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DEPLOYMENT FORCE REQUIREMENTS TIMELINESS OF ACTION IN LIMITED W--ETC(U)
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DOCUMENT NO. D6-9603

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TIMELINESS OF ACTION IN LIMITED WARS

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ISSUE NO. 30 ISSUED TO W. L. Hamilton

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INTRODUCTION

At the beginning of a limited war the aggressor has the advantages of surprise and force superiority. The survival of an attacked country depends upon its immediate and sustained response.

When a friendly country is invaded, the United States, in its efforts to contain the encroachment of Communism, is invariably faced with two questions:

(1) How much force is required to stop the aggressor

(2) How soon is that force needed

It is the purpose of this document to show a method by which these questions may be answered.

SUMMARY

In the past, sizeable defensive aid to distant countries has, of necessity, been somewhat slow. The transportation of vast quantities of men and material is time consuming. This gives an attacker a larger advantage than he would have if the distance or the time were reduced.

The size of the military force required to contain an aggressive action determines the amount of deployment capability that must be applied.

The speed with which a deterring force must be delivered determines the method of its delivery.

Several methods are available which allow determination of the force size and delivery speed required to halt an aggressor.

The methods include:

(1) The physical enactment of a complete war game.

(2) Averaged estimates taken from several experts.

(3) An examination of history extended into the future.

(4) A combination of one or more of the above.

Each of these methods has the common shortcoming of being only an estimate. Method (1) has the added disadvantage of being extremely costly.

Boeing has developed a simple war gaming method which combines the advantages of being free of opinion, low in cost, and historically accurate. The method has been applied to six limited war situations. The results are applicable to the time period 1965 - 1975.

The war gaming method was applied to the Korean War and was found to closely duplicate history regarding the actual penetration achieved by the North Koreans in the initial phase of the conflict.

Consideration of the many factors involved in the overrunning of an invaded country led to the establishment of two basic factors. The length of a war is determined by the number of casulaties either side can sustain without collapse or the time taken by the attacker to advance and occupy a country.

The casualties sustainable without collapse are a function of original force size and the daily attrition rate.

The force ratio (attackers/defenders) which exists at war's beginning is therefore of primary importance.

Since aggressors do not normally attack except in the possession of numerical superiority, the defenders will normally lose through casualties.

Considering men and fire power as force, it follows that if the defenders may be supplied with sufficient force to offset the initial force ratio advantage of the attackers, the result will be stalemate.

The timeliness of augmentation of defense forces is dependent upon the length of time which can expire before the defense force collapses through casualty rate or the time taken for the attacker to overrun the country.

Both the latter times are a function of the originally mentioned force ratio (attackers/defenders).

These items can be calculated with the aid of force figures and terrain maps.

METHOD OF ANALYSIS

In any conflict there are several conditions that limit the length of the war:

(1) the physical size of the country

(2) terrain of the country

(3) area of major population

(4) transportation system of the country

(5) the ratio of the size and strength of the attackers to that of the defenders

(6) the collapse of either armed force because of extreme casualties

Items (1) through (4) can be determined from any good map but the time in which an aggressor could overrun the country or the major population areas is dependent on items (5) and (6) in addition to the other items.

Therefore, the rate of advance or the distance advanced in some time is determined as a function of the force ratio (attacking force to defending force), considering the terrain involved, the time it would take an aggressor to overrun a country can be determined. An attrition rate can then be applied to the attackers and the defenders and the force ratio can be varied with time. The defensive force can be varied by augmentation with outside forces, thereby changing the force ratio and consequently the distance advanced by the attacker. Application of the attrition rate to both forces allows the casualties to either side to be determined at any time. By setting some unacceptable casualty level, the time when that level is exceeded can be determined.

DEVELOPMENT OF METHOD

The War Gaming Handbook (Reference A) shows rates of movement, for dismounted troops, over various types of terrain for different force ratios. Terrain types are divided into four main classes as described in Table I. The rate of advance, for dismounted troops, is compared to force ratio in Figure 1. Each of the four terrain classes is used in this comparison.

Limitations

The movement rates and force ratios, as presented in the War Gaming Handbook, are for forces contacting in individual engagements rather than application over a whole front, or as in this study, as a steady rate of movement.

The movement rates are modified in the Handbook for the conditions of day and night, road and cross country, haze, fog, artillery fire, air strikes, terrain, soil, vegetation, etc., and are dependent on a random number. The rates presented in Figure 1 are for dismounted troops moving across country during daylight for the most expected value of the random number.

The force ratio must be modified by applying a rate of attrition to both forces to determine the effect of time. The Army's Staff Officers Field Manual (Reference B) presents the daily personnel losses as a percentage of their strength for various types of operation. Table II shows the daily losses for attackers and defenders for different operations and the ratio of attackers losses to defenders losses. The ratio of losses is fairly constant, varying

TABLE I

TERRAIN TYPES

TERRAIN TYPES	DESCRIPTION
A	Contour interval varies from 0 to 100 meters per kilometer. Permits maximum cross country rates of movement.
B	Contour interval varies from 100 to 200 meters per kilometer. Small hills and gentle slopes cause slight reduction in cross country speeds.
C	Contour interval varies from 200 to 400 meters per kilometer. Has sufficient contour variance to cause a significant slowing of cross country movements.
D	Contour interval from 400 meters and over per kilometer. Not suitable for track or wheel vehicle movement.

TABLE II

DAILY PERSONNEL LOSSES AS PERCENTAGE OF STRENGTH

(Reference: FM101-10 Part I, p. 46)

General Type of Operation for Whole Forces	Division in Contact		Loss Ratio Attack / Defense
	Attack	Defense	
Meeting Engagement	2.7	1.8	1.50
First Day	4.1	2.2	1.86
Position - Succeeding Days	2.2	1.3	1.69
Fortified Zone - First Day	6.6	3.5	1.89
Fortified Zone - Succeeding Days	3.5	1.9	1.84
Pursuit	1.6		1.60
Retirement and Delaying Action		1.0	
Inactive Situations		1.0	

from 1.6:1 to 1.9:1 (attackers loss: defenders loss). Since the losses presented are for divisions in contact and do not consider the units in the rear, a ratio of 1.7:1 will be used as an average to determine the attackers losses. The defense losses vary from 1.0 to 3.5 percent per day. Since these defense losses are for divisions in contact an average loss rate of 1.0 percent per day will be assumed to allow for days when no contact is made.

Limitations

The loss table used in (Reference B) is for short period estimates (5 days or less). In this study the losses are applied over long periods of time. The table was used only to obtain a ratio of attacker losses to defenders losses and as a guide to obtaining the defenders loss rate per day. Instead of determining losses for each engagement (not a complete war game), the losses were averaged over the whole period of conflict.

An equation was developed to give the force ratio at any time:

$$F_x = \frac{A_I - (1.7)\,(.01)D_I t_x}{D_I - (.01)D_I t_x}$$

F_x = Force ratio at time x

A_I = Initial attacking force size

D_I = Initial defending force size

t_x = Any time x

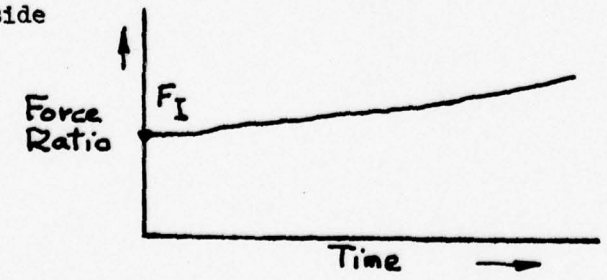
The force size is expressed as a number of men. The number of men used in the force ratio need not be the actual number of men that one side or the other has, but should be increased by its relative effectiveness when

compared to the other force. For example, when the Korean War started the following personnel and heavy fire power was available to each side:

	North Korean	South Korean	Ratio
Personnel	135,438	98,000	1.4:1
Artillery	728	91	8:1
Anti-Tank Guns	504	140	3.6:1
Mortars	1,930	609	3.2:1
Tanks	150	0	00:1
Artillery, Mortars and Tanks	3,312	840	4:1

Although the personnel ratio is only 1.4 to 1 the North Koreans were better trained (many being veterans of the Chinese Army) and better equipped (with automatic weapons). The result was that the North Korean solider was probably worth two or three South Koreans, giving a personnel force ratio of 3 or 4 to 1. As shown, the ratio of heavy firepower was 4 to 1, giving the North Koreans approximately a 4 to 1 force advantage even though the actual personnel ratio was only 1.4 to 1.

The previously mentioned formula $F_x = \frac{A_I - (1.7)(.01)D_I t_x}{D_I - (.01)D_I t_x}$ gives the variation of force ratio with time assuming no forces are added to either side



Where F_I is the initial force ratio (A_I/D_I)

The formula can be expanded to show the effect on the force ratio of augmenting the defending force with outside help. If time (a) is the first arrival of the augmentation and time (b) is the last arrival of the augmentation, then:

$$F_a = \frac{A_I - (.017)D_I t_a}{D_I - (.01)D_I t_a} = \frac{A_a}{D_a}$$

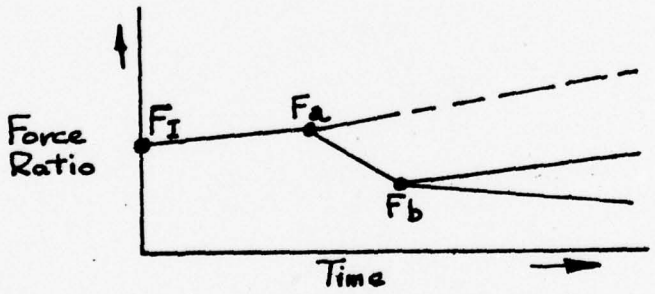
$$F_b = \frac{A_a - (.017)\left(D_I + \frac{D_{aug}}{2}\right)(t_b - t_a)}{D_a - (.01)\left(D_I + \frac{D_{aug}}{2}\right)(t_b - t_a)} = \frac{A_b}{D_b}$$

D_{aug} = Defenders augmentation

Only half of the augmentation is assumed deployed during the period t_a to t_b on the average. The force ratio for any time (x) beyond time (b) is then:

$$F_x = \frac{A_b - (.017)(D_I + D_{aug})(t_x - t_b)}{D_a - (.01)(D_I + D_{aug})(t_x - t_b)}$$

Augmenting the defending force lowers the force ratio:



The shape of the curve beyond time (b) depends on the amount of augmentation provided. If a small augmenting force is applied the force ratio will continue to increase. If a large augmenting force is applied the force ratio will decrease.

The amount of augmentation added to the defending force will be measured as a percentage of the initial attacking force.

It should be noted that the attrition is applied to the initial force in the above formulas and not to the force remaining. This results in a small error which is not worth considering in view of the amount of simplification applied to the rest of the method.

The force ratio with time having been defined, the ground lost or distance penetrated can be determined. Using a Class B terrain from Figure 1 as an average, the following equation results:

distance in meters = $(200F - 100)(\text{time})$

distance in nautical miles = $(.0054)(200F - 100)(\text{time})$

= $1.296\ (2F - 1)(\text{days})$

Substituting for force ratio, F:

with no augmentation

$$\text{distance} = 1.296(F_x + F_I - 1)t_x$$

with augmentation:

$$\text{distance} = 1.296(F_a + F_I - 1)t_a + (F_a + F_b - 1)(t_b - t_a) + (F_b + F_x - 1)(t_x - t_b)$$

The distance penetrated, for other terrain classes, may be determined by multiplying the distance for a Class B terrain by a rate of advance ratio determined from Figure 1. If a highly mobile war, such as World War II's North African campaign, is assumed, then the Class B terrain distance can be adjusted, Table III.

TABLE III

RATE OF MOVEMENT IN KILOMETERS PER HOUR; DAYLIGHT/DARKNESS

Terrain Type	Class A	Class B	Class C
Troop Trucks	20/10	10/5	5/4
Truck Drawn Artillery	20/10	10/5	5/4
Light Tank	20/10	15/5	5/4
Armored Personnel Carrier	20/10	15/5	5/4
Self Propelled Artillery	20/10	15/5	5/4
Tractor Drawn Artillery	12/5	5/4	5/4
Medium or Main Battle Tank	16/6	10/4	5/4

RESULTS

An examination may now be made of the effect of deployment time and rate, for various levels of augmentation, on the penetration distance achieved by an attacker, for differing force ratios. Figs. 2 through 4 present the time and distance plots for initial force ratios of 2 to 1, 4 to 1, and 6 to 1. Augmentation of 10, 25, and 50 percent of the initial attacking force was considered. The augmentation was assumed to commence arriving at D + 3 days (where D = beginning of war). The deployment period was determined as 5, 17, and 27 days. Figs 5 through 9 present the casualty rates for Figs 2 through 4. Cross plots were made of the casualty rate curves for a casualty level of 40 percent (Ref. C) for attacker and defenders, Figs. 10 through 12. These determine the augmentation that must be applied for both sides to reach the 40 percent casualty level at the same time. If more augmentation is applied the attackers will reach the unacceptable casualty level before the defenders. A 60 percent casualty level was determined for a 4 to 1 force ratio.and was found to result in the same augmentation level requirement as at 40 percent casualty level. The augmentation required for equal casualty level at equal time is independent of the deployment period. The augmentation requirement is dependent only on the initial force ratio. Fig. 13 shows the time when the 40 percent casualty level is reached as a function of the force ratio and varying deployment periods for the augmentation commencing at D + 3 days. The time at which the 40 percent level is reached is approximately 40 days (+10 days, - 2 days) which should be expected as the assumed loss rate was 1 percent per day for the defense.

In Figs. 14 through 17, the effect of varying the starting time of the deployment was examined for the 4 to 1 force ratio. Figs. 16 and 17 demonstrate the fact that the augmentation required for equal casualty level at equal time is independent of the time the deployment starts. Fig. 18 illustrates the effect of the deployment initiation time and deployment period on the time when the unacceptable casualty level (40 percent) is reached.

In order to give more flexibility to the variation of deployment initiation, deployment time and force augmentation and their effect on penetration distance and time, Fig. 19 with overlays A and B was developed from the data used in the 4 to 1 force ratio plots. When compared to the other force ratios, it checks to within about 10 percent of the calculated values. Overlay A is positioned on Fig. 19 at the time when the augmentation first arrives (when the deployment is initiated) with the 0 percent curve tangent to the desired initial force ratio. Overlay B is positioned on overlay A at the time the deployment is completed with the 0 percent curve tangent to the desired percent augmentation on overlay A. The penetration distance versus time can thus be determined for variations in deployment time, force ratio, and augmentation.

Fig. 20 summarizes the augmentation required for various force ratios, as determined by Figs. 10, 11, 12, 16 and 17, for both attacker and defender to reach an unacceptable casualty level at the same time. Also shown is a curve based on an analysis of the Korean War, Page 18, in which augmentation was 30 percent greater than for both sides reaching the casualty level at the same time.

It has been determined that the force augmentation is independent of time and dependent only on the initial force ratio. The timing of augmentation of the defense force depends on the time it takes the attacker to overrun (a) the country in total or (b) the major population, industrial and agricultrual areas of the country or (c) the time when an unacceptable casualty level is reached by one side or the other. The time when the unacceptable casualty level is reached has already been examined in Figs. 13 and 18. An examination of six countries to determine the time required for an attacker to overrun these countries follows. Since the unacceptable casualty level is reached in 40 to 50 days the countries will be examined for penetration out to 60 days. Table IV presents the six countries considered and a short scenario for each. For the purposes of this study, scenario is interpreted as meaning all the background information for a given war situation at war's beginning. The following list identifies the figures which show the penetration distance for various force ratios, the figures which show terrain and the figures which show road and rail systems.

	Figure Number				
	Terrain Class	Road and Rail System	Penetration 2:1	4:1	6:1
India	21	22	23	24	25
Iran	26	27	28	29	30
Korea	31	32	33	33	34
Thailand	35	36	37	38	39
W. Germany	40 1/	41	42	43	44
Venezuela	45	46	47	49	50

Venezuela was also examined at a 3.3 to 1 force ratio (Fig. 48).

Table V presents the force required and time limit for the six countries using the scenarios of Table IV.

1/ not included, to be furnished later

TABLE IV

SIX SHORT SCENARIOS

Country (Assistance) Source	No. Troops in use	Effectiveness Ratio	Attack Location
China	500,000	1.3	Present indefinite boundary extending
India (U.S. & USSR)	300,000	1.0	from Pakistan to Repal.
Kurds (Russ Iraq)	250,000	1.1	Between Iraq and the Caspian Sea
Iran (Cento, U.S.)	150,000	1.0	
North Korea (China)	1,000,000	1.0	Below present boundary
South Korea (U.N.)	550,000	1.1	
Shan State (China)	500,000	2	Through Burma across 18th parallel in
Thailand (U.S.)	125,000	1	northwest Thailand
Russia (Warsaw Pact)	1,500,000	1	Russia attempts to unify Germany. A
West Germany (NATO)	800,000	1	highly mobile war west of present boundary.
People Republic of Venezuela (Cuba)	10,000	2	War has escalated from guerrilla type to open fighting for control of land areas.
Nationalist Venezuela (U.S.)	6,000	1	Attackers have taken Caracas and Barcelona and are advancing toward Barinas.

TABLE V

FORCE AND TIME REQUIREMENTS FOR SIX COUNTRIES

Country	1/ Force Ratio Table IV	2/ Augmentation Required Fig. 20	TIME = Days 3/ For Casualty Level of 40%	For Casualty Level of 60%	To Overrun Country	Critical Time Days	Reason
India	2.2:1	88,000	40	60	140	40	Defense Collapses
Iran	1.8:1	33,000	40	60	45	40	Defense Collapses
South Korea	1.6:1	118,000	40	60	60	40	Defense Collapses
Thailand	8.0:1	275,000	40	60	42	40	Country overrun
West Germany	1.9:1	195,000	40	60	70	40	Country Overrun and defense collapses
Nationalist Venezuela	3.3:1	3,800	40	60	60	40	Country overrun

1/ Use 2:1 ratio for values below 2:1 and 6:1 for value greater than 6:1 for determining the penetration.

2/ Using an augmentation 30% greater than that required for equal casualty level. Assuming a 1:1 effectiveness ratio between the augmentation force and the attacking force.

3/ Assuming no augmentation

COMPARISON OF METHOD WITH THE KOREAN WAR

The validity of this method of war gaming was confirmed by checking it against the initial phase of the Korean War, where the United Nation's deployed forces to augment the South Korean force.

The following data were obtained from a book (Official U.S. Army History of the Korean War),titled "South to the Naktong North to the Yalu," by Roy E. Appleton. The initial force ratio was 4 to 1 as previously developed on Page 8. The United Nations augmentation was 44% of the initial North Korean force (assuming a 1 to 1 force effectiveness between the U.S. and North Korean forces). Fig. 51 shows the buildup of U.N. forces compared to time. Fig. 52 shows the front at various times, the Pusan perimeter being reached in 41 days. Applying the above data and using Fig. 19 1/ the front line positions were determined for various times (Overlay A, Fig. 52). The calculated penetration agrees very closely with the actual front line positions. Therefore, it was assumed that the simplified war gaming method developed in this document is valid for limited war situations.

1/ The penetration distance read from Figure 19 was cut in half because the rate of advance used in Figure 19 is based on a daylight rate applied for the total day and it was assumed that there would be some days when no advance would take place due to regrouping, resupplying, consolidation, and mop-up operations. Therefore, the penetration distance shown by Figure 19 was reduced by a factor of 0.5.

CONCLUSIONS

Force and Time Requirements

The augmentation force required in the event of a limited war is dependent only on the initial force ratio (attackers/defenders at onset of war).

The augmentation is independent of the initiation time of deployment and the period of deployment. The timeliness of any augmentation force depends on two factors. Those factors are:

(1) How long it will take an aggressor to overrun the attacked country

(2) When the defending forces will collapse through reaching an unacceptable level of casualties.

The length of time required to overrun a country is related to the attacked country's size and must be determined by a map exercise.

A defensive force collapses in 40 days if some augmentation of force is not provided, and if the unacceptable casualty level is 40%. (See Table V)

Method of War Gaming

1. The simple war gaming method developed appears to provide a reasonable means of determining the effect of augmentation and deployment time for known initial force ratios. This conclusion is supported by the application of this method to the Korean War. It may be that the basic data used to develop the simple war game method was also based on the Korean War. Then the extrapolation of the method to other limited wars becomes questionable.

2. The method is valid only for the initial phase of a war, up to the time an aggression is halted or contained. It does not allow for aggressive action to drive the aggressors back to the initial front.

3. This method does not allow for any augmentation applied to the aggressors.

4. The method does not allow for the effect of obstacles (rivers), air strikes, weather conditions, etc. These may be accounted for by varying the rate of advance.

5. The method is dependent on the initial input, the effective force ratio between the two forces. This may be estimated by examining the personnel ratio, firepower ratio, and armor ratio of the forces. (see Page 8).

REFERENCES

A. The War Gaming Handbook (U) JSCONARC. Pamphlet No. 70-5 (dated Sept. 1961)

B. Army Staff Officers Field Manual (FM 101-10. part 1, page 46).

C. War Gaming Handbook, Figs 28-1 and 28-3 show that infantry attackers break at 30 percent casualties and the defense breaks at 40 percent. Artillery breaks at 60 percent casualties and armored breaks at 67 percent. For the purposes of this study both defenders and attackers are assumed to break at 40 percent casualties.

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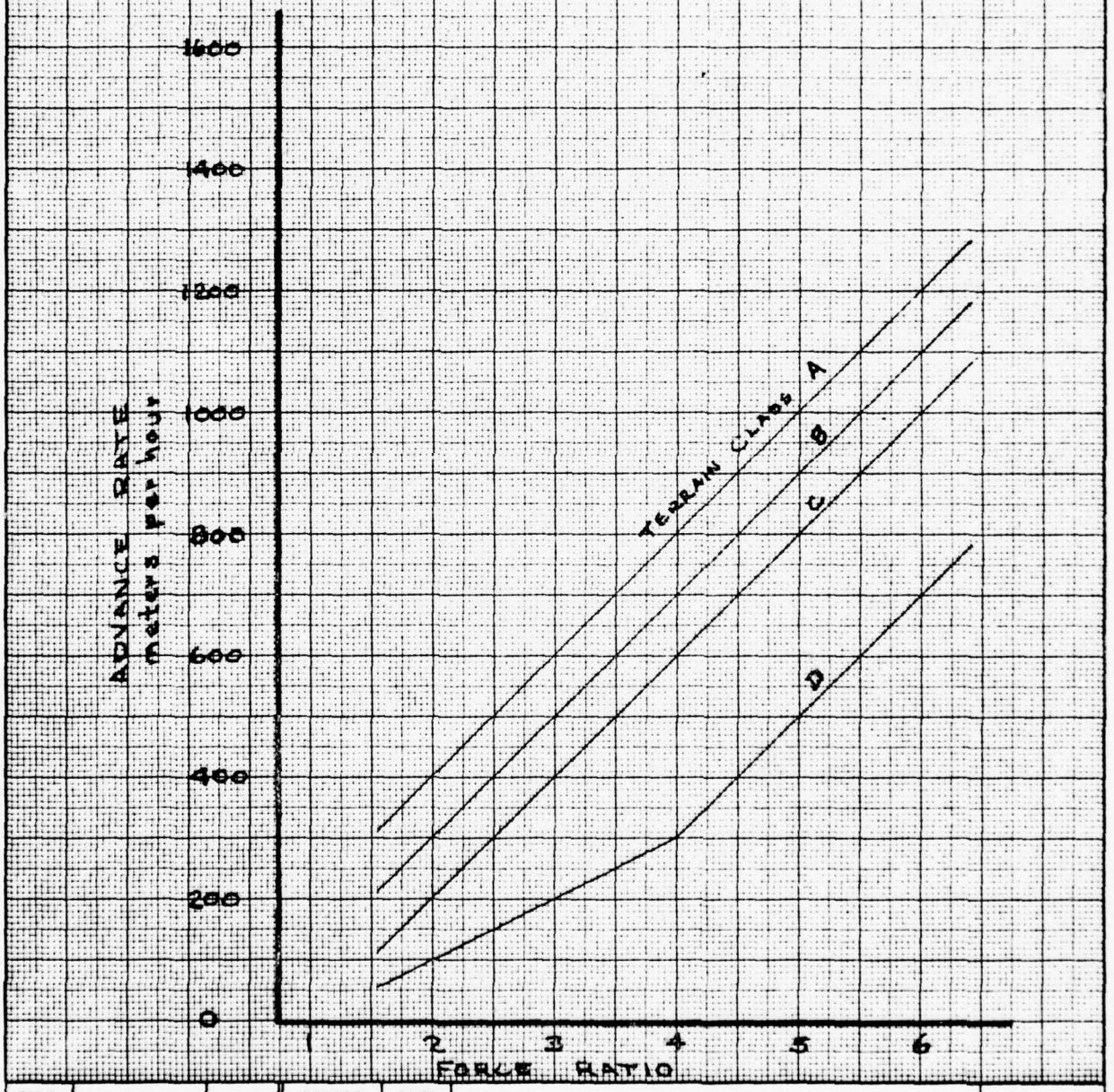
RATES OF MOVEMENT FOR
DISMOUNTED TROOPS

DAYLIGHT HOURS



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RATES OF MOVEMENT FOR
DISMOUNTED TROOPS

Fig. 1

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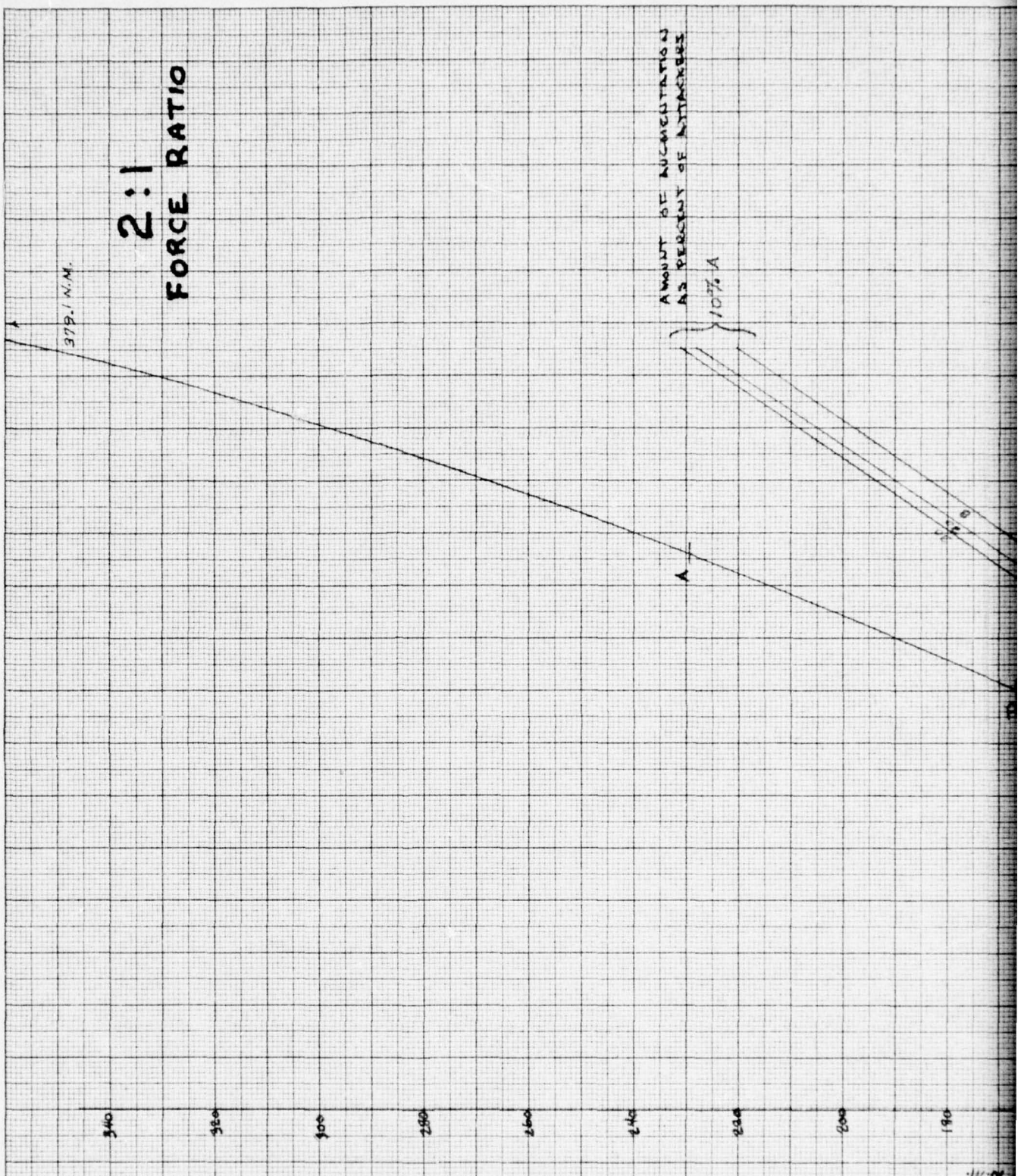

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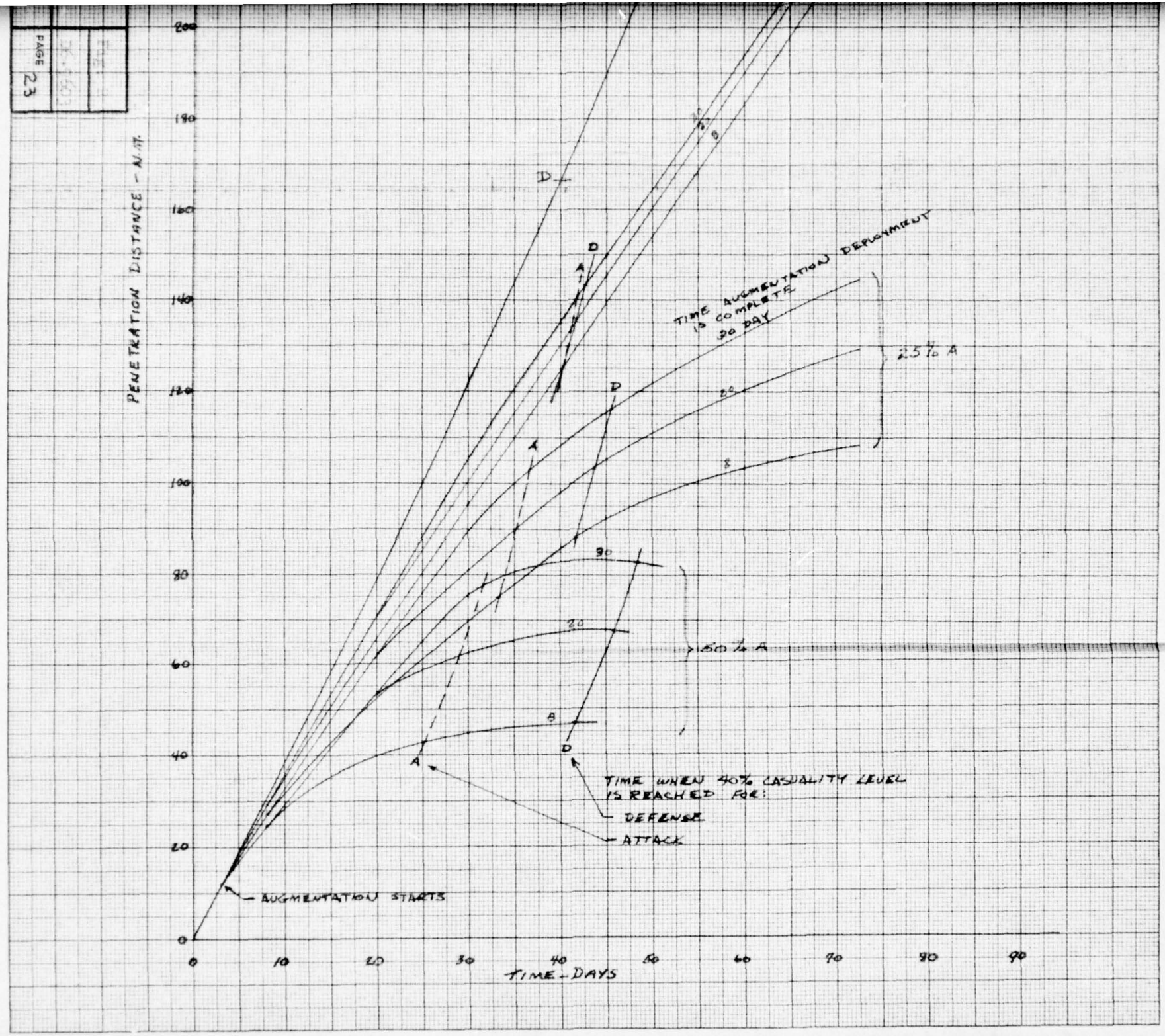
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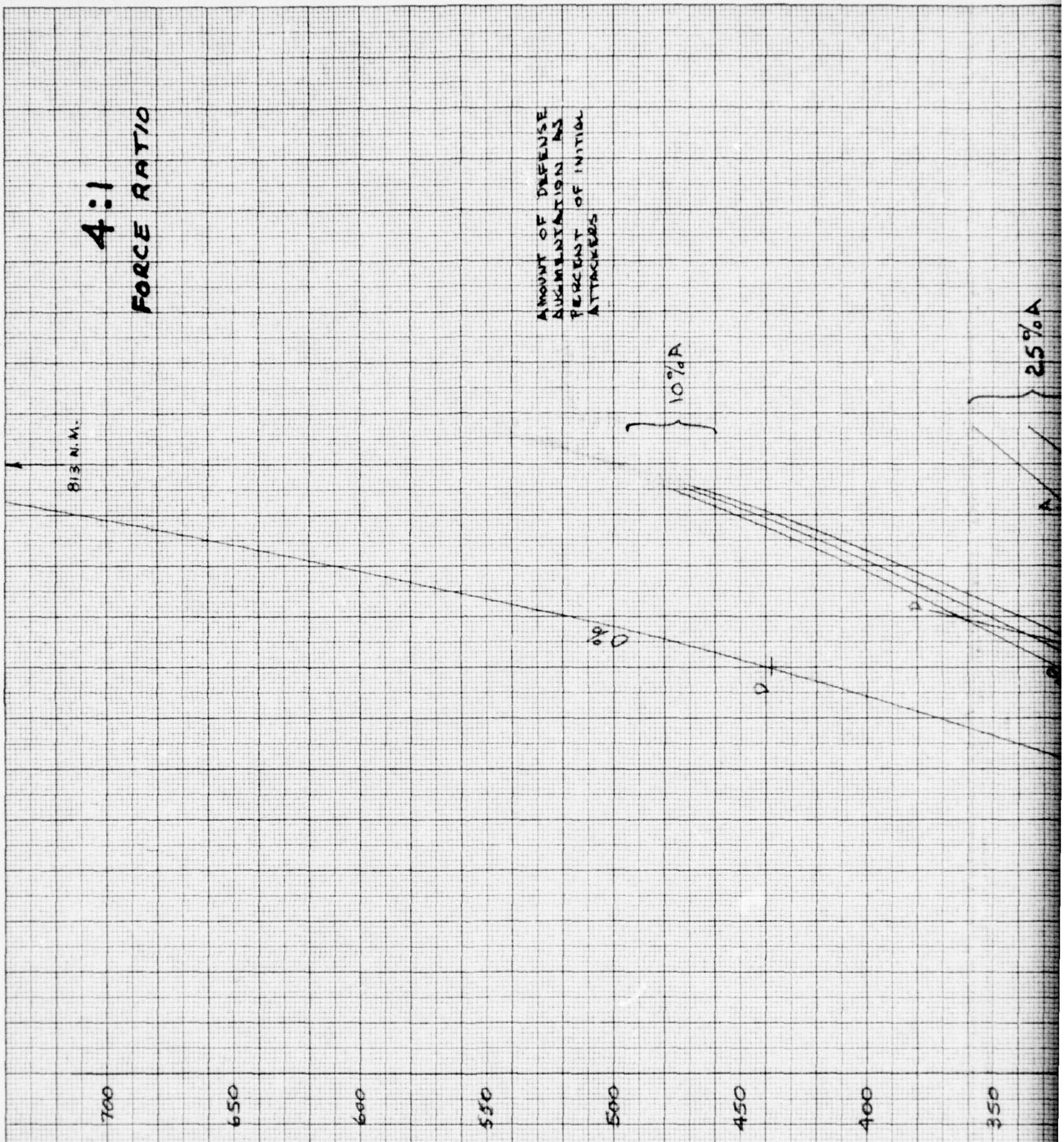
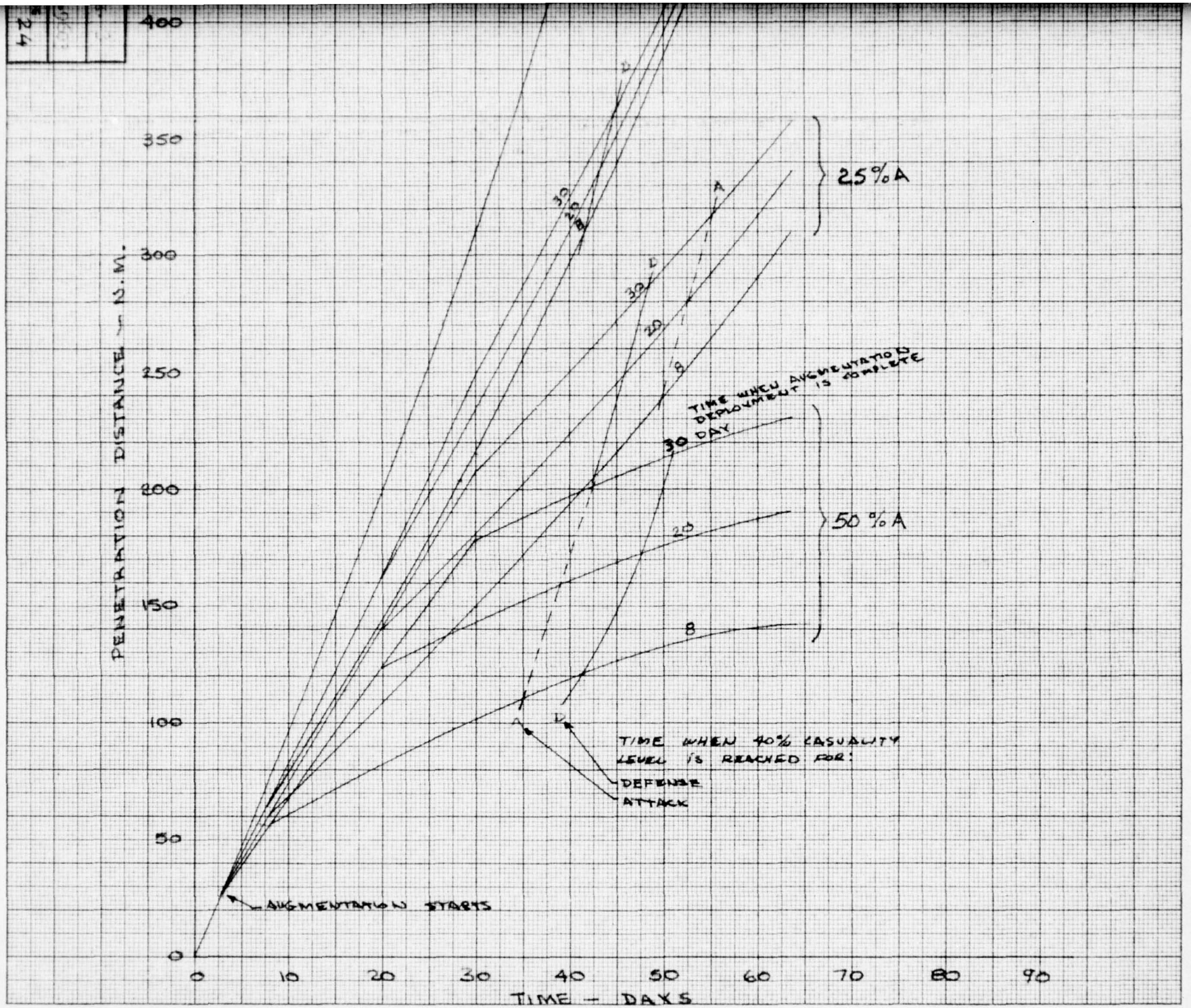
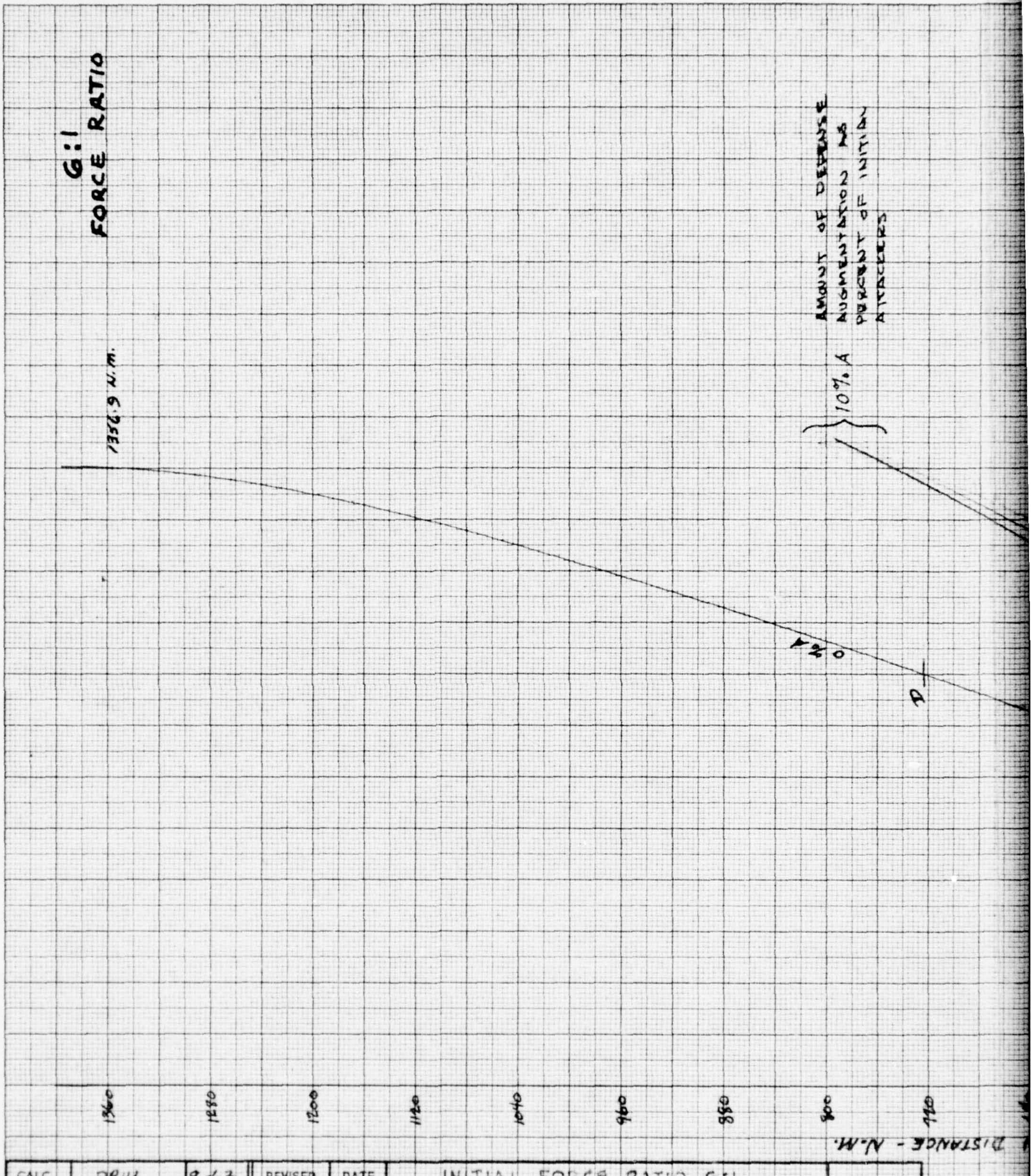
20
30
40
50
60
70
80
90
D
A
B
TIME AUGMENTATION DEPLOYMENT IS COMPLETE 30 DAY
25% A
150 % A
TIME WHEN 40% CASUALITY LEVEL IS REACHED FOR:
DEFENSE
ATTACK
AUGMENTATION STARTS



CALC	DRW	8-63	REVISED	DATE	INITIAL FORCE RATIO 4:1 AUGMENTATION STARTS D+3
CHECK					
APPD					
APPD					THE BOEING COMPANY

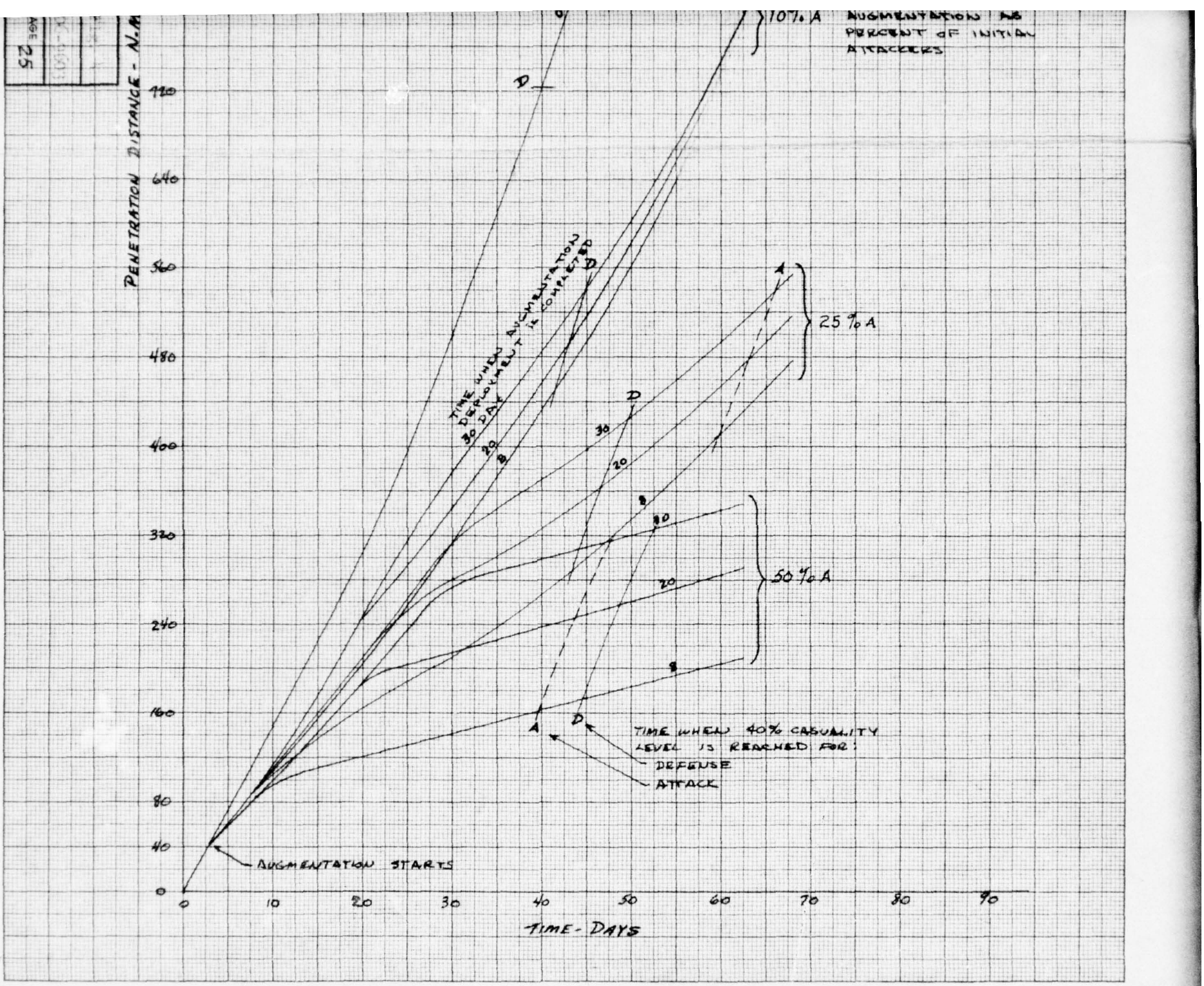

PENETRATION DISTANCE – N.M.
TIME – DAYS
0
50
100
150
200
250
300
350
400
0
10
20
30
40
50
60
70
80
90
25% A
50% A
30 DAY
TIME WHEN AUGMENTATION DEPLOYMENT IS COMPLETE
TIME WHEN 40% CASUALTY LEVEL IS REACHED FOR:
DEFENSE
ATTACK
AUGMENTATION STARTS

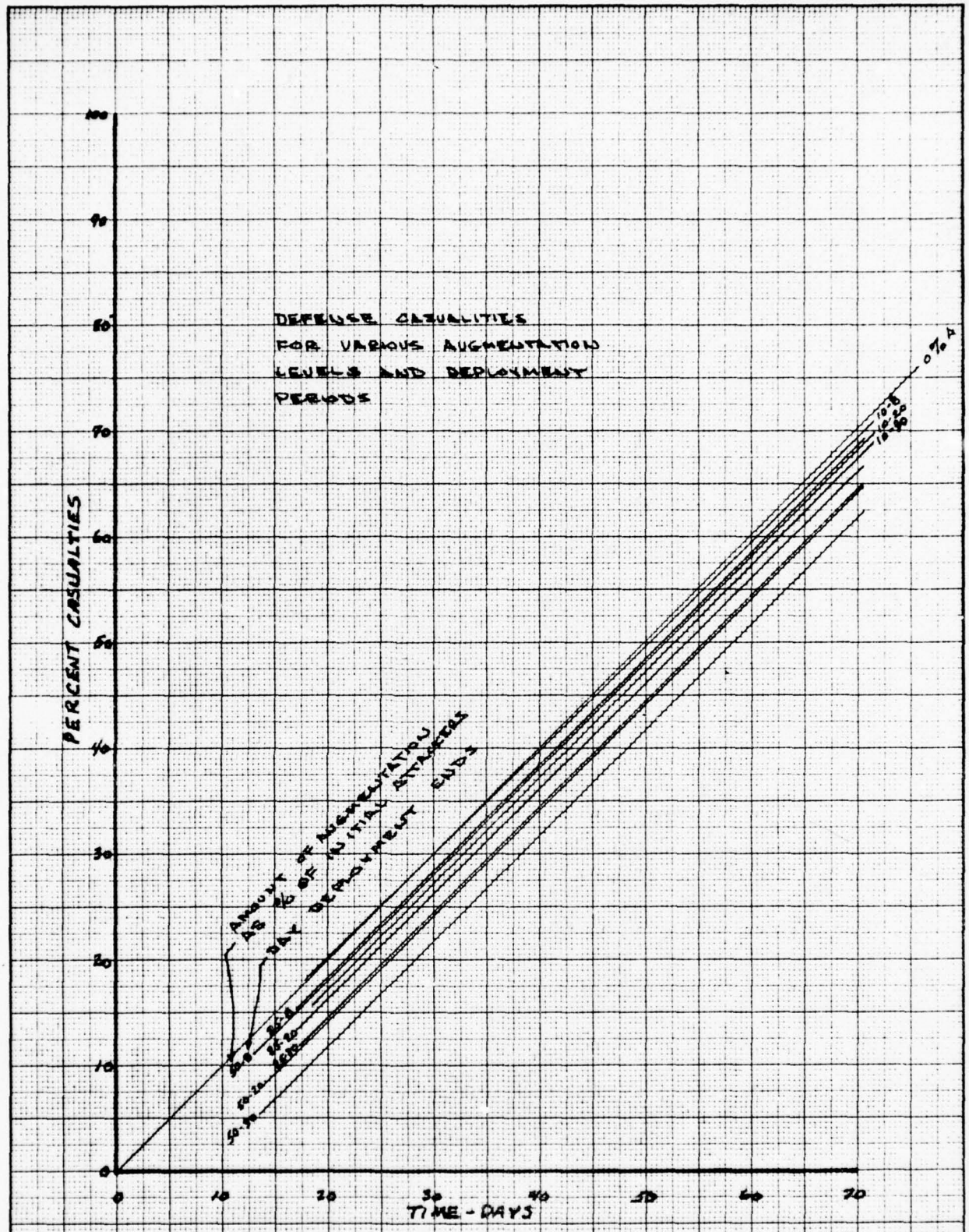


CALC	DRW	8-63	REVISED	DATE	INITIAL FORCE RATIO 6:1
CHECK					AUGMENTATION STARTS D+3
APPD					
APPD					THE BOEING COMPANY

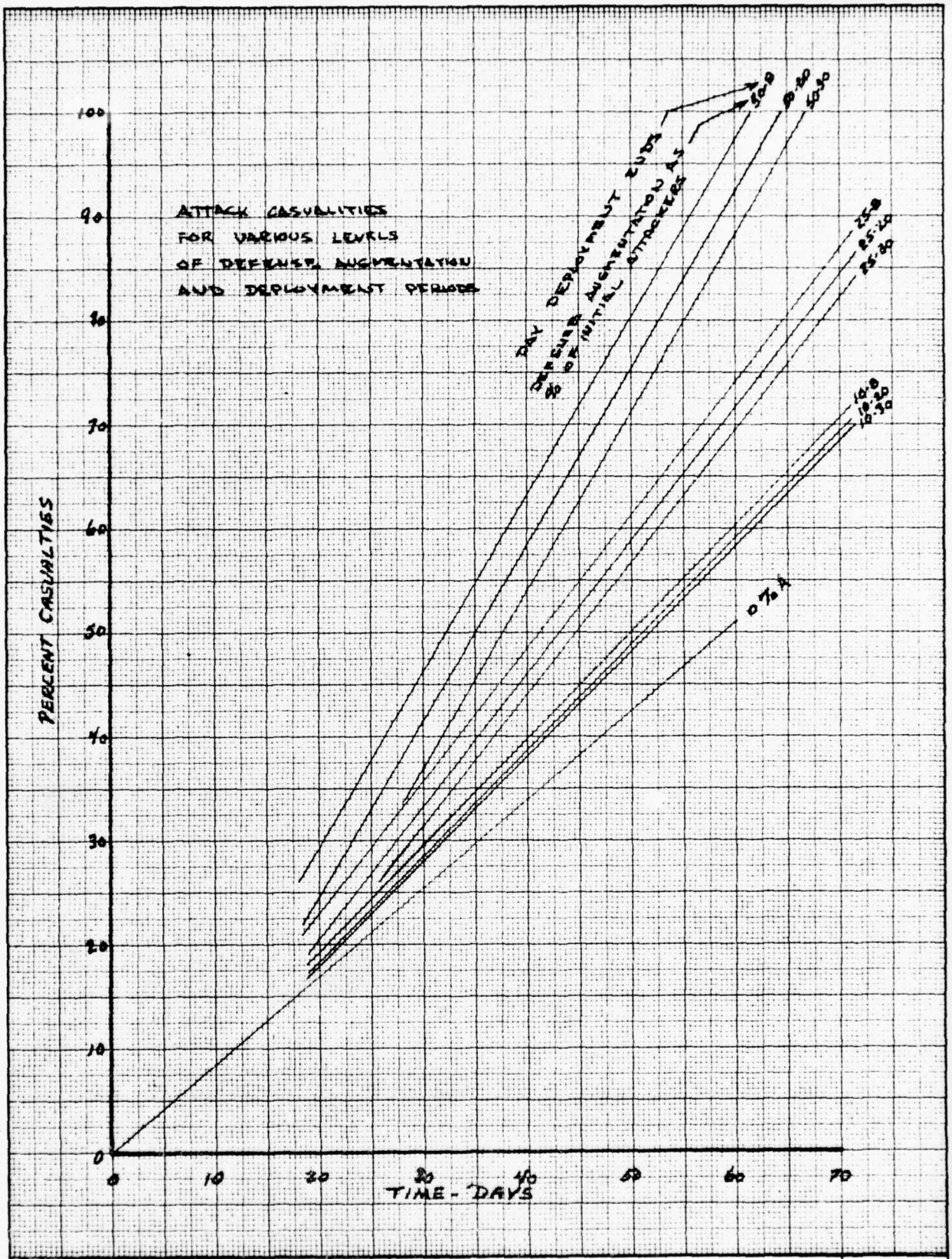
[illegible]

[illegible]


PENETRATION DISTANCE - N.M.
TIME - DAYS
0
40
80
160
240
320
400
480
560
640
720
0
10
20
30
40
50
60
70
80
90
AUGMENTATION STARTS
TIME WHEN AUGMENTATION DEPLOYMENT IS COMPLETED
30 DAY
20
10% A
AUGMENTATIONS AS PERCENT OF INITIAL ATTACKERS
25 % A
50 % A
TIME WHEN 40% CASUALITY LEVEL IS REACHED FOR:
DEFENSE
ATTACK
A
D



CALC	DRW	8-63	REVISED	DATE	INITIAL FORCE RATIO 2:1 DEFENSE CASUALTIES AUGMENTATION STARTS D+3	Fig. 5 D6-9603
CHECK						
APR						
APR					THE BOEING COMPANY	PAGE 26



CALC	DRW	8-63	REVISED	DATE	INITIAL FORCE RATIO 2:1 ATTACK CASUALTIES AUGMENTATION STARTS D+3	Fig. 6 D6-9603
CHECK						
APR					THE BOEING COMPANY	PAGE 27
APR						

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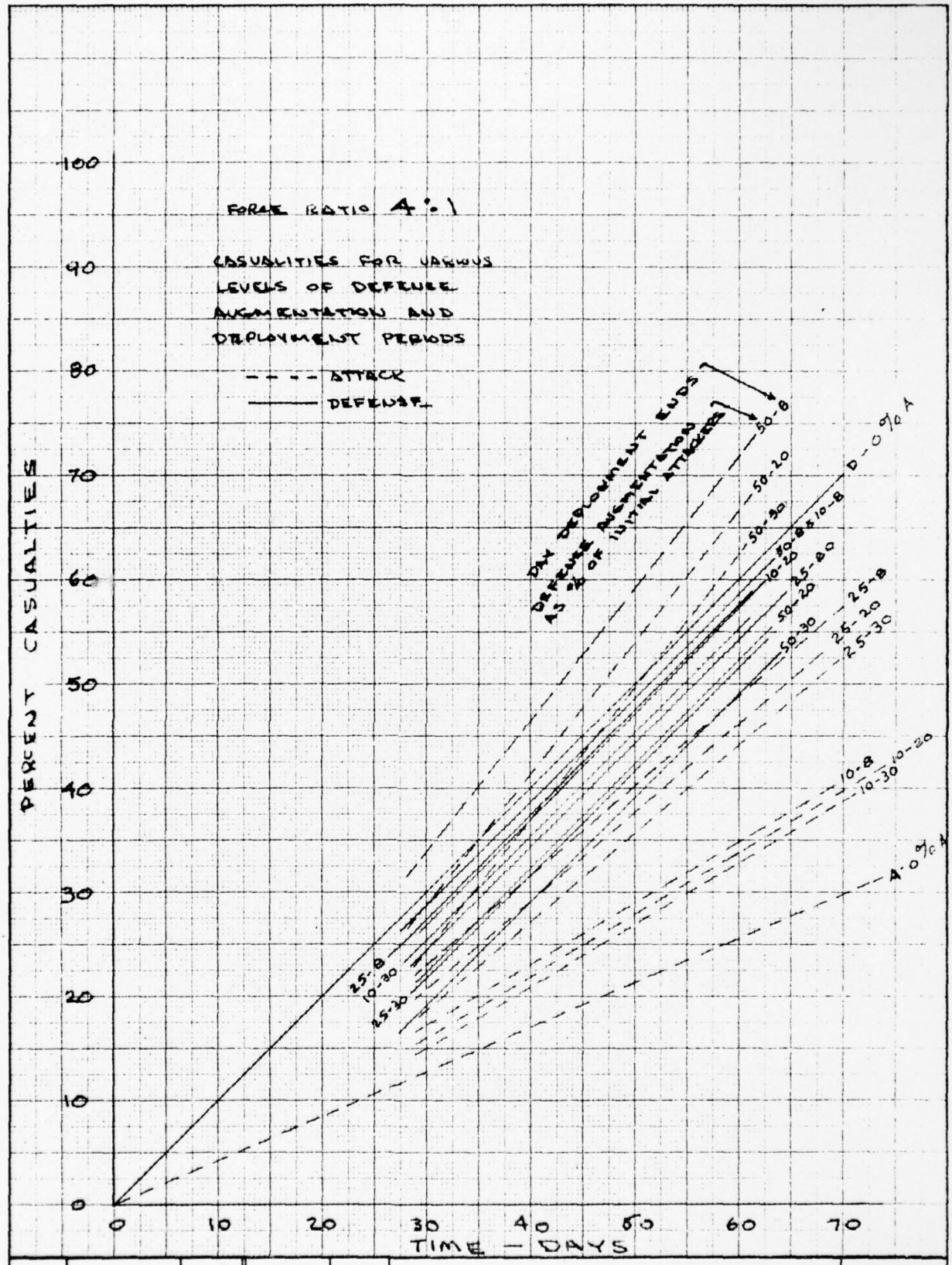
K·E ALBANENE® 6-7000 TRACING PAPER



CALC	WRT	4/63	REVISED	DATE	CASUALTIES - DEFENSE & ATTACK AUGMENTATION STARTS D+3
CHECK					
APR					
APR					

THE BOEING COMPANY

Fig. 7
D6-9603
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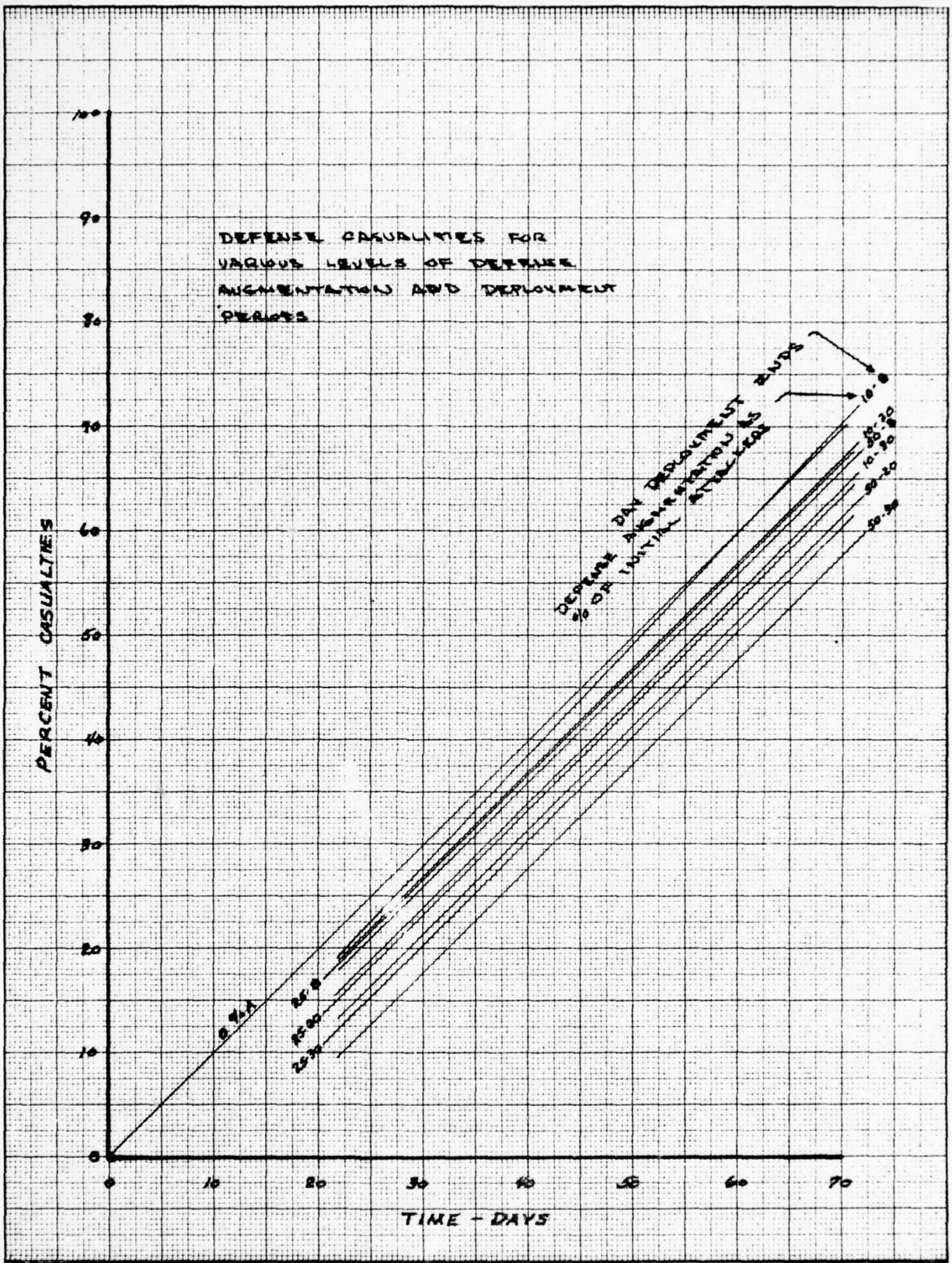
K+E ALBANY, N.Y. 6-7000



CALC	DRW	8163	REVISED	DATE	INITIAL FORCE RATIO 6:1	Fig. 8
CHECK					DEFENSE CASUALTIES	D6-9603
APR					AUGMENTATION STARTS D+3	
APR					THE BOEING COMPANY	PAGE 29

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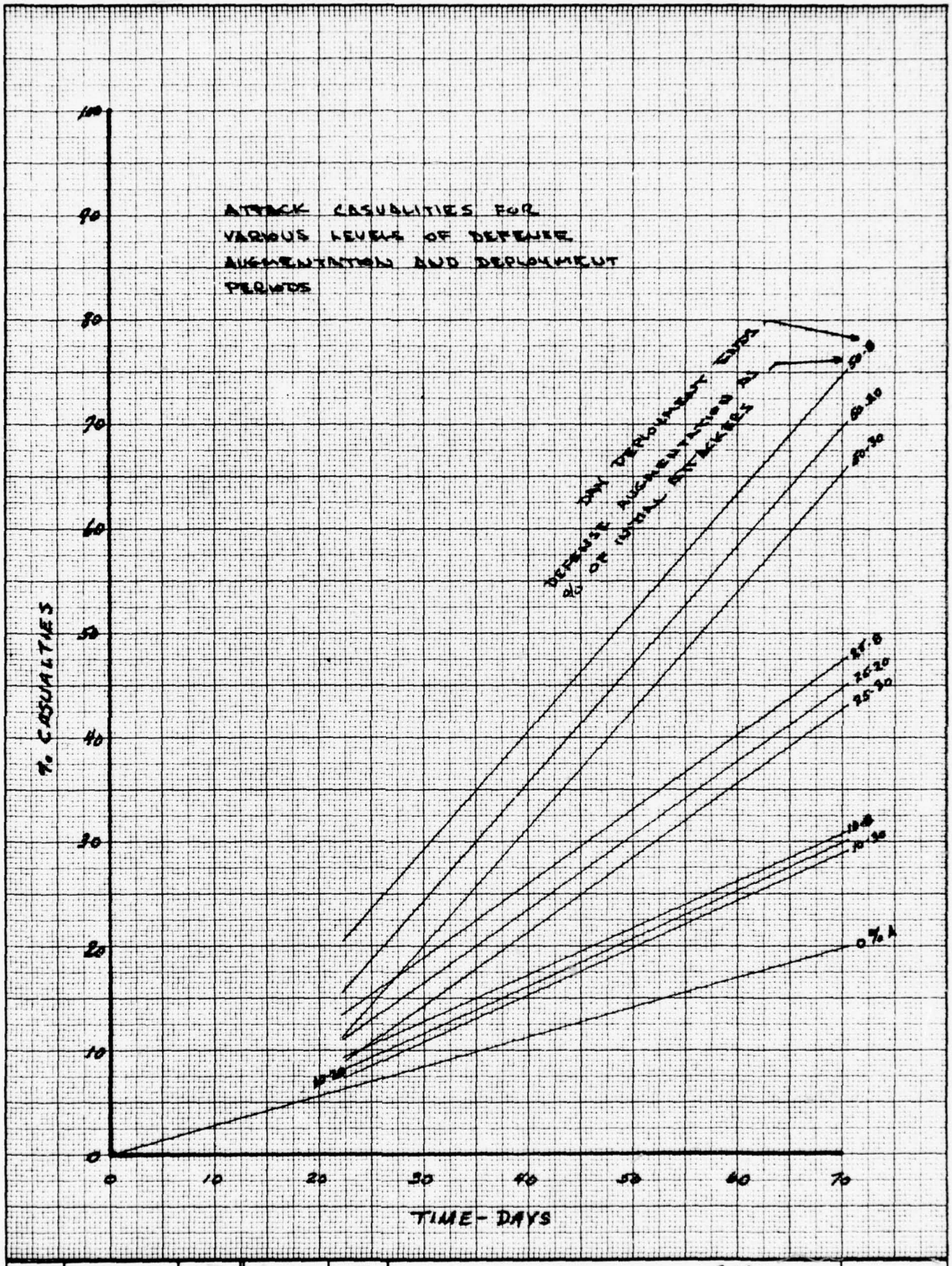
K·E ALBANENE® 6-7000 TRACING PAPER



CALC	DRW	9-63	REVISED	DATE	INITIAL FORCE RATIO 6:1 ATTACK CASUALTIES AUGMENTATION STARTS D+3	Fig. 9 D6-9603
CHECK						
APR						
APR					THE BOEING COMPANY	PAGE 30

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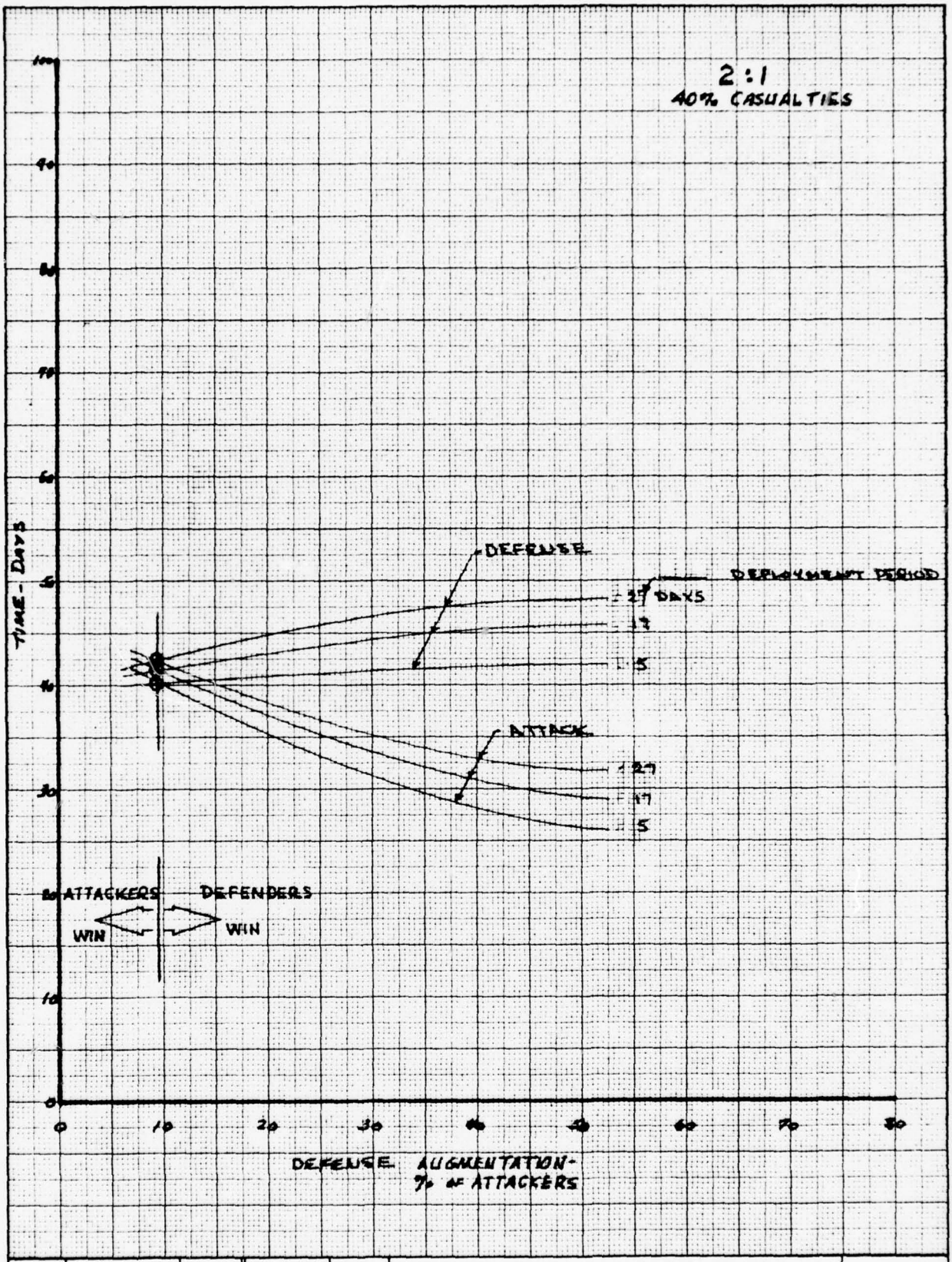
K·E ALBANENE® 6-7000 TRACING PAPER



CALC	DRW	8/63	REVISED	DATE	UNACCEPTABLE CASUALTY LEVEL TIME vs AUGMENTATION INITIAL FORCE RATIO 2:1
CHECK					
APR					
APR					THE BOEING COMPANY

FIG. 10

D6-9603

PAGE 31

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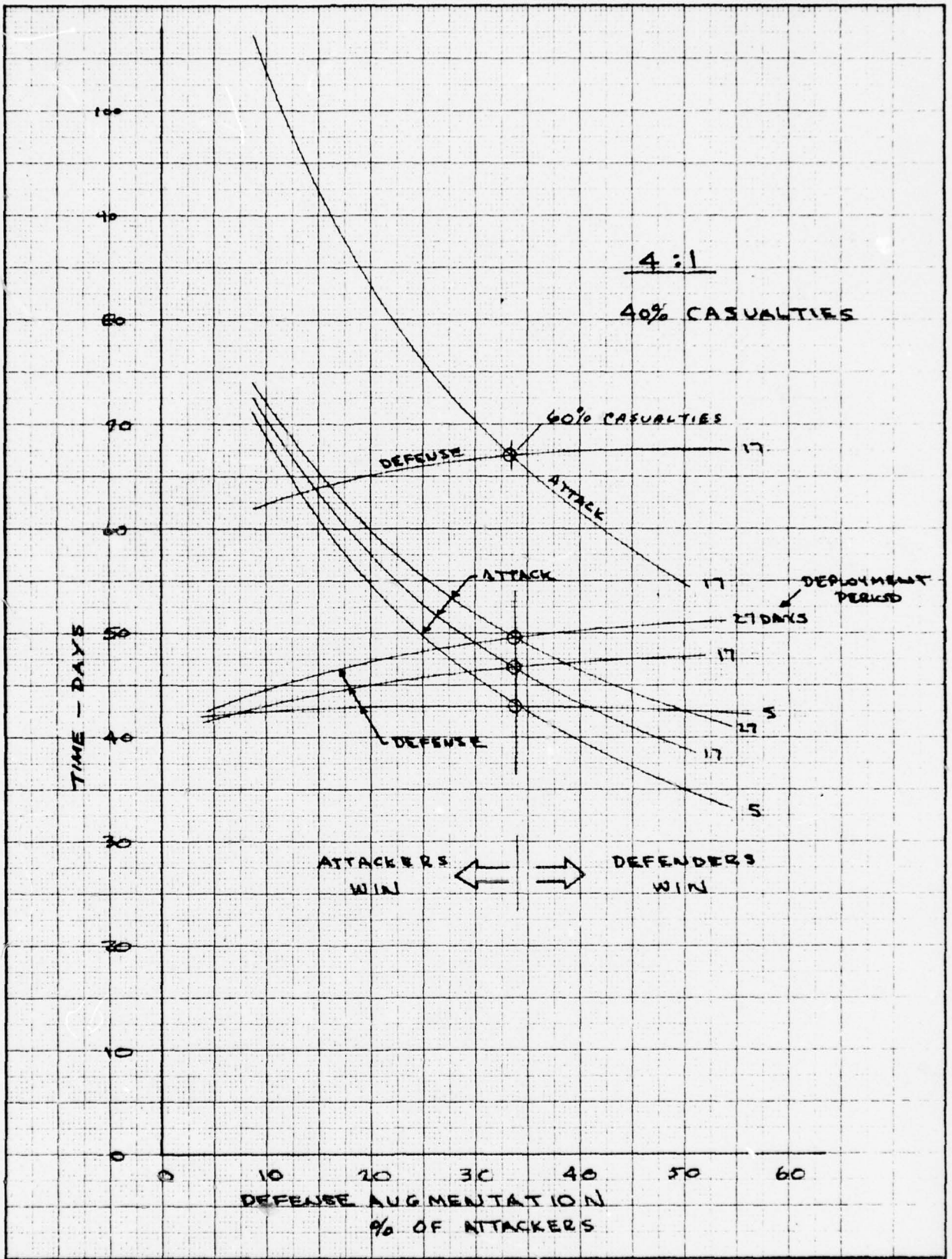
K+E ALBANENE 10X6 6-7000



CALC	DRW	8-63	REVISED	DATE	UNACCEPTABLE CASUALTY LEVEL TIME VS AUGMENTATION INITIAL FORCE RATIO 4:1
CHECK					
APR					
APR					
					THE BOEING COMPANY

FIG. 11
D6-9603
PAGE 32

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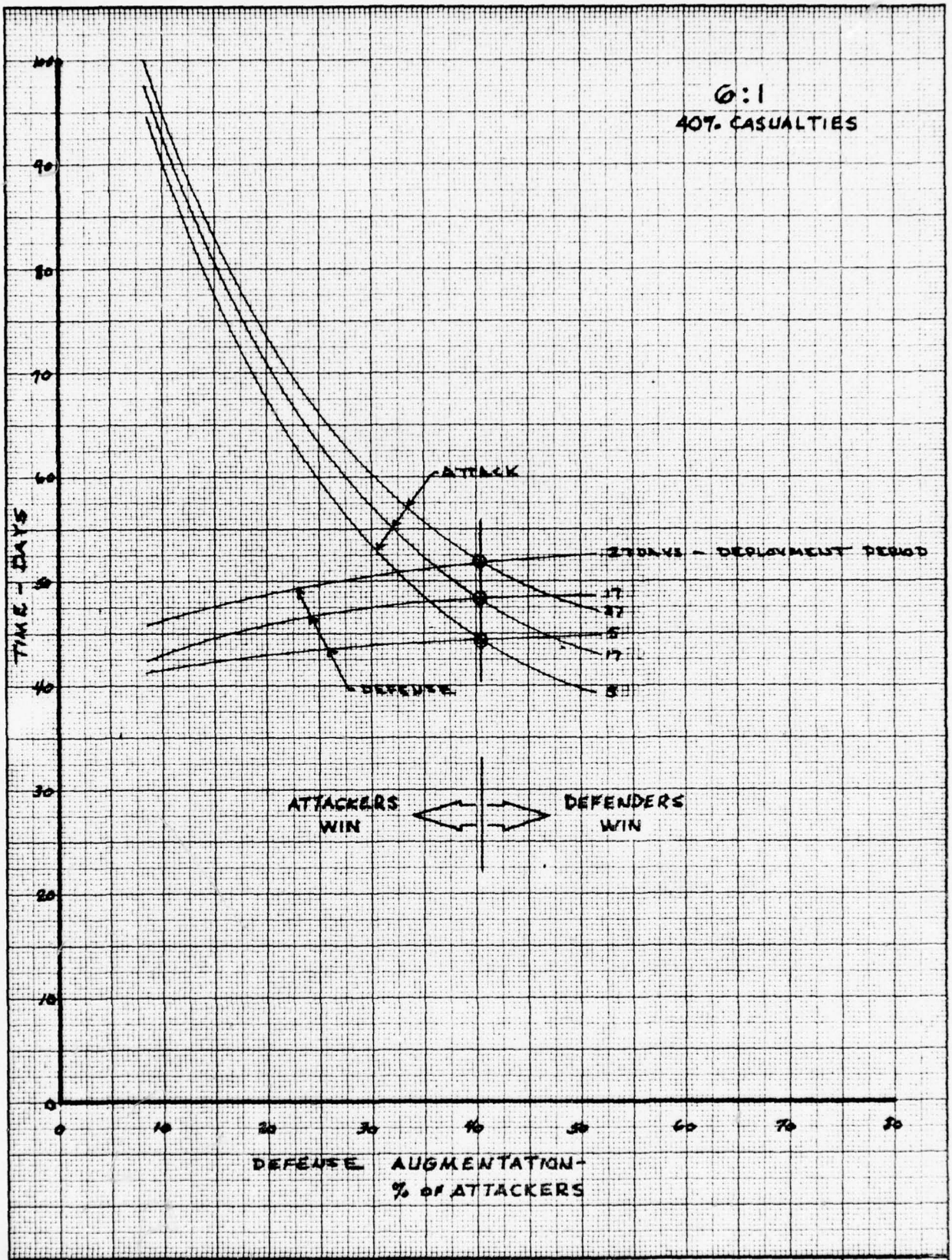

CALC	DRW	4-63	REVISED	DATE	UNACCEPTABLE CASUALTY LEVEL TIME VS AUGMENTATION INITIAL FORCE RATIO 6:1	FIG 12
CHECK						D6-9603
APR						
APR					THE BOEING COMPANY	PAGE 33

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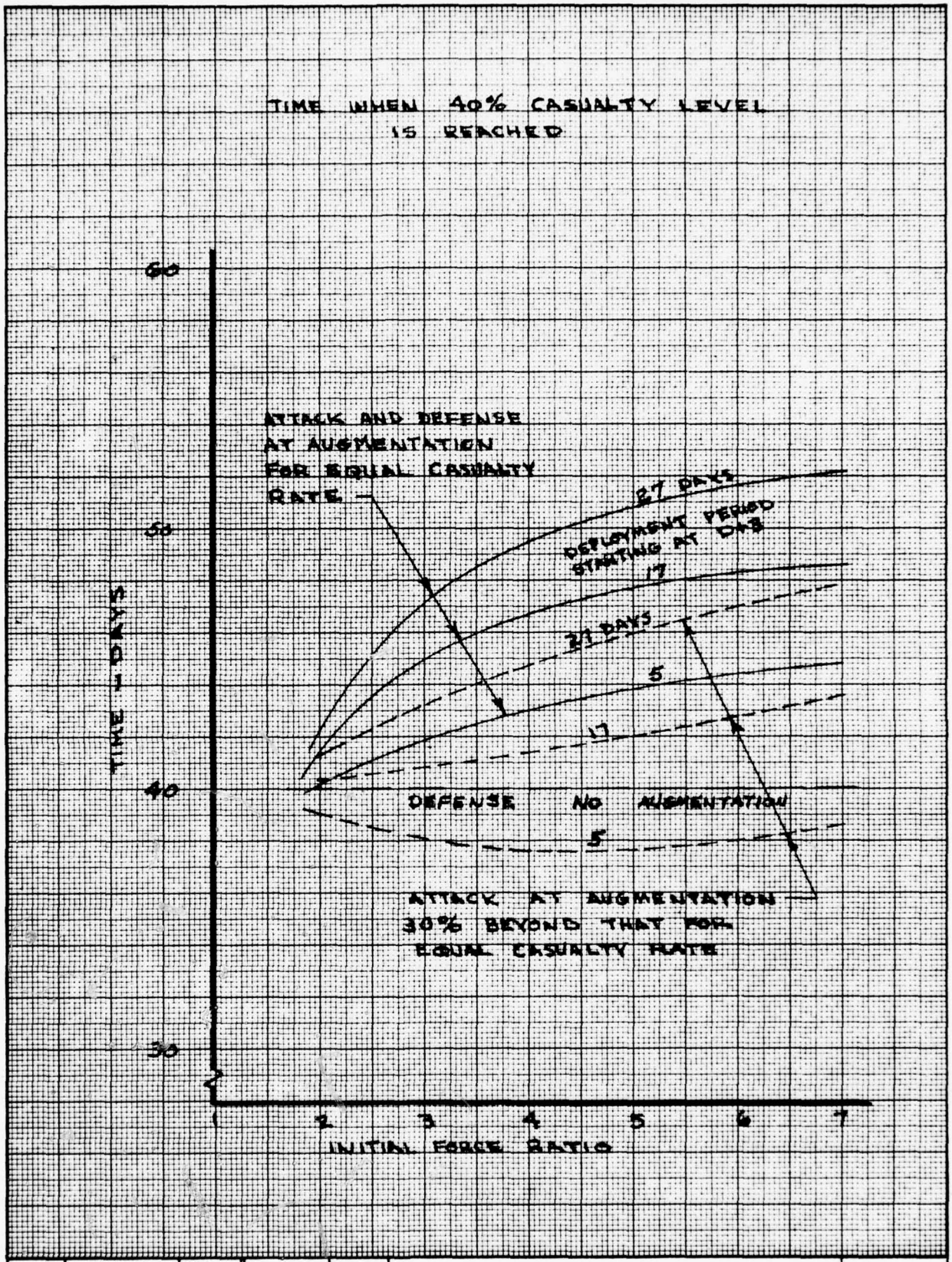
K·E ALBANENE® 6-7000 TRACING PAPER



CALC	GRT	8-63	REVISED	DATE	40% CASUALTY LEVEL TIME VS FORCE RATIO
CHECK					
APR					
APR					THE BOEING COMPANY

Fig. 13

D6-9603

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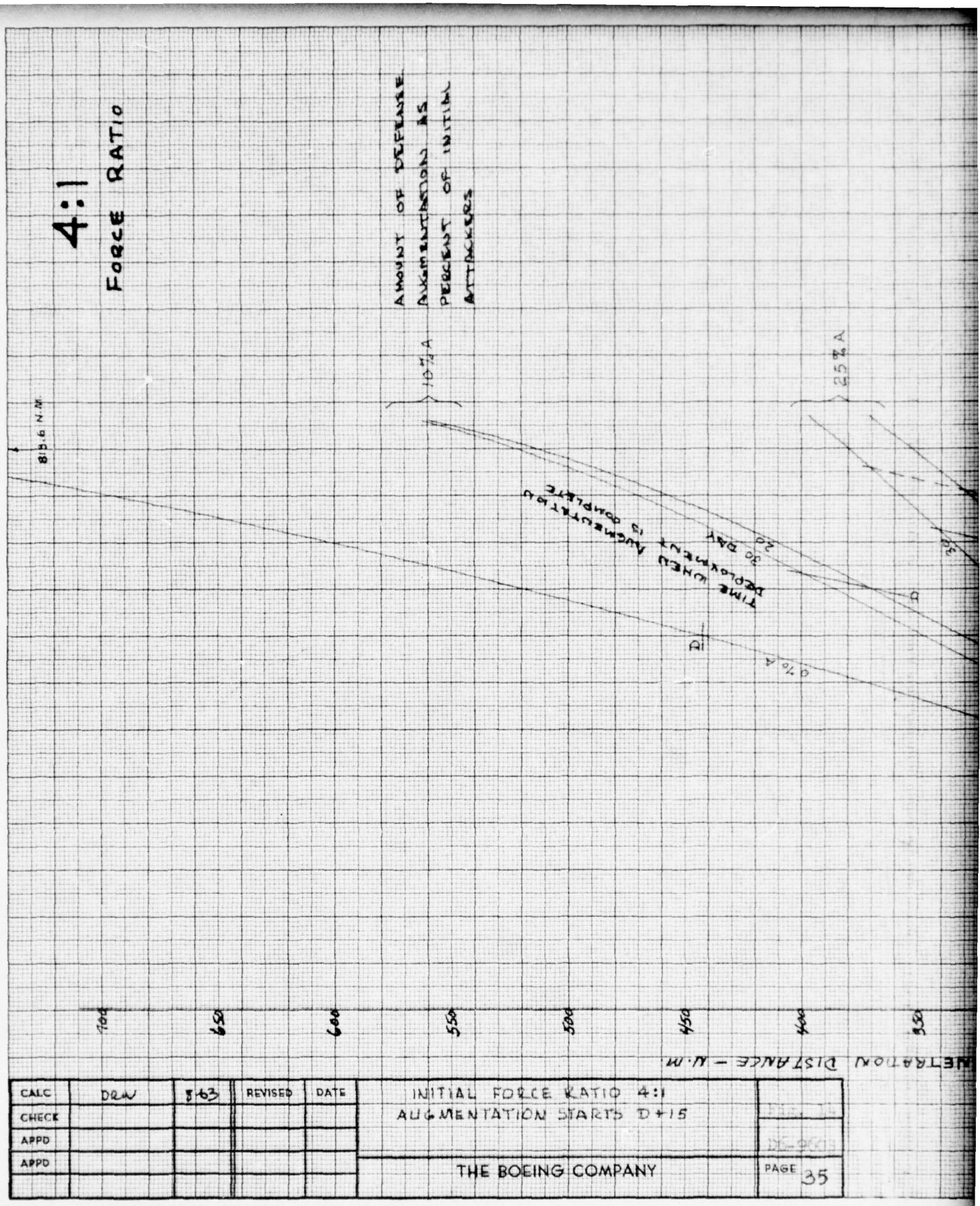
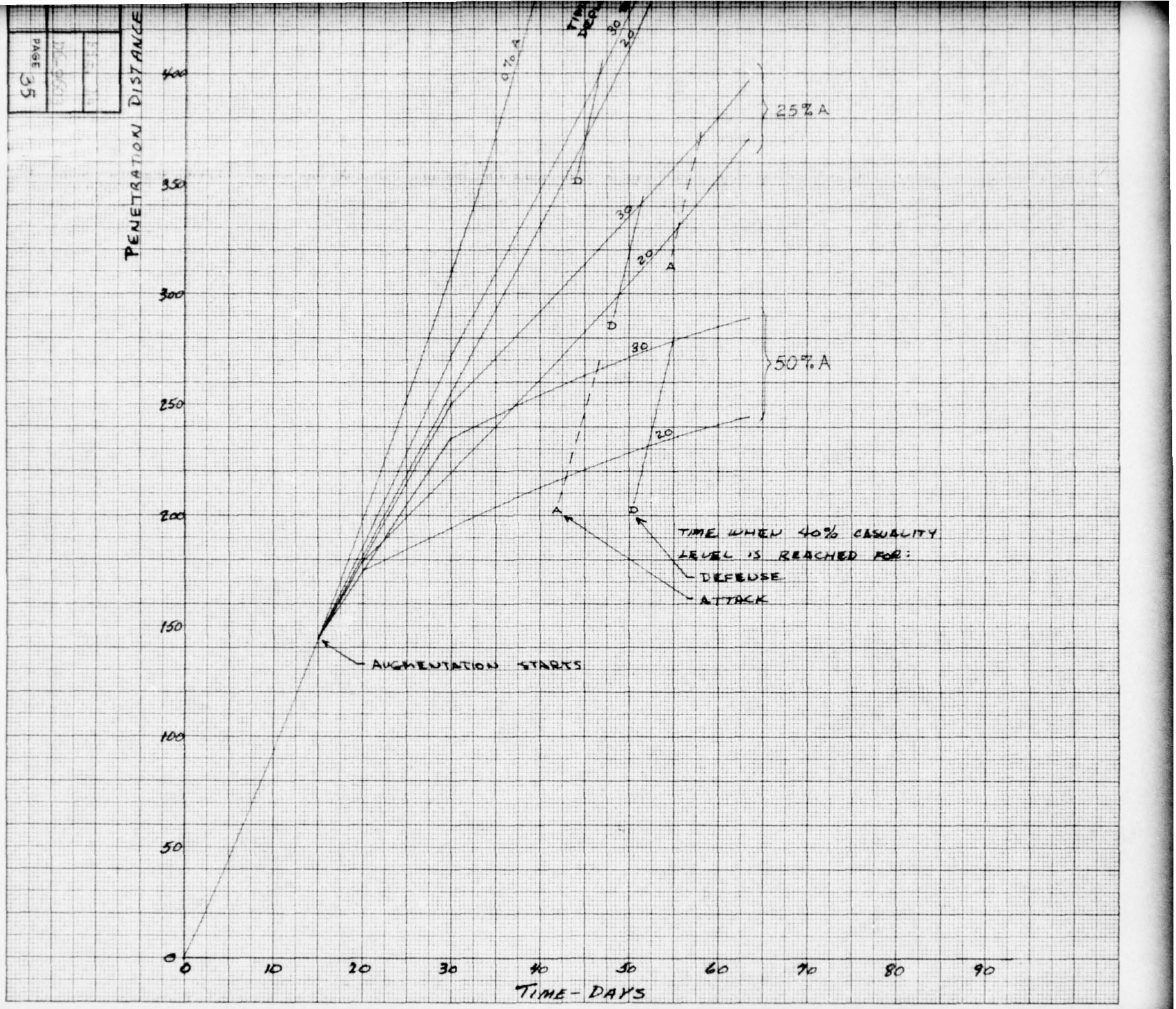
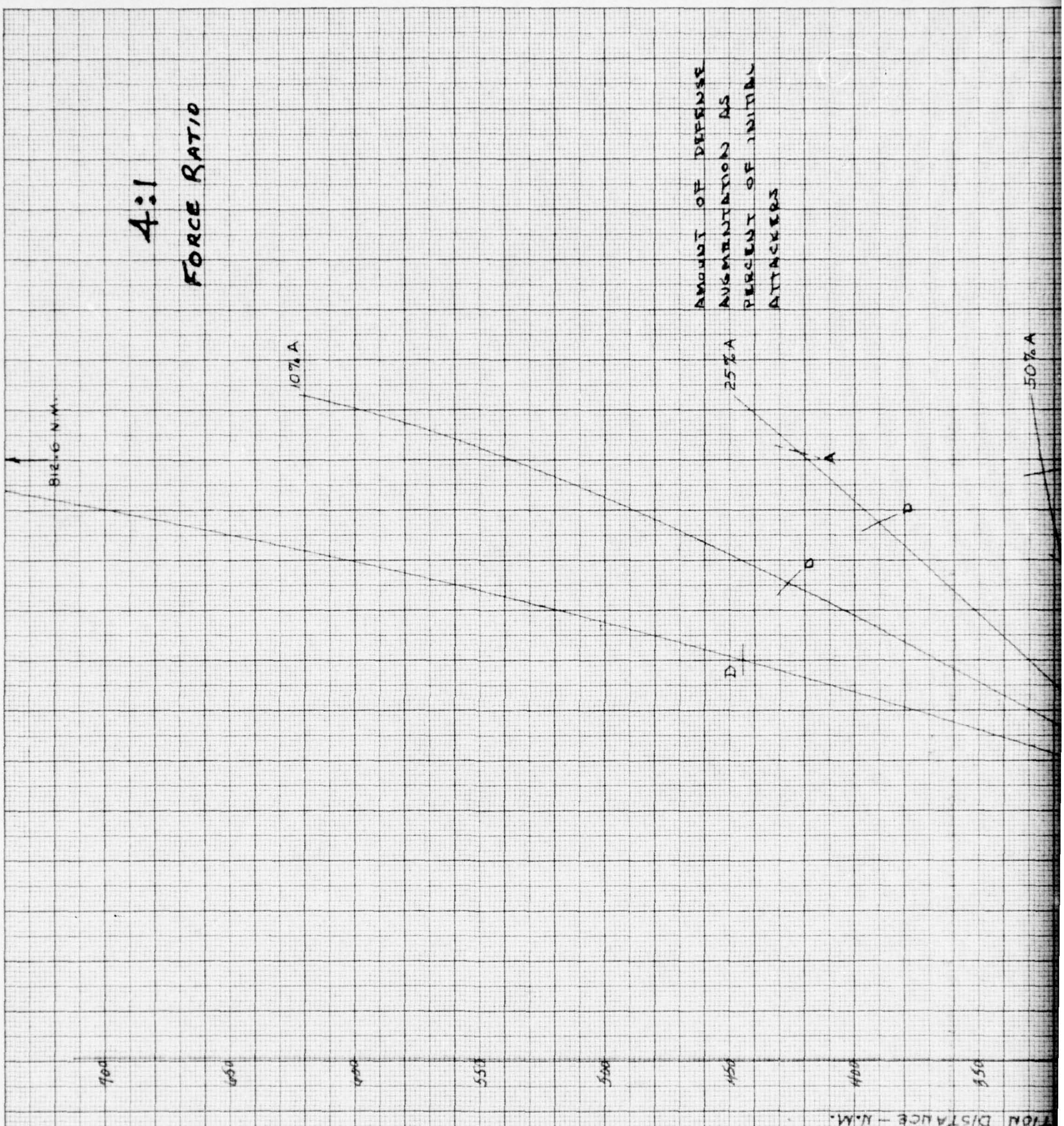
TD 461 C-R4

K-E ALBANENE 1551 6-7000

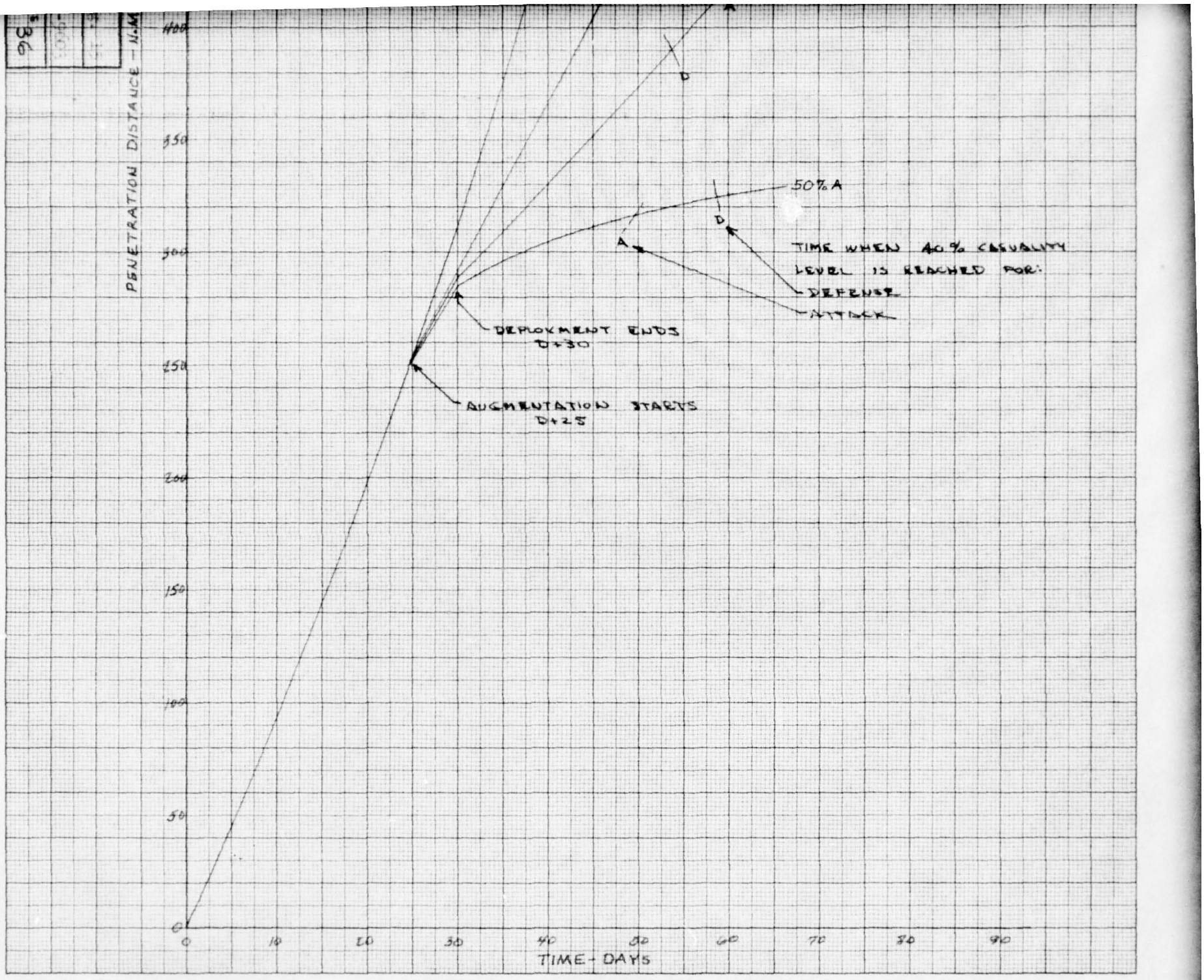


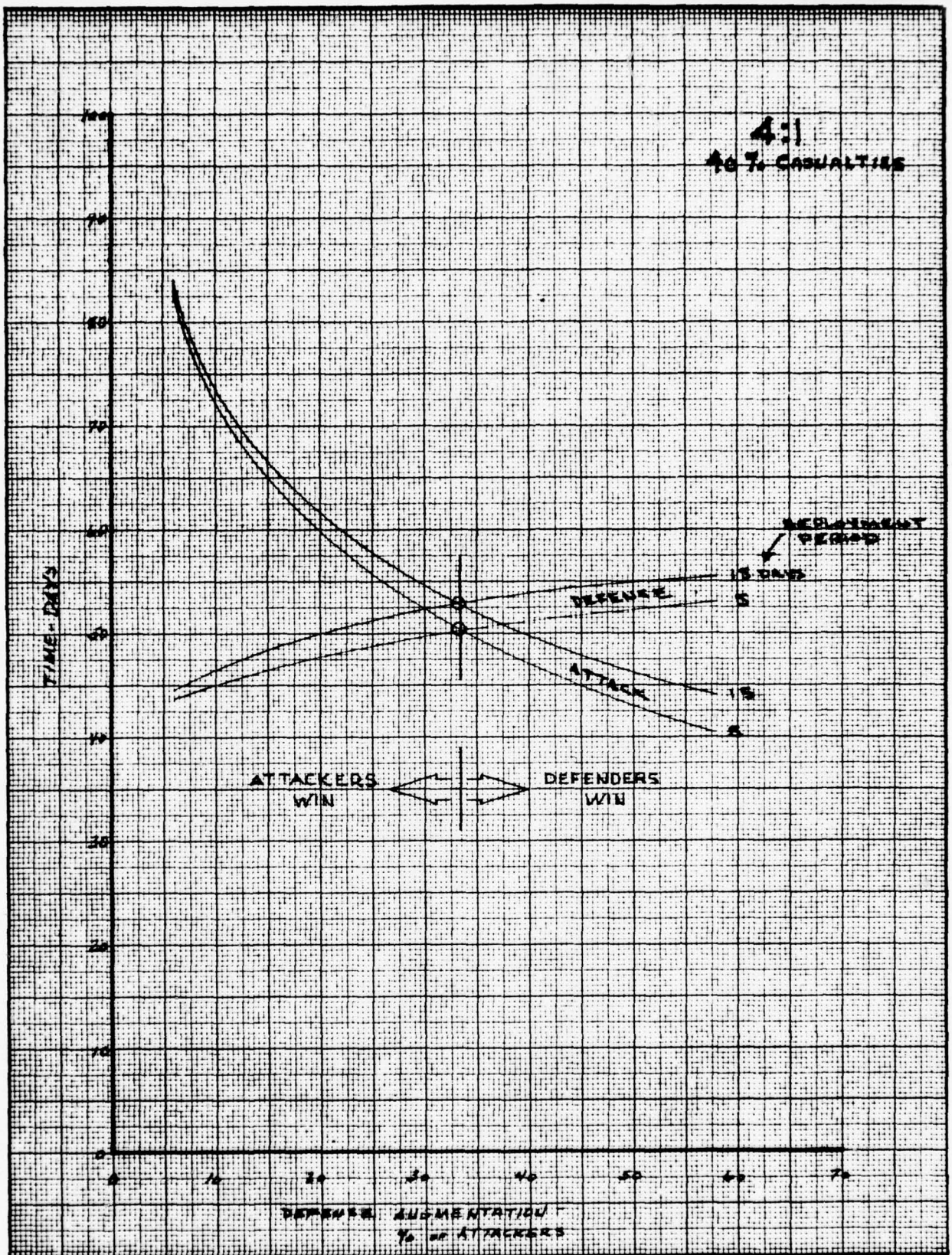
CALC	DRW	363	REVISED	DATE	INITIAL FORCE RATIO 4:1 AUGMENTATION STARTS D+15	
CHECK						
APPD						DC-9001
APPD					THE BOEING COMPANY	PAGE 35


PENETRATION DISTANCE
TIME - DAYS
0
10
20
30
40
50
60
70
80
90
50
100
150
200
250
300
350
400
25% A
50% A
AUGMENTATION STARTS
TIME WHEN 40% CASUALITY LEVEL IS REACHED FOR:
DEFENSE
ATTACK
A
D
30
20

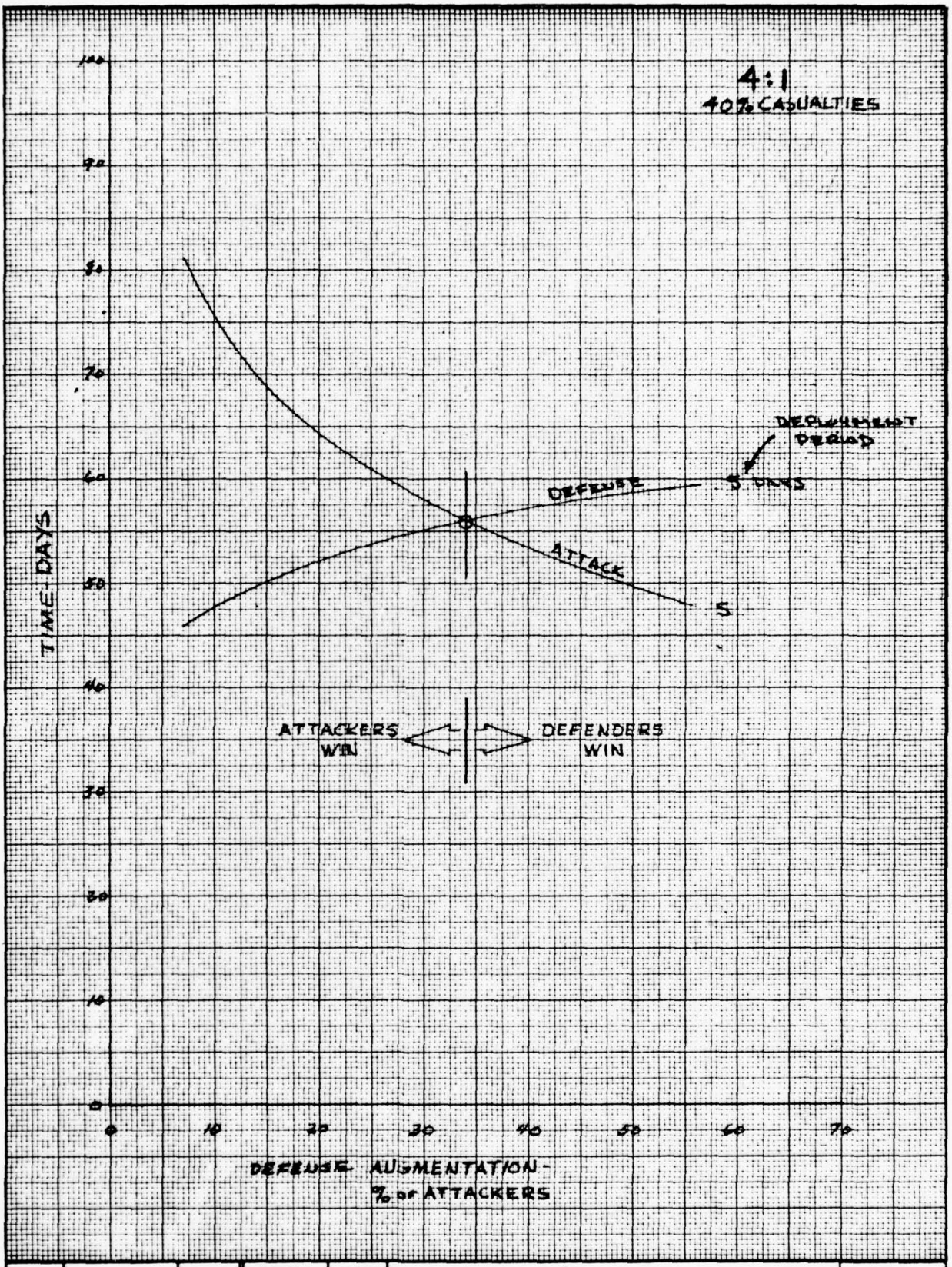


CALC	DRW	8-63	REVISED	DATE	INITIAL FORCE RATIO 4:1 AUGMENTATION STARTS D+25
CHECK					
APPD					
APPD					THE BOEING COMPANY


PENETRATION DISTANCE — N.M.
400
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
TIME - DAYS
D
50% A
A
D
TIME WHEN 40% CASUALTY LEVEL IS REACHED FOR:
DEFENSE
ATTACK
DEPLOYMENT ENDS D+30
AUGMENTATION STARTS D+25



CALC	DRW	B-S	REVISED	DATE	UNACCEPTABLE CASUALTY LEVEL TIME vs AUGMENTATION INITIAL FORCE RATIO 4:1	Fig. 16
CHECK						D6-9603
APR					THE BOEING COMPANY	PAGE 37
APR						



CALC	DQW	863	REVISED	DATE	UNACCEPTABLE CASUALTY LEVEL TIME vs AUGMENTATION INITIAL FORCE RATIO 4:1
CHECK					
APR					
APR					
					THE BOEING COMPANY

Fig. 17
D6-9603
PAGE 38

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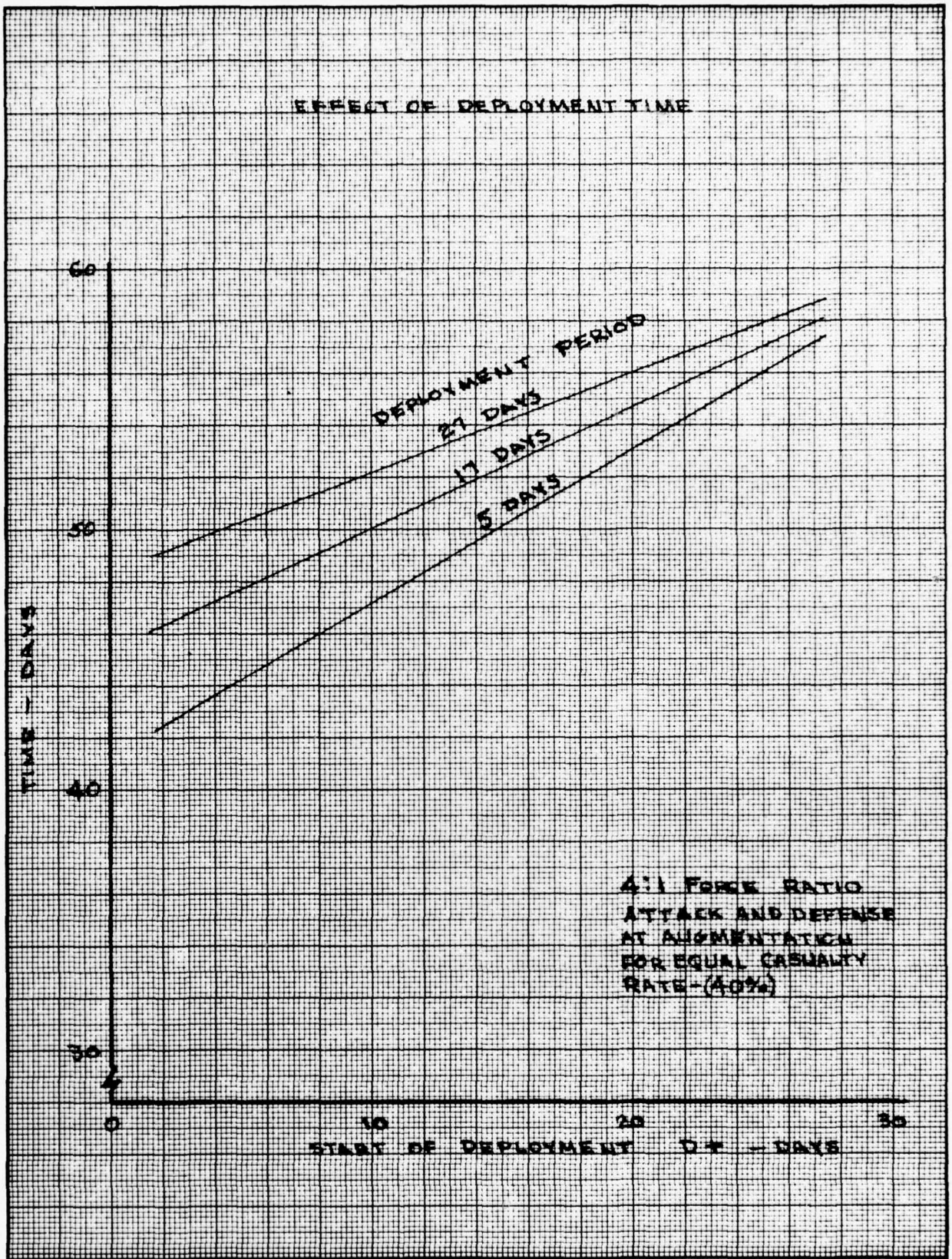
K•E ALBANENE® 6-7000 TRACING PAPER



CALC	GRT	863	REVISED	DATE	40% CASUALTY LEVEL TIME VS FORCE RATIO	Fig. 18
CHECK						D6-9603
APR					THE BOEING COMPANY	PAGE 39
APR						

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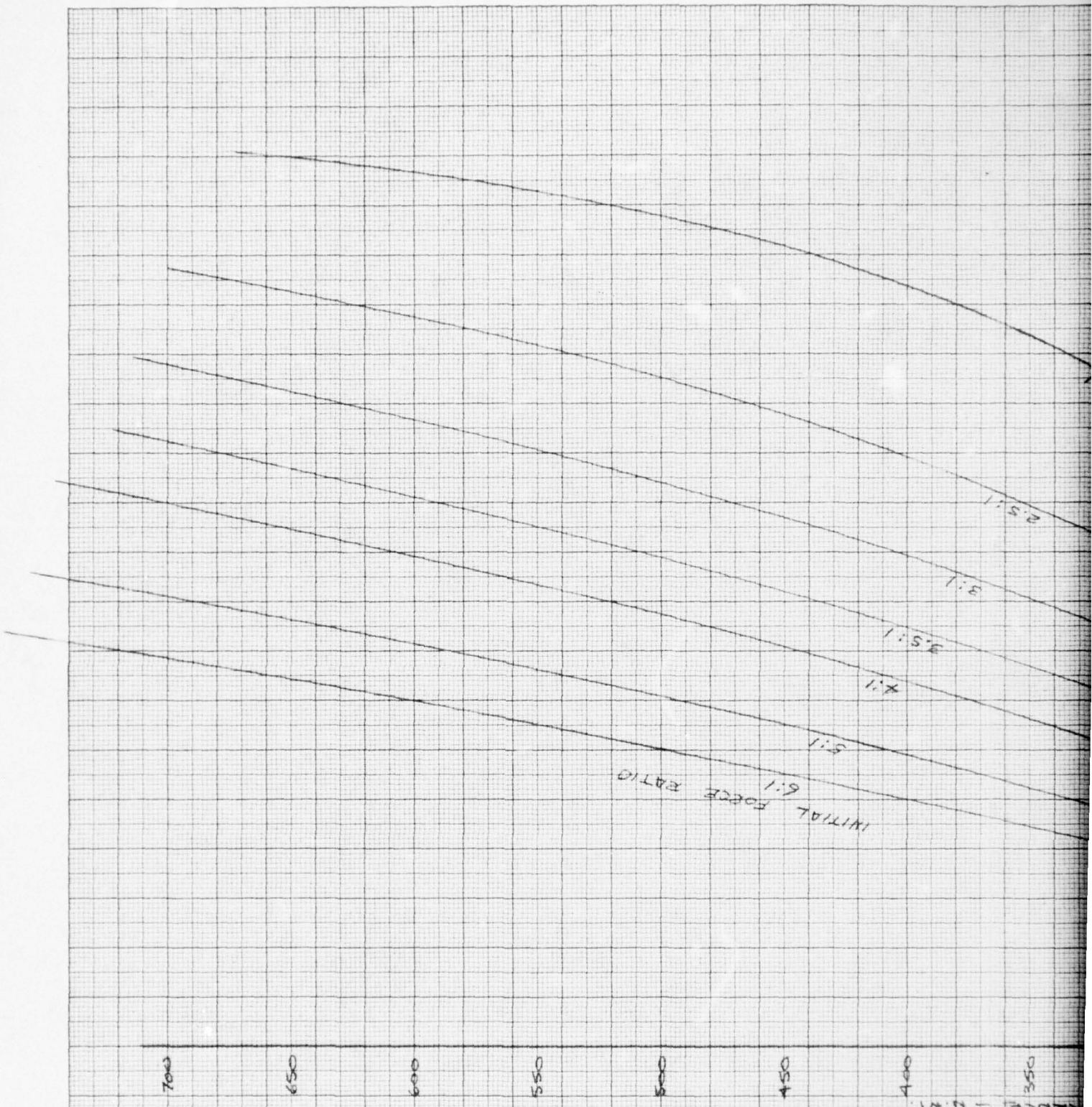
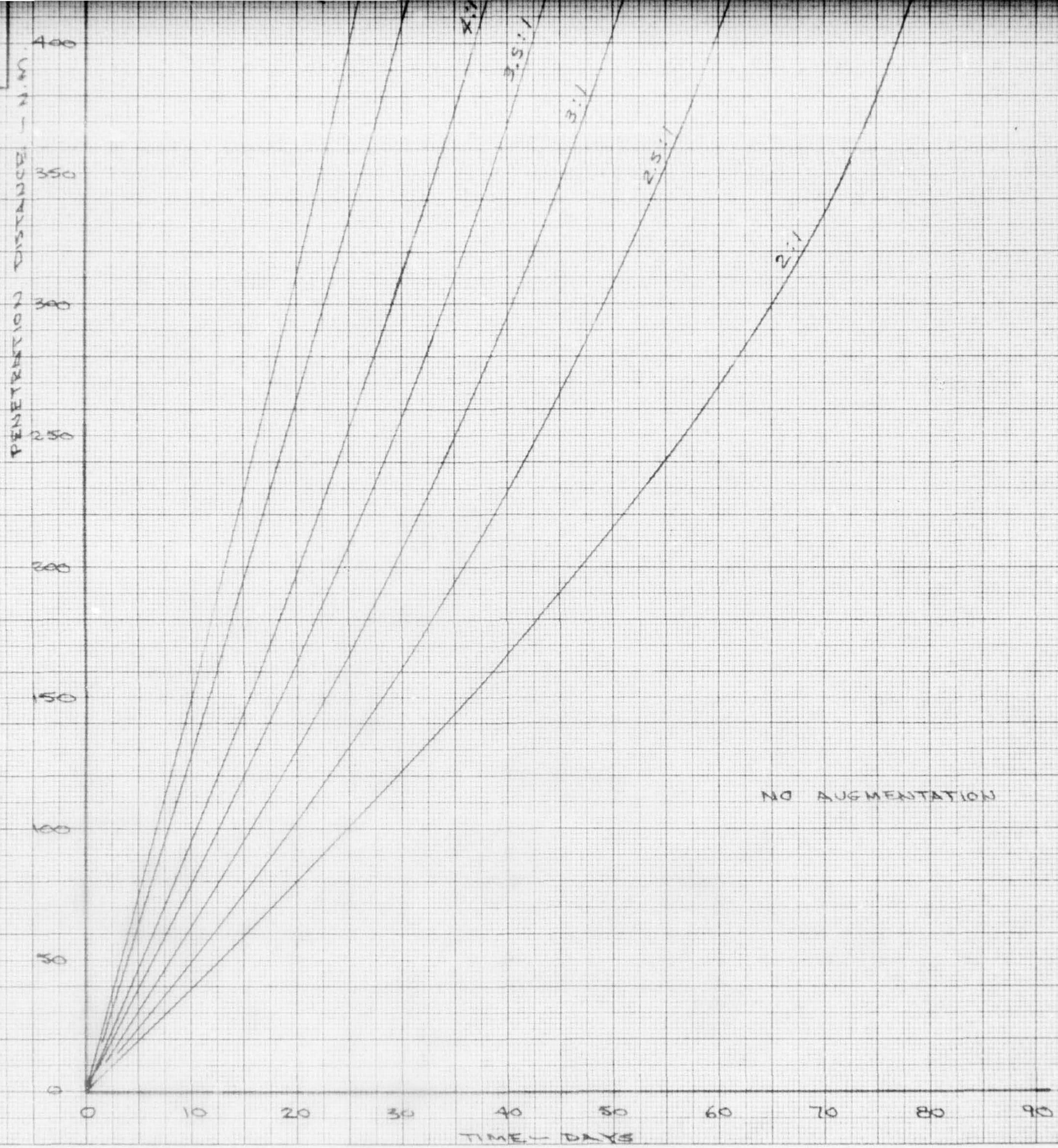
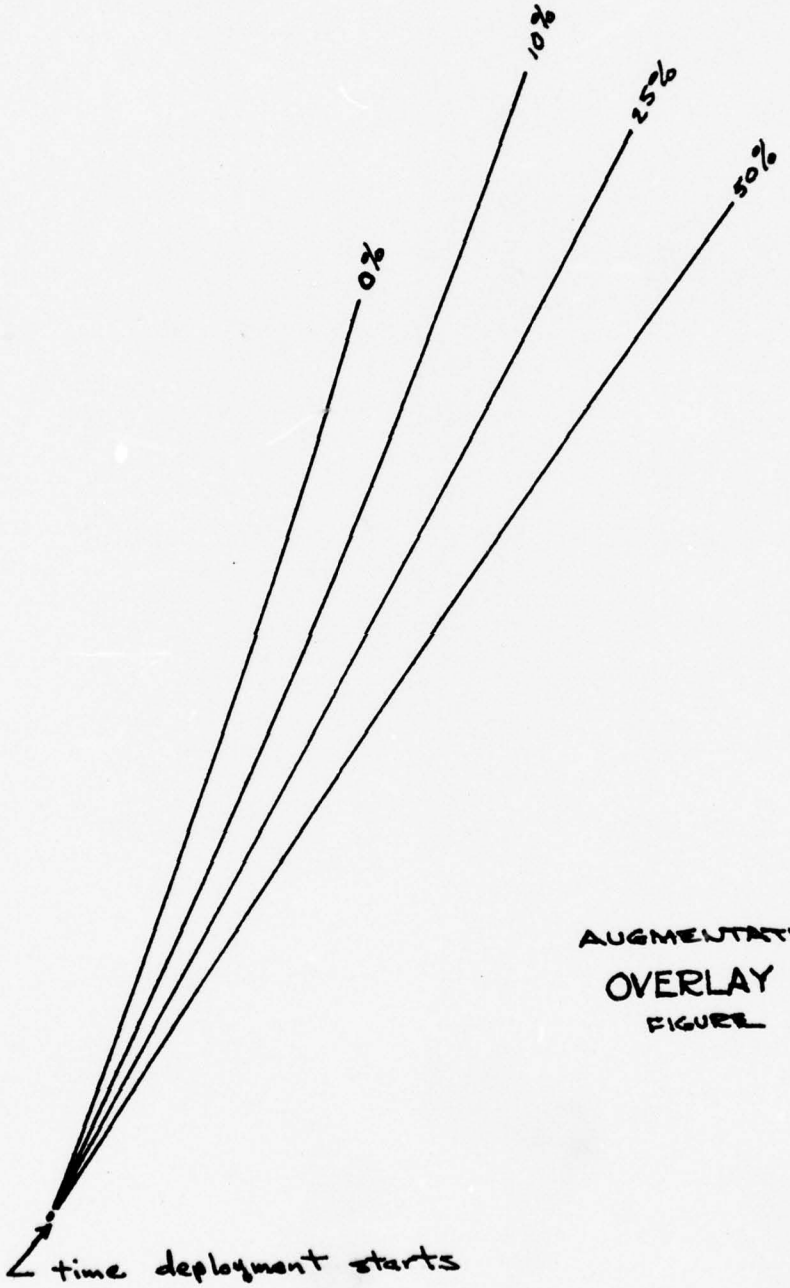
K+E ALBANENE 195L 6-7000



CALC	GRT-ORW	7-63	REVISED	DATE	DETERMINATION OF PENETRATION DISTANCE AND TIME	
CHECK						
APPD						
APPD					THE BOEING COMPANY	PAGE 40



NO AUGMENTATION
2:1
2.5:1
3:1
3.5:1
X:1
PENETRATION DISTANCE – N.M.
0
50
100
150
200
250
300
350
400
TIME – DAYS
10
20
30
40
50
60
70
80
90



AUGMENTATION
OVERLAY A
FIGURE 19

Fig. 19A
D6-9603
Page 41

10

POST-AUGMENTATION
OVERLAY B
FIGURE 19

Fig. 19B
D6-9603
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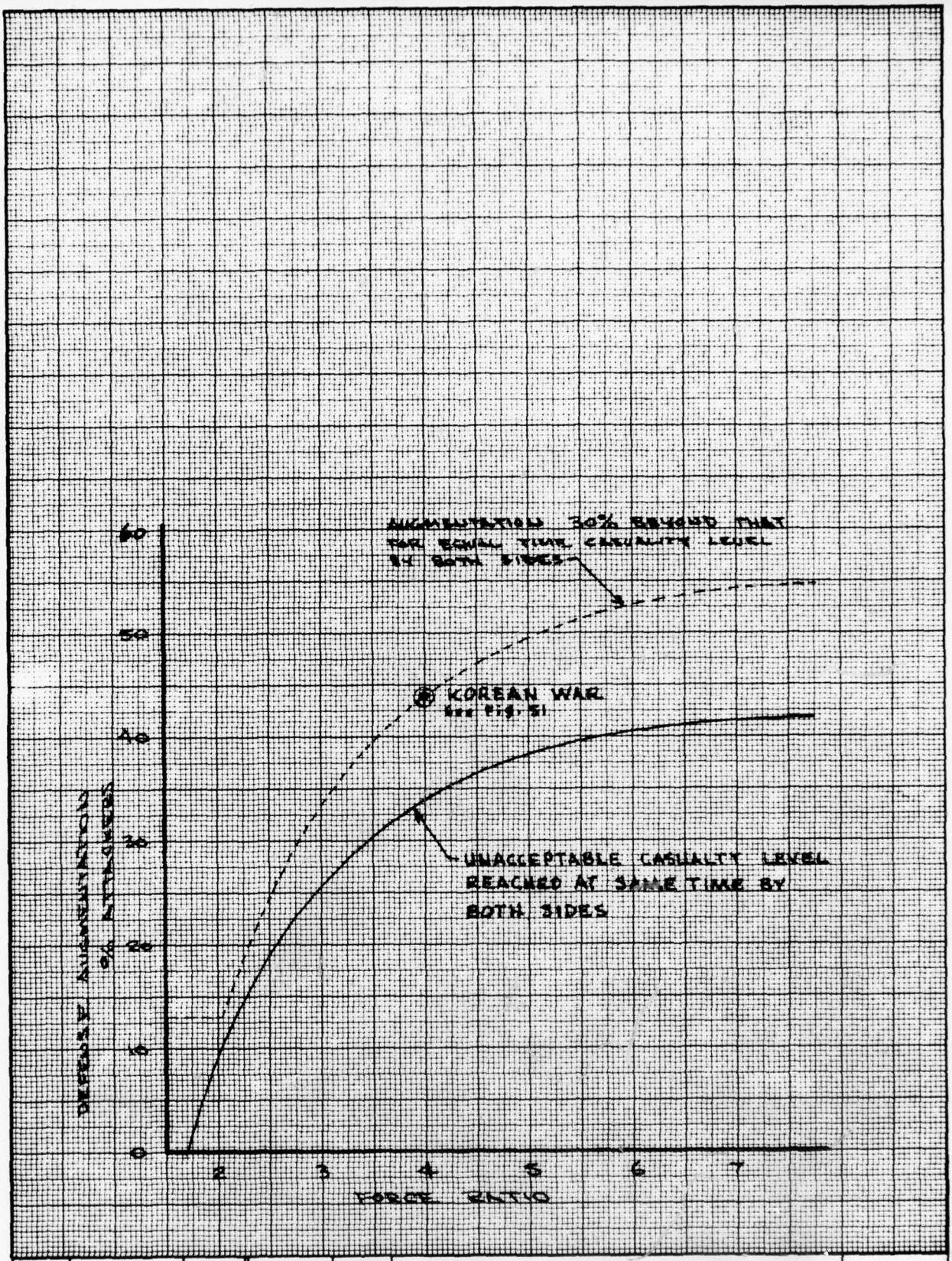

CALC	GRT	8-63	REVISED	DATE	DETERMINATION of AUGMENTATION FORCE SIZE	Fig. 20
CHECK						D6-9603
APR					THE BOEING COMPANY	PAGE 43
APR						

Fig. 21
D6-9603
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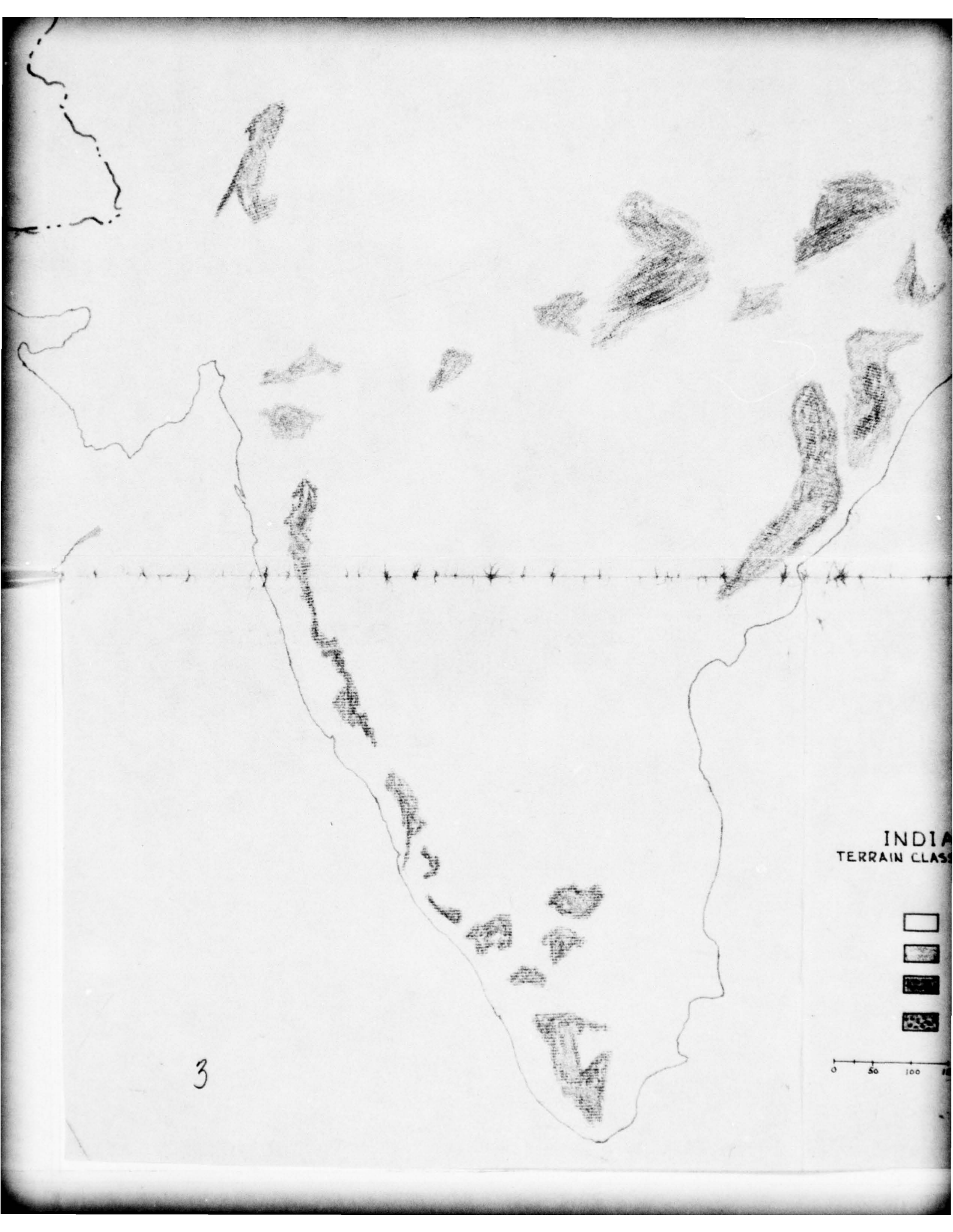
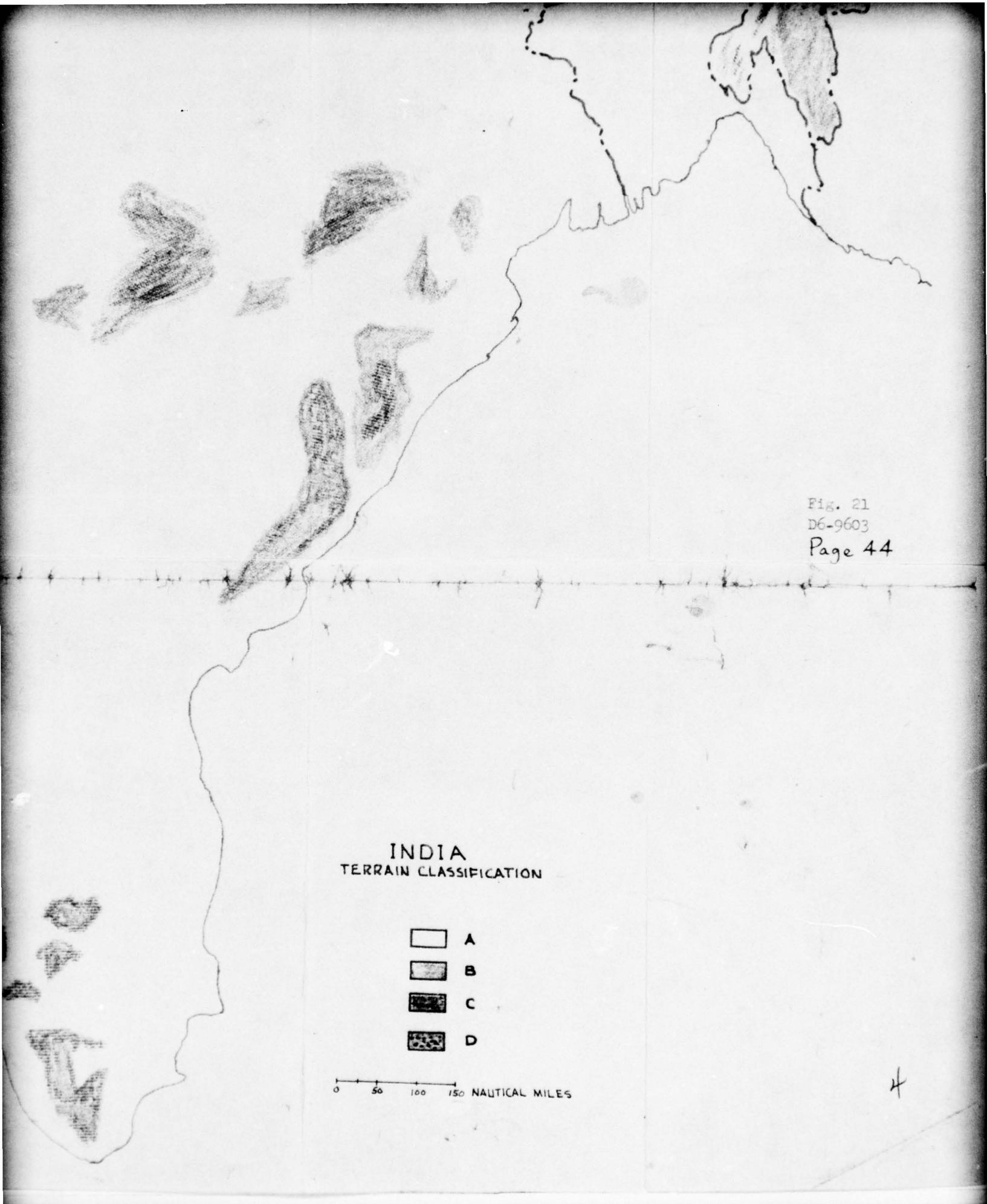
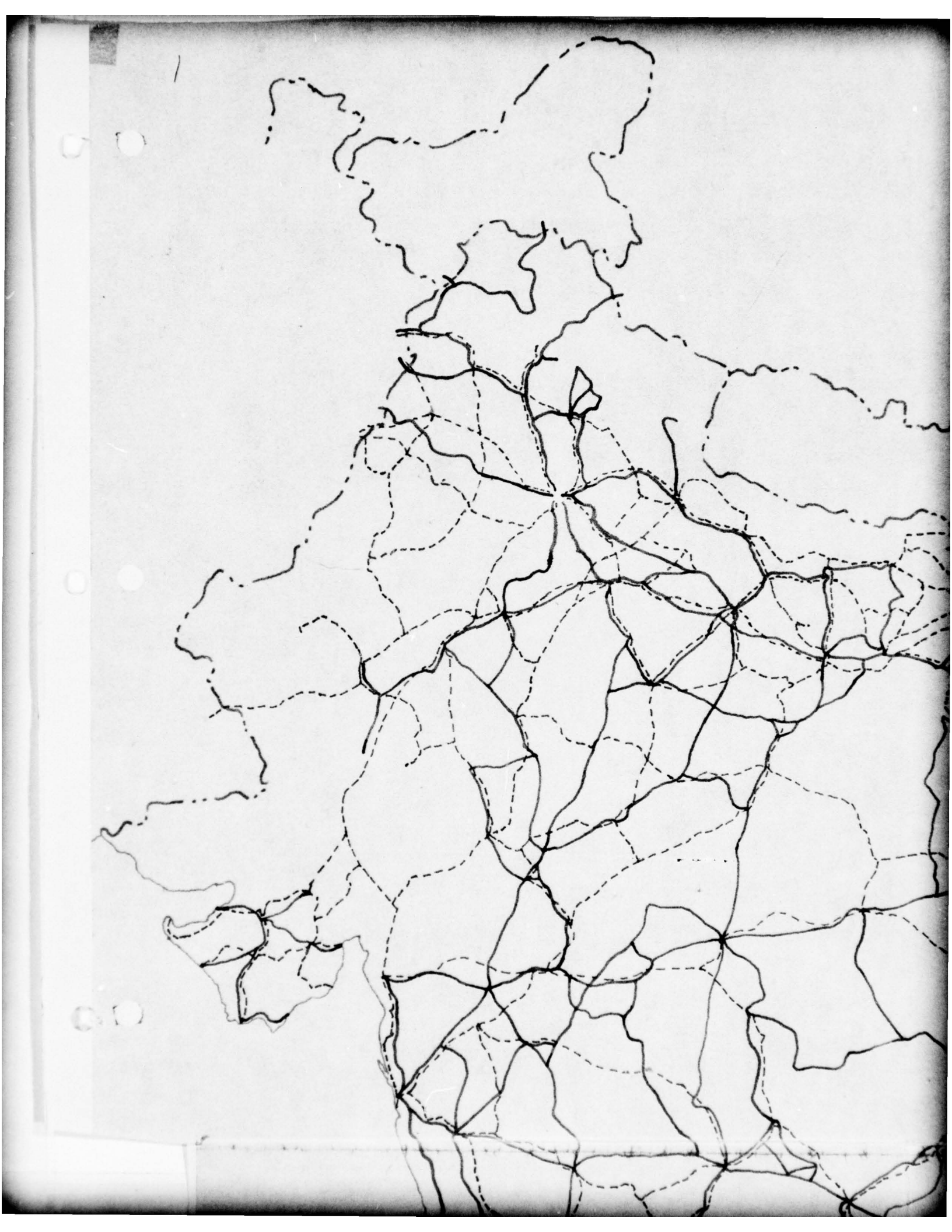

INDIA
TERRAIN CLASS
0
50
100


INDIA
TERRAIN CLASSIFICATION
A
B
C
D
0
50
100
150 NAUTICAL MILES



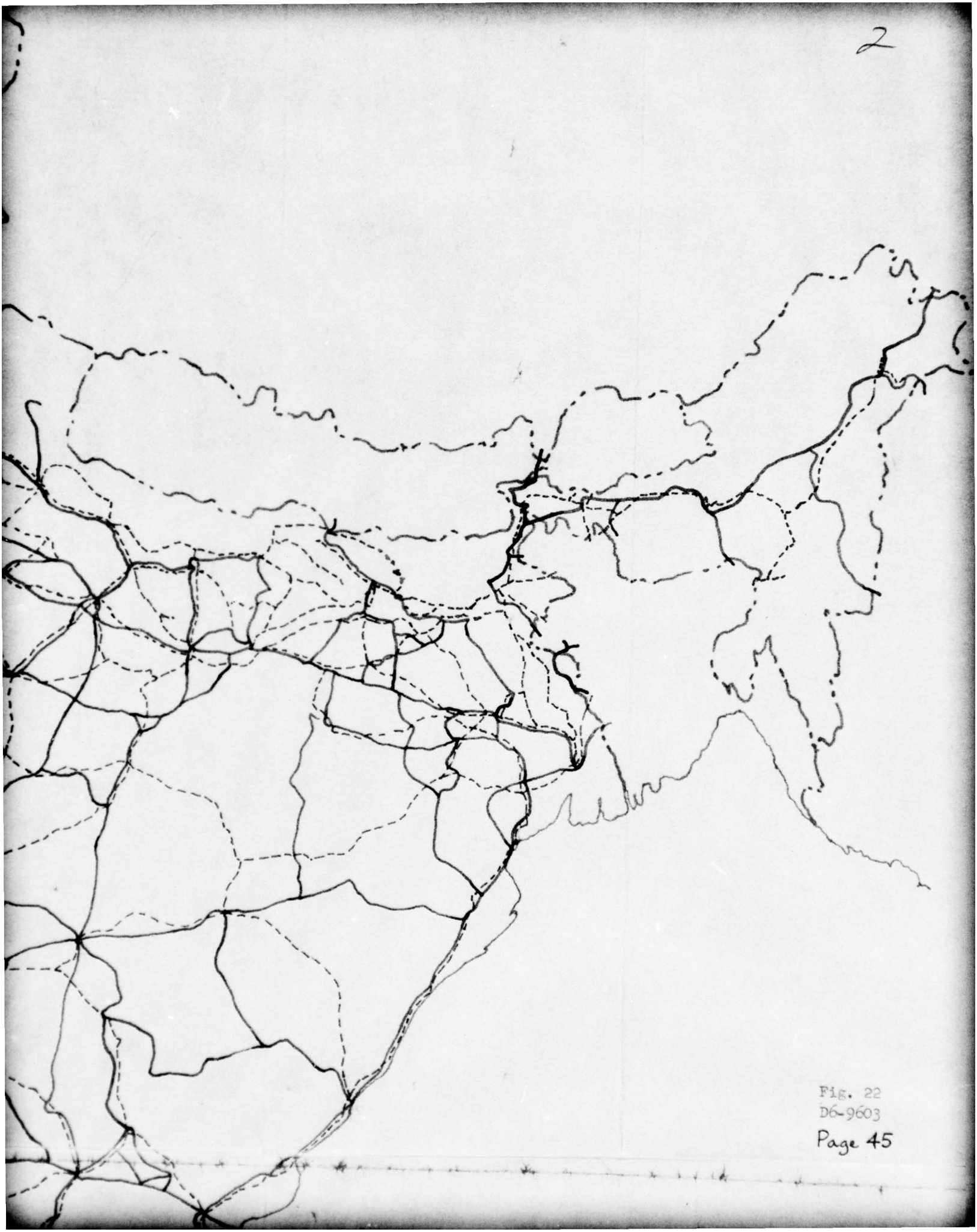
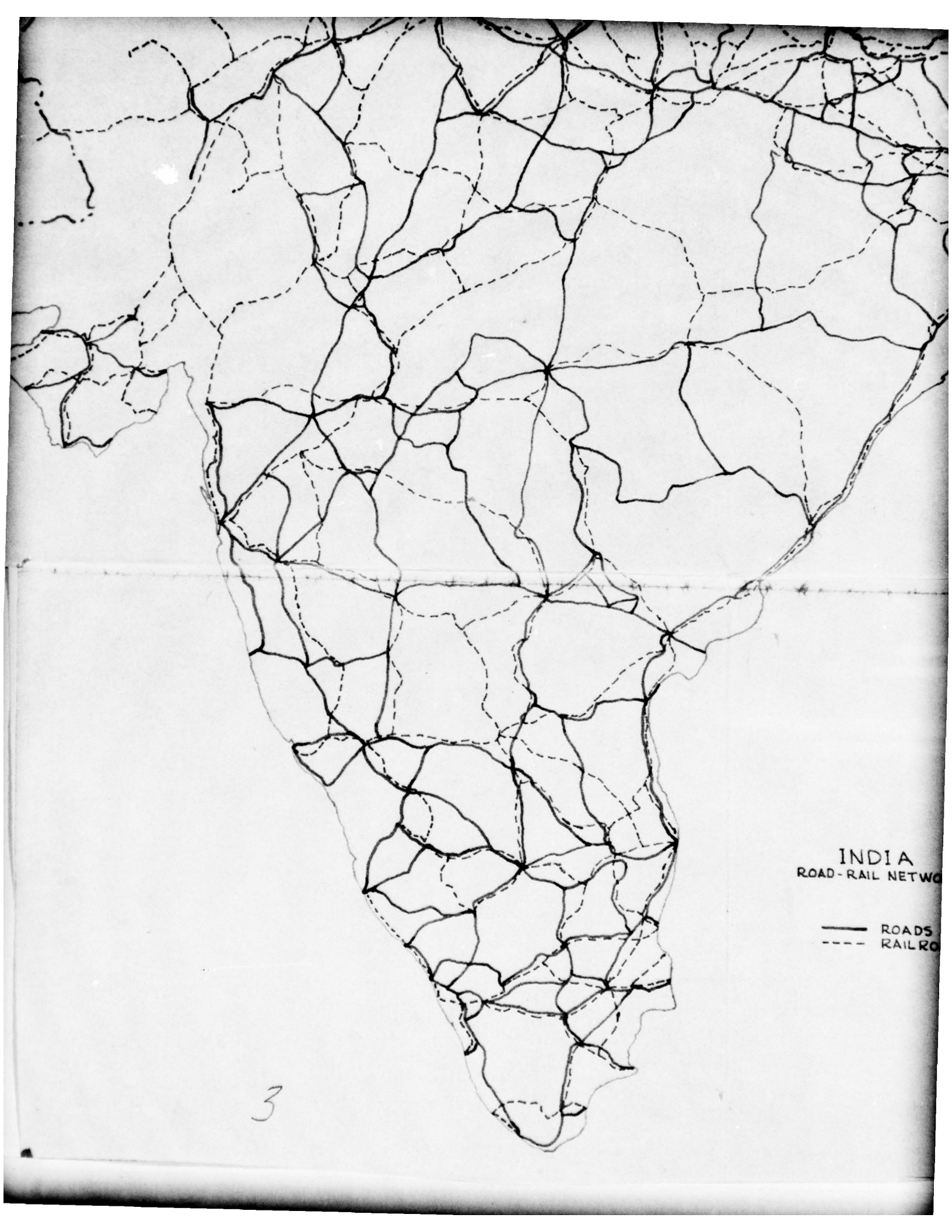
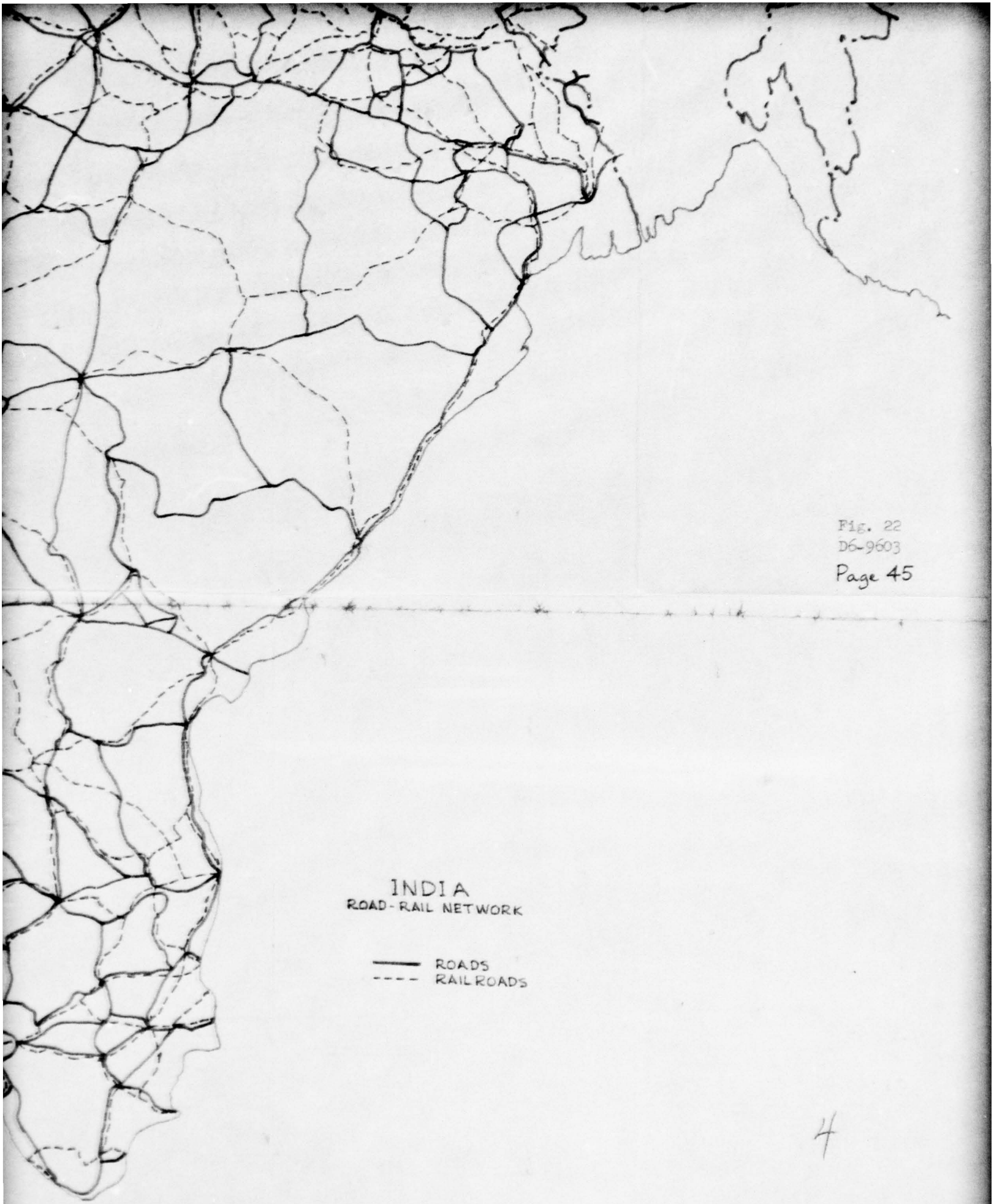
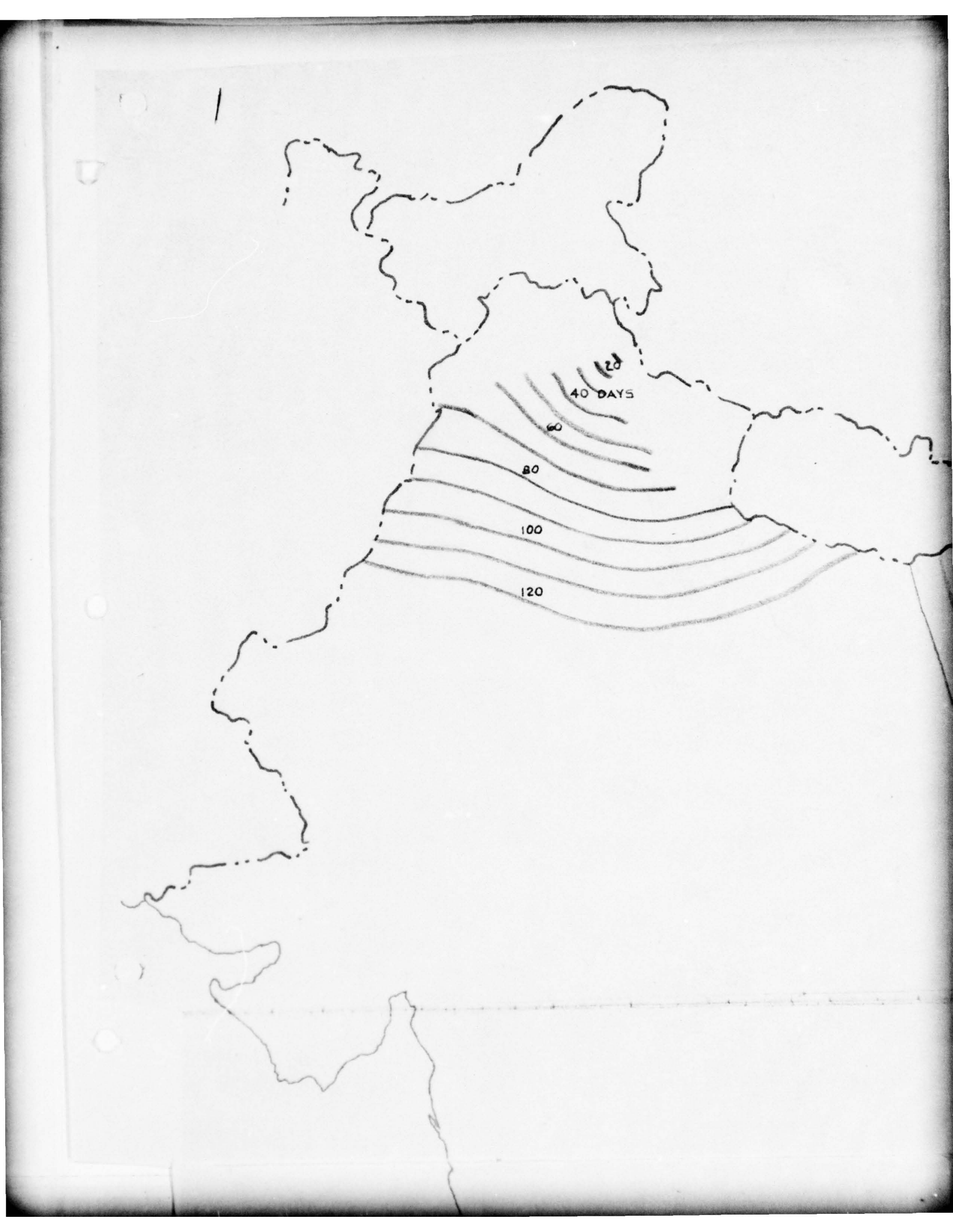


Fig. 22
D6-9603


INDIA
ROAD - RAIL NETWO
ROADS
RAIL RO


INDIA
ROAD - RAIL NETWORK
ROADS
RAILROADS


20
40 DAYS
60
80
100
120

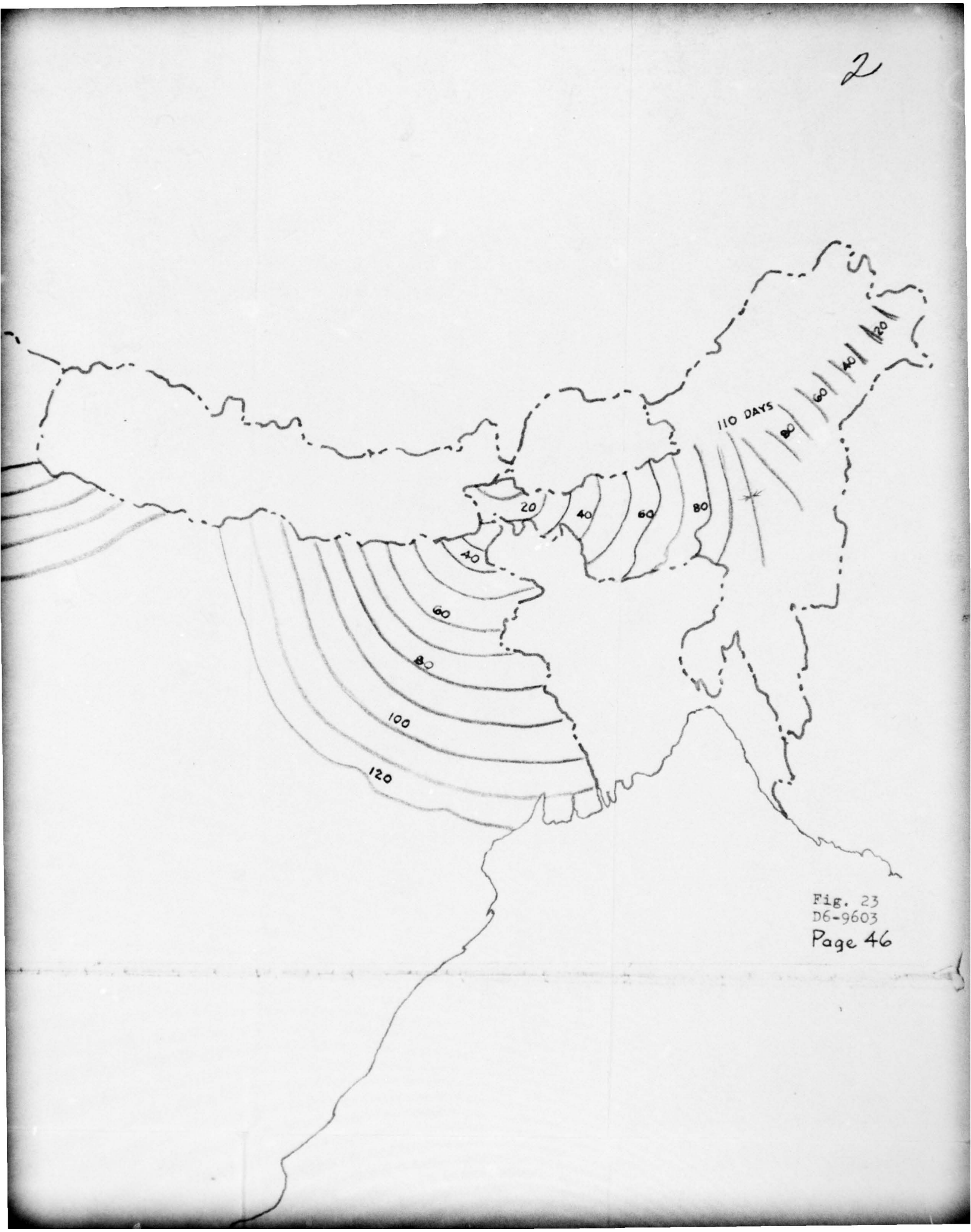
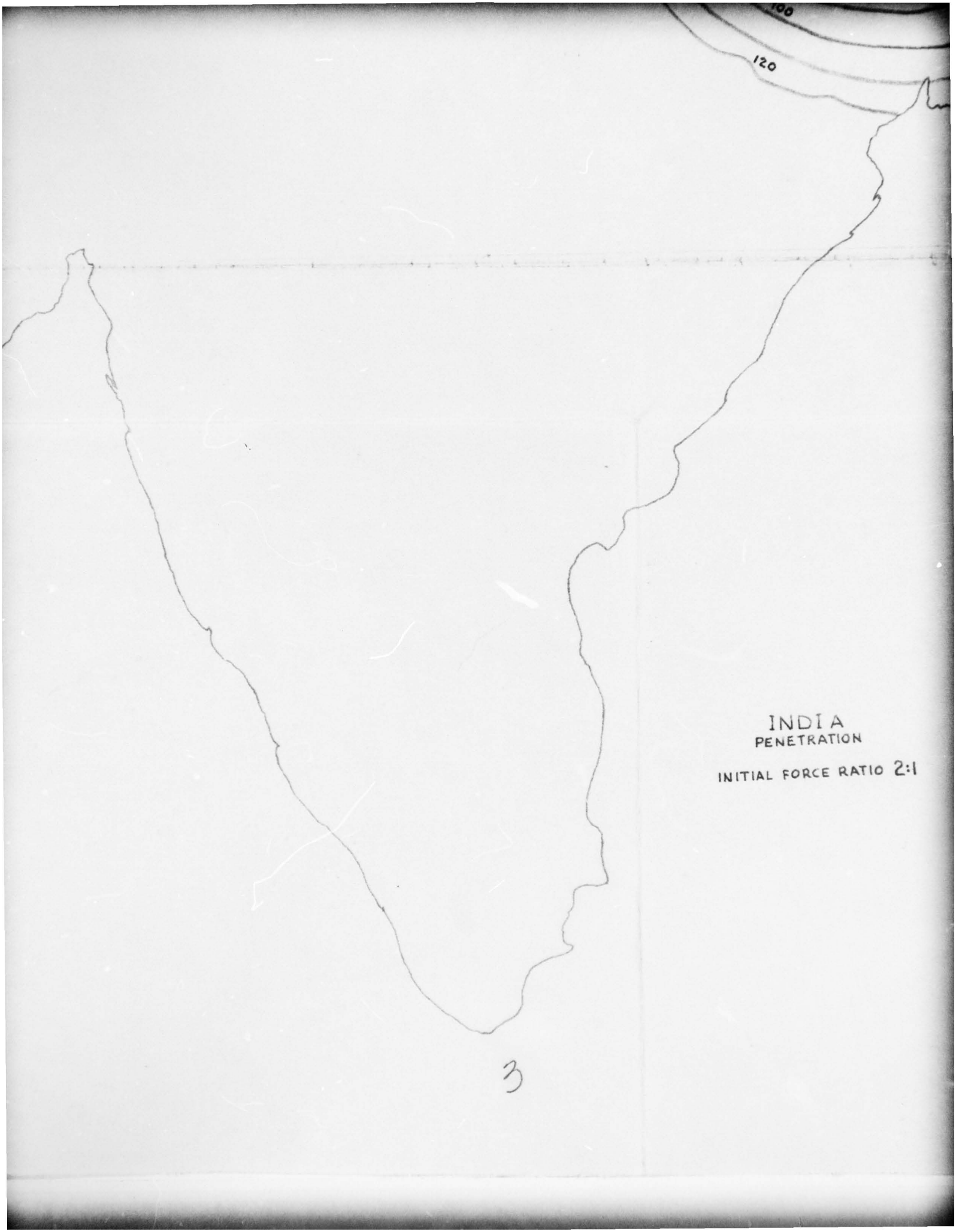


Fig. 23
D6-9603
Page 46


100
120
INDIA
PENETRATION
INITIAL FORCE RATIO 2:1


1
10
20 DAYS
30
40
50
60
70
80
90
100
110
120

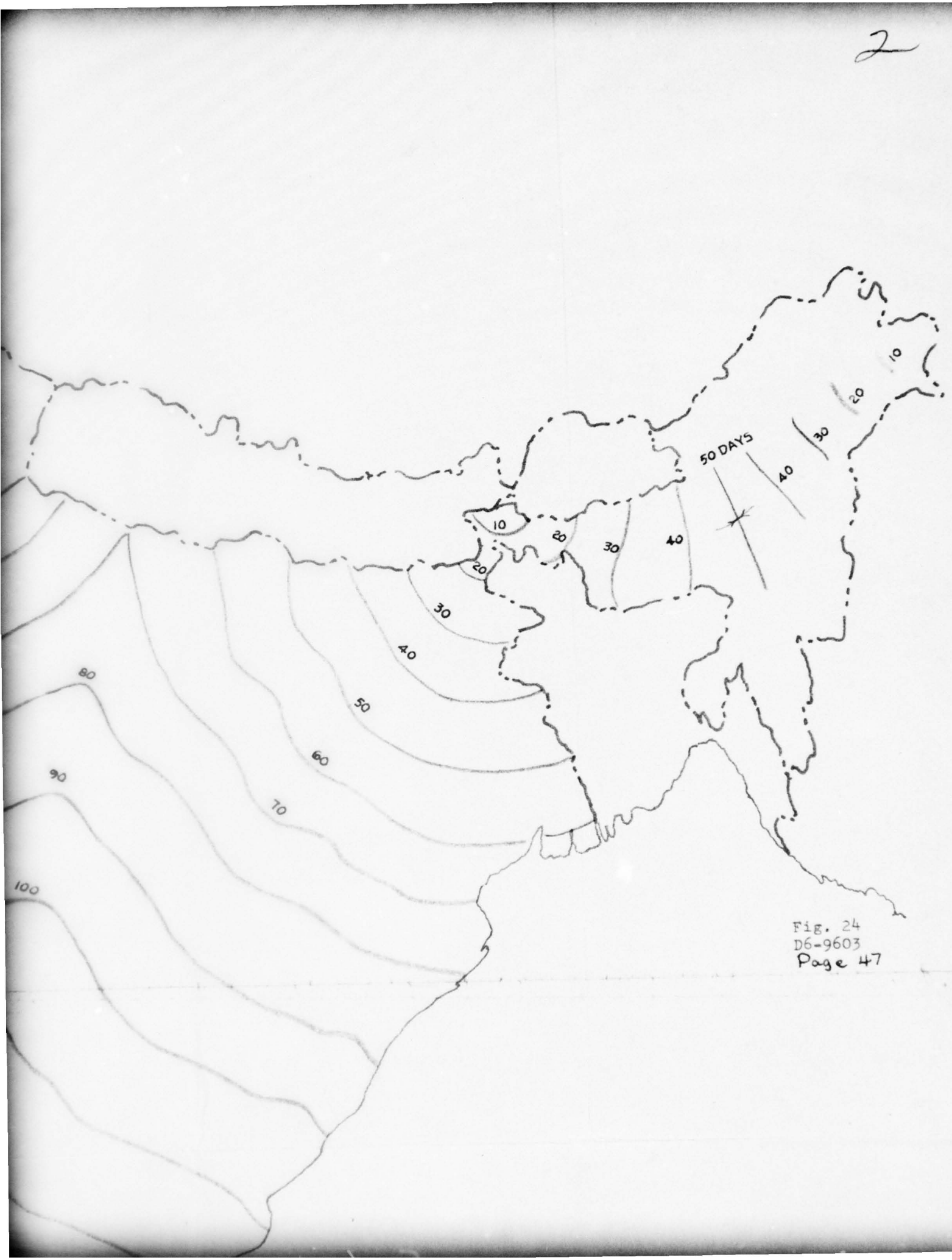
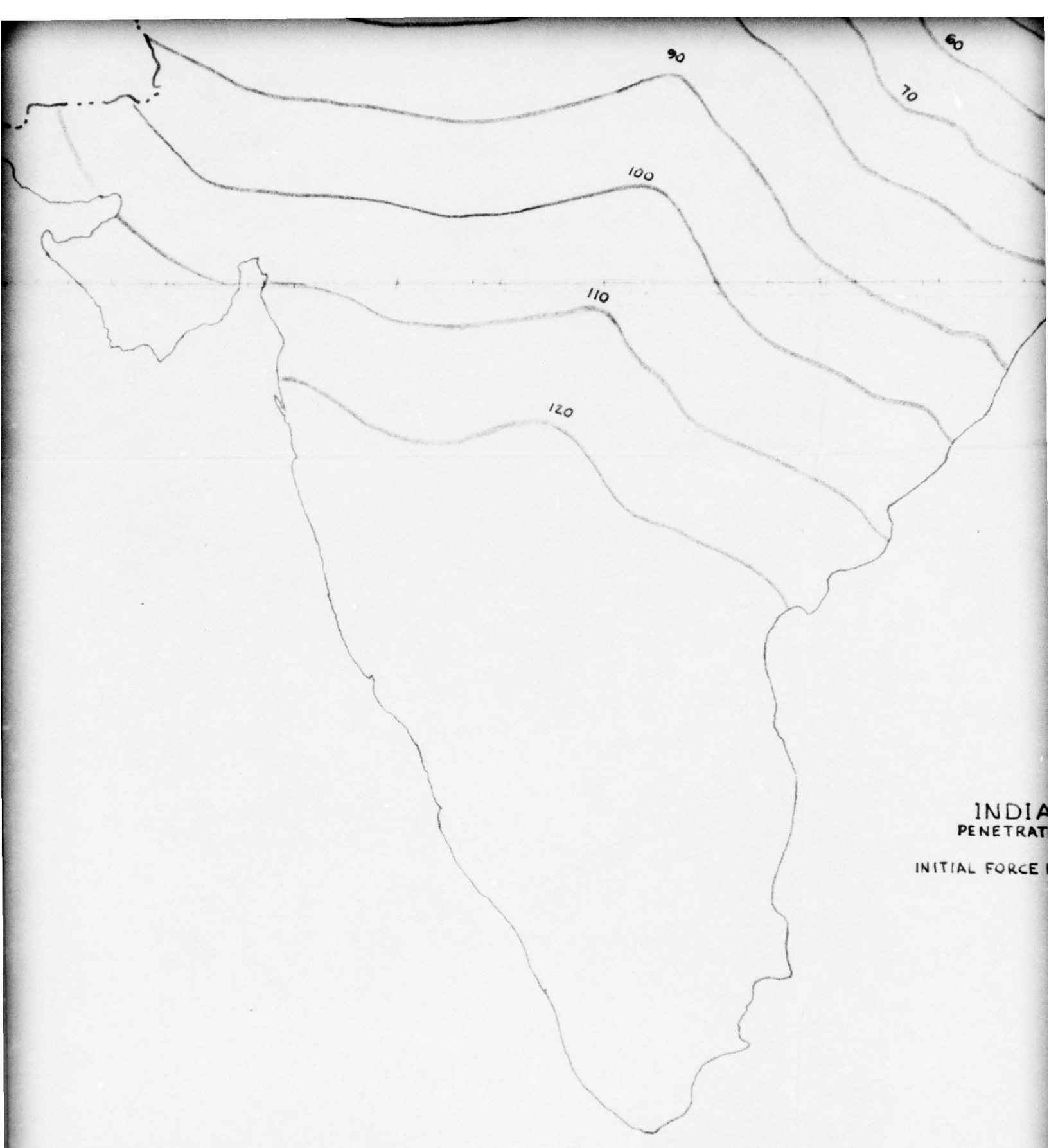
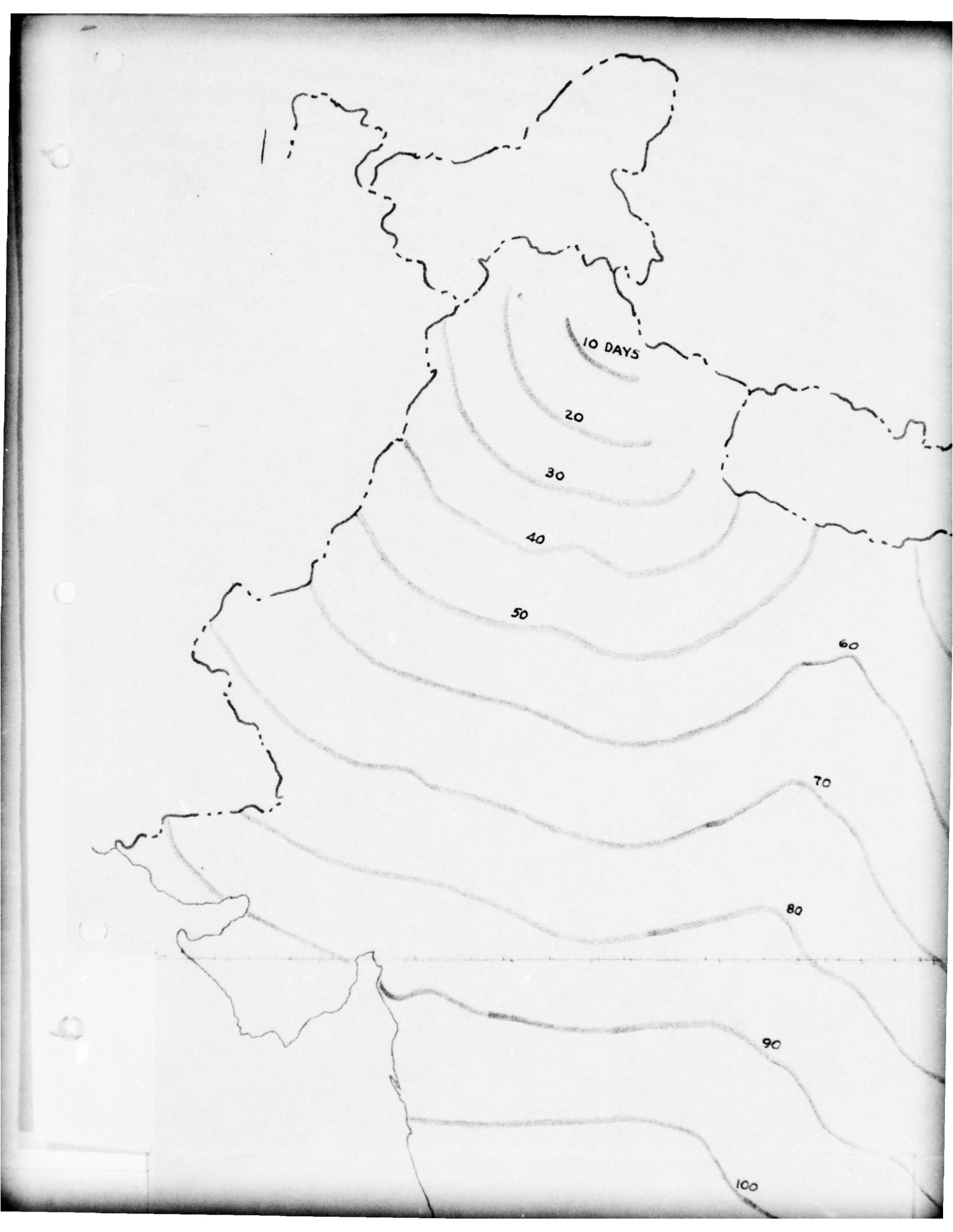


Fig. 24
D6-9603
Page 47


90
100
110
120
60
70
INDIA
PENETRAT
INITIAL FORCE


10 DAYS
20
30
40
50
60
70
80
90
100

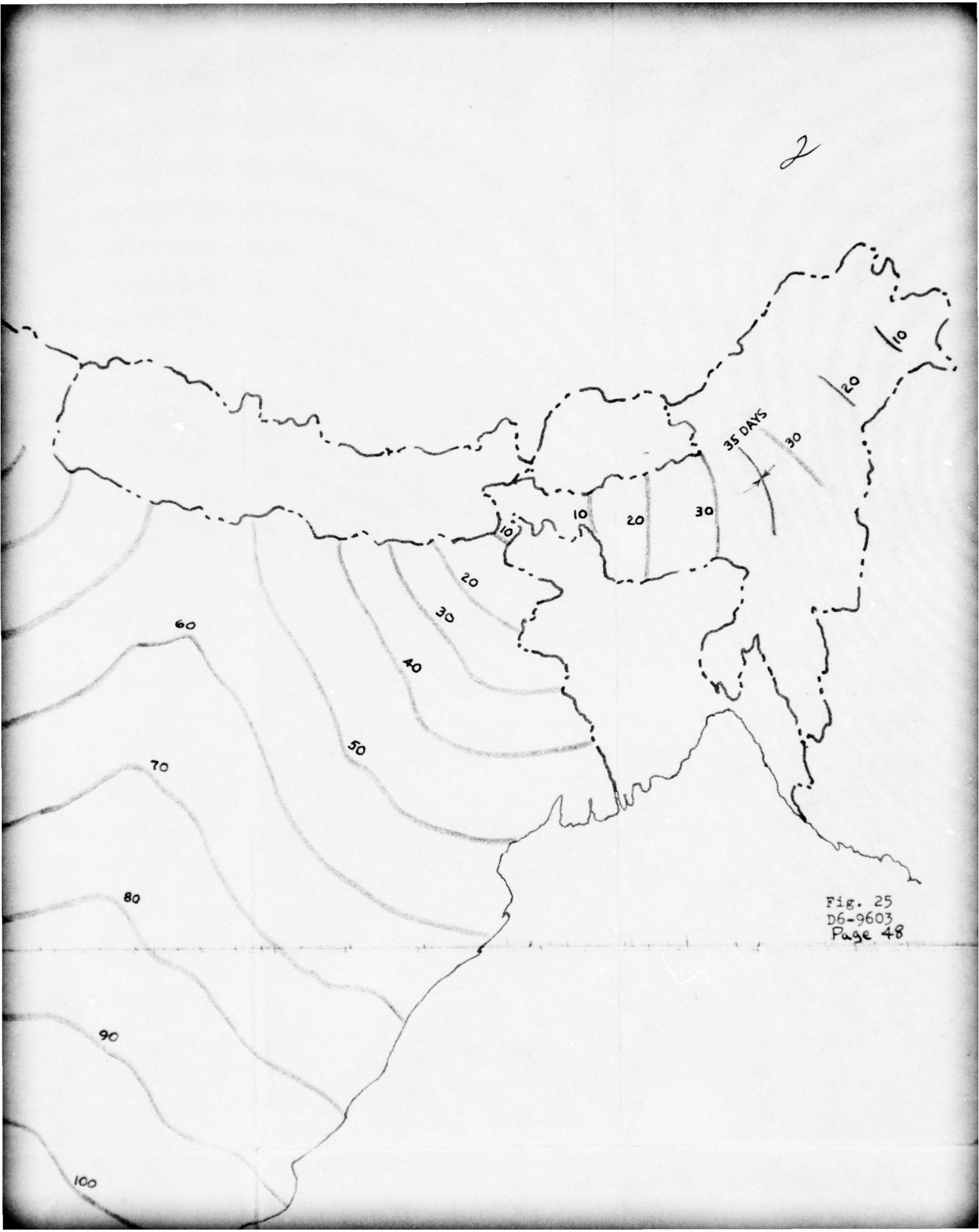
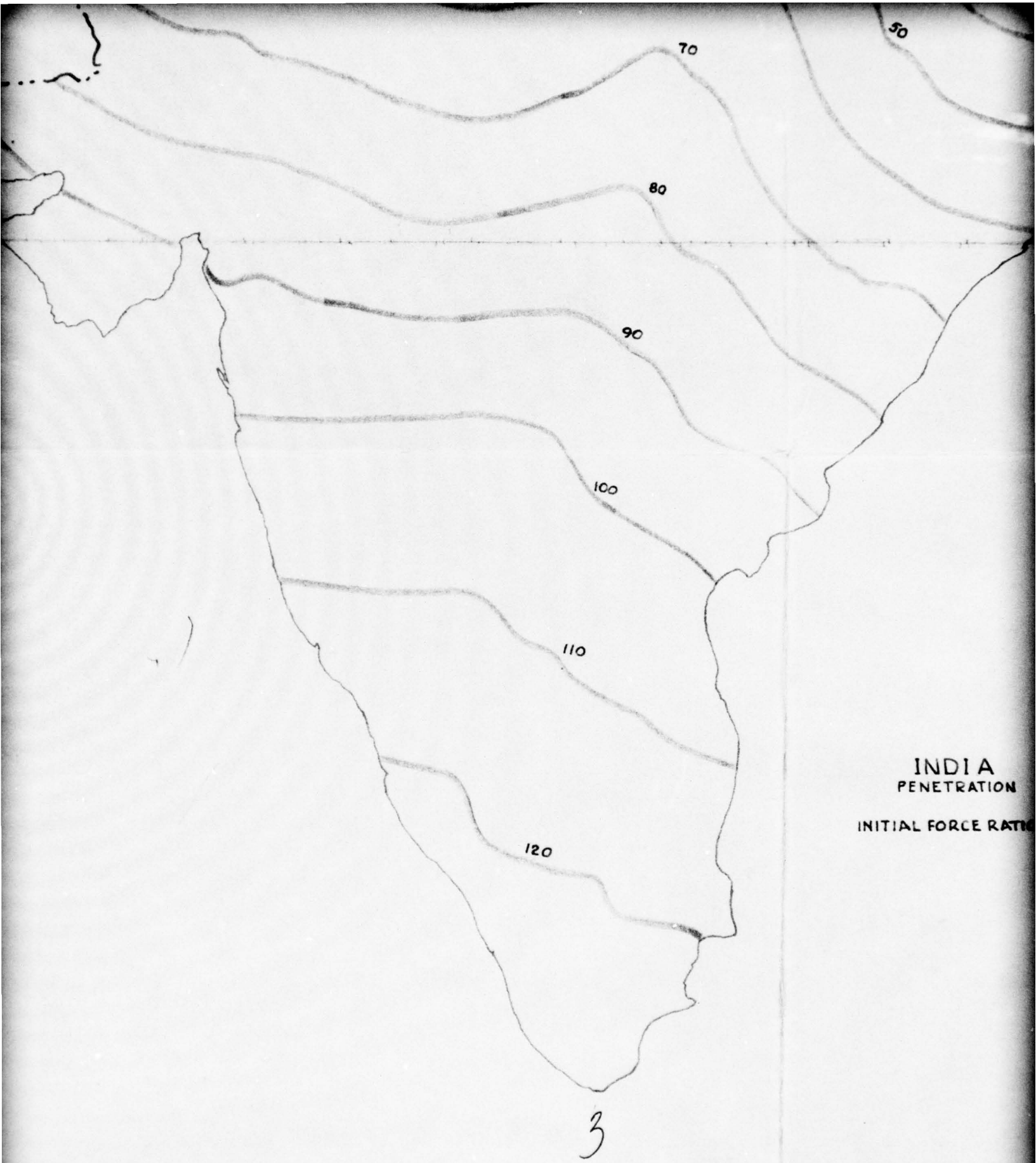


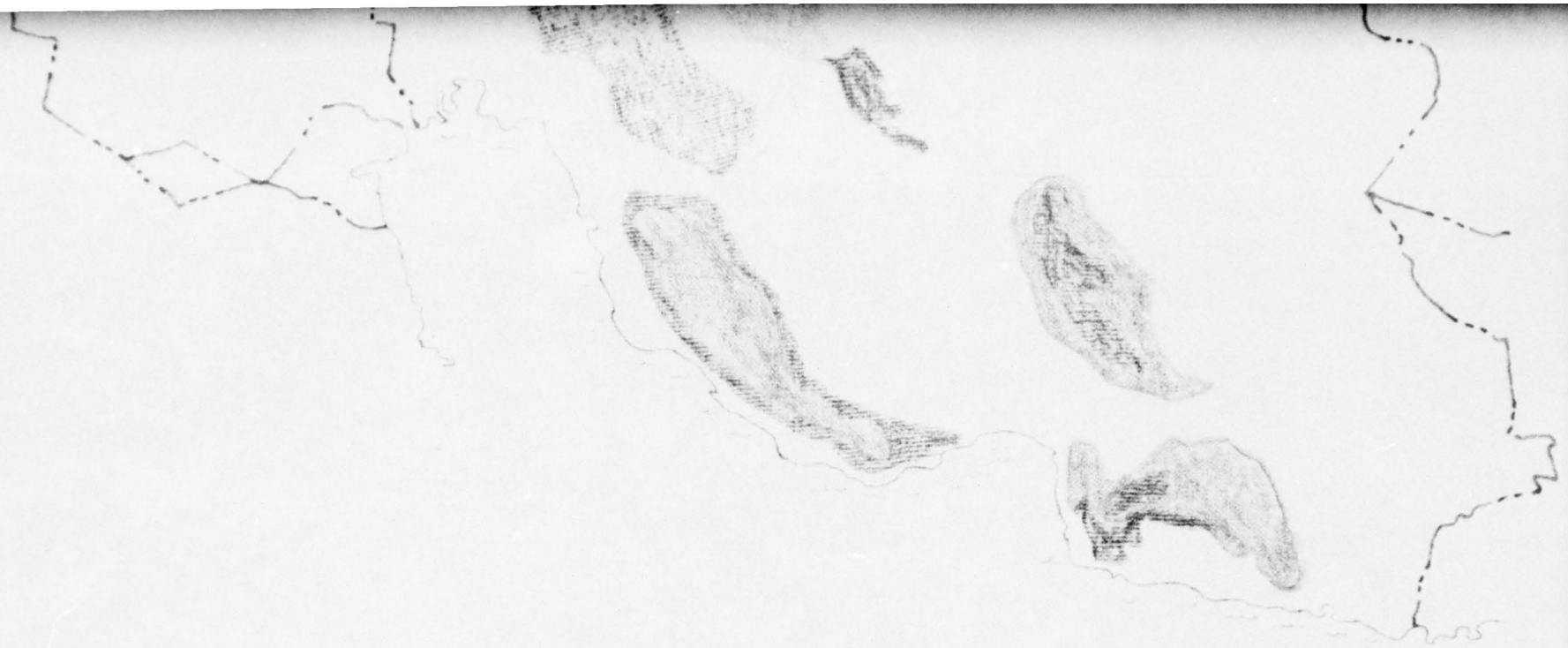
Fig. 25
D6-9603
Page 48



INDIA
PENETRATION

INITIAL FORCE RATIO

3

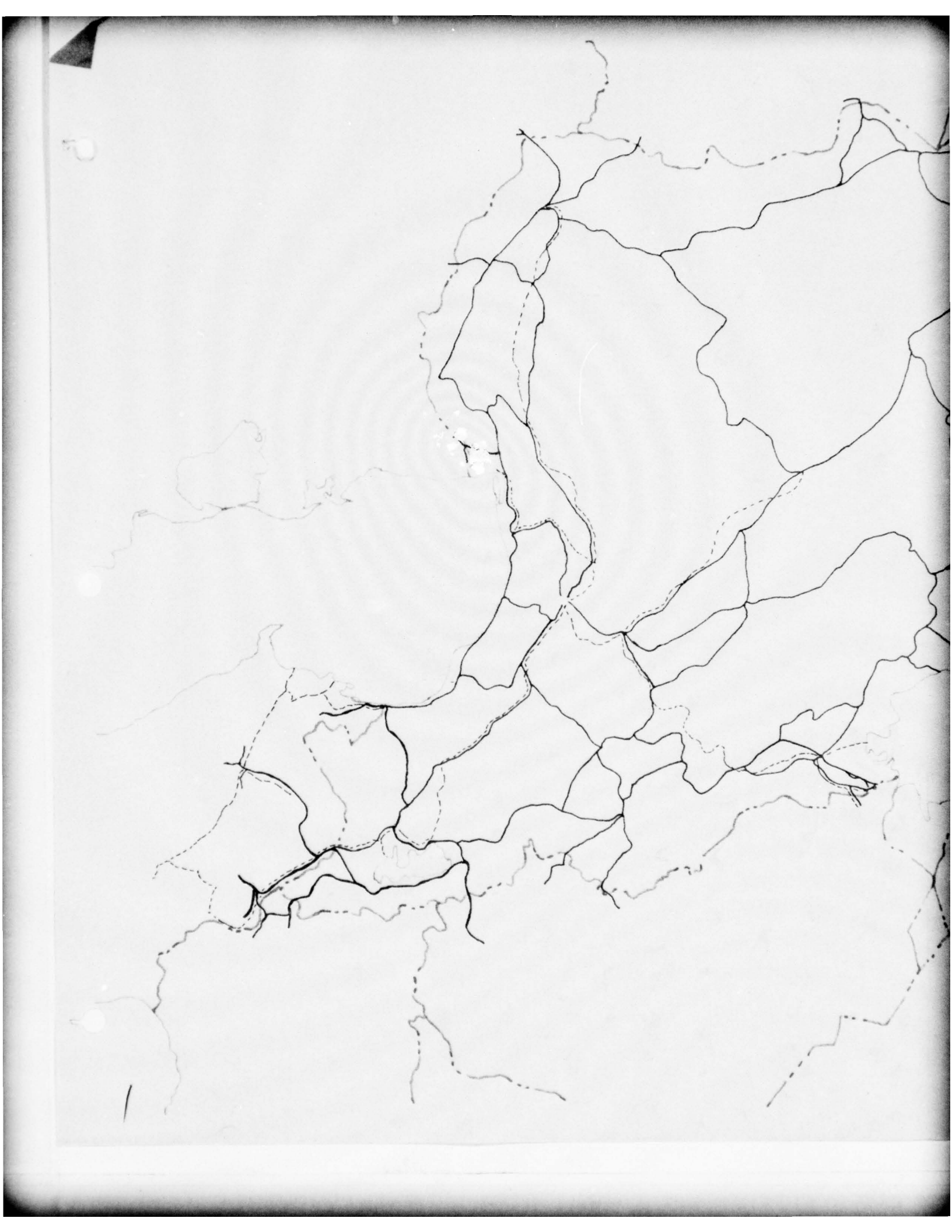


IRAN
TERRAIN CLASSIFICATION

A
B
C
D

0 50 100 150 NAUTICAL MILES

Fig. 26
D6-9603
Page 49



IRAN
ROAD-RAIL NETWORK

——— ROADS
- - - - - RAILROADS

Fig. 27
D6-9603
Page 50


20 DAYS
40
40
60
60
80
80
100
100
120

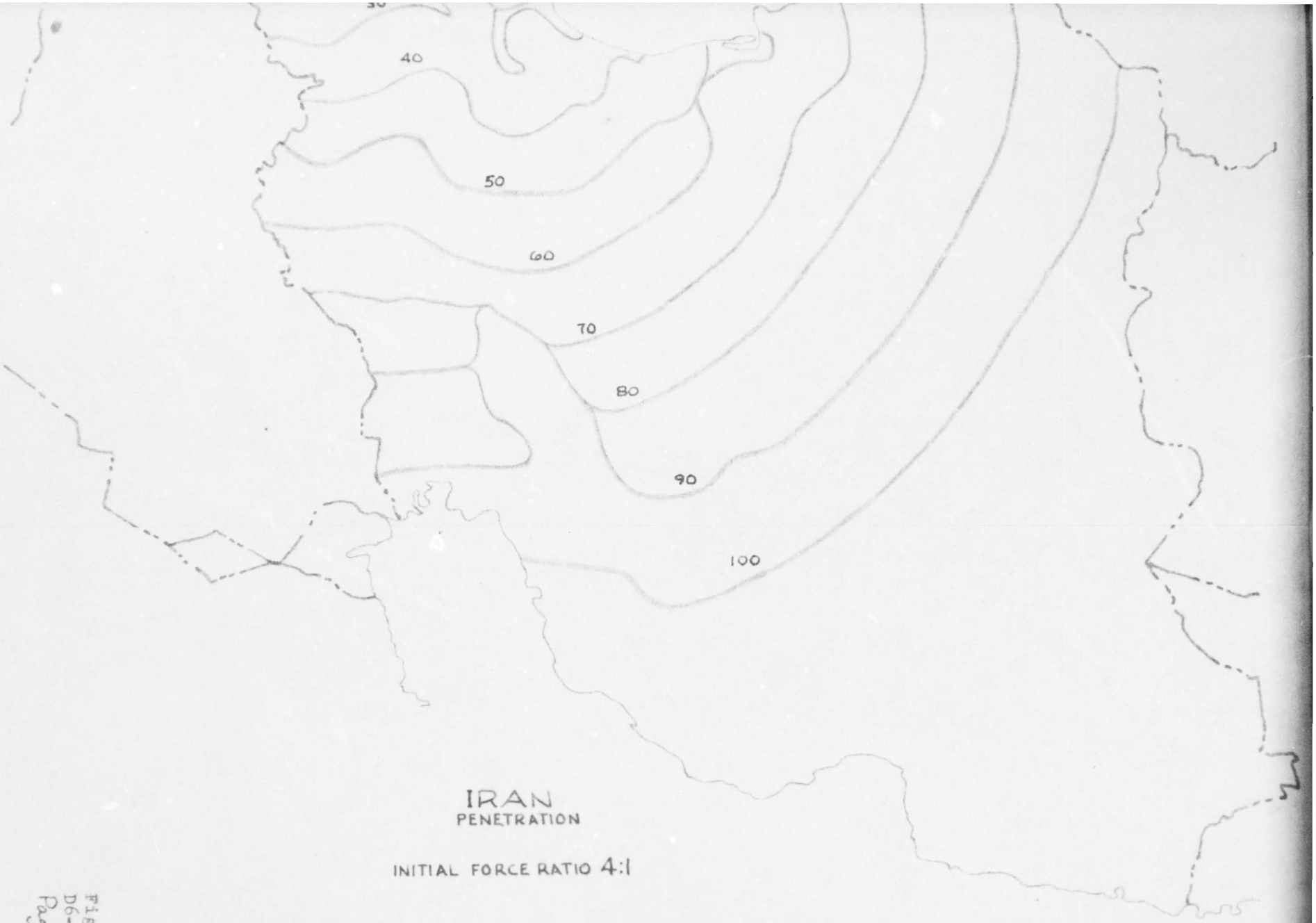
IRAN
PENETRATION

INITIAL FORCE RATIO 2:1

Fig. 28
D6-9603
Page 51

2


10 DAYS
20
30
40
50
60
70
80
90



IRAN
PENETRATION

INITIAL FORCE RATIO 4:1

Fig. 29
D6-9603
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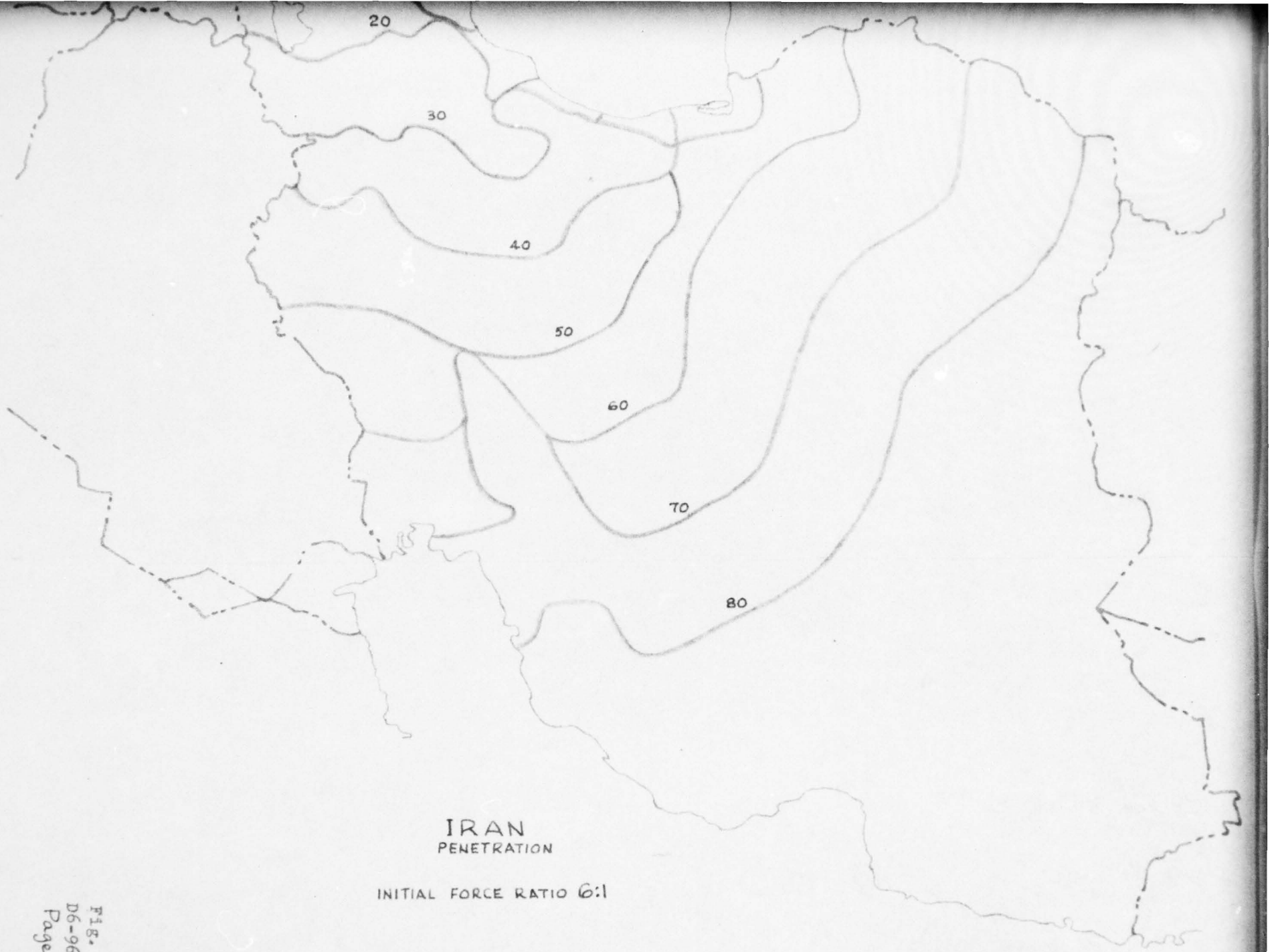
10 DAYS
20
30
40
50
60



IRAN
PENETRATION

INITIAL FORCE RATIO 6:1

FIG. 30
D6-9603
Page 53

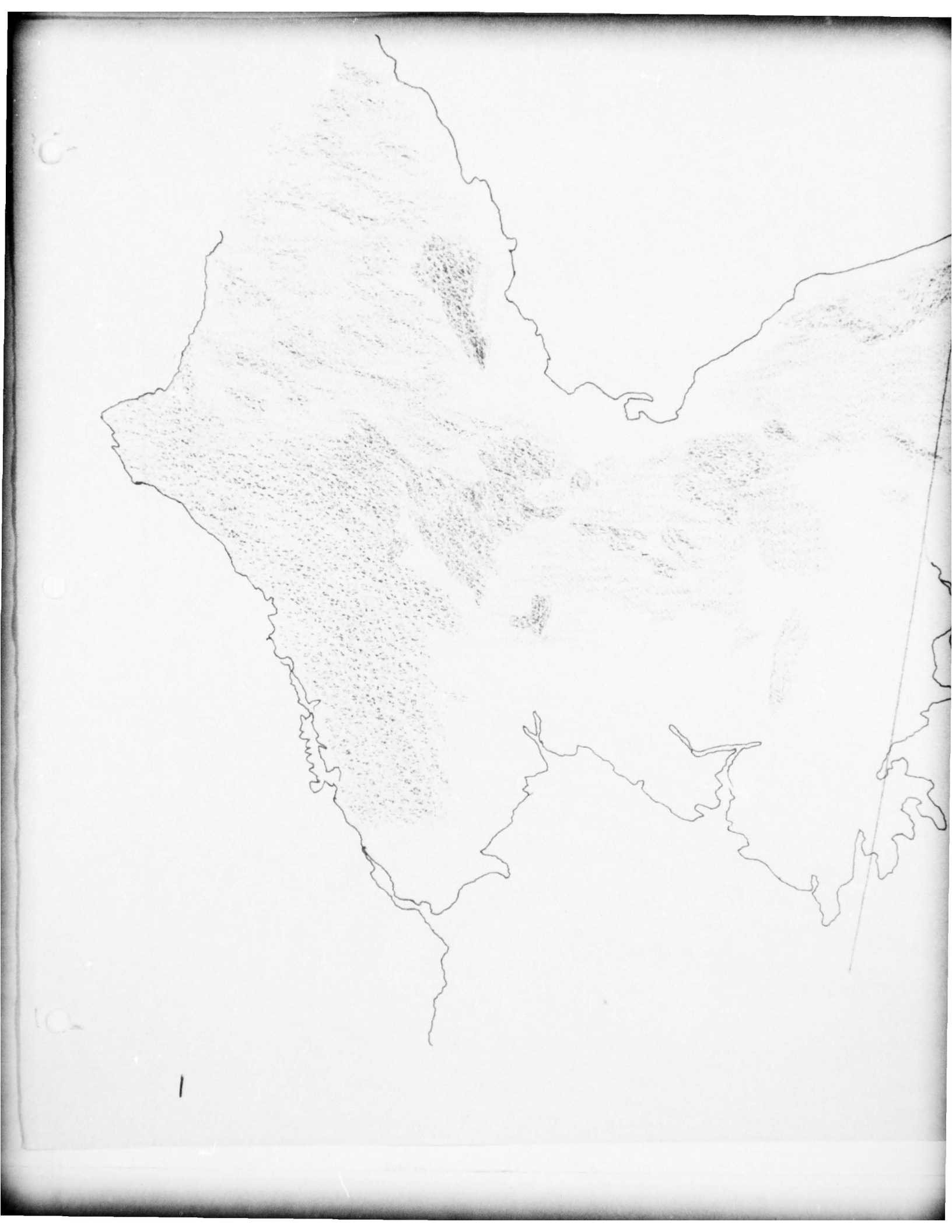
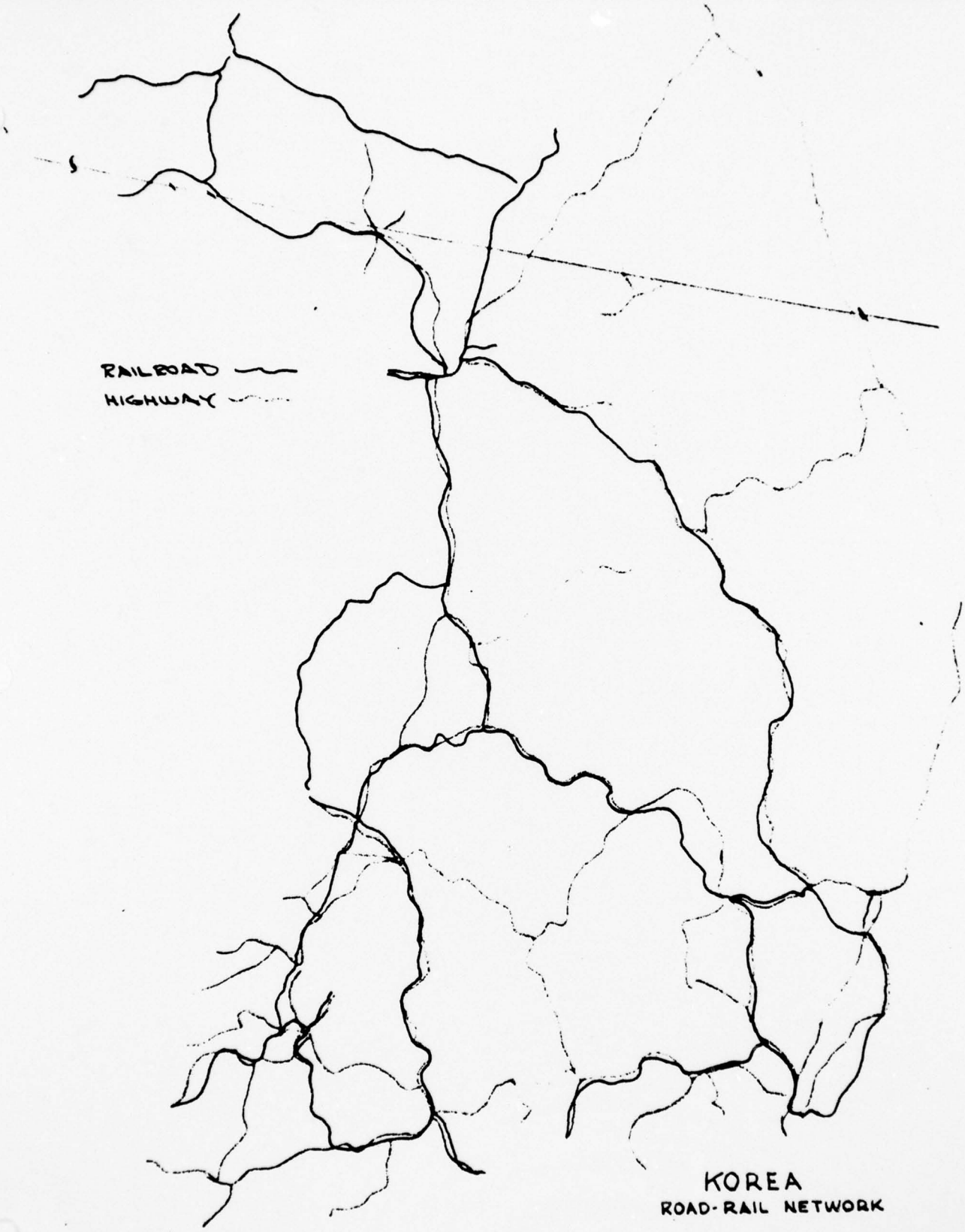


Fig. 31
D6-9603
Page 54



KOREA
ROAD-RAIL NETWORK

Fig. 32
D6-9603
Page 55

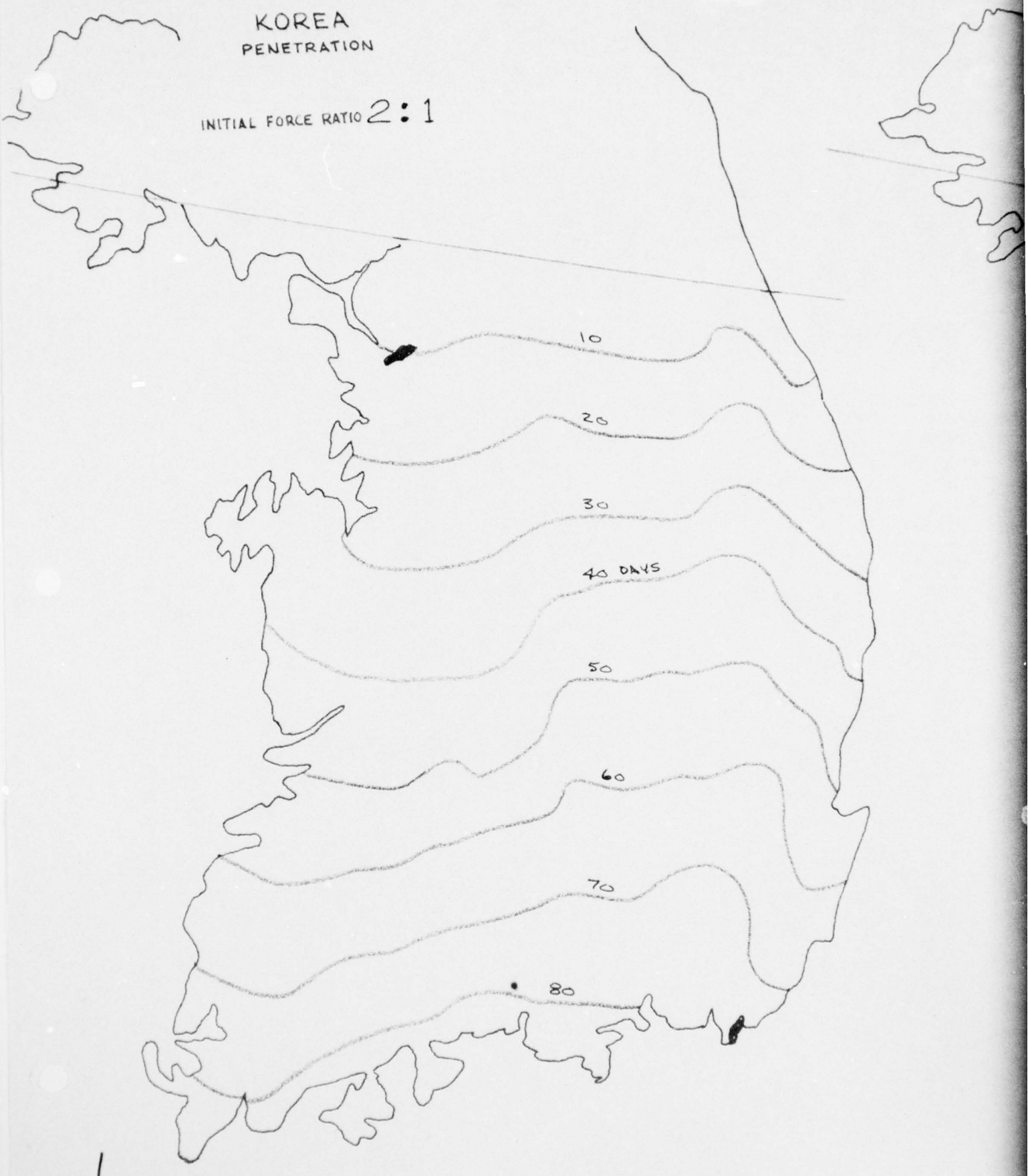

KOREA
PENETRATION
INITIAL FORCE RATIO 2:1
10
20
30
40 DAYS
50
60
70
80

Fig. 33
D6-9603
Page 56

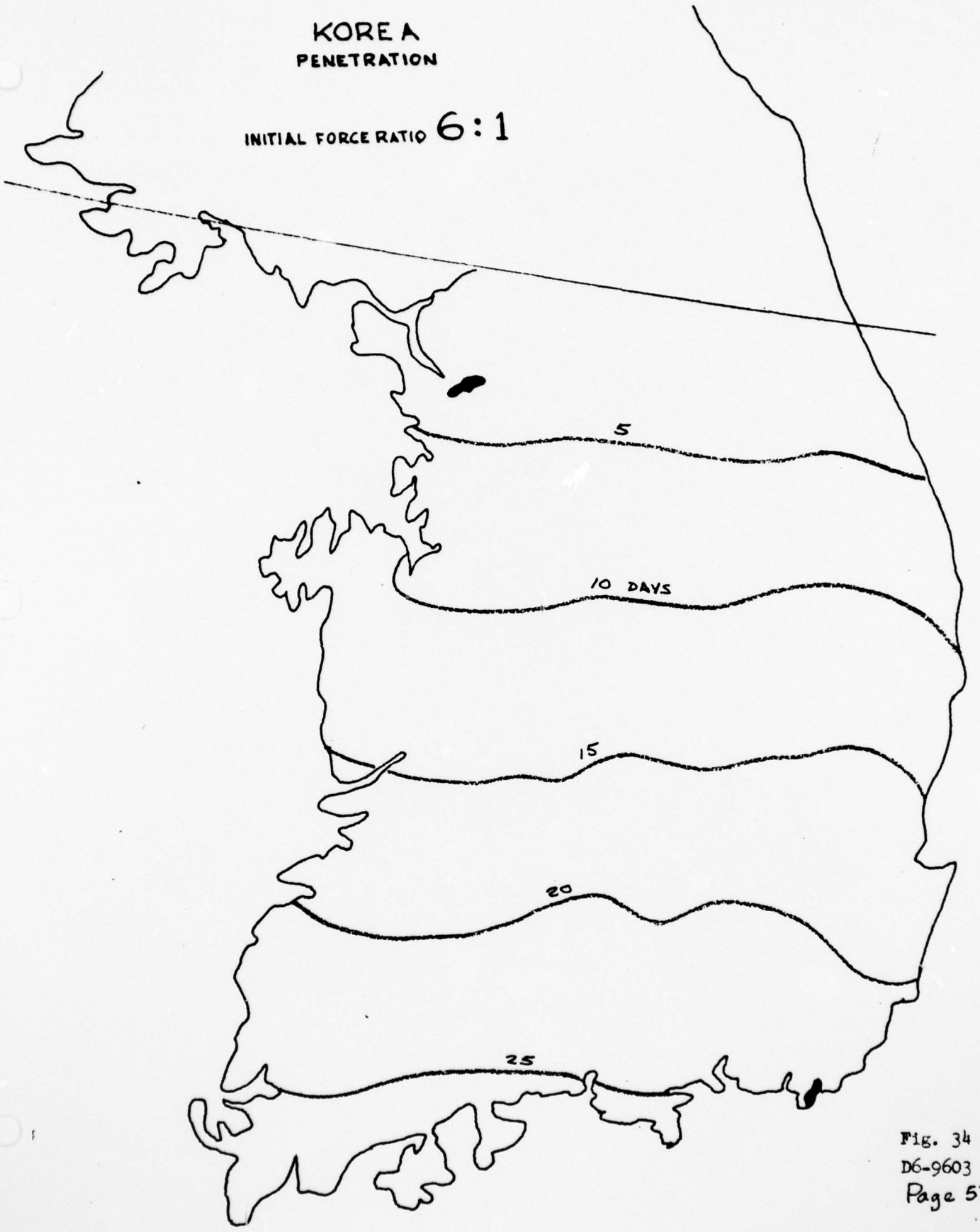


Fig. 34
D6-9603
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Fig. 35
D6-9603

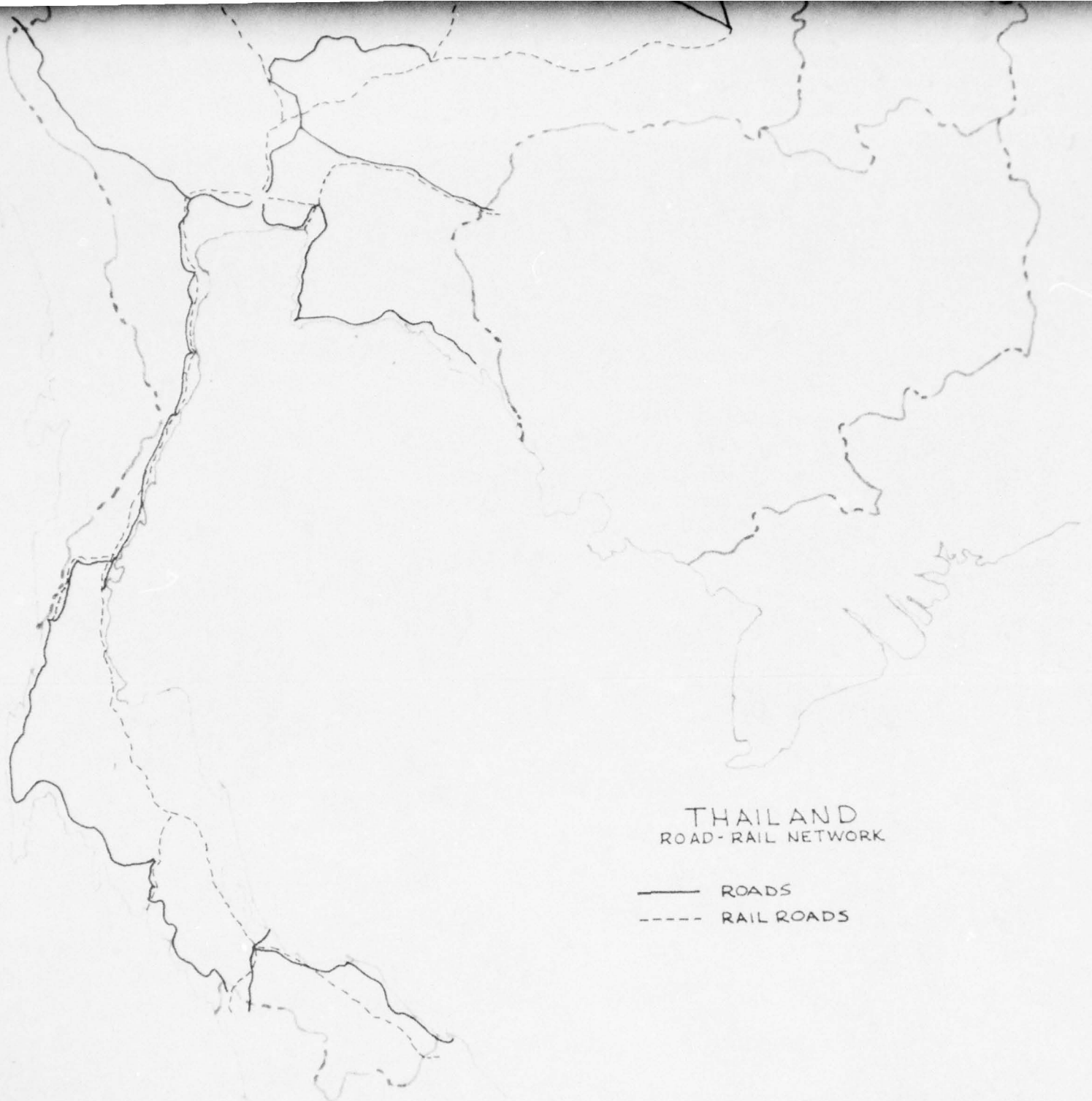


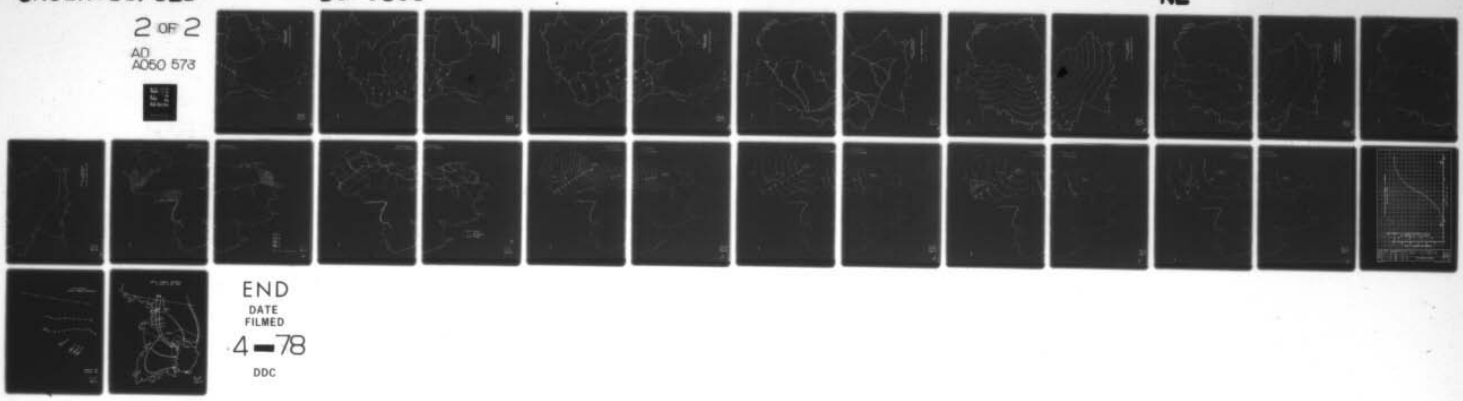
Fig. 36
D6-9603
Page 59

2


10 DAYS
20
30
40
50
60
70
80
90
100
110
120
10
20
30
20
10
40
50
60
70
80
90

AD-A050 573 BOEING CO RENTON WASH TRANSPORT DIV F/G 15/7
DEPLOYMENT FORCE REQUIREMENTS TIMELINESS OF ACTION IN LIMITED W--ETC(U)
1963 G R TURINA
UNCLASSIFIED D6-9603 NL

2 OF 2
AD
A050 573



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DATE
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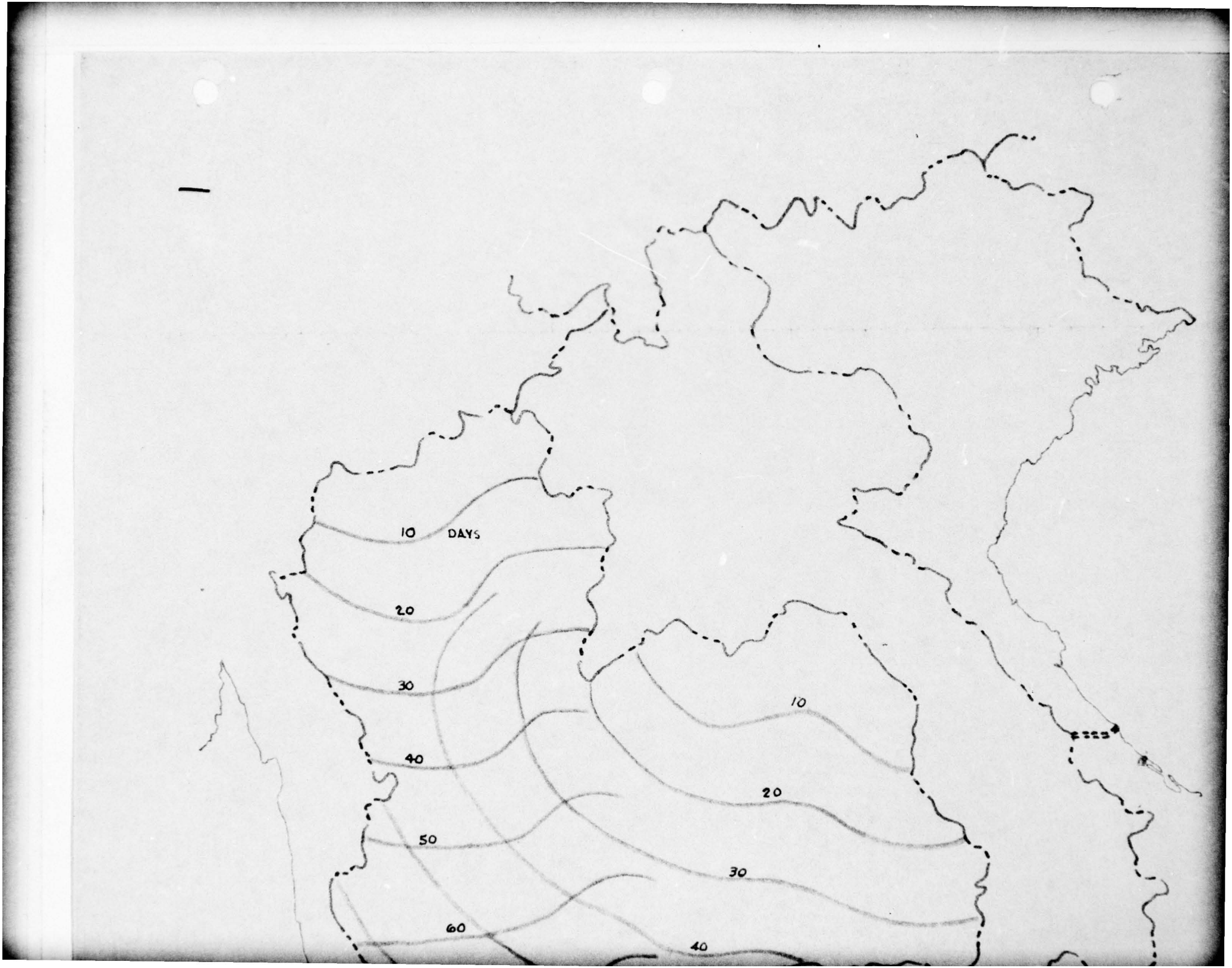
4-78
DDC

THAILAND
PENETRATION

INITIAL FORCE RATIO 2:1

Fig. 37
D6-9603
Page 60


10 DAYS
20
30
40
50
60
10
20
30
40

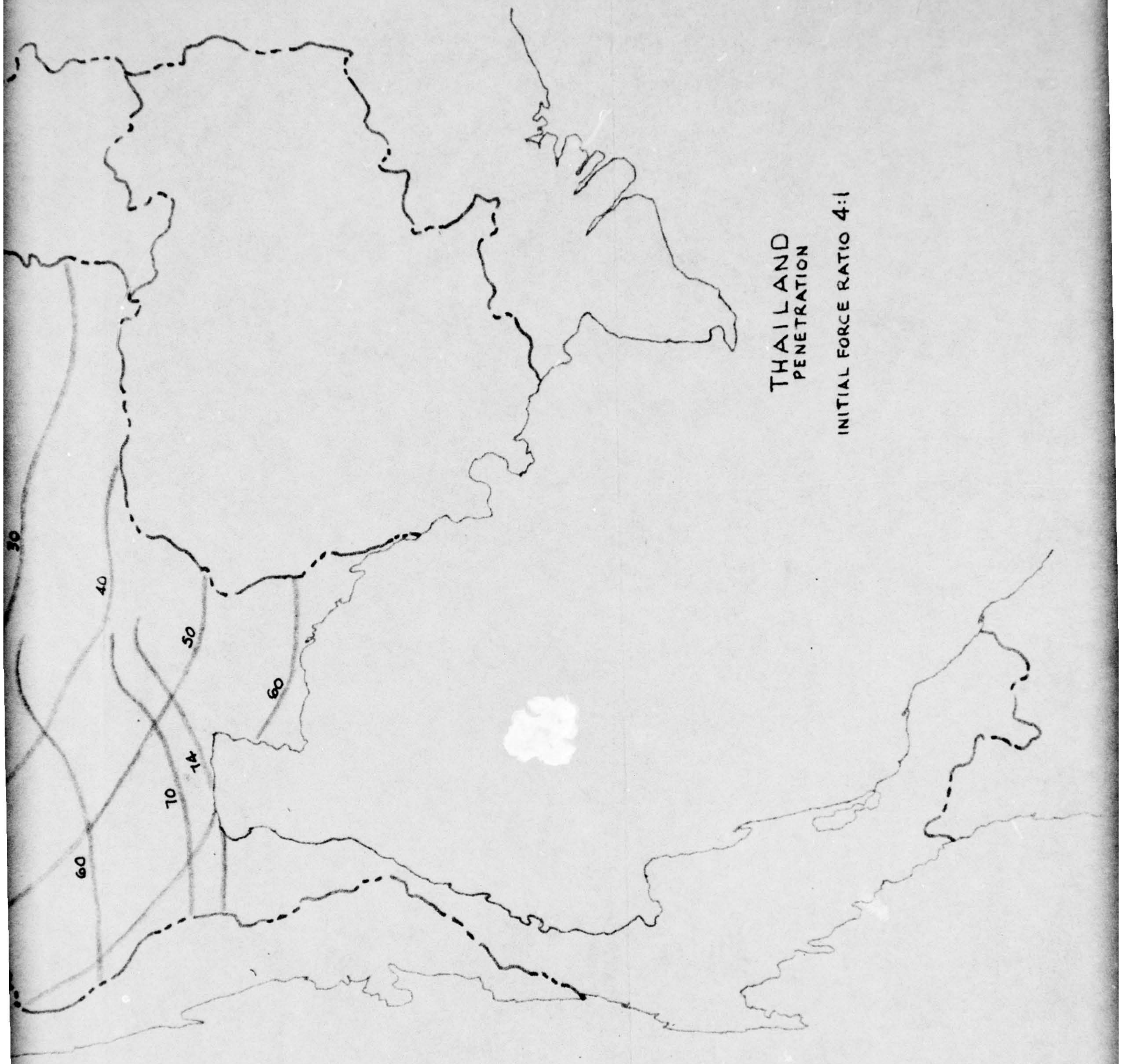
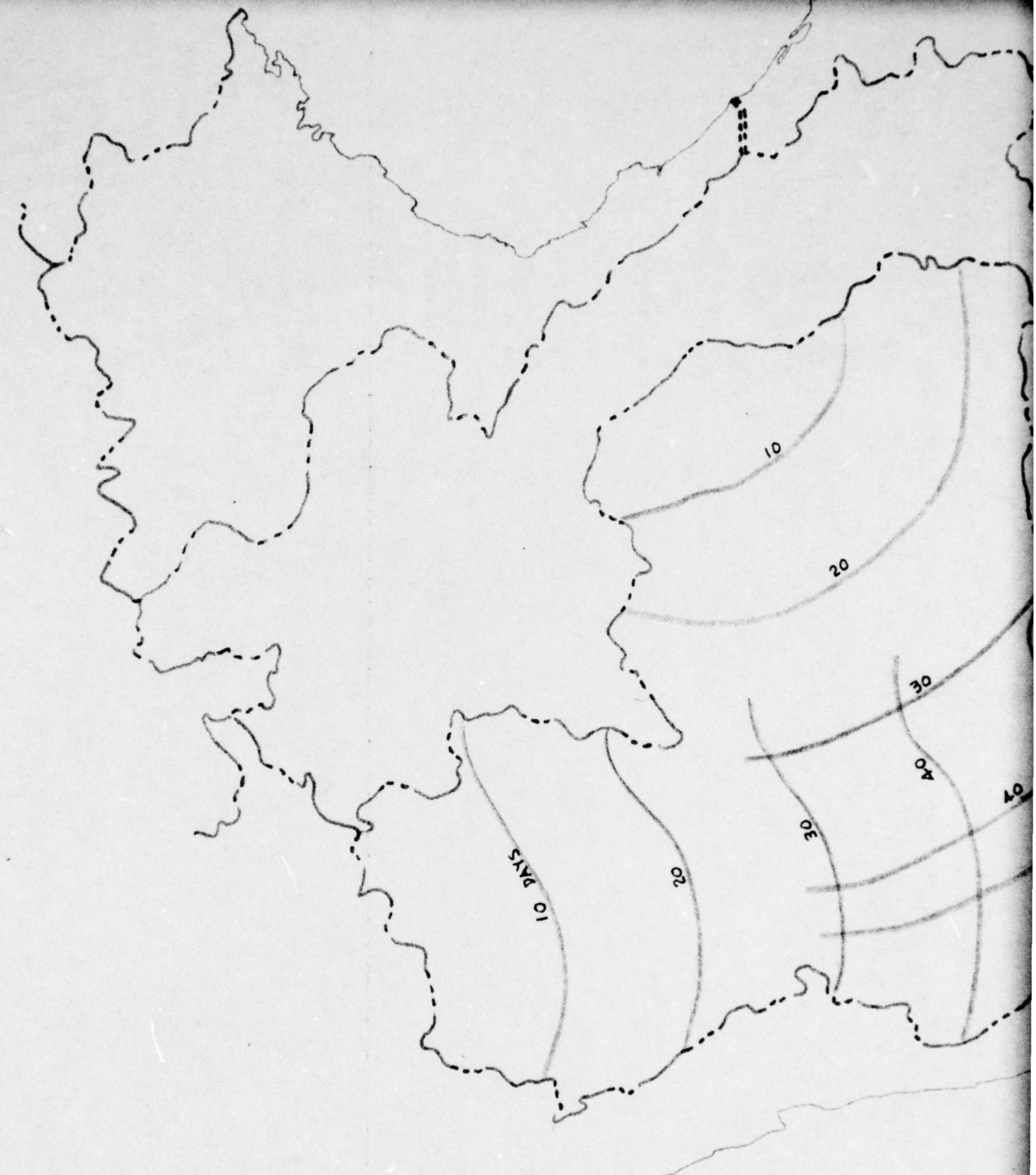

THAILAND
PENETRATION
INITIAL FORCE RATIO 4:1
30
40
50
60
74
70
60

Fig. 38



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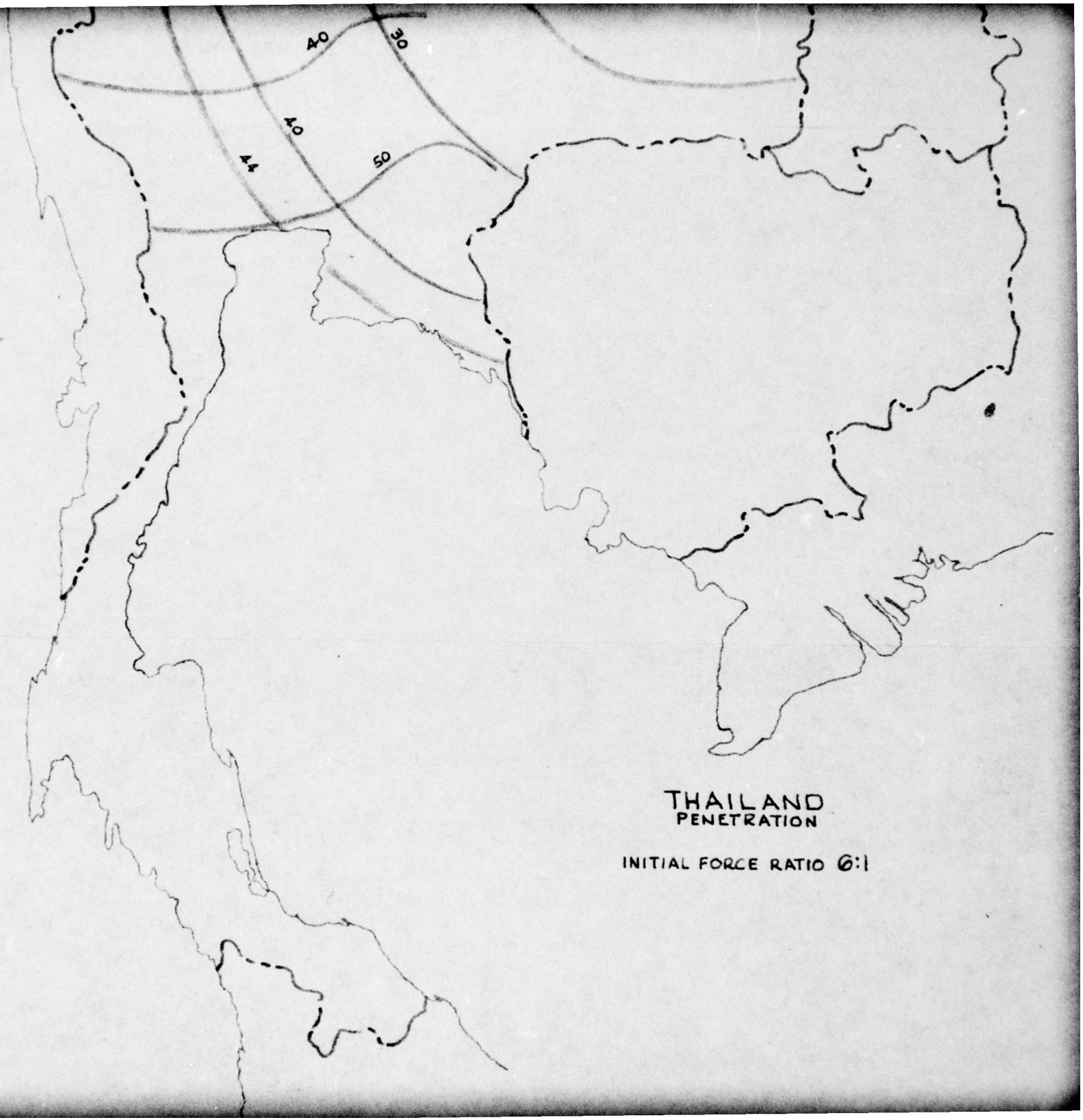
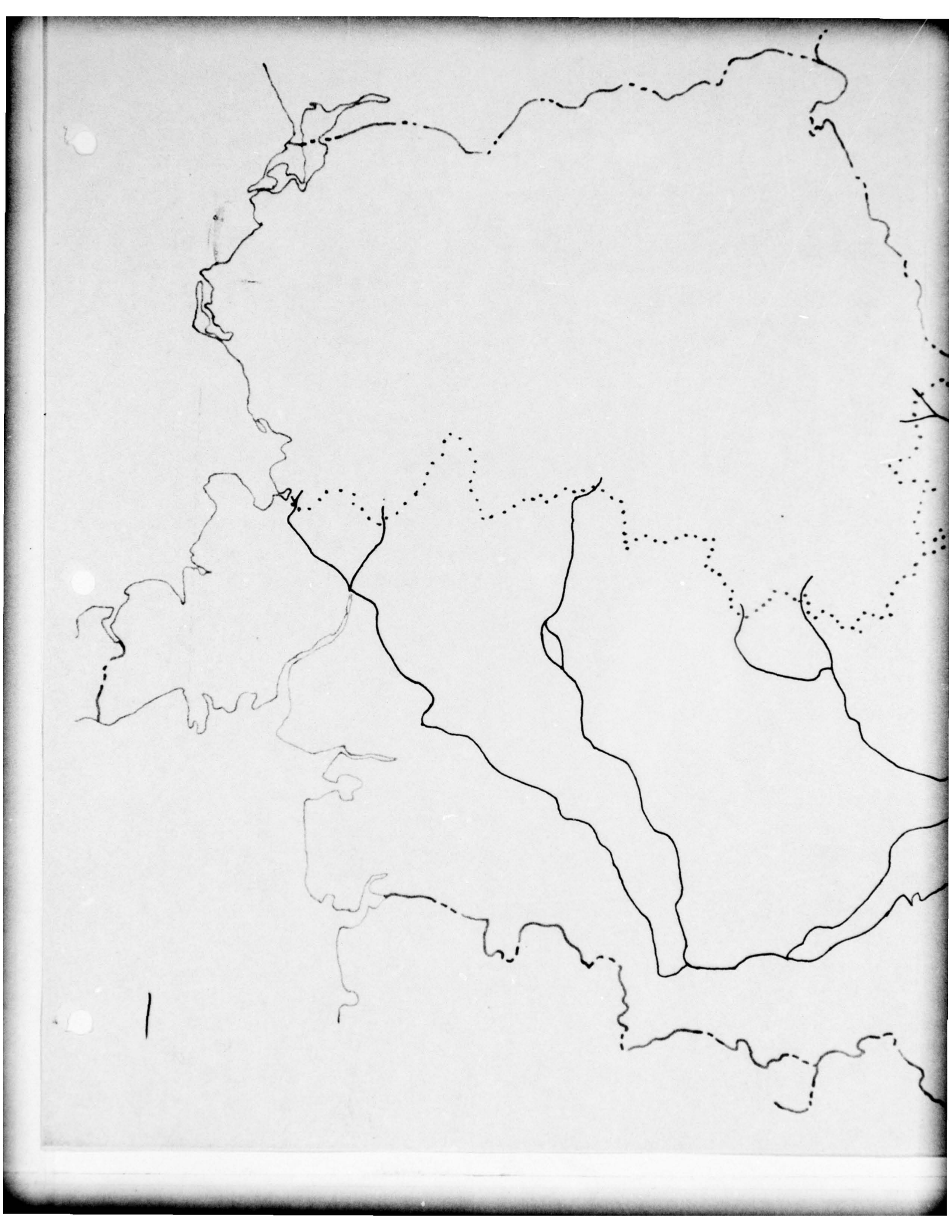


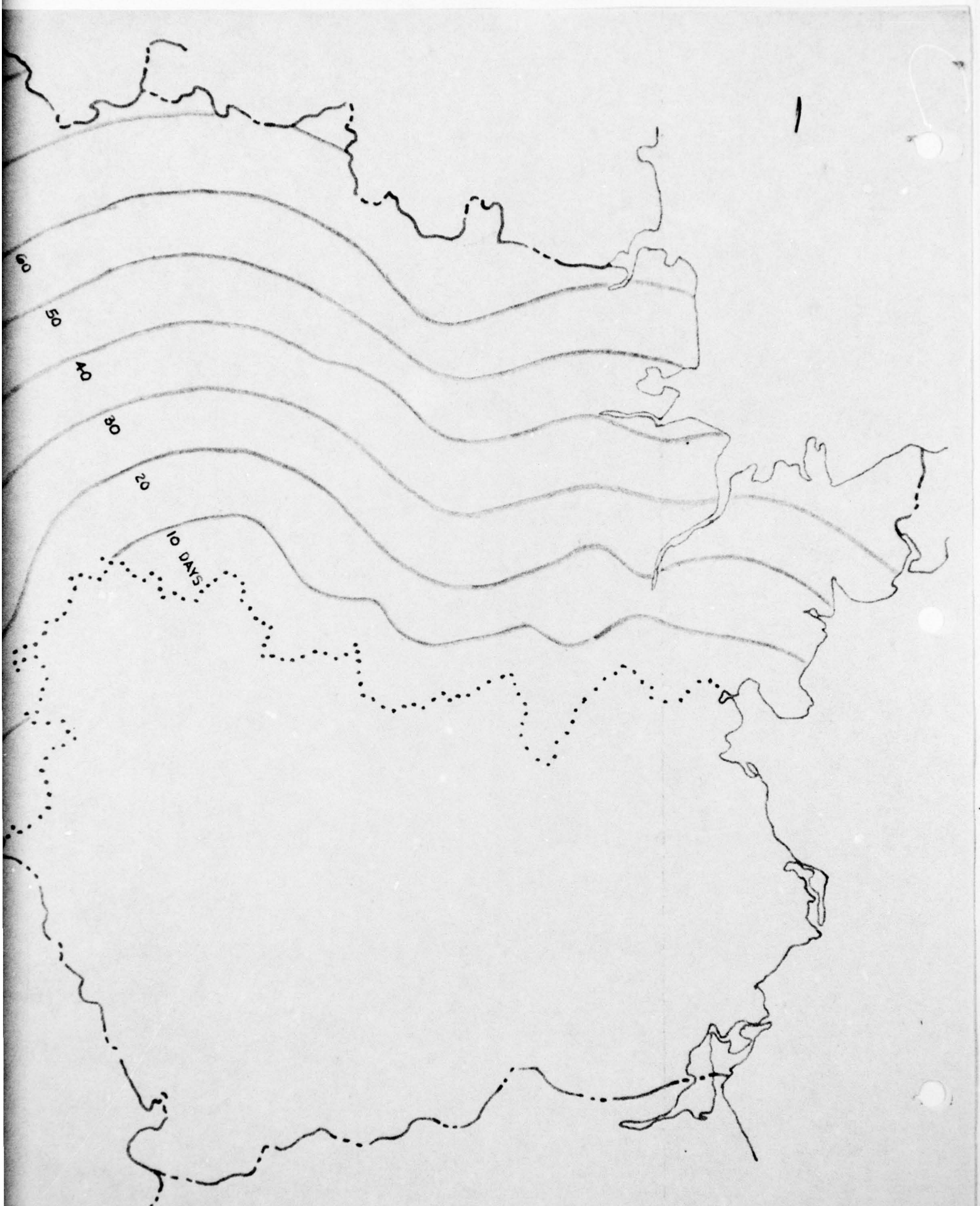
THAILAND
PENETRATION

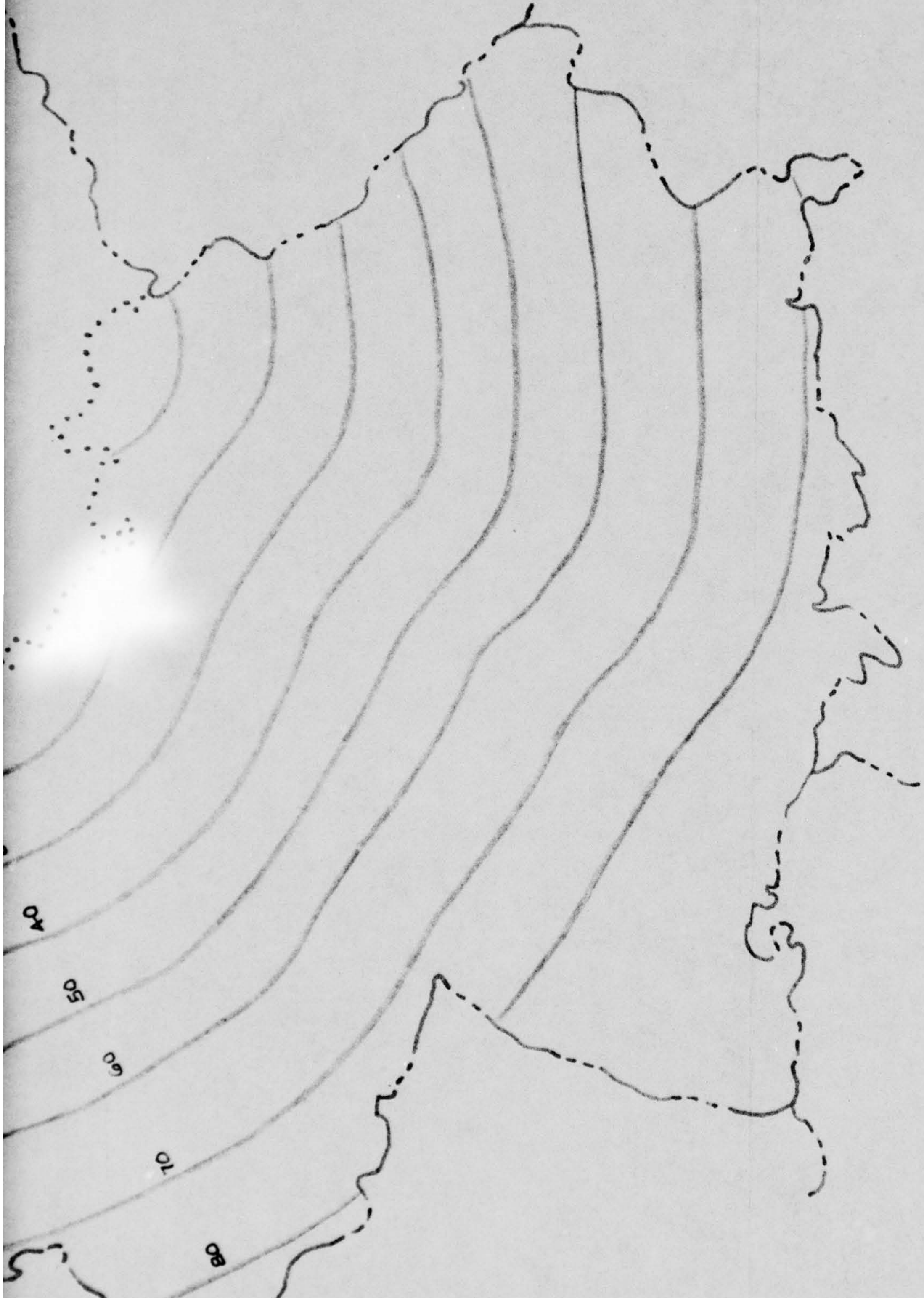
INITIAL FORCE RATIO 6:1

Fig. 39
D6-9603
Page 62



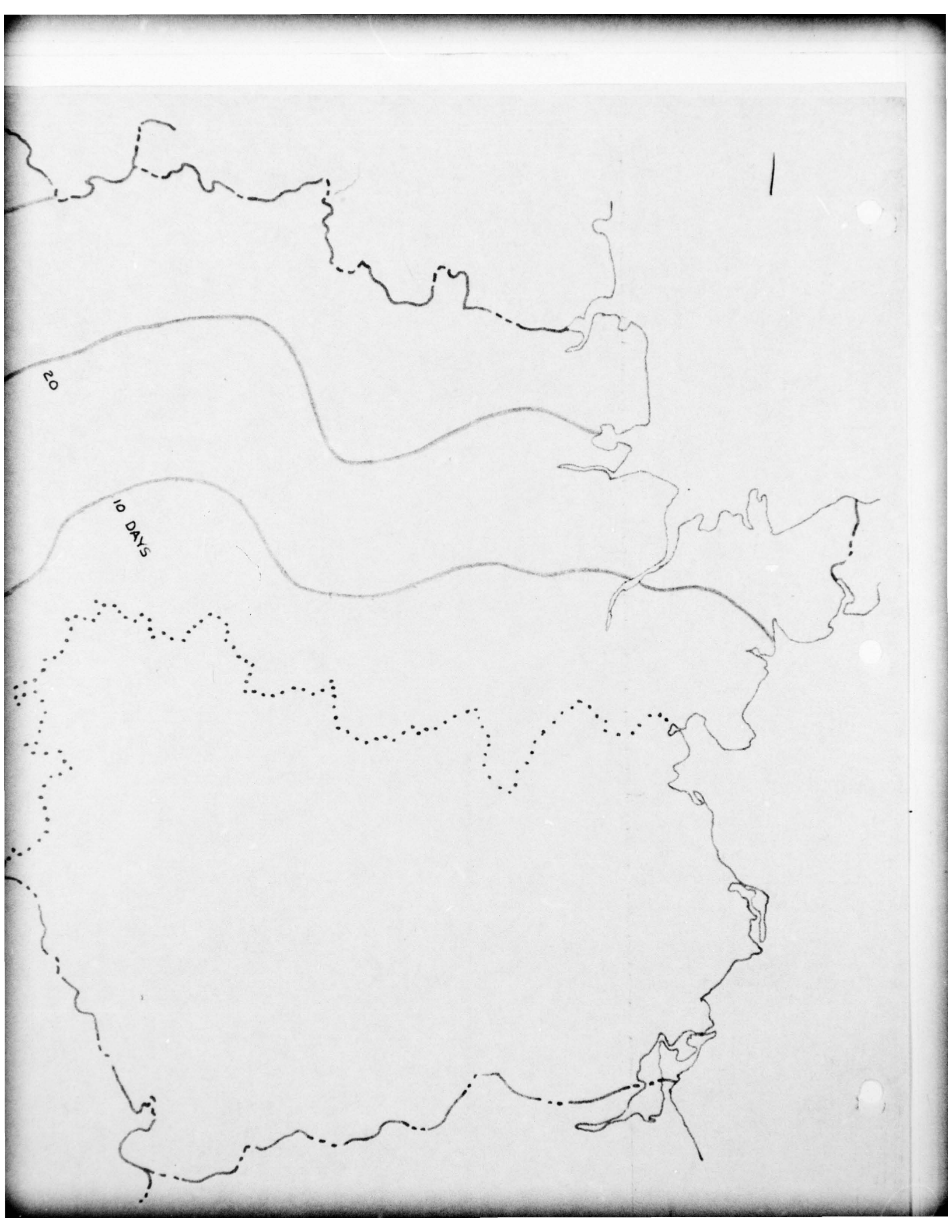

WEST GERMANY
ROAD NETWORK
ROADS- SPECIAL & MAIN
0 10 25 50 100 NAUTICAL MILES


1
60
50
40
30
20
10 DAYS



WEST GERMANY
PENETRATION
INITIAL FORCE RATIO 2:1

Fig. 42
D6-9603

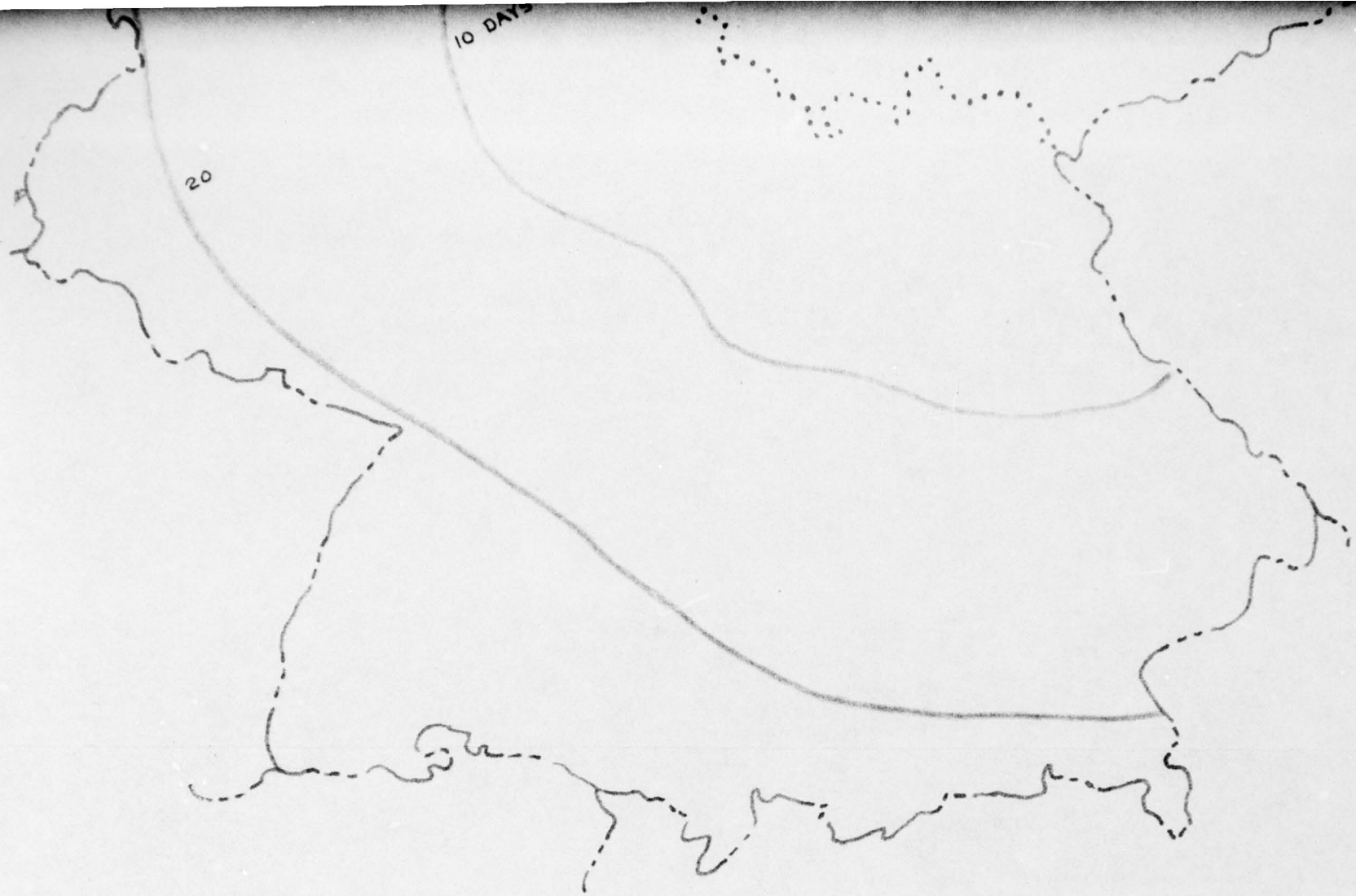

20
10 DAYS

WEST GERMANY
PENETRATION

INITIAL FORCE RATIO 4:1

Fig. 43
D6-9603
Page 65


10 DAYS



WEST GERMANY
PENETRATION

INITIAL FORCE RATIO 6:1

Fig. 44
D6-9603
Page 66

2


VENEZUELA
TERRAIN CLASSIFICATION

VENEZUELA
TERRAIN CLASSIFICATION

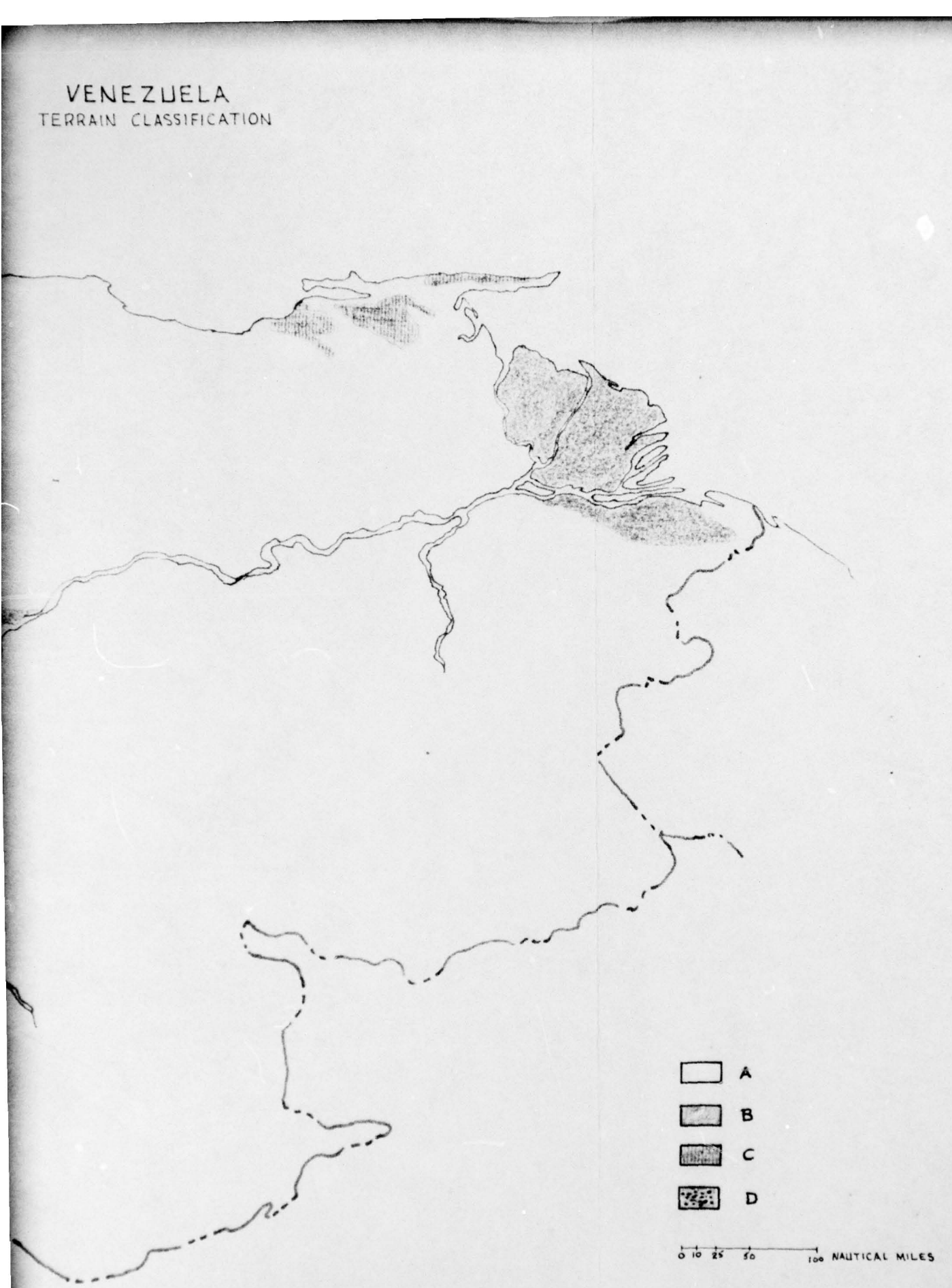


Fig. 45
D6-9603
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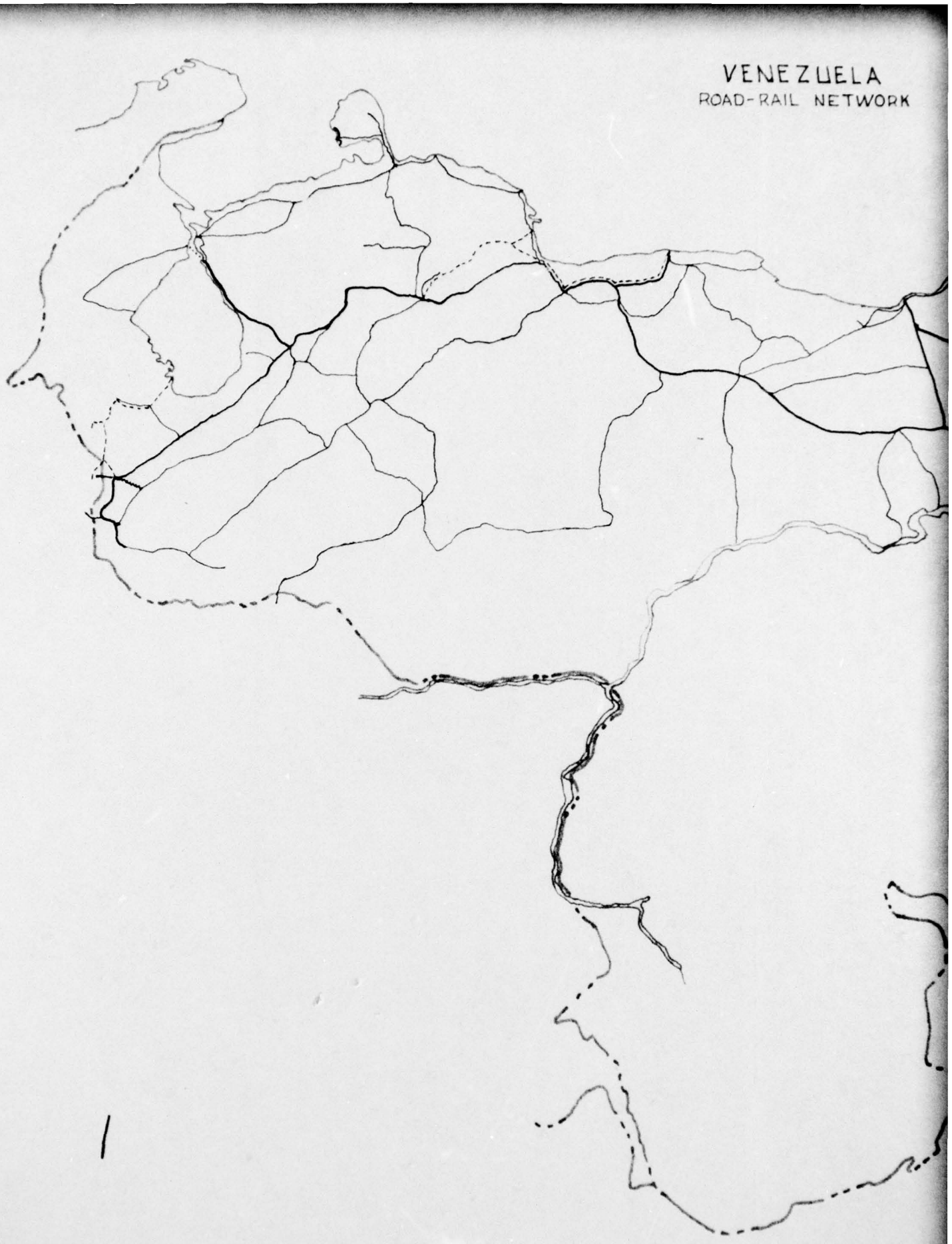
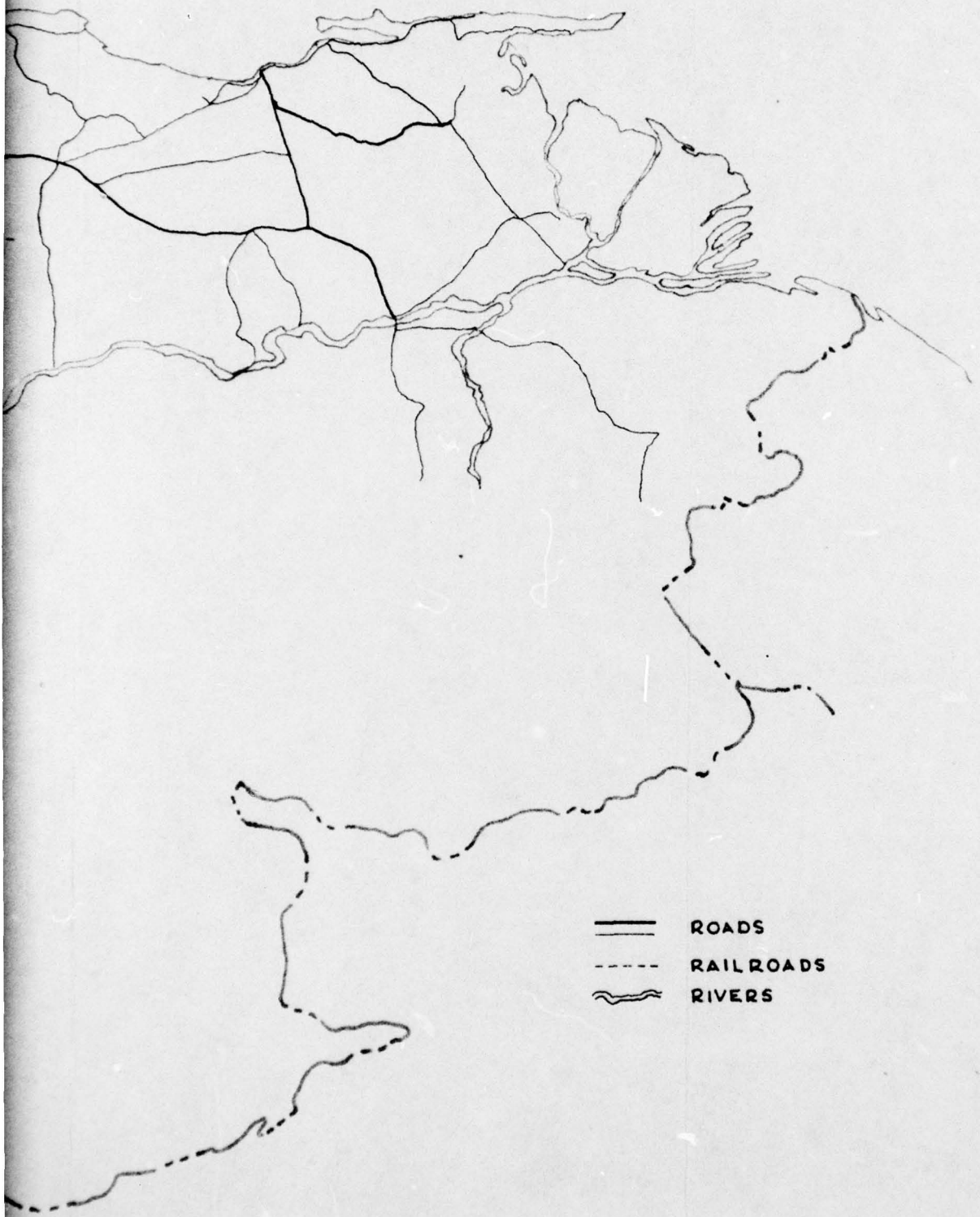
2


VENEZUELA
ROAD-RAIL NETWORK

VENEZUELA
ROAD-RAIL NETWORK



2

Fig. 46
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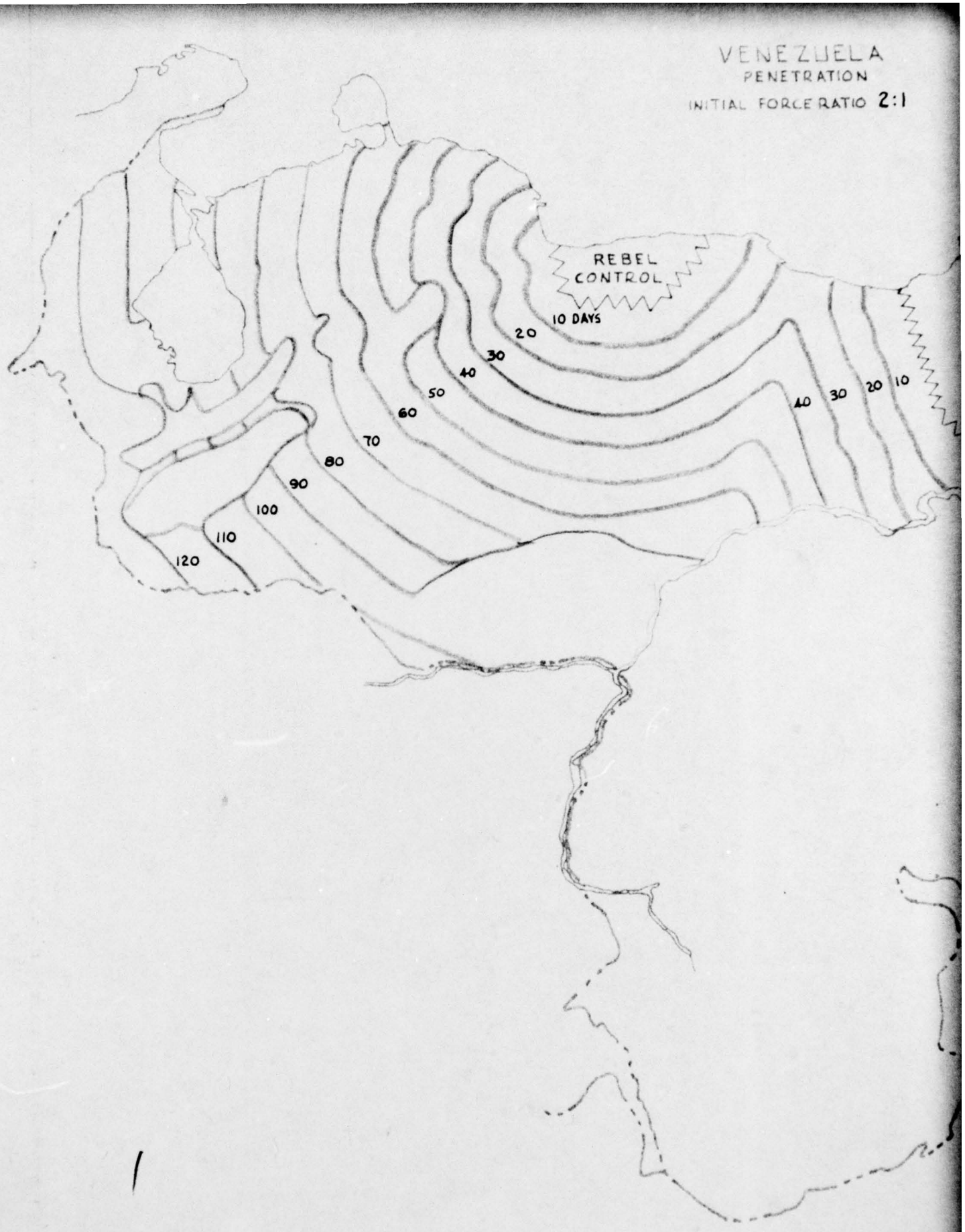
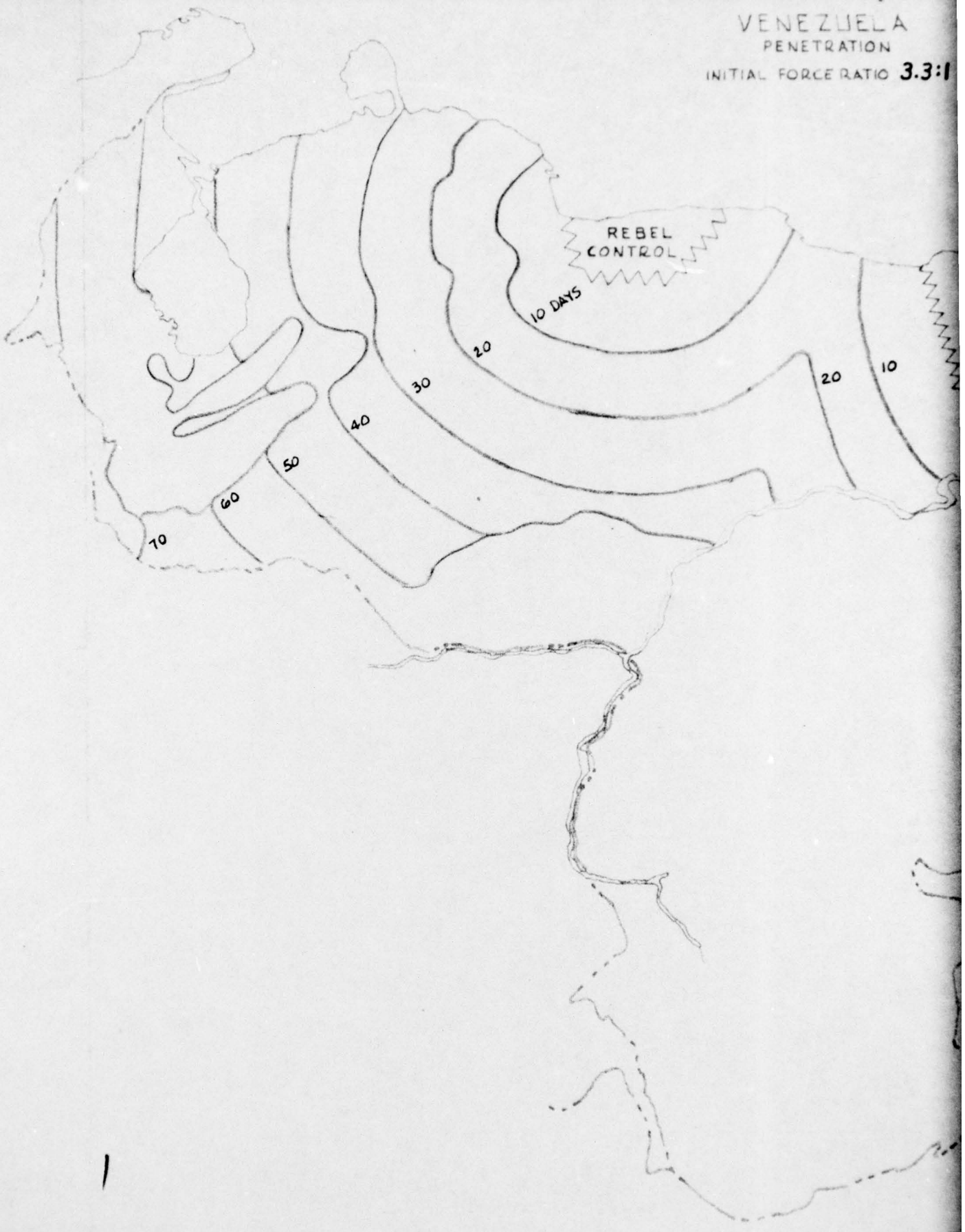

VENEZUELA
PENETRATION
INITIAL FORCE RATIO 2:1
REBEL CONTROL
10 DAYS
20
30
40
50
60
70
80
90
100
110
120
40
30
20
10

VENEZUELA
PENETRATION
INITIAL FORCE RATIO 2:1

Fig. 47
D6-9603
Page 69

2


VENEZUELA
PENETRATION
INITIAL FORCE RATIO 3.3:1
REBEL CONTROL
10 DAYS
10
20
30
40
50
60
70
20
10

VENEZUELA
PENETRATION
INITIAL FORCE RATIO 3.3:1

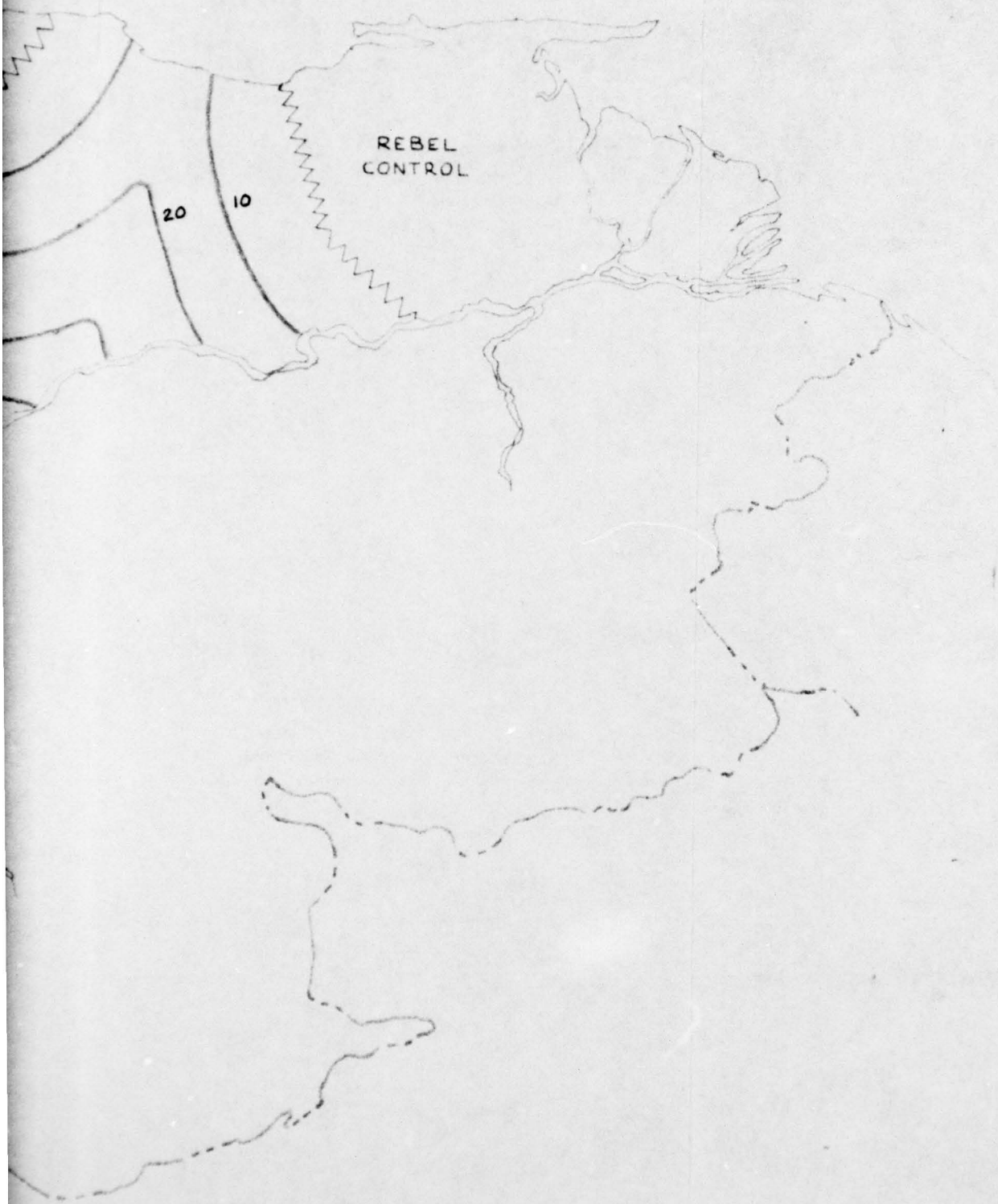


Fig. 48
D6-9603
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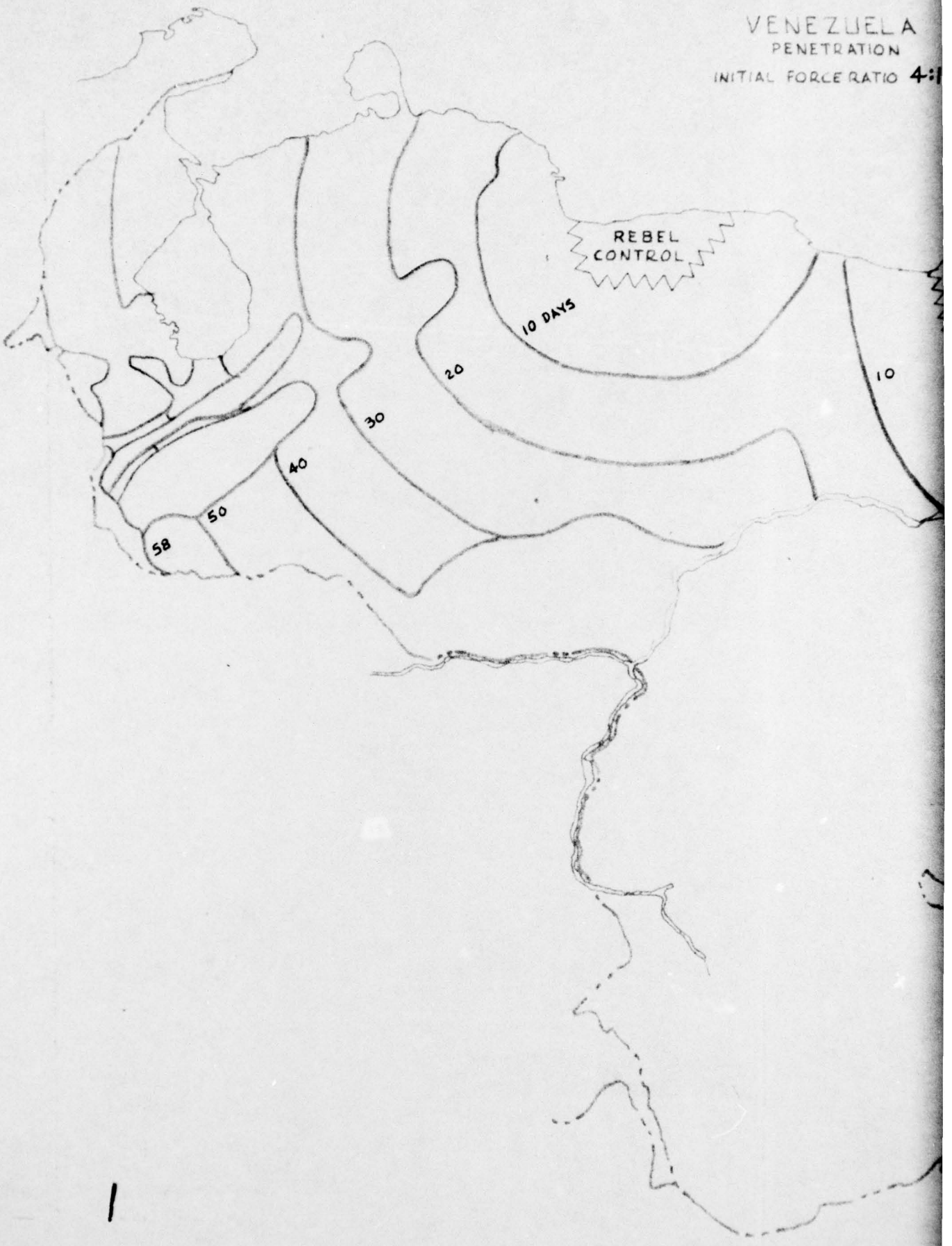
2


VENEZUELA
PENETRATION
INITIAL FORCE RATIO 4:1
REBEL CONTROL
10 DAYS
10
20
30
40
50
58

VENEZUELA
PENETRATION
INITIAL FORCE RATIO 4:1

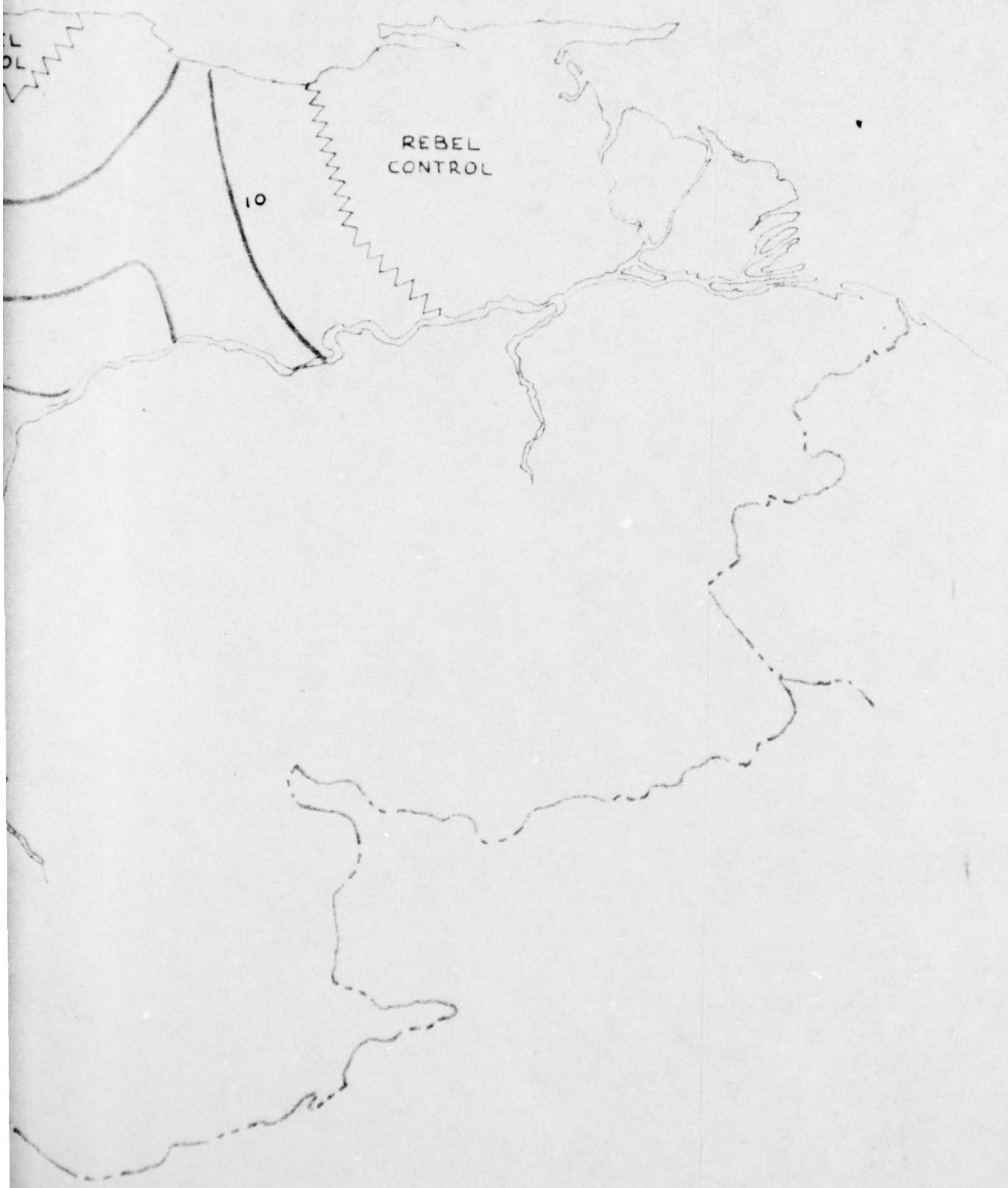


Fig. 49
D6-9603
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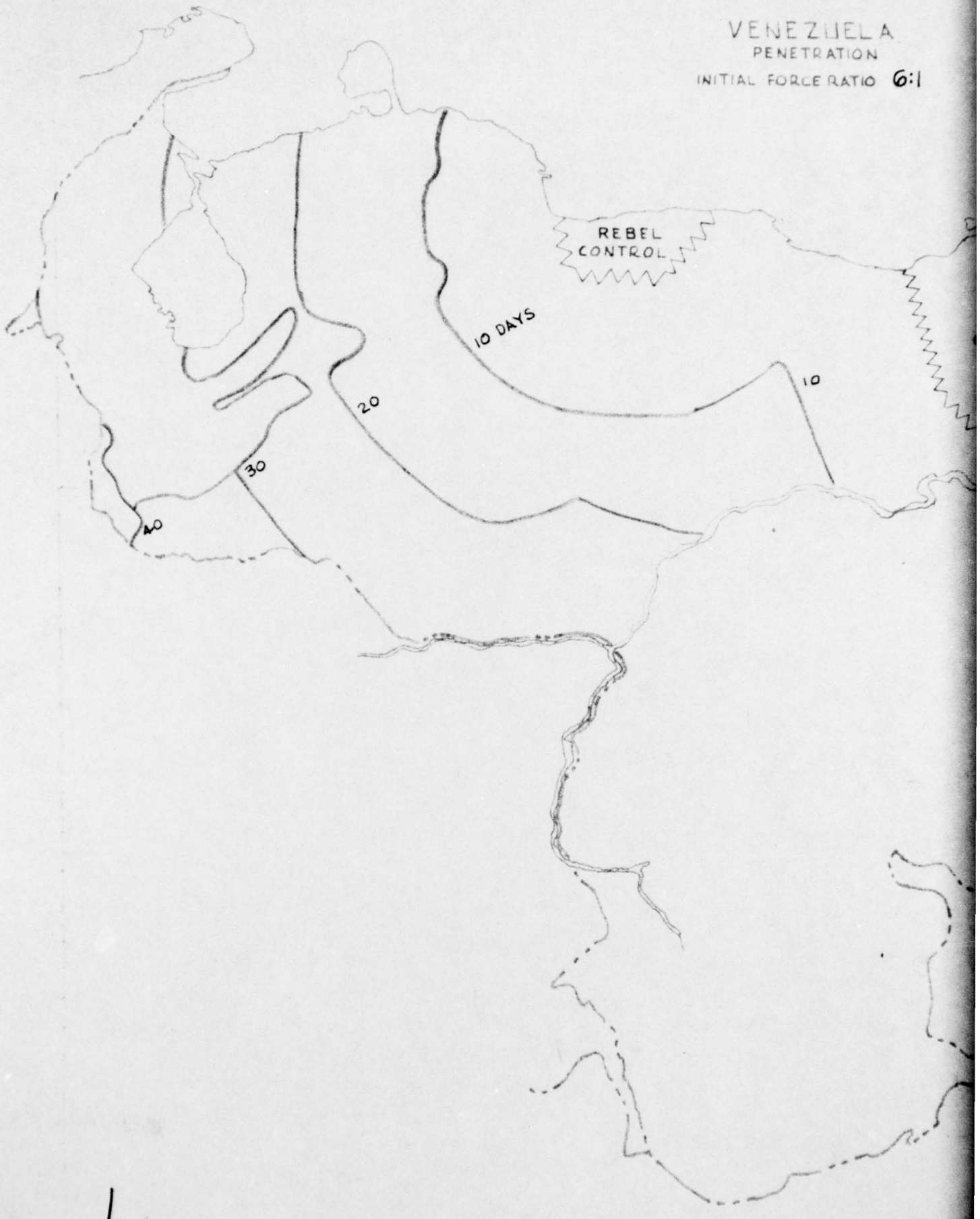
2


VENEZUELA
PENETRATION
INITIAL FORCE RATIO 6:1
REBEL CONTROL
10 DAYS
10
20
30
40

1

VENEZUELA
PENETRATION
ITIAL FORCE RATIO 6:1

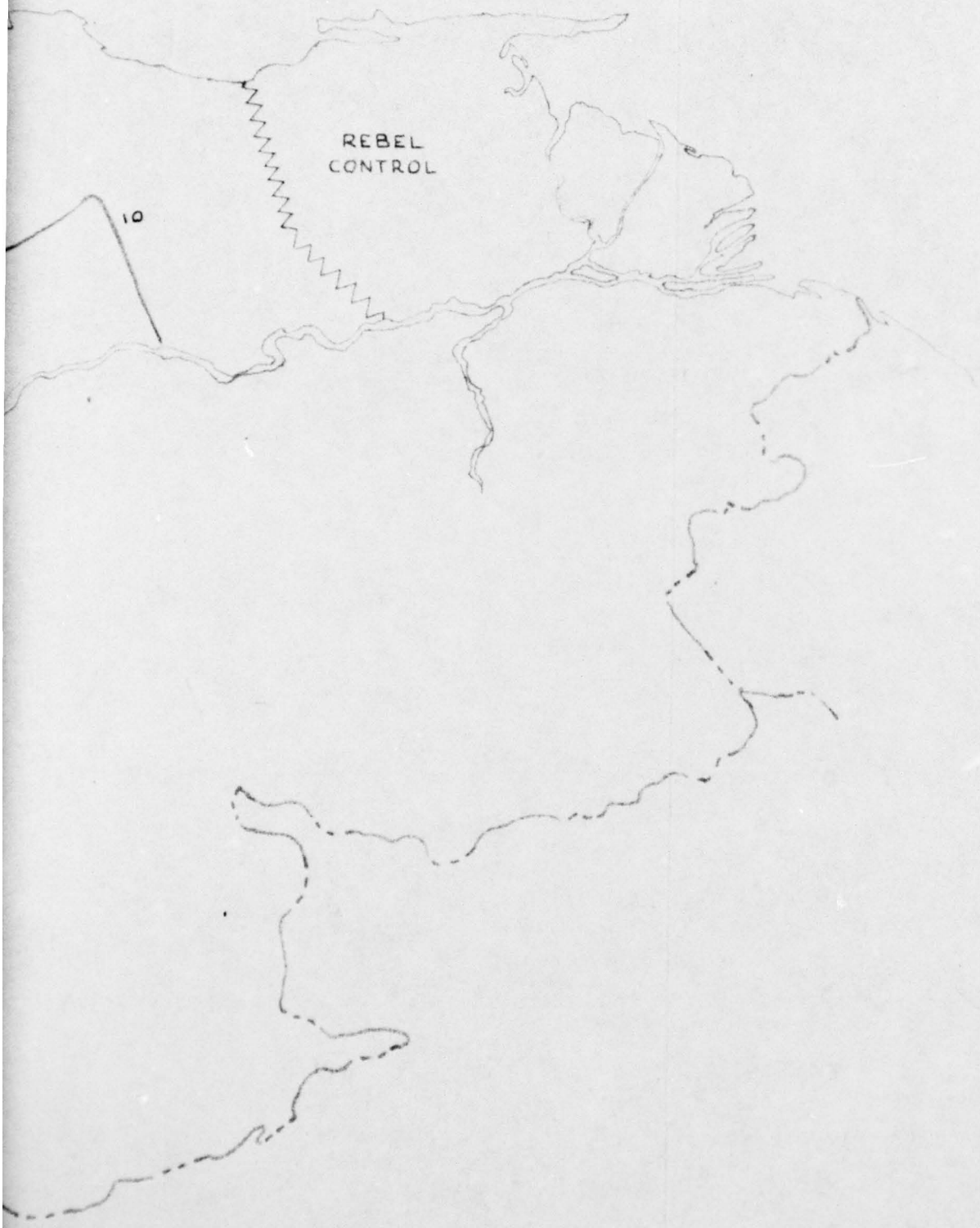


Fig. 50
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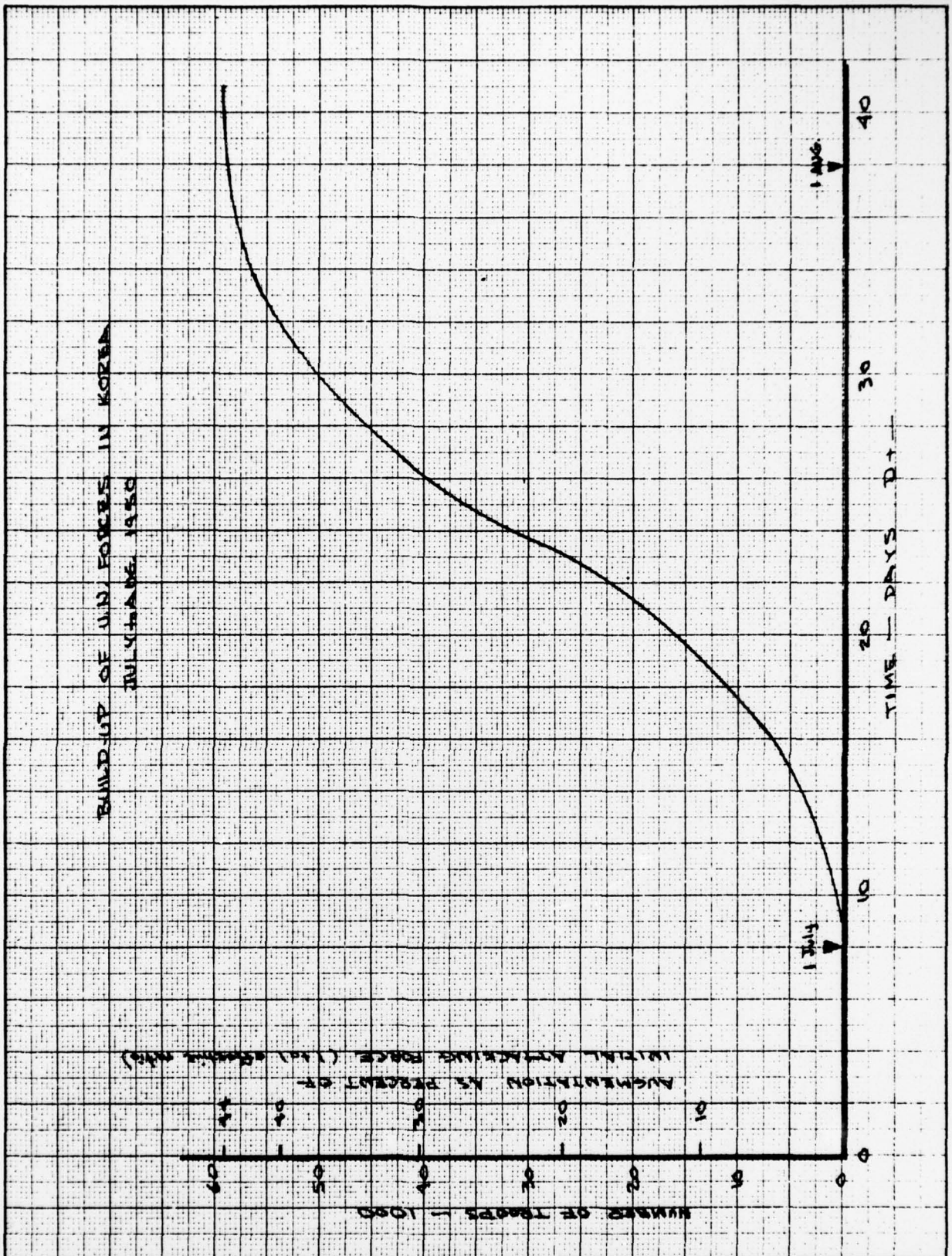
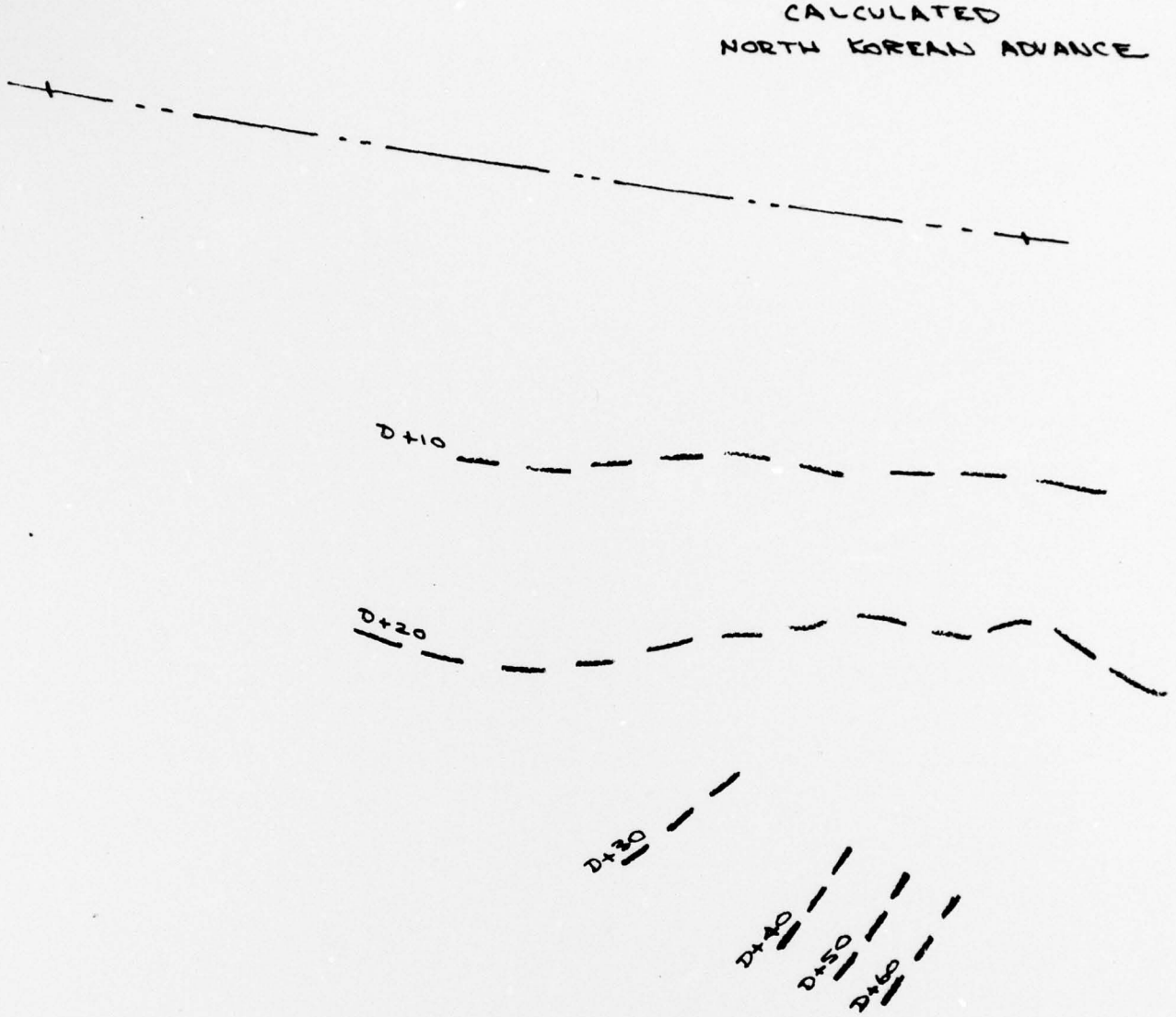
50

2



CALC	GRT	563	REVISED	DATE	BUILD-UP OF U.N. FORCES IN KOREA — JULY to AUGUST 1950	Fig. 51
CHECK						D6-9603
APR					THE BOEING COMPANY	PAGE 73
APR						



OVERLAY A
FIGURE 52

NORTH KOREAN ADVANCE
24 JUNE to AUG. 1950

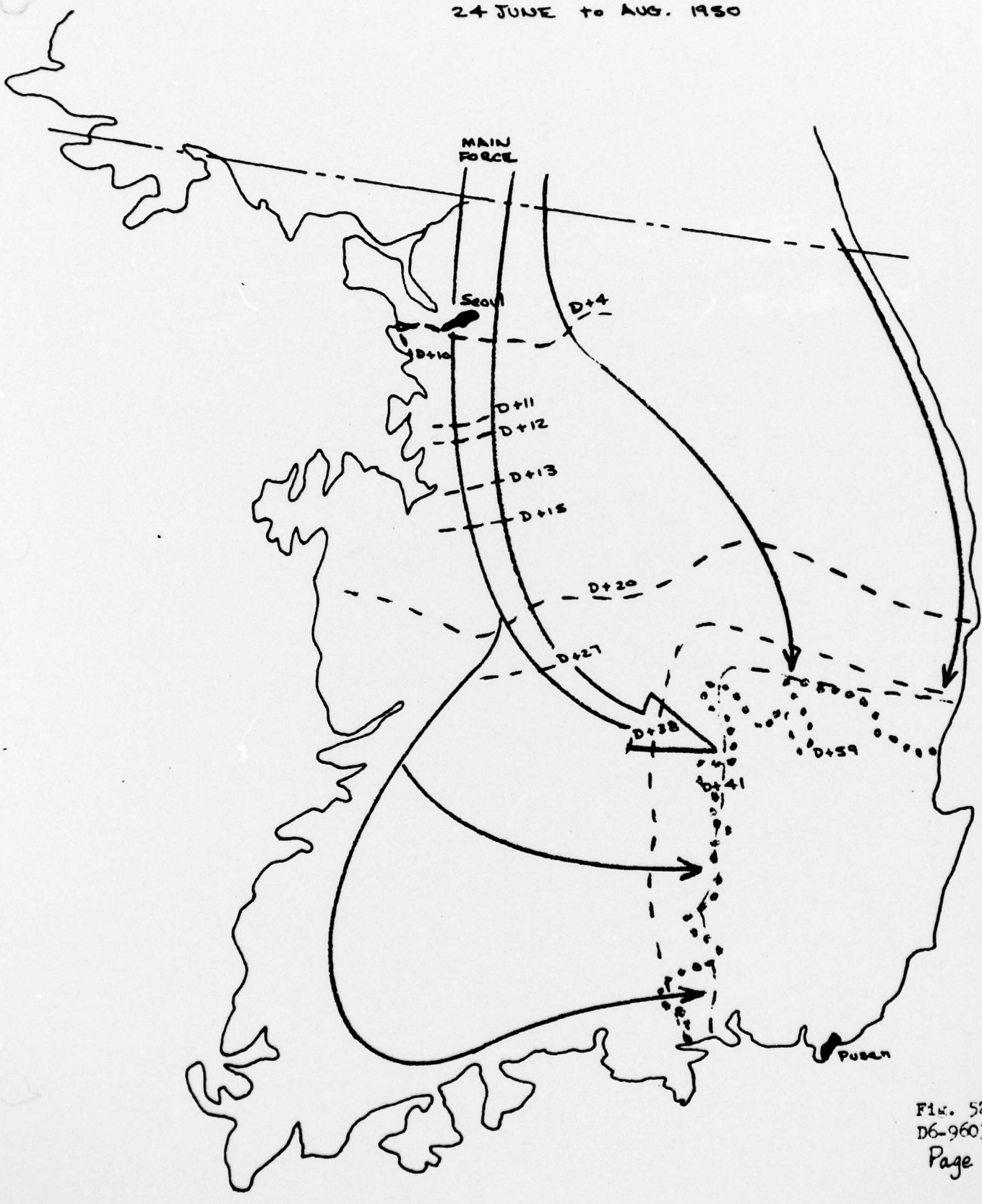


Fig. 52B
D6-9603
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