET LISTS (Weapons 13 to 34)

Side	Weapon	List 1						List 2						List 3						Identification	
		Target class preference																		ID	Seq. no.
		1*	2	3	4	5	6	1*	2	3	4	5	6	1*	2	3	4	5	6		
R	1 3																			W P N 5	
R	1 4																			W P N 5	
R	1 5																			W P N 5	
R	1 6	10						10						10						W P N 5	17
R	1 7																			W P N 5	
R	1 8																			W P N 5	
R	1 9																			W P N 5	
R	2 0																			W P N 5	
R	2 1																			W P N 5	
R	2 2																			W P N 5	
R	2 3																			W P N 5	
R	2 4																			W P N 5	
R	2 5																			W P N 5	
R	2 6																			W P N 5	
R	2 7																			W P N 5	
R	2 8																			W P N 5	
R	2 9																			W P N 5	
R	3 0																			W P N 5	
R	3 1																			W P N 5	
R	3 2																			W P N 5	
R	3 3																			W P N 5	
R	3 4																			W P N 5	

*First preference.

Fig. 13 - WEAPON 5 Entries (Red)

CARMONETTE

WEAPON 5 - RED

TARGET LISTS (Weapons 35 to 56)

Side	Weapon	List 1						List 2						List 3						Identification	
		Target class preference																		ID	Seq. no.
		1*	2	3	4	5	6	1*	2	3	4	5	6	1*	2	3	4	5	6		
1 2 3	4 5	6 7 8 9 10 11 12 13 14 15						16 17 18 19 20 21 22 23 24 25 26 27						28 29 30 31 32 33 34 35 36 37 38 39						73 74 75 76	77 78 79 80
R	3 5																			W P N 5	
R	3 6																			W P N 5	
R	3 7																			W P N 5	
R	3 8																			W P N 5	
R	3 9																			W P N 5	
R	4 0																			W P N 5	
R	4 1																			W P N 5	
R	4 2																			W P N 5	
R	4 3																			W P N 5	
R	4 4																			W P N 5	
R	4 5																			W P N 5	
R	4 6																			W P N 5	
R	4 7																			W P N 5	
R	4 8																			W P N 5	
R	4 9																			W P N 5	
R	5 0																			W P N 5	
R	5 1																			W P N 5	
R	5 2																			W P N 5	
R	5 3	10						10						10						W P N 5	29
R	5 4																			W P N 5	
R	5 5																			W P N 5	
R	5 6																			W P N 5	

*First preference.

Fig. 13 - WEAPON 5 Entries (Red) continued

STEP 5 - SENSOR DATA

In order for the weapon considered in STEP 4 to engage targets, it is first necessary to detect targets. Detection in CARMONETTE is done by sensors and is a function of sensor type, range, target size, and target and observer activity. The model provides for six sensor classes of six types each. Three are for general sensor classes and three are special sensor classes.

General Sensors

The probability of detecting an exposed tank at a given range is much greater than that of detecting a man at the same range; however if the man is moved closer there is a range at which the probability of detecting the man is equal to that of detecting the tank at the original range. The parameter that provides a measure of the above phenomena is the solid angle subtended by each target. The solid angle subtended by a target is equal to the visible area of the target divided by the square of the range from the observer to the target. A tank (11.5 m^2) at 3000 meters subtends the same solid angle as a man (0.5 m^2) at 625 meters. CARMONETTE uses four intervals of solid angle to compute detection probabilities. These are determined by four threshold values, α_1, α_2, α_3, and α_{max}. Let A denote the solid angle presented by a target to an observer; the intervals are defined as follows:

a. $\alpha_{max} < A < \alpha_1$
b. $\alpha_1 \leq A < \alpha_2$
c. $\alpha_2 \leq A < \alpha_3$
d. $\alpha_3 \leq A$

Four states are used to describe the information possessed by an observing unit concerning a target unit. These states are:

1. Target's location unknown
2. Target known to be located in a certain grid square
3. Target erroneously pinpointed within a grid square
4. Target correctly pinpointed

Changes in the information state of an observer are determined by the model based on a transition matrix similar to the one shown below.

Present state \ Subsequent state	1	2	3	4
1	P11	P12	P13	P14
2	P21	P22	P23	P24
3	P31	P32	P33	P34
4	P41	P42	P43	P44

Probabilities of changing from the present state to the subsequent state are contained in the body of the matrix. Six probabilities; P11, P12, P14, P44, P41, and P21, are input for each sensor, in each solid angle, for stationary and moving targets, and for normal and partially suppressed observers. The other probabilities are calculated by the first preprocessor, and the matrices are then stored for use by the model.

Sensor data is generally provided by the US Army Electronics Command and is in the form of detection probability curves such as that shown in Fig. 14. CARMONETTE inputs are derived and recorded as follows. Identify the four ranges R_1, R_2, R_3, and R_{max} with their corresponding solid angle thresholds α_1, α_2, α_3, and α_{max} as shown in Fig. 15. The general sensor forms are completed as follows.

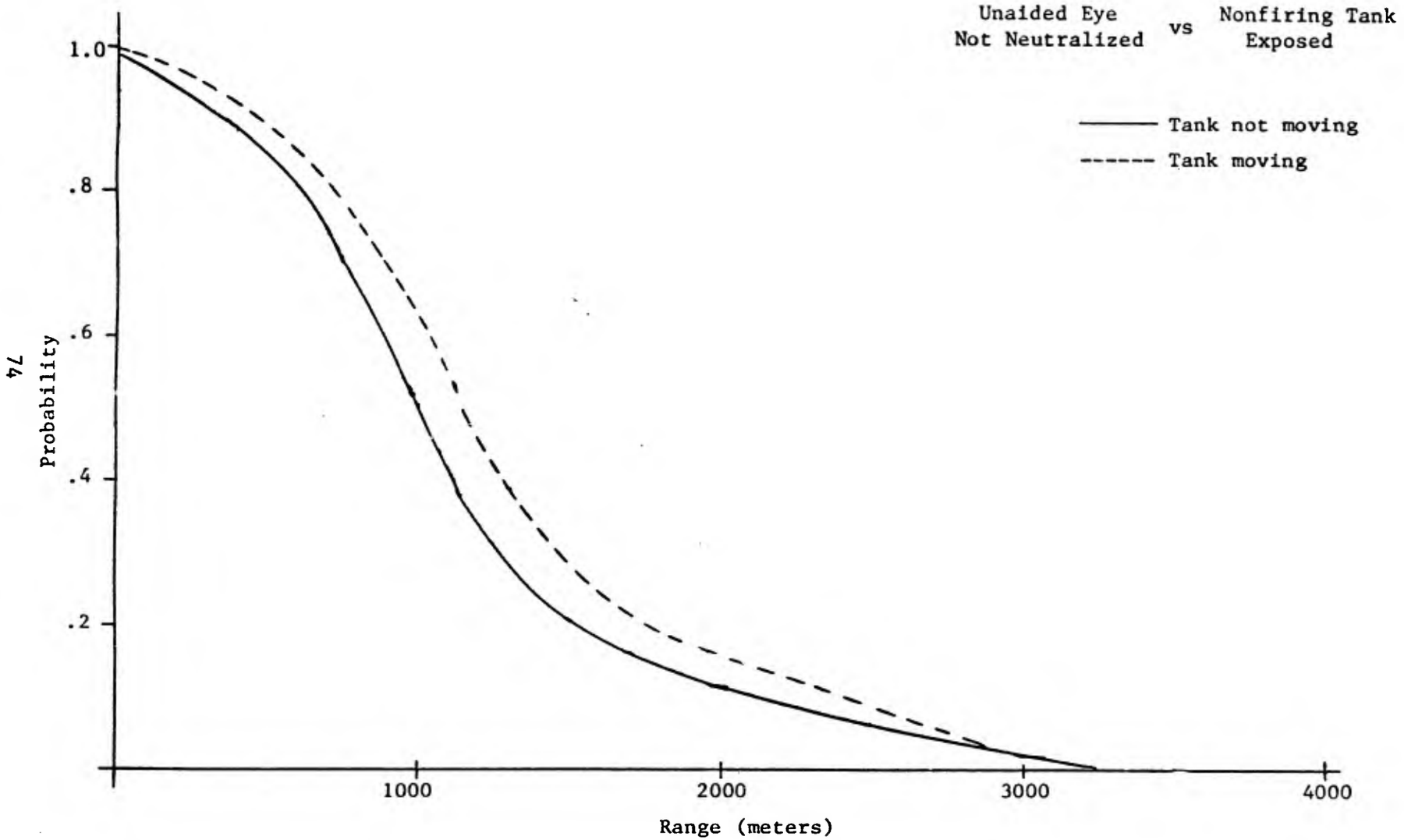


Fig. 14 - Detection Probability

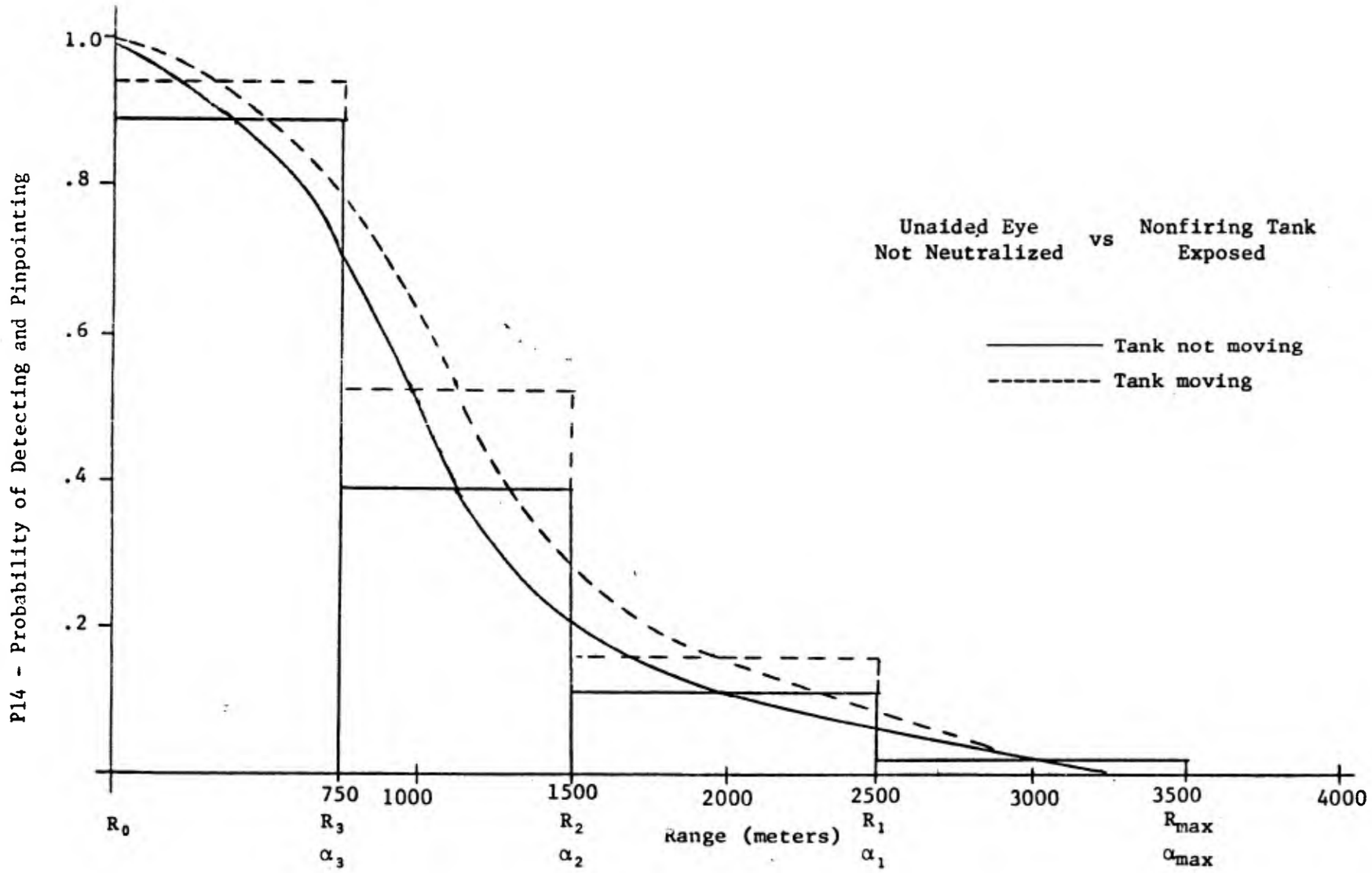


Fig. 15 — Detection Probability Curve with Ranges and Solid Angles

SENSOR 1

Sensor number 51 was identified as unaided eyes on the preliminary work sheets. When line of sight to a target is lost, two methods are used to degrade information states. The first item on SENSOR 1, the probability of loss of target information, is used each scan time to degrade the information state from State 2 to State 1 if LOS has been lost. If a unit has a higher state of information and LOS is lost, the information state will be degraded one state each time until State 2 is reached. Record in cols 3 and 4 of SENSOR 1, Fig. 16, the estimated probability that an observing unit will completely forget the existence of a target unit after line of sight has been lost; this is 0.50 for the unaided eye.

The Surveillance Interval, also referred to as the Intelligence Cycle, controls the frequency with which an observer using a specific sensor will have the opportunity to change his information state. The surveillance interval is set at 1 minute for the unaided eye and is entered in cols 5 through 8. The solid angle thresholds for non-firing targets are based on the visible area of the largest target when it is fully exposed. This area is recorded on TERRAIN 2 as the presented visible area of element size 0 in Cover State 1 and is 11.5 m^2. Calculate the thresholds as follows:

$$\alpha_1 = \frac{11.5}{(2500)^2} = 1.84 \times 10^{-6}. \quad \text{Enter in cols 9-15}$$

$$\alpha_2 = \frac{11.5}{(1500)^2} = 5.11 \times 10^{-6}. \quad \text{Enter in cols 16-22}$$

$$\alpha_3 = \frac{11.5}{(750)^2} = 2.04 \times 10^{-5}. \quad \text{Enter in cols 23-29}$$

$$\alpha_{max} = \frac{11.5}{(3500)^2} = 9.39 \times 10^{-7}. \quad \text{Enter in cols 30-36}$$

The same technique is used to determine the solid angle thresholds for firing targets, and the largest firing signature shown in cols 51-53 of WEAPON 1. It is not necessary for the ranges used for detection of firing targets be the same as those used for non-firing targets.

CARMONETTE
SENSOR 1
SENSOR CLASS TABLES

Sensor Class & Type	Probability of Loss of Tgt Info	Surveillance Interval (min)	Non-Firing Targets: Solid Angle Thresholds α1	α2	α3	Max Range	Firing Targets: Solid Angle Thresholds β1	β2	β3	Max Range	Identification: ID	Seq. No.
5 1	50	1000	1.84E-6	5.11E-6	2.04E-5	9.39E-7	3.33E-6	7.50E-6	5.32E-5	2.45E-7	SENS	1

Fig. 16 - SENSOR 1 Entries

SENSOR 2, 3, AND 4

Six probabilities of changing information state are required as inputs; three are probabilities of improving information:

P11 - The probability of not detecting a target

P12 - The probability of detecting but not pinpointing a target (probability of gaining nearest square information)

P14 - The probability of detecting and pinpointing a target

These probabilities are so related that their sum must not be greater than one. Restrictions imposed by the computations require that P11 and P12 be 0.02 or greater and that P14 may be zero but must be less than 0.96.

Example

The curve shown in Fig. 15 represents P14; the following procedure is used to input this data. P14 for the unaided eye, not neutralized, against a fully exposed, stationary tank between ranges of 3500 and 2500 meters is read from Fig. 15 as 0.03 and is entered in cols 21 and 22 of SENSOR 4 (see Fig. 19). In the next range interval the probability 0.12 is entered in cols 23 and 24. The remaining two probabilities are 0.40 and 0.90 and are entered in cols 25 and 26, and cols 27 and 28 respectively. The probabilities for moving tanks can also be read directly from this figure and recorded in the appropriate columns. The probabilities when the observer is partially suppressed can be obtained from a similar curve or may be described as a percent degradation from the normal curve. They are also recorded in the appropriate columns.

If curves are available for P11 and P12, the above technique is used to determine entries on SENSOR 2 (Fig. 17) and SENSOR 3 (Fig. 18) respectively. If data on these probabilities are not available, inputs are derived judgmentally, based on the restrictions discussed above.

SENSOR 2

PROBABILITY OF NOT DETECTING A TARGET

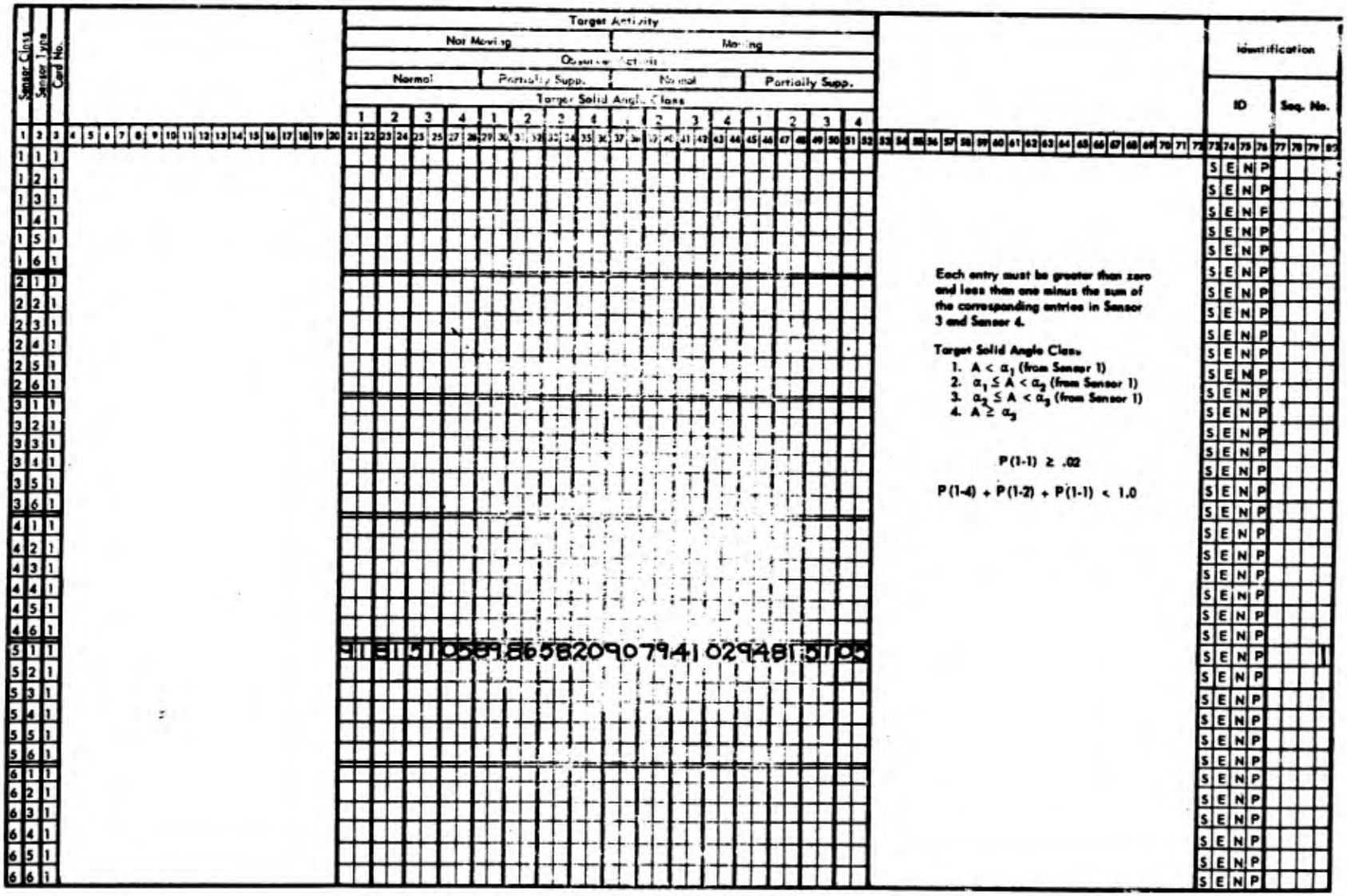


Fig. 17 - SENSOR 2 Entries

CARMONETTE

SENSOR 3

PROBABILITY OF DETECTING BUT NOT PINPOINTING A TARGET

Sensor Class	Sensor Type	Card No.	Target Activity: Not Moving / Observer Activity: Normal / Target Solid Angle Class 1	2	3	4	Not Moving / Partially Supp. 1	2	3	4	Moving / Normal 1	2	3	4	Moving / Partially Supp. 1	2	3	4	Identification: ID	Seq. No.
1	2	3	21 22	23 24	25 26	27 28	29 30	31 32	33 34	35 36	37 38	39 40	41 42	43 44	45 46	47 48	49 50	51 52	73 74 75 76	77 78 79 80
1	1	2																	S E N P	
1	2	2																	S E N P	
1	3	2																	S E N P	
1	4	2																	S E N P	
1	5	2																	S E N P	
1	6	2																	S E N P	
2	1	2																	S E N P	
2	2	2																	S E N P	
2	3	2																	S E N P	
2	4	2																	S E N P	
2	5	2																	S E N P	
2	6	2																	S E N P	
3	1	2																	S E N P	
3	2	2																	S E N P	
3	3	2																	S E N P	
3	4	2																	S E N P	
3	5	2																	S E N P	
3	6	2																	S E N P	
4	1	2																	S E N P	
4	2	2																	S E N P	
4	3	2																	S E N P	
4	4	2																	S E N P	
4	5	2																	S E N P	
4	6	2																	S E N P	
5	1	2	0 3	0 3	0 4	0 2	0 4	0 4	0 6	0 5	0 2	0 2	0 3	0 2	0 2	0 3	0 4	0 2	S E N P	5
5	2	2																	S E N P	
5	3	2																	S E N P	
5	4	2																	S E N P	
5	5	2																	S E N P	
5	6	2																	S E N P	
6	1	2																	S E N P	
6	2	2																	S E N P	
6	3	2																	S E N P	
6	4	2																	S E N P	
6	5	2																	S E N P	
6	6	2																	S E N P	

Each entry must be greater than zero.

Target Solid Angle Class

1. $A < \alpha_1$ (from Sensor 1)
2. $\alpha_1 \leq A < \alpha_2$ (from Sensor 1)
3. $\alpha_2 \leq A < \alpha_3$ (from Sensor 1)
4. $A \geq \alpha_3$

$P(1\text{-}2) \geq 0.02$

$P(1\text{-}4) + P(1\text{-}2) + P(1\text{-}1) < 1.0$

Fig. 18 - SENSOR 3 Entries

CARMONETTE

SENSOR 4

PROBABILITY OF DETECTING AND PINPOINTING A TARGET

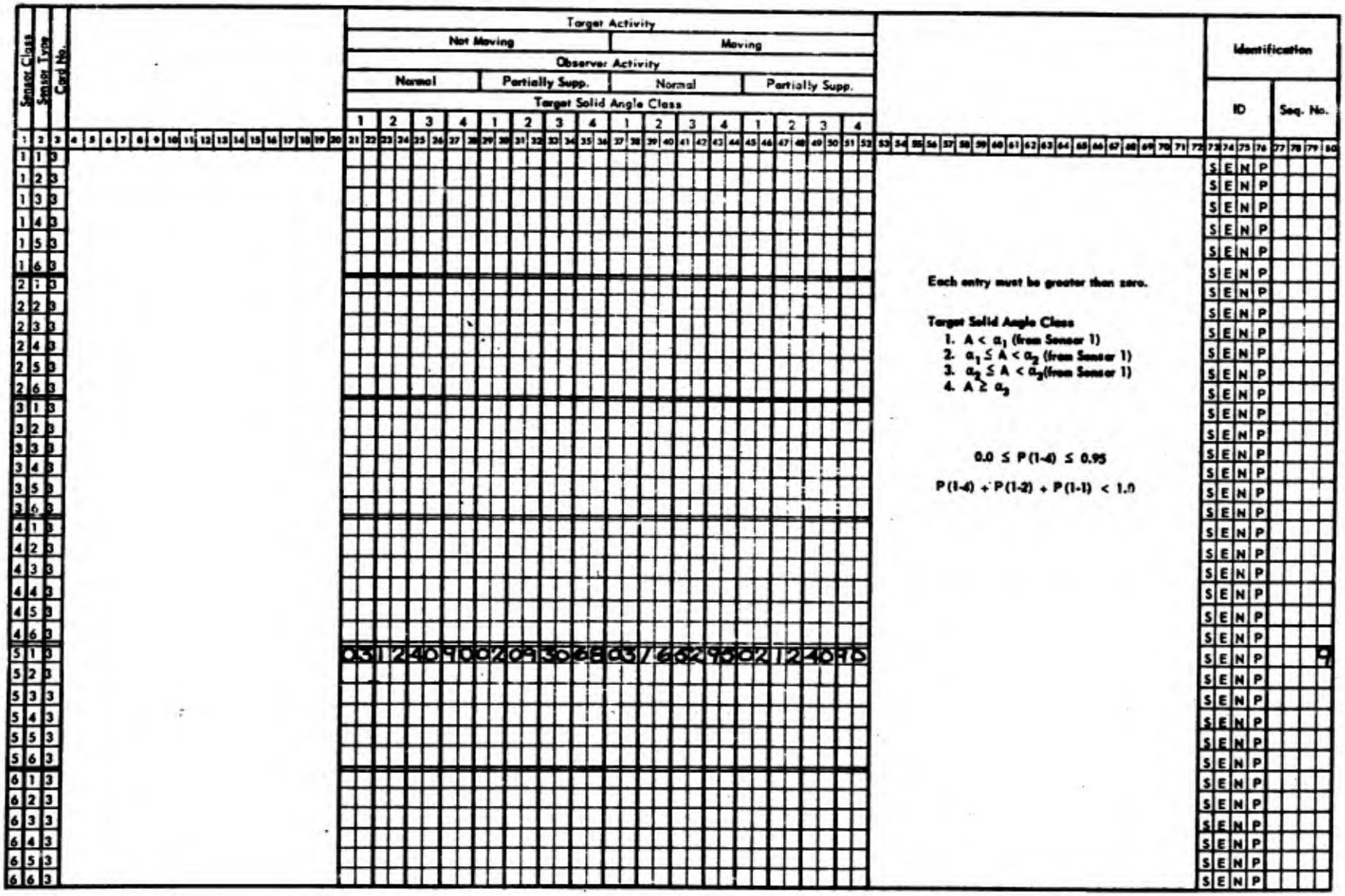


Fig. 19 - SENSOR 4 Entries

SENSOR 5, 6, AND 7

Three probabilities of loss of information state are also required. The probability that a target is still pinpointed—P44, the probability that a target that has been pinpointed is lost—P41, and the probability that a detected target is lost—P21. The sum of P44 and P41 must be less than 1.0. Also P41 must be less than the product of 1.0 minus P44 and P21, [1-P44]P21 > P41. As before, computer restrictions require that P44 and P21 each be 0.02 or greater.

The loss of target information can be caused by the minor movements of a target unit within a grid square. Using available data or judgment and observing the above restrictions, record for the same target and observer activity and sensor index the probabilities P44, P41, and P21 on SENSOR 5, 6, and 7 respectively (see Figs. 20, 21, and 22).

For other conditions of target and observer activity and for other sensor indexes these same procedures must be used.

SENSOR 8

The probability of detecting that a target is dead is used each surveillance interval to provide this information to observers that did not receive it at the time the target was killed, (i.e., for observers that come into line of sight after the death of the target). Using available data or judgment, construct range-time plots for this probability for each observer activity and sensor index and develop the values for input to SENSOR 8 in a manner similar to that described for SENSOR 2 and 3. The model does not presently differentiate between mobility and fire-power kills; moving targets stop when they are killed, therefore no entries are required in cols 37 through 52 (see Fig. 23).

CARMONETTE

SENSOR 5

PROBABILITY THAT A TARGET IS STILL PINPOINTED

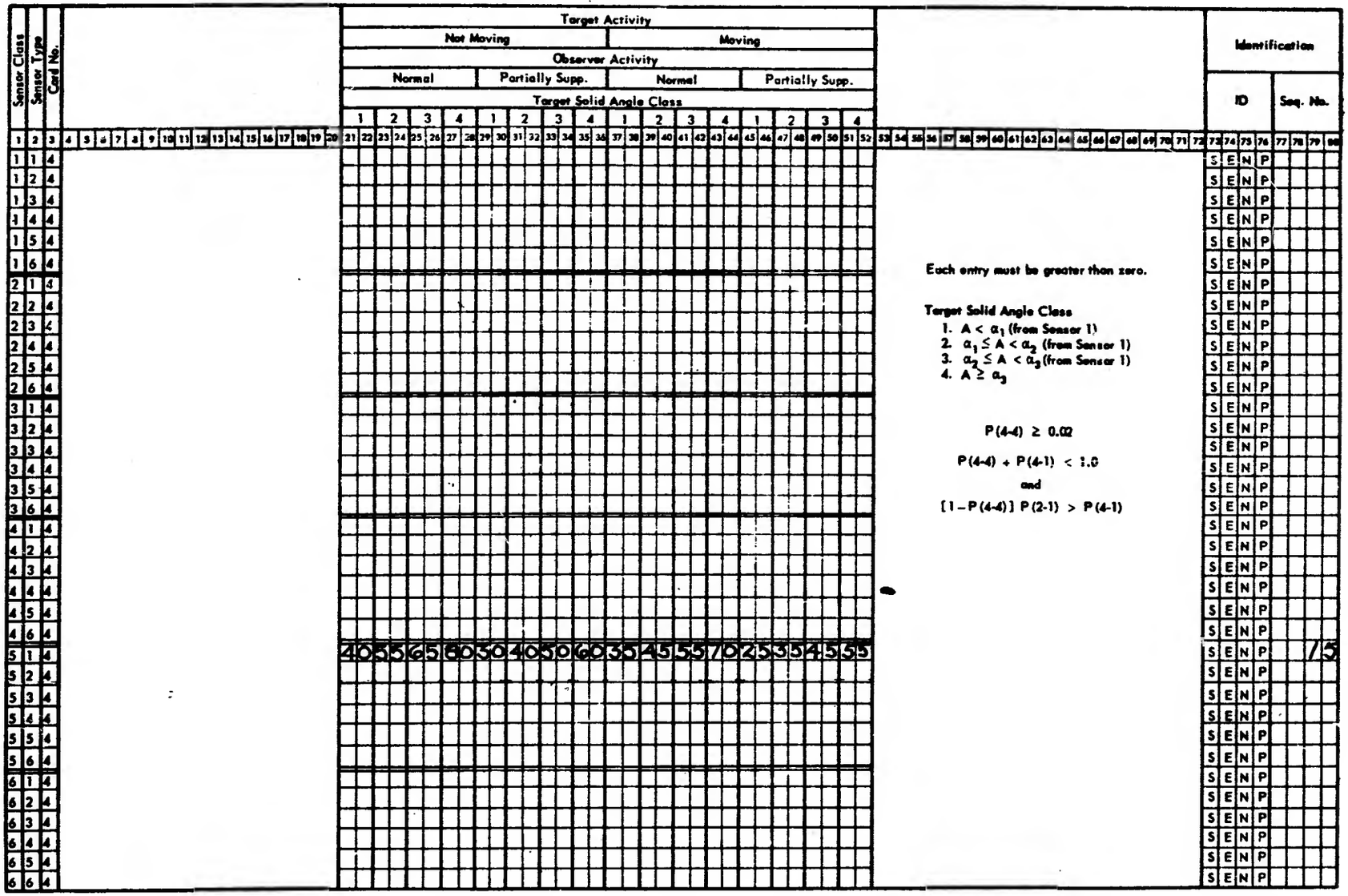


Fig. 20 - SENSOR 5 Entries

CARMONETTE

SENSOR 6

PROBABILITY THAT A PINPOINTED TARGET IS LOST

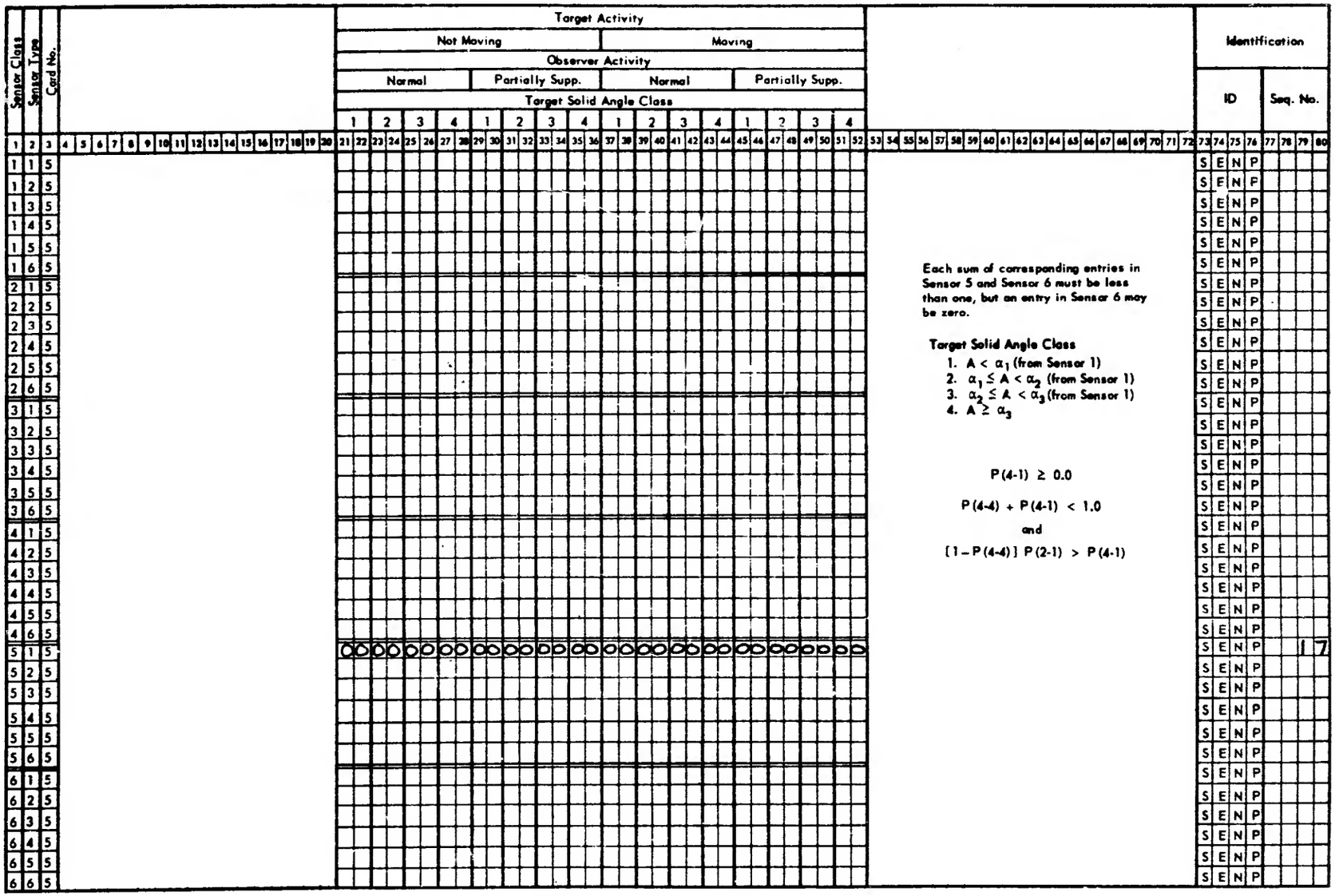


Fig. 21 – SENSOR 6 Entries

CARMONETTE

SENSOR 7

PROBABILITY THAT A DETECTED TARGET IS LOST

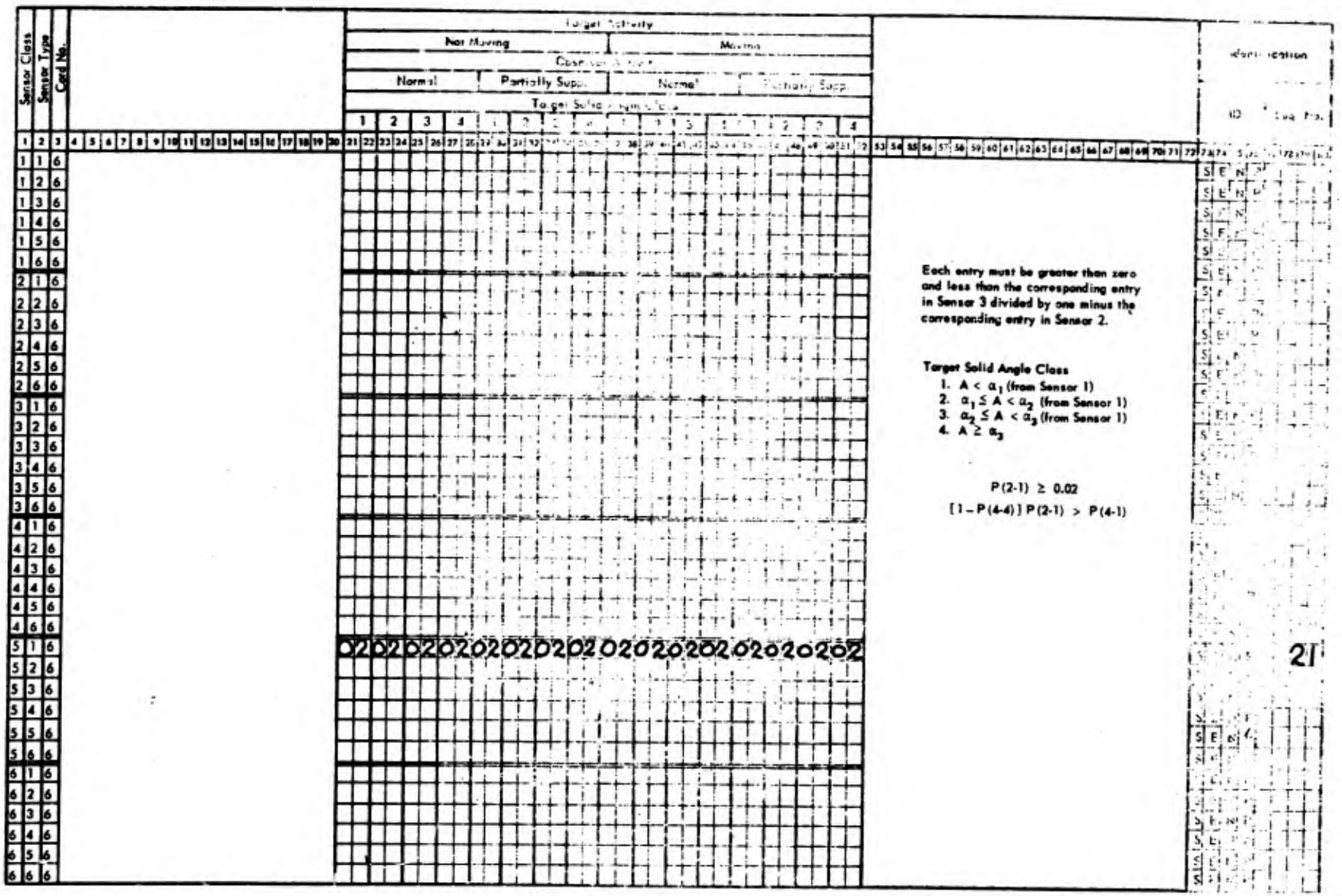


Fig. 22 – SENSOR 7 Entries

CARMONETTE

SENSOR 8

PROBABILITY OF DETECTING THAT A TARGET IS DEAD

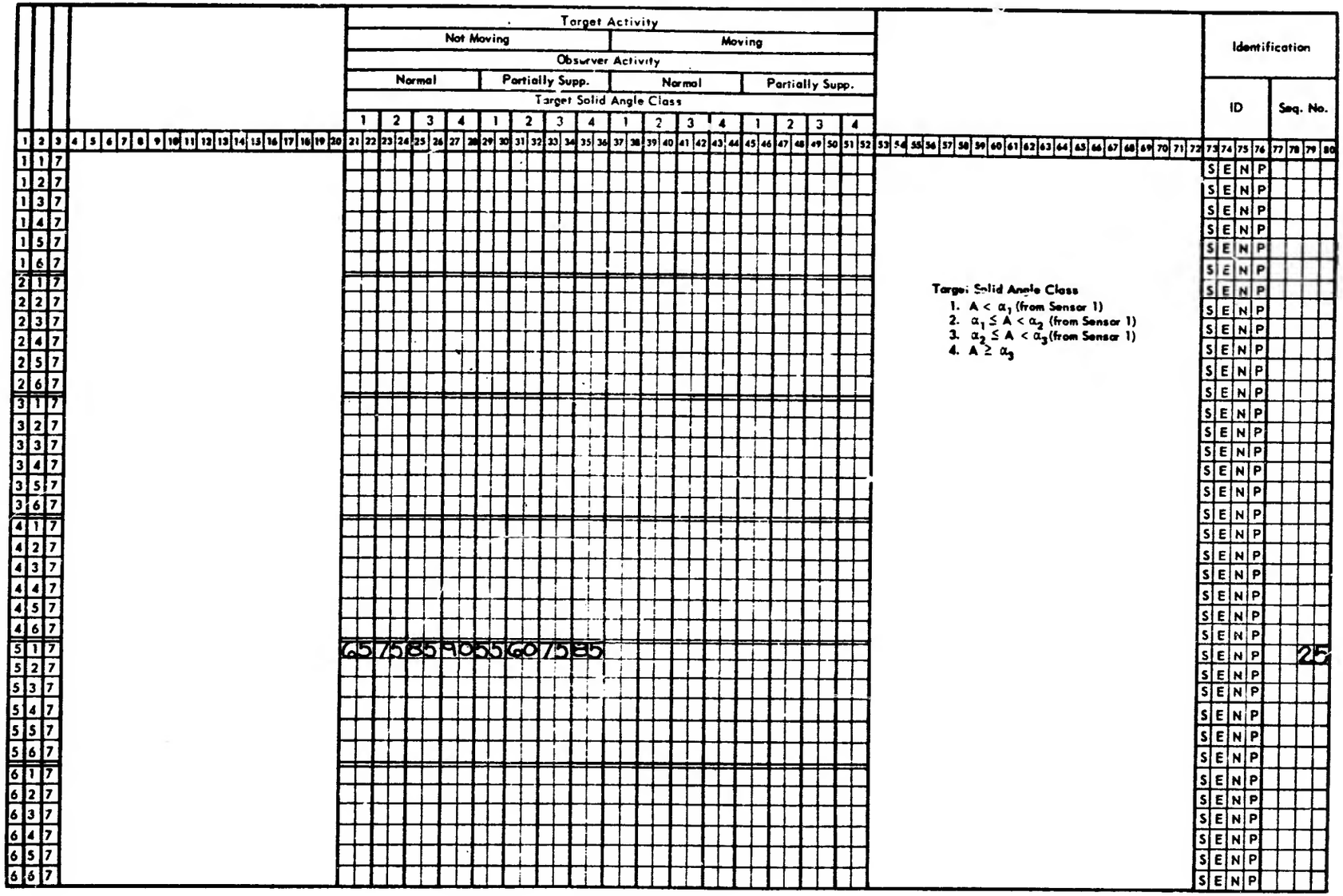


Fig. 23 - SENSOR 8 Entries

SENSOR 9 AND 10

The position of a weapon may be disclosed by the muzzle flash, back blast, smoke, dust, etc. caused by firing. CARMONETTE treats the locating of firing targets as a two-step process. Pinpoint (Level 4) information on a firing target can be gained only from erroneous pinpoint (Level 3), therefore the probability of erroneously pinpointing a previously unknown firing target is input using SENSOR 9 (Fig. 24). The probability of pinpointing a firing target given that it was already erroneously pinpointed is input using SENSOR 10 (Fig. 25).

CARMONETTE

SENSOR 9

PROBABILITY OF ERRONEOUSLY PINPOINTING A FIRING TARGET

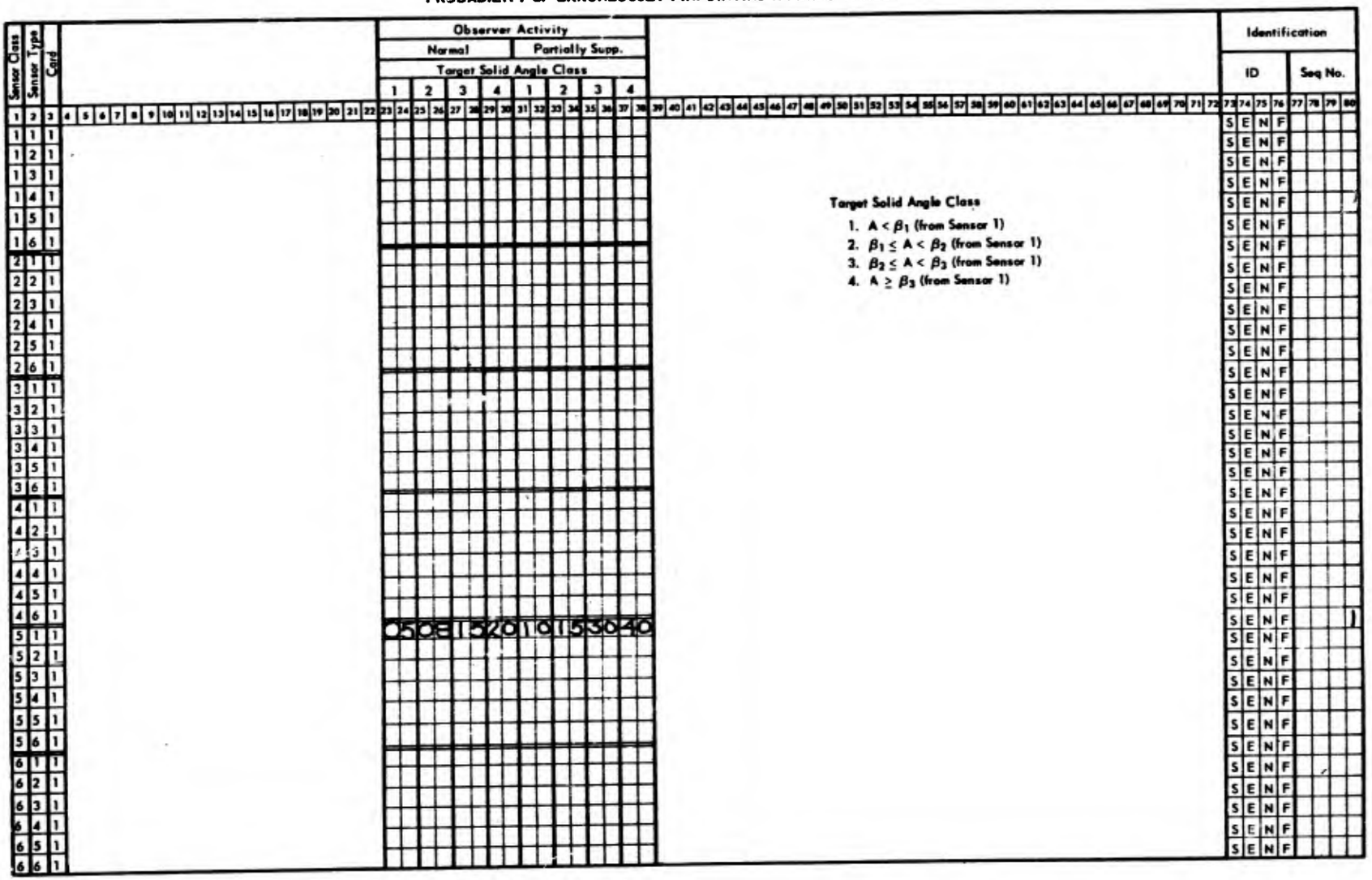


Fig. 24 - SENSOR 9 Entries

CARMONETTE

SENSOR 10

PROBABILITY OF PINPOINTING A FIRING TARGET GIVEN ERRONEOUS PINPOINT INFORMATION

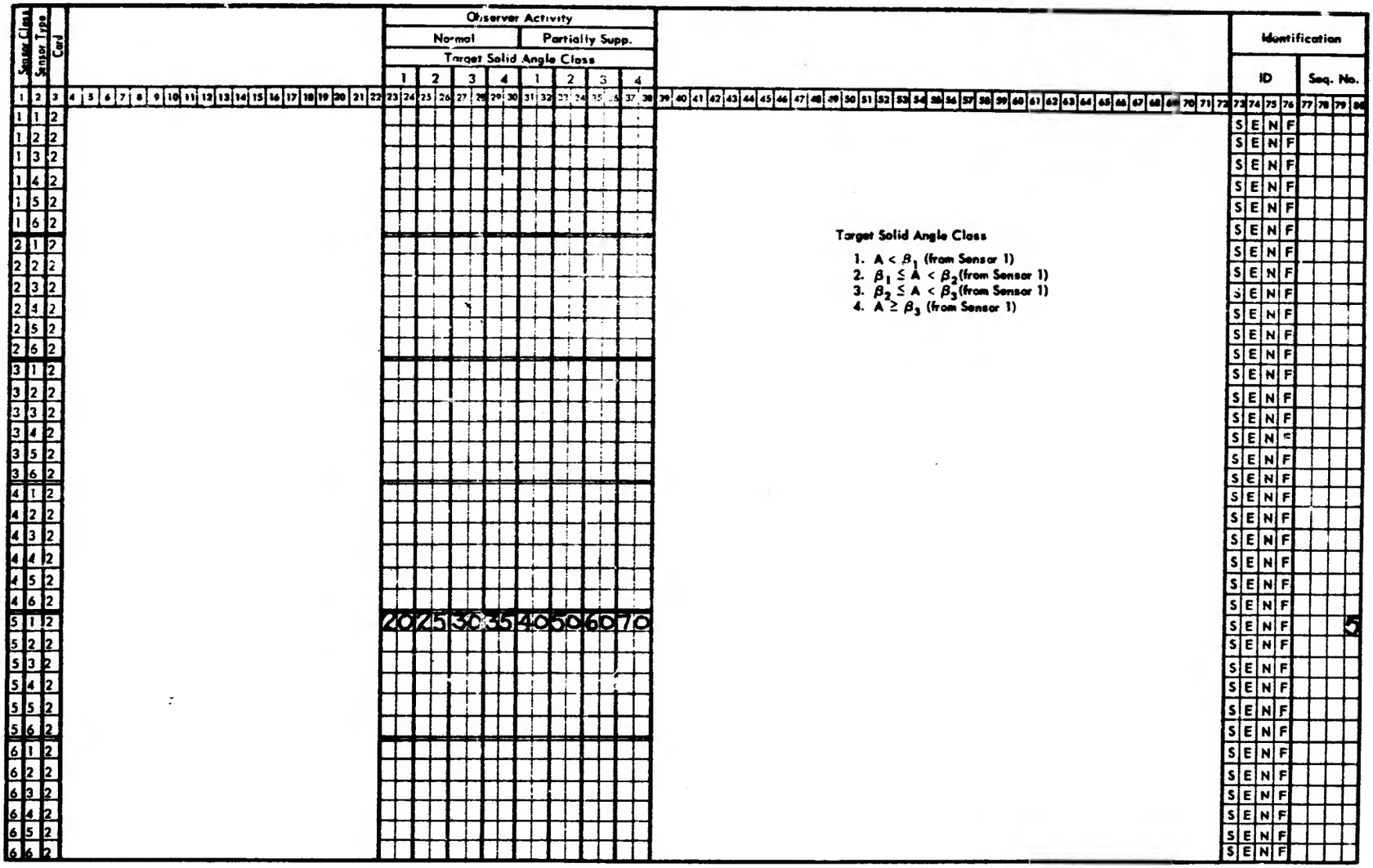


Fig. 25 - SENSOR 10 Entries

SPECIAL SENSORS

Image Intensifier Data

Forms 37A and 37B, Image Intensifier Data, are used to input the characteristics of the image intensifier class of the passive night vision devices used in the game. (See Fig. 26.)

The entries in columns 18 through 50 of Form 37A are the values of the ordinate of the curve of the system modulation transfer function at selected values of γ along the abscissa of the curve for the type device concerned. Figure 27 shows a type curve which can be used to prepare these inputs. The values of γ_0 to γ_{10} against which the ordinate values are determined must be eleven equally spaced values along the abscissa. It is suggested that values 0.0 to 4.0 in steps of 0.4 be used if the example curve is used.

The entries in cols 3 to 8, 15 to 17, and 51 to 62 do not at present enter into the calculation routine and are provided for possible future refinement of the routine.

The entries in cols 7 to 72 of Form 37B are the ordinate values of the curve of the photocathode tube sensitivity at selected points along the abscissa of the curve. Figure 28 shows a type curve which can be used to prepare these inputs. The values of λ_0 to λ_{10} must be eleven equally spaced values along the abscissa. If the example curve is used it is suggested that values from 0.4 to 0.9 in steps of 0.05 be used. These same values for λ_0 to λ_{10} are used for determining the entries in Forms 38 and 39 for background and target reflectance.

FORM 37A
IMAGE INTENSIFIER DATA

Sensor Class	Sensor Type	Field of View deg	Magnification	Objective F Number	Objective Focal Length mm, F_0	Maximum Angular Spatial Freq, c/m rad	Ordinates of System Modulation Transfer Function, T(y)										Photo Cathode Type	Lower Limit of Detection Wave length, microns	Upper Limit of Detection, Wave length, microns	X Surveillance Mode	Y Target Acq Mode	Device Transmission		ID Name	Seq. No.
							y_0	y_1	y_2	y_3	y_4	y_5	y_6	y_7	y_8	y_9	y_{10}								
1	2	3 4 5	6 7 8	9 10 11	12 13 14	15 16 17 18	19 20	21 22 23	24 25 26	27 28 29 30	31 32 33 34 35	36 37 38 39 40 41	42 43 44 45 46 47	48 49 50	51 52 53 54	55 56 57	58 59 60	61	62 63	64	65 66 67 68 69 70 71 72	73 74 75 76	77 78 79 80
																							PNV1	1501
																							PNV1	1502
																							PNV1	1503
																							PNV1	1504
																							PNV1	1505
																							PNV1	1506
																							PNV1	1507

FORM 37B

Sensor Class	Sensor Type	Photocathode Type	Ordinates of Photo cathode Sensitivity, Amps/Watt (Q(λ)										ID Name	Seq. No.
			y_0	y_1	y_2	y_3	y_4	y_5	y_6	y_7	y_8	y_9	y_{10}	
1	2	3 4 5	6 7 8 9 10 11 12	13 14 15 16 17 18	19 20 21 22 23 24	25 26 27 28 29 30	31 32 33 34 35 36	37 38 39 40 41 42	43 44 45 46 47 48	49 50 51 52 53 54	55 56 57 58 59 60	61 62 63 64 65 66	67 68 69 70 71 72	73 74 75 76	77 78 79 80
			E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	PNV2	1508
			E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	PNV2	1509
			E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	PNV2	1510
			E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	PNV2	1511
			E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	PNV2	1512
			E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	PNV2	1513
			E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	E-1	PNV2	1514

Fig. 26 - Example of FORM 37A and FORM 37B

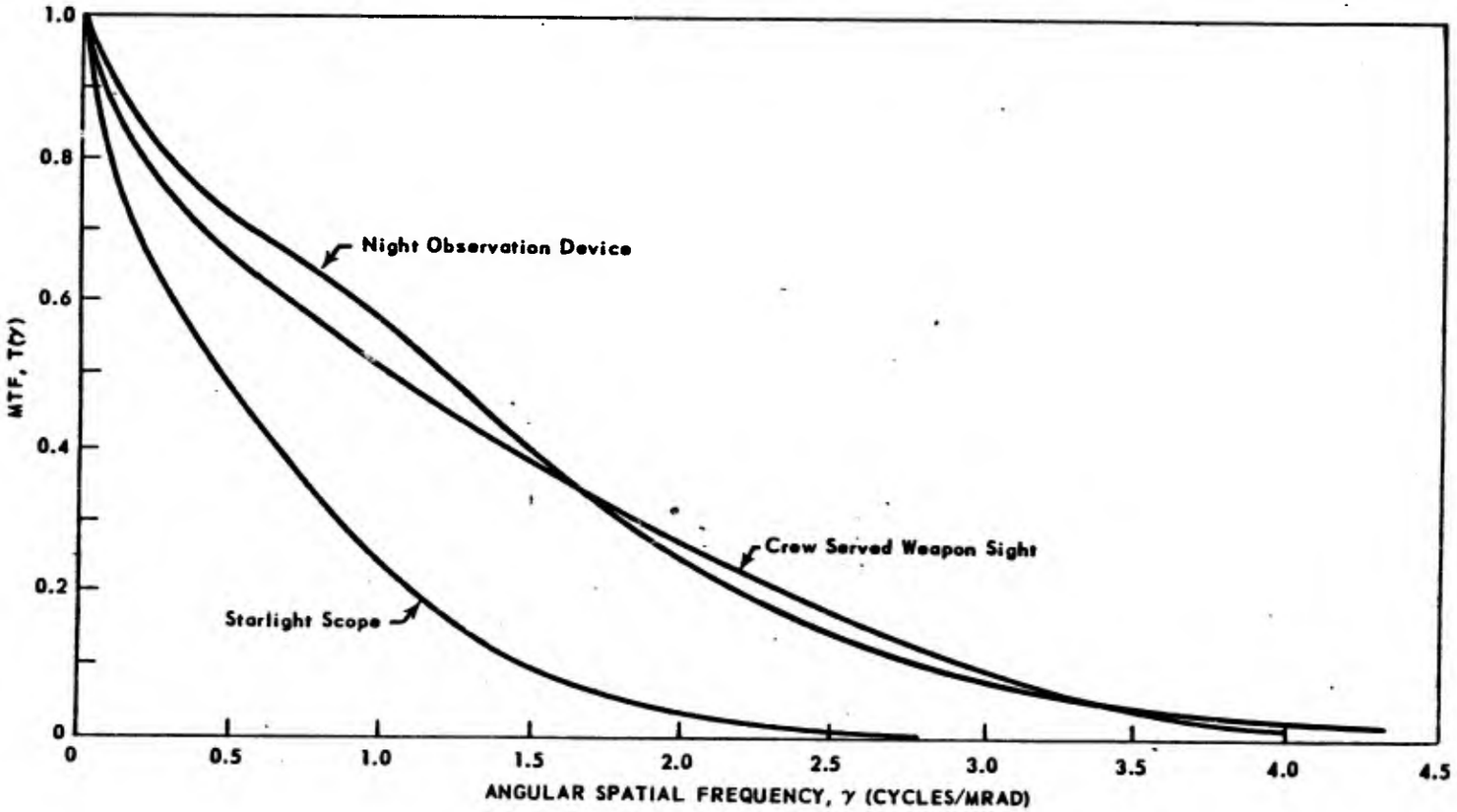


Fig. 27—System Modulation Transfer Function (MTF)

Note: The Modulation Transfer Function is a characteristic of an imaging system which expresses the loss in modulation in the output signal reference the input signal in relation to the object spatial frequency γ in cycles per milliradians.

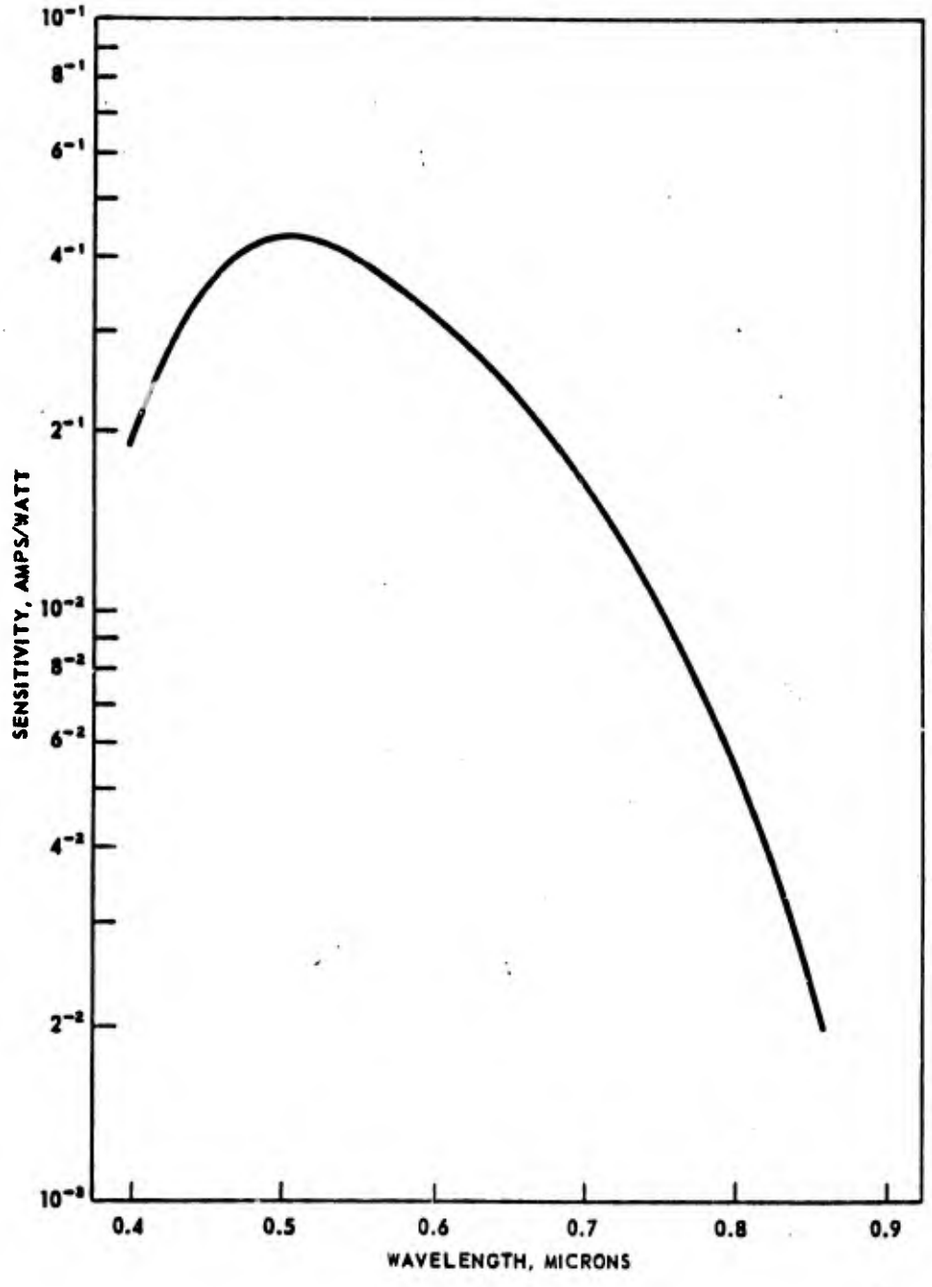


Fig. 28 - S-20 Photocathode Sensitivity, $Q(\lambda)$

Note: The S-20 is the photocathode tube used in the first generation of passive night vision devices.

Background and Target Reflectance

Form 38, Background and Form 39, Target, (Figs. 29 and 30) are used for the entries of the spectral reflectance of the types of background and of target to be played. The values of λ_0 to λ_{10} on each form on which the reflectance values are entered must be the same as the equivalent values used in preparing Form 37B. Examples of data for these inputs are shown in Tables 13 and 14.

On Form 38 the background numbers in cols 1 and 2 are equated to the values of the concealment index for the grid square as established in the preparation of the terrain inputs for the game. A determination must be made as to the type of background, i.e., sand, loam, grass, bushes, etc., to be related to the concealment indexes used.

On Form 39 the target types are identified in cols 1 and 2 and are the same as the target class numbers entered in cols 4 and 5 of UNIT 3.

Background Number	Wavelength, Microns and Background Reflectance, Percent																							ID Name	Seq. No.
	λ_0	%	λ_1	%	λ_2	%	λ_3	%	λ_4	%	λ_5	%	λ_6	%	λ_7	%	λ_8	%	λ_9	%	λ_{10}	%			
1 2	3 4 5	6 7	8 9 10	11 12	13 14 15	16 17	18 19 20	21 22	23 24 25	26 27	28 29 30	31 32	33 34 35	36 37	38 39 40	41 42	43 44 45	46 47	48 49 50	51 52	53 54 55	56 57	58 59 60 61 62 63 64 65 66 67 68 69 70 71 72	73 74 75 76	77 78 79 80
0 1																								B K V 1	1 5 1 5
0 2																								B K V 1	1 5 1 6
0 3																								B K V 1	1 5 1 7
0 4																								B K V 1	1 5 1 8
0 5																								B K V 1	1 5 1 9
0 6																								B K V 1	1 5 2 0
0 7																								B K V 1	1 5 2 1
0 8																								B K V 1	1 5 2 2
0 9																								B K V 1	1 5 2 3
1 0																								B K V 1	1 5 2 4
1 1																								B K V 1	1 5 2 5
1 2																								B K V 1	1 5 2 6
1 3																								B K V 1	1 5 2 7
1 4																								B K V 1	1 5 2 8
1 5																								B K V 1	1 5 2 9
1 6																								B K V 1	1 5 3 0

Values for λ_0 to λ_{10} must be the same as the values of λ used as entry points on Form 37 for Photocathode $Q(\lambda)$

Fig. 29 - FORM 38 BACKGROUND

	Target Size			Wavelength, Microns and Target Reflectance, Percent																							ID Name	Seq. No.
	Length Meters	Width Meters	Height Meters	λ_0	%	λ_1	%	λ_2	%	λ_3	%	λ_4	%	λ_5	%	λ_6	%	λ_7	%	λ_8	%	λ_9	%	λ_{10}	%			
1 2	3 4 5 6	7 8 9	10 11 12	13 14 15	16 17	18 19 20	21 22	23 24 25	26 27	28 29 30	31 32	33 34 35	36 37	38 39 40	41 42	43 44 45	46 47	48 49 50	51 52	53 54 55	56 57	58 59 60	61 62	63 64 65	66 67	68 69 70 71 72	73 74 75 76	77 78 79 80
0 1																											T G V 1	1 5 3 2
0 2																											T G V 1	1 5 3 3
0 3																											T G V 1	1 5 3 4
0 4																											T G V 1	1 5 3 5
0 5																											T G V 1	1 5 3 6
0 6																											T G V 1	1 5 3 7
0 7																											T G V 1	1 5 3 8
0 8																											T G V 1	1 5 3 9
0 9																											T G V 1	1 5 4 0
1 0																											T G V 1	1 5 4 1
1 1																											T G V 1	1 5 4 2
1 2																											T G V 1	1 5 4 3
1 3																											T G V 1	1 5 4 4
1 4																											T G V 1	1 5 4 5
1 5																											T G V 1	1 5 4 6
1 6																											T G V 1	1 5 4 7

Values for λ_0 to λ_{10} must be the same as the values of λ used as entry points on Form 37 for Photocathode $Q(\lambda)$

Fig. 30 - FORM 39 TARGET

Table 13

BACKGROUND REFLECTANCE

Wave length (Microns)	Type background				
	Trees, grass (Summer)	Coniferous (Summer)	Trees, grass (Autumn)	Leaves	Elephant grass
0.4	0.04	0.04	0.05	0.03	0.05
0.5	0.07	0.04	0.08	0.05	0.05
0.6	0.12	0.08	0.20	0.12	0.05
0.7	0.18	0.14	0.32	0.18	0.12
0.8	0.52	0.28	0.54	0.20	0.38
0.9	0.56	0.32	0.56	0.19	0.41

Table 14

TARGET REFLECTANCE

Wave length (Microns)	Type target			
	Fatigues	Tank	Viet hat	Black shirt
0.4	0.05	0.10	0.18	0.05
0.5	0.05	0.11	0.25	0.05
0.6	0.08	0.13	0.30	0.05
0.7	0.12	0.13	0.38	0.08
0.8	0.25	0.13	0.52	0.15
0.9	0.32	0.13	0.55	0.16

Environmental Data

Form 40 (Fig. 31) is used for the entry of the scattering and absorption coefficients associated with the different light levels. The radar degradation factors are also entered on this form.

This form could be easily expanded to include other types of environmental conditions such as fog, dust, smoke, rain and similar conditions. Such an expansion would require changes in the present programming.

Radar Characteristics

Form 41 (Fig. 31) is used for entry of the pertinent factors of radar performance that are used in the radar detection routine. The entries in cols 3 to 6 for "Threshold Target Velocity" are not used at the present time in the program and until the program is changed can be left blank.

FORM 40
ENVIRONMENTAL DATA

		Conditions	Visible Light Attenuation Coefficients: Scattering (σ_s)	Visible Light Attenuation Coefficients: Absorption (σ_a)	Radar Degradation Factor		ID Name	Seq. No.
1	1	STARLIGHT	E–	E–			COND	1548
1	2	PART MOON	E–	E–			COND	1549
1	3	MOONLIGHT	E–	E–			COND	1550

FORM 41
RADAR CHARACTERISTICS

Sensor Class	Sensor Type	Threshold Target Velocity (m/sec)	Maximum Range (m): Personnel	Maximum Range (m): Vehicles	ID Name	Seq. No.
A	1				RADR	1927
A	2				RADR	1928
A	3				RADR	1929
A	4				RADR	1930
A	5				RADR	1931
A	6				RADR	1932

Fig. 31 – Forms 40 and 41 Entries

STEP 6 - MOBILITY DATA

Four basic data areas are used to describe mobility within the model: the frequency with which fire and movement decisions will be made, a series of doctrines that describe the movement preferences of each unit, the maximum rates at which units may move, and rates at which units can be ordered to move in various situations. CARMONETTE provides for eight mobility classes. Class 0 is always dismounted infantry, classes 1-4 are always ground vehicles, and classes 5-7 are always air vehicles. "On call" helicopters must be class 5. The doctrines and rates mentioned above are described for each mobility class which is used in the game; it is not necessary to use all classes.

MOBILITY 1

This form consists of four sets of movement doctrines for the eight mobility indexes. These doctrines give the probability of a unit moving when it has: (a) no cover and no target, (b) no cover with target, (c) cover but no target, and (d) cover and a target. Only one doctrine is used in the example; however, up to four may be provided for each side and mobility index. An example of MOBILITY 1 entries is shown in Fig. 32. No Blue units are moving under a doctrine; so no entries are required. The only Red units moving under doctrine are the three HAW; therefore probabilities must be entered for Red Mobility Class 2. If the HAW has no cover and not target, it should keep moving—enter 99 in cols 9 and 10. If it has no cover and a target, it is more likely to keep moving than to stop and fire—enter 70 in cols 11 and 12. If it has cover and no target, it should keep moving to its objective—enter 99 in cols 13 and 14. If it has cover and a target it is more likely to stop and fire than to keep moving—enter 40 in cols 15 and 16.

MOBILITY 2

Three threshold values are used to establish five slope classes. The rate of travel across a grid square of each ground-mobility index depends on these slope classes. Figure 33 illustrates how these

CARMONETTE
MOBILITY 1
MOVEMENT DOCTRINES

Side	Mobility class			Movement Doctrine 1				Movement Doctrine 2				Movement Doctrine 3				Movement Doctrine 4					Identification	
				Basic tactical situation																	ID	Seq. no.
				a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d			
B	0																			BLUE	M|Ø|B|1	
B	1																				M|Ø|B|1	
B	2																				M|Ø|B|1	
B	3																				M|Ø|B|1	
B	4																				M|Ø|B|1	
B	5																				M|Ø|B|1	
B	6																				M|Ø|B|1	
B	7																				M|Ø|B|1	
R	0																			RED	M|Ø|B|1	
R	1																				M|Ø|B|1	
R	2																				M|Ø|B|1	
R	3																				M|Ø|B|1	
R	4																				M|Ø|B|1	
R	5																				M|Ø|B|1	
R	6																				M|Ø|B|1	
R	7																				M|Ø|B|1	

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

a—no cover, no target
b—no cover, target
c—cover, no target
d—cover, target

Fig. 32 - MOBILITY 1 Entries

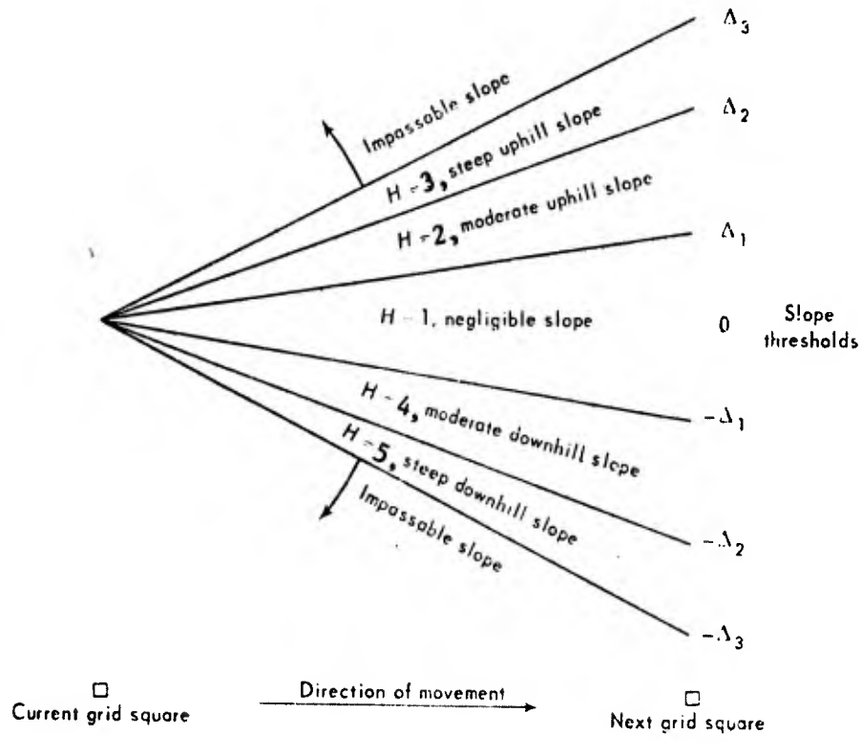


Fig. 33 - Definition of Slope Class
H = slope class

thresholds are used to define the slope classes. One set of thresholds is used for both negative and positive slopes. The direction of movement from a grid square of origin to the next grid square is illustrated in relation to the slope classes. In traveling from one square to the next, a vehicle is said to encounter:

(a) A negligible slope if the elevation of the two squares differs by less than Δ_1 (slope class 1).

(b) A moderate uphill slope if the destination square is higher than the square of origin, and the difference in elevation is greater than Δ_1 but less than Δ_2 (slope class 2).

(c) A steep uphill slope if the vehicle travels uphill, and the two squares differ in elevation by an amount greater than Δ_2 and less than Δ_3 (slope class 3).

(d) A moderate downhill slope if the vehicle travels from a square to one that is lower, and the difference in elevation is greater than Δ_1 but less than Δ_2 (slope class 4).

(e) A steep downhill slope if the vehicle travels downhill, and the two squares differ in elevation by an amount greater than Δ_2 and less than Δ_3 (slope class 5).

(f) An impassable slope if the absolute difference in elevation of the two squares is greater than Δ_3.

The slope thresholds (minimum 0 feet, maximum 200 ft) should be entered in cols 4 to 17 of the first five cards of the form (see Fig. 34). In the example the thresholds are 7, 20, and 60 feet for dismounted infantry (mobility class 0); 7, 20, and 50 feet for tracked and wheeled vehicles (mobility classes 1 and 2). A dismount and remount time must be entered for troop carrying vehicles in cols 33-39. This time must be greater than zero and less than 512.

To complete the form, a rate in meters per second must be indicated for each ground mobility index being used for each slope class. In the example, dismounted troops (mobility class 0) traverse moderate uphill

CARMONETTE
MOBILITY 2
GROUND MOBILITY TABLE

Ground mobility class	Card	Slope threshholds Δ_1 (feet)	Δ_2 (feet)	Δ_3 (feet)		Dismount and remount time (minutes)	Slope class 1 (negligible) $-\Delta_1 < \text{Slope} < \Delta_1$ (meters per second) Cross-country trafficability 1	2	3	Trafficability of roads 1	2	3		Identific. ID	Seq. no.
0	1	07	20	60			13	10	07	14	12	10		M|Ø|B|2	1
1	1	07	20	50		05	45	32	22	67	67	67		M|Ø|B|2	2
2	1	07	20	50		05	45	32	22	67	67	67		M|Ø|B|2	3
3	1													M|Ø|B|2	
4	1													M|Ø|B|2	
		Slope class 2 (moderate uphill) $\Delta_1 < \text{Slope} < \Delta_2$ (meters per second) Cross-country trafficability 1	2	3	Trafficability of roads 1	2	3					Slope class 3 (steep uphill) $\Delta_2 < \text{Slope} < \Delta_3$ (meters per second) Cross-country trafficability 1	2	3	Trafficability of roads 1	2	3			
0	2	09	07	05	10	08	07					05	04	02	06	05	04		M|Ø|B|2	4
1	2	32	24	17	58	58	58					28	21	12	35	35	35		M|Ø|B|2	5
2	2	50	34	17	58	58	58					28	21	12	35	35	35		M|Ø|B|2	6
3	2																		M|Ø|B|2	
4	2																		M|Ø|B|2	
		Slope class 4 (moderate downhill) $-\Delta_2 < \text{Slope} < -\Delta_1$ (meters per second) Cross-country trafficability 1	2	3	Trafficability of roads 1	2	3					Slope class 5 (steep downhill) $-\Delta_3 < \text{Slope} < -\Delta_2$ (meters per second) Cross-country trafficability 1	2	3	Trafficability of roads 1	2	3			
0	3	15	11	08	17	14	12					12	09	05	17	14	12		M|Ø|B|2	7
1	3	32	24	17	65	65	65					28	21	12	40	40	40		M|Ø|B|2	8
2	3	32	24	17	65	65	65					28	21	12	40	40	40		M|Ø|B|2	9
3	3																		M|Ø|B|2	
4	3																		M|Ø|B|2	

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

Fig. 34 - MOBILITY 2 Entries

(slope class 2) terrain with good trafficability (trafficability index 1) at a rate of 0.9 meters per second; this value is entered in cols 3-7, line 02 of MOBILITY 2. The slope encountered by both tracked (mobility class 1) and wheeled (mobility class 2) vehicles influence their maximum speed, but the trafficability index of the road does not; the respective entries on MOBILITY 2 reflect this.

MOBILITY 3

Data for air units include altitude data, air mobility data, and ordered altitudes.

When air units change altitude with little net horizontal movement, such movement is measured in integral multiples of the standard altitude increment. This increment for vertical measurements is analogous to the grid size. A standard altitude increment is chosen and entered in the first field of MOBILITY 3 (Fig. 35). An estimate is made of the time required for each type of air unit to descend or climb one standard altitude increment and is entered as shown. In addition, record the maximum altitude of each air-mobility index. In the example the helicopter (mobility class 5) data are entered as shown in Fig. 35. The first entry, cols 1 to 4, indicates the desired increment of altitude change. The next two entries are the length of time to descend (0.05 min) and to climb (0.05 min) that increment. The last entry for each mobility class is the maximum altitude that the helicopter can fly during the battle (400 ft).

MOBILITY 4

Altitude-change thresholds are entered in cols 2 to 25 on MOBILITY 4 for each air-mobility class. The same or different values may be assigned to each air-mobility class.

For each air-mobility class, six altitude changes, designated alpha 1 to alpha 6 (α_1 to α_6) must be selected. Alpha 1, 2, and 3 are negative and the other three are positive. They have the following significance:

If the change in altitude of an aircraft as it goes from the center of one square to the center of the adjacent square is

CARMONETTE

MOBILITY 3

ALTITUDE DATA

Std. incr. (feet)	Air mobility class 5				Air mobility class 6				Air mobility class 7				[redacted]	Identification	
	Class	Descent time (minutes)	Climb time (minutes)	Maximum altitude (feet)	Class	Descent time (minutes)	Climb time (minutes)	Maximum altitude (feet)	Class	Descent time (minutes)	Climb time (minutes)	Maximum altitude (feet)		ID	Seq. no.
50	5	005	005	4100	6				7					MØB3	

MOBILITY 4

AIR MOBILITY DATA

Air mobility class	Altitude change thresholds (feet)						Dismount and remount time	Movement rates (meters per second)					[redacted]	Identification	
	α_1	α_2	α_3	α_4	α_5	α_6		Steep descent $\alpha_1 < \alpha < \alpha_2$	Moderate descent $\alpha_2 < \alpha < \alpha_3$	Negligible slope $\alpha_3 < \alpha < \alpha_4$	Moderate climb $\alpha_4 < \alpha < \alpha_5$	Steep climb $\alpha_5 < \alpha < \alpha_6$		ID	Seq. no.
5	85	55	25	20	40	175		20	40	60	30	12		MØB4	
6														MØB4	
7														MØB4	

MOBILITY 5

ORDERED ALTITUDE

Contour flight altitude (feet)			Level flight altitude (feet)			[redacted]	Identification	
Index								
2	3	4	5	6	7		ID	Seq. no.
20	50	150	200	300	4100		MØB5	

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

MOBILITY 6

ORDERED MOVEMENT RATES

Ordered movement rates (meters per second)														[redacted]	Identification	
Ground units							Aircraft units									
Index							Index									
1	2	3	4	5	6	7	1	2	3	4	5	6	7		ID	Seq. no.
05	10	15	25	35	45	67	25	50	100	200	350	500	600		MØB6	

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

Fig. 35 - MOBILITY 3, 4, 5, and 6 Entries

(a) Equal to or more than α_1 and less than α_2, the flight path is a steep descent.

(b) Equal to or more than α_2 and less than α_3, the flight path is a moderate descent.

(c) Equal to or more than α_3 and less than α_4, the flight path is of negligible slope.

(d) Equal to or more than α_4 and less than α_5, the flight path is a moderate ascent.

(e) Equal to or more than α_5 and less than α_6, the flight path is a steep ascent.

Changes of altitude may not be less than α_1 nor greater than α_6 per grid square. (Remember that α_1 is the most negative number in the set.) Such forbidden values would represent unreasonably steep dives or climbs.

If the air mobility class is a troop carrier, the time required for troops to leave the aircraft after landing and be ready to fire is entered in cols 26 to 32 of MOBILITY 4 (see Fig. 35).

Finally, movement rates (forward speeds) for each mobility index for each of the five altitude changes are entered in cols 33 to 62 of the form.

MOBILITY 5

Air units may be ordered to conduct either contour or level flight. Altitudes at which the air units should fly are input using MOBILITY 5 (see Figure 35). Under indexes 2, 3, and 4 enter three altitudes above the ground, including vegetation, at which contour flying can be ordered and under indexes 5, 6, and 7 enter three altitudes above sea level at which level flight can be ordered. The programs automatically set index 1 as "Treetop" which is 5 feet above the vegetation. The highest altitude entered must not exceed the maximum altitude entered on MOBILITY 3.

MOBILITY 6

Ordered movement rates for both ground and air units are entered on MOBILITY 6. The rate at which the unit will attempt to move may be specified or the unit will move at its maximum rate. If units are to go slower than the rates detailed on MOBILITY 2 and 4, specify these rates on MOBILITY 6. Seven rates should be selected for ground units and seven for air units. Each rate is assigned an index from one to seven. Let the index one denote the slowest rate; it is also the rate at which partially suppressed units will move. Index seven denotes the fastest rate at which units are able to move. These indexes are used in conjunction with movement orders given to units.

STEP 7 - UNIT DATA

The CARMONETTE units that were discussed during the preliminary considerations are formed by combining the weapons, sensors, and other characteristics described during the previous steps. The Organization Lists shown in Tables 3 and 4 identify these units by number. An inspection of these lists shows that CARMONETTE units may or may not be the same as the TOE units with which we are familiar.

UNIT 1

The task organization and chain of command is recorded on UNIT 1. Command, control, and surveillance (CCS) units are somewhat analogous to headquarters in that they are the medium through which weapon units pass intelligence information; they conduct surveillance with their own sensors; and they can direct supporting helicopters and artillery to engage targets. CCS units are not subject to detection and will be killed only when their last assigned subordinate unit is killed. A weapon unit must be identified as the "Buddy Unit" for each CCS unit. Separate movement orders are not prepared for the CCS units; instead each CCS unit accompanies his buddy and moves in accordance with that unit's orders. If the first assigned buddy unit should be killed, the CCS unit transfers itself to the next listed subordinate unit. If the CCS unit is not in the actual chain of command, i.e., the forward observers and the radar teams, one of the weapon units must still be assigned as the buddy unit. Dummy subordinate units may also be assigned to provide for continuity of action by the CCS unit if the first buddy unit is killed. A weapon unit may serve as the buddy unit for more than one CCS unit in which case they would all be assumed to move together.

Weapon units will respond to calls for support only from CCS units to whom they are assigned; therefore, artillery (including mortar) and helicopter units may be subordinate to more than one CCS unit. The Target Priority Lists (WEAPON 5) prepared during STEP 4 did not include priorities for artillery and mortars, Weapons 1 through 12. Priorities for these weapons are assigned on UNIT 1; artillery and mortar units will

follow the artillery call priorities of the CCS unit to whose call they are responding. The helicopter call priorities indicate the target class preference of the CCS unit, but the helicopter will select targets based on its own selection procedures when it arrives in the battle area.

UNIT 1 is completed as shown below.

Column	Characteristic
1	Side. 1 is Blue; 2 is Red.
2-3	Enter command unit number. CCS units must be numbered consecutively starting with 49 and ending with 63. There is no hierarchy implied by a CCS unit's number.
4-5	Enter number of CCS unit to which this unit is subordinate. The senior headquarters on a side is subordinate to itself.
6-17	Enter numbers of CCS units subordinate to this unit.
18-33	Enter numbers of weapon units subordinate to this unit. Since command units transfer buddy units in the order weapon units are listed, initial buddy unit should be listed first and other units in the desired priority. Limits: 1-48.
34-35	Enter number of initial buddy unit. Should be same as entered in cols 18-19.
36-37	Enter class and type of Sensor 1.
38-39	Enter height of Sensor 1. Limits: 0-63 meters.
40-41	Enter class and type of Sensor 2.
42-43	Enter height of Sensor 2.
44-46	Enter communication cycle in hundredths of minutes. The communication cycle controls the frequency with which units pass intelligence information. Limits: 002-999.
47	Enter X if command unit is able to call for artillery support. Only artillery units subordinate to this command unit will respond to call.
48	Enter X if command unit is able to call for helicopter support. Only helicopter units subordinate to this command unit will respond to call.
49-60	List, in priority, the target class index of target types against which this command unit will call artillery. Limits: 1-15.
61-72	Same as above for helicopters.

Example

UNIT 1 is completed as described below and as shown in Fig. 36.

The Blue company commander and each of his platoon leaders are represented by a CCS unit. The commander of the outpost in front of the northern most platoon is also represented by a CCS unit. The program limitation of not more than eight subordinate weapons units per CCS unit requires that an additional CCS unit be assigned to the southern platoon. The Blue company commander is designated unit 49 and is represented on line 1 of side 1. The unit number, 49, is entered in cols 2 and 3; his superior CCS unit is also 49 and is entered in cols 4 and 5. The platoon leaders (units 50, 52, 53, and 54) are his subordinate CCS units and are entered in cols 6 through 17. The supporting helicopters (units 34 and 35) and artillery (units 36, 37, 38, 39, and 40) are his subordinate weapons units and are entered in cols 18 through 33. The commander will not ride an attack helicopter, therefore his initial buddy unit will be the lowest numbered artillery unit, unit 36, which is entered in cols 34 and 35. The commander has both binoculars (sensor 52) and eyeballs (sensor 51), and he is about 2 meters tall; these characteristics are entered in cols 36 through 43. The communications cycle controls the frequency with which the CCS unit passes information to its superior and subordinate units. The company commander is assigned a 4-minute cycle which is entered in cols 44-46. There is an implied decimal point between cols 44 and 45, hence the inputs for communication cycle are in minutes and hundredths. The artillery and helicopter call priorities are as shown. Other CCS units are processed in the same manner as the Blue company commander.

UNIT 2

Each force is divided into no more than 48 weapon units. The elements in each unit must have the same mobility, vulnerability, location, and order at all times. A unit moves from square to square with all its elements. Each unit may have up to four independent sets of weapons. Each of these four sets contains one type of weapon.

CARMONETTE

UNIT 1

TASK ORGANIZATION

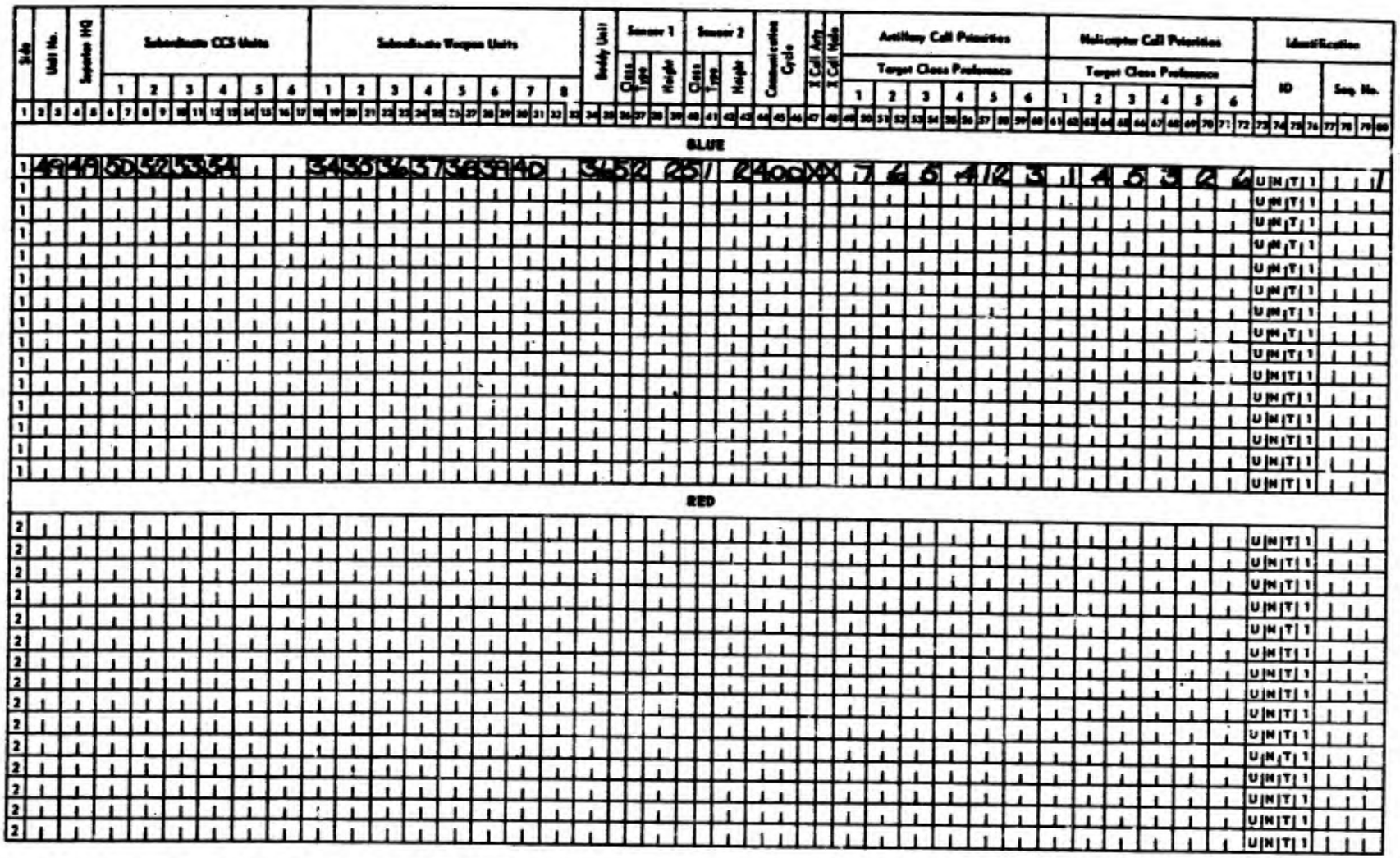


Fig. 36 - UNIT 1 Entries

The constraints to bear in mind when assigning the forces to separate units are: (a) not more than 48 separate weapon units may be described for a side (units that are composed of a troop unit mounted in personnel carriers must be counted twice in this computation), (b) when two or more elements of the table of organization and equipment (TOE) are placed in one unit they must be homogeneous to the extent described above, and (c) each unit may have no more than 63 killable elements.

When the situation being simulated calls for infantry to operate in both the mounted and dismounted role, the infantry unit must start the game mounted. It may subsequently be dismounted and remounted as many times as desired.

UNIT 2 lists important properties of each unit. This form must be filled out twice, once for each side. Each unit on a side is given a number from 1 to 48. If less than 48 units are on a side, numbers must be assigned starting with 1 and utilizing all numbers up to the maximum on the side.

UNIT 2 (one for Blue and one for Red) must be completed with data characteristics of the units as shown in the accompanying explanation.

Column	Characteristic
4-5	Enter number corresponding to main weapon type of each unit as assigned on WEAPON 1.
6-7	Enter the quantity of each main weapon type in the unit, maximum of 63.
8-15	Enter ammunition supply of type I and type II for all weapons in the main weapon group. These numbers must be less than 4095.
16-51	Enter information for unit's second, third, and fourth weapon types in decreasing order of importance.
52-53	Enter the total number of men in each unit, maximum 63. If unit is a troop carrier, this entry should include both the crew and the mounted unit.
54-55	Enter the number of vehicles in each unit, maximum 63.

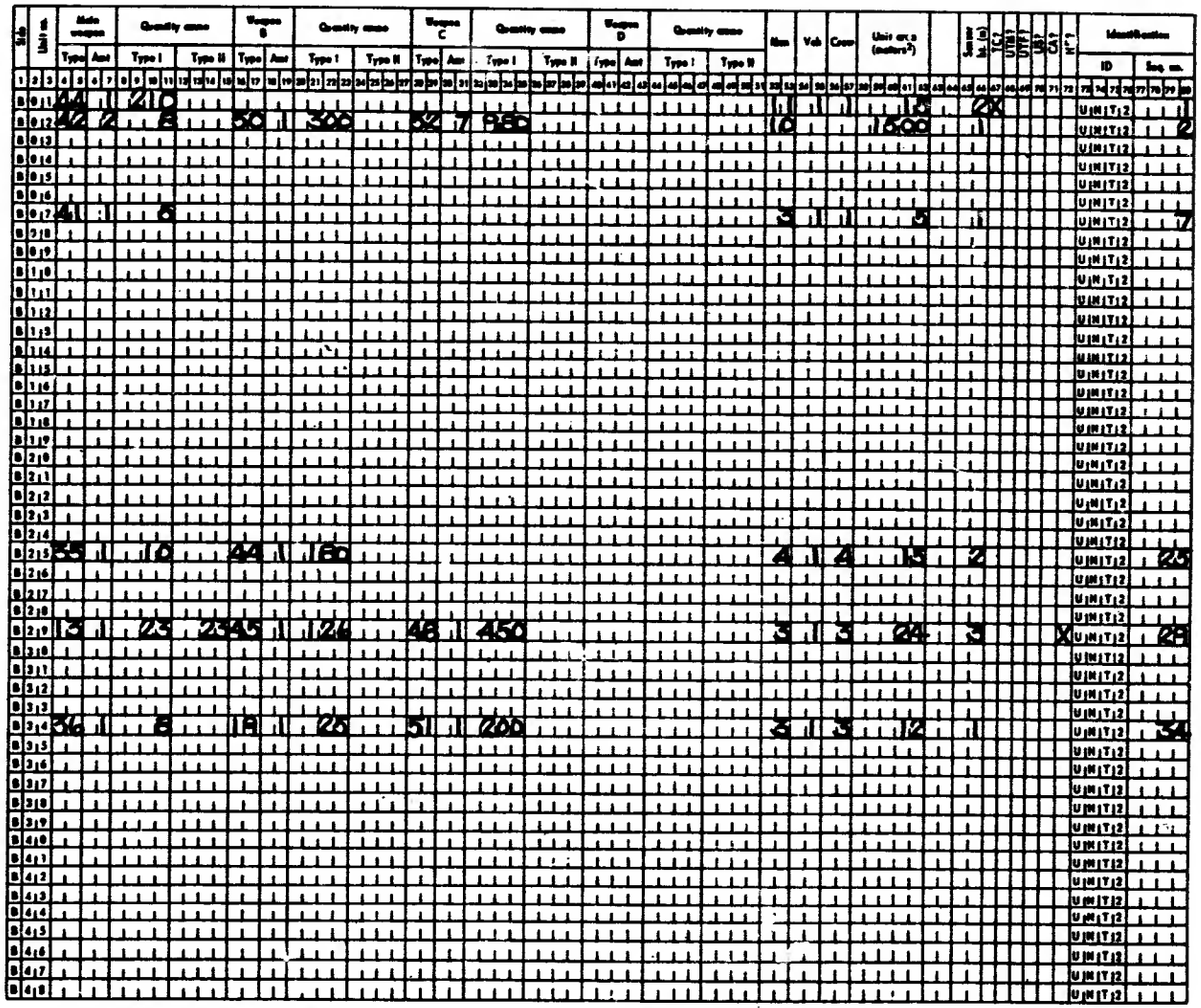
Column	Characteristic
56-57	Enter number of men that remain in vehicle (drivers, weapon operators, etc.), maximum 63.
58-62	Enter average area each unit is expected to occupy when deployed. This area is used in assessing casualties from fragmenting ammunition.
63-64	Not presently used.
65-66	Enter height of unit's sensor device above ground, e.g., the height of a man's eyes above the ground.
67	Enter X if unit is troop carrier. If a unit is a troop carrier, the next line in the table must describe the characteristics of the passenger unit.
68	Enter X if unit cannot move.
69	Enter X if unit cannot fire. If a unit is unable to fire or unable to move, an X is made in the appropriate column. For example, a headquarters unit might be designated immobile.
70	Enter X if unit's sensor is not to be restricted to the grid square adjacent to known targets on the target priority lists.
71	Enter X if unit can call artillery. If a unit has the communication, organization, and mission allowing it to call artillery, the appropriate column is marked X.
72	Enter X if unit is to hold fire until targets are within hold-fire range. In effect the hold-fire option presents a unit from initiating the fire fight. Maximum entry is 4095.

Example

UNIT 2 is completed as shown on Figs. 37 and 38.

Blue unit 1 is an APC armed with one heavy machine gun which has 210 rounds of ammunition. Eleven men ride this vehicle, one of whom is the crew. Since the unit is a single vehicle, its unit area is the area of the top of the vehicle (15 m^2). Its sensor height is 2 meters, and it is a troop carrier. This data is input as shown in Fig. 37.

CARMONETTE
UNIT 2
UNIT EQUIPMENT - BLUE



TC ~ X, if unit is primarily a troop carrier. The next unit must refer to the dismounted troops.
UTM ~ X, if unit unable to move.
UTF ~ X, if unit unable to fire.

US ~ X, if sensor is not restricted.
CA ~ X, if unit able to call artillery.
HF ~ X, if unit holds fire until within eye range.

Fig. 37 - UNIT 2 Blue Entries

The squad which rides the carrier is listed immediately after it; Blue unit 2 is this squad. Blue unit 2 has 2 LAW with 8 rounds, 1 machine gun with 300 rounds, and 7 rifles with 140 rounds each. The ten squad members have no vehicles and occupy an area of 1500 m^2 when deployed.

Blue unit 7 and 8 are MAW teams; they each have 1 launcher and 5 rounds. The model does not kill weapons, it kills people and vehicles, therefore it is necessary to designate the launcher as a vehicle. The unit area assigned is that occupied by the gunner and launcher.

The other two platoons are identical to the one just discussed and their entries are the same as those above.

Blue units 25 through 28 are heavy antitank weapons mounted on an APC that also mounts a heavy machine gun. Blue units 29 through 33 are tanks with 23 rounds of type I and 23 rounds of type II ammunition for the main gun; they also have a heavy machine gun and a coaxial machine gun. The tanks will not open fire until they have target within the hold-fire range, or until they know that they or a friendly unit has been fired upon. In effect the hold-fire option prevents a unit from initiating the fire fight.

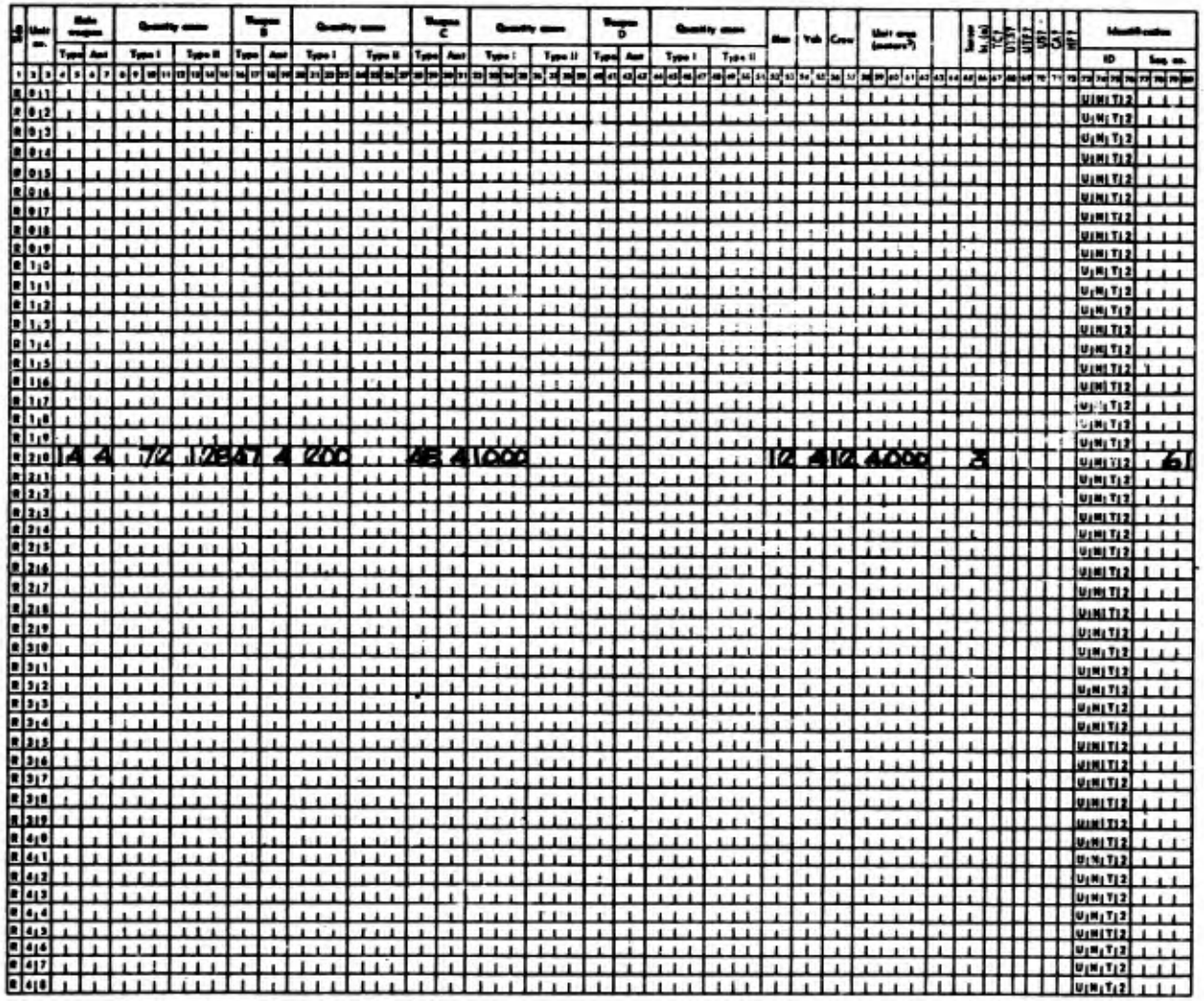
The entries in cols 52 through 57 for the helicopters, units 34 and 35, demonstrate another model idiosyncrasy. The program assigns the number of individuals required to operate the weapon as entered on WEAPON 1 to the weapons in the order of importance indicated on UNIT 2. If there are not enough men in a unit to fire all the weapons, the program will not permit the unmanned weapons to fire. Although the crew of the attack helicopter is really two men it is necessary to assign three so that Weapon C, the minigun, can shoot at the same time as the other weapons.

Entries for the Red force (Fig. 38) are made in the same manner as for the Blue. Since many of the Red units are platoons rather than individual vehicles, the entries are for three or four vehicles; e.g., Red unit 20 is a platoon of tanks plus the company commander's tank and has 4 main guns, 4 heavy machine guns, 4 coaxial machine guns, 12 men, 4 vehicles, and occupies a unit area of 4000 m^2.

CARMONETTE

UNIT 2

UNIT EQUIPMENT - RED



TC ~ X, if unit is primarily a troop carrier. The next unit must refer to the dismounted troops.
UTR ~ X, if unit unable to move.
UTF ~ X, if unit unable to fire.
US ~ X, if sensor is not restricted.
CA ~ X, if unit able to call artillery.
HF ~ X, if unit holds fire until visible eye range.

Fig. 38 - UNIT 2 Red Entries

UNIT 3

The units identified on UNIT 2 must be further described by assigning each of them to a target class, vulnerability class, mobility class, fire-response class, sensor class, and element-size class. The Unit Classification List (Table 5) prepared during the preliminary considerations assigns an index to each item included in the games; the appropriate indices are assigned to the units using UNIT 3 which is explained below.

Column	Characteristic
4-5	Target Class. An index number from 1 to 16 is used to assign units to target classes. All 16 need not be used. Two factors, vulnerability and firepower of the unit, determine its target class. Each hostile weapon will be given a priority ordering of target types. The target-class index therefore describes the relative desirability of units as targets for different hostile weapon types. Target class 16 is not targetable, hence it may be used for artillery units and dummy CCS units.
6-7	Vulnerability Class. An index number from 1 to 12 is used to assign units to vulnerability classes. No ranking is implied by the index numbers; they simply identify eleven or less different sets of units whose elements have similar vulnerabilities. Vulnerability class 12 is always used for the probability of survival of troops inside troop carriers when the carrier is destroyed. Any two vulnerability classes should be appreciably different in their vulnerabilities to the different weapons of the opposing force. Remember that only vulnerability classes 1 through 4 can be killed by fragmenting ammunition.
8	Element-Size Class. An index, numbers 0 to 9, is used to determine the probability that an element may be detected and the probability that an element may be hit by enemy fire. Index 0 corresponds to units with largest elements (e.g., tanks) and index 9 to units with smallest elements (e.g., dismounted infantrymen). Not all indexes need to be used.
9	Mobility Class. An index number from 0 to 7 is assigned to all units. Dismounted infantry must be indexed zero, index 1 to 4 apply to ground vehicles, and 5 to 7 to air vehicles. "On call" helicopters must be mobility class 5. The classes are used to determine rates of movement under various conditions of trafficability and combat. Should there be more than four different ground vehicles or three different air

Column	Characteristic
	vehicles, those units that are most similar should be placed in the same mobility class. Since dismount and remount times are determined by mobility class (see MOBILITY 2, Fig. 34), troop carriers that do not have a common time should be in different mobility classes.
10	Fire-Response Class. An index number from 1 to 5 is assigned to all units. Each unit is placed in a fire-response class from 1 to 5; infantry in 1, open vehicles in 2, light armored vehicles in 3, heavy armored vehicles in 4, and aircraft in 5. These fire-response classes are used to describe how the units respond to hostile fire.
11-12	Sensor Class. Six sensor classes with index 1 to 6 are available to classify all units. Each class is further subdivided into six types. The sensors are described in SENSOR 1 through 10 and Forms 37A through 41. Each unit is assigned the appropriate type and class of sensor.
13-14	Maximum Men Per Vehicle. This number is used if one of the vehicles of a multiple vehicle unit is destroyed so that the survivors can mount the remaining vehicles of the troop-carrier unit. The number of men and vehicles per unit is shown on UNIT 2. If the survivors cannot be accommodated in the remaining vehicles, all troops will dismount and proceed as a dismounted unit. Limits: 1-63.
15-16	Fraction of Time Unavailable. For support units that are not exclusively supporting the simulated force, the fraction (expressed in percent) of time they are unavailable (due to supporting flank units not in the simulation) should be entered. Limits: 02-99.
17-18	Superior HQ. A superior headquarters identification must be entered for each unit listed. The superior headquarters identification numbers must start with 49 regardless of the number of weapon units and cannot be larger than 63. The superior HQ listed will receive intelligence information from the weapon unit each surveillance cycle.

Example

UNIT 3 is completed as follows, see Figs. 39 and 40.

Blue unit 1 is an APC and from Table 5 we determine the following: Target Class 2 (col 5), Vulnerability Class 3 (col 7), Element-Size Class 4 (col 8), Mobility Class 1 (col 9), Fire-Response Class 3 (col 10),

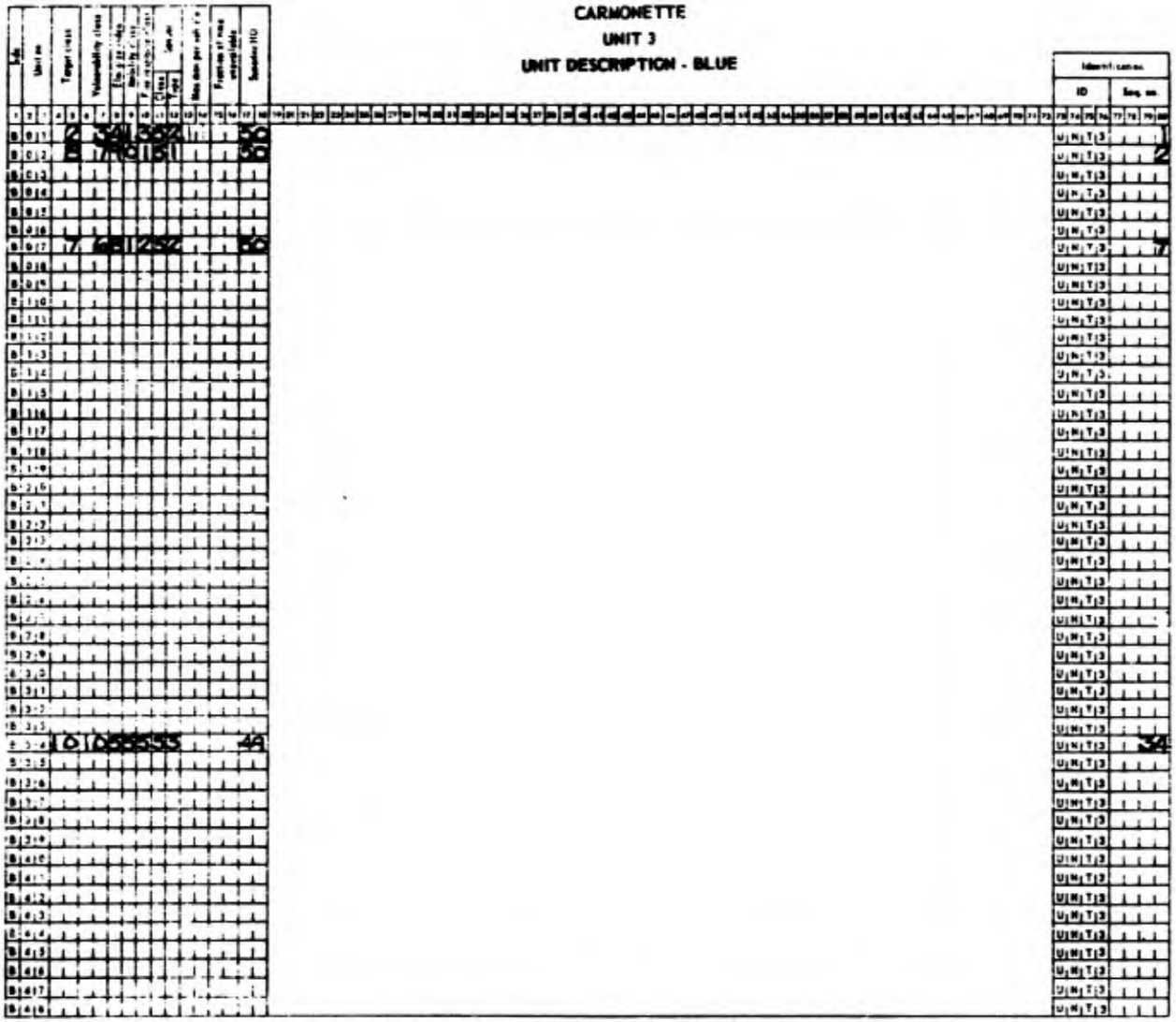


Fig. 39 - UNIT 3 Blue Entries

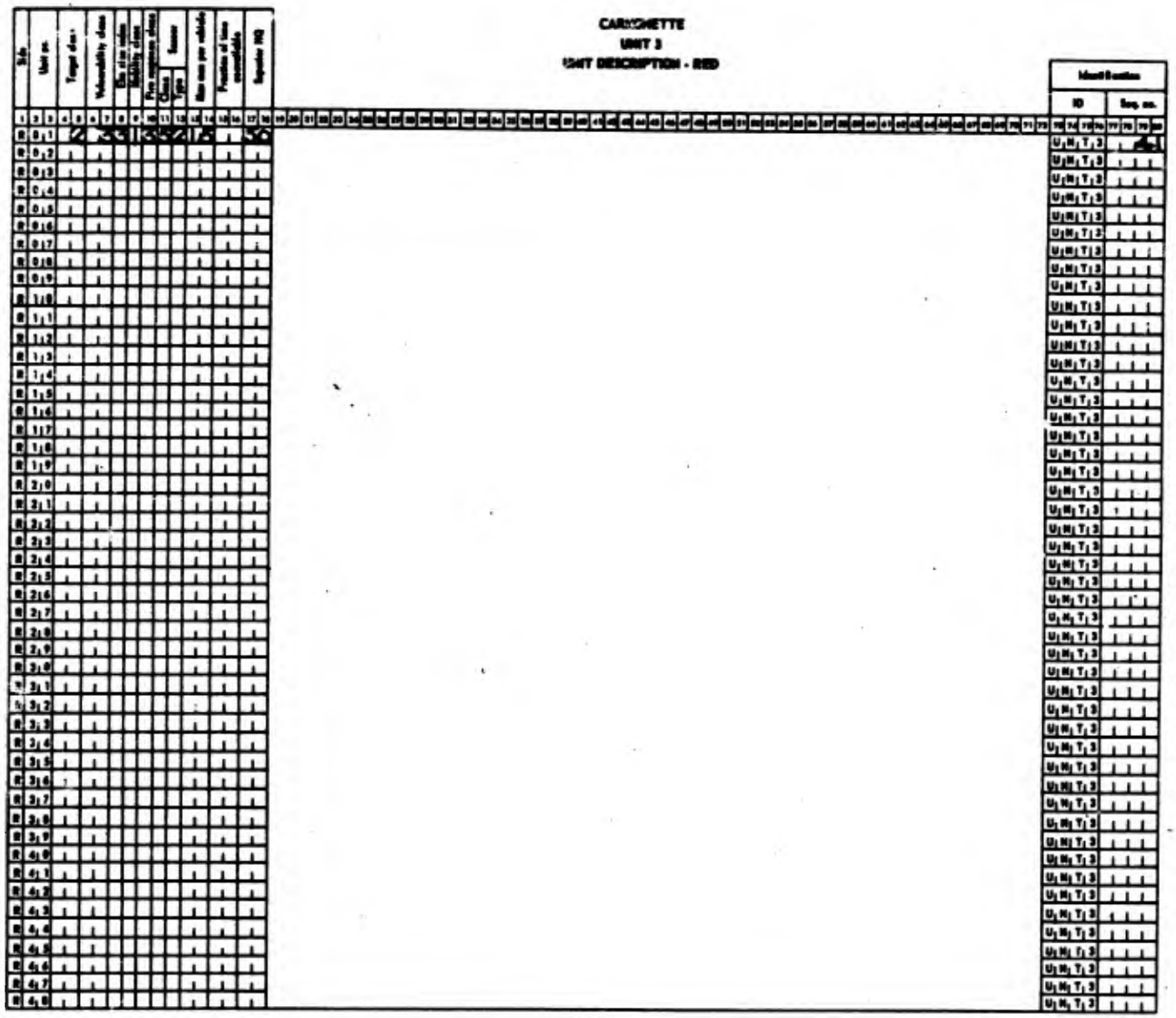


Fig. 40 - UNIT 3 Red Entries

Sensor Class and Type 52 (cols 11 and 12). Since the unit contains only one carrier the maximum men per vehicle is the size of the squad or 11 men. Enter this number in cols 13 and 14. This carrier is part of the northern most platoon, therefore its superior headquarters is 50 (cols 17 and 18). Blue unit 2 is the squad that rides in the carrier described above and is input in the same manner as are all other Blue units.

The Blue medium antitank weapons (units 7, 8, 15, 16, 23, and 24) are described as separate units so that they can be killed separately; the model kills units not weapons. The entries for the MAW are straightforward except for their mobility class. They cannot mount the carriers with the squads since they are not part of the squad; so they are assigned the same mobility class as the carriers and will move at the same rate as the carrier during periods when they should be mounted.

Blue units 34 and 35 are "On call" helicopters, therefore Mobility Class 5.

Red units are input in the same manner except for the carriers in the rifle platoons. These units are allowed a maximum of 15 men per vehicle. This permits two carriers in a platoon to carry the survivors of the third vehicle if it is killed. When the platoon loses a second vehicle, the last vehicle cannot carry all the surviving troops; so it dismounts its squad and the platoon continues its mission on foot.

UNIT 4

A relation between target class and vulnerability class of units, as a function of range intervals, is established by the Danger State Table, UNIT 4. Two ranges are selected that specify three range intervals. The two ranges are entered under R_1 and R_2 in cols 3 to 11 of the first UNIT 4 card, see Fig. 41. In the example $R_1 = 1000$ and $R_2 = 2000$ since these were the maximum ranges of the Blue MAW and HAW 2 respectively.

A unit in a vulnerability class may be regarded, for a given range interval, as being seriously vulnerable, moderately vulnerable, or effectively invulnerable to a unit in a target class. The states are identified by the letters S, M and I respectively and one of these letters should be placed in each square in the body of UNIT 4 for every vulnerability-class target-class combination being simulated. UNIT 4 is completed as shown in the accompanying explanation.

Column	Characteristic
12-23	Enter S, M, or I as seriously vulnerable, moderately vulnerable, or invulnerable for each vulnerability class against each target class within the range interval $0 < \text{range} < R_1$.
24-35	Same for range interval $R_1 < \text{range} < R_2$.
36-47	Same for range interval $R_2 < \text{range}$.

Example

Between 0 and 1000 meters, tanks (vulnerability class 1) are seriously vulnerable to other tanks (target class 1); invulnerable to APC (target class 2); seriously vulnerable to the Red APC 2 because of its cannon and ATGM, HAW 1, HAW-ground, HAW 2 and MAW (target classes 3, 4, 5, 6 and 7 respectively); moderately vulnerable to the LAW within the infantry squads (target class 8); seriously vulnerable to attack helicopters (target class 10); invulnerable to the AD systems (target classes 10 and 11); and moderately vulnerable to the antiarmor munitions of artillery pieces (target class 16). States for the other vulnerability classes

are input using the same logic. Note that all vulnerability classes are invulnerable to the MAW (target class 7) beyond 1000 meters and to the HAW 2 (target class 6) beyond 2000 meters.

CARMONETTE

UNIT 4

DANGER STATE TABLE

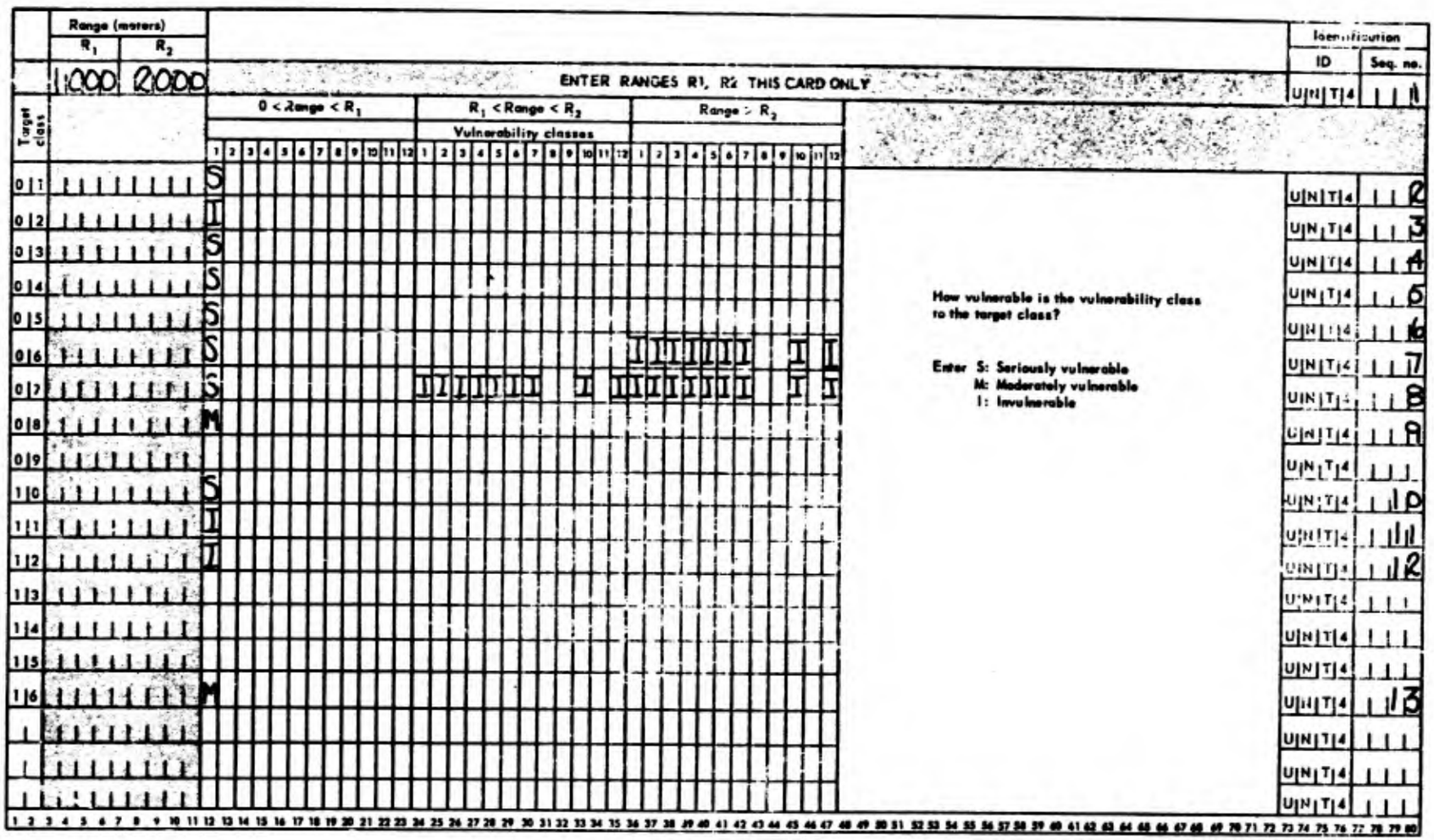


Fig. 41 - UNIT 4 Entries

UNIT 5

Suppression or neutralization has long been recognized as a primary weapons effect, however it is not sufficiently well understood to accurately quantify all of its effects. CARMONETTE provides for two levels of suppression. Dismounted infantry and open vehicles (fire response classes 1 and 2) may be "Pinned down." In addition to these classes, light armor, heavy armor and aircraft (classes 3, 4, and 5) can be "Partially neutralized" by either direct or indirect fire. A "Pinned down" unit retains only "nearest square" intelligence, does not conduct surveillance, does not move and does not fire. A "Partially neutralized" ground unit conducts surveillance and fires its weapons with reduced accuracy, requires twice as much time to aim weapons, and moves at a slower speed. Aircraft (helicopters) drop to treetop level when fired upon, provided they are not guiding a missile to a target. If the helicopter is guiding a missile, it will drop to treetop level after the missile impacts.

In addition to many other factors, suppression is a function of the number and caliber of rounds impacting in an area and the time during which these rounds fall. The caliber of the round is represented by the neutralization weight entered on WEAPON 1, the impact area for artillery is as entered on WEAPON 1 and is one grid square for other weapons, the time to be considered is optional and is input on the first card of UNIT 5. (See Fig. 42.)

The total neutralization weight of rounds falling per neutralization interval required to cause a unit to respond to fire is listed on UNIT 5 as described below.

Column	Characteristic
2-5	On first card only, enter desired neutralization interval in minutes (nn.nn).
2-5	Enter number of rounds (of neutralization weight 1) required for fire-response class 1 (dismounted infantry) to be pinned down by a combination of direct and indirect fire.
6-9	To be partially suppressed by direct fire.

CARMONETTE

UNIT 5

THRESHOLD FOR RESPONSE

Side	Rounds per interval (each entry must be less than 4096)												Identification	
	Fire response class													
	1 Dismounted infantry		2 Open vehicles		3 Light armor		4 Heavy armor		5 Aircraft					
									Firing run		Not on firing run			
	Response posture													
	1 Pinned down	Partially suppressed		1 Pinned down	Partially suppressed		Partially suppressed		Partially suppressed		Abort msn, drop to treetop level		ID	Seq. no.
		DF	IF		DF	IF	DF	IF	DF	IF				
	150	ENTER NEUTRALIZATION INTERVAL IN MINUTES THIS CARD ONLY											UNIT5	1
B	400	150	210	400	160	225	170	275	1100	425	112	112	UNIT5	2
R	400	150	210	400	160	225	170	275	1100	425	112	112	UNIT5	3

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

Pinned down ~ severe fire (combination of direct and indirect)

Fig. 42 - UNIT 5 Entries

Column	Characteristics
10-13	To be partially suppressed by indirect fire.
14-25	Same for fire-response class 2 (open vehicles).
26-29	Enter number of rounds for fire-response class 3 (light armor): to be partially suppressed by direct fire.
30-33	To be partially suppressed by indirect fire.
42-45	Enter number of rounds required for fire-response class 5 (aircraft): to drop to treetop level.
46-49	Same as 42-45.

UNIT 6

CARMONETTE units that run out of ammunition for their main weapon can either continue their mission firing their other weapons, or they can withdraw from action. Units that cannot perform their mission without their main weapon, such as ground or helicopter mounted ATGM, should be given out of ammunition orders by placing an X under their numbers on UNIT 6 (see Fig. 43).

UNIT 7

The points to which units withdraw after running out of ammunition are listed on UNIT 7 (see Fig. 43). The model will order units to the nearest escape point.

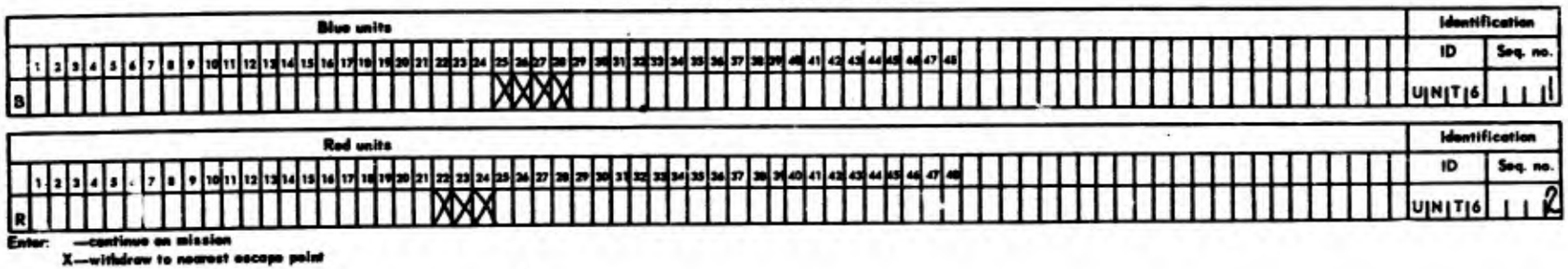
UNIT 8

There is a probability that a unit will exhibit its death by smoke, ceasing fire, stopping movement, crashing, etc., when it is killed. These probabilities are entered on UNIT 8 for each vulnerability class as shown in Fig. 43.

CARMONETTE

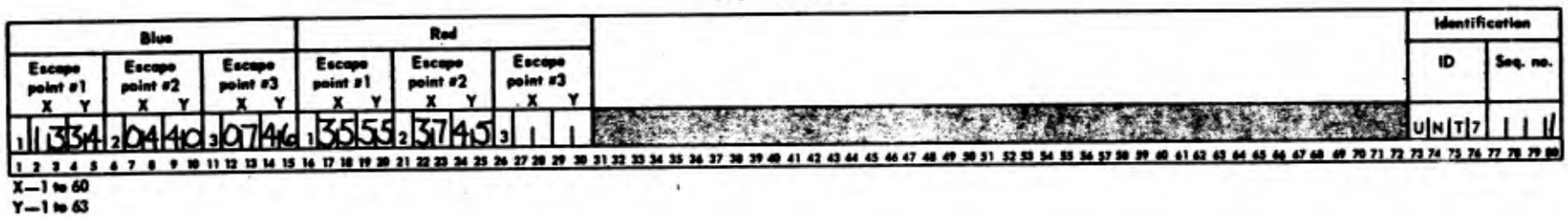
UNIT 6

OUT OF AMMUNITION ORDERS



UNIT 7

ESCAPE POINTS



UNIT 8

PROBABILITY OF INDICATING DEATH

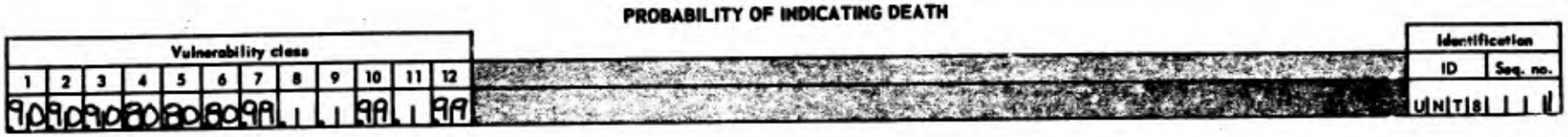


Fig. 43 - UNIT 6, 7, and 8 Entries

UNIT 9

Each CARMONETTE unit is given specific orders that control its action throughout the simulated battle. If the unit is killed, it simply quits executing the orders. The model presently executes the 22 commands shown in Table 15. Any logical sequence of these commands may be employed to direct the actions of a unit throughout the simulated battle. UNIT 9 (Fig. 44) is used to record the order number, the prowords, and numerical values of the qualifiers. No more than 999 orders can be employed to control the battle. Each unit must be given one or more orders, and the same sequence of orders can be given to any number of units. Columns 1 to 3 indicate the order number, which must be less than 999. Columns 4 to 7 are for the order. Only five qualifiers are currently allowed and are to be recorded in the same order as listed in Table 15. The interpretation of the order, qualifier proword, and qualifier numerical values is as follows.

Order	Interpretation
NSTP	Move without stopping. Used for units capable of firing on the move. RATE must be first qualifier.
MOVE	Move, and at the center of each grid square, compare the probability of moving under the units current doctrine with a random number. If unit does not move, it may fire if so ordered. Used for units that cannot fire on the move. DOCT must be first qualifier.
STAY	Remain in place. Must be followed by qualifier FIRE, TIME, or INTL.
DISM	Causes carrier and passenger units to dismount. Carrier and passenger must be in same grid square and executing same order.
REMO	Causes carrier and passenger units to remount. Subject to same restrictions as DISM.
CHAL	Cause helicopter units to change altitude. Must be followed by qualifier LOS, TRTP, LAND.
SKIP	Causes unit to skip forward or backward a specific number of orders. Must be followed by qualifier FORW or BACK.

Table 15

CARMONETTE COMMANDS

Narrative order[a]	Order	Qual[b] 1	No 1	Qual 2	No 2	Qual 3	No 3	Qual 4	No 4	Qual 5	No 5
move NoSToPping at RATE r to SQuaRE xx yy with KIND of fire k PRiORity p[c]	NSTP	RATE	r	SQRE	xxyy	KIND	k	PROR	p	ALT	a
MOVE under DOCTrine m at RATE r to SQuaRE xx yy with KIND of fire k PRiORity p	MOVE	DOCT	m	RATE	r	SQRE	xxyy	KIND	k	PROR	p
STAY and FIRE s shots at SQuaRE xx yy with KIND of fire k PRiORity p	STAY	FIRE	s	SQRE	xxyy	KIND	k	PROR	p		
STAY until TIME tt.tt or FIRE s shots with KIND of fire k PRiORity p	STAY	TIME	tt.tt	FIRE	s	KIND	k	PROR	p		
STAY for INTerval tt.tt or FIRE s shots with KIND of fire k PRiORity p	STAY	INTL	tt.tt	FIRE	s	KIND	k	PROR	p		
DISMount in present location	DISM										
REMOunt in present location	REMO										
CHange ALtitude to get LOS	CHAL	LOS									
CHange ALtitude to TReeToP	CHAL	TRTP									
CHange ALtitude to LAND	CHAL	LAND									
SKIP FORWard / BACKward nn orders UNConDitionally	SKIP	FORW BACK	nn nn	UNCD UNCD							
if current TIME ≤ tt.tt				TIME	tt.tt						
if dead FRiendly UNits ≥ uu				FRUN	uu						
if dead ENemy UNits ≥ uu				ENUN	uu						
UNTiL friendly unit uu is in SQuaRE xx yy, if uu dies STAY 63.99				UNTL	uu	SQRE	xxyy	STAY			
UNTiL friendly unit uu is in SQuaRE xx yy, if uu dies SKiP 1 order				UNTL	uu	SQRE	xxyy	SKP1			
UNTiL friendly unit uu is in SQuaRE xx yy if uu dies go to EXIT pt				UNTL	uu	SQRE	xxyy	EXIT			
if FRiendly CAsualties ≥ nnnn				FRCA	nnnn						
if ENemy CAsualties ≥ nnnn				ENCA	nnnn						
if ENemy UNits ≥ uu are closer then RaNGE nnnn meters				ENUN	uu	RNGE	nnnn				
if FRiendly UNIT CAsualties ≥ uu for vul class TYPE vv				FRCA	uu	TYPE	vv				

[a] r:1-7 a:1-7 xx:1-60 vv:1-12
k:0-7 m:1-4 yy:1-63 nnn:1-4095
p:1-7 s:1-7 nn:1-63 tt.tt:1-63.99
uu:1-48

[b] Qual is left justified

[c] ... at ALTitude a (if unit is helicopter)

Qual	No	(Qual is left justified, No is right justified)
RATE	r	Identifies rate (r) at which unit is to move. Values for "r" are from 1 to 7 and refer to the ordered movement rates assigned on MOBILITY 6.
DOCT	m	Identifies movement doctrine (m) under which a unit is moving. Values of "m" are from 1 to 4 and refer to probabilities of moving assigned on MOBILITY 1.
FIRE	s	Identifies the number of rounds (s) a unit is to fire under this order. Values of "s" are from 0 to 7. 0 is used if the unit is not to fire. 7 indicates that no shot limit is to be observed and other conditions determine the completion of the order.
TIME	tt.tt	A time measured in minutes (tt.tt) from the start of the game. Limits: 00.02-63.99.
INTL	tt.tt	A time measured in minutes (tt.tt) from the time the order is read.
LOS		When combined with CHAL, causes a helicopter unit to change altitude to get line of sight to an enemy unit.
TRTP		When combined with CHAL, causes a helicopter unit to drop from its present altitude to 5 feet above the treetop (vegetation as input on TERRAIN 1).
LAND		When combined with CHAL, causes a helicopter unit to land in the square it is presently above.
FORW	nn	When combined with SKIP, causes a unit to skip forward nn orders. nn varies from 1 to 63.
BACK	nn	Same as above except skip is backward.
SQRE	xxyy	Identifies a grid square. xx = 1 to 60, yy = 1 to 63.
UNCD		Indicates that there are no conditions on the SKIP order.
FRUN	uu	Indicates that condition on SKIP order is at least uu friendly units are dead. uu varies from 1 to 48.
ENUN	uu	Same as above for enemy units.
UNTL	uu	Indicates that condition on SKIP order is until friendly unit uu arrives in grid square xxyy. If uu dies before reaching xxyy the unit receiving SKIP order will take one of the following actions:

STAY	Stay in place and continue to execute order prior to SKIP.
SKP1	Skip forward one order.
EXIT	Go to nearest escape point.

Qual	No	Interpretation
FRCA	nnnn	Indicates that condition on SKIP order is that there are at least nnnn friendly casualties. nnnn varies from 1 to 4095.
ENCA	nnnn	Same as above for enemy casualties.
RNGE	nnnn	Indicates that condition on SKIP order is that at least uu enemy units are known to be closer than nnnn meters.
TYPE	vv	Indicates that condition on SKIP order is that at least uu vehicles of vulnerability class vv are dead.
KIND	k	Describes the kind of fire to be employed.

k	Kind of fire
0	Do not fire. Can be used in conjunction with Priority 7 to put artillery and mortar units "On Call."
1	Suppressive fire at or pinpointed targets in SQRE xxyy.
2	Not defined.
3	Suppressive fire at or pinpointed targets in SQRE xxyy while the firing unit is moving.
4	Pinpointed targets anywhere.
5	Pinpointed targets in SQRE xxyy.
6	Pinpointed target anywhere while the firing unit is moving.
7	Pinpointed targets in SQRE xxyy while the firing unit is moving.

The grid square mentioned in KINDS 1 and 3 for non-zero suppressive fire area (recorded on GAME) can be the center of an area in searching for pinpointed targets. The grid square can only be indicated once in any order. Thus the destination for a move must be the same as the grid square desired for firing.

PROR p Describes the priority of fire to be used.

p	Priority of fire
1	Choose dangerous targets and use first target list.
2	Choose dangerous targets and use second target list.
3	Choose dangerous targets and use third target list.

Qual	No	Interpretation
	p	Priority of fire
	4	Choose targets of opportunity from first priority list.
	5	Choose targets of opportunity from second priority list.
	6	Choose targets of opportunity from third priority list.
	7	Fire as directed. Used for "On Call" artillery and mortar units and for suppressive fire.
ALT	a	Indicates the altitude (a) at which helicopters are to move. Values of "a" are from 1 to 7 and refers to altitudes assigned on MOBILITY 5.

Preparation of Orders

A narrative of each unit's actions throughout the battle should be prepared keeping in mind the conditions that can be used to indicate the completion of orders. This narrative can then be used to prepare a sequence of orders for each unit's actions. The formats shown on the right side of Table 15, and the limits on the values of the qualifiers must be precisely observed.

Care should be taken to ensure that a unit does not attempt to execute an order number that either does not exist or is intended for other units. A non-existent order will cause the unit to be killed. Unintended actions can occur when the last order in a unit's sequence does not provide for actions to or beyond the termination time, and the next sequential order is intended for other units. A convenient way to avoid this type of trouble is to follow the last STAY order by an order to skip backward one order unconditionally (SKIP BACK 1 UNCD). A non-terminating computer loop will occur if an exit from two or more SKIP orders cannot be found.

Special Orders. Orders for supporting units follow the formats shown in Table 15, however specific entries are required. Artillery and mortars are placed "On call" by being ordered to fire with KIND 0 and PROR 7. If helicopters are to be placed in an "On call" status, two orders are required. The first order must be STAY INTL nn.nn (not less than 1.00) and the second must be STAY TIME 5000.

If a unit is designated a troop carrier on UNIT 2, the program mounts the following unit in the carrier, therefore the order DISM must be given to both the carrier and the mounted unit before they can act independently.

Examples. Orders for the elements manning the outpost on Hill 341.2 (1348) are shown in Fig. 44. Because of the manner in which the program initializes command and weapons units, it is desirable to initially order all units to stay an interval of 1 minute; it is mandatory to give this order to "On call" helicopters.

Blue 5 is an APC, Blue 6 is the squad riding in the APC, and Blue 8 is the MAW that is attached to the squad. Orders must be given first to the carrier and then to the squad, and orders must be the same for both during the time the squad is mounted. After staying an interval of 1 minute (orders 1 and 15), the carrier and squad are ordered to dismount (orders 2 and 16). The carrier then proceeds as rapidly as it can (RATE 7) to a covered position (SQRE 1247) where it will wait for the squad to rejoin it (orders 3 thru 5). After dismounting, the squad deploys and conducts surveillance until it sees three enemy units within 1000 meters of the outpost (orders 17 thru 19). The squad then proceeds to the carrier's location (order 20), and both are ordered to remount (orders 6 and 21). They then move to their final defensive position and dismount (orders 7 and 22, and 8 and 23). The final orders (9 and 10, and 24 and 25) will cause the two units to fire at pinpointed targets anywhere (KIND 4) from their first target priority list (PROR 4).

The orders for the MAW are intended to cause it to fire from the squad position (order 31), cover the withdrawal of the squad (orders 32

CARMONETTE
UNIT 9
ORDERS

Order no.	Order	1 Qual 1	1 Number 1	2 Qual 2	2 Number 2	3 Qual 3	3 Number 3	4 Qual 4	4 Number 4	5 Qual 5	5 Number 5	6 Qual 6	6 Number 6	Qual 7	Identification ID	Identification Seq.* no.
1	STAY	UNTIL	100												UNIT19	1001
2	DISM														UNIT19	1002
3	NSTP	RATE	7	SQRE	1247	KIND	0	PROR	10						UNIT19	1003
4	STAY	UNTIL	50												UNIT19	1004
5	SKIP	BACK	1	UNTIL	06	SQRE	1247	EXIT							UNIT19	1005
6	REMO														UNIT19	1006
7	NSTP	RATE	7	SQRE	09416	KIND	0	PROR	2						UNIT19	1007
8	DISM														UNIT19	1008
9	STAY	TIME	5000	FIRE	1	KIND	4	PROR	4						UNIT19	1009
10	SKIP	BACK	1	UNCD											UNIT19	1010
															UNIT19	
15	STAY	UNTIL	100												UNIT19	1015
16	DISM														UNIT19	1016
17	STAY	UNTIL	50												UNIT19	1017
18	SKIP	FORW	2	ENUN	3	RNGE	1000								UNIT19	1018
19	SKIP	BACK	2	UNCD											UNIT19	1019
20	NSTP	RATE	7	SQRE	1247	KIND	0	PROR	0						UNIT19	1020
21	REMO														UNIT19	1021
22	NSTP	RATE	7	SQRE	09416	KIND	0	PROR	0						UNIT19	1022

Fig. 44 - UNIT 9 Entries

CARMONETTE
UNIT 9
ORDERS

Order no.	Order	1 Qual 1	1 Number 1	2 Qual 2	2 Number 2	3 Qual 3	3 Number 3	4 Qual 4	4 Number 4	5 Qual 5	5 Number 5	6 Qual 6	6 Number 6	Qual 7	Identification ID	Identification Seq.* no.
23	DISM														UNIT9	1023
24	STAY	TIME	5000	FIRE	1	KIND	4	PROR	4						UNIT9	1024
25	SKIP	BACK	1	UNCD											UNIT9	1025
															UNIT9	
30	STAY	INTL	100												UNIT9	1030
31	STAY	INTL	50	FIRE	1	KIND	4	PROR	4						UNIT9	1031
32	SKIP	BACK	1	UNTL	06	SQRE	1247	EXIT							UNIT9	1032
33	STAY	INTL	50	FIRE	1	KIND	4	PROR	4						UNIT9	1033
34	NSTP	RATE	7	SQRE	0946	KIND	0	PROR	0						UNIT9	1034
35	STAY	TIME	5000	FIRE	1	KIND	4	PROR	5						UNIT9	1035
36	SKIP	BACK	1	UNCD											UNIT9	1036
															UNIT9	
															UNIT9	
															UNIT9	
															UNIT9	
															UNIT9	
															UNIT9	
															UNIT9	
															UNIT9	

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

Fig. 44 - UNIT 9 Entries continued

and 33), move with the squad and carrier to the defensive position (order 34), and then to fight with the squad during the remainder of the battle (orders 35 and 36).

UNIT 10

The final input form tells each unit the number of its first order and its starting location. More than one unit may have the same first order number, and more than one unit may be located in the same grid square. A troop carrier and its mounted unit must have the same starting location, and it is very unlikely that they will have the same first order number. Data for each unit is input using UNIT 10 as shown in Fig. 45.

Example

The first order for Blue 5 is number 1 (line 1, cols 40-42), for Blue 6 is number 15 (line 1, cols 49-51), and for Blue 8 is 30 (line 2, cols 13-15). All three units are initially located in grid square 1348 (line 1, cols 43-46 and cols 52-55; and line 2, cols 16-19).

CARMONETTE
UNIT 10
FIRST ORDER AND STARTING LOCATION

Side	Unit	First order no.	Starting location X	Starting location Y	Unit	First order no.	Starting location X	Starting location Y	Unit	First order no.	Starting location X	Starting location Y	Unit	First order no.	Starting location X	Starting location Y	Unit	First order no.	Starting location X	Starting location Y	Unit	First order no.	Starting location X	Starting location Y		Identification ID	Identification Seq. no.
B	01				02				03				04				05	09	13	46	06	01	51	34	BLUE	UNT0	1
B	07				08	03	01	34	09				10				11				12					UNT0	2
B	13				14				15				16				17				18					UNT0	
B	19				20				21				22				23				24					UNT0	
B	25				26				27				28				29				30					UNT0	
B	31				32				33				34				35				36					UNT0	
B	37				38				39				40				41				42					UNT0	
B	43				44				45				46				47				48					UNT0	
R	01				02				03				04				05				06				RED	UNT0	
R	07				08				09				10				11				12					UNT0	
R	13				14				15				16				17				18					UNT0	
R	19				20				21				22				23				24					UNT0	
R	25				26				27				28				29				30					UNT0	
R	31				32				33				34				35				36					UNT0	
R	37				38				39				40				41				42					UNT0	
R	43				44				45				46				47				48					UNT0	

X—1 to 60
Y—1 to 63

Fig. 45 - UNIT 10 Entries

Part III

OUTPUT AND DATA DIAGNOSTICS

INTRODUCTION

CARMONETTE outputs can be classified as those from the Terrain Generator, Preprocessors, and Game. These outputs will be discussed in the following sections.

TERRAIN GENERATOR

The terrain data prepared in STEP 3 is punched on cards and input to the terrain generator and are processed for proper format and correctness. Errors of improper format are indicated by computer printouts for debugging. An error is indentified by an item number and a type number. The item number is simply the sequence number of the data item. Since there are seven data items per card/line, a simple method of finding the one in error is to divide the item number by seven. The error is in the card/line numbered one greater than the quotient, and the remainder shows its sequence number in that line. For example, if the item number printed out is 75, the error is in the fifth item on line 11.

$$\frac{75}{7} = 10, \text{ remainder} = 5$$

Line number = 10 + 1 + 11

Sequence number = 5

The error type numbers are:

1 Illegal array name
2 Illegal grid coordinate
3 Value input not within allowable limits
4 Illegal sequencing of coordinates
5 Meters or feet not designated

6 Array name changed before 999 terminator

7 Illegal first grid data

The erroneous data item is also shown.

Three errors detected by the terrain generator are shown in Fig. 46. The first error message indicates that coordinates 2456 are illegally sequenced (error number 4) in the fourth item of line 51 ($354 \div 7 = 50$, $r = 4$). A search of the line designated COV51 shows no coordinate 2456. A more detailed look, however, shows that there are two lines designated COV50, and that coordinates 2456 are entered in the fourth data item after coordinates 2856 were entered in the third data item. The second error message indicates that coordinates 2656 in the fifth data item of the same line are also incorrect. The errors in coordinates are eliminated by correcting the coordinates in the third data item to 2356. The sequence now reads: 2356, 2456, 2656 now is legal. Since the computer program does not use the sequence numbers in cols 77-80, no effort was made to correct two lines numbered 50.

The function of the terrain generator, in essence, is to collect data for a given grid square from each of the six characteristic forms (ELE, VEG, TRF, RDS, COV, and CON), convert the input number to octal, punch this data on the appropriate card in the LAND deck and print a final listing of terrain data.

LAND Deck

The organization of the LAND deck is shown in Fig. 47. As shown on the left of the figure, there are 640 cards in the LAND deck. When the input was prepared, coding started in square 0101 and X was incremented to 6001, Y was then incremented by one and the process repeated from 0102 through 6002. This procedure was continued until all squares through 6063 were represented. The data in the LAND deck follows a similar scheme. Six squares are represented on each card, therefore the 60 X-coordinates corresponding to each Y-coordinate are represented on ten cards as is shown in the center of Fig. 47. The arrangement of

```
 22  53    8  28  53    4  41  53   13  42  53    4   4  54   10  12  54    4  15  54   12  COV  48
 20  54    4  42  54   13  44  54    4   5  55   10   8  55    8  11  55   10  13  55    4  COV  49
 35  55   13  36  55    4  44  55   13  52  55    4   6  56   10   7  56    8  13  56   10  COV  50
 14  56    4  22  56   10  28  56    6  24  56   12  26  56    4  34  56   13  36  56    4  COV  50
 51  56   13  54  56    4   5  57   10   7  57    8  14  57   10  15  57    4  24  57   11  COV  51
 27  57    4  34  57   10  35  57    4  39  57    8  41  57    4  54  57   13  56  57    4  COV  52
  2  59   15   4  58    4   5  58   10   6  58    8  14  58   10  17  58    4  23  58   12  COV  53
 29  58    4  39  58    8  41  58    4  55  58   13  57  58    4   5  59   10   6  59    8  COV  54
 19  59    4  23  59   13  25  59    4  26  59   12  29  59    4  40  59   10  42  59    4  COV  55
 46  59   12  47  59    4  56  59   13   1  60    4   5  60   10   6  60    8  13  60   10  COV  56
 14  60    8  17  60    4  24  60   10  28  60    4  39  60   12  45  60   15  46  60   12  COV  57
 47  60    4  55  60   13  59  60    4   4  61   10   5  61    8  19  61    4  26  61    8  COV  58
 28  61    4  40  61   10  41  61    6  49  61    4  52  61   13  54  61    4  58  61   12  COV  59
  1  62    4   3  62    8  13  62    6  19  62    4  25  62   10  30  62    4  39  62   10  COV  60
 41  62    4  45  62   13  52  62    4  55  62   12  56  62    4  60  62   13   1  63    8  COV  61
 11  63    4  28  63   12  31  63    4  41  63   13  47  63   15  48  63    4  56  63   10  COV  62
 58  63   15  59  63    4 999 -0   -0  -0  -0   -0  -0  -0   -0  -0  -0   -0  -0  -0   -0  COV  63
JSWCH = ,     5 ITEMS =   443

ITEM =   354
  ERROR NUMBER  4   ILLEGAL SEQUENCING OF COORDINATES  24  56

ITEM =   355
  ERROR NUMBER  4   ILLEGAL SEQUENCING OF COORDINATES  26  56
```

Fig. 46 - Terrain Generator Detected Errors

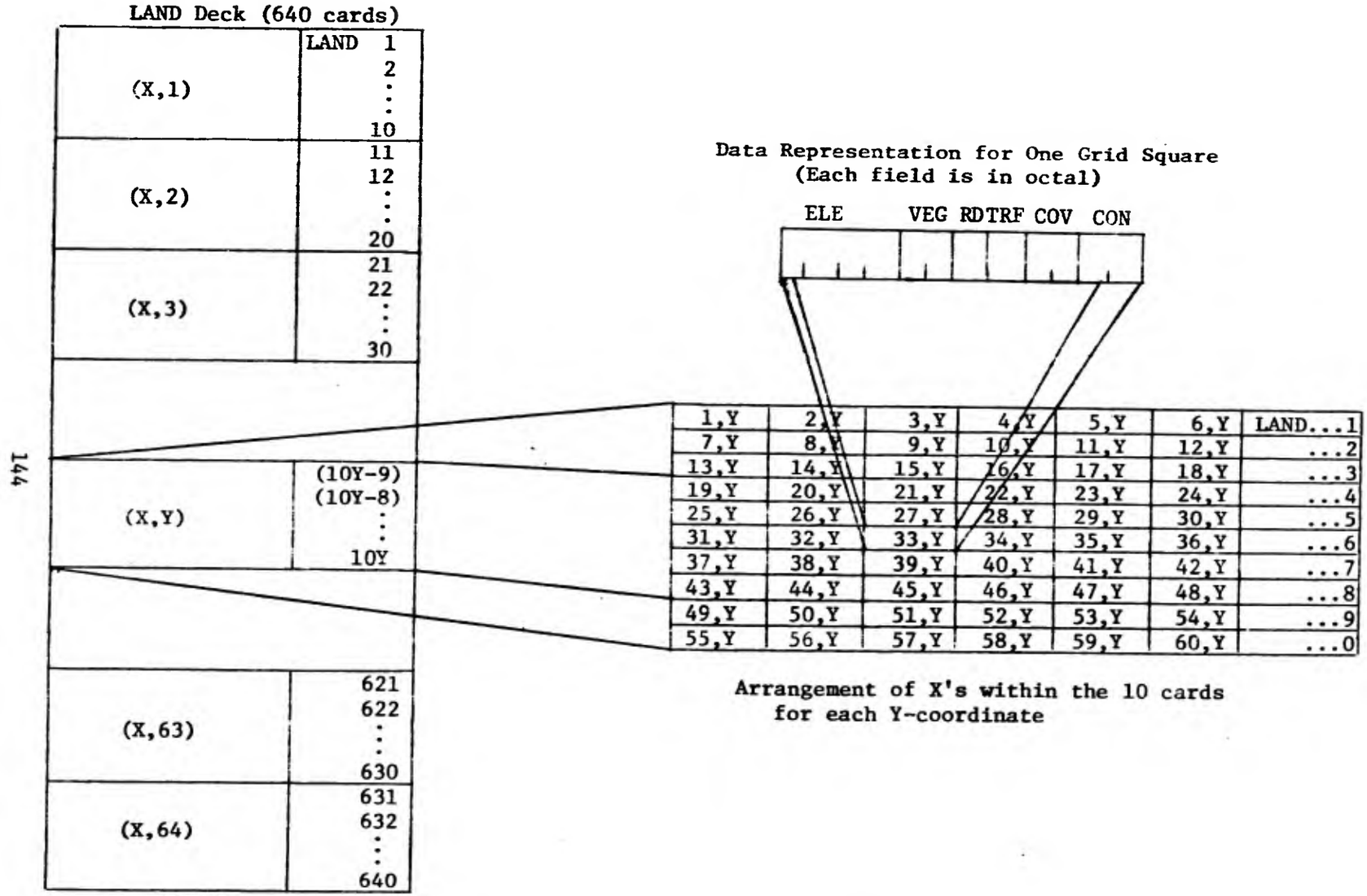


Fig. 47 - Organization of the LAND Deck

data (stored in octal representation) for a single grid square is shown at the top center of the figure. An example of a card from the LAND deck is shown in Fig. 48. The first two digits of the identification number, 30, shows that the card is one of those pertaining to Y = 31; the third digit, 6, shows that it pertains to squares 3131 through 3631. The following data pertains to square 3331: Elevation - $1770_8 = 1016$ ft, Vegetation - $2_8 = 2$ ft, Roads - $0_8 = 0$, Trafficability - $1_8 = 1$, Cover - $04_8 = 4$, Concealment - $06_8 = 6$. These values may be checked against the printed output shown in Fig. 49.

Final Listing of Terrain Data

Final printed output after error corrections from the terrain data input routine will appear as shown in Fig. 49. For each grid square the printout contains coordinates, the packed octal data word, and the specific values of the six terrain factors.

PREPROCESSOR

When all data prepared during STEPS 4-7 is combined with the LAND deck, it makes up the game input deck. Before this final deck can be input to the computer, the form from which this data was taken must be identified by a header card. The header card is simply a card on which only the form ID has been punched in columns 73-76 (GAME, WPN1, SENP, MOB6, UNTO, TER2, LAND). The header card is placed in front of the portion of the input deck it identifies, appropriate control cards as discussed in Volume III are added, and the deck is input to the preprocessor that compiles the data and produces a listing of the data arrays and an intermediate file. The preprocessor then uses the intermediate data file to compose a final data file and a final listing of certain combinations of data. This part describes the output of the preprocessors. The diagnostics should be studied with extreme care before making computer runs with the data.

Because of differences in computer systems and their use and differences in the output formats used by the General Research Corporation

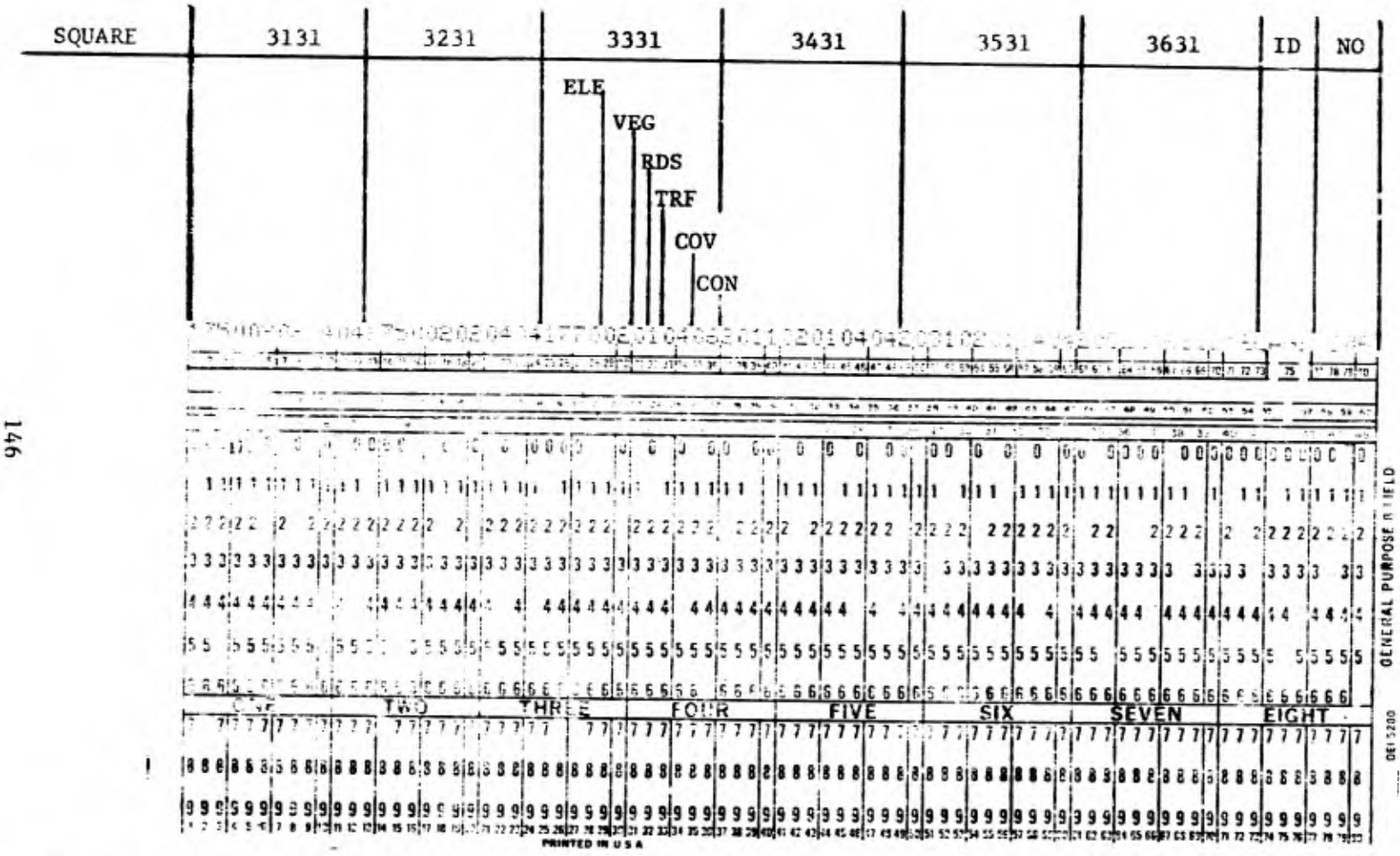


Fig. 48 - Example of a card from the LAND Deck

PAGE 1	COORDINATES	PACKED OCTAL	ELE	VEG	ROADS	TRF	CVR	CON
	(1, 1)	002145771212	1125	63	0	2	8	10
NO CHANGE THROUGH	(61,30) INCLUSIVE							
	(62,30)	002153771617	1131	63	0	3	8	15
	(63,30)	002174777617	1148	63	3	3	8	15
	(1,31)	002145771212	1125	63	0	2	8	10
	(2,31)	002153771617	1131	63	0	3	8	15
	(3,31)	002174777617	1148	63	3	3	8	15
	(4,31)	002214361217	1164	30	0	2	8	15
	(5,31)	002174241657	1148	20	0	3	10	15
	(6,31)	002133020612	1115	2	0	1	8	10
	(7,31)	002112020604	1098	2	0	1	8	4
	(8,31)	002060020604	1072	2	0	1	8	4
	(9,31)	002040020604	1056	2	0	1	8	4
	(10,31)	002031020604	1049	2	0	1	8	4
	(11,31)	002052020604	1066	2	0	1	8	4
	(12,31)	002112241232	1098	20	0	2	9	10
	(13,31)	002133020624	1115	2	0	1	9	4
	(14,31)	002133020715	1115	2	0	1	12	13
	(15,31)	002060020715	1072	2	0	1	12	13
	(16,31)	002072020704	1082	2	0	1	12	4
	(17,31)	002052020704	1066	2	0	1	12	4
	(18,31)	002031437735	1049	35	3	3	13	13
	(19,31)	002011437735	1033	35	3	3	13	13
	(20,31)	001750437735	1000	35	3	3	13	13
	(21,31)	001750177335	1000	15	3	2	13	13
	(22,31)	001750021212	1000	2	0	2	8	10
	(23,31)	001750020606	1000	2	0	1	8	6
NO CHANGE THROUGH	(25,31) INCLUSIVE							
	(26,31)	001750147326	1000	12	3	2	13	6
	(27,31)	001750147324	1000	12	3	2	13	4
	(28,31)	001750010504	1000	1	0	1	4	4
NO CHANGE THROUGH	(30,31) INCLUSIVE							
	(31,31)	001750021106	1000	2	0	2	4	6
NO CHANGE THROUGH	(32,31) INCLUSIVE							
	(33,31)	001770020506	1016	2	0	1	4	6
	(34,31)	002011020506	1033	2	0	1	4	6
	(35,31)	002031020506	1049	2	0	1	4	6
	(36,31)	002052241652	1066	20	0	3	10	10
	(37,31)	002063241114	1075	20	0	2	4	12
	(38,31)	002072241114	1082	20	0	2	4	12

Fig. 49 - Printout of Final Terrain Data

(GRC) and the US Army Concepts Analysis Agency (CAA), the preprocessor outputs are not identical in appearance, but they do contain the same information. In the examples that follow, the version of the model that produced the sample will be identified.

The input data shown in Appendix A contains the correct entries that produced the sample game. The errors shown were diagnosed by the data-preparation preprocessors during the development of the sample game and are typical of those made by individuals using the model.

After compilation of the input data the preprocessor yields computer printouts of the transactions that have been conducted, illegalities present in the data, and input data arrays.

Transactions and Illegalities

In the GRC version, three types of transactions may be performed: install, change, and copy. In Fig. 50, which shows the GRC version Transaction Record and Data Errors, the install transaction, INST, is printed to the left of the treatment identification, 9901. The transaction and treatment are preceded by the run control card. The remaining two columns of information in the upper right side of Fig. 50 are the form header cards used to identify input data. The minus zero is the Control Data computer translation of the blanks that follow the ID in columns 73-76 of the header card.

In Fig. 50 there was a keypunch error on WEAPON 2, card sequence number 33; the arrow points to a minus sign in the first data entry to the right of 383. This should have been 0, and the error was corrected by repunching the card. Card number 10 in WPN5 indicates a target class 20 on the Target Priority List for Blue weapon 44. A check of the input shows that the number 12 was punched on column to the left of the proper field, therefore the computer only read the 2 in the first cell and assumed a zero in the second. This error was also corrected by repunching the card. The errors shown for UNIT 9 601 and 803 also resulted from entries being out of field and were corrected by repunching the cards. (ENDP 9901 indicates the completion of the data-illegality

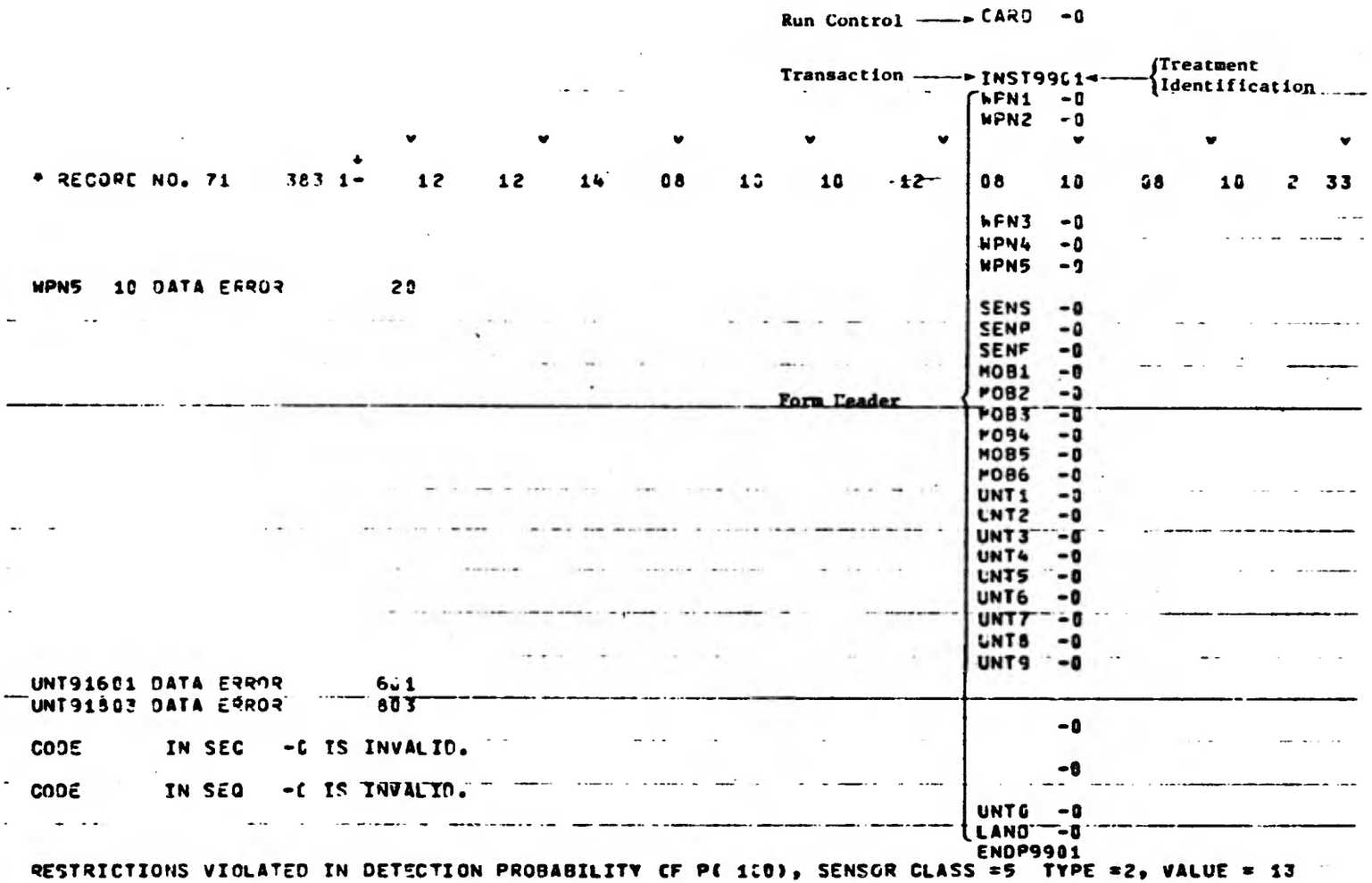


Fig. 50 - Transaction Record and Data Errors

processing of the treatment.) The final message indicates that the thirteenth data entry for sensor number 52 caused the sum of P11, P12, and P14 to be greater than 99. The error was corrected by changing the thirteenth entry from 94 to 93. It should also be noted that TER2 data was not included in the inputs; the Second Preprocessor will not function without this data.

The CAA version of the preprocessor produces the same information in nearly identical format. The apparent differences are: the run control, transaction, treatment identification, and completion of data-illegality processing are not listed. A major difference that is not obvious is that the CAA version checks to insure that all possible decks are present, and if one is not, a message is printed indicating that the subject input was not used; e.g., INPUT FORM NOT USED TER2.

Data Arrays

After the input data have been compiled, they are listed as FORTRAN arrays, with several items stored (packed) into each word of the array. The packing specifications are of little interest to the CARMONETTE gamer and are dependent upon the computer system being used; they are described in Volume III. The arrays are presented and discussed on the following pages in the order of their appearance in the CAA preprocessor output. Because of rounding and base changes (from decimal to octal) some data may vary slightly from the input values.

Data input from Form WEAPON 1 is shown in Fig. 51. The range and crew are stored in ARRAY KR; aim and reaim times and standard deviations in KWPAT; flight time (calculated by dividing the grid size by round velocity in meters per minute), reload time and standard deviation, round velocity, and rounds per trigger pull in KWPLT. The firing signature, which is scaled to 7.9, is stored in KWS; and the direction, width and length of artillery and mortar impact areas is stored in LWARTY.

The total tactical standard deviations shown in Fig. 52 come from Form WEAPON 2 and are stored in ARRAY KSIG. Figure 53 shows the probabilities of a kill given a hit that were input from Form WEAPON 3 and

and are stored in KPKH; the figure also shows the probabilities of indicating death as input from Form UNIT 8 and that are stored in KBURN. The probability of killing infantry with fragmenting ammunition and vehicles with dual purpose ammunition was input from Form WEAPON 4; this data is stored in KPKIH and is shown is Fig. 54. The target lists are shown in Fig. 55; they were input from WEAPON 5 and are stored in KCTP. The arrays shown in Fig. 56 were prepared from UNIT 3 inputs and are intended to assist the gamer in reading the Target Lists and Danger State Tables. The Danger State Tables shown in Fig. 57 were input from Form UNIT 4 and are stored in KSVR; the critical ranges were taken from the same form and are stored in KSVRR.

Figure 58 shows unit description data that was taken from Forms UNIT 2 and 3 and is stored in KUDW. The data shown in Fig. 59 comes from several Unit forms; it is discussed below. Starting Order and Location are from UNIT 10 and are stored in KNTR and LOC respectively. Assigned weapons are input from UNIT 2 and are stored in KWT; the number of weapons is also from UNIT 2 and is stored in KNTB. UNIT 2 also identifies the amount of ammunition available for each weapon; this data is stored in LAMW. The number of drivers, vehicles, and men are input from UNIT 2, and the maximum men per vehicle from UNIT 3; all of this data is stored in MAN.

An X under a unit's number on Form UNIT 6 indicates that that unit withdraws to the nearest escape point when it runs out of ammunition for its main weapon; units having escape orders are shown in ARRAY KACX (see Fig. 60). An X in the appropriate column of Form UNIT 2 identifies certain unit characteristics. These characteristics and the array that contains the information are described below.

Characteristic	Array
Is unit able to call artillery?	KHQ
Is unit a troop carrier unit?	KTCJ
Does the unit's main weapon require guidance?	LGM
Is unit unable to fire?	IFIRE
Is unit unable to move?	IMOB
Is unit a hold-fire unit?	KEY

As shown in Fig. 60, all seven of the arrays discussed in this paragraph are simply one dimensional packed arrays. The numbers in these arrays represents three bits in the following octal-binary conversion:

Octal	Binary
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111

The first sixteen of these numbers represent the 48 units that may be on each side. If the bit representing a specific unit is "ON" (=1), the unit has the appropriate characteristic. The technique of interpreting these arrays is shown in Table 16. The bits for units 1, 3, 5, 9, 11, 13, 17, 19, and 21 are "ON;" therefore these Blue units are troop carriers. The bits for units 41-48 are also "ON," but there are only 40 Blue units, so these last bits are ignored.

The input forms and array names pertaining to the other data shown in Fig. 60 are listed below.

Title	Form	Array
Infantry Pin-Down Threshold	UNIT 5	LTFI
Direct Fire Threshold	UNIT 5	LTF2
Indirect Fire Threshold	UNIT 5	LTF3
Firing Run Thresholds for Aircraft	UNIT 5	LTHF
Treetop Thresholds for Aircraft	UNIT 5	LTHN
Direct Fire Thresholds for Light Armor	UNIT 5	LTM2
Indirect Fire Thresholds for Light Armor	UNIT 5	LTM3
Direct Fire Thresholds for Heavy Armor	UNIT 5	LTT2
Indirect Fire Thresholds for Heavy Armor	UNIT 5	LTT3
Pin-Down Thresholds for Soft Vehicles	UNIT 5	LTZ1
Direct Fire Thresholds for Soft Vehicles	UNIT 5	LTZ2
Indirect Fire Thresholds for Soft Vehicles	UNIT 5	LTZ3
Suppressive Fire Searching Distances	GAME	KASQ
Escape Points	UNIT 7	JEXIT

The slope thresholds and dismount times for ground units shown at the top of Fig. 61 was input from MOBILITY 2 and is stored in KSLOPE and KDMTIM. The ordered ground movement rates are from MOBILITY 6 and

Table 16

TECHNIQUE FOR INTERPRETING PACKED ARRAYS
TROOP CARRIER UNIT, BLUE

Array (Octal)	5	2	1	2	4	2	5	0	0	0	0	0	0	3	7	7
Represents (Binary)	101	010	001	0 1 0	1 0 0	0 1 0	1 0 1	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 1 1	1 1 1	1 1 1
Unit number	123	456	789	101112	131415	161718	192021	222324	252627	282930	313233	343536	373839	404142	434445	464748

are stored in LTG; RATE is as input (in meters per second), and TIME indicates the time (in minutes) required by a unit moving at that rate to cross one-half of a grid square. Maximum ground travel rate is taken from MOBILITY 2 and is stored in MMTG; TIME and RATE are as described above.

The probabilities of moving by doctrine shown at the top of Fig. 62 were input from Form MOBILITY 1 and are stored in MOVPRB. The other arrays shown in Fig. 62 pertain to air units and are analogous to that for ground units; their input forms and array names are listed below.

Title	Form	Array
Air Units Mobility Input Data		
Descend and Climb Times	MOBILITY 3	INCTON
Altitude Thresholds	MOBILITY 4	LACTT
Altitude Increment, Maximum Altitude	MOBILITY 3	LACTT
Minimum Movement Rate	MOBILITY 4	MMTA
Ordered Air Movement Rates	MOBILITY 6	LTA
Ordered Altitudes	MOBILITY 5	LACTT

The radii for detection and hit shown in Fig. 63 are scaled from TERRAIN 2 inputs and are stored in KON1, KOV1, and KOV2.

The solid angle thresholds, surveillance intervals, and probabilities of loss of target information shown in Fig. 64 are from Form SENSOR 1 and are stored in KGTEST, KSA, ISCAN, and IP4 respectively. The probabilities of pinpointing an enemy that has fired are from SENSOR 9 and 10, and are stored in KDP13 and KDP34. The assess and cycle times at the bottom of the page are from GAME and are stored in KATIME and KCTIME.

The effective solid angle thresholds are calculated by the preprocessor and are printed out for the gamers information as shown in Fig. 65 for non-firing targets and in Fig. 66 for firing weapons. Figure 67 shows the detection probabilities that were input from Forms SENSOR 2 through 8 and those that were computed by the preprocessor. The probability of detecting that a target is dead is stored in LPDC; the other probabilities are stored in arrays labeled as shown (LP12, LP13, etc.).

The Task Organization input from UNIT 1 is stored in CCSU and is shown in Fig. 68. The orders given each unit on UNIT 9 are stored in MISN and shown in Fig. 69.

After all data has been read in, all errors corrected, and the data stored in the proper arrays, the preprocessor calculates the probability of hitting each element size with each type of ammunition from each weapon at selected ranges. An example of these calculations is shown in Fig. 70. The preprocessor also determines the initial cover and concealment for each unit, and enemy units to which it has line of sight; this report is shown in Fig. 71.

The final output of the preprocessor is shown in Fig. 72. This data is of little direct interest to the gamer, but is of great assistance to the individual responsible to assist the gamer in determining why some unit did not do as expected in a game and for that reason is included in the second preprocessor output.

Tables 17 and 18 provide a cross index between input sources and FORTRAN array names.

Table 17

FORTRAN ARRAY NAMES AND INPUT DATA SOURCES

Figure number	FORTRAN array name	Source input form
51	KR	WPN1
51	KWPAT	WPN1
51	KWPLT	WPN1
51	LWARTY	WPN1
51	KWS	WPN1
52	KSIG	WPN2
53	KBURN	UNT8
53	KPKH	WPN3
54	KPKIH	WPN4
55	KCTP	WPN5
57	KSVR, KSVRR	UNT4
58	KUDW	UNT2 & 3
59	KNTB	UNT3
59	KNTR	UNT0
59	LAMW	UNT2
59	LOC	UNT0
59	MAN	UNT2 & 3
60	KACX	UNT6
60	KHQ, KTCJ, IFIRE, IMOB	UNT2
60	LGM	WPN1
60	KEY	UNT2
60	LTF1, LTF2, LTF3, LTHF, LTHN LTM2, LTM3, LTT2, LTT3, LTZ1 LTZ2, LTZ3	UNT5
60	JEXIT	UNT7
61	KDMTIM, KSLOPE	MOB3
61	LACTT	MOB3, 4, & 5
61	LTA	MOB4 & 6
61	LTG	MOB6
61	MMTG	MOB2
61	MOVPRB	MOB1
62	MMTA	MOB4
63	KON1, KOV1, KOV2	TER2
64	KSA	SENS
64	KDP13, KDP34	SENF
64	KGTEST	SENS
64	LPDC	SENP
64	ISCAN	SENS
67	LP12, LP13, ...,LP34, LP44	SENP
64	IP4	SENS
	KATIME, KCTIME	MOB1
68	CCSU	UNT1
69	MISN	UNT9

Table 18

INPUT DATA SOURCE AND FORTRAN ARRAY NAME

Source input form	FORTRAN array name	Figure number
TER1	LAND	
TER2	KON1, KOV1, KOV2	63
WPN1	KR, KWPAT, KWPLT, LWARTY, KWS	51
WPN2	KSIG	52
WPN3	KPKH	53
WPN4	KPKIH	54
WPN5	KCTP	55
SENS	KSA, KGTEST, ISCAN, IP4	64
SENP	LP11, LP12, LP13, LP14, LP21, LP23, LP24, LP31, LP32, LP34, LP41, LP42, LP43, LP44. LPDC	67
SENF	KDP13, KDP34	64
MOB1	MOVPRB	61
MOB2	KDTIM, KSLOPE, MMTG	61
MOB3	LACTT	61
MOB4	LACTT, LTA	61
	MMTA	62
MOB5	LACTT	61
MOB6	LTA, LTG	61
UNT1	CCSU	68
UNT2	KUDW	58
	LAMW, MAN	59
	KHQ, KTCJ, IFIRE, IMOB, KEY	60
UNT3	KUDW	58
	KNTB, MAN	59
UNT4	KSVR, KSVRR	55
UNT5	LTF1, LTF2, LTF3, LTEF, LTHN, LTM2, LTM3, LTT2, LTT3, LTZ1, LTZ2, LTZ3	60
UNT6	KACX	60
UNT7	JEXIT	60
UNT8	KBURN	53
UNT9	MISN	69
UNTO	KNTR, LOC	59

WEAPON CHARACTERISTICS

WEAPON TYPE	RANGE MIN	RANGE MAX	WEAPON CREW	AIMING TIME MEAN	AIMING TIME S.D.	REAIMING TIME MEAN	REAIMING TIME S.D.	FLIGHT TIME	RELOAD TIME MEAN	RELOAD TIME S.D.	ROUND VELOCITY M/SEC	ROUND PER TRIGGER PULL	FIRING SIGNATURE (SCALED 7.9)
1	100	47000	3	.25	.05	.25	.05	.015	.20	.05	110	1	.000
2	500	5500	3	.25	.05	.25	.05	.007	.20	.05	252	1	.000
3	458	5700	3	.25	.05	.25	.05	.007	.20	.05	243	1	.000
4	200	15300	6	.25	.05	.25	.05	.007	.20	.05	243	1	.000
5	200	12200	6	.25	.05	.25	.05	.007	.20	.05	227	1	.000
6	500	18000	3	.25	.05	.25	.05	.007	.20	.05	227	1	.000
7	500	16800	3	.25	.05	.25	.05	.009	.20	.05	184	1	.000
13	0	3000	1	.17	.03	.15	.03	.001	.28	.06	1706	1	7.875
14	0	3000	1	.17	.03	.15	.03	.001	.28	.06	1706	1	7.875
15	0	2000	1	.17	.03	.15	.03	.003	.20	.02	620	1	7.875
16	0	3000	2	.13	.02	.04	.02	.005	.05	.02	359	12	4.875
17	0	2500	2	.13	.02	.04	.02	.005	.05	.02	359	1	4.875
18	0	1500	1	.20	.03	.10	.02	.008	.10	.02	200	1	3.125
19	0	3000	1	.20	.03	.10	.02	.007	.10	.02	252	1	4.500
35	0	3000	2	.12	.02	.40	.08	.009	.33	.06	195	1	6.375
36	0	3000	1	.06	.00	.40	.00	.009	.20	.02	195	1	6.375
37	500	3000	1	.07	.03	.15	.03	.009	.50	.11	195	1	6.375
38	500	3000	1	.07	.03	.15	.03	.009	.50	.11	195	1	6.375
39	500	3000	1	.07	.03	.15	.03	.009	.10	.02	195	1	6.375
40	0	2000	1	.02	.02	.22	.05	.009	.22	.05	179	1	5.500
41	0	1000	1	.02	.02	.22	.05	.019	.22	.05	89	1	5.500
42	0	600	1	.02	.02	.17	.03	.005	.10	.02	359	1	3.125
43	0	547	1	.02	.02	.10	.02	.010	.25	.05	170	1	3.125
44	0	1700	1	.13	.03	.50	.02	.004	.40	.00	401	2	2.000
45	0	1700	1	.04	.02	.03	.00	.004	.40	.00	401	2	2.000
46	0	2000	1	.13	.03	.05	.02	.004	.40	.00	455	2	2.375
47	0	1500	1	.04	.00	.03	.00	.004	.40	.00	379	2	2.000
48	0	1000	1	.04	.02	.03	.00	.004	.40	.00	455	3	2.000
49	0	1000	1	.04	.02	.03	.00	.004	.40	.00	455	3	2.000
50	0	1000	1	.04	.02	.03	.00	.004	.40	.00	455	3	2.000
51	0	1100	1	.05	.02	.05	.02	.004	.40	.00	455	3	2.000
52	0	447	1	.05	.02	.05	.02	.002	.40	.00	682	1	1.375
53	100	3800	1	.17	.03	.17	.03	.002	.30	.06	682	1	5.500

LENGTH AND WIDTH OF ARTILLERY IMPACT AREAS

WEAPON	DIRECTION	WIDTH	LENGTH
1	1	1	3
2	1	1	3
3	1	3	3
4	1	3	3
5	1	3	3
6	1	3	3
7	1	3	3

Fig. 51 - Example of Arrays KR, KWPAT, KWPLT, KWS, and LWARTY

(WEAPON ACCURACY FORM 2)

TOTAL TACTICAL STANDARD DEVIATION (MISS DISTANCE IN METERS)

WEAPON TYPE	FIRER MOVING	TARGET MOVING	ROUND		NORMAL FIRER AMMO I ZERO RANGE	NORMAL FIRER AMMO I .707 RANGE	NORMAL FIRER AMMO I MAX RANGE	NORMAL FIRER AMMO II ZERO RANGE	NORMAL FIRER AMMO II .707 RANGE	NORMAL FIRER AMMO II MAX RANGE	PARTIALLY SUPPRESSED FIRER AMMO I ZERO RANGE	PARTIALLY SUPPRESSED FIRER AMMO I .707 RANGE	PARTIALLY SUPPRESSED FIRER AMMO I MAX RANGE	PARTIALLY SUPPRESSED FIRER AMMO II ZERO RANGE	PARTIALLY SUPPRESSED FIRER AMMO II .707 RANGE	PARTIALLY SUPPRESSED FIRER AMMO II MAX RANGE
13	YES	NO	1		.8	1.5	2.4	.5	2.5	7.0	.6	2.0	3.0	.6	3.1	8.8
13	YES	YES	1		.6	1.9	3.0	.6	3.0	9.1	.8	2.5	3.9	.8	4.0	11.5
13	NO	NO	1		.5	1.4	2.0	.5	2.1	6.1	.5	1.7	2.5	.5	2.7	7.6
13	NO	YES	1		.5	1.6	2.6	.5	2.5	8.0	.6	2.1	3.4	.6	3.4	10.0
13	NO	NO	2	1=HIT	.5	.9	1.0	.5	1.1	1.5	.5	1.1	1.4	.5	1.5	2.0
13	NO	NO	2	1=MISS	.5	1.6	3.5	.5	2.0	4.5	.5	2.4	4.0	.0	.0	.0
14	YES	NO	1		.5	2.0	3.8	.5	6.3	9.1	.6	2.5	4.6	.5	8.0	11.5
14	YES	YES	1		.6	2.5	4.9	.5	7.5	11.9	.8	3.0	6.1	.6	9.5	15.0
14	NO	NO	1		.5	1.7	3.2	.4	5.5	8.0	.5	2.1	4.0	.5	6.9	10.0
14	NO	YES	1		.5	2.1	4.2	.5	6.5	10.4	.6	2.5	5.4	.5	8.2	13.0
14	NO	NO	2	1=HIT	.5	1.1	1.5	.5	1.3	1.5	.5	1.5	1.9	.5	1.5	1.9
14	NO	NO	2	1=MISS	.5	2.1	3.6	.5	3.0	4.0	.5	2.7	4.5	.5	3.9	5.0
15	YES	NO	1		.6	3.4	8.4	.6	3.4	8.4	.9	4.1	10.5	.9	4.1	10.5
15	YES	YES	1		.9	4.0	11.0	.9	4.0	11.0	1.0	5.0	13.5	1.0	5.0	13.5
15	NO	NO	1		.5	2.7	7.0	.5	2.7	7.0	.8	3.5	8.8	.8	3.5	8.8
15	NO	YES	1		.6	3.4	9.0	.6	3.4	9.0	.9	4.1	11.5	.9	4.1	11.5
15	NO	NO	2	1=HIT	.5	2.0	3.8	.5	2.0	3.8	.6	2.5	4.6	.6	2.5	4.6
15	NO	NO	2	1=MISS	.5	2.4	5.6	.5	2.4	5.6	.6	3.0	7.0	.6	3.0	7.0
16	YES	NO	1		.8	3.8	5.0	.0	.0	.0	1.0	4.7	6.4	.0	.0	.0
16	YES	YES	1		.8	3.8	5.0	.0	.0	.0	1.0	4.7	6.4	.0	.0	.0
16	NO	NO	1		.8	3.8	5.0	.0	.0	.0	1.0	4.7	6.4	.0	.0	.0
16	NO	YES	1		.8	3.8	5.0	.0	.0	.0	1.0	4.7	6.4	.0	.0	.0
16	NO	NO	2	1=HIT	.8	3.8	5.0	.0	.0	.0	1.0	4.7	6.4	.0	.0	.0
16	NO	NO	2	1=MISS	.8	3.8	5.0	.0	.0	.0	1.0	4.7	6.4	.0	.0	.0
17	YES	NO	1		.8	3.5	5.0	.8	3.5	5.0	1.0	4.5	6.3	1.0	4.5	6.3
17	YES	YES	1		.8	4.6	6.5	.8	4.6	6.5	1.0	5.9	8.0	1.0	5.9	8.0
17	NO	NO	1		.8	4.6	6.5	.8	4.6	6.5	1.0	5.9	8.0	1.0	5.9	8.0
17	NO	YES	1		.8	4.6	6.5	.8	4.6	6.5	1.0	5.9	8.0	1.0	5.9	8.0
17	NO	NO	2	1=HIT	.6	2.5	3.5	.6	2.5	3.5	.9	3.0	4.4	.9	3.0	4.4
17	NO	NO	2	1=MISS	.6	2.5	3.5	.6	2.5	3.5	.9	3.0	4.4	.9	3.0	4.4
18	YES	NO	1		.4	5.0	7.4	.0	.0	.0	.4	5.0	7.4	.0	.0	.0
18	YES	YES	1		.4	5.0	7.4	.0	.0	.0	.4	5.0	7.4	.0	.0	.0
18	NO	NO	1		.4	5.0	7.4	.0	.0	.0	.4	5.0	7.4	.0	.0	.0
18	NO	YES	1		.4	5.0	7.4	.0	.0	.0	.4	5.0	7.4	.0	.0	.0
18	NO	NO	2	1=HIT	.4	5.0	7.4	.0	.0	.0	.4	5.0	7.4	.0	.0	.0
18	NO	NO	2	1=MISS	.4	5.0	7.4	.0	.0	.0	.4	5.0	7.4	.0	.0	.0

Fig. 52 - Example of Array KSIG

(INPUT FORM WEAPON 3)

PROBABILITY OF A KILL GIVEN A HIT

WEAPON TYPE	AMMO TYPE	VULNERABILITY INDEX 1	2	3	4	5	6	7	8	9	10	11	12
13	1	.58	.52	.52	.52	.00	.98	.98	.00	.00	.00	.00	.98
13	2	.50	.90	.70	.70	.00	.98	.98	.00	.00	.00	.00	.98
14	1	.64	.48	.55	.55	.55	.98	.98	.00	.00	.00	.00	.83
14	2	.61	.86	.98	.98	.98	.98	.98	.00	.00	.00	.00	.83
15	1	.47	.80	.80	.80	.80	.98	.98	.00	.00	.00	.00	.88
15	2	.47	.80	.80	.80	.80	.98	.98	.00	.00	.00	.00	.88
16	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.33	.00	.00
17	1	.05	.09	.25	.25	.25	.34	.98	.00	.00	.00	.00	.98
17	2	.05	.09	.25	.25	.25	.34	.98	.00	.00	.00	.00	.00
18	1	.00	.02	.02	.02	.00	.19	.98	.00	.00	.00	.00	.89
19	1	.00	.02	.02	.02	.00	.19	.98	.00	.00	.00	.00	.89
35	1	.70	.81	.88	.88	.00	.98	.98	.00	.00	.00	.00	.94
36	1	.70	.81	.88	.88	.00	.98	.98	.00	.00	.00	.00	.94
37	1	.61	.00	.88	.88	.88	.98	.98	.00	.00	.00	.00	.72
38	1	.61	.00	.88	.88	.88	.98	.98	.00	.00	.00	.00	.72
39	1	.61	.00	.88	.88	.88	.98	.98	.00	.00	.00	.00	.72
40	1	.52	.42	.81	.81	.00	.98	.98	.00	.00	.00	.00	.98
41	1	.52	.42	.81	.81	.00	.98	.98	.00	.00	.00	.00	.98
42	1	.38	.33	.58	.58	.00	.98	.98	.00	.00	.00	.00	.98
43	1	.38	.00	.63	.63	.63	.98	.98	.00	.00	.00	.00	.94
44	1	.00	.08	.23	.23	.00	.14	.98	.00	.00	.00	.00	.98
45	1	.00	.19	.59	.59	.00	.14	.98	.00	.00	.00	.00	.98
46	1	.02	.00	.30	.30	.30	.14	.98	.00	.00	.00	.00	.98
47	1	.00	.00	.23	.23	.23	.14	.98	.00	.00	.00	.00	.00
48	1	.00	.00	.00	.00	.00	.09	.69	.00	.00	.00	.00	.00
49	1	.00	.00	.00	.00	.00	.09	.69	.00	.00	.00	.00	.00
50	1	.00	.00	.00	.00	.00	.09	.69	.00	.00	.00	.00	.00
51	1	.00	.00	.00	.00	.00	.09	.69	.00	.00	.00	.00	.00
52	1	.00	.00	.00	.00	.00	.05	.69	.00	.00	.00	.00	.69
53	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.94	.00	.00

(INPUT FORM UNIT 8)

PROBABILITY OF INDICATING DEATH

VULNERABILITY INDEX 1	2	3	4	5	6	7	8	9	10	11	12
.89	.89	.89	.80	.80	.80	.98	.00	.00	.98	.00	.98

Fig. 53 - Example of Arrays KPKH and KBURN

(INPUT FORM WEAPON 4) PROBABILITY OF A KILL GIVEN A HIT ON INFANTRY BY FRAGMENT AMMO

WEAPON TYPE	AMMO TYPE	RESPONDING TO FIRE NET COVER INDEX 1	2	3	NOT RESPONDING TO FIRE NET COVER INDEX 1	2	3
1	1	.02	.02	.02	.02	.02	.03
2	1	.02	.03	.05	.02	.05	.06
3	1	.02	.02	.02	.02	.02	.03
4	1	.02	.02	.02	.02	.02	.03
4	2	.02	.02	.02	.02	.02	.03
5	1	.02	.02	.03	.02	.03	.05
5	2	.02	.02	.03	.02	.03	.05
6	1	.02	.02	.03	.03	.03	.05
6	2	.02	.02	.03	.03	.03	.05
7	1	.02	.03	.05	.03	.05	.05
7	2	.02	.03	.05	.03	.05	.05
13	1	.02	.02	.02	.02	.02	.02
13	2	.02	.03	.05	.05	.06	.08
14	2	.02	.03	.05	.05	.06	.08
15	1	.02	.02	.02	.02	.03	.05
15	2	.02	.02	.02	.02	.03	.05
17	1	.02	.02	.02	.02	.03	.05
17	2	.02	.02	.02	.02	.02	.02
18	1	.02	.02	.02	.02	.02	.02
19	1	.02	.02	.02	.02	.02	.02

KILL PROBABILITY OF DUAL PURPOSE MUNITIONS AGAINST VEHICLES

WEAPON TYPE	VEHICLE TYPE	VULNERABILITY CLASSES 1	2	3	4	12
1	4	.0029	.0022	.0022	.0022	.9375
1	5	.0034	.0027	.0027	.0027	.9375
1	6	.0037	.0029	.0029	.0029	.9375
1	7	.0120	.0090	.0090	.0090	.9375

Fig. 54 - Example of Array KPKIH

(INPUT FORM WEAPON S)

TARGET LISTS BY TARGET CLASS NUMBER

WEAPON TYPE	LIST I						LIST II						LIST III					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
BLUE SIDE																		
13	1	2	4	5	12	0	4	5	2	1	12	0	2	5	1	4	12	0
28	11	5	8	4	2	3	11	8	5	2	3	4	8	4	11	5	2	3
29	11	8	5	4	3	2	11	5	4	8	2	3	11	4	5	2	3	8
35	5	4	3	1	12	2	1	4	5	3	2	12	4	5	1	2	3	12
36	12	1	2	4	5	0	12	4	5	2	1	0	12	2	5	1	4	0
40	1	4	5	3	2	12	4	5	1	2	3	12	5	4	3	1	12	2
41	4	5	1	2	3	12	5	4	3	1	12	2	1	4	5	3	2	12
42	1	2	3	0	0	0	2	3	1	0	0	0	3	1	2	3	2	12
44	2	3	11	12	8	0	8	2	3	12	11	0	11	8	2	3	12	0
45	8	2	3	12	11	0	11	8	2	3	12	0	2	3	11	12	8	0
48	8	11	5	0	0	0	11	8	5	0	0	0	8	5	11	0	0	0
51	11	8	5	0	0	0	11	5	8	0	0	0	8	11	5	0	0	0
52	8	11	0	0	0	0	11	8	0	0	0	0	8	11	0	0	0	0
RED SIDE																		
14	1	2	4	6	7	0	4	6	7	1	2	0	4	1	6	7	2	0
15	4	6	7	1	2	0	1	2	4	6	7	0	4	1	6	7	2	0
16	10	0	0	0	0	0	10	0	0	0	0	0	10	0	0	0	0	0
17	4	6	7	2	8	0	6	7	4	8	2	0	8	4	6	7	2	0
37	4	6	7	1	2	0	1	4	6	7	2	0	1	2	6	7	4	0
38	1	4	6	7	2	0	1	2	6	7	4	0	4	6	7	1	2	0
39	1	2	6	7	4	0	4	6	7	1	2	0	1	4	6	7	2	0
43	1	7	2	4	6	0	7	2	1	4	6	0	2	1	7	4	6	0
46	7	6	4	2	8	0	4	2	6	7	8	0	6	7	2	4	8	0
47	4	2	6	7	8	0	6	7	2	4	8	0	7	6	4	2	8	0
48	8	7	6	4	0	0	7	6	4	8	0	0	6	4	8	7	0	0
49	8	7	6	4	0	0	6	4	8	7	0	0	4	8	7	6	0	0
50	8	7	6	4	0	0	4	8	7	6	0	0	7	6	4	8	0	0
52	8	7	6	4	0	0	8	6	4	7	0	0	8	4	6	7	0	0
53	10	0	0	0	0	0	10	0	0	0	0	0	10	0	0	0	0	0

Fig. 55 - Example of Array KCTP

BLUE UNITS ASSIGNED TO TARGET CLASSES

TARGET CLASS									
1	29	30	31	32	33				
2	1	3	5	9	11	13	17	19	21
4	25	26	27	28					
7	7	8	15	16	23	24			
8	2	4	6	10	12	14	18	20	22
10	34	35							
16	36	37	38	39	40				

RED UNITS ASSIGNED TO TARGET CLASSES

TARGET CLASS									
1	19	20	21						
2	1	3	5	7	9	11	13	15	17
4	22	23	24						
5	25	26							
8	2	4	6	8	10	12	14	16	18
11	31	32	33	34	35	36	37	38	39
12	27	28	29	30					
16	40	41	42	43	44				

BLUE UNITS ASSIGNED TO VULNERABILITY CLASSES

VULNERABILITY CLASS									
1	29	30	31	32	33				
3	1	3	5	9	11	13	17	19	21
4	36	37	38	39	40				
5	25	26	27	28					
6	7	8	15	16	23	24			
7	2	4	6	10	12	14	18	20	22
10	34	35							

RED UNITS ASSIGNED TO VULNERABILITY CLASSES

VULNERABILITY CLASS																	
1	19	20	21														
3	1	3	5	7	9	11	13	15	17								
4	22	23	24	27	28	29	30										
6	25	26	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
7	2	4	6	8	10	12	14	16	18								

Fig. 56 - Assignment of Units to Target and Vulnerability Classes

(INPUT FORM UNIT 4)

DANGER STATE TABLE

TARGET CLASS	0 - 1000 RANGE VULNERABILITY CLASS												1000 - 2000 RANGE VULNERABILITY CLASS												GREATER THAN 2000 RANGE VULNERABILITY CLASS											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	S	S	S	S	S	S	S			M		S	S	S	S	S	S	M	M			M		M	M	M	M	M	M	M						M
2		M	M	M	M	M	S					M		M	M	M	M	M	M					M												
3	S	S	S	S	S	S	S					S	S	S	S	S	S	S	M					M	S	S	S	S	S	S						
4	S	S	S	S									S	S	S	S									S	S	S	S								
5	S		S	S	S	S							S		S	S	S	S							S		S	S	S	S						
6	S	S	S	S									S	S	S	S																				
7	S	S	S	S																																
8	M	M	S	S	S	S	S					S																								
9																																				
10	S	S	S	S		S	S					S	S	S	S	S		S	S						S	S	S	S		S	S					
11										S												S												M		
12			M	M	M	M	S			S		S		M	M	M	M	M				S		M										M		
13																																				
14																																				
15																																				
16	M	S	S	S	S	S	S					S	M	S	S	S	S	S	S					S	M	S	S	S	S	S	S					S

WHERE S INDICATE SERIOUSLY VULNERABLE AND M INDICATES MODERATELY VULNERABLE

Fig. 57 - Example of Arrays KSVR and KSVRR

(INPUT FORM UNIT 3) BLUE UNIT DESCRIPTION INDICES

UNIT NUMBER	TGT CLASS	VULN CLASS	ELEMENT SIZE	MOBILITY CLASS	FIRE RESP CLASS	SENSOR CLASS	SENSOR HT	UNIT DEPLOY RADIUS, M
1	2	3	5	1	3	5 2	6	2
2	8	7	10	0	1	5 1	3	21
3	2	3	5	1	3	5 2	6	2
4	8	7	10	0	1	5 1	3	21
5	2	3	5	1	3	5 2	6	2
6	8	7	10	0	1	5 1	3	21
7	7	6	9	1	2	5 2	3	1
8	7	6	9	1	2	5 2	3	1
9	2	3	5	1	3	5 2	6	2
10	8	7	10	0	1	5 1	3	21
11	2	3	5	1	3	5 2	6	2
12	8	7	10	0	1	5 1	3	21
13	2	3	5	1	3	5 2	6	2
14	8	7	10	0	1	5 1	3	21
15	7	6	9	1	2	5 2	3	1
16	7	6	9	1	2	5 2	3	1
17	2	3	5	1	3	5 2	6	2
18	8	7	10	0	1	5 1	3	21
19	2	3	5	1	3	5 2	6	2
20	8	7	10	0	1	5 1	3	21
21	2	3	5	1	3	5 2	6	2
22	8	7	10	0	1	5 1	3	21
23	7	6	9	1	2	5 2	3	1
24	7	6	9	1	2	5 2	3	1
25	4	5	5	1	3	5 2	6	2
26	4	5	5	1	3	5 2	6	2
27	4	5	5	1	3	5 2	6	2
28	4	5	5	1	3	5 2	6	2
29	1	1	1	1	4	5 2	9	2
30	1	1	1	1	4	5 2	9	2
31	1	1	1	1	4	5 2	9	2
32	1	1	1	1	4	5 2	9	2
33	1	1	1	1	4	5 2	9	2
34	10	10	6	5	5	5 3	3	1
35	10	10	6	5	5	5 3	3	1
36	14	4	2	1	3	5 1	3	35
37	14	4	2	1	3	5 1	3	37
38	14	4	2	1	3	5 1	3	37
39	14	4	2	1	3	5 1	3	20
40	14	4	2	1	3	5 1	3	14

Fig. 58 - Example of Array KUDW

INPUT FORM UNIT 21 RED UNIT ASSIGNMENTS

UNIT	STARTING ORDER LOCATION X	Y	WEAPON I TYPE	#	AMMO	I & 2	WEAPON II TYPE	#	AMMO	I & 2	WEAPON III TYPE	#	AMMO	I & 2	WEAPON IV TYPE	#	AMMO	I & 2	DRIVERS	VEHICLES	MEN	MAX MEN/VEH
1	500	35 62	46	4	840	0	49	4	1680	0	0	0	0	0	0	0	0	0	0	4	40	15
2	510	35 62	43	3	12	0	50	3	300	0	52	23	3220	0	0	0	0	0	0	0	32	0
3	525	35 61	46	3	630	0	49	3	1260	0	0	0	0	0	0	0	0	0	4	3	30	15
4	535	35 61	43	3	12	0	50	3	300	0	52	15	2100	0	0	0	0	0	0	0	24	0
5	550	37 61	46	3	630	0	49	3	1260	0	0	0	0	0	0	0	0	0	6	3	30	15
6	560	37 61	43	3	12	0	50	3	300	0	52	15	2100	0	0	0	0	0	0	0	24	0
7	580	40 56	46	4	840	0	49	4	1680	0	0	0	0	0	0	0	0	0	8	4	40	15
8	590	40 56	43	3	12	0	50	3	300	0	52	23	3220	0	0	0	0	0	0	0	32	0
9	610	40 55	46	3	630	0	49	3	1260	0	0	0	0	0	0	0	0	0	4	3	30	15
10	620	40 55	43	3	12	0	50	3	300	0	52	15	2100	0	0	0	0	0	0	0	24	0
11	640	41 55	46	3	630	0	49	3	1260	0	0	0	0	0	0	0	0	0	6	3	30	15
12	650	41 55	43	3	12	0	50	3	300	0	52	15	2100	0	0	0	0	0	0	0	24	0
13	685	46 49	46	4	840	0	49	4	1680	0	0	0	0	0	0	0	0	0	8	4	40	15
14	695	46 49	43	3	12	0	50	3	300	0	52	23	3220	0	0	0	0	0	0	0	32	0
15	715	46 48	46	3	630	0	49	3	1260	0	0	0	0	0	0	0	0	0	6	3	30	15
16	725	46 48	43	3	12	0	50	3	300	0	52	15	2100	0	0	0	0	0	0	0	24	0
17	740	47 48	46	3	630	0	49	3	1260	0	0	0	0	0	0	0	0	0	6	3	30	15
18	770	47 48	43	3	12	0	50	3	300	0	52	15	2100	0	0	0	0	0	0	0	24	0
19	790	35 63	14	3	64	96	47	3	150	0	48	3	750	0	0	0	0	0	9	3	9	0
20	800	41 54	14	4	72	128	47	4	200	0	48	4	1000	0	0	0	0	0	12	4	12	0
21	810	47 49	14	3	64	96	47	3	150	0	48	3	750	0	0	0	0	0	9	3	9	0
22	575	36 62	38	1	8	0	46	1	25	0	0	0	0	0	0	0	0	0	3	1	3	0
23	670	41 56	38	1	8	0	46	1	25	0	0	0	0	0	0	0	0	0	3	1	3	0
24	745	47 49	38	1	8	0	46	1	25	0	0	0	0	0	0	0	0	0	3	1	3	0
25	820	29 63	37	1	10	0	46	1	25	0	0	0	0	0	0	0	0	0	1	1	2	0
26	820	30 63	37	1	10	0	46	1	25	0	0	0	0	0	0	0	0	0	1	1	2	0
27	575	36 62	16	1	180	0	17	1	20	0	0	0	0	0	0	0	0	0	3	1	3	0
28	675	41 56	16	1	180	0	17	1	20	0	0	0	0	0	0	0	0	0	3	1	3	0
29	750	47 49	16	1	180	0	17	1	20	0	0	0	0	0	0	0	0	0	3	1	3	0
30	680	41 56	16	1	180	0	17	1	20	0	0	0	0	0	0	0	0	0	3	1	3	0
31	520	35 62	53	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
32	545	35 61	53	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
33	570	37 61	53	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
34	600	40 56	53	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
35	630	40 55	53	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
36	660	41 55	53	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
37	705	46 49	53	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
38	735	46 48	53	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
39	760	47 48	53	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
40	81	59 45	5	4	250	300	0	0	0	0	0	0	0	0	0	0	0	0	0	4	43	0
41	81	48 63	4	4	250	300	0	0	0	0	0	0	0	0	0	0	0	0	0	4	43	0
42	81	58 63	4	4	250	300	0	0	0	0	0	0	0	0	0	0	0	0	0	4	43	0
43	81	45 60	4	4	250	300	0	0	0	0	0	0	0	0	0	0	0	0	0	4	43	0
44	81	35 56	3	6	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	50	0

Fig. 59 - Example of Arrays KNTR, LOC, KNTB, LAMW, and MAN

OUT OF AMMUNITION CONTINGENCY ORDERS	BLUE	RED
ESCAPE UNITS	00000000790000000000000	00000007000000000000000
ABLE TO CALL ARTILLERY	00000000000000000000000	00000000000000000000000
TROOP CARRIER UNITS	52124250000003770000000	52525200000001700000000
MAIN WEAPONS REQUIRE GUIDANCE	00401403740400000000000	00000007777770000000000
UNABLE TO FIRE	00000000000000000000000	00000000000000000000000
UNABLE TO MOVE	00000000000000000000000	00000000000000000000000
HOLD FIRE UNITS	00000000037000000000000	00000000000000000000000
INFANTRY PIN-DOWN THRESHOLD	400	400
DIRECT FIRE THRESHOLD	50	50
INDIRECT FIRE THRESHOLD	210	210
FIRING RUN THRESHOLDS FOR AIRCRAFT	12	12
TREE TOP THRESHOLDS FOR AIRCARFT	12	12
DIRECT FIRE THRESHOLDS FOR LIGHT ARMOR	70	70
INDIRECT FIRE THRESHOLDS FOR LIGHT ARMOR	275	275
DIRECT FIRE THRESHOLDS FOR HEAVY ARMOR	100	100
INDIRECT FIRE THRESHOLDS FOR HEAVY ARMOR	425	425
PIN DOWN THRESHOLDS FOR SOFT VEHICLES	400	400
DIRECT FIRE THRESHOLDS FOR SOFT VEHICLES	60	60
INDIRECT FIRE THRESHOLDS FOR SOFT VEHICLES	225	225
SUPPRESSIVE FIRE SEARCHING DISTANCES BY GRID SQ	1	1
ESCAPE POINTS	X Y X Y X Y 13 34 4 40 7 46	X Y X Y X Y 35 55 37 45 63 63

Fig. 60 – Example of Arrays KACX, KHQ, KTCJ, LGM, IFIRE, IMOB, KEY, LTFI, LTF2, LTF3, LTHF, LTHN, LTM2, LTM3, LTT2, LTT3, LTZ1, LTZ2, LTZ3, KASQ, and JEXIT

INPUT FORMS MOBILITY 1,2,& 6)

DISMOUNTED INFANTRY & GROUND VEHICLES INPUT DATA

MOBILITY INDEX	SLOPE THRESHOLDS I	II	III	DISMOUNT/REMOUNT TIME
0	07	20	40	.000
1	07	20	50	.500
2	07	20	50	.500
3	0	0	0	.000
4	0	0	0	.000

ORDERED GROUND MOVEMENT RATES (1/2 GRID SQ M/SEC)

MIN 1 TIME	RATE	2 TIME	RATE	3 TIME	RATE	4 TIME	RATE	5 TIME	RATE	6 TIME	RATE	MAX TIME	RATE
9.166	.20	1.666	.50	.832	1.00	.555	1.50	.332	2.51	.236	3.53	.184	4.54

MAX GROUND TRAVEL RATE FROM ONE GRID SQUARE TO ANOTHER

MOBILITY INDEX	SLOPE	CROSS COUNTRY TRAFFICABILITY 1 TIME	RATE	2 TIME	RATE	3 TIME	RATE	TRAFFICABILITY OF ROADS 1 TIME	RATE	2 TIME	RATE	3 TIME	RATE
0	LEVEL GROUND	.69	1.30	.83	1.00	1.19	.70	.59	1.40	.69	1.20	.83	1.00
	MODERATE UPHILL	.93	.90	1.19	.70	1.67	.50	.83	1.00	1.04	.80	1.19	.70
	STEEP UPHILL	1.67	.50	2.08	.40	4.17	.20	1.39	.60	1.67	.50	2.08	.40
	MODERATE DOWNHILL	.55	1.50	.76	1.10	1.04	.80	.49	1.71	.59	1.40	.69	1.20
	STEEP DOWNHILL	.69	1.20	.93	.90	1.67	.50	.49	1.71	.59	1.40	.69	1.20
1													
	LEVEL GROUND	.18	4.54	.26	3.21	.38	2.21	.12	6.77	.12	6.77	.12	6.77
	MODERATE UPHILL	.26	3.21	.35	2.41	.49	1.71	.14	5.84	.14	5.84	.14	5.84
	STEEP UPHILL	.30	2.81	.40	2.10	.69	1.20	.24	3.53	.24	3.53	.24	3.53
	MODERATE DOWNHILL	.26	3.21	.35	2.41	.49	1.71	.13	6.56	.13	6.56	.00	.00
	STEEP DOWNHILL	.30	2.81	.40	2.10	.69	1.20	.21	4.03	.21	4.03	.21	4.03
2													
	LEVEL GROUND	.18	4.54	.26	3.21	.38	2.21	.12	6.77	.12	6.77	.12	6.77
	MODERATE UPHILL	.17	5.02	.24	3.41	.49	1.71	.14	5.84	.14	5.84	.14	5.84
	STEEP UPHILL	.30	2.81	.40	2.10	.69	1.20	.24	3.53	.24	3.53	.24	3.53
	MODERATE DOWNHILL	.26	3.21	.35	2.41	.49	1.71	.13	6.56	.13	6.56	.00	.00
	STEEP DOWNHILL	.30	2.81	.40	2.10	.69	1.20	.21	4.03	.21	4.03	.21	4.03
3													
	LEVEL GROUND	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	MODERATE UPHILL	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	STEEP UPHILL	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	MODERATE DOWNHILL	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	STEEP DOWNHILL	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
4													
	LEVEL GROUND	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	MODERATE UPHILL	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	STEEP UPHILL	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	MODERATE DOWNHILL	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	STEEP DOWNHILL	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

Fig. 61 - Example of Arrays KSLOPE, KDMTIM, LTG, and MMTG

PROBABILITY OF MOVING BY DOCTRINE

SIDE	MOBILITY INDEX	DOCTRINE	NO COVER NO TARGET	NO COVER TARGET	COVER NO TARGET	COVER TARGET
BLUE						
	0	1	.98	.89	.98	.25
	1	1	.98	.69	.98	.50
	5	1	.98	.98	.98	.98
RED						
	0	1	.98	.89	.98	.25
	2	1	.98	.69	.98	.39

AIR UNITS MOBILITY INPUT DATA

MOBILITY CLASS	DESCEND TIME	CLIMB TIME	ALTITUDE THRESHOLDS 1	2	3	4	5	6	ALTITUDE INCREMENT	MAX ALTITUDE	MIN MOVEMENT RATE STEEP	MOD	LEVEL	CLIMB	STEEP
5	.0498	.049A	85	55	25	20	40	75	50	400	.04150	.02075	.01367	.02368	.04934
6	.0000	.0000	0	0	0	0	0	0	50	0	.00000	.00000	.00000	.00000	.00000
7	.0000	.0000	0	0	0	0	0	0	50	0	.00000	.00000	.00000	.00000	.00000

ORDERED AIR MOVEMENT RATES (M/SEC)

MIN TIME	MIN RATE	2 TIME	2 RATE	3 TIME	3 RATE	4 TIME	4 RATE	5 TIME	5 RATE	6 TIME	6 RATE	MAX TIME	MAX RATE
.333	2.50	.167	5.00	.083	10.01	.042	20.08	.024	35.19	.017	50.20	.014	60.95

ORDERED ALTITUDES BY INDEX NUMBER

ABOVE THE TREETOPS 1	2	3	4	ABOVE SEA LEVEL 5	6	7
5	20	50	150	200	300	400

Fig. 62 - Example of Arrays MOVPRB, INCTDN, LACTT, MMTA, and LTA

(INPUT FORM TERRAIN 2)

TARGET RADIUS SIZE FOR DETECTION AND A HIT

TERRAIN CONCEALMENT INDEX	ELEMENT SIZE INDEX 1	2	3	4	5	6	7	8	9	10
DETECTION (SCALED TO 7.9)										
1	7.9	7.2	6.7	6.4	5.6	5.2	.0	.0	2.2	1.6
2	7.5	7.0	6.5	6.1	5.5	5.0	.0	.0	2.1	1.6
3	7.2	6.7	6.3	5.9	5.2	4.9	.0	.0	2.1	1.4
4	6.9	6.5	6.0	5.6	5.0	4.6	.0	.0	2.0	1.4
5	6.6	6.1	5.7	5.4	4.7	4.4	.0	.0	1.9	1.4
6	6.3	5.9	5.4	5.0	4.5	4.1	.0	.0	1.7	1.3
7	5.9	5.5	5.1	4.7	4.2	4.0	.0	.0	1.7	1.3
8	5.5	5.1	4.7	4.5	4.0	3.8	.0	.0	1.6	1.0
9	5.1	4.7	4.4	4.1	3.6	3.4	.0	.0	1.4	1.0
10	4.6	4.4	4.0	3.8	3.4	3.1	.0	.0	1.4	1.0
11	4.1	3.9	3.5	3.4	3.0	2.7	.0	.0	1.3	.6
12	3.6	3.4	3.1	2.9	2.6	2.4	.0	.0	1.0	.6
13	2.9	2.7	2.5	2.4	2.1	1.9	.0	.0	.6	.6
14	2.0	1.9	1.7	1.6	1.4	1.4	.0	.0	.6	.6
HIT RADIUS (SCALED TO 1.9)										
1	1.9	1.7	1.6	1.5	1.4	1.3	.0	.0	.5	.4
2	1.7	1.6	1.5	1.4	1.3	1.1	.0	.0	.5	.4
3	1.7	1.6	1.5	1.4	1.3	1.1	.0	.0	.5	.3
4	1.6	1.5	1.4	1.3	1.1	1.1	.0	.0	.5	.3
5	1.5	1.5	1.4	1.3	1.1	1.0	.0	.0	.4	.3
6	1.5	1.4	1.3	1.1	1.0	1.0	.0	.0	.4	.3
7	4.5	4.2	3.9	3.6	3.2	3.0	.0	.0	.4	.3
8	1.3	1.3	1.1	1.0	.9	.9	.0	.0	.4	.3
9	1.1	1.1	1.0	1.0	.9	.8	.0	.0	.3	.3
10	1.1	1.0	.9	.9	.8	.8	.0	.0	.3	.3
11	1.0	.9	.8	.8	.6	.6	.0	.0	.3	.1
12	.9	.8	.8	.6	.6	.5	.0	.0	.3	.1
13	.6	.6	.5	.5	.5	.4	.0	.0	.1	.1
14	.5	.4	.4	.4	.3	.3	.0	.0	.1	.0
NET COVER INDEX										
1	3	3	3	3	3	3	0	0	3	3
4	2	2	2	2	2	2	0	0	2	2
5	2	2	2	2	2	2	0	0	2	2
6	2	2	2	2	2	2	0	0	2	2
7	2	2	2	2	2	2	0	0	2	2
8	2	2	2	2	2	2	0	0	2	2
9	2	2	2	2	2	2	0	0	2	2
10	2	2	2	2	2	2	0	0	1	1
11	2	2	2	2	2	2	0	0	1	1
12	2	2	2	2	2	2	0	0	1	1
13	2	2	2	2	2	2	0	0	1	1
14	2	2	2	2	2	2	0	0	1	1
15	2	2	2	2	2	2	0	0	1	1

Fig. 63 - Example of Arrays KONI, KOV1, and KOV2

(INPUT FORM SENSOR 1)

SOLID ANGLE THRESHOLDS FOR DETECTING NON-FIRING AND FIRING WEAPONS

SENSOR CLASS	SENSOR TYPE	NON FIRING WEAPONS 1	2	3	FIRING WEAPONS 1	2	3
5	1	.0999	.2771	1.1069	.0691	.1560	1.1067
5	2	.0999	.2771	1.1069	.0691	.1560	1.1067
5	3	.0999	.2771	1.1069	.0691	.1560	1.1067
5	4	.0999	.2771	1.1069	.0691	.1560	1.1067

PROBABILITY OF PINPOINTING AN ENEMY WHICH HAS FIRED

	SENSOR CLASS	SENSOR TYPE	(SOLID ANGLE/RESPONSE STATE IDENTIFIERS) 1	2	3	4	5	6	7	8
ERRONEOUSLY	5	1	.05	.08	.14	.19	.09	.14	.30	.39
	5	2	.05	.08	.14	.19	.09	.14	.30	.39
	5	3	.19	.25	.33	.44	.25	.30	.38	.50
	5	4	.19	.25	.33	.44	.25	.30	.38	.50
ACCURATELY	5	1	.19	.25	.30	.34	.39	.50	.59	.69
	5	2	.30	.33	.34	.38	.59	.64	.69	.75
	5	3	.39	.52	.63	.75	.39	.52	.63	.75
	5	4	.30	.36	.41	.50	.39	.52	.63	.75

SENSOR SURVEILANCE INTERVAL AND PROBABLE LOSS OF TARGET INFORMATION

SENSOR CLASS	SENSOR TYPE	SCAN TIME	PROBABLE LOSS
5	1	1.00	.50
5	2	1.00	.50
5	3	.00	.25
5	4	.00	.25

TARGET ASSESS TIME	DECISION CYCLE TIME
.10	1.00

Fig. 64 - Example of Arrays KGTEST, KSA, ISCAN, IP4, KDP13, KDP34, KATIME, and KCTIME

EFFECTIVE SOLID ANGLE THRESHOLDS

NON-FIRING TARGETS

SENSOR CLASS	SENSOR TYPE	TARGET SIZE	RANGE BRACKET MIN-1ST SA	1ST SA-2ND SA	2ND SA-3RD SA	3RD SA-MAX
5	1	1	0 - 748	749 - 1493	1494 - 2491	2492 - 3494
5	2	1	0 - 748	749 - 1493	1494 - 2491	2492 - 5170
5	3	1	0 - 748	749 - 1493	1494 - 2491	2492 - 7776
5	4	1	0 - 748	749 - 1493	1494 - 2491	2492 - 3494
5	1	2	0 - 685	686 - 1374	1375 - 2293	2294 - 3217
5	2	2	0 - 685	686 - 1374	1375 - 2293	2294 - 4760
5	3	2	0 - 685	686 - 1374	1375 - 2293	2294 - 7159
5	4	2	0 - 685	686 - 1374	1375 - 2293	2294 - 3217
5	1	3	0 - 640	641 - 1280	1281 - 2135	2136 - 2994
5	2	3	0 - 640	641 - 1280	1281 - 2135	2136 - 4431
5	3	3	0 - 640	641 - 1280	1281 - 2135	2136 - 6665
5	4	3	0 - 640	641 - 1280	1281 - 2135	2136 - 2994
5	1	4	0 - 600	601 - 1208	1209 - 2017	2018 - 2828
5	2	4	0 - 600	601 - 1208	1209 - 2017	2018 - 4185
5	3	4	0 - 600	601 - 1208	1209 - 2017	2018 - 6295
5	4	4	0 - 600	601 - 1208	1209 - 2017	2018 - 2828
5	1	5	0 - 529	530 - 1067	1068 - 1777	1778 - 2495
5	2	5	0 - 529	530 - 1067	1068 - 1777	1778 - 3693
5	3	5	0 - 529	530 - 1067	1068 - 1777	1778 - 5554
5	4	5	0 - 529	530 - 1067	1068 - 1777	1778 - 2495
5	1	6	0 - 489	490 - 994	995 - 1661	1662 - 2328
5	2	6	0 - 489	490 - 994	995 - 1661	1662 - 3446
5	3	6	0 - 489	490 - 994	995 - 1661	1662 - 5184
5	4	6	0 - 489	490 - 994	995 - 1661	1662 - 2328
5	1	9	0 - 200	201 - 424	425 - 707	708 - 994
5	2	9	0 - 200	201 - 424	425 - 707	708 - 1476
5	3	9	0 - 200	201 - 424	425 - 707	708 - 2220
5	4	9	0 - 200	201 - 424	425 - 707	708 - 994

Fig. 65 - Example of Computed Effective Solid Angle Thresholds for Non-Firing Targets

EFFECTIVE SOLID ANGLE THRESHOLDS

FIRING WEAPONS

SENSOR CLASS	SENSOR TYPE	FIRING SIGNATURE	RANGE BRACKET MIN-1ST S_A	1ST S_A-2ND S_A	2ND S_A-3RD S_A	3RD S_A-MAX	FIRING TYPE
5	1	7.875	0 - 748	749 - 1992	1993 - 2994	2995 - 3494	13 14 15
5	1	4.875	0 - 458	459 - 1232	1233 - 1852	1853 - 2163	16 17
5	1	3.125	0 - 282	283 - 787	788 - 1187	1188 - 1385	18 42 43
5	1	4.500	0 - 424	425 - 1135	1136 - 1711	1712 - 1994	19
5	1	6.375	0 - 600	601 - 1612	1613 - 2424	2425 - 2828	35 36 37 38 39
5	1	5.500	0 - 519	520 - 1389	1390 - 2090	2091 - 2439	40 41 53
5	1	2.000	0 - 173	174 - 500	501 - 754	755 - 883	44 45 47 48 49 50 51
5	1	2.375	0 - 223	224 - 600	601 - 900	901 - 1053	46
5	1	1.375	0 - 100	101 - 346	347 - 519	520 - 608	52
5	2	7.875	0 - 748	749 - 1992	1993 - 2994	2995 - 3494	13 14 15
5	2	4.875	0 - 458	459 - 1232	1233 - 1852	1853 - 2163	16 17
5	2	3.125	0 - 282	283 - 787	788 - 1187	1188 - 1385	18 42 43
5	2	4.500	0 - 424	425 - 1135	1136 - 1711	1712 - 1994	19
5	2	6.375	0 - 600	601 - 1612	1613 - 2424	2425 - 2828	35 36 37 38 39
5	2	5.500	0 - 519	520 - 1389	1390 - 2090	2091 - 2439	40 41 53
5	2	2.000	0 - 173	174 - 500	501 - 754	755 - 883	44 45 47 48 49 50 51
5	2	2.375	0 - 223	224 - 600	601 - 900	901 - 1053	46
5	2	1.375	0 - 100	101 - 346	347 - 519	520 - 608	52
5	3	7.875	0 - 748	749 - 1992	1993 - 2994	2995 - 3494	13 14 15
5	3	4.875	0 - 458	459 - 1232	1233 - 1852	1853 - 2163	16 17
5	3	3.125	0 - 282	283 - 787	788 - 1187	1188 - 1385	18 42 43
5	3	4.500	0 - 424	425 - 1135	1136 - 1711	1712 - 1994	19
5	3	6.375	0 - 600	601 - 1612	1613 - 2424	2425 - 2828	35 36 37 38 39
5	3	5.500	0 - 519	520 - 1389	1390 - 2090	2091 - 2439	40 41 53
5	3	2.000	0 - 173	174 - 500	501 - 754	755 - 883	44 45 47 48 49 50 51
5	3	2.375	0 - 223	224 - 600	601 - 900	901 - 1053	46
5	3	1.375	0 - 100	101 - 346	347 - 519	520 - 608	52
5	4	7.875	0 - 748	749 - 1992	1993 - 2994	2995 - 3494	13 14 15
5	4	4.875	0 - 458	459 - 1232	1233 - 1852	1853 - 2163	16 17
5	4	3.125	0 - 282	283 - 787	788 - 1187	1188 - 1385	18 42 43
5	4	4.500	0 - 424	425 - 1135	1136 - 1711	1712 - 1994	19
5	4	6.375	0 - 600	601 - 1612	1613 - 2424	2425 - 2828	35 36 37 38 39
5	4	5.500	0 - 519	520 - 1389	1390 - 2090	2091 - 2439	40 41 53
5	4	2.000	0 - 173	174 - 500	501 - 754	755 - 883	44 45 47 48 49 50 51
5	4	2.375	0 - 223	224 - 600	601 - 900	901 - 1053	46
5	4	1.375	0 - 100	101 - 346	347 - 519	520 - 608	52

Fig. 66 - Example of Computed Effective Solid Angle Thresholds for Firing Weapons

PROBABILITY OF DETECTING AND PINPOINTING TARGETS (TARGET SOLID ANGLE CLASS 1-4)

TARGET DETECTION	SENSOR CLASS	SENSOR TYPE	TARGET NOT MOVING OBSERVER NORMAL 1	2	3	4	TARGET NOT MOVING PARTIALLY SUPPRESSED 1	2	3	4	TARGET MOVING OBSERVER NORMAL 1	2	3	4	TARGET MOVING PARTIALLY SUPPRESSED 1	2	3	4
DEAD																		
	5	1	.64	.75	.84	.89	.55	.59	.75	.84	.64	.75	.84	.89	.55	.59	.75	.84
	5	2	.80	.84	.89	.94	.69	.75	.80	.89	.80	.84	.89	.94	.69	.75	.80	.89
	5	3	.80	.84	.89	.94	.80	.84	.89	.94	.80	.84	.89	.94	.80	.84	.89	.94
	5	4	.89	.91	.94	.98	.80	.84	.89	.94	.89	.91	.94	.98	.80	.84	.89	.94
LP12																		
	5	1	.02	.02	.03	.02	.03	.03	.05	.05	.02	.02	.02	.02	.02	.02	.03	.02
	5	2	.02	.02	.02	.02	.02	.02	.03	.03	.02	.02	.02	.02	.02	.02	.02	.02
	5	3	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
	5	4	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
LP13																		
	5	1	.02	.03	.05	.02	.05	.00	.05	.06	.05	.02	.03	.00	.02	.03	.05	.02
	5	2	.00	.00	.00	.00	.03	.02	.03	.05	.00	.00	.00	.00	.00	.00	.00	.00
	5	3	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	5	4	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
LP14																		
	5	1	.02	.11	.39	.89	.02	.08	.30	.67	.02	.16	.52	.94	.02	.11	.39	.89
	5	2	.03	.16	.45	.91	.02	.11	.34	.69	.05	.19	.61	.94	.03	.16	.45	.91
	5	3	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
	5	4	.25	.30	47	.92	.19	.25	.39	.80	.25	.30	.47	.92	.19	.25	.39	.80
LP21																		
	5	1	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
	5	2	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
	5	3	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
	5	4	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
LP23																		
	5	1	.31	.19	.09	.02	.44	.06	.13	.08	.48	.13	.05	.00	.31	.19	.09	.02
	5	2	.13	.05	.02	.00	.38	.16	.08	.06	.11	.03	.00	.00	.13	.05	.02	.00
	5	3	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	5	4	.02	.02	.00	.00	.03	.02	.02	.00	.02	.02	.00	.00	.03	.02	.02	.00
LP24																		
	5	1	.31	.61	.78	.91	.16	.61	.69	.83	.28	.73	.86	.94	.31	.61	.78	.91
	5	2	.55	.81	.91	.94	.28	.64	.78	.89	.61	.84	.92	.94	.55	.81	.91	.94
	5	3	.91	.91	.91	.91	.91	.91	.91	.91	.91	.91	.91	.91	.91	.91	.91	.91
	5	4	.86	.88	.91	.94	.84	.86	.91	.94	.86	.88	.91	.94	.84	.86	.91	.94

Fig. 67 - Example of Arrays LPDC, LP12, LP13, LP14, LP21, LP23, LP24, LP31 and LP32

(INPUT FORM UNIT 1)

TASK ORGANIZATION

UNIT	HQ	SUBORDINATE 1	2	3	4	WPNS 5	6	UNITS 7	8	BUDDY UNIT	SENSOR 1 C	T	HT	SENSOR 2 C	T	HT	COMM CYCLE	CALL ARTY	HELO	ARTILLERY TGT CLASS 1	2	3	4	5	6	HELICOPER TGT CLASS 1	2	3	4	5	6
BLUE																															
49	49	34	35	36	37	38	39	40	0	36	5	2	6	5	1	6	6.25	X	X	7	6	5	4	12	3	1	4	5	3	2	6
50	49	1	2	3	4	7	25	34	36	1	5	2	3	5	1	3	1.56	X	X	1	3	4	5	7	12	1	3	4	5	7	12
51	50	5	6	8	2A	34	37	39	40	5	5	2	3	5	1	3	1.56	X	X	3	1	7	6	4	5	3	1	5	4	7	12
52	49	9	10	11	12	15	32	33	35	9	5	2	3	5	1	3	1.56		X	0	0	0	0	0	0	1	4	3	5	6	12
53	49	29	30	31	13	14	16	35	38	29	5	2	6	5	1	6	1.56	X	X	1	3	4	5	12	7	3	1	5	4	7	12
54	49	17	18	19	20	23	27	35	37	17	5	2	3	5	1	3	1.56	X	X	3	7	1	6	5	4	5	1	3	7	4	12
55	54	21	22	24	2B	35	38	39	40	21	5	2	3	5	1	3	1.56	X	X	7	6	1	3	4	5	1	3	4	5	7	12
RED																															
49	49	25	26	30	40	41	42	43	44	40	5	2	6	5	1	6	6.25	X		3	5	7	2	1	0	0	0	0	0	0	0
50	49	1	2	3	4	22	31	32	41	1	5	2	6	5	1	6	1.56	X		5	3	7	2	1	0	0	0	0	0	0	0
51	50	5	6	19	27	33	41	44	0	5	6	2	6	5	1	6	1.56	X		3	7	5	2	1	0	0	0	0	0	0	0
52	49	7	8	9	10	23	34	35	42	7	5	2	6	5	1	6	1.56	X		5	7	3	2	1	0	0	0	0	0	0	0
53	52	11	12	20	2B	36	42	44	0	11	5	2	6	5	1	6	1.56	X		3	5	7	2	1	0	0	0	0	0	0	0
54	49	13	14	15	16	24	37	38	43	13	5	2	6	5	1	6	1.56	X		5	7	3	2	1	0	0	0	0	0	0	0
55	54	17	18	21	29	39	43	44	0	17	5	2	6	5	1	6	1.56			7	3	5	2	1	0	0	0	0	0	0	0

Fig. 68 - Example of Array CCSU

```
(INPUT FORM UNIT 9)                    UNIT MISSION ORDERS

 1 STAY FOR AN INTERVAL OF   1. 0 MINS
 2 DISMOUNT
 3 MOVE WITHOUT STOPPING AT A RATE  7  TO SQUARE (12,47)

 4 STAY FOR AN INTERVAL OF   0.50 MINS
 5 SKIP BACK  1 ORDERS UNTIL FRIENDLY UNIT #  6 IS IN SQUARE (12,47), IF UNIT DIES EXIT
 6 REMOUNT
 7 MOVE WITHOUT STOPPING AT A RATE  7  TO SQUARE ( 9,46)
 8 DISMOUNT
 9 STAY UNTIL TIME 50. 0 OR FIRE  1 SHOTS WITH KIND OF FIRE # 4 AT PRIORITY # 4 TARGETS
10 SKIP BACKWARD  1 ORDERS  UNCD

15 STAY FOR AN INTERVAL OF   1. 0 MINS
16 DISMOUNT

17 STAY FOR AN INTERVAL OF   0.50 MINS
18 SKIP FORWARD  2 ORDERS,IF ENEMY UNIT  3 IS CLOSER THAN  1000 METERS
19 SKIP BACKWARD  2 ORDERS  UNCD
20 MOVE WITHOUT STOPPING AT A RATE  7  TO SQUARE (12,47)
21 REMOUNT
22 MOVE WITHOUT STOPPING AT A RATE  7  TO SQUARE ( 9,46)
23 DISMOUNT
24 STAY UNTIL TIME 50. 0 OR FIRE  1 SHOTS WITH KIND OF FIRE # 4 AT PRIORITY # 4 TARGETS
25 SKIP BACKWARD  1 ORDERS  UNCD

30 STAY FOR AN INTERVAL OF   1. 0 MINS

31 STAY FOR INTERVAL  0.50 OR FIRE  1 SHOTS WITH KIND OF FIRE # 4 AT PRIORITY # 4 TARGETS
32 SKIP BACK  1 ORDERS UNTIL FRIENDLY UNIT #  6 IS IN SQUARE (12,47), IF UNIT DIES EXIT

33 STAY FOR INTERVAL  0.50 OR FIRE  1 SHOTS WITH KIND OF FIRE # 4 AT PRIORITY # 4 TARGETS
34 MOVE WITHOUT STOPPING AT A RATE  7  TO SQUARE ( 9,46)
35 STAY UNTIL TIME 50. 0 OR FIRE  1 SHOTS WITH KIND OF FIRE # 4 AT PRIORITY # 5 TARGETS
36 SKIP BACKWARD  1 ORDERS  UNCD

40 STAY FOR AN INTERVAL OF   1. 0 MINS
41 DISMOUNT
42 STAY UNTIL TIME  5. 0 OR FIRE  1 SHOTS WITH KIND OF FIRE # 4 AT PRIORITY # 4 TARGETS
43 SKIP BACKWARD  1 ORDERS,IF TIME IS LESS THAN   5. 0
44 STAY UNTIL TIME 10. 0 OR FIRE  1 SHOTS WITH KIND OF FIRE # 4 AT PRIORITY # 5 TARGETS
45 SKIP BACKWARD  1 ORDERS,IF TIME IS LESS THAN  10. 0
46 STAY UNTIL TIME 50. 0 OR FIRE  1 SHOTS WITH KIND OF FIRE # 4 AT PRIORITY # 6 TARGETS
47 SKIP BACKWARD  1 ORDERS  UNCD
```

Fig. 69 - Example of Array MISN

PROBABILITY OF HIT VS. RANGE

WEAPON TYPE	AMMO TYPE	TARGET RADIUS	RANGE	TARGET MOVING (FIRER MOVING) NEUTRALIZED YES	TARGET MOVING (FIRER MOVING) NEUTRALIZED NO	TARGET MOVING (FIRER NOT MOVING) NEUTRALIZED YES	TARGET MOVING (FIRER NOT MOVING) NEUTRALIZED NO	TARGET NOT MOVING (FIRER MOVING) NEUTRALIZED YES	TARGET NOT MOVING (FIRER MOVING) NEUTRALIZED NO	TARGET NOT MOVING (FIRER NOT MOVING) NEUTRALIZED 1ST	2/H	2/M	TARGET NOT MOVING (FIRER NOT MOVING) NOT NEUTRALIZED 1ST	2/H	2/M
13	1	1.9	0.	.92	1.00	1.00	1.00	1.00	.92	1.00	1.00	1.00	1.00	1.00	1.00
			750.	.84	.92	.91	1.00	.91	.91	.97	1.00	.94	1.00	1.00	1.00
			1500.	.45	.67	.58	.78	.61	.77	.72	.91	.55	.86	.94	.86
			2250.	.19	.33	.27	.41	.30	.48	.38	.72	.20	.55	.89	.39
			3000.	.09	.16	.13	.20	.16	.25	.22	.59	.09	.33	.84	.11
13	1	1.7	0.	.92	.98	.98	1.00	.98	.92	1.00	1.00	1.00	1.00	1.00	1.00
			750.	.80	.94	.89	.95	.89	.89	.94	1.00	.92	.98	1.00	1.00
			1500.	.41	.61	.53	.73	.55	.72	.66	.88	.50	.81	.92	.81
			2250.	.17	.28	.23	.38	.27	.42	.33	.67	.19	.50	.86	.34
			3000.	.08	.14	.11	.17	.14	.22	.19	.55	.08	.30	.80	.09
13	1	1.6	0.	.91	.94	.94	1.00	.94	.91	1.00	1.00	1.00	1.00	1.00	1.00
			750.	.75	.89	.86	.94	.88	.86	.92	.95	.91	.94	1.00	.95
			1500.	.36	.55	.47	.67	.50	.66	.59	.84	.44	.77	.91	.77
			2250.	.14	.25	.20	.33	.22	.38	.30	.61	.16	.44	.81	.31
			3000.	.06	.13	.09	.16	.13	.19	.17	.48	.06	.25	.73	.08
13	1	1.5	0.	.88	.92	.92	1.00	.92	.88	1.00	1.00	1.00	1.00	1.00	1.00
			750.	.69	.84	.81	.92	.83	.81	.91	.92	.88	.92	.95	.92
			1500.	.31	.48	.41	.61	.44	.59	.53	.80	.39	.70	.89	.70
			2250.	.13	.22	.17	.28	.19	.33	.25	.55	.14	.39	.75	.27
			3000.	.06	.09	.08	.13	.09	.16	.14	.42	.05	.22	.67	.08
13	1	1.4	0.	.83	.91	.91	.97	.91	.83	.97	.97	.97	.97	.97	.97
			750.	.61	.80	.75	.89	.77	.75	.88	.92	.83	.91	.92	.91
			1500.	.27	.42	.36	.55	.38	.52	.47	.72	.33	.63	.84	.63
			2250.	.11	.19	.14	.23	.17	.28	.22	.48	.11	.33	.69	.22
			3000.	.05	.08	.06	.11	.08	.14	.13	.38	.05	.19	.61	.06
13	1	1.3	0.	.75	.88	.80	.92	.88	.75	.92	.92	.92	.92	.92	.92
			750.	.53	.72	.69	.86	.69	.67	.83	.89	.77	.88	.91	.89
			1500.	.22	.36	.30	.47	.33	.45	.41	.66	.28	.55	.78	.55
			2250.	.08	.16	.13	.20	.14	.23	.17	.41	.09	.28	.61	.19
			3000.	.03	.06	.05	.09	.06	.11	.09	.31	.03	.16	.53	.05

Fig. 70 - Example of Probability of Hit vs Range Arrays

SIDE BLUE

INITIAL COVER, CONCEALMENT AND LINE OF SIGHT TO ENEMY UNITS

UNIT	LCOV1	LCOV2	LCON1	LINE OF SIGHT TO ENEMY UNITS
1	.5	2	2.1	25, 26,
3	.5	2	2.1	25, 26,
5	.5	2	2.1	25, 26,
7	.1	1	.6	25, 26,
8	.1	1	.6	25, 26,
9	.5	2	2.1	0,
11	.5	2	2.1	0,
13	.5	2	2.1	25, 26,
15	.1	1	.6	0,
16	.1	1	.6	25, 26,
17	.6	2	2.1	25, 26,
19	.6	2	2.1	0,
21	.6	2	2.1	0,
23	.3	1	.6	0,
24	.3	1	.6	0,
25	.5	2	2.1	25, 26,
26	.5	2	2.1	25, 26,
27	.6	2	2.1	0,
28	.6	2	2.1	0,
29	.6	2	2.9	25, 26,
30	.6	2	2.9	25, 26,
31	.6	2	2.9	25, 26,
32	.6	2	2.9	0,
33	.6	2	2.9	0,
34	.0	0	.0	0,
35	.0	0	.0	0,
36	1.3	2	4.4	0,
37	.0	2	.0	0,
38	1.3	2	4.4	0,
39	1.3	2	4.4	0,
40	4.2	2	.0	0,

Fig. 71 - Example of Initial Cover, Concealment and Line of Sight Report

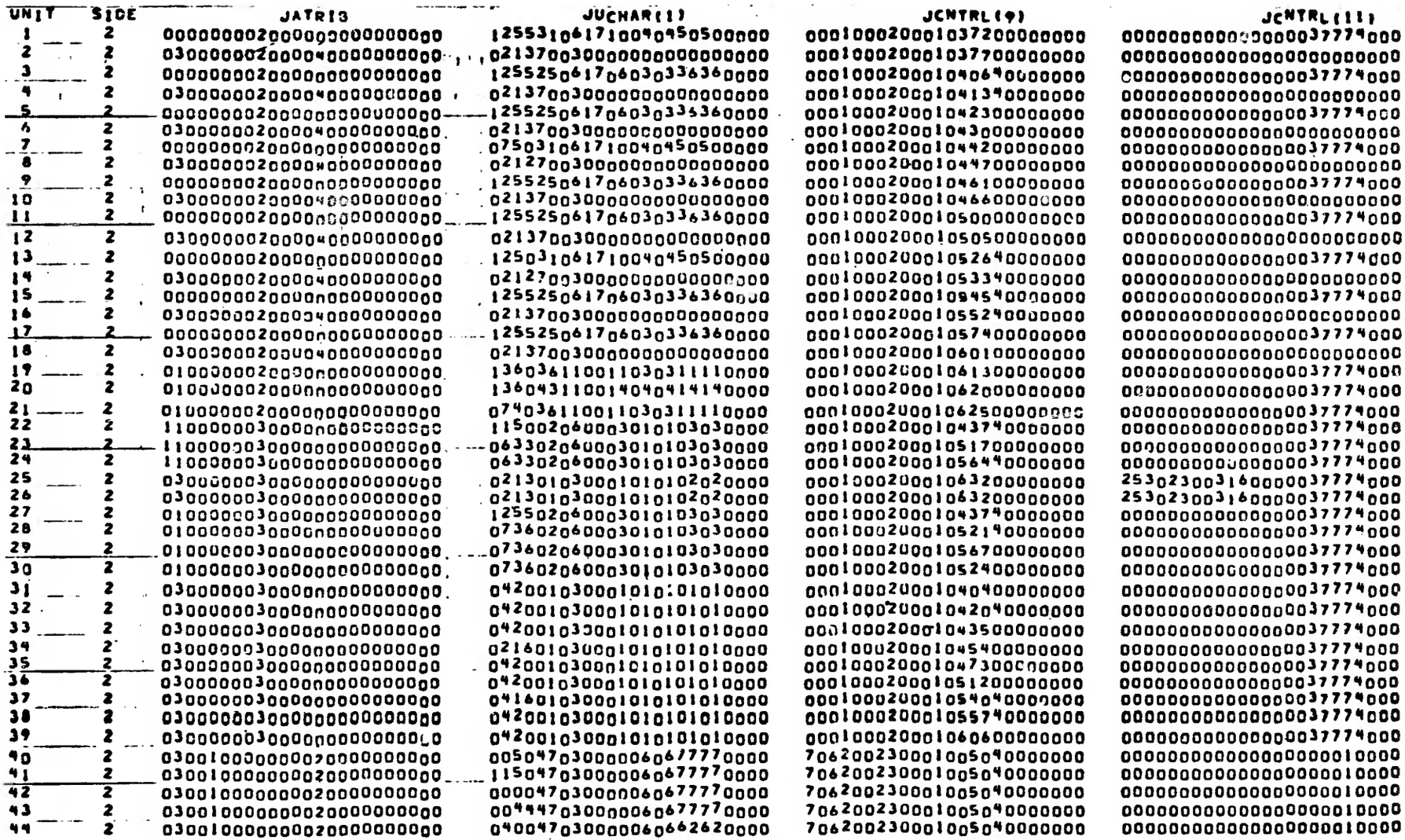


Fig. 72 - Example of Arrays JATRIB, JACHAR(1), JCNTL(9), and JCNTL(11)

GAME OUTPUT

The philosophy that has guided the design of the output program is that only the minimum required output would be provided without the user specifically requesting more detail. In the sections that follow, the source of information, the messages transmitted, and the output formats will be explained in non-technical terms. The details of how to obtain the output options and the system configuration are explained in Vol III.

Sources of Output Information

During the processing of each event that is deemed to have significance an output message is placed on magnetic tape. The primary record of events is referred to as the history tape. The history tape records all move selections, target selections, boundary crossings, firings, impacts, and status information such as out-of ammunition, response to fire, line of sight, intelligence level, and recognition of target death for each live unit.

Non-events are not recorded. For example, if a unit does not select a target, a message is not transmitted. The consequence of this approach is that a very careful study of the input is required to determine if a unit that does not appear to be taking part in the battle is in fact present.

Non-Optional Reports

CARMONETTE produces six non-optional reports. Figure 73 is an example of the Chronological Cumulative Casualties Report. An example of the Target-Kill Report is shown in Fig. 74. The Operational-Statistical Report is shown in Fig. 75, and the Ammunition Expenditure Report in Fig. 76. Whenever a treatment is replicated, the average results of all replications are summarized in the Treatment Summary Target Kill Report, an example of which is in Fig. 77. An example of the Average Ammunition Expenditure by Weapon Type Report is in Fig. 78.

TREATMENT9901 SUMMARY OF REPLICATION 1 07/19/74

CHRONOLOGICAL CUMULATIVE CASUALTIES

RED	27	2.8835	32,58,	0	CASUALTY WPN NO.	36	FIRER NO.	34	VEH BEFORE	1	AFTER	0	MEN BEFORE	3	AFTER	0	CUMULATIVE	3
RED	1	5.3386	26,55,	0	CASUALTY WPN NO.	13	FIRER NO.	31	VEH BEFORE	4	AFTER	3	MEN BEFORE	40	AFTER	38	CUMULATIVE	5
RED	1	5.6284	26,55,	0	CASUALTY WPN NO.	13	FIRER NO.	31	VEH BEFORE	3	AFTER	2	MEN BEFORE	38	AFTER	36	CUMULATIVE	7
RED	1	5.7839	26,55,	0	CASUALTY WPN NO.	35	FIRER NO.	25	VEH BEFORE	2	AFTER	1	MEN BEFORE	4	AFTER	2	CUMULATIVE	9
RED	7	6.1694	29,49,	0	CASUALTY WPN NO.	36	FIRER NO.	35	VEH BEFORE	4	AFTER	3	MEN BEFORE	40	AFTER	36	CUMULATIVE	13
RED	2	6.8074	25,55,	0	CASUALTY WPN NO.	6	FIRER NO.	37	VEH BEFORE	0	AFTER	0	MEN BEFORE	32	AFTER	31	CUMULATIVE	14
RED	1	7.2383	26,55,	0	CASUALTY WPN NO.	13	FIRER NO.	30	VEH BEFORE	1	AFTER	0	MEN BEFORE	2	AFTER	0	CUMULATIVE	16
BLUE	35	7.9602	6,56,	0	CASUALTY WPN NO.	16	FIRER NO.	28	VEH BEFORE	1	AFTER	0	MEN BEFORE	3	AFTER	0	CUMULATIVE	3
RED	11	8.5542	27,45,	0	CASUALTY WPN NO.	13	FIRER NO.	31	VEH BEFORE	3	AFTER	2	MEN BEFORE	30	AFTER	28	CUMULATIVE	18
RED	2	8.6892	24,54,	0	CASUALTY WPN NO.	6	FIRER NO.	37	VEH BEFORE	0	AFTER	0	MEN BEFORE	31	AFTER	29	CUMULATIVE	20
BLUE	31	8.7944	15,39,	0	CASUALTY WPN NO.	14	FIRER NO.	24	VEH BEFORE	1	AFTER	0	MEN BEFORE	3	AFTER	0	CUMULATIVE	6
RED	30	9.0974	26,49,	0	CASUALTY WPN NO.	35	FIRER NO.	25	VEH BEFORE	1	AFTER	0	MEN BEFORE	3	AFTER	0	CUMULATIVE	23
RED	11	9.2880	27,45,	0	CASUALTY WPN NO.	45	FIRER NO.	30	VEH BEFORE	2	AFTER	1	MEN BEFORE	28	AFTER	26	CUMULATIVE	25
RED	11	9.9443	27,45,	0	CASUALTY WPN NO.	44	FIRER NO.	17	VEH BEFORE	1	AFTER	0	MEN BEFORE	2	AFTER	0	CUMULATIVE	27
RED	19	9.9858	20,54,	0	CASUALTY WPN NO.	41	FIRER NO.	8	VEH BEFORE	3	AFTER	2	MEN BEFORE	9	AFTER	6	CUMULATIVE	30
RED	22	10.0276	26,52,	0	CASUALTY WPN NO.	35	FIRER NO.	26	VEH BEFORE	1	AFTER	0	MEN BEFORE	3	AFTER	0	CUMULATIVE	33
RED	8	10.7114	24,44,	0	CASUALTY WPN NO.	6	FIRER NO.	37	VEH BEFORE	0	AFTER	0	MEN BEFORE	30	AFTER	29	CUMULATIVE	34
BLUE	30	11.5342	15,40,	0	CASUALTY WPN NO.	14	FIRER NO.	21	VEH BEFORE	1	AFTER	0	MEN BEFORE	3	AFTER	0	CUMULATIVE	9
RED	18	11.6448	24,43,	0	CASUALTY WPN NO.	1	FIRER NO.	40	VEH BEFORE	0	AFTER	0	MEN BEFORE	24	AFTER	23	CUMULATIVE	35
BLUE	34	12.7109	6,56,	0	CASUALTY WPN NO.	16	FIRER NO.	26	VEH BEFORE	1	AFTER	0	MEN BEFORE	3	AFTER	0	CUMULATIVE	12
BLUE	1	14.5132	10,46,	0	CASUALTY WPN NO.	46	FIRER NO.	5	VEH BEFORE	1	AFTER	0	MEN BEFORE	1	AFTER	0	CUMULATIVE	13
RED	5	15.6340	14,47,	0	CASUALTY WPN NO.	45	FIRER NO.	29	VEH BEFORE	3	AFTER	2	MEN BEFORE	6	AFTER	2	CUMULATIVE	39
RED	3	15.7429	13,48,	0	CASUALTY WPN NO.	44	FIRER NO.	25	VEH BEFORE	3	AFTER	2	MEN BEFORE	6	AFTER	4	CUMULATIVE	41
RED	5	15.8437	14,47,	0	CASUALTY WPN NO.	41	FIRER NO.	8	VEH BEFORE	1	AFTER	0	MEN BEFORE	2	AFTER	0	CUMULATIVE	43

Fig. 73 - Example of Chronological Cumulative Casualties Report

TARGET KILLS BY WEAPON TYPE

RED WEAPON NUMBERS	BLUE TARGET CLASSES											
	CLASS 1		CLASS 2		CLASS 4		CLASS 7		CLASS 8		CLASS 10	
	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH
3	0	0	0	0	0	0	0	0	2	0	0	0
4	0	0	0	0	0	0	1	0	0	0	0	0
14	6	2	0	0	4	1	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	6	2
46	0	0	1	1	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	1	0	0	0
52	0	0	0	0	0	0	0	0	5	0	0	0
TOTALS	6	2	1	1	4	1	1	0	8	0	6	2

RED WEAPON NUMBERS	TOTAL KILLS	
	MEN	VEH
3	2	0
4	1	0
14	10	3
16	6	2
46	1	1
50	1	0
52	5	0
TOTALS	26	6

Fig. 74 - Example of Target Kills by Weapon Type Report

BLUE UNITS	LOCATION INITIAL	LOCATION FINAL	NUMBER OF MOVES	NUMBER OF ROUNDS FIRED	NUMBER OF ROUNDS RECEIVED	TROOPS INITIAL	TROOPS FINAL	VEHICLES INITIAL	VEHICLES FINAL	UNIT DEATH TIME
1	10,46, 0	10,46, 0	0	6	24	11	0	1	0	14.5132
2	10,46, 0	10,46, 0	0	8	36	0	10	0	0	0.0000
3	10,44, 0	10,44, 0	0	22	18	11	1	1	1	0.0000
4	10,44, 0	10,44, 0	0	8	8	0	10	0	0	0.0000
5	13,48, 0	9,46, 0	4	0	0	11	1	1	1	0.0000
6	13,48, 0	9,46, 0	1	0	81	0	4	0	0	0.0000
7	10,45, 0	10,45, 0	0	5	266	3	2	1	1	0.0000
8	13,48, 0	13,48, 0	0	5	163	3	3	1	1	0.0000
9	7,41, 0	7,41, 0	0	0	0	11	1	1	1	0.0000
10	7,41, 0	7,41, 0	0	0	0	0	10	0	0	0.0000
11	7,41, 0	7,41, 0	0	0	0	11	1	1	1	0.0000
12	7,41, 0	7,41, 0	0	0	0	0	10	0	0	0.0000
13	15,41, 0	15,41, 0	0	34	55	11	1	1	1	0.0000
14	15,41, 0	15,41, 0	0	0	0	0	8	0	0	0.0000
15	7,41, 0	7,41, 0	0	0	0	3	3	1	1	0.0000
16	15,41, 0	15,41, 0	0	5	32	3	3	1	1	0.0000
17	16,34, 0	16,34, 0	0	32	0	11	1	1	1	0.0000
18	16,34, 0	16,34, 0	0	0	0	0	10	0	0	0.0000
19	15,32, 0	15,32, 0	0	0	0	11	1	1	1	0.0000
20	15,32, 0	15,32, 0	0	0	0	0	10	0	0	0.0000
21	15,31, 0	15,31, 0	0	0	0	11	1	1	1	0.0000
22	15,31, 0	15,31, 0	0	0	0	0	10	0	0	0.0000
23	16,33, 0	16,33, 0	0	0	0	3	3	1	1	0.0000
24	14,31, 0	14,31, 0	0	0	0	3	3	1	1	0.0000
25	10,44, 0	10,44, 0	0	20	36	4	0	1	0	17.7961
26	10,45, 0	10,45, 0	0	28	267	4	4	1	1	0.0000
27	15,33, 0	15,33, 0	0	0	0	4	4	1	1	0.0000
28	15,32, 0	15,32, 0	0	0	0	4	4	1	1	0.0000
29	14,41, 0	14,41, 0	0	198	55	3	3	1	1	0.0000
30	15,40, 0	15,40, 0	0	47	27	3	0	1	0	11.5342
31	15,39, 0	15,39, 0	0	21	22	3	0	1	0	8.7944
32	8,41, 0	8,41, 0	0	0	0	3	3	1	1	0.0000
33	7,41, 0	7,41, 0	0	0	0	3	3	1	1	0.0000
34	2,58, 0	6,56, 0	98	4	14	3	0	1	0	12.7109
35	2,58, 0	6,56, 0	51	3	14	3	0	1	0	7.9602
36	1,21, 0	1,21, 0	0	64	0	48	48	5	5	0.0000
37	1,34, 0	1,34, 0	0	96	0	48	48	7	7	0.0000
38	1,10, 0	1,10, 0	0	96	0	48	48	7	7	0.0000
39	2,21, 0	2,21, 0	0	24	0	33	33	5	5	0.0000
40	4,39, 0	4,39, 0	0	36	0	24	24	4	4	0.0000
TOTALS				778	1110	331	305	54	48	

Fig. 75 - Example of Operational Statistics Report

BLUE UNIT	MAIN WEAPON WPN	AMMO TYPE 1 BEGIN	AMMO TYPE 1 END	AMMO TYPE 2 BEGIN	AMMO TYPE 2 END	WEAPON B WPN	AMMO TYPE 1 BEGIN	AMMO TYPE 1 END	AMMO TYPE 2 BEGIN	AMMO TYPE 2 END	WEAPON C WPN	AMMO TYPE 1 BEGIN	AMMO TYPE 1 END	AMMO TYPE 2 BEGIN	AMMO TYPE 2 END	WEAPON D WPN	AMMO TYPE 1 BEGIN	AMMO TYPE 1 END	AMMO TYPE 2 BEGIN	AMMO TYPE 2 END
1	44	210	204	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	42	8	0	0	0	50	300	300	0	0	52	980	980	0	0	0	0	0	0	0
3	44	210	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	42	8	0	0	0	50	300	300	0	0	52	980	980	0	0	0	0	0	0	0
5	44	210	210	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	42	8	8	0	0	50	300	300	0	0	52	980	980	0	0	0	0	0	0	0
7	41	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	41	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	44	210	210	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	42	8	8	0	0	50	300	300	0	0	52	980	980	0	0	0	0	0	0	0
11	44	210	210	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	42	8	8	0	0	50	300	300	0	0	52	980	980	0	0	[illegible]				
13	44	210	176	0	0	0	0	0	0	0	0	0	[illegible]							
14	42	8	0	0	0	50	300	300	[illegible]										0	0
15	41	5	5	0	[illegible]											0	0	0	0	0
16	41	[illegible]										[illegible]	450	0	0	0	0	0	0	0
									0	0	48	450	450	0	0	0	0	0	0	0
						49	25	25	0	0	51	200	200	0	0	0	0	0	0	0
		[illegible]	5	0	0	19	25	25	0	0	51	200	200	0	0	0	0	0	0	0
36	7	960	928	240	208	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	6	1080	996	720	708	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	6	1080	984	720	720	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	2	624	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	1	465	429	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TOTAL AMMUNITION EXPENDITURE BY WEAPON TYPE

WEAPON TYPE	AMMO 1	AMMO 2
1	36	0
2	24	0
5	180	12
7	32	32
13	24	48
35	20	0
36	7	0
41	15	0
42	24	0
44	122	0
45	110	0
46	84	0

Fig. 76 - Example of Ammunition Expenditure Report

SUMMARY OF TREATMENT9901
NUMBER OF REPLICATIONS 3

AVERAGE TARGET KILLS BY WEAPON TYPE

BLUE WEAPON NUMBERS	RED TARGET CLASSES													
	CLASS 1		CLASS 2		CLASS 4		CLASS 5		CLASS 9		CLASS 11		CLASS 12	
	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH
1	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	.3	.3	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
6	1.0	.3	1.3	.7	0.0	0.0	.3	0.0	6.0	0.0	0.0	0.0	0.0	0.0
7	2.0	.7	.7	.3	0.0	0.0	.3	0.0	1.0	0.0	0.0	0.0	0.0	0.0
13	6.0	2.0	5.3	2.7	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	5.0	1.7	1.3	.7	2.0	.7	0.0	0.0	0.0	0.0	0.0	0.0	6.0	2.0
36	0.0	0.0	3.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	4.0	1.3	3.3	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	.3
44	0.0	0.0	4.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	1.3	.7	0.0	0.0								
TOTALS	19.0	6.0	21.0	9.7	5.0	1.7	.7	0.0	9.0	0.0	.3	.3	7.0	2.3

VARIANCE OF TARGET KILLS BY WEAPON TYPE

RED WEAPON NUMBERS	BLUE TARGET CLASSES											
	CLASS 1		CLASS 2		CLASS 4		CLASS 7		CLASS 8		CLASS 10	
	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH	MEN	VEH
3	0.0	0.0	0.0	0.0	0.0	0.0	.3	0.0	2.3	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	.3	0.0	2.3	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.3	0.0	0.0	0.0
14	0.0	.3	2.3	2.3	5.3	.3	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	.3
37	12.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	9.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	.3	.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.3	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	0.0	0.0	0.0

Fig. 77 - Example of Treatment Summary Target Kill Report

BLUE AVERAGE AMMUNITION EXPENDITURE BY WEAPON TYPE

WEAPON TYPE	AMMO 1	AMMO 2
1	44.0	0.0
2	45.3	0.0
6	196.0	12.0
7	45.3	18.7
13	11.7	25.0
35	20.0	0.0
36	11.3	0.0
41	13.7	0.0
42	21.3	0.0
44	180.0	0.0
45	18.0	0.0

RED AVERAGE AMMUNITION EXPENDITURE BY WEAPON TYPE

WEAPON TYPE	AMMO 1	AMMO 2
3	36.0	0.0
4	96.0	40.0
5	0.0	20.0
14	27.3	28.0
16	48.0	0.0
17	.7	0.0
37	11.7	0.0
38	15.0	0.0
43	24.0	0.0
46	252.0	0.0
47	7.3	0.0
49	168.0	0.0
50	165.0	0.0
52	219.3	0.0
53	3.3	0.0

Fig. 78 - Example of Average Ammunition Expenditure by Weapon Type Report

Optional Report

A very useful optional report is the chronological history report. By requesting this option, most of the event messages placed on the event history tape will be printed. The primary purpose of this option is to ensure that the battle scenario is being followed. The event history message contains two parts. The first part is the same for messages from all sources within the battle model. The second part contains information of interest concerning the specific event from which it is transmitted. Part one of every message contains the side, unit, time of the event, location of the unit, and the nature of the event. Part two of the messages varies depending on the event and is summarized in Table 19.

Examples of chronological history report messages, as described in Table 19, are contained in Fig. 79. The INTELLIGENCE Report is usually the first message encountered when reading a CARMONETTE history. Samples of this report are shown at (1). Line one is described in Event Code 3, and is interpreted as follows:

ENUN DEAD	- Enemy units known dead
LOS	- In line of sight
IN SENRG	- In sensor range
NKON	- In LOS and not concealed
PP	- Pinpoint (Intelligence level 4)
ERRPP	- Erroneous pinpoint (Intelligence level 3)
NS	- Nearest square (Intelligence level 2)
B /A	- Before /After

Line two is described in Event Code 15. I2, 3, and 4 pertain to intelligence levels, and the array after each shows which enemy units are at each level. Each level is inclusive of those below it; that is, a unit at level 4 is also known at levels 3 and 2. The array (bit pattern) is interpreted using the technique described on page 153 of this volume. The example in Fig. 79 is from the GRC version and the bit pattern is interpreted from right to left. Line three is described in Event Code 26. LOS and ENUN are as described above. SURV identifies the units against which the observer is conducting surveillance. In the first message, Red 50 is not conducting surveillance against anyone because no weapon units are initialized until time 0.5000. In the second message, Blue 32 has its sensor restricted to the Red units indicated.

Table 19

EVENT HISTORY MESSAGE, PART II

Event code	Message origin	Message
1	Move select	Squares moving from and to, time from center to boundary of squate, velocity.
2	Boundary crossing	Square moved from, time to move boundary to center of new square, velocity, concealment, cover, net cover and line of sight after move.
3	Intelligence report (First line)	Number of enemy units known dead, in line of sight, in sensor range, not concealed if in line of sight, and number of enemy units pinpointed, erroneously pinpointed, known to nearest sqaure both before and after the surveillance. (Message from target acquisition.)
4	Impact firer	Firing weapon number, target number, hit probability, kill probability, number of rounds, firer dead prior to impact.
5	Impact firer (Reload after impact)	Firing weapon number, target number, hit probability, kill probability, number of rounds, reload time.
6	Impact firer	Firing weapon number, target number, hit probability, kill probability, number of rounds, number of hits.
7	Impact target	Firing weapon number, firing unit, vehicles before and after, troops before and after.
8	Firing	Firing weapon number, target number, range, time of flight, reload time.
9	Firing	Firing weapon number, target number, range, time of flight.
10	New mission	New order number, octal representation of mission word.
11	Battle terminated due to casualties	Side that caused termination, casualty limit, number of casualties.

Table 19 cont'd

Event code	Message origin	Message
12	Battle terminated due to proximity of forces	Side that caused termination, location indicated for proximity, number of units within designated range.
13	Target select	Weapon number that made selection, target selected, target location, aim time, ammo type to be used.
14	Area target selected	Weapon number that made selection, area location, aim/reaim time.
15	Intelligence report (Second line)	Bit patterns of enemy units, units known to nearest square, erroneous pinpoint and pinpoint.
16	Artillery called	Responding weapon number, responding unit number, target area location, aim time, target number, ammo type.
17	Dismount	Carrier unit number, dismounting unit number, number of vehicles in carrier unit, number of men dismounting, dismount time.
18	Response to fire	Total rounds received, total direct fire, total indirect fire, suppression status.
19	Out of ammunition	Weapon number which fired last of ammo.
20	Begin treatment	No message printed.
21	Begin replication	No message printed.
22	End replication	No message printed.
23	End treatment	No message printed.
24	Firing	Suppressive fire. Firing weapon number, target number, range, time of flight, reload time.
25	Firing	Suppressive fire. Firing weapon number, target number, range, time of flight.
26	Intelligence report (Third line)	Bit pattern of enemy units in line of sight, known dead, and under surveillance.

Table 19 cont'd

Event code	Message origin	Message
27	Impact area fire	Firing weapon number, target number, hit probability, kill probability, number of rounds, reload time.
28	Impact area fire	Firing weapon number, target number, hit probability, kill probability, number of rounds, number of hits.
29	Impact target (Artillery)	Firing weapon number, firing unit number, vehicles and troops in target unit before and after impact.
30	Not used	
31	Mount	Mounting unit number, number of vehicles in carrier unit, number of men mounting, mount (remount) time.
32	Battle terminated due to vehicle losses	Side that caused termination, vehicle casualty limit, number of vehicle casualties.
33	Helicopter called	Helicopter unit number, target unit number, target location, altitude.
34	Not used	
35	Position disclosure	Bit pattern of enemy units intelligence change on firer, no info to erroneous pinpoint, erroneous pinpoint to pinpoint.
36	Change altitude	New altitude, new line of sight.

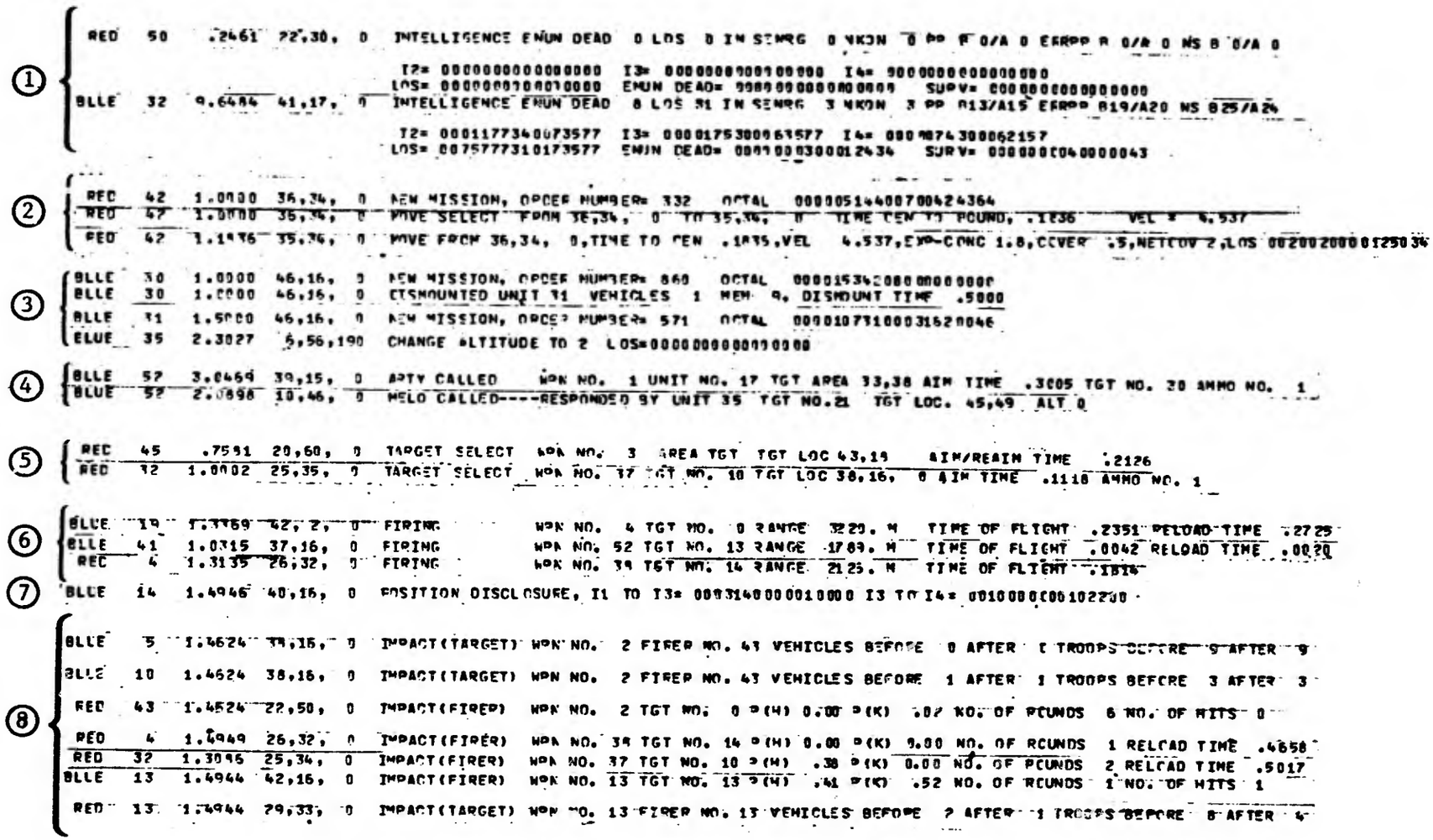


Fig. 79 – Example of Chronological History Report Messages

```
(9)  BLUE   21   9.5000  18,34,  0  RESPONSE      TOTAL RNDS   96, TOTAL DF   96, TOTAL INDF    0. STATUS PARTIAL DF
     BLUE    4   9.5000  15,49,  0  RESPONSE      TOTAL RNDS  216, TOTAL DF    0, TOTAL INDF  216. STATUS PARTIAL INDF
     BLUE    7   9.5205  16,49,  0  RESPONSE      TOTAL RNDS  552, TOTAL DF  480, TOTAL INDF   72. STATUS PINNED DOWN

(10) BLUE   16  11.6370  18,40,  0  OUT OF AMMO   WPN NO. 40
     BLUE   16  11.6370  19,40,  0  FIRING       WPN NO. 40 TGT NO.  7 RANGE  721. M  TIME OF FLIGHT  .1372

(11)                    BATTLE TERMINATED, MAXIMUM TIME  12 EXCEEDED
```

Fig. 79 - Example of Chronological History Report Messages cont'd

The next message generally encountered is New Mission, an example of which is at (2) and (3). The form of this message is described in Event Code 10. Also shown at (2) are examples of move messages. The first is described in Event Code 1 and is printed when the unit moves from the center of a square to its boundary. The second is described in Event Code 2 and is printed when the unit crosses the boundary between the two squares. Because of the large number of moves made by helicopter units, only boundary crossing messages are printed for them. The sequence shown at (3) is that which occurs when the new mission is DISMOUNT. The form of the message is described in Event Code 17. After the time required to dismount has passed, the first message from the dismounted unit (Blue 31 in this case) is NEW MISSION. If the order had been REMOUNT rather than DISMOUNT, the message would have been very similar and is described in Event Code 31.

If a command unit has at least "Nearest Square" information on an enemy unit that is on his artillery or helicopter call priorities, the command unit may call for artillery and/or helicopter support. These messages are shown at (4) and are described by Event Codes 16 and 33 respectively.

When an area fire (artillery or mortar) unit answers a call for support, or when a direct fire unit (tank, HAW, AD, etc.) elects to fire at a target, a TARGET SELECT message is written. Examples of this message are at (5) . The first message is for area fire weapons and is described in Event Code 14. Event Code 13 describes the message for direct fire units; the second message is an example.

After a unit completes aiming, it fires. Three examples of this message are shown at (6). The first message is for an area fire weapon, and the second for a direct fire weapon that does not require guidance. Note that these messages are identical in form; they are described by either Event Code 8 or 24. The reload time is shown since these weapons may fire again before the round impacts. The third message is for a weapon that cannot reload until after impact, Event Codes 9 and 25. The firing of a direct fire weapon may disclose its position, hence when these weapons fire, a POSITION DISCLOSURE message is printed; see (7) and Event Code 35.

When rounds impact, two types of messages are written, one for the firer and one for the target; examples of these are at (8). If the rounds impacting are from area fire weapons, the IMPACT (TARGET) messages for all units in the impact area are written first; this message is described in Event Code 29 and is shown in the first two messages. The IMPACT (FIRER) message is then written as shown on the third line and described in Event Code 6. Note that both the target number and probability of hit are zero when the firer is an area fire weapon. The order of the messages is reversed for direct fire weapons and is shown in the last four messages at (3). Red 4 and 32 fired weapons that reload after impact (guided missiles), hence their messages show a reload time as described in Event Code 5. Blue 13 fired a weapon that may be reloaded and fired again before impact and receives the message described in Event Code 6. The final message is for the target and is as described in Event Code 7. The IMPACT (FIRER) messages for Red 4 and 32 and for Blue 13 contain more information than is readily apparent. By observing the probability of hit, P(H), and the probability of kill, P(K), in the message, the gamer may determine the following information:

P(H)0.00 P(K)0.00 : Firer fired on an erroneously pinpointed target. (Red 4)

P(H) .nn P(K)0.00 : Firer fired on a pinpointed target and missed. (Red 32)

P(H) .nn P(K) .nn : Firer fired on a pinpointed target and hit. (Blue 13)

It is necessary to read the IMPACT(TARGET) message to see if the hit killed the target. In the example, the hit killed 1 vehicle and 4 troops.

If a unit is killed while it has a round in flight toward a target, one of two outcomes is possible. If the round in flight does not require guidance, it will continue to impact, with a message similar to those for Red 4 and 32 in (8), but the phrase FIRER DEAD PRIOR TO IMPACT will be substituted for RELOAD TIME. If the round in flight does require guidance, the program will not enter the impact subroutine, and no message will be printed.

In addition to killing when they impact, rounds fired at targets can suppress those that are not killed. Examples of RESPONSE messages are shown at (9) and described in Event Code 18.

A unit always checks to determine if a round is the last one on hand before it is fired. If it is, the OUT OF AMMO message described in Event Code 19 and shown at (10) is printed. Note that the message is printed before the FIRING message.

The final message printed is BATTLE TERMINATED which is shown at (11). In addition to time, the battle may be terminated for casualties (Event Code 11), proximity of forces (Event Code 12), or vehicle losses (Event Code 32).

If a selective history, which records only the events pertaining to selected units is desired, this option may be selected in place of the chronological history. An example of this report is in Fig. 80. The information contained in the Average Ammunition Expenditure by Weapon Type can be reported by time interval; an example of this optional report is shown in Fig. 81.

The Range Interval Post Processor lists the number of engagements (firings), number of rounds fired, troop and vehicle casualties for each weapon on both sides, for all target classes that were engaged, in range intervals of a specified number of meters. Total accumulated casualties are then listed by range interval from the longest to the nearest range. The averages for all replications of the treatment follow. The listing is for each replication of each treatment and is shown in Fig. 82.

Examples of Game Outputs

Selected messages and arrays from the game outputs from the GRC version are discussed below. When the gamer completes this discussion, he should be able to interpret the complete game output contained in Vol IV.

The first array encountered in the game output is shown in Fig. 83. The first line shows the parameters that controlled the game; these parameters are described in detail in Vol III. Parameters of interest to the

```
    1 9931    1 9931

SELMIS

1 351 342 51* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0* -0

     TREATMENT 9911                                  BATTLE HISTORY                                  07/30/74
                                                     REPLICATION  1

SIDE UNIT   TIME   LOCATION     EVENT

BLUE   34    .6953   2,58,  3  INTELLIGENCE ENUM DEAD  2 LOS  0 IN SENRC  2 NKCN  0 PP E G/A 0 ERRPP 5 G/A 0 NS E G/A 0

                                I2= ..........[illegible]  I3= 0000[illegible]  I4= 0000[illegible]
                               LOS= 0000[illegible]  ENUM DEAD= 0000[illegible]  SURV= 0377777777777777
BLUE   34    .9652   2,58,  0  INTELLIGENCE ENUM DEAD  0 LOS  0 IN SENRC  2 NKCN  0 PP E G/A 0 ERRPP 0 G/A 0 NS E G/A 0

                                I2= 0000[illegible]  I3= 0000[illegible]  I4= 0000[illegible]
                               LOS= 0000[illegible]  ENUM DEAD= 0000[illegible]  SURV= 0377777777777777

BLUE   30   5.2273  15,47,  2  NEW MISSION, ORDER NUMBER=  59   CCTAL  0[illegible]
BLUE   30   5.2276  15,47,  2  TARGET SELECT  WPN NO. 13 TGT NO. 19 TGT LOC 25,56,  0 REAIP TIME  .1929 AMMC NO. 1

BLUE   34   6.2334   2,58,  7  NEW MISSION, ORDER NUMBER= 117   CCTAL  0000[illegible]
BLUE   34   6.2334   2,58,  4  CHANGE ALTITUDE TO 0  LOS=0[illegible]
BLUE   34   6.2736   2,58,  2  NEW MISSION, ORDER NUMBER=  93   CCTAL  0[illegible]

BLUE   30   9.5742  15,40,  2  CASUALTY WPN NO. 14  FIRER NO. 20 VEH BEFORE  1 AFTER  0 MEN BEFORE  3 AFTER  0 CUMULATIVE    3
BLUE   34  10.2229   4,47,  3  CASUALTY WPN NO. 15  FIRER NO. 30 VEH BEFORE  1 AFTER  0 MEN BEFORE  3 AFTER  0 CUMULATIVE    6

                               BATTLE TERMINATED, MAXIMUM TIME   20 EXCEEDED

                               COMPUTER TIME THIS REPLICATION  333.858 SECONDS

                               LAST RANDOM NO. THIS REPLICATION  2635808419
```

Fig. 80 - Example of Selective History Report

BLUE AVERAGE AMMUNITION EXPENDITURE BY WEAPON TYPE AND TIME INTERVAL

TIME FROM	0.0000	TO	4.9999
1			5.0
2			5.3
6			36.0
7			8.0
13			.3
35			4.0
36			3.0

TIME FROM	5.0000	TO	9.9999
1			17.0
2			13.3
6			52.0
7			22.7
13			25.3
35			13.0
36			4.3
41			.7
44			12.3
45			12.3

TIME FROM	10.0000	TO	14.9999
1			12.0
2			13.3
6			76.0
7			17.3
13			10.7
35			3.0
36			3.6
41			4.0
42			13.3
44			84.7

TIME FROM	15.0000	TO	19.9999
1			10.0
2			13.3
6			44.0
7			16.0
13			.3
36			.7
41			9.0
42			9.0
44			78.0
45			.7

Fig. 81 - Example of Average Ammunition Expenditure by Weapon Type by Time Interval Report

TREATMENT NO. 9901 REPLICATION NO. 1 07/30/74

BLUE WEAPON NO. 3F

RED TARGET CLASSES

	1				2				4			
	ENG	RDS	VEH	TPS	ENG	RDS	VEH	TPS	ENG	RDS	VEH	TPS
1501 2000	7	7	1	3	2	2	1	2	4	4	1	3
2001 2500	3	3	0	0	3	3	0	0	0	0	0	0
2501 3000	0	0	0	0	1	1	0	0	1	0	0	0

TREATMENT NO. 9901 REPLICATION NO. 1 07/30/74

BLUE CASUALTY TOTALS TO RANGE INDICATED

TARGET CLASS	1		2		4		8		10	
	TPS	VEH	TPS	VEH	TPS	VEH	TPS	VEH	TPS	VEH
2001 2500	0	0	0	0	0	0	0	0	0	0
1501 2000	3	1	0	0	0	0	0	0	0	0
501 1000	3	1	1	1	1	1	1	1	1	1
0 500	3	1	2	2	4	1	5	0	5	1

AVERAGES OF TREATMENT NO. 9901 3 REPLICATIONS 07/30/74

BLUE WEAPON NO. 1?

RED TARGET CLASSES

	1				2				4				5			
	ENG	RDS	VEH	TPS	ENG	RDS	VEH	TPS	ENG	RDS	VEH	TPS	ENG	RDS	VEH	TPS
501 1000	0.1	0.0	0.0	0.0	1.7	1.7	.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1001 1500	4.7	4.7	1.7	5.0	.3	.3	.3	.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1501 2000	6.3	6.3	.3	1.0	7.3	7.3	1.7	3.3	8.0	8.0	1.0	3.0	0.0	0.0	0.0	0.0
2501 3000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.0	0.0

Fig. 82 - Example of the Range Interval Post Processor

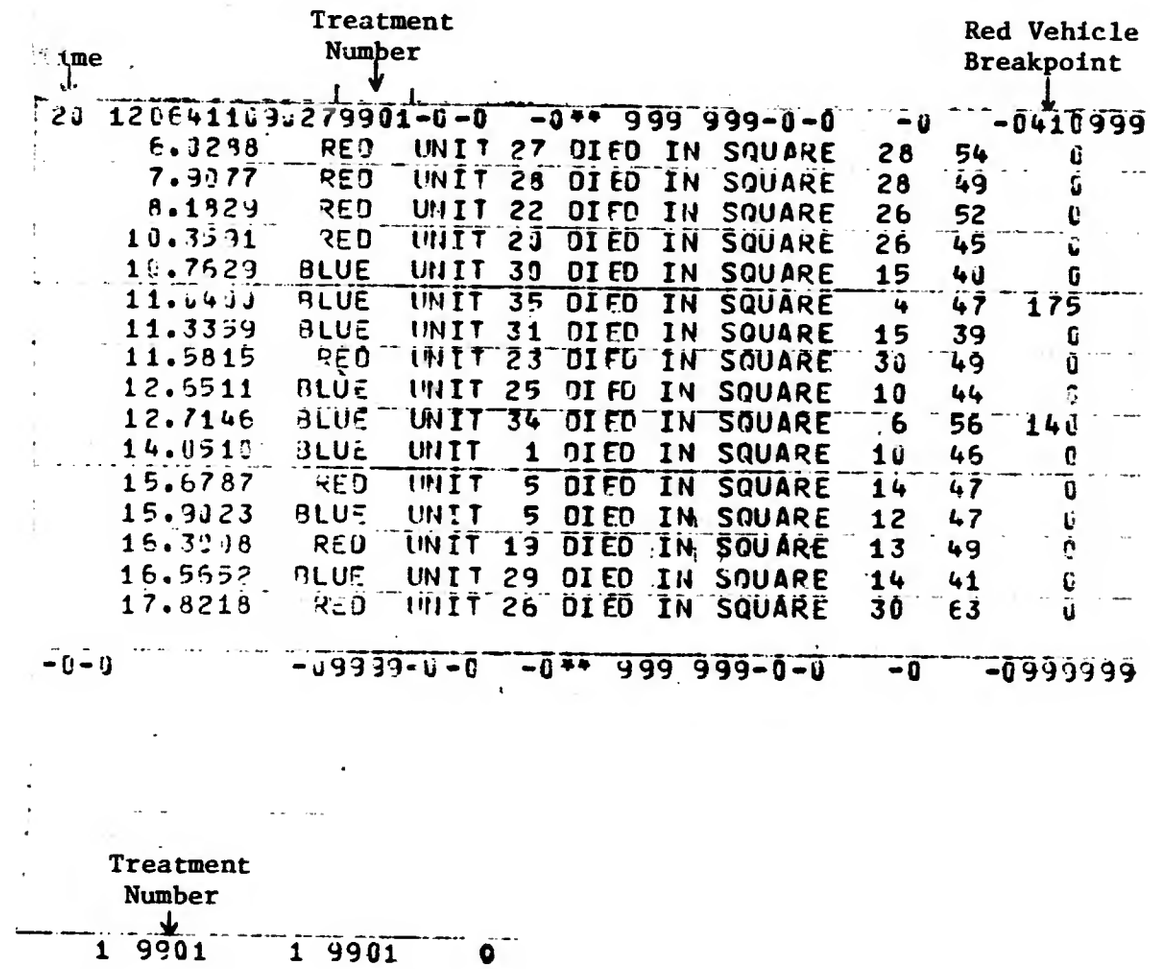


Fig. 83 - Example of Run Parameters and Output Option Report

gamer are: the maximum game time - 20 minutes, the treatment number - 9901; and the Red break point - 41 vehicles. The second item encountered, also shown in Fig. 83, is another of the job control parameters; it indicates that the gamer has requested a complete battle history of the first replication of treatment 9901.

Selected messages from the battle history are shown in Figs. 84 through 86. As indicated earlier in this discussion, these messages have two parts: the first part shows the side, unit, time, and location; the second part shows the event being recorded. The accompanying figures show selected messages that will further demonstrate how this part of the output is read.

Dismounting and remounting are demonstrated by the units on the outpost and are shown in Fig. 84. After waiting the 1 minute prescribed by its initial order, Blue 5 receives a "New Mission;" order 2 is Dismount. The second message shows that Blue 5 dismounted Blue 6 and that the time required for this action is 0.5 minutes. At time 1.5000, dismounting is complete, and both Blue 5 and 6 receive a new mission. Blue 6 starts its move to the rear. CARMONETTE units move from the center of a square to its boundary with the adjacent square and then from the boundary to the center of the adjacent square. The first move is shown; it will require 0.2598 minutes for Blue 6 to move to the boundary. At time 17.0193, Blue 6 determines that Blue 5 is in square 1247 and receives the order to Remount (order 6). At 17.8123, Blue 6 receives the same order. The second message at that time shows how much direct and indirect fire Blue 6 has received during the current neutralization cycle and shows that the unit is partially neutralized by direct fire. At time 18.0193 there is a Response message on Blue 5 similar to the previous one on Blue 6, and a message indicating that Blue 5 has started to remount the surviving four members of Blue 6.

The actions of supporting units are shown in Fig. 85. The first message shows the company commander, Blue 49, has called for an attack helicopter strike against Red 22, a HAW which is first on its helicopter call priority, in square 3157. Since this target is also on his artillery call

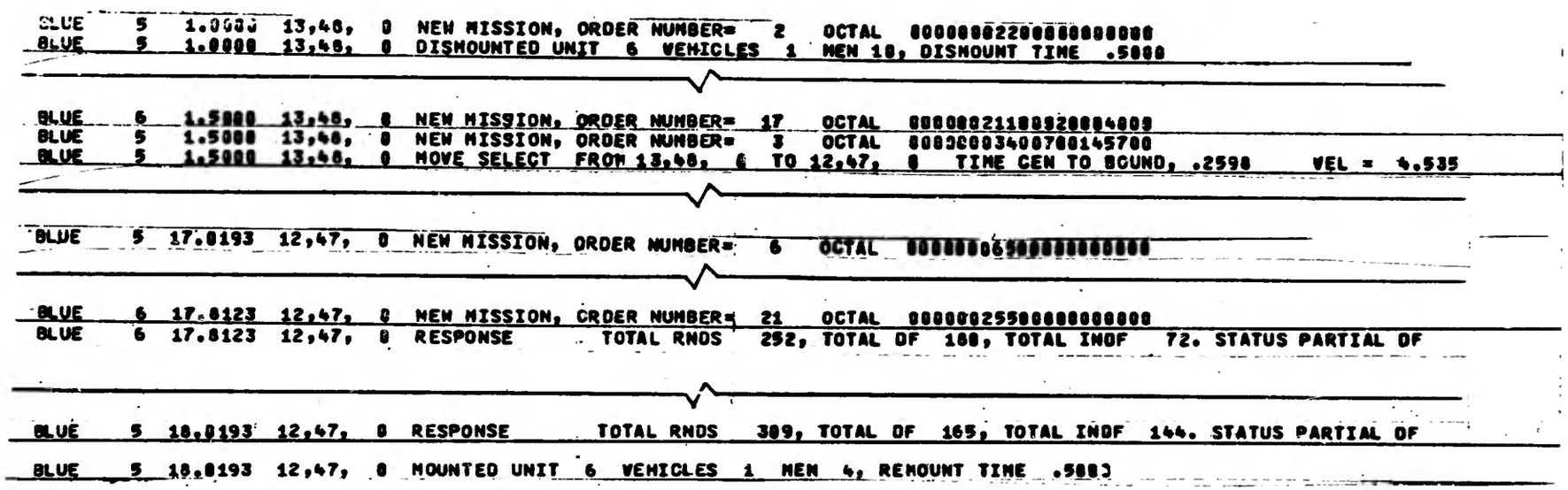


Fig. 84 - Example of Dismounting and Remounting

```
BLUE   49   3.0742   1,21,  0  HELO CALLED----RESPONDED BY UNIT 35  TGT NO.22  TGT LOC. 31,57  ALT 0
BLUE   49   3.0742   1,21,  0  ARTY CALLED    WPN NO.  7 UNIT NO. 36 TGT AREA 31,57 AIM TIME  .2112 TGT NO. 22 AMMO NO.  1

BLUE   35   3.0748   2,58,  0  NEW MISSION, ORDER NUMBER=  94   OCTAL  0000013642070000700

BLUE   35   3.1039   3,58, 22  MOVE FROM  2,58, 22,TIME TO CEN  .0295,VEL  28.289,EXP-CONC 5.3,COVER 1.3,NETCOV 3,LOS 0000000000000003

BLUE   35   3.1387   3,58, 22  INTELLIGENCE ENUN DEAD  0 LOS  0 IN SENRG  0 NKON  0 PP 0 0/A 0 ERRPP 0 0/A 0 NS 0 1/A 1
                               I2= 0000000010000036  I3= 0000000000000000  I4= 0000000000000000
                              LOS= 4500000000000000  ENUN DEAD= 0000000000000000  SURV= 0377777777777777

BLUE   35   3.2646   6,56, 40  MOVE FROM  5,57, 40,TIME TO CEN  .0227,VEL  51.696,EXP-CONC 5.3,COVER 1.3,NETCOV 3,LOS 0000000000000003

BLUE   35   3.2871   6,56, 40  NEW MISSION, ORDER NUMBER=  95   OCTAL  0000013732000000000
BLUE   35   3.2871   6,56,190  CHANGE ALTITUDE TO 2  LOS=3000000000000000

BLUE   35   3.4365   6,56,190  NEW MISSION, ORDER NUMBER=  96   OCTAL  0003014010006210004044

BLUE   35   3.6064   6,56,190  INTELLIGENCE ENUN DEAD  1 LOS 14 IN SENRG  7 NKON 14 PP 0 0/A 4 ERRPP 0 0/A 4 NS 0 1/A 4
                               I2= 0000000011000035  I3= 0000000011000005  I4= 0000000011000005
                              LOS= 0000072755000025  ENUN DEAD= 0000000040000000  SURV= 0377777777777777
BLUE   35   3.6067   6,56,190  TARGET SELECT  WPN NO. 36 TGT NO. 19 TGT LOC 38,59,  0 AIM TIME  .0586 AMMO NO. 1

BLUE   35   3.6653   6,56,190  FIRING         WPN NO. 36 TGT NO. 19 RANGE  2419. M  TIME OF FLIGHT  .2061
BLUE   35   3.6653   6,56,190  POSITION DISCLOSURE, I1 TO I3= 0000000000000000 I3 TO I4= 0000000000000000

BLUE   35   3.8713   6,56,190  IMPACT(FIRER)  WPN NO. 36 TGT NO. 19 P(H)  .61 P(K) 0.00 NO. OF RCUNDS  1 RELCAD TIME  .1885
REO    19   3.8713  29,58,  0  IMPACT(TARGET) WPN NO. 36 FIRER NO. 35 VEHICLES BEFORE  3 AFTER  3 TROOPS BEFORE  9 AFTER  9
```

Fig. 85 - Example of Actions of Supporting Units

```
BLUE   35   3.9712   6,56,198  NEW MISSION, ORDER NUMBER=  97   OCTAL  0000014141670000306000

BLUE   35   4.7744   4,47, 75  INTELLIGENCE ENUN DEAD  1 LOS 11 IN SENRG  6 NKON 11 PP 0 0/A 5 ERRPP 0 0/A 5 NS 0 4/A 6
                               I2= 0000000015000025  I3= 0000000011000025  I4= 0000000011000025
                               LOS= 0000070711000025  ENUN CEAD= 0300000400000000   SURV= 0377777777777777
BLUE   35   4.7747   4,47, 75  TARGET SELECT  WPN NO. 36 TGT NO. 22 TGT LOC 28,54,  0 RE..N TIME  .3984 AMMO NO. 1

BLUE   35   5.1045   4,47, 75  NEW MISSION, ORDER NUMBER= 101   OCTAL  0000014541670000215000

BLUE   35   6.1694   2,36,168  IMPACT(FIRER)  WPN NO. 36 TGT NO.  7 P(H)  .58 P(K)  .94 NO. OF ROUNDS  1 RELOAD TIME  .1758
 RED    7   6.1694  29,49,  0  IMPACT(TARGET) WPN NO. 36 FIRER NO. 35 VEHICLES BEFORE  4 AFTER  3 TROOPS BEFORE 48 AFTER 36

BLUE   35   7.1663   2,58,  7  NEW MISSION, ORDER NUMBER= 107   OCTAL  0000015330000000000J00
BLUE   35   7.1663   2,58,  0  CHANGE ALTITUDE TO 0  LOS=0000000000J00C300
BLUE   35   7.1665   2,58,  0  NEW MISSION, ORDER NUMBER=  93   OCTAL  0000013510000300200000

BLUE   36   3.2854   1,21,  0  FIRING          WPN NO.  7 TGT NO.  0 RANGE  4606. M   TIME OF FLIGHT  .4221 RELOAD TIME  .2571

 RED    1   3.7075  30,57,  0  IMPACT(TARGET) WPN NO.  7 FIRER NO. 36 VEHICLES BEFORE  4 AFTER  4 TROOPS BEFORE 48 AFTER 48
 RED    3   3.7075  31,57,  0  IMPACT(TARGET) WPN NO.  7 FIRER NO. 36 VEHICLES BEFORE  3 AFTER  3 TROOPS BEFORE 30 AFTER 30
 RED   22   3.7075  30,56,  0  IMPACT(TARGET) WPN NO.  7 FIRER NO. 36 VEHICLES BEFORE  1 AFTER  1 TROOPS BEFORE  3 AFTER  3
 RED   32   3.7075  31,57,  0  IMPACT(TARGET) WPN NO.  7 FIRER NO. 36 VEHICLES BEFORE  1 AFTER  1 TROOPS BEFORE  1 AFTER  1
BLUE   36   3.7075   1,21,  0  IMPACT(FIRER)  WPN NO.  7 TGT NO.  0 P(H) 0.00 P(K)  .05 NO. OF ROUNDS  4 NO. OF HITS  0
```

Fig. 85 - Examples of Actions of Supporting Units continued

priority list, he also called for artillery, and Blue 36 responded. B35 responded to "Call Helo" and in accordance with order 94 started to move to square 0656. Since helicopters move so rapidly, only the boundary crossing messages are printed, one is shown at time 3.1035. The intelligence message received by Blue 35 at 3.1387 is read as shown below:

Line 1 - He knows of no dead enemy units, ENUN DEAD 0

He has line of sight to no units, LOS 0

He has no enemy units in sensor range, IN SENRG 0

He had no enemy units pinpointed before this message, and he has none now, PP BO/AO

The same is true of erroneous pinpoint, ERRPP BO/AO

He had one enemy unit located to nearest square before message and still does, NS B1/A1

Line 2 - This is a packed octal representation of the intelligence level at which he has the Red units. By reading the I2 array from right to left, it is determined he knows in which square Red 22 is located.

Line 3 - This is also a packed octal representation indicating which units are in line of sight, are known to be dead, and against which surveillance is to be conducted.

At time 3.2646 Blue 35 arrived at his first pop-up point (0656) at an altitude of 40 feet. At 3.2871 he received a new mission (order 95) which told him to pop-up until he gained line of sight to square 3157; the 190 in his location shows the altitude to which he will have to go to get the required line of sight. At 3.4365, he is told to stay for ½ minute or to fire one round (order 96). He had four targets (Red 1, 3, 19, and 22) pinpointed at 3.6064. Although he had the target for which he was called (R22) pinpointed, he selected a tank (R19), which is higher on his target priority list, as a target. Blue 35 fired a HAW at Red 19 at a range of 2419 meters at time 3.6653; the time of flight of the round is 0.2061. The position disclosure message at the same time shows what Red units saw Blue fire; there were none. After 0.2061 minutes (time 3.8713), the round impacted. There are three possible outcomes of this impact and are indicated as shown:

Firer fired on erroneously pinpointed target - P(H)0.00 P(K)0.00
Firer fired on pinpointed target and missed - P(H)0.nn P(K)0.00
Firer fired on pinpointed target and hit - P(H)0.nn P(K)0.nn

In this instance Blue 35 missed. Had B35 scored a kill, the Impact (target) message for Red 19 would have shown a difference in vehicles and/or troops before and after. After waiting 0.1 minutes to assess his firing, Blue 35 receives the order to drop to treetop level and move to the next pop-up point (order 97). At 4.7747 Blue 35 had popped up, pinpointed Red 22 and decided to engage it. The impact messages for time 6,1694 show that he was successful this time. Blue 35 got back to his staging area at 7.1663 and landed; at 7.1665 he returned to "On Call" status (order 93).

Blue 36 responded to Blue 49's call for artillery at the same time that Blue 35 started on his mission; this response is shown in the last six lines of Fig. 85. Blue 36 fired at time 3.2854. The rounds impacted in square 3157 at 3.7075. Since weapon number 7 has a 300 × 300 impact area, its effects are assessed against all targets in squares 3056, 3156, 3256, 3057, 3157, 3257, 3058, 3158, and 3258. As can be seen by the messages, there were four Red targets in the impact area.

The duel between Blue 35 and Red 28 (Fig. 86) shows the result of killing the firer during the flight of a guided missile. Blue 35 fired a HAW at Red 28 at time 7.7678 with a time of flight of 0.1965 minutes. Red 28 fired at Blue 35 at 7.8535 with a time of flight of 0.1067 minutes. Blue 35 died at 7.9602 before his round impacted at 7.9643. A check of the messages for that time period shows that the HAW did not impact. Had the situation been reversed and the HAW impacted first, the rounds from R28 would still have killed B35.

A message similar to the one below is printed at the end of the battle history.

BATTLE TERMINATED, MAXIMUM TIME 20 EXCEEDED

COMPUTER TIME THIS REPLICATION 342.465 SECONDS

LAST RANDOM NO. THIS REPLICATION 2762389485

```
RED   28   7.7109  28,49,  0  INTELLIGENCE ENUM DEAD  0 LOS 28 IN SENRG  2 NKON 28 PP 0 0/A 1 ENRPP 0 0/A 1 NS 0 2/A 3
                                I2= 0000202100000030  I3= 0000200000000000  I4= 0000200000000000
                              LOS= 0000316320730357  ENUM CEAC= 0000000000000000   SURV= 0017777777777777
RED   28   7.7112  28,49,  0  TARGET SELECT  WPN NO. 16 TGT NO. 35 TGT LOC  6,56,  0 AIM TIME  .1423 AMMO NO. 1

BLUE  35   7.7678   6,56,140  FIRING         WPN NO. 36 TGT NO. 28 RANGE  2309. M   TIME OF FLIGHT  .1965
BLUE  35   7.7678   6,56,140  POSITION DISCLOSURE, I1 TO I3= 0000100000000000 I3 TO I4= 0000000000000000

RED   28   7.8535  28,49,  0  FIRING         WPN NO. 16 TGT NO. 35 RANGE  2309. M   TIME OF FLIGHT  .1067 RELOAD TIME  .0576
RED   28   7.8535  28,49,  0  POSITION DISCLOSURE, I1 TO I3= 0000014000000002 I3 TO I4= 0000000000000000

RED   28   7.8845  28,49,  0  MOVE SELECT  FROM 28,49,  0  TO 27,49,  0   TIME CEN TO BOUND, .1836     VEL =  4.537

RED   28   7.9602  28,49,  0  IMPACT(FIRER)  WPN NO. 16 TGT NO. 35 P(H)  .33 P(K)  .33 NO. OF ROUNDS 12 NO. OF HITS  3
BLUE  35   7.9602   6,56,  0  IMPACT(TARGET) WPN NO. 16 FIRER NO. 28 VEHICLES BEFORE  1 AFTER  0 TROOPS BEFORE  3 AFTER  0

RED   22   7.9607  26,52,  0  RESPONSE       TOTAL RNDS   300, TOTAL DF    0, TOTAL INDF  300. STATUS PARTIAL INDF
BLUE  31   7.9663  15,39,  0  FIRING         WPN NO. 45 TGT NO. 11 RANGE  1476. M   TIME OF FLIGHT  .0610 RELOAD TIME  .3984
BLUE  31   7.9663  15,39,  0  POSITION DISCLOSURE, I1 TO I3= 0000000000000000 I3 TO I4= 0000000000000000
BLUE  13   7.9675  15,41,  0  NEW MISSION, ORDER NUMBER=  74   OCTAL  0000011210003112004S
BLUE  13   7.9678  15,41,  0  TARGET SELECT  WPN NO. 44 TGT NO. 11 TGT LOC 28,46,  0 REAIM TIME  .5000 AMMO NO. 1
```

Fig. 86 - Example of Firer Being Killed During Flight of a Guided Missile

Appendix A

INPUT LISTING

This appendix contains a listing of all inputs used in the sample game. The input form can be identified by the header card and/or the identification in cols 73 through 76; the format can be determined by consulting the appropriate figure in the main body of Volume II. The LAND deck is in coded form; a discussion of how it is organized and interpreted is contained in Part III, Output.

```
9901
        100   100    100  2200 2200   40  44     7   7    010       100     GAME
                                                                            WPN1
01  100 4700 302500602500600    020005  110 300 100  1      HEX         1 9  WPN1   2
02  500 5500 302500602500600    020005  250 300 100  1      HEX         110  WPN1   3
03  460 5700 302500602500600    020005  237 300 300  1      HEX         112  WPN1   4
04  200153001602500602500600    020005  238 300 300  1    ICMX   HEX  112  WPN1   5
05  200122001602500602500600    020005  222 300 300  1    ICMX   HEX  115  WPN1   6
06  500180001302500602500600    020005  222 300 300  1    ICMX   HEX  115  WPN1   7
07  500168001302500602500600    020005  180 300 300  1    ICMX   HEX  115  WPN1   8
13    0 3000 101700401500400    028007 1500          30   APDS HEATX  112  WPN1   9
14    0 3000 101700401500400    028007 1500          30   HVAP HEATX  113  WPN1  10
15    0 2000 101700401500400    020003  600          30   HEAT   HEX  110  WPN1  11
16    0 3000 201300200400200    005002  350         12X     HEX     12 1  WPN1  12
17    0 2500 201300200400200    005002  350          12     HEX   AP  112  WPN1  13
18    0 1500 102000401000200    010002  200          05     HEX       1 3  WPN1  14
19    0 3000 102000401000200    010002  250          10     HEX       1 3  WPN1  15
35   75 3000 201200304000900    033007  190        20XX  HEAT          112  WPN1  16
36   75 3000 100600104000100    020002  190        20XX  HEAT          112  WPN1  17
37  500 3000 100700401500400    050012  190        20XX  HEAT          110  WPN1  18
38  500 3000 100700401500400    050012  190        20XX  HEAT          110  WPN1  19
39  500 3000 100700401500400    010002  190        20XX  HEAT          110  WPN1  20
40   50 2000 100200302200500    022005  178        15XX  HEAT          110  WPN1  21
41   50 1000 100200302200500    022005   89        15XX  HEAT          110  WPN1  22
42   25  600 100200301700400    010002  350           5  HEAT        1 7  WPN1  23
43   25  550 100200301000200    025006  170           5  HEAT        1 6  WPN1  24
44    0 1700 101300405000200    040001  400           2    AP        2 6  WPN1  25
45    0 1700 100400200300100    040001  400           2    AP        2 6  WPN1  26
46    0 2000 101300400500200    040001  450           3    AP        2 7  WPN1  27
47    0 1500 100400100300100    040001  375           2    AP        2 6  WPN1  28
48    0 1000 100400200300100    040001  450           2  BALL        3 5  WPN1  29
49    0 1000 100400200300100    040001  450           2  BALL        3 5  WPN1  30
50    0 1000 100400200300100    040001  450           2  BALL        3 5  WPN1  31
51    0 1100 100500200500200    040001  450           2  BALL        3 5  WPN1  32
52    0  450 100500200500200    040001  650           1  BALL        1 1  WPN1  33
53  100 3800 101700401700400    030007  675         15X    HE        112  WPN1  34
                                                                            WPN2
131 24 71 30 88 31 92 39 115 21 62 26 77 27 80 34 100 11 16 14 20 36 45 41    2   1
132 16 25 21 32 19 30 25 40 14 22 18 28 17 26 22 34 09 12 12 15 17 21 24    2   2
133 08 06 07 07 07 07 08 08 05 05 06 06 06 06 07 07 05 05 06 06 05 06 06    2   3
141 38 92 47 115 49 119 62 150 33 80 41 100 43 104 54 130 15 15 19 19 37 41 46 512  4
142 21 63 25 80 25 76 30 95 18 55 22 69 22 66 26 80 12 13 15 16 22 31 28 392  5
143 06 05 07 06 07 06 08 07 05 04 06 05 06 05 07 06 05 05 06 06 05 05 06 062  6
151 84 84 106 106 101 101 36 36 70 70 88 88 91 91 115 115 38 38 47 47 57 57 71 712  7
152 34 34 42 42 41 41 50 50 28 28 35 35 34 34 42 42 20 20 25 25 24 24 30 302  8
153 07 07 09 09 09 09 11 11 06 06 08 08 07 07 09 09 06 06 07 07 06 06 07 072  9
161 51    64    51    64    51    64    51    64    51    64    51    64    2  10
162 38    48    38    48    38    48    38    48    38    48    38    48    2  11
163 08    10    08    10    08    10    08    10    08    10    08    10    2  12
171 50 50 63 63 65 65 81 81 65 65 81 81 65 65 81 81 35 35 44 44 35 35 44 442  13
172 36 36 45 45 47 47 59 59 47 47 59 59 47 47 59 59 25 25 31 31 25 25 31 312  14
173 08 08 10 10 08 08 10 10 08 08 10 10 08 08 10 10 07 07 09 09 07 07 09 092  15
181 74    74    74    74    74    74    74    74    74    74    74    74    2  16
182 50    50    50    50    50    50    50    50    50    50    50    50    2  17
183 04    04    04    04    04    04    04    04    04    04    04    04    2  18
191 116   116   116   116   116   116   116   116   116   116   116   116   2  19
```

192	80	80	80	80	80	80	80	80	80	80	80	60	2	20
193	04	04	04	04	04	04	04	04	04	04	04	04	2	21
351	10	12	12	16	08	10	10	13	08	10	08	10	2	22
352	10	12	12	15	08	10	10	12	08	10	08	10	2	23
353	10	12	12	14	08	10	10	12	08	10	08	10	2	24
361	09	11	11	13	09	11	11	13	09	11	09	11	2	25
362	08	10	10	12	08	10	10	12	08	10	08	10	2	26
363	08	10	10	12	08	10	10	12	08	10	08	10	2	27
371	10	12	12	16	08	10	10	13	08	10	08	10	2	28
372	10	12	12	15	08	10	10	12	08	10	08	10	2	29
373	10	12	12	14	08	10	10	12	08	10	08	10	2	30
381	10	12	12	16	08	10	10	13	08	10	08	10	2	31
382	10	12	12	15	08	10	10	12	08	10	08	10	2	32
383	10	12	12	14	08	10	10	12	08	10	08	10	2	33
391	10	12	12	16	08	10	10	13	08	10	08	10	2	34
392	10	12	12	15	08	10	10	12	08	10	08	10	2	35
393	10	12	12	14	08	10	10	12	08	10	08	10	2	36
401	10	12	12	16	08	10	10	13	08	10	08	10	2	37
402	10	12	12	15	08	10	10	12	08	10	08	10	2	38
403	10	12	12	14	08	10	10	12	08	10	08	10	2	39
411	10	12	12	16	08	10	10	13	08	10	08	10	2	40
412	10	12	12	15	08	10	10	12	08	10	08	10	2	42
413	10	12	12	14	08	10	10	12	08	10	08	10	2	42
421	60	75	78	98	50	63	65	82	30	37	46	58	2	43
422	28	35	34	42	23	29	28	35	17	21	21	26	2	44
423	12	16	15	19	10	13	12	16	10	13	10	13	2	45
431	60	75	78	98	50	63	65	82	30	37	46	58	2	46
432	28	35	34	42	23	29	28	35	17	21	21	26	2	47
433	12	16	15	19	10	13	12	16	10	13	10	13	2	48
441	35	43	42	53	29	36	35	44	29	36	29	36	2	49
442	26	32	31	37	22	27	26	31	22	27	22	27	2	50
443	11	13	13	14	09	11	11	12	09	11	09	11	2	51
451	35	43	42	53	29	36	35	44	29	36	29	36	2	52
452	26	32	31	37	22	27	26	31	22	27	22	27	2	53
452	26	32	31	37	22	27	26	31	22	27	22	27	2	53
453	11	13	13	14	09	11	11	12	09	11	09	11	2	54
461	35	43	42	53	29	36	35	44	29	36	29	36	2	55
462	26	32	31	37	22	27	26	31	22	27	22	27	2	56
463	11	13	13	14	09	11	11	12	09	11	09	11	2	57
471	35	43	42	53	29	36	35	44	29	36	29	36	2	58
472	26	32	31	37	22	27	26	31	22	27	22	27	2	59
473	11	13	13	14	09	11	11	12	09	11	09	11	2	60
481	32	39	38	48	27	33	32	40	27	33	27	33	2	61
482	23	28	27	32	19	24	23	27	19	24	19	24	2	62
483	09	11	11	13	07	09	09	11	07	09	07	09	2	63
491	32	39	38	48	27	33	32	40	27	33	27	33	2	64
492	23	28	27	32	19	24	23	27	19	24	19	24	2	65
493	09	11	11	13	07	09	09	11	07	09	07	09	2	66
501	32	39	38	48	27	33	32	40	27	33	27	33	2	67
502	23	28	27	32	19	24	23	27	19	24	19	24	2	68
503	09	11	11	13	07	09	09	11	07	09	07	09	2	69
511	36	45	47	59	36	45	47	59	36	45	36	45	2	70
512	25	31	30	39	25	31	30	39	25	31	25	31	2	71
513	10	13	12	15	10	13	12	15	10	13	10	13	2	72
521	20	24	24	27	16	20	21	25	16	20	16	20	2	73
522	14	15	15	18	11	14	14	17	11	14	11	14	2	74
523	05	06	06	08	04	05	05	06	04	05	04	05	2	75

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531|50   150    14     18   150   150    14     18   150   150   150   150   2  76
532|50   150    14     18   150   150    14     18   150   150   150   150   2  77
533|50   150    14     18   150   150    14     18   150   150   150   150   2  78

 111          X  X  X  X                                                    WPN3
 211             X  X                                                       WPN3   1
 311          X  X  X  X                                                    WPN3   2
 411          X  X  X  X                                                    WPN3   3
 511          X  X                                                          WPN3   4
 621          X  X  X  X                                                    WPN3   5
 721          X  X  X  X                                                    WPN3   6
1211          X95X95X95X95                                                  WPN3   7
 112X59X65X48    05                                                         WPN3   8
 122 50 61 48   X05                                                         WPN3   9
 212 53 49X80    10 03 03                                                   WPN3  10
 222X71X86 80   X10                                                         WPN3  11
 312 53 56X80    25 03 03                                                   WPN3  12
 322X71X99 80   X25                                                         WPN3  13
 412 53 56X80    25 03 03                                                   WPN3  14
 422X71X99 80   X25                                                         WPN3  15
 512     56X80    25                                                        WPN3  16
 522    X99 80   X25                                                        WPN3  17
 612 99 99X99    35 20 20                                                   WPN3  18
 622X99X99 99   X35                                                         WPN3  19
 712 99 99 99   X99 99 99                                                   WPN3  20
 722X99X99X99    99                                                         WPN3  21
1012          X31                                                           WPN3  22
1212 99 83 89    99 90 90                                                   WPN3  23
1222 99 83 89                                                               WPN3  24
 113 71 71 61 61 61 52 52 38 39       03                                    WPN3  25
 213 82 82          43 43 33    08 20                                       WPN3  26
 313 89 89 88 8A A8 82 82 58 64 24 60 30 24                                 WPN3  27
 413 89 89 88 8A 88 82 82 58 64 24 60 30 24                                 WPN3  28
 513       88 8A 88          64       30 24                                 WPN3  29
 613 99 99 99 99 99 99 99 99 99 15 15 15 15 10 10 10 10 05                  WPN3  30
 713 99 99 99 99 99 99 99 99 99 99 99 99 99 70 70 70 70 70                  WPN3  31
1013                                                        95              WPN3  32
1213 95 95 73 73 73 99 99 99 95 99 99 99                    70              WPN3  33
                                                                            WPN3  34

 110202030202030                                                            WPN4
 210304050305070                                                            WPN4   1
 310202030202030                                                            WPN4   2
 410202030202030400300022002200022                                          WPN4   3
 420202030202030                                                            WPN4   4
 510203040304050035002800280028                                             WPN4   5
 520203040304050                                                            WPN4   6
 610203040404050038003000300030                                             WPN4   7
 620203040404050                                                            WPN4   8
 710204050405060120009200920092                                             WPN4   9
 720204050405060                                                            WPN4  10
1310202020202020                                                            WPN4  11
1320204050507080                                                            WPN4  12
1420204050507080                                                            WPN4  13
1510203030304050                                                            WPN4  14
1520203030304050                                                            WPN4  15
1710202030304050                                                            WPN4  16
1720202020202020                                                            WPN4  17
                                                                            WPN4  18
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18102020202020202                                                         WPN4  19
19102020202020202                                                         WPN4  20
                                                                          WPN5
B13 1 2 4 512    4 5 2 112    2 5 1 412                                   WPN5   2
B2811 5 8 4 2 311 8 5 2 3 4 8 411 5 2 3                                   WPN5   3
B2911 8 5 4 3 211 5 4 8 2 311 4 5 2 3 8                                   WPN5   4
B35 5 4 3 112 2 1 4 5 3 212 4 5 1 2 312                                   WPN5   5
B3612 1 2 4 5  12 4 5 2 1  12 2 5 1 4                                     WPN5   5
B40 1 4 5 3 212 4 5 1 2 312 5 4 3 112 2                                   WPN5   7
B41 4 5 1 2 312 5 4 3 112 2 1 4 5 3 212                                   WPN5   8
B42 1 2 3        2 3 1        3 1 2 3 212                                 WPN5   9
B44 2 31112 8    8 2 31211   11 8 2 312                                   WPN5  10
C45 8 2 31211    11 8 2 312   2 31112 8                                   WPN5  11
348 811 5        11 8 5       8 511                                       WPN5  12
B5111 8 5        11 5 8       811 5                                       WPN5  13
B52 811          11 8         811                                         WPN5  14
R14 1 2 4 6 7    4 6 7 1 2    4 1 6 7 2                                   WPN5  16
R15 4 6 7 1 2    1 2 4 6 7    4 1 6 7 2                                   WPN5  17
R1610            10           10                                          WPN5  18
R17 4 6 7 2 8    6 7 4 8 2    8 4 6 7 2                                   WPN5  19
R37 4 6 7 1 2    1 4 6 7 2    1 2 6 7 4                                   WPN5  20
R38 1 4 6 7 2    1 2 6 7 4    4 6 7 1 2                                   WPN5  21
R39 1 2 6 7 4    4 6 7 1 2    1 4 6 7 2                                   WPN5  22
R43 1 7 2 4 6    7 2 1 4 6    2 1 7 4 6                                   WPN5  23
R46 7 6 4 2 8    4 2 6 7 8    6 7 2 4 8                                   WPN5  24
R47 4 2 6 7 8    6 7 2 4 8    7 6 4 2 8                                   WPN5  25
R48 8 7 6 4      7 6 4 8      6 4 8 7                                     WPN5  26
R49 8 7 6 4      6 4 8 7      4 8 7 6                                     WPN5  27
R50 8 7 6 4      4 8 7 6      7 6 4 8                                     WPN5  28
R52 8 7 6 4      8 6 4 7      8 4 6 7                                     WPN5  29
R5310            10           10                                          WPN5  30
                                                                          SENS
5150 1001.84E-65.11E-62.04E-59.39E-7   3.33E-77.50E-75.32E-62.45E-7       SENS   1
5250 1001.84E-65.11E-62.04E-54.31E-7   3.33E-77.50E-75.32E-62.45E-7       SENS   2
5325  171.84E-65.11E-62.04E-51.92E-7   3.33E-77.50E-75.32E-62.45E-7       SENS   3
5425  341.84E-65.11E-62.04E-59.39E-7   3.33E-77.50E-75.32E-62.45E-7       SENS   4
                                                                          SENP
511              91815105898658209079410294815105                         SENP   1
521              93815105908257209277360293815105                         SENP   2
531              47474747474747474747474747474747                         SENP   3
541              71675004777257177167500477725717                         SENP   4
512              03030402040406050202030202030402                         SENP   5
522              02020202030304040202020202020202                         SENP   6
532              02020202020202020202020202020202                         SENP   7
542              02020202020202020202020202020202                         SENP   8
513              03124090020930680316529502124090                         SENP   9
523              04164692031235700520619504164692                         SENP  10
533              50505050505050505050505050505050                         SENP  11
543              26304793202540802630479320254080                         SENP  12
514              40556580304050603545557025354555                         SENP  13
524              50607080405055654050607530405060                         SENP  14
534              70808590708085907080859070808590                         SENP  15
544              90909090909090909090909090909090                         SENP  16
515              00000000000000000000000000000000                         SENP  17
525              00000000000000000000000000000000                         SENP  18
535              00000000000000000000000000000000                         SENP  19
545              00000000000000000000000000000000                         SENP  20
```

```
516                 02020202020202070202020202020202                                SENP  21
526                 02020202020202020202020202020202                                SENP  22
536                 02020202020202020202020202020202                                SENP  23
546                 02020202020202020202020202020202                                SENP  24
517                 65758590556075856575859055607585                                SENP  25
527                 80859095707580908085909570758090                                SENP  26
537                 80859095808590958085909580859095                                SENP  27
547                 90929599808590959092959980859095                                SENP  28
                                                                                    SENF
511                   0508152010153040                                              SENF   1
521                   0508152010153040                                              SENF   2
531                   2025334525303850                                              SENF   3
541                   2025334525303850                                              SENF   4
512                   2025303540506070                                              SENF   5
522                   3033353860657075                                              SENF   6
532                   4062637540526375                                              SENF   7
542                   3036425040526375                                              SENF   8
                                                                                    MOB1
80        99909925                                                                  MOB1   2
81        99809950                                                                  MOB1   3
85        99999990                                                                  MOB1   4
R0        99909925                                                                  MOB1   5
81        99709950                                                                  MOB1   6
R2        99709940                                                                  MOB1   7
                                                                                    MOB2
01   07   20   40                        13   10   07   14   12   10               MOB2   1
11   07   20   50                   05   45   32   22   67   67   67               MOB2   2
21   07   20   60                   05   45   32   22   67   67   67               MOB2   3
02 09   07   05   10   08   07         05   04   02   06   05   04               MOB2   4
12 32   24   17   58   58   58         28   21   12   35   35   35               MOB2   5
22 50   34   17   58   58   58         28   21   12   35   35   35               MOB2   6
03 15   11   08   17   14   12         12   09   05   17   14   12               MOB2   7
13 32   24   17   65   65              28   21   12   40   40   40               MOB2   8
23 32   24   17   65   65              28   21   12   40   40   40               MOB2   9
                                                                                    MOB3
  505  005   006  4006                                                            MOB3   1
                                                                                    MOB4
5  85  55  25  20  40  75        20    40    60    35    12                       MOB4   1
                                                                                    MOB5
  20  50 150 200 300 400                                                         MOB5   1
                                                                                    MOB6
 02 05 10 15 25 35 45 25 50100200350500600                                      MOB6   1
                                                                                    UNT1
149495052554    3435363738394O   3652 251 2400XX 7 6 5 412 3 1 4 5 3 2 6UNT1   1
1504951          1 2 3 4 7253436 152 151 1100XX 1 3 4 5 712 1 3 4 5 7 2UNT1   2
15150            5 6 826343739405 52 151 1100XX 3 1 7 6 4 5 3 1 5 4 7 2UNT1   3
15249            9101112153233355 52 151 1100 X                1 4 3 5 6 2UNT1   4
15349           2930311314163530295 2 251 2100XX 1 3 4 512 7 3 1 5 4 7 2UNT1   5
1544955         1718192023273537 1752 151 1100XX 3 7 1 6 5 4 5 1 3 7 4 2UNT1   6
15554           2122242835383940 2152 151 1100XX 7 6 1 3 4 5 1 3 4 5 7 2UNT1   7
24949505254     2526304041424344 052 251 2400X  3 5 7 2 1                      UNT1   8
2504951          1 2 3 422313241 152 251 2100X  5 3 7 2 1                      UNT1   9
25150            5 6192733414455 2 251 2100X  3 7 5 2 1                        UNT1  10
2524953          7 8 9102334354 2 752 251 2100X  5 7 3 2 1                     UNT1  11
25352           1112202836424455 2 251 2100X  3 5 7 2 1                        UNT1  12
2544955         1314151624373843 352 251 2100X  5 7 3 2 1                      UNT1  13
25554           1718212939434455 2 251 2100_  7 3 5 2 1                        UNT1  14
```

```
B0144 1 210
B0242 2   8      50 1 300     52 7 980
B0344 1 210
B0442 2   8      50 1 300     52 7 980
B0544 1 210
B0642 2   8      50 1 300     52 7 980
B0741 1   5
B0841 1   5
B0944 1 210
B1042 2   8      50 1 300     52 7 980
B1144 1 210
B1242 2   8      50 1 300     52 7 980
B1344 1 210
B1442 2   8      50 1 300     52 7 980
B1541 1   5
B1641 1   5
B1744 1 210
B1842 2   8      50 1 300     52 7 980
B1944 1 210
B2042 2   8      50 1 300     52 7 980
B2144 1 210
B2242 2   8      50 1 300     52 7 980
B2341 1   5
B2441 1   5
B2535 1  10      44 1 180
B2635 1  10      44 1 180
B2735 1  10      44 1 180
B2835 1  10      44 1 180
B2913 1  23  2345 1 126     48 1 450
B3013 1  23  2345 1 126     48 1 450
B3113 1  23  2345 1 126     48 1 450
B3213 1  23  2345 1 126     48 1 450
B3313 1  23  2345 1 126     48 1 450
B3436 1   8    19 1  25     51 1 200
B3536 1   8    19 1  25     51 1 200
B36 7 4 960 240
037 6 61080 720
038 6 61080 720
039 2 4 624
B40 1 3 465
RC 46 4 840      49 41680
RC743 3  12      50 3 300     52233220
RC 46 3 630      49 31260
R 743 3  12      50 3 300     52152100
R 46 3 630       49 31260
RD643 3  12      50 3 300     52152100
RD 46 4 840      49 41680
RD943 3  12      50 3 300     52233220
RD946 3 630      49 31260
R1043 3  12      50 3 300     52152100
R1146 3 630      49 31260
R1243 3  12      50 3 300     52152100
R1346 4 840      49 41680
R1443 3  12      50 3 300     52233220
R1546 3 630      49 31260
R1643 3  12      50 3 300     52152100
```

```
                                  UNT2
11 1 1   15   2x     UNT2   2
10       1500  1     UNT2   3
11 1 1   15   2x     UNT2   4
10       1500  1     UNT2   5
11 1 1   15   2x     UNT2   6
10       1500  1     UNT2   7
 3 1 1    5   1     UNT2   8
 3 1 1    5   1     UNT2   9
11 1 1   15   2x     UNT2  10
10       1500  1     UNT2  11
11 1 1   15   2x     UNT2  12
10       1500  1     UNT2  13
11 1 1   15   2x     UNT2  14
10       1500  1     UNT2  15
 3 1 1    5   1     UNT2  16
 3 1 1    5   1     UNT2  17
11 1 1   15   2x     UNT2  18
10       1500  1     UNT2  19
11 1 1   15   2x     UNT2  20
10       1500  1     UNT2  21
11 1 1   15   2x     UNT2  22
10       1500  1     UNT2  23
 3 1 1    5   1     UNT2  24
 3 1 1    5   1     UNT2  25
 4 1 4   15   2     UNT2  26
 4 1 4   15   2     UNT2  27
 4 1 4   15   2     UNT2  28
 4 1 4   15   2     UNT2  29
 3 1 3   24   3    XUNT2  30
 3 1 3   24   3    XUNT2  31
 3 1 3   24   3    XUNT2  32
 3 1 3   24   3    XUNT2  33
 3 1 3   .24  3    XUNT2  34
 3 1 3   12   1     UNT2  35
 3 1 3   12   1     UNT2  36
40 5 5 4000  1     UNT2  37
40 7 7 4500  1     UNT2  38
40 7 7 4500  1     UNT2  39
33 5 5 1350  1     UNT2  40
24 4 4  700  1     UNT2  41
40 4 8 2000  2x    UNT2  42
32      10000  1     UNT2  43
30 3 6 1500  2x    UNT2  44
24      10000  1     UNT2  45
30 3 6 1500  2x    UNT2  46
24      10000  1     UNT2  47
40 4 8 2000  2x    UNT2  48
32      10000  1     UNT2  49
30 3 6 1500  2x    UNT2  50
24      10000  1     UNT2  51
30 3 6 1500  2x    UNT2  52
24      10000  1     UNT2  53
40 4 8 2000  2x    UNT2  54
32      10000  1     UNT2  55
30 3 6 1500  2x    UNT2  56
24      10000  1     UNT2  57
```

```
R1746 3 630      49 31260
R1843 3  12      50 3 300     52152100
R1914 3  64   9647 3 150     48 3 750
R2014 4  72   2847 4 200     48 41000
R2114 3  64   9647 3 150     48 3 750
R2238 1   8      46 1  25
R2338 1   8      46 1  25
R2438 1   8      46 1  25
R2537 1  10      46 1  25
R2637 1  10      46 1  25
R2716 1 180      17 1  20
R2816 1 180      17 1  20
R2916 1 180      17 1  20
R3016 1 180      17 1  20
R3153 1   5
R3253 1   5
R3353 1   5
R3453 1   5
R3553 1   5
R3653 1   5
R3753 1   5
R3853 1   5
R3953 1   5
R40 5 6 250 300
R41 4 6 250 300
R42 4 6 250 300
R43 4 6 250 300
R44 3 6 300

B01 2 34135211   50
B02 8 790151     50
B03 2 34135211   50
B04 8 790151     50
B05 2 34135211   51
B06 8 790151     51
B07 7 681252     50
B08 7 681252     51
B09 2 34135211   52
B10 8 790151     52
B11 2 34135211   52
B12 8 790151     52
B13 2 34135211   53
B14 8 790151     53
B15 7 681252     52
B16 7 681252     53
B17 2 34135211   54
B18 8 790151     54
B19 2 34135211   54
B20 8 790151     54
B21 2 34135211   55
B22 8 790151     55
B23 7 681252     54
B24 7 681252     55
B25 4 541352     50
B26 4 541352     51
B27 4 541352     54
B28 4 541352     55

30 3 6 1500    2X      UNT2  58
24     10000   1       UNT2  59
 9 3 9 3000    3       UNT2  60
12 4 2 4000    3       UNT2  61
 9 3 9 3000    3       UNT2  62
 3 1 3   20    2       UNT2  63
 3 1 3   20    2       UNT2  64
 3 1 3   20    2       UNT2  65
 2 1 1   10    1       UNT2  66
 2 1 1   10    1       UNT2  67
 3 1 3   15    2       UNT2  68
 3 1 3   15    2       UNT2  69
 3 1 3   15    2       UNT2  70
 3 1 3   15    2       UNT2  71
 1 1 1    5    1       UNT2  72
 1 1 1    5    1       UNT2  73
 1 1 1    5    1       UNT2  74
 1 1 1    5    1       UNT2  75
 1 1 1    5    1       UNT2  76
 1 1 1    5    1       UNT2  77
 1 1 1    5    1       UNT2  78
 1 1 1    5    1       UNT2  79
 1 1 1    5    1       UNT2  80
63 6     5000  1       UNT2  81
63 6     5000  1       UNT2  82
63 6     5000  1       UNT2  83
63 6     5000  1       UNT2  84
50 6     5000  1       UNT2  85
                         UNT3
                         UNT3   2
                         UNT3   3
                         UNT3   4
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                         UNT3  28
                         UNT3  29
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B29 1 101452      53
B30 1 101452      53
B31 1 101452      53
B32 1 101452      52
B33 1 101452      52
B34|0|055555|4    49
B35|0|055555|     49
B36|6 411351      49
B37|6 411351      49
B38|6 411351      49
B39|6 411351   5n49
B40|6 411351      49
R01 2 331352|5    50
R02 8 790151      50
R03 2 331352|5    50
R04 8 790151      50
R05 2 331352|5    5:
R06 8 790151      51
R07 2 331352|5    52
R08 8 790151      52
R09 2 331352|5    52
R10 8 790151      52
R11 2 331352|5    53
R12 8 790151      53
R13 2 331352|5    54
R14 8 790151      54
R15 2 331352|5    54
R16 8 790151      54
R17 2 331352|5    55
R18 8 790151      55
R19 1 121452      51
R20 1 121452      53
R21 1 121452      55
R22 4 442352      50
R23 4 442352      52
R24 4 442352      54
R25 5 682252      49
R26 5 682252      49
R27|2 431354      51
R28|2 431354      53
R29|2 431354      55
R30|2 431354      49
R31|1 681251      50
R32|1 681251      50
R33|1 681251      51
R34|1 681251      52
R35|1 681251      52
R36|1 681251      53
R37|1 681251      54
R38|1 681251      54
R39|1 681251      55
R40|6 642251      49
R41|6 642251      49
R42|6 642251      49
R43|6 642251      49
R44|6 642251      49
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UNT3  30
UNT3  31
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UNT3  81
UNT3  82
UNT3  83
UNT3  84
UNT3  85
UNT4
```

```
   1000 2000
01          SSSSSSS   M SSSSSSMM   M MMMMMMMM   I M
02          IMMMMMS   I MIMMMMMM   I MIIIIIII   I I
03          SSSSSSS   I SSSSSSSM   I MSSSSSSI   I I
04          SSSSIII   I ISSSSIII   I ISSSSIII   I I
05          SISSSSI   I ISISSSSI   I ISISSSSI   I I
0606        SSSSIII   I ISSSSIII   I IIIIIIII   I I
07          SSSSIII   I IIIIIIII   I IIIIIIII   I I
08          MMSSSSS   I SIIIIIII   I IIIIIIII   I I
10          SSSSISS   I SSSSSISS   I ISSSSISS   I I
11          IIIIIII   S IIIIIIII   S IIIIIIII   M I
12          IIMMMMS   S SIIMMMMM   S MIIIIIII   M I
16          MSSSSSS   I SMSSSSSS   I SMSSSSSS   I S

   150
B 400  50 210 400   60 225   70 275 100 425   12  12
R 400  50 210 400   60 225   70 275 100 425   12  12

B                        XXXX
R                      XXX

1133420440307461355523746

909090808080999     99  99

  1STAY INTL  100
  2DISM
  3NSTP RATE    7 SQRE 1247 KIND    0 PROR    0
  4STAY INTL   50
  5SKIP BACK    1 UNTL   06 SQRE 1247 EXIT
  6REMO
  7NSTP RATE    7 SQRE 0946 KIND    0 PROR    0
  8DISM
  9STAY TIME 5000 FIRE    1 KIND    4 PROR    4
 10SKIP BACK    1 UNCD
 15STAY INTL  100
 16DISM
 17STAY INTL   50
 18SKIP FORW    2 ENUN    3 RNGE 1000
 19SKIP BACK    2 UNCD
 20NSTP RATE    7 SQRE 1247 KIND    0 PROR    0
 21REMO
 22NSTP RATE    7 SQRE 0946 KIND    0 PROR    0
 23DISM
 24STAY TIME 5000 FIRE    1 KIND    4 PROR    4
 25SKIP BACK    1 UNCD
 30STAY INTL  100
 31STAY INTL   50 FIRE    1 KIND    4 PROR    4
 32SKIP BACK    1 UNTL   06 SQRE 1247 EXIT
 33STAY INTL   50 FIRE    1 KIND    4 PROR    4
 34NSTP RATE    7 SQRE 0946 KIND    0 PROR    0
 35STAY TIME 5000 FIRE    1 KIND    4 PROR    5
 36SKIP BACK    1 UNCD
 40STAY INTL  100
 41DISM
 42STAY TIME  500 FIRE    1 KIND    4 PROR    4
 43SKIP BACK    1 TIME  500
```

```
UNT4    1
UNT4    2
UNT4    3
UNT4    4
UNT4    5
UNT4    6
UNT4    7
UNT4    8
UNT4    9
UNT4   10
UNT4   11
UNT4   12
UNT4   13
UNT5
UNT5    1
UNT5    2
UNT5    3
UNT6
UNT6    1
UNT6    2
UNT7
UNT7    1
UNT8
UNT8    1
UNT9
UNT91001
UNT91002
UNT91003
UNT91004
UNT91005
UNT91006
UNT91007
UNT91008
UNT91009
UNT91010
UNT91015
UNT91016
UNT91017
UNT91018
UNT91019
UNT91020
UNT91021
UNT91022
UNT91023
UNT91024
UNT91025
UNT91030
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UNT91033
UNT91034
UNT91035
UNT91036
UNT91040
UNT91041
UNT91042
UNT91043
```

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44STAY TIME 1000 FIRE    1 KIND    4 PROR    5                          UNT91044
45SKIP BACK    1 TIME 1000                                               UNT91045
46STAY TIME 5000 FIRE    1 KIND    4 PROR    6                          UNT91046
47SKIP BACK    1 UNCD                                                    UNT91047
48STAY INTL  100                                                         UNT91048
49SKIP BACK    7 UNCD                                                    UNT91049
55STAY INTL  100                                                         UNT91055
56DISM                                                                   UNT91056
57STAY TIME  500 FIRE    1 KIND    4 PROR    5                          UNT91057
58SKIP BACK    1 TIME  500                                               UNT91058
59STAY TIME 1000 FIRE    1 KIND    4 PROR    4                          UNT91059
60SKIP BACK    1 TIME 1000                                               UNT91060
61STAY TIME 5000 FIRE    1 KIND    4 PROR    6                          UNT91061
62SKIP BACK    1 UNCD                                                    UNT91062
63STAY INTL  100                                                         UNT91063
64SKIP BACK    7 UNCD                                                    UNT91064
70STAY INTL  100                                                         UNT91070
71DISM                                                                   UNT91071
72STAY TIME  500 FIRE    1 KIND    4 PROR    6                          UNT91072
73SKIP BACK    1 TIME  500                                               UNT91073
74STAY TIME 1000 FIRE    1 KIND    4 PROR    5                          UNT91074
75SKIP BACK    1 TIME 1000                                               UNT91075
76STAY TIME 5000 FIRE    1 KIND    4 PROR    4                          UNT91076
77SKIP BACK    1 UNCD                                                    UNT91077
78STAY INTL  100                                                         UNT91078
79SKIP BACK    7 UNCD                                                    UNT91079
81STAY TIME 5000 FIRE    2 KIND    0 PROR    7                          UNT91081
82STAY INTL   60                                                         UNT91082
83SKIP BACK    2 UNCD                                                    UNT91083
90STAY INTL  100                                                         UNT91090
91SKIP FORW    2 UNCD                                                    UNT91091
92STAY INTL  200                                                         UNT91092
93STAY TIME 5000                                                         UNT91093
94NSTP RATE    7 SQRE 0656 KIND    0 PROR    0 ALT    1                  UNT91094
95CHAL LOS                                                               UNT91095
96STAY INTL   60 FIRE    1 KIND    4 PROR    4                          UNT91096
97NSTP RATE    7 SQRE 0354 KIND    0 PROR    0 ALT    1                  UNT91097
98NSTP RATE    7 SQRE 0447 KIND    0 PROR    0 ALT    1                  UNT91098
99CHAL LOS                                                               UNT91099
100STAY INTL   60 FIRE    1 KIND    4 PROR    5                          UNT91100
101NSTP RATE    7 SQRE 0245 KIND    0 PROR    0 ALT    1                 UNT91101
102NSTP RATE    7 SQRE 0236 KIND    0 PROR    0 ALT    1                 UNT91102
103CHAL LOS                                                              UNT91103
104STAY INTL   60 FIRE    1 KIND    4 PROR    6                          UNT91104
105NSTP RATE    7 SQRE 0137 KIND    0 PROR    0 ALT    1                 UNT91105
106NSTP RATE    7 SQRE 0258 KIND    0 PROR    0 ALT    1                 UNT91106
107CHAL LAND                                                             UNT91107
108SKIP BACK   15 UNCD                                                   UNT91108
500STAY INTL  100                                                        UNT91500
501NSTP RATE    7 SQRE 1449 KIND    6 PROR    5                         UNT91501
502DISM                                                                  UNT91502
503NSTP RATE    7 SQRE 1349 KIND    6 PROR    6                         UNT91503
504STAY TIME 5000 FIRE    2 KIND    4 PROR    4                         UNT91504
505SKIP BACK    1 UNCD                                                   UNT91505
510STAY INTL  100                                                        UNT91510
511NSTP RATE    7 SQRE 1449 KIND    6 PROR    6                         UNT91511
512DISM                                                                  UNT91512
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513NSTP RATE    7 SQRE 1047 KIND    6 PROR    4                    UNT91513
514STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91514
515SKIP BACK    1 UNCD                                             UNT91515
520STAY INTL 1000                                                  UNT91520
521NSTP RATE    7 SQRE 1349 KIND    6 PROR    4                    UNT91521
522STAY TIME 5000 FIRE    1 KIND    4 PROR    4                    UNT91522
523SKIP BACK    1 UNCD                                             UNT91523
525STAY INTL 1000                                                  UNT91525
526NSTP RATE    7 SQRE 1448 KIND    6 PROR    6                    UNT91526
527DISM                                                             UNT91527
528NSTP RATE    7 SQRE 1348 KIND    6 PROR    5                    UNT91528
529STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91529
530SKIP BACK    1 UNCD                                             UNT91530
535STAY INTL 1000                                                  UNT91535
536NSTP RATE    7 SQRE 1448 KIND    6 PROR    6                    UNT91536
537DISM                                                            UNT91537
538NSTP RATE    7 SQRE 1146 KIND    6 PROR    4                    UNT91538
539STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91539
540SKIP BACK    1 UNCD                                             UNT91540
545STAY INTL 1000                                                  UNT91545
546NSTP RATE    7 SQRE 1348 KIND    6 PROR    4                    UNT91546
547STAY TIME 5000 FIRE    1 KIND    4 PROR    4                    UNT91547
548SKIP BACK    1 UNCD                                             UNT91548
550STAY INTL 1000                                                  UNT91550
551NSTP RATE    7 SQRE 1448 KIND    6 PROR    5                    UNT91551
552DISM                                                            UNT91552
553NSTP RATE    7 SQRE 1447 KIND    6 PROR    6                    UNT91553
554STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91554
555SKIP BACK    1 UNCD                                             UNT91555
560STAY INTL 1000                                                  UNT91560
561NSTP RATE    7 SQRE 1448 KIND    6 PROR    5                    UNT91561
562DISM                                                            UNT91562
563NSTP RATE    7 SQRE 1145 KIND    6 PROR    4                    UNT91563
564STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91564
565SKIP BACK    1 UNCD                                             UNT91565
570STAY INTL 1000                                                  UNT91570
571NSTP RATE    7 SQRE 1447 KIND    6 PROR    4                    UNT91571
572STAY TIME 5000 FIRE    1 KIND    4 PROR    4                    UNT91572
573SKIP BACK    1 UNCD                                             UNT91573
575STAY INTL 1000                                                  UNT91575
576MOVE DOCT    1 RATE    7 SQRE 2652 KIND    4 PROR    5          UNT91576
577STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91577
578SKIP BACK    1 UNCD                                             UNT91578
580STAY INTL 1000                                                  UNT91580
581NSTP RATE    7 SQRE 3050 KIND    6 PROR    6                    UNT91581
582NSTP RATE    7 SQRE 2444 KIND    6 PROR    5                    UNT91582
583DISM                                                            UNT91583
584STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91584
585SKIP BACK    1 UNCD                                             UNT91584
590STAY INTL 1000                                                  UNT91590
591NSTP RATE    7 SQRE 3050 KIND    6 PROR    6                    UNT91591
592NSTP RATE    7 SQRE 2444 KIND    6 PROR    5                    UNT91592
593DISM                                                            UNT91593
594NSTP RATE    7 SQRE 1641 KIND    6 PROR    4                    UNT91594
595STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91595
596SKIP BACK    1 UNCD                                             UNT91596
600STAY INTL 1000                                                  UNT91600
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601NSTP RATE    7 SQRE 3050 KIND    6 PROR    6                    UNTV1601
602NSTP RATE    7 SQRE 2444 KIND    6 PROR    5                    UNT91602
603STAY TIME 5000 FIRE    1 KIND    4 PROR    4                    UNT91603
604SKIP BACK    1 UNCD                                             UNT91604
610STAY INTL  100                                                  UNT91610
611NSTP RATE    7 SQRE 3049 KIND    6 PROR    5                    UNT91611
612NSTP RATE    7 SQRE 2443 KIND    6 PROR    6                    UNT91612
613DISM                                                            UNT91613
614STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91614
615SKIP BACK    1 UNCD                                             UNT91615
620STAY INTL  100                                                  UNT91620
621NSTP RATE    7 SQRE 3049 KIND    6 PROR    5                    UNT91621
622NSTP RATE    7 SQRE 2443 KIND    6 PROR    6                    UNT91622
623DISM                                                            UNT91623
624NSTP RATE    7 SQRE 1640 KIND    6 PROR    4                    UNT91624
625STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91625
626SKIP BACK    1 UNCD                                             UNT91626
630STAY INTL  100                                                  UNT91630
631NSTP RATE    7 SQRE 3049 KIND    6 PROR    6                    UNT91631
632NSTP RATE    7 SQRE 2443 KIND    6 PROR    5                    UNT91632
633STAY TIME 5000 FIRE    1 KIND    4 PROR    4                    UNT91633
634SKIP BACK    1 UNCD                                             UNT91634
640STAY INTL  100                                                  UNT91640
641NSTP RATE    7 SQRE 3147 KIND    6 PROR    4                    UNT91641
642NSTP RATE    7 SQRE 2442 KIND    6 PROR    6                    UNT91642
643DISM                                                            UNT91643
644STAY TIME 5000 FIRE    2 KIND    4 PROR    5                    UNT91644
645SKIP BACK    1 UNCD                                             UNT91645
650STAY INTL  100                                                  UNT91650
651NSTP RATE    7 SQRE 3149 KIND    6 PROR    4                    UNT91651
652NSTP RATE    7 SQRE 2442 KIND    6 PROR    6                    UNT91652
653DISM                                                            UNT91653
654NSTP RATE    7 SQRE 1639 KIND    6 PROR    5                    UNT91654
655STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91655
656SKIP BACK    1 UNCD                                             UNT91656
660STAY INTL  100                                                  UNT91660
661NSTP RATE    7 SQRE 3149 KIND    6 PROR    6                    UNT91661
662NSTP RATE    7 SQRE 2442 KIND    6 PROR    5                    UNT91662
663STAY TIME 5000 FIRE    1 KIND    4 PROR    4                    UNT91663
664SKIP BACK    1 UNCD                                             UNT91664
670STAY INTL  100                                                  UNT91670
671MOVE DOCT    1 RATE    7 SQRE 3049 KIND    4 PROR    4          UNT91671
672STAY TIME 5000 FIRE    1 KIND    4 PROR    5                    UNT91672
673SKIP BACK    1 UNCD                                             UNT91673
675STAY INTL  100                                                  UNT91675
676NSTP RATE    7 SQRE 3049 KIND    6 PROR    6                    UNT91676
677NSTP RATE    7 SQRE 2449 KIND    6 PROR    5                    UNT91677
678STAY TIME 5000 FIRE    2 KIND    4 PROR    4                    UNT91678
679SKIP BACK    1 UNCD                                             UNT91679
680STAY INTL  100                                                  UNT91680
681STAY INTL   50 FIRE    2 KIND    4 PROR    4                    UNT91681
682SKIP BACK    6 UNTL   28 SQRE 3049 SKPI                         UNT91682
683SKIP BACK    7 UNCD                                             UNT91683
685STAY INTL  100                                                  UNT91685
686NSTP RATE    7 SQRE 3444 KIND    6 PROR    4                    UNT91686
687NSTP RATE    7 SQRE 2236 KIND    6 PROR    5                    UNT91687
688DISM                                                            UNT91688
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689STAY TIME 5000 FIRE     2 KIND     4 PROR     6                    UNT91689
690SKIP BACK    1 UNCD                                                 UNT91690
695STAY INTL  100                                                      UNT91695
696NSTP RATE    7 SQRE 3444 KIND     6 PROR     4                      UNT91696
697NSTP RATE    7 SQRE 2236 KIND     6 PROR     5                      UNT91697
698DISM                                                                 UNT91698
699NSTP RATE    7 SQRE 1734 KIND     6 PROR     4                      UNT91699
700STAY TIME 5000 FIRE     2 KIND     4 PROR     4                    UNT91700
701SKIP BACK    1 UNCD                                                 UNT91701
705STAY INTL  100                                                      UNT91705
706NSTP RATE    7 SQRE 3444 KIND     6 PROR     4                      UNT91706
707NSTP RATE    7 SQRE 2236 KIND     6 PROR     5                      UNT91707
708STAY TIME 5000 FIRE     1 KIND     4 PROR     6                    UNT91708
709SKIP BACK    1 UNCD                                                 UNT91709
715STAY INTL  100                                                      UNT91715
716NSTP RATE    7 SQRE 3443 KIND     6 PROR     5                      UNT91716
717NSTP RATE    7 SQRE 2235 KIND     6 PROR     6                      UNT91717
718DISM                                                                UNT91718
719STAY TIME 5000 FIRE     2 KIND     4 PROR     4                    UNT91719
720SKIP BACK    1 UNCD                                                 UNT91720
725STAY INTL  100                                                      UNT91725
726NSTP RATE    7 SQRE 3443 KIND     6 PROR     5                      UNT91726
727NSTP RATE    7 SQRE 2235 KIND     6 PROR     6                      UNT91727
728DISM                                                                UNT91728
729NSTP RATE    7 SQRE 1733 KIND     6 PROR     4                      UNT91729
730STAY TIME 5000 FIRE     2 KIND     4 PROR     4                    UNT91730
731SKIP BACK    1 UNCD                                                 UNT91731
735STAY INTL  100                                                      UNT91735
736NSTP RATE    7 SQRE 3443 KIND     6 PROR     5                      UNT91736
737NSTP RATE    7 SQRE 2235 KIND     6 PROR     6                      UNT91737
738STAY TIME 5000 FIRE     1 KIND     4 PROR     4                    UNT91738
739SKIP BACK    1 UNCD                                                 UNT91739
745STAY INTL  100                                                      UNT91745
746MOVE DOCT    1 RATE    7 SQRE 3641 KIND     4 PROR     5           UNT91746
747STAY TIME 5000 FIRE     2 KIND     4 PROR     5                    UNT91747
748SKIP BACK    1 UNCD                                                 UNT91748
750STAY INTL  100                                                      UNT91750
751MOVE DOCT    1 RATE    7 SQRE 3641 KIND     4 PROR     6           UNT91751
752MOVE DOCT    1 RATE    7 SQRE 2741 KIND     4 PROR     5           UNT91752
753STAY TIME 5000 FIRE     2 KIND     4 PROR     4                    UNT91753
754SKIP BACK    1 UNCD                                                 UNT91754
760STAY INTL  100                                                      UNT91760
761NSTP RATE    7 SQRE 3442 KIND     6 PROR     6                      UNT91761
762NSTP RATE    7 SQRE 2135 KIND     6 PROR     5                      UNT91762
763DISM                                                                UNT91763
764STAY TIME 5000 FIRE     2 KIND     4 PROR     4                    UNT91764
765SKIP BACK    1 UNCD                                                 UNT91765
770STAY INTL  100                                                      UNT91770
771NSTP RATE    7 SQRE 3442 KIND     6 PROR     6                      UNT91771
772NSTP RATE    7 SQRE 2135 KIND     6 PROR     5                      UNT91772
773DISM                                                                UNT91773
774NSTP RATE    7 SQRE 1632 KIND     6 PROR     4                      UNT91774
775STAY TIME 5000 FIRE     2 KIND     4 PROR     4                    UNT91775
776SKIP BACK    1 UNCD                                                 UNT91776
780STAY INTL  100                                                      UNT91780
781NSTP RATE    7 SQRE 3442 KIND     6 PROR     6                      UNT91781
782NSTP RATE    7 SQRE 2135 KIND     6 PROR     5                      UNT91782
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783STAY TIME 5000 FIRE     1 KIND     4 PROR     4
784SKIP BACK     1 UNCD
790STAY INTL   100
791NSTP RATE     7 SQRE 1350 KIND     6 PROR     5
792STAY INTL    50 FIRE     3 KIND     4 PROR     4
793NSTP RATE     1 SQRE 1146 KIND     6 PROR     4
794STAY TIME 5000 FIRE     2 KIND     4 PROR     6
795SKIP BACK     1 UNCD
800STAY INTL   100
801NSTP RATE     7 SQRE 3150 KIND     6 PROR     6
802NSTP RATE     7 SQRE 2443 KIND     6 PROR     5
803STAY INTL   400 FIRE     7 KIND     4 PROR     4
804NSTP RATE     7 SQRE 1640 KIND     6 PROR     4
805STAY TIME 5000 FIRE     2 KIND     4 PROR     4
806SKIP BACK     1 UNCD
810STAY INTL   100
811NSTP RATE     7 SQRE 3442 KIND     6 PROR     6
812NSTP RATE     7 SQRE 2135 KIND     6 PROR     5
813STAY TIME 5000 FIRE     2 KIND     4 PROR     4
814SKIP BACK     1 UNCD
820STAY INTL   100
821STAY TIME  500 FIRE     2 KIND     4 PROR     4
822SKIP BACK     1 TIME  500
823STAY TIME 1000 FIRE     2 KIND     4 PROR     5
824SKIP BACK     1 TIME 1000
825STAY TIME 5000 FIRE     2 KIND     4 PROR     6
826SKIP BACK     1 UNCD
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 8 58 50 42 38 30 26
 9 49 42 36 32 25 22
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11 33 29 24 21 17 15
12 25 21 18 16 13 11
13 16 14 12 11 09 07
14 08 07 06 05 04 04
15 00 00 00 00 00 00
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06 03 66 57 49 43 34 30
05 02 58 50 42 38 30 26
04 02 49 42 36 32 25 22
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10 05333333 33TER2    1
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09 04         TER2    3
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07 04222222 22TER2    5
06 03222222 22TER2    6
06 03222222 22TER2    7
05 02222222 22TER2    8
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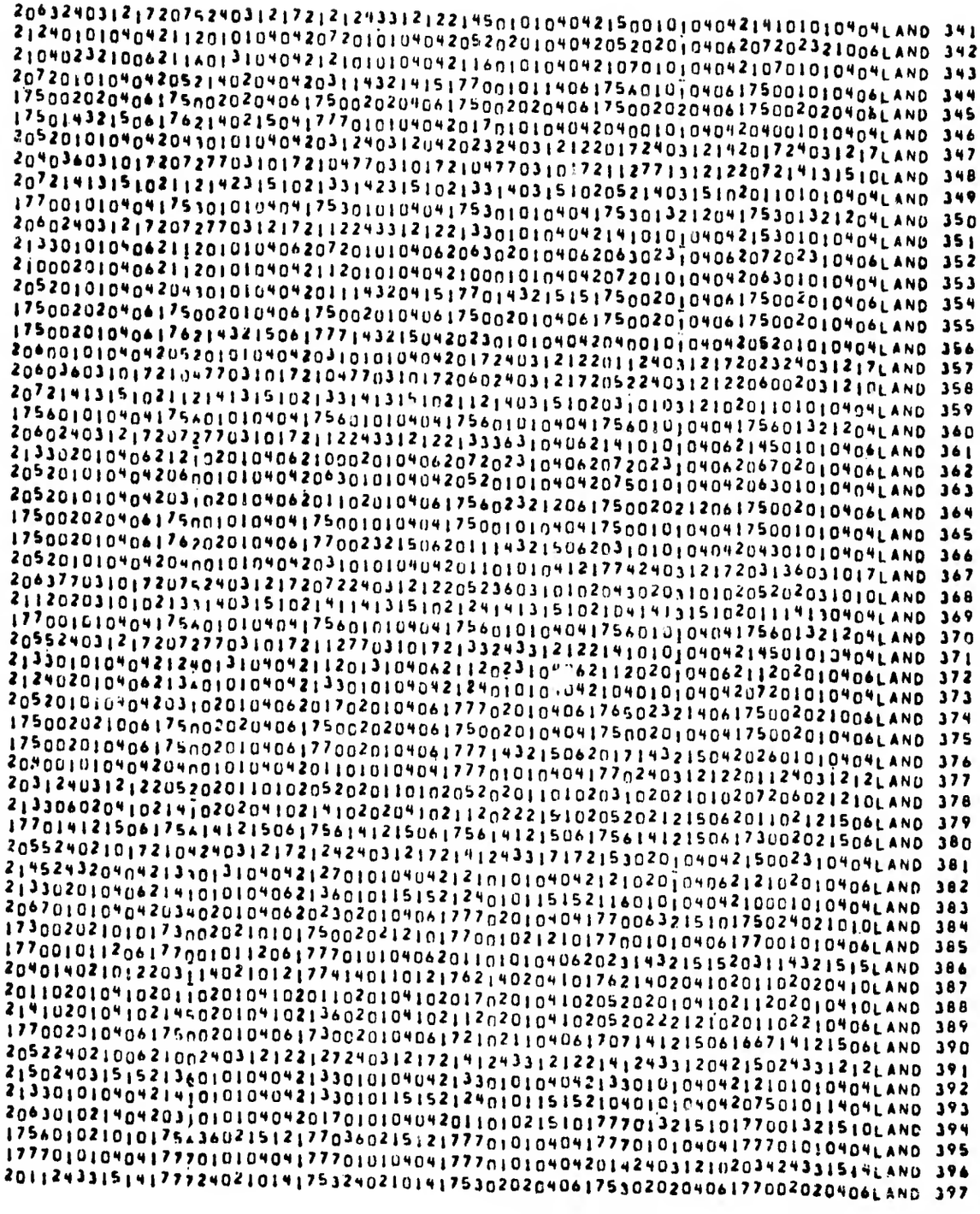

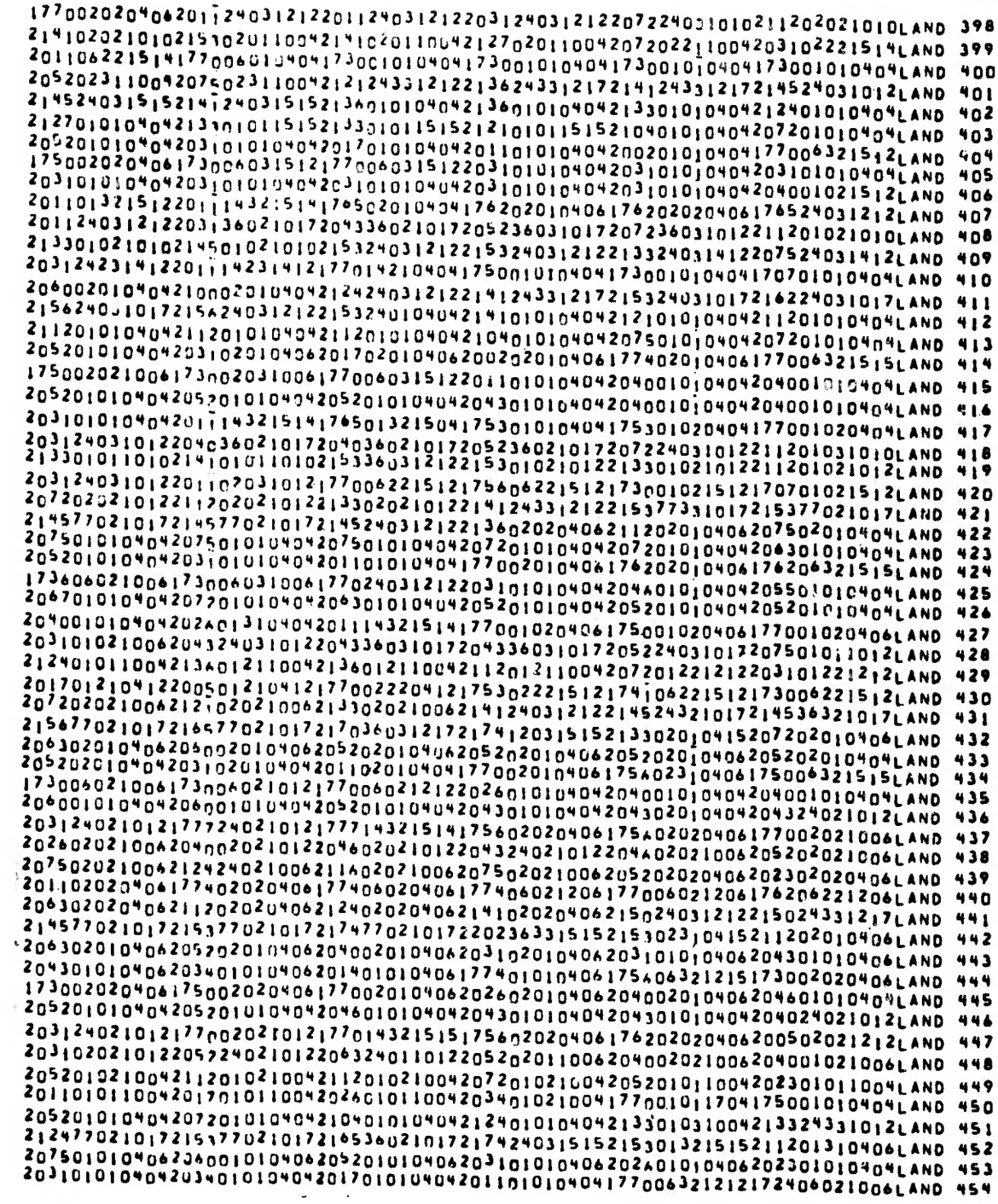

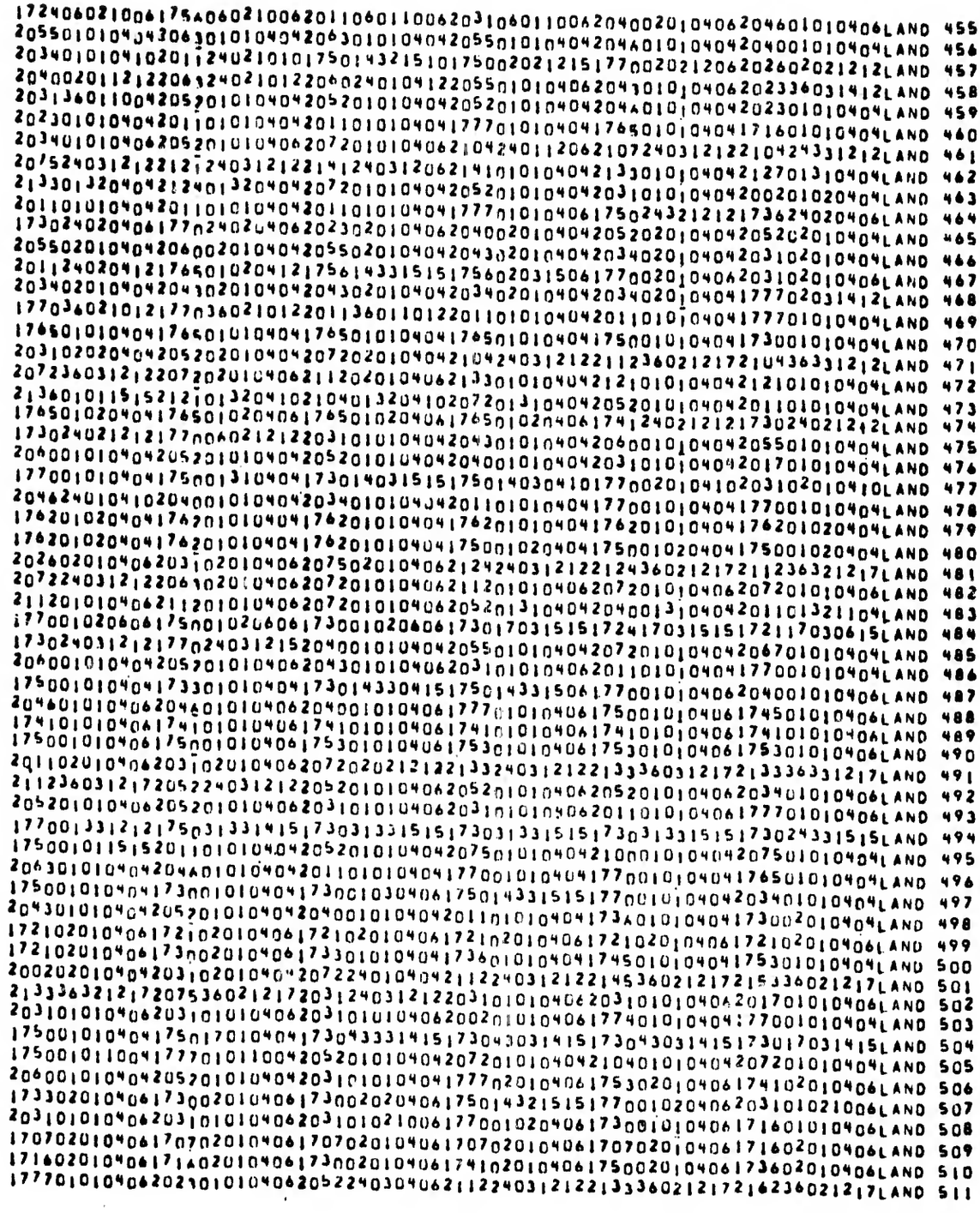

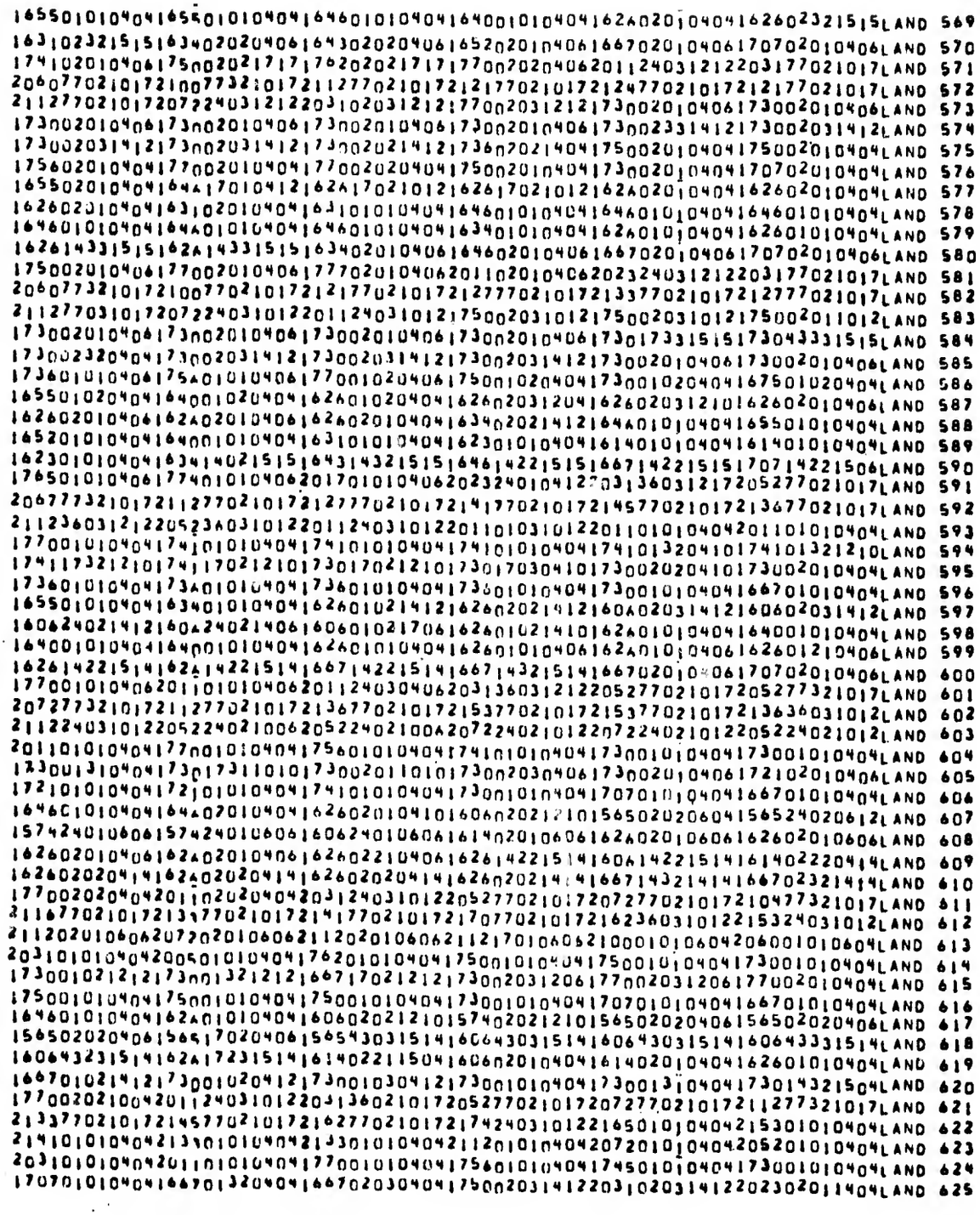

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Appendix B

CONSIDERATIONS RELATING TO NUMBER OF ITERATIONS REQUIRED FOR A SINGLE CARMONETTE TREATMENT

INTRODUCTION

Whenever a Monte Carlo (stochastic) model such as CARMONETTE is used one is faced with the question of how many replications of a single game are required to insure statistical confidence in the summarized data output by the model.

There are many statistical procedures that can be used to determine the number of iterations of a single treatment required to achieve a given confidence level. Since these methods are discussed in detail in all texts on basic statistics, no effort has been made to reproduce them here. If time and/or resources do not permit the use of one or more of these statistical techniques, the following discussion by Norman W. Parsons on the variability of the model provide a "Rule of Thumb" that can be used in consideration of iterations required.

THE VARIABILITY OF CARMONETTE

CARMONETTE is a Monte Carlo computer simulation of small unit combat. Random numbers are used extensively throughout the simulation. Uniform random numbers are used to determine the success or failure of target acquisition and firing events and the course of action in some movement decisions. Normally distributed random numbers are used to determine the time duration of weapon aiming and loading events for which a mean and standard deviation are entered as inputs. An analysis of a specific CARMONETTE game showed that 1120 random numbers were used during 1 minute of simulated battle time. The usual CARMONETTE game will simulate from 20 to 40 minutes of battle.

The stochastic nature of CARMONETTE has resulted in a perennial question as to the number of replications of a specific battle that are required to be assured of a stable set of outcomes of the battle. In an attempt to answer this question an analysis has been made of two output variables from a set of 30 replications of a single game situation played during the course of the COMCAP II study projects.

The output variables of CARMONETTE can be grouped into three general classes; the total number of personnel and vehicles killed for each side, the total number of each type vehicle killed for each side, and the number of vehicle types killed by each weapon type. It has been observed that these types of outputs increase in variability in the order listed.

Figure B1 shows the results from 30 replications of treatment 4201 from COMCAP II in terms of the total number of Blue vehicles killed per replication and the number of replications in which that number of kills were realized.

Figure B2 shows the results of a statistical analyses of these game results. The running means, that is the mean computed for all replications up to and including the replication in question; and the specific results of each replication are shown. The standard deviation of the sample and the standard error of the mean, computed for the set of replications up to and including the replication in question, are shown.

As the figure shows the results of a single replication can be extremely variable compared to the mean of several games. Deviations of 30% are common and one game (replication 28) has a deviation of 57.5% from the previous mean. It is interesting to note that the two extreme results occurred in succession on replications 28 and 29. The standard deviation is on the order of 20% of the mean after the tenth replication and has a value of 22.6% for the set of 30 replications.

However it is noted that the variability of the mean, as measured by the standard error of the mean, became reasonably stable after five replications.

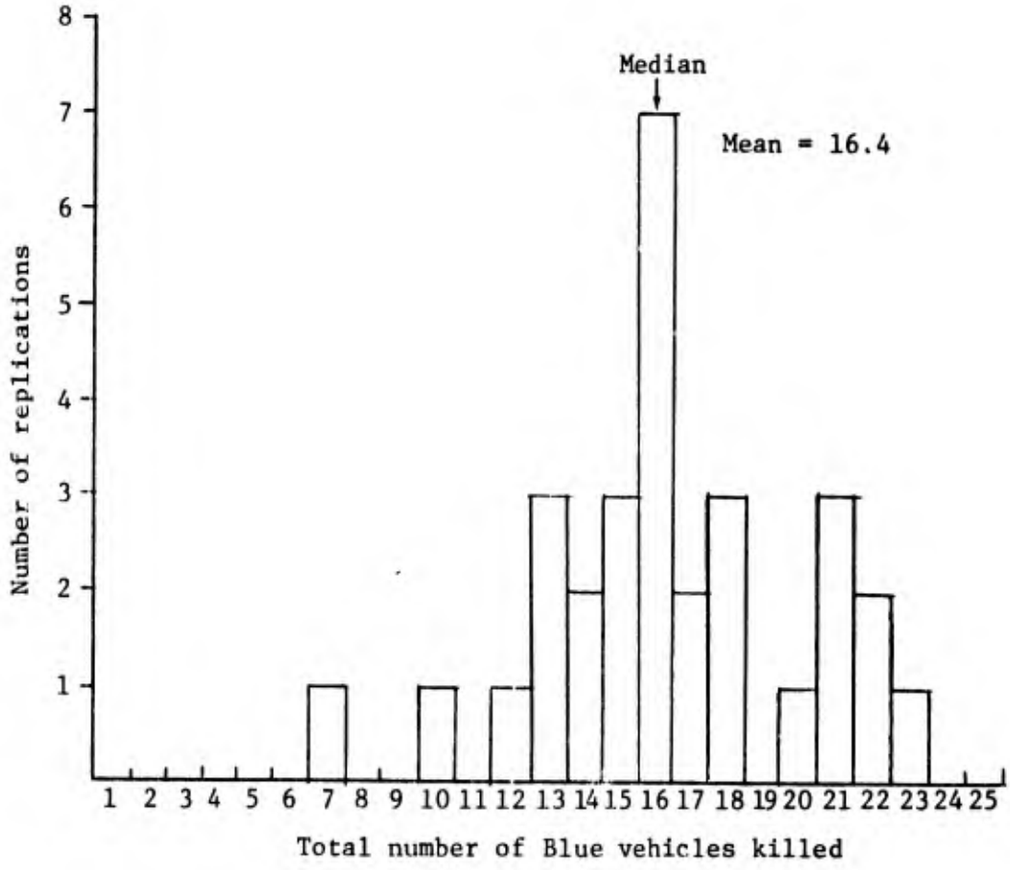

Fig. B1 - Number of Replications with the Same Outcomes

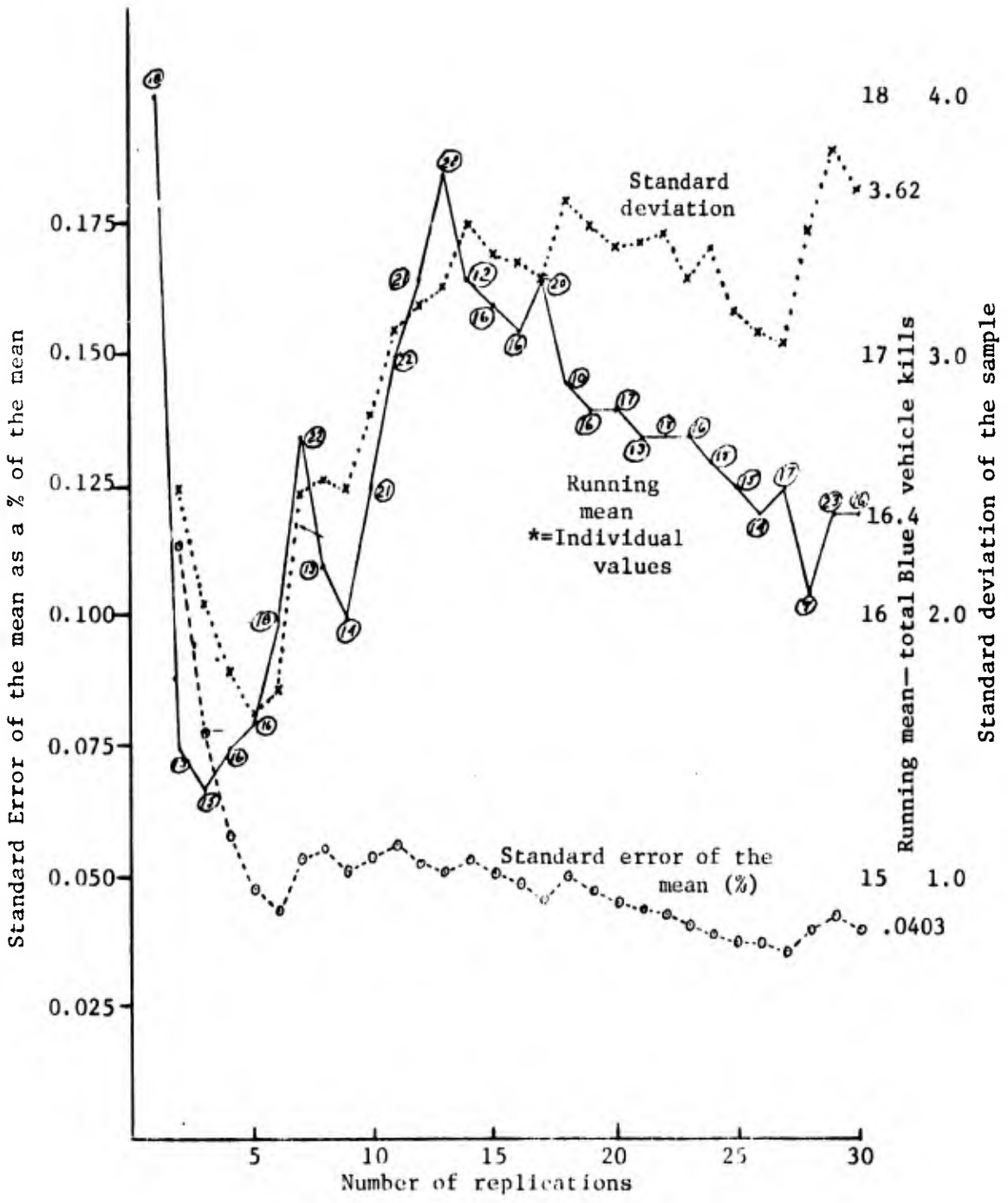

Fig. B2 - Variability of CARMONETTE, COMCAP II, Treatment 4201
Total Blue Vehicles Killed - Beginning Strength 59

However it is also noted that each additional replication can have the effect of changing the previous mean by several percentage points. Figure B3 shows the percent difference between the value of the running mean and the final mean.

An analysis was made of the outcomes of the kills of a single type target by a single type weapon, in this case Red tanks killed by the TOW armed COBRA helicopter. Figure B4 shows the number of Red tanks killed per replication and the number of replications in which that result occurred. Note that the two extreme values are 50% less and 75% greater than the mean value.

Figure B5 shows the results of a statistical analses of these data. In these results the running mean shows apparent stability after the 7th replication; however the standard deviation is now 30% or more of the mean. The standard error of the mean is 13% at the 7th replication, is below 10% at the 11th replication, but does not get below 5% by the 30th replication. It is apparent that this output, the kills of a specific type target by a specific type weapon, shows more variability than the first output, total kills on one side, examined.

The question as to the number of replications required in any given project can now be seen to be dependent on the type of information desired from the simulation and the degree of accuracy desired in the results. If the total number of kills on each side is sufficient to answer the questions poised by the project then 5 to 7 replications appears to be sufficient to provide mean values with about a 5% standard error in the mean. If a killer-victim scoreboard type of answer is required then 10 to 15 replications will be required to provide a 10% standard error in the mean values. If a 5% standard error is desired in the mean values then 30 to 35 replications will be required.

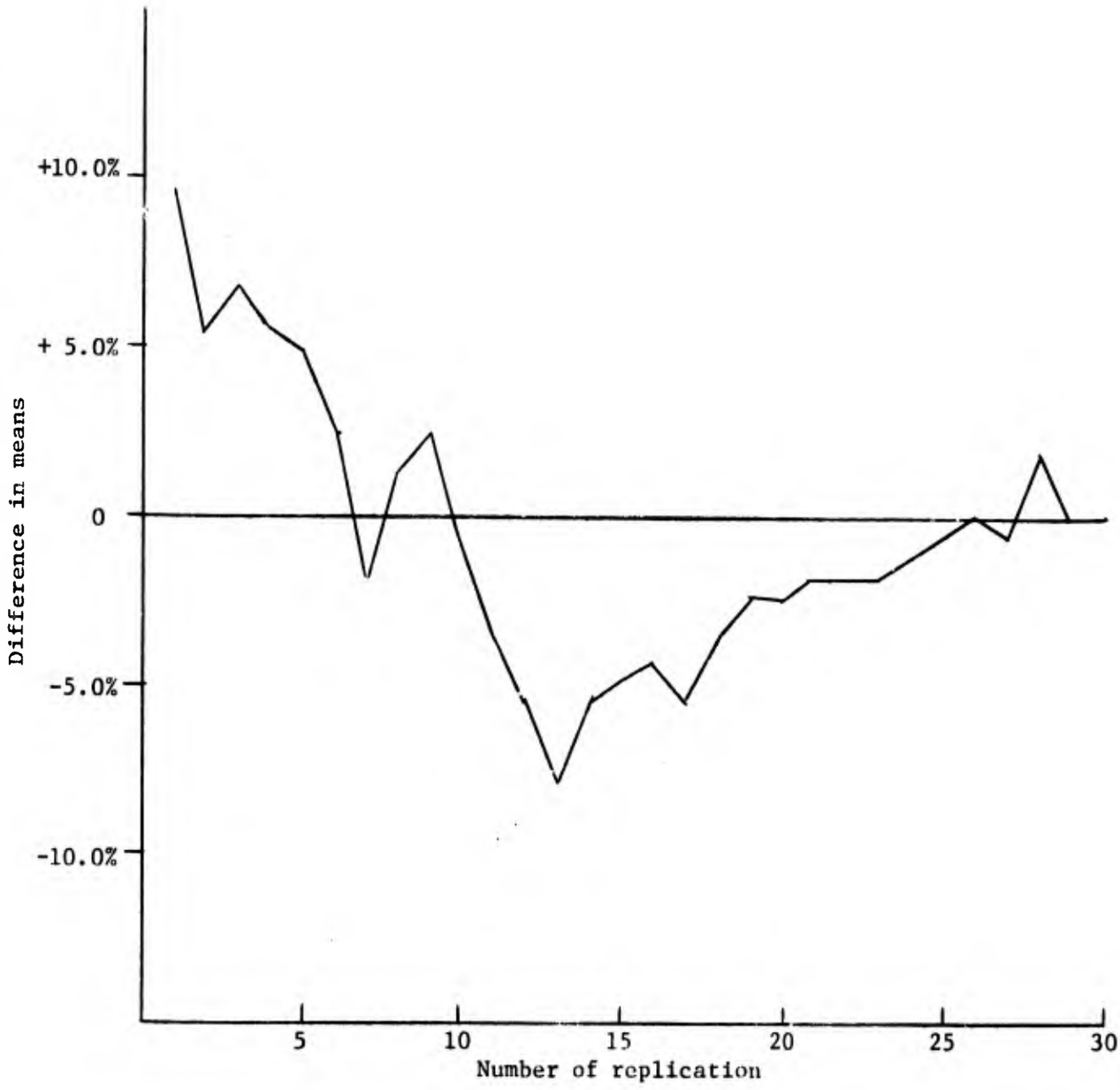

Fig. B3 - Percent Difference of Running Mean
and Mean After 30 Replications
(Total Blue vehicles killed)

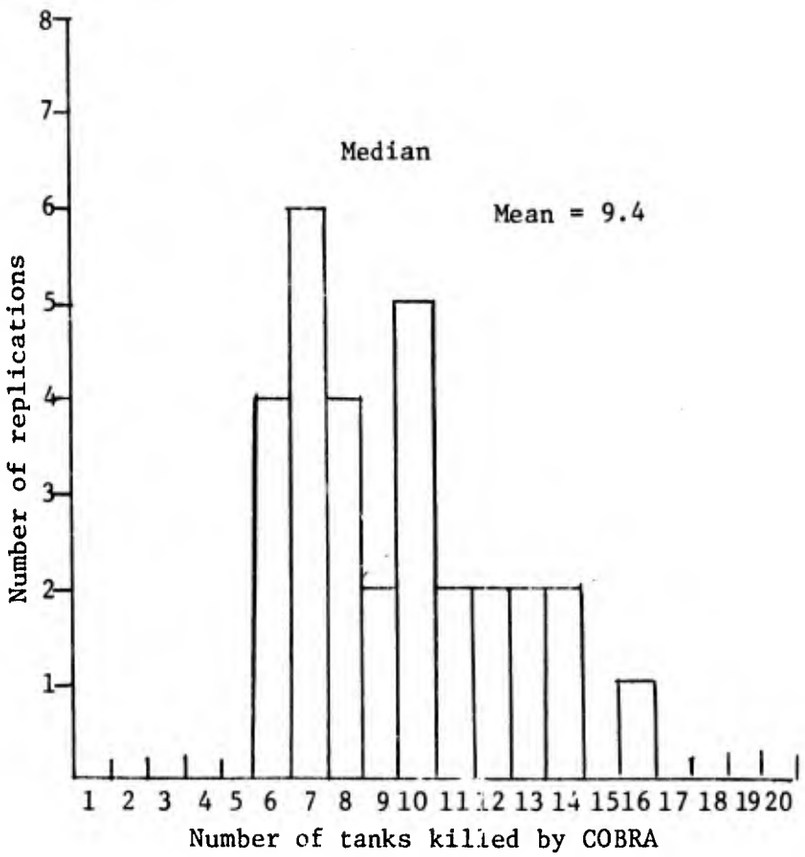

Fig. B4 - Number of Replications with the Same Outcomes

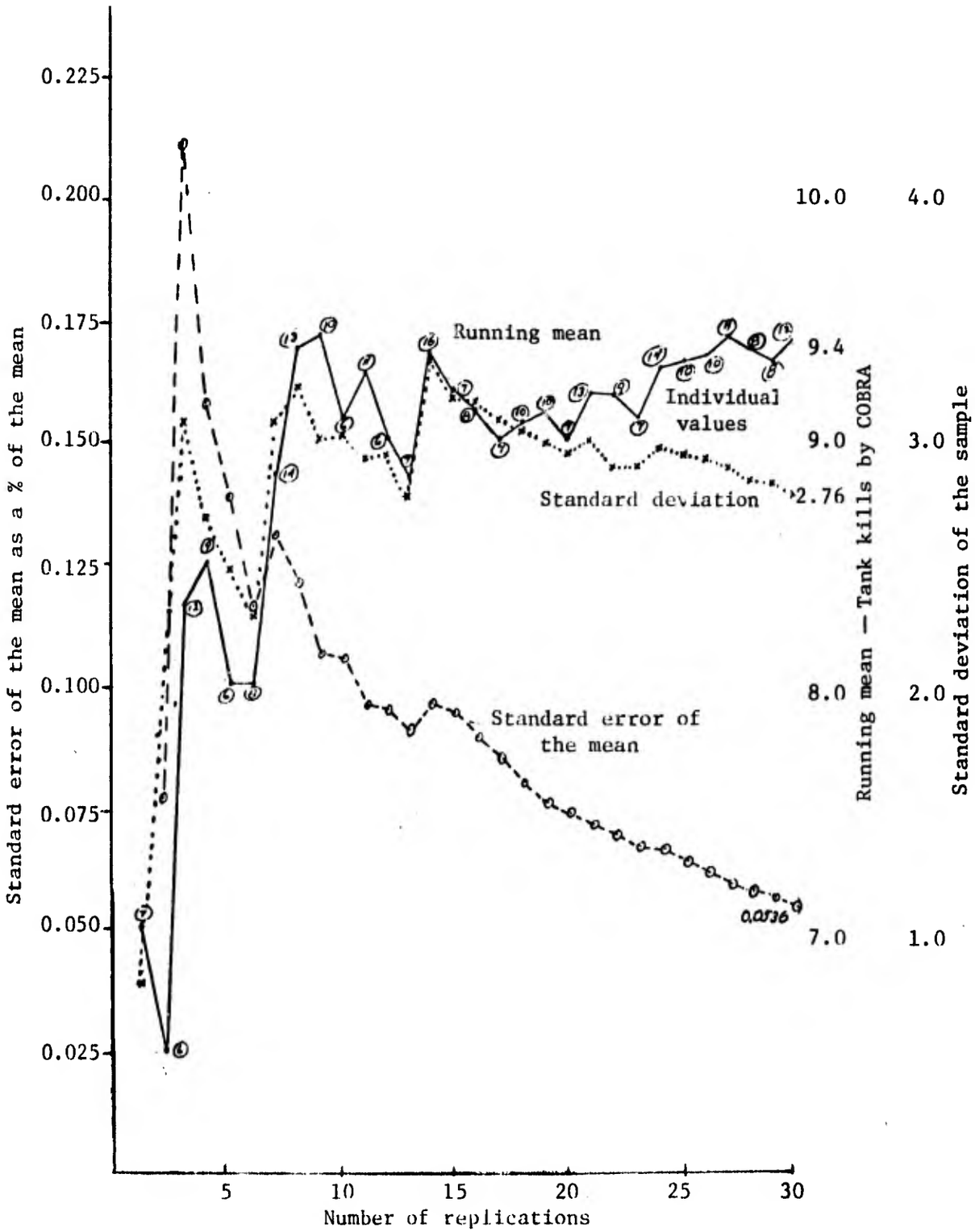

Fig. B5 - Variability of CARMONETTE, COMCAP II, Treatment 4201
(30 Red tanks — 6 COBRA)

Appendix C

GLOSSARY

air-mobility class	Any one of three groups of air units indexed 5, 6 or 7 having similar mobility performance characteristics. Discussed in introduction under "Classification of Units" and during STEP 6. Used on MOBILITY 3 and 4 and on UNIT 3.
air-mobility data	Consists of altitude change thresholds, time required for troop dismount and movement rates (forward speeds) for each air-mobility index. Discussed in relation to and entered on MOBILITY 4.
altitude-change thresholds	Six measures, designated alpha 1 (α_1) through alpha 6 (α_6), by which ordered changes of altitude are defined according to rate of descent or ascent, for each air-mobility class. Discussed in relation to and entered on MOBILITY 4.
artillery direction of fire	The alignment of grid squares over which the fire will be assessed in determination of the orientation of the impact area of artillery shells. Discussed in introduction and in relation to and entered on WEAPON 1.
average round velocity	The velocity (meters per second) of a projectile averaged over its useful range. Discussed in relation to and entered on WEAPON 1.
backward extrapolation	The process by which the total tactical SD at range zero is derived from the minimum effective range of a weapon and from the actual point-blank error. Discussed in relation to WEAPON 2.
battlefield	The selected terrain on which the computer simulation takes place and whose size must not exceed a graphic representation of 60 columns and 63 rows of grid squares into which the battlefield must be divided. The 60 by 63 grid squares need not be used in entirety; however, the size of a square must not be less than the unit coverage area and the total battlefield area must be large enough for the play of the battle.

concealment conversion table	The tabulation of the largest area that an element of a unit will present to an enemy observer if a unit of a certain element-size index is situated in a terrain grid square of a certain concealment index. Discussed in relation to and entered on TERRAIN 2.
concealment index	The average amount of protection in a terrain grid square against hostile detection and indicated by increasing integral numbers from 1 to 15 as concealment increases, and recorded on TERRAIN 1 as the concealment index for each terrain grid square.
contour flight	The path of an air unit following the undulations indexed as 2, 3, or 4 in the ordered altitude table (MOBILITY 5). Discussed in relation to MOBILITY 5.
cover conversion table	A tabulation of the exposed area (to flat-trajectory weapons) of the largest element in a unit if the unit of a given element-size index is located in a terrain grid square with a given cover index. Discussed in relation to and entered on TERRAIN 2.
cover index	A number from 1 to 15 which indicates the average cover available in a terrain grid square as protection from direct fire, and recorded on TERRAIN 1 with increasing indexes indicating increasing cover.
cross-country trafficability	The condition of a grid square described on TERRAIN 1 by a 1, 2, or 3 indicating the difficulty involved in movement across the square without using roads. Discussed in relation to TERRAIN 1 and MOBILITY 2.
critical ranges	Two ranges that divide targets available to a given unit into three range groups. Discussed in relation to and entered on UNIT 4.
danger-state table	The tabulation of danger of units as seriously vulnerable, moderately vulnerable, or invulnerable, to an attack by a unit of a certain target index. Discussed in relation to and entered on UNIT 4.
decision cycle	The time interval after which an inactive unit re-evaluates its situation and recorded on GAME.
dismount time	The average time (in minutes) required for troops to disembark from a carrier vehicle and be ready to fire, and recorded on MOBILITY 2 for each ground mobility index.

element	One of the components of a unit.
element-size class	Used to determine the ease with which an element may be seen and the likelihood of being hit by enemy fires, and assigned index numbers 0 through 9 to units on the basis of the element area. Discussed in introduction under "Classification of Units" and entered on UNIT 3.
environmental conditions	Consist of the TERRAIN factors included explicitly, and the implicit conditions (included in the units' operational characteristics) of weather and time of day.
equally desirable targets	A description of identical targets that are located at different ranges from which the nearest target will be selected for fire unless WEAPON 1 indicates that fire should be directed at target of greatest range.
escape points	The preselected locations to which a unit may move at its fastest possible rate when it runs out of ammunition for its main weapon. Discussed in relation to UNIT 6 and 7 and entered on UNIT 7.
fire qualifier	A qualifier, the numerical value which dictates the number of shots from a unit's main weapon group. Discussed in relation to and entered on UNIT 9.
fire-response class	Five groupings of units used to describe how a unit responds or reacts to hostile fire. Fire-response class 1 contains dismounted infantry, class 2 open vehicles, class 3 lightly armored vehicles, class 4 heavily armored vehicles, and class 5 aircraft. Discussed in introduction under "Classification of Units," UNIT 3 and 5. Entered on UNIT 3.
first order number	The reference number found in the left-hand column of UNIT 9 and indicated on UNIT 10 as the first order for each unit to follow.
grid square	One of the 60 by 63 divisions of the CARMONETTE battlefield, all of equal size.
ground-mobility class	Five or fewer groups into which all ground units on both sides are divided. Index zero is used for dismounted infantry, and index 1 to 4 are used for the remaining ground units. Each ground-mobility class contains units having similar movement capabilities that are different from those of other ground-mobility classes. Discussed in introduction under "Classification of Units." Used on MOBILITY 1 and 2. Entered on UNIT 3.

ground-mobility table	A tabulation on MOBILITY 2 of the emplacement times and rates of movement of the ground-mobility classes for the five ground-slope classes.
ground-slope class	A five way change in elevation from one grid square to an adjacent grid square, defined by means of three slope thresholds indicating slopes as uphill or downhill and steep, moderate, or negligible.
hold-fire range	A range entered on GAME indicating the range within which a designated unit will start to fire on targets. If a unit knows that an enemy unit has fired and if that enemy unit is on the unit's target priority list, the unit will engage the enemy unit regardless of hold-fire range.
impact area	The average area covered by a one-round volley from an artillery piece in a firing unit and having one of the following four sizes of grid squares: 1 by 1, 1 by 3, 3 by 1, or 3 by 3. Discussed in introduction and in relation to WEAPON 1 and 4. Entered on WEAPON 1.
information-state change	The changing of intelligence state according to Markov procedure using tables of probabilities and intelligence states. Discussed in STEP 3.
information-state decay	The changing state of a unit's intelligence, which decays automatically one state for each time interval during which the unit loses line-of-sight visibility of a potential target. Discussed in STEP 3.
information states	Four states of a unit's information about a target defined as: (1) target's location unknown, (2) target known to be located in a certain terrain grid square, (3) target erroneously pinpointed within a grid square, and (4) target correctly pinpointed. Discussed in introduction and STEP 3.
kind of fire	Indicated by order qualifier KIND and its numerical value (0-7) as to location of target, suppression, moving, etc. Discussed in relation to and entered on UNIT 9.
level flight	An aircraft ordered altitude flight at an altitude above sea level, as indexed by 5, 6, or 7 on MOBILITY 5.

likelihood of moving — A tabulation of MOBILITY 1 of as many as four different probabilities per mobility index (indexed 0-7) for each of four different movement doctrines. Also tabulated on MOBILITY 1 are two decision times (in minutes): (1) target assessment time; and (2) decision time for each of the Red and Blue sides.

maximum altitude — The altitude that aircraft in each air mobility class may be expected to achieve, and limited to 4096 ft above the highest terrain square. Entered on MOBILITY 3.

mobility class — Eight groups of units, each of which possesses similar rates of movement in terrain of various trafficability and road conditions, with ascending and descending slopes in various degrees. Discussed in introduction under "Classification of Units." Used on all MOBILITY forms.

mobility-class index — The numerical value from 0-7 used to indicate the mobility of a unit. Entered on UNIT 3.

movement order — Any one of four kinds of decisions designated by the proword MOVE: (1) amount of movement and stopping permitted depending on such conditions as target's availability, (2) details of aircraft flight, (3) movement (probability) doctrine, and (4) choose speed from the ordered-movement-rate table. Discussed in relation to and entered on UNIT 9.

movement doctrine — The movement decision-making process for four basic tactical situations with the probability of moving assigned to units in each situation (depending on the unit's cover or not, and the main weapon's target availability or not). Discussed in relation to MOBILITY 1.

net cover — Shelter or protection, either natural or artificial, defined on the basis of a combination of the cover index of a terrain grid square and the element-size index of a unit. Discussed in relation to TERRAIN 2.

net cover index — One of three integral numbers (1. 2, or 3) assigned to each possible combination of terrain-grid-square cover state and element index size: 1 for good cover (good protection from fragmentation burst for dismounted infantry), 2 for fair cover, and 3 for negligible cover and quite exposed to fire, and recorded on TERRAIN 2.

net cover table — The tabular presentation on TERRAIN 2 of net-cover-state indexes of each possible combination of cover state and element-size index of a unit.

neutralization interval	A period of time over which the incoming rounds will be considered to affect the behavior of a unit and to be applicable to both sides and all fire-response classes. Discussed in relation to and entered on UNIT 5.
neutralization interval rounds received	The evaluation of the number of incoming rounds in a neutralization interval considered to affect the behavior of a unit.
neutralization weighting factor	An arbitrary weighting of each round based on the demoralizing effect of that round, e.g., if a rifle round is assigned a weight of 1, then a tank round may be assigned a larger weight. Discussed in relation to and entered on WEAPON 1.
on-road trafficability	An environmental condition of terrain that describes the rates of movement to each unit according to the kinds of road in each terrain grid square and the capabilities of the vehicles in the units. Discussed in relation to TERRAIN 1.
on-road-trafficability index	An integral number from 1 to 3 (or 0 indicating no roads in the grid square) recorded on TERRAIN 1, with best roads indexed 1 and worst roads indexed 3.
opportunity targets	Targets selected in the priority indicated by its target-priority list following List 1, 2, or 3, WEAPON 5.
ordered altitude	Any one of three specified altitudes for air units to conduct either contour or level flight (i.e., three altitudes for contour flights, and three for level flights) recorded on MOBILITY 5; the specified altitudes for contour flights refer to altitudes above ground and those for level flights refer to altitudes above ground zero.
ordered-altitude index	Any of six numbers from 2 to 7 which order air units to conduct either contour (index 2, 3, or 4) or level (index 5, 6, or 7) flights at specified altitudes. Discussed in relation to and used on MOBILITY 5 and UNIT 9.
ordered-movement rates	The seven prearranged rates of travel during the battle for air units and ground units, indicated by a number from 1 to 7 and recorded on MOBILITY 6; 1 denotes the slowest rate and 7 the fastest.

orientation of battlefield	The way the 60 by 63 grid is placed on the battlefield map so as to include the desired ground area.
out-of-ammunition order	An order for use of a unit that expends all its main weapon ammunition which can result in one of two outcomes: continue its mission or withdraw immediately to an escape point, indicated by no entry or X respectively on UNIT 6.
overkill	The wasteful use of a unit's ammunition on dead targets in the absence of visual evidence of a target's death.
pinned down	A description of a dismounted infantry unit or wheeled vehicle that is under severe fire and does not move, resulting in a reduction of its presented area. It also ceases surveillance and firing. Discussed in relation to and used on UNIT 5.
pinpoint locations	A precisely and accurately known location of a target in a terrain grid square. Discussed in introduction and in STEP 3.
priority of fire	Used with the qualifier PROR and value 1 to 7 in an order to indicate which target-priority list a unit is to use and whether dangerous targets are preferred. Discussed in relation to WEAPON 5 and UNIT 9 and entered on these forms.
probability of indicating death	To be recorded on UNIT 8 for each vulnerability class and provide a means to affect the "overkill" of a unit. Discussed in relation to and entered on UNIT 8.
proword	A four-lettered word such as SKIP, MOVE, STAY, DISM, and REMO used at the beginning of an order on UNIT 9.
qualifier	A four-lettered word used in the detailed order form of UNIT 9 to give the condition or action of the order.
qualifier numerical value	An integral number with limits defined according to the qualifier and used to designate the action of the qualifier. Discussed in relation to and used with UNIT 9.
rounds per trigger pull	The number of rounds fired each time one of the weapon types is fired. Entered on WEAPON 1.
rounds received per neutralization period	An enumeration of the number of incoming rounds of ammunition at a unit during a neutralization interval done in order to consider the behavior (reaction) of the unit.

sensor class	A maximum of six classifications of a unit according to its detection capabilities as a function of visual detection devices, including human vision. Discussed in STEP 5 and in relation to SENSOR 1. Entered on all SENSOR forms.
sensor index	The integral value from 1 to 6 assigned to a unit as its sensor class and entered on UNIT 3.
sensor height	The height in meters of each unit's target-acquisition device used for line-of-sight calculations for a unit to acquire and fire directly on a target. Entered on UNIT 1 and 2.
skip orders	Orders used to change the sequence of a unit's orders on stated condition or unconditionally and indicated by the proword SKIP with appropriate qualifiers and values. Discussed in relation to and used with UNIT 9.
slope thresholds	Three values of uphill or downhill differences in elevation used to determine the maneuverability from one grid square to another and to define the limits of the five slope classes. Discussed in relation to and entered on MOBILITY 2.
solid angle	The angle subtended by the area that a target presents to the sensor (i.e., a small target at a close range is equivalent to a larger target at a greater range). Discussed in STEP 5.
solid-angle thresholds	Three values each for non-firing and firing targets by which changes in detection probabilities occur and the solid angles are denoted. Discussed in relation to and entered on SENSOR 1.
standard altitude increment	A measurement of the vertical change of elevation of air units; the magnitude of this increment (in feet) should be large enough to be militarily significant, but small enough to be accomplished in a length of time compatible with the time required for other simulated events. Discussed in relation to and entered on MOBILITY 3.
stay orders	Used to keep the location of a unit on the battlefield for firing and indicated by the proword STAY with appropriate qualifiers and values. Discussed in relation to and entered on UNIT 9.
steradian	A unit of measure for size of solid angles.

suppressive fire area — The selected integral multiples of grid squares in each direction from the designated target grid square for delivery of artillery unit fire and entered on the target-priority lists for each side. Discussed in relation to and entered on GAME.

surveillance interval — A selected interval of time after which the entire battlefield is evaluated. It should be neither so long that a target could cross a square in a unit's line-of-sight without the unit reacting nor so short that significantly more computer time is necessary for the battle simulation. Discussed in relation to and entered on SENSOR 1.

target-assessment time — The prescribed time for a firing unit to evaluate the damage after a round has been fired at a target and impact has occurred, and entered on GAME.

total tactical standard deviation — The dispersion of a weapon computed by the formula:

$$\sigma_r = \frac{-A}{2\pi \log(1-P_r)}$$

where A = target area

P_r = hit probability

Discussed in relation to and entered on WEAPON 2.

target class — A grouping of units that present targets that would be of the same priority to the different hostile weapon types used to describe the relative desirability of units as to targets for different hostile weapon types, and described by an index from 1 to 16, corresponding to 16 different target classes and recorded on UNIT 3 for each of the two forces, (i.e., the unit's vulnerability to the various hostile weapons and the firepower possessed by the unit: the greater the firepower of a target, the more desirable to destroy it). Discussed in introduction under "Classification of Unit" and in relation to WEAPON 3 and 5, and UNIT 3 and 4.

target square — The grid square within which the target is located.

target-priority list — One, two, or three lists of preferable or priority targets are presented by each non-artillery weapon type assembled on WEAPON 5 separately for the two forces and used to determine opportunity targets for units during the battle.

time of flight — The time required for a round of a weapon type, computed from the average round velocity (from WEAPON 1) and used to determine time of impact at targets of specific ranges.

terrain data	The six factors of elevation, height of vegetation, cover, concealment, cross-country trafficability, and on-road trafficability. One set of inputs must be prepared describing the terrain for each factor. Discussed in STEP 3 and entered on TERRAIN 1.
threshold for response	Levels that indicate severity of reaction to hostile fire as indicated by number of rounds received per interval of time which would force a unit of the class to respond in the indicated manner.
treatment	A combination of the independent variables in the experiment.
unit	One of not more than 48 elements of the force on either side that possesses no more than 63 killable elements, each element having the same vulnerability, mobility, detection ability, location, and orders. Discussed in STEP 8 and entered on UNIT forms.
unit area	The average area occupied by the unit when deployed; e.g., a platoon in defense occupies more ground than a platoon in the attack. (This number has a meaning only in the case of hitting the area with direct-fire fragmentation ammunition.) Discussed in relation to and entered on UNIT 2.
vulnerability class	Any of 12 classifications of units whose common characteristic is that the units in any one class have essentially similar vulnerabilities appreciably different from the vulnerabilities in another class. Discussed in introduction and in relation to WEAPON 3 and 4 and to UNIT 3 and 4. Entered on UNIT 3.
vulnerability-class index	One of 12 integral numbers (1 to 12) recorded in UNIT 3 and assigned to a unit as its vulnerability class with no ranking implied by the numbers. See vulnerability class.
vulnerability state	One of three conditions indicating the relative vulnerability of each target class—vulnerability class combination for each of three range groups (defined by two critical ranges) and tabulated (in total) as the danger-state table (UNIT 4).

weapon type	One of a maximum of 56 types of weapons with the same characteristics, of which 1 to 12 are reserved for artillery pieces or mortars, 13 to 34 for weapons with fragmenting round, and 35 to 56 for weapons with non-fragmenting projectiles and whose characteristics are listed on WEAPON 1.
weapon group	One of a maximum of four independent sets of weapons per unit with any quantity of one kind of weapon type per weapon group. See discussion for UNIT 2.