~~RESTRICTED DATA~~
ATOMIC ENERGY ACT - 1946

~~SECRET~~
SECURITY INFORMATION

OPERATIONS RESEARCH OFFICE

PROJECT RUSH

Nicholas M. Smith, Jr.
Franklin C. Brooks
W. Scott Payne

This document consists of 33 Pages
No. 1 of 3 Copies
Lo; 28870

~~SECRET~~
SECURITY INFORMATION

SPECIAL HANDLING REQUIRED, NOT RELEASABLE TO FOREIGN NATIONALS

Project RUSH --

A Comparison of the Costs of Delivery of Atomic Weapons on Tactical Targets Within Ten Miles of the MLR

by

Nicholas M. Smith, Jr.
Franklin C. Brooks
W. Scott Payne

1 June 1953

The COCOA Study Group
Operations Research Office
The Johns Hopkins University
Chevy Chase, Maryland

Copy 1 of 3 Copies
Log No. 28870

This paper describes the results of a study made at a request originated by General J. Lawton Collins, Chief of Staff, U. S. Army and has been conducted on very short notice from data and calculations made for the COCOA Study. For an analysis of other factors not included here the reader is referred to a report of the COCOA Study in preparation. The inclusion of these other factors tends, in general, to make the comparative costs less widely divergent, and permits some pertinent conclusions, herein not permitted, concerning the effective utilization of combined delivery systems.

A Note on the Costing

The costs in this study are taken from the COCOA report and represent the annual operations costs plus initial equipment and personnel costs with associated logistics. Except in the cases of the additional airstrips (for dispersal reasons) the costs of the airfields have not been included; and by the same token, the cost of additional construction for digging in and protecting the assembly and ordnance area of the dispersed missile battalions were not included. The additional dispersed airstrips were costed at five million dollars.

[redacted] These costs are based on data supplied by the Department of the Army monitor of the COCOA project, Lt. Col. C. R. Eisenschmidt.

1 June 1953

PROJECT RUSH

PROBLEM:

To make a comparison of the costs of delivering atomic weapons by various Army guided missiles and Air Force Aircraft in terms of dollars and in such intangibles as human lives and critical materials in attacks against tactical targets in the zone of 10 mile penetration in enemy territory. The delivery means considered shall include the 280mm Gun; the unguided rocket, HONEST JOHN; the guided rockets, CORPORAL and HERMES A-3B; the tactical aircraft F-84F fighter bomber; the B-66B light bomber, and the strategic aircraft B-47B, medium bomber.

FACTS:

The primary characteristics of these delivery means fall naturally into two classes: (a) the type and size of atomic weapons delivered, and (b) the time delay between the discovery of a target of opportunity and the moment of detonation of the atomic weapon over the target. In this zone the accuracy of delivery affects the comparison unimportantly with respect to the troop targets attacked. This condition is brought about by the fact that the uncertainty in the knowledge of the location of troop targets is generally much greater than the delivery accuracy. On the other hand the accuracy of delivery is an important characteristic when an attempt is made to bombard the enemy with an atomic weapon as close to our lines as is possible. Such operations, which we shall call very close support operations, in general require a weapon of high accuracy and low

energy yield in order to make the separation between the radius of immediate military affects to the enemy and eventual casualty production to friendly troops as narrow as possible. Deliveries of low expected accuracy and/or high atomic yield penalize the very close support operations in that the aiming point must be selected deeper in enemy territory, thus leaving a wider zone of unaffected enemy troops in contact with friendly forces after the attack. The width of this unaffected zone as a function of a constant risk (constant friendly casualties per very close attack) to friendly forces can be taken as a rough measure of the worth of a delivery means for these very close support operations.

[redacted]

In general, the smallest yield is selected which will guarantee the required degree of military damage for the specified target, considering all factors.

The delay time from discovery of the target at Division level to TOT has been estimated from extrapolations made from actual maneuver operations. The time consumed in the experimental trials has been reduced to a considered minimum through the elimination of all avoidable delays. These delay times are estimated as follows: for 280mm Gun and HONEST JOHN, 3 hours; for CORPORAL and HERMES A-3B, 4 hours; for the Fighter Bomber,

F-84F, 6 hours; for the B-66B under Tactical Air Force control, 7 hours; for the B-47B under Strategic Air Force control, 10 hours.

A military setting for this particular study is envisioned as a front in Western Europe extending for approximately 600 nautical miles and defended by six NATO armies for a time period of one year. In order to meet the necessary requirements of operational flexibility and magnitude of total delivery, it is assumed that one basic organization of delivery means is required per Army; that is, there will be six battalions of the 280mm Gun or of HONEST JOHN, CORPORAL, OR HERMES A-3B; or six squadrons of F-84F, B-66B, B-47B. Appropriate organizations for these specific delivery means are taken from an established Table of Organization and Equipment whenever available. Whenever a T/O&E is not available, manpower and equipment requirements are assumed on the basis of past studies which have been revised slightly to adjust the vulnerabilities.

In particular the T/O&E of the aircraft and of the beam riding missiles has been adjusted in order to reduce the vulnerability to enemy counter battery attacks against the ground installations. Studies made of the aircraft dispersed to the extent of one squadron per landing strip have revealed that not only would the aircraft losses be from a factor of two to four times greater than those losses of the other delivery means but that these losses would be so great that the aircraft could not be maintained operational. Therefore, it was necessary to postulate that the aircraft have been dispersed to the more extreme extent of one flight per landing strip where a flight would consist of three or four aircraft plus one or two spares. By this means the relative losses have been cut down to a more reasonable figure, the overall costs have been decreased, and there is a higher likelihood that some aircraft could be operational at

a particular time. The equipment and personnel requirements associated with this extreme dispersion were assumed to be increased by 15%. The organizations are summarized in Table 1.

The costs of the additional landing strips required has been added to the amount of $5,000,000 per additional airstrip. The beam riding missiles, CORPORAL and HERMES were judged to be most vulnerable to enemy counter battery attack aimed at the cluster of launchers around the guiding and fueling systems. The study further indicates that savings can be afforded by dispersing these delivery means such that there is not more than three launchers per guided system. This degree of dispersion increases the requirements for fueling and guidance equipment and personnel.

The basic data for this report have been those assembled for the COCOA Study and consist of three types: (a) data as to basic costs of fissile material, of delivery vehicles, and of training and equipping the battalions or squadrons of the particular delivery means; (b) the basic atomic weapons effects in relation to the particular class of targets selected; (c) estimates or assumptions as to self and enemy attritions. Estimates of the losses suffered in flight of the aircraft have been made on the basis of the Air Force Project RAND studies, assuming that the enemy has a counter air weapon of the NIKE characteristics. The gross errors have been assumed on a reasonable basis. Although there is room for disagreement about the actual magnitude of these gross errors, the values assumed are in the reasonable range and furthermore, the conclusions of this study are unaffected by changing these magnitudes in any reasonable manner. The estimate as to the enemy inflicted ground attrition from counter battery operations have been the subject of a special part of

Table 1

Characteristics of Delivery Means

Delivery Means	Maximum Range (N.M.)	Atomic Capability	Estimated Delivery Times (HRS.)	Manpower per BN or SQDN	Launchers or A/C Per BN or SQDN	Guidance Systems per BN or SQDN	T/O&E
280mm	13	[redacted]	3	438	6	NONE	6-535
HONEST JOHN	14		3	732	9	NONE	6-538
CORPORAL	80		4	1017 [a]	18	8 [a]	6-545
HERMES A-3B	90		4	1033 [a]	18	8 [a]	Proposed
F-84F	560		6	805 [b]	25	MPQ	1-1253T
B-66B (TAC)	1150		7	1035 [b]	15	SHORAN and MPQ	Proposed
B-47B (SAC)	1750		10	1150 [b]	15	SHORAN and MPQ	1163T

a. T/O&E manpower increased by 15%, and number of guidance systems doubled, to allow for additional dispersion.
b. T/O&E manpower increased to allow squadron to operate with one flight per airfield.

the COCOA Study. In this segment of the COCOA Study, it is assumed that the USSR would have available and be capable of delivering a total of 18 crits of fissile material against our atomic weapons delivery systems with the exception of the B-47B as noted below. Furthermore, it was assumed that these deliveries would be made in the most efficient manner from a standpoint of nuclear effectiveness. A map study of the deployed battalions or squadrons enabled an estimate of a manpower and equipment losses per crit, per battalion (or squadron). As a conclusion of this study it was found necessary to disperse the aircraft to the extreme amount of only one flight of five or six aircraft per landing strip and to disperse the beam riding battalions, CORPORAL and HERMES A-3B to only three launchers per guidance system. The assumed gross errors, the estimated inflight losses, and ground losses from enemy counter battery attacks are listed in Table 2.

In this Table, special attention has been given to the 280mm and HONEST JOHN, since these particular means will suffer losses from other affects which outweigh the level of attack assumed. In the first place, they will be subject to close support atomic bombardment from the enemy and also from the other normal battle losses of troops within the first five mile zone. The greater portion of ground losses are those of normal battle attrition appropriate to division artillery which amount according to FM-101-10 to about 15% per year. Allowance for the passive protection afforded the B-47B by virtue of its greater distance from bases to targets has been made by assuming that one-third of the enemy crits dispatched against this delivery means is lost to our counter air weapons.

TABLE 2

GROSS ERRORS, INFLIGHT ATTRITION AND GROUND ATTRITION FOR VARIOUS DELIVERY MEANS

Delivery Means	Gross Error Percentage	Inflight Attrition		% Ground Attrition per Battalion, per Crit (a)	
		In Flight	Return Flight	Personnel	Equipment
280mm	1%	0	0	18% (b)	18% (b)
HONEST JOHN	2%	0	0	18% (b)	18% (b)
CORPORAL	5%	0	0	9%	9%
HERMES A-3B	10%	0	0	9%	9%
F-84F (TAC)	1%	½%	½%	14%	28%
B-66B (TAC)	1%	1%	1%	18%	36%
B-47B (SAC)	1%	1%	1%	18%	36%

(a) Per Crit delivered on target. Only 2/3 of dispatched crits hit the B-47B.

(b) These figures are yearly losses composed of 15% for normal Corp or Army artillery and 3% resulting from aggressor use of 48 crits randomly against friendly front line area.

DISCUSSION

The methodology for comparison of the selected delivery means has been guided by the following considerations: (1) the variety of the characteristics of the delivery means, and (2) the necessity to produce the same military effect. This latter constraint would be simple if it were not for the fact that each delivery means has a different delay time and hence a different capability with respect to attacking fleeting targets of opportunity of enemy troops in the attack. Therefore, it has been required that each delivery means be so employed as to produce a total of 150,000 enemy casualties. This constancy of enemy casualties is achieved by attacking all the possible targets of opportunity and then by making up the difference by area attacks made in either planned preparations or ground attacks by ourselves, or by random atomic attacks over enemy territory.

An enemy preparing to attack us in the face of our having an atomic capability will plan to concentrate his men, attack toward a limited objective and then disperse them before they can be hit by an atomic weapon. Throughout the attack, the enemy will be unprotected and in concentration and will therefore present a much more vulnerable target than otherwise. On the basis of a Ft. Leavenworth study made for ORO, troops in defensive positions will be deployed to a density of about 200 men per square mile and will be well dug in and relatively protected from atomic attack. An attack to be successful against such a defensive deployment would have to be made in concentrations of about 1,000 men per square mile.

The time duration required for formation and initiation of an attack is a function of the numbers of troops involved. The probability of a successful attack depends upon the average duration of a fleeting target after discovery and the delivery time required by the specific means employed. These times have been estimated in two separate fashions in order to bracket the most probable values. Thus, two separate analyses will be employed; the first involved estimations of longer enduring fleeting targets and the second, much shorter lived fleeting targets. As the lifetime of a fleeting target involving a specific number of men is decreased the effect is first to favor the delivery means consuming the least amount of time in their delivery process. This effect continues until almost none of the fleeting targets are attackable (as the lifetime of the fleeting targets is decreased) at which time the delivery means making most efficient use of the fissile material becomes most favorable. Thus, if all fleeting targetx were to exist less than three hours after discovery, regardless of the size of the enemy attack, the aircraft capable of delivering the 60" bomb would, without question, be the best delivery means. However, such a contingency is highly unlikely.

The relationship between the target lifetime, its duration after discovery and the delivery time are given in Tables 3 and 4 for the longer lived and shorter lived target systems respectively.

Long Lived Target Model

Referring now to Table 3 concerning the longer lived target, it is seen that any enemy aggregate composed of a division or greater is almost certain to be completely destroyed by our atomic attacks.

TABLE 3

Percentage of Fleeting Targets of Various Sizes Attackable By The Delivery Means,

Long Lived Target Model

Attacking Unit	B-47B 10 hrs	B-66B 7 hrs	F-84F 6 hrs	Hermes 4 hrs	Corporal 4 hrs	Honest John 3 hrs	280mm Gun 3 hrs
Army 21 hrs	100	100	100	100	100	100	100
Corp 16 hrs	100	100	100	100	100	100	100
Div 12 hrs	80	100	100	100	100	100	100
Rgt 8 hrs	15	80	100	100	100	100	100
BN 5 hrs	0	15	15	75	75	100	100
Co 3 hrs	0	0	0	15	15	50	50

TABLE 4

Percentage of Fleeting Targets of Various Sizes Attackable by the Delivery Means,

Short Lived Target Model

Attacking Unit	B-47B 10 hrs	B-66B 7 hrs	F-84F 6 hrs	Hermes 4 hrs	Corporal 4 hrs	Honest John 3 hrs	280mm Gun 3 hrs
Army 18 hrs	100	100	100	100	100	100	100
Corps 13 hrs	80	100	100	100	100	100	100
Div 9 hrs	40	80	90	100	100	100	100
Rgt 5 hrs	0	5	15	75	75	100	100
BN 2 hrs	0	0	0	0	0	15	15
Co. 0 hrs	0	0	0	0	0	0	0

Since attacks of these sizes involve a considerable number of men, it is judged unlikely that the enemy would risk so much loss with such high probability of destruction. On the other hand, our delivery capabilities prevent our attacking any enemy target of company size or smaller. Thus leaves then only two sizes of enemy attack: regimental and battalion attacks. Furthermore, it is assumed that the frequency of such attacks occur in the same proportion as the frequency of enemy regimental and battalion headquarters. Thus there would be four battalion attacks to every one regimental attack. [redacted]

On this basis, there resulted 115,000 enemy casualties in highly profitable attacks against fleeting targets of enemy troops concentrated and in the open and 32,000 enemy casualties in attacks against area targets of enemy troops well dug in and dispersed. [redacted] It will be seen that these area attacks are much less effective than those against the concentrated and fleeting attacking targets. In fact, the area bombings yield only 300 to 400 casualties per crit whereas the fleeting battalion target bombings yield 900 to 1500 casualties per crit and the fleeting regimental bombings, 2,500 to 4,000 casualties per crit.

OVERALL CONCLUSIONS:

On the basis of the conclusions resulting from the study of both the short lived target model and the long lived target model we conclude that the HONEST JOHN is significantly cheaper in operation for deliveries in the first 10 miles into enemy territory than are the other delivery means.

We conclude that the HERMES A-3B costs only slightly more than the HONEST JOHN delivery means.

It is concluded that the CORPORAL delivery system is significantly more expensive than the HERMES A-3B.

It is concluded that the aircraft, F-84F, B-66B and B-47B are of intermediate costs.

It is concluded that on the basis of any reasonable assumption the 280mm is very significantly more costly than any other delivery means.

[redacted]

A further consideration of the possible friendly losses to gross errors in these very close support operations will also increase the requirement for the 280mm Gun in this unique type of operation. On the other hand, for all other types of operations it is concluded that the 280mm Gun should not be used after the HONEST JOHN or HERMES A-3B become operational.

To make the comparison meaningful every other delivery system is required to produce the same total number of enemy casualties. This is accomplished by conducting all of the attacks possible against the profitable fleeting targets and making up the difference in the area attacks in order to make a constant quantity of enemy casualties. The manner in which this is accomplished for the various delivery systems compared is presented in Table 5. An inspection of this Table will reveal two characteristics which serve to improve a delivery means: shortness of time of delivery and efficient utilization of fissile materials.

[redacted]

The results of the combined calculations in terms of total manpower required and direct costs in terms of dollars, lives lost, and crits consumed are presented in Table 7. In order to rank these delivery systems in terms of preference, the ranking according to each of the cost components is first, separately displayed in Tables 8, where they are ranked separately according to increased dollar costs, Table 8a; increasing life costs, Table 8b; and increasing crits costs, Table 8c. It will be seen that no single system is cheapest in all three components, that is, that the ranking according to increased costs by the separate components does not permit one to select the cheapest system according to any rational process without regard to the judgment of the relative values of dollars, and lives and crits of fissile material. The fact that

TABLE 5

Division of Effort Between Fleeting Targets and Area Targets in Zone 1 for Various Delivery Systems Operating Alone.

Long Lived Target Model

Delivery Means	Fleeting Targets			Area Targets		
	Deliveries	Crits	Casualties	Deliveries	Crits	Casualties
280mm	100	[redacted]	95,000	192	[redacted]	51,840
HON JOHN	100		114,750	180		32,080
CORPORAL	100		102,980	245		43,502
HERMES	100		102,980	245		43,502
F-84F	25		67,500	445		79,445
B-66B (TAC)	25		54,000	522		93,032
B-47B (SAC)	0		0	824		146,910

TABLE 6

Division of Effort Between Fleeting Targets and Area Targets in Zone 1 for Various Delivery Systems Operating Alone.

Short Lived Target Model

Delivery Means	Fleeting Targets			Area Targets		
	Deliveries	Cuts	Casualties	Deliveries	Cuts	Casualties
280 mm	100	[redacted]	73,963	282	[redacted]	76,140
HON JOHN	100		94,350	311		55,482
Corporal	25		53,125	541		96,337
Hermes	25		53,125	541		96,337
F-84F	25		18,625	736		131,379
B-66B(TAC)	25		12,875	769		137,125
B-47B(SAC)	--		—	841		149,995

TABLE 7

MANPOWER REQUIRED AND COSTS IN DOLLARS, LIVES AND CRITS OF VARIOUS DELIVERY MEANS

INFLICTING 150,000 ENEMY CASUALTIES.

LONG LIVED TARGET MODEL.

Delivery Means	Manpower 6 BN or SQDN	No. of Deliveries	Dollars (Millions)	Lives	Crits	Value Consumed (Megavals)
280MM	2628	292	697	198	[redacted]	
HONEST JOHN	4392	280	222	306		
CORPORAL	6102	345	353	1236		
HERMES A-3B	6198	345	365	1250		
F-84F	4830	470	472	1497		
B-66B (TAC)	6210	547	548	2585		
B-47B (SAC)	6900	824	696	1926		

TABLE 8a *

Ranking of Delivery Means According to
Increasing Dollar Costs

HON. JOHN	222	millions
CORPORAL	353	"
HERMES	365	"
F-84F	472	"
B-66B (TAC)	548	"
B-47B (SAC)	696	"
280mm	697	"

* All parts of Table 8 refer to long life target model.

TABLE 8b

Ranking of Delivery Means According To
Increasing Life Costs

280mm	198	lives
HON. JOHN	306	"
CORPORAL	1236	"
HERMES A-3B	1250	"
F-84F	1497	"
B-47B (SAC)	1925	"
B-66B (TAC)	2585	"

TABLE 8c

Ranking of Delivery Means According To
Crits Consumed

HERMES A-3B	[redacted]
B-66B (TAC)	
HONEST JOHN	
CORPORAL	
B-47B (SAC)	
F-84F	
280mm	

TABLE 8d

Ranking of Delivery Means According To
Increasing Value Consumed

HONEST JOHN	[redacted] megavals
HERMES A-3B	"
CORPORAL	"
B-66B (TAC)	"
F-84F	"
B-47B (SAC)	"
280mm	"

HONEST JOHN ranks cheapest in dollar costs, second in life cost, and second in crits cost would lead one to suspect that it is the overall cheapest delivery means, particularly so when the numbers of the cost components are studied.

The problem of the relative evaluation of these components has been studied in some detail with respect to the COCOA Study analysis and has resulted in the following evaluation:

One life has the same value to society as $250,000 dollars of war materiel.

[redacted]

The arguments for these relative evaluations can be outlined as follows. On the basis of World War II average expenditures of lives per division per year (7,700) and dollars expended per year (1.35 billion) and on the relative friendly and enemy loss rates (40 casualties per day) it is estimated that the additional expenditure of $250,000 (1953 dollars) will on the average lessen our loss of life by one man.

The value of the crit is estimated from the cost of producing the same results by conventional artillery means. [redacted]

On the other hand, the adequacy of the stockpile reduces the value of crit such that if the stockpile were completely adequate its value would reduce to simply its cost of production. The term "adequacy of stockpile" refers to its adequacy with respect to the economy of use.

The stockpile is judged to be "adequate" if there are sufficient numbers of atomic weapons to attack every target which could be profitably (dollar-wise) attacked, in comparison with conventional high explosive means. Since the term "adequacy of stockpile" is often used in the sense that the stockpile is judged to be adequate if it gives our nation a reasonable chance of winning a war, it is necessary to differentiate between these definitions. It will require a stockpile in the order of the factor of 10 greater to be economically adequate compared to a stockpile that is adequate in the sense of giving us a chance to win. We have had no recourse to stockpile information, and have taken the stockpile to be approximately one-half adequate.

Having two relationships between three values, it is then possible to assume one arbirarily and thus fix the other two relative to the assumed value. We prefer to express value consumed in an abstract unit (the val) in order to differentiate between costs in real dollars and costs in value dollars. [redacted]

In Table 7, the costs of producing 150,000 energy casualties by the various delivery means in terms of relative military value consumed is given in megavals where we have attempted to combine the intangible values of the cost components: dollars, lives, and crits. In Table 8 then is also

given the ranking of the delivery means according to military values consumed. Since this concept of value replaces the 3 separate cost components by a single number it is possible then to rank the delivery means according to degree of preference.

[redacted]

CONCLUSIONS: (Long Lived Target Model)

Thus, it is concluded on this analysis that for delivery of an atomic weapon within the first 10 miles into enemy territory that the HONEST JOHN and HERMES A-3B are the cheapest delivery means, that the CORPORAL and B-66B compete at a slightly higher level of cost, that the B-47B is significantly more costly than the best delivery means and that the 280mm Gun is by far the most costly delivery means of the group.

Short Lived Target Model

In order to bracket the probable distribution of target lifetime, we have duplicated the analysis as conducted for the longer lived target model but have assumed the duration of targets after discovery of some three hours less than in the former case. In Table 4 the attackability of the various sized fleeting targets resulting in these assumptions is portrayed. It is still reasonable to assume that enemy aggregate of regimental and battalion size are the most probable sizes of enemy attacks. Again, in order to make the comparisons meaningful, every delivery system has been constrained to produce a total number of enemy casualties amounting to 150,000. The manner in which this is accomplished for the various delivery systems is presented in Table 6.

The results of the combined calculations in terms of total manpower required and direct costs in terms of dollars, lives lost, and crits consumed are presented in Table 9. Again, the ranking of these delivery systems in terms of preference, the ranking according to each of the cost components is separately displayed in Tables 10, where the ranking is according to increased dollar costs, Table 10a; increasing life costs, Table 10b, and increasing crit cost, Table 10c. Again, it will be seen that no single system is cheapest in all three components and that it is necessary to resort to judgment of relative intrinsic values to obtain a single preference ranking.

The results of the calculations based on the short lived target model differ from those resulting from a study of the long lived target model in that the ranking of the aircraft is raised with

respect to the other delivery means. Again, the HONEST JOHN turns out to be significantly cheaper and the 280mm significantly more expensive than the other delivery means.

CONCLUSIONS Short Lived Target Model:

[redacted]

TABLE 9

MANPOWER REQUIRED AND COSTS IN DOLLARS, LIVES AND CRITS OF VARIOUS DELIVERY MEANS

INFLICTING 150,000 ENEMY CASUALTIES.

SHORT LIVED TARGET MODEL

Delivery Means	Manpower 6 BN or SQDN	No. of Deliveries	Dollars (Millions)	Lives	Crits	Value Consumed (Megavals)
280MM	2628	382	871	198	[redacted]	
HONEST JOHN	4392	411	274	306		
CORPORAL	6102	566	451	1236		
HERMES A-3B	6198	566	454	1250		
F-84F (TAC)	4830	761	651	1498		
B-66B (TAC)	6210	794	699	2595		
B-47B (SAC)	6900	841	779	1926		

TABLE 10a*

Ranking of Delivery Means According to
Increasing Dollar Costs

HONEST JOHN

CORPORAL

HERMES

F-84F

B-66B (TAC)

B-47B (SAC)

280mm

* All parts of Table 10 refer to short life target model.

TABLE 10b

Ranking of Delivery Means According to
Increasing Life Costs

280mm

HONEST JOHN

CORPORAL

HERMES A-3B

F-84F

B-47B (TAC)

B-66B (SAC)

TABLE 10c

Ranking of Delivery Means According to Increasing Crits Consumed

HONEST JOHN	[redacted]
B-66B (TAC)	
HERMES A-3B	
B-47B (SAC)	
CORPORAL	
F-84F	
280mm	

TABLE 10d

Ranking of Delivery Means According to Increasing Value Consumed

HONEST JOHN	[redacted]
HERMES A-3B	
B-47B (SAC)	
B-66B (TAC)	
CORPORAL	
F-84F	
280mm	

Very Close Support Consideration

Special attention must be given the various delivery means for their capability of being used in very close support operations. These operations are defined as atomic detonations over enemy troops in the attack, the detonations being placed as close to friendly troops as safety permits. It is obviously desirable to have the capability of striking the enemy up to the MLR while not exposing friendly troops to the effects of the A-weapon. There is a fundamental difference between the weapons effects on enemy and friendly troops. The interest in producing enemy casualties is in making immediate effects; in friendly casualties, in not producing any long-term casualties. The difference in these effects is about a factor of ten with respect to gamma radiation (the principle effect of very low crit weapons).

Thus two factors affect the selected aiming point: 1.) The CEP, and 2.) the energy yield. In order to reduce the width of the crust of unaffect (immediate effects) enemy troops it is desirable to have high accuracy [smaller allowance for errors] and a small yield weapon [smaller difference between radius of safety to friendly troops and radius of immediate effects to enemy troops].

The thickness of this crust of unaffected enemy troops has been calculated assuming

1) Friendly troops are protected from heat effects, but exposed to gamma radiation.
2) Level of long time casualty effect to friendly troops is $\approx$ 200 Roentgens of gamma radiation.

3) Level of immediate effects to enemy troops is $\approx$ 2000 Roentgens.

4) It is allowable to permit an expectation of one friendly casualty per very close support delivery

5) Friendly troops are deployed at 200 men per square mile.

The results of this calculation, based on studies made by the Technical Operations, Inc. for the ORO CCCCA Study Group are presented in Table 11. In this table the operational CEP's are based on operational data where available, rehearsal or proving ground data degraded by a factor of two, or design data degraded by a factor of four.

[redacted]

TABLE 11

The Thickness of the Crust of Unaffected Enemy Troop (Immediate Effects) in Very Close Support Atomic Attacks. Permanent Friendly Casualties Constrained to One per Attack.

All distances in Yards

Delivery Means	KT	σ CEP (Operational)	R_f (a)	R_e (b)	(c)	Crust Thickness
280mm	[redacted]	100	3,000	2,250	-1.0	650
HONEST JOHN		400	1,500	1,250	1.3	770
CORPORAL		300	1,500	1,250	1.0	550
HERMES A-3B		300	1,500	1,250	1.0	550
F-84F		200	1,500	1,250	0.6	370
B-66B		200	1,500	1,250	0.6	370
B-47B		200	1,500	1,250	0.6	370
280mm		100	1,500	1,250	0.0	250

a) Radius of "Safe" Distance for Friendly Troops
b) Radius for 2 Hr. Effects on Enemy Troops
c) Number of σ's to allow for One Expected Friendly Casualty
d) Requires New Development.