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REQUIREMENTS FOR TACTICAL NUCLEAR WEAPONS

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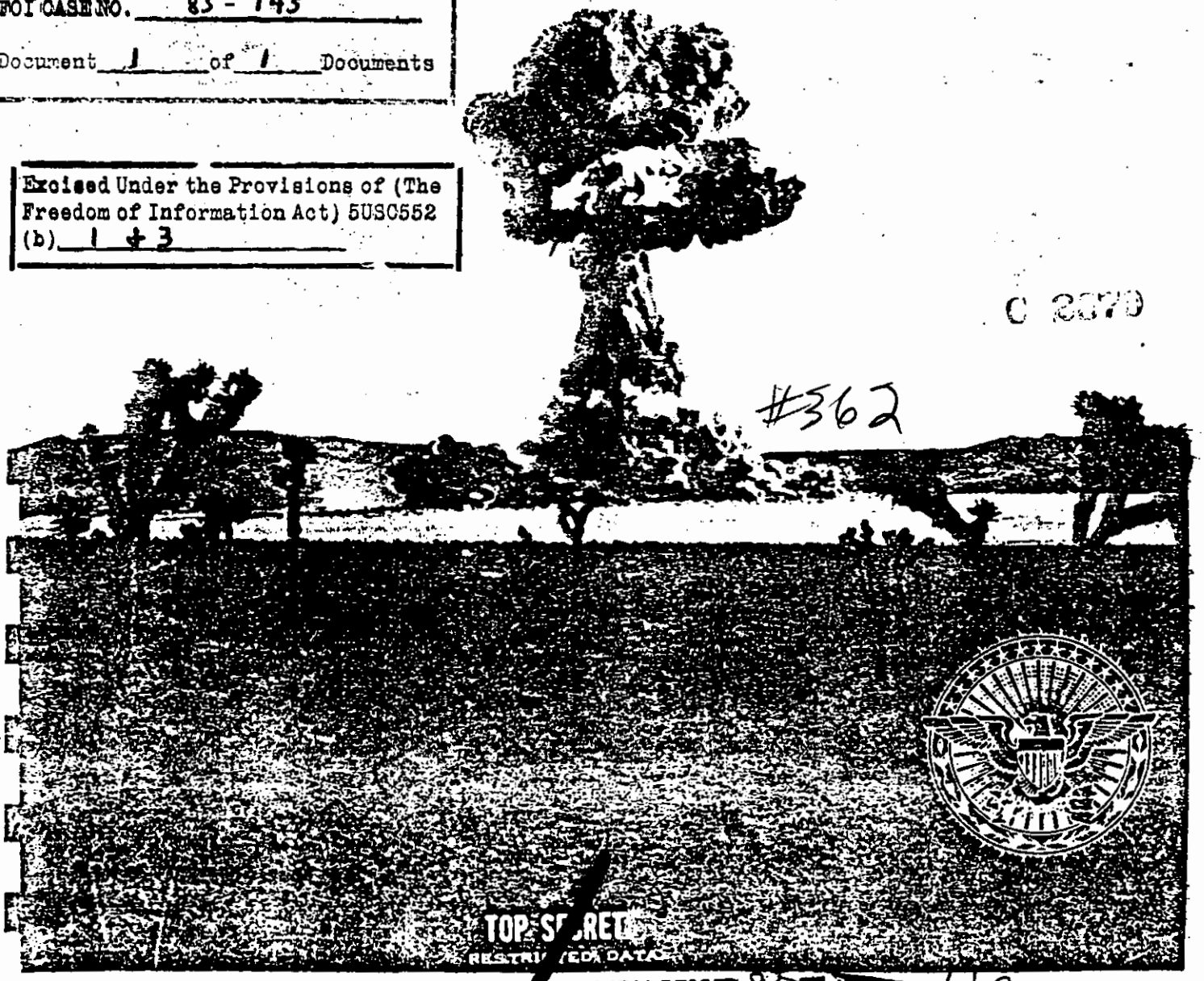

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REQUIREMENTS FOR TACTICAL NUCLEAR WEAPONS

Prepared By:
Special Studies Group (JCS)
October 1962

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FOREWORD

The study was conducted by the Special Studies Group under the Chairmanship of Major General Paul S. Emrick, USAF, Director, J-5 (Plans and Policy). Members of the Study Group were:

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REQUIREMENTS FOR TACTICAL NUCLEAR WEAPONS

SUMMARY AND CONCLUSIONS

A. This study responds to a memorandum for the Chairman, Joint Chiefs of Staff, from the Secretary of Defense, dated 23 May 1962, Subject: "A Study of Requirements for Tactical Nuclear Weapons and Continuation of the Study of Requirements for General Purpose Forces." The study is limited to consideration of tactical nuclear weapons in Western Europe.

B. One basic hypothesis is used for the principal analyses. This hypothesis is that both NATO and the Soviet Bloc will exercise constraints in the employment of nuclear weapons. [redacted]

C. Within the boundaries of the basic hypothesis and study guidance, the Study Group examined:

[redacted]

[redacted]

F. The report that follows describes briefly the rationale and data which support the conclusions reached. Amplifying analyses are contained in appendixes to the basic report. Additional backup is available in studies conducted by agencies that assisted the Study Group.

G. For convenience, the Study Group's conclusions are listed ahead of the basic report.

CONCLUSIONS

[redacted]

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METHODOLOGY

1. Guidance. Guidance for the study was provided in a memorandum from the Secretary of Defense to the Chairman, Joint Chiefs of Staff, dated 23 May 1962, subject: "A Study of Requirements for Tactical Nuclear Weapons and Continuation of the Study of Requirements for General Purpose Forces," and in Item 23 of the Master Projects List, dated 29 May 1962, which directs the Chairman, Joint Chiefs of Staff, [redacted] Study effort was directed toward satisfying both study requirements. The Office of the Assistant Secretary of Defense (Comptroller), the designated point of contact, furnished amplifying guidance to the Study Group.

2. Study Sequence. To accommodate the interaction of the various elements of the problem the Study Group used a planning sequence that proceeded from objectives to policies to strategies to force levels. In order to apply this technique most effectively, and to determine the cumulative effect of actual force capabilities, it was necessary to arrive at an initial assessment [redacted]

3. Other Contributing Agencies. Early in the study sequence the Study Group isolated researchable sub-tasks. Requirements were placed with the Military Services, other agencies of the Department of Defense, the Atomic Energy Commission and research organizations under contract to the various Services to develop required basic information and to perform analyses in their specialty fields bearing on selected sub-tasks. The Study Group centralized the functions of providing situations and assumptions for each of the agencies that

conducted exercises or prepared studies. A partial list of inputs from contributing agencies follows:

[redacted]

d. The tactical land battle was examined in the setting of a manual map exercise established as a coordinated effort by the Combined Arms Group of the Combat Development Command and the US Army Command and General Staff College of the Continental Army Command at Fort Leavenworth, Kansas. [redacted]

e. The Air Battle Analysis Division of Headquarters, US Air Force conducted a series of air battle games which were used to pinpoint the different times that air superiority could be determined under the varying assumptions. The air battle considered the entire central region of Europe. Reconnaissance and strike sorties used in the war game in support of the land battle were within the residual capability of the tactical air forces.

[redacted]

g. The Military Services provided collateral studies on dual capability, nuclear weapon system characteristics and employment, command and control of nuclear weapons, and reconnaissance and surveillance.

4. Situations Analyzed. The methodology employed and study inputs described provided the Study Group with information permitting analyses of several variations of basic situations.

a. General War. Two basic situations were examined in detail:

[redacted]

Cursory examinations of variations of these two basic general war situations were also made.

[redacted]

ROLE OF TACTICAL NUCLEAR WEAPONS

5. Distinction Between Tactical and Strategic Nuclear Warfare. A brief description of the differences between tactical and strategic nuclear warfare as well as their interrelationship defines the Study Group's area of emphasis.

[redacted]

Figure 1 - Spectrum of Battle.

b. The REMOTE Battle. Strategic forces have tasks that include destroying enemy nuclear delivery forces, military controls and industrial floor space by selective and controlled application of strategic nuclear power. The nature of the strategic battle, with its cycle of strike and counterstrike actions, parallels that part of the Spectrum of Battle titled the REMOTE Battle. The purpose of nuclear weapons in the REMOTE Battle is selective destruction. Targets in the REMOTE Battle area are generally fixed with respect to terrain, have various degrees of hardness and lend themselves to comparatively precise location. The REMOTE Battle is characterized by the ability to exercise a high degree of centralized control over delivery systems and target selection and by the comparatively finite nature of the target complex under attack.

c. The INTERDICTION Battle. The purpose of nuclear weapons in the INTERDICTION Battle is to break the continuity between the forward and rear areas of the theater by rupturing routes over which troops, munitions and supplies are moved and attacking units and supplies in transit. Reserve formations, trains and headquarters with a frequent movement rate (at least once each day) are types of moving targets. Fixed targets whose destruction will create obstacles to movement constitute the majority of targets in the INTERDICTION Battle area.

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d. The ENGAGED Battle. The ENGAGED Battle is characterized by the requirement to maintain or to impose control over an area. Target destruction takes place to the extent necessary to gain control. Targets in the area of the ENGAGED Battle consist of a combination of targets that move at varying speeds ranging from supply dumps with an infrequent movement rate to combat forces that may be in motion as much as 50% of the time.

e. Segments of the ENGAGED Battle. The ENGAGED Battle area can be broken down into two distinctive segments as follows:

(1) Brigade Area of Engagement. The most important, from the point of view of the requirement for control, is the Brigade Area of Engagement which encompasses a narrow band astride the zone in which the opposing forces confront and mix with each other during the course of battle. The Brigade Area of Engagement is that part of the entire Spectrum of Battle where decisions in the land battle are reached.

(2) Areas of Responsibility. Behind the Brigade Area of Engagement there are areas of responsibility varying in depth in approximate relation to the extent of influence and responsibility of the respective division, corps, army or army group commanders who have resources at their command to influence the battle.

f. Targets. Targets in the ENGAGED Battle area can assume a variety of patterns. Generally speaking, targets near the zone of contact are comparatively small and move frequently. As the distance behind the zone of contact increases, targets will become larger and tend to move less frequently. In addition, targets of a semi-fixed nature begin to appear, such as maintenance areas.

g. Use of Terms. Spectrum of Battle, ENGAGED Battle, Brigade Area of Engagement, INTERDICTION Battle and REMOTE Battle will be used within the context described here throughout this report.

[redacted]

[redacted]

a. Disposition of Forces. The enemy's forces are the primary target [redacted] These forces are disposed throughout the area behind the zone of contact in varying densities [redacted] The pre-attack density is shown in Figure 2.

Figure 2 - Pre-Attack Distribution of Soviet Forces.

The locations of high density areas change as the attack progresses. This change is shown graphically in Figure 3.

Figure 3 - Changes in Distribution of Soviet Forces as Attack Progresses.

Normally, the attacker must expose a greater percentage of his forces for longer periods of time than the defender in order to move towards his objectives. In addition, he must increase the density of his force in order to succeed in the attack. In contrast, the defender has greater advantage from the protection afforded by passive protective measures and the higher casualty producing effect per weapon resulting from the higher density of attacking forces. Paradoxically, the time the defender spends in protected positions increases the probability of being acquired as a target.

[redacted]

(1) Air Superiority Battle. There is an uncertainty as to the time that the outcome of the air superiority battle will be determined. Under the situations war gamed, the earliest determination, with NATO favored, would require [redacted] (Appendix E, Annex 5). During this same period of time, enemy ground forces would move through the defensive screen [redacted] (Appendix E, Annex 1).

(2) Troop Density. Troop density varies throughout the depth of the battle area. The most detailed analysis

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has been made within the first [redacted] of the zone of contact (Page B-99, Appendix E, Annex 1). The Study Group has analyzed a range of troop densities sufficiently broad to cover the probable densities that may occur.

(3) Target frequency.

(a) Targets occur with varying frequency and in markedly varying configurations throughout the depth of the battle area. Target detection and identification vary with the distance from the zone of contact (Page B-101, Appendix E, Annex 1). In examining the target array presented to the ground forces in the engaged battle, the small targets will be the class of target most frequently presenting an opportunity for precision fire and which can be identified and attacked. Distributions of finite targets in the area of the engaged battle are shown in Figures 4 and 5.

Figure 4 - Pre-attack Distribution of Targets in a Soviet Front.

Figure 5 - Average Target Density - US Deployments.

Figure 4 shows the expected distribution of enemy targets while Figure 5 is a prediction of targets [redacted] The lower density of US targets close to the zone of contact results partially from the fact that [redacted] In addition, there

(b) The enemy's major strength for sustaining the attack is in the mass of the larger units to the rear, which are ill-defined for purposes of identification, although intelligence will indicate approximate locations. Therefore, it would appear plausible [redacted] even though lower troop densities can be expected there.

(c) The narrow band of [redacted]

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requires continued efforts to locate targets accurately [redacted] This is dictated by general tactical considerations. Also [redacted] Targets in this zone create the requirement for quick reaction, quick kill, precision fires because of the immediacy of the threat. However, the use of area fire* for this zone cannot be excluded entirely as an option available to commanders, although fire at acquired targets is more reliable and dependable.

(4) Troop Safety. Troop safety in relation to weapons effects radii coupled with delivery system accuracy combine to establish a limiting condition. The graph in Figure 6 shows [redacted]

Figure 6 [redacted]

(5) Effectiveness of Fire.

(a) The effectiveness of nuclear weapons in relation to target movement or displacement falls off rapidly with respect to time after acquisition. Target kill probabilities against infantry, armor and command installations are shown graphically in Figures 7, 8 and 9.

Figure 7 - Target Kill Probability, Infantry.

Figure 8 - Target Kill Probability, Armor.

Figure 9 - Target Kill Probability, Division and Corps Headquarters.

These figures support the requirement for quick response delivery systems, with minimum time elapsing between the acquisition of the target and the time that the weapon is detonated over the target.

* See Glossary

pages 14-17 are denied in total

(b) A primary factor governing the deployment of Soviet forces will be the expected effectiveness of NATO's nuclear fires. With increased dispersal of troop targets in rear areas [redacted] the value of precise target location is diminished. If area fires are used against the rear-most areas of the engaged battle, damage effects per weapon delivered varies directly with the density of enemy formations. Area fire gives a lesser expectancy of damage on a weapon-for-weapon basis, and, therefore, requires more weapons to destroy a given force. Conversely, it offers the probability of earlier destruction of the opposing force, with attendant fewer casualties suffered by the friendly force.

(6) Target Types. The targets presented by either side in the conflict are of numerous varieties but are categorized into hard, medium and soft types as is shown on the table below:

Target Type	Example	Weapons Effect That Governs
Hard	Tanks, Artillery Pieces	Blast (dynamic over-pressure)
Medium	Troops in Foxholes	Nuclear radiation
Soft	Troops in open	Nuclear radiation or blast depending on yield (Protection from thermal assumed for troops)

(7) Assessment.

(a) Target Areas. Three distinctive target areas are apparent from the foregoing. The first area covers [redacted] the second area spans a depth [redacted] from the zone of contact. The third

covers the area [redacted] from the zone of contact and can be identified more specifically as the interdiction area.

[redacted] The frequent change in location of the zone of contact and the high rate of movement of individual targets within [redacted] quick-response requirement.

2. [redacted] in depth is characterized by changing troop densities, a somewhat higher uncertainty of target location and a comparatively high density for each target. [redacted] against semi-static targets. Moving targets must be engaged as quickly as possible following acquisition.

3. [redacted] Targets in the area beyond [redacted] can be engaged by [redacted] and can be delivered by systems with somewhat slower response time.

(b) Categories of Weapons. Weapons employed against targets [redacted] Weapons employed in the area [redacted]

c. Battle Area Uncertainties. The preceding subparagraph has discussed variables, each of which will occur in some degree. In addition, there is some uncertainty associated with the conditions that follow:

(1) Logistics and Command and Control. The degradation of logistics, communications and transport, is uncertain because the priority of enemy targeting is not known.

[redacted]

[redacted]

(4) Delivery System Attrition. The attrition of nuclear delivery units on both sides will occur. This attrition probably could be considered as being [redacted]. An exception occurs when the systems of one side outrange the comparable systems on the other or when one side enjoys a substantial margin of superiority in warhead and missile availability.

7. Objectives

a. Background

(1) The fact that a military organization [redacted] to enforce its will on its opponents. The employment of some weapons will depend upon the tactical situation that exists during a particular engagement. Some weapons can be pre-targeted. On balance, the [redacted] to the extent that such objectives can be established.

(2) The objectives of the enemy have a significant bearing [redacted] The standard objective of any military force is to defeat forces of the opposing side. However, the methods employed can range from attempting total annihilation to the application of only that force required to force capitulation of the enemy. In the analysis that will follow, the [redacted]

No significant developments have been identified since the report was prepared that would change the approach to the problem under consideration. Consequently, no separate analysis will be presented and the policy and strategy considerations in Appendix A of the ISA study have been accepted as the point of departure.

(4) The United States has provided nuclear armament to the NATO countries and currently is committed to do so in accordance with the statement by the Secretary of State in December of 1957 to the North Atlantic Council.* However, the objectives which were set forth at that time,

[redacted]

b. Objectives. To meet the broad objective stated by the Secretary of Defense at Athens, [redacted]

* Speech of Secretary of State at the Second Session of the NATO Heads of Government Conference, December 16, 1957.

[redacted]

9. Further Considerations. To better understand how NATO objectives might be fulfilled in actual nuclear conflict, it is necessary to examine NATO plans for employing

nuclear weapons. The Study Group, therefore, reviewed and analyzed existing NATO planning documents [redacted]

[redacted]

10. Hypotheses. Having discussed the role of tactical nuclear weapons in Europe, it is necessary, before attempting to analyze quantitative requirements, to examine a range of possible conflict situations in Europe in order to select the more probable areas as the basis for detailed analysis. The group, therefore, adopted the following hypotheses:

[redacted]

Each situation could begin under conditions of strategic warning or no strategic warning and tactical warning or no tactical warning.

[redacted]

d. From the matrix of possible situations shown, Figure 10 - Situation Matrix, the Study Group selected for analysis the cases indicated by an asterisk. Cases indicated by an asterisk in a circle were considered in detail. The details are presented in Appendices B, D, and E, and the method used to determine survivability is presented in Appendix B. The following paragraphs present the summary results of the cases analyzed in detail.

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[redacted]

18. Determination of [redacted] various delivery systems was based upon an evaluation of [redacted] A comparison of ground and air delivery systems was not made since this would require an analysis of theater air defense systems which the directive reserves for a later phase of the study. The weapons derived could be delivered by a mix of air- and ground systems.

19. Nature of the Model. Estimates of the number of nuclear weapons required are drawn from a mathematical model developed in a study by the Operations Research Office for the Department of the Army (ORO-T-386). Weapons requirements are established as the sum of delivered weapons necessary to produce a desired effect and weapons lost to enemy action. The method provides a basis for gaining an insight into requirements, even though it is theoretical and has the limitations arising from a high degree of aggregation. Inputs for the analysis include:

[redacted]

20. Derivations of Inputs. For purposes of this study the values assigned the factors listed above have been derived as follows:

[redacted]

[redacted]

c. Weapons Effects.

(1) For simplicity in computation, the analysis to follow is carried out in terms [redacted] relative densities have been examined. These are:

[redacted]

(2) In order to simplify calculations [redacted] The ratios of casualties and the effects of the various yields are shown in Figure 11. [redacted]

d. Relative Rates of Nuclear Fire.

(1) A count of the estimated Soviet delivery vehicles and means does not immediately translate [redacted] The rates of fire that have been used are the sustained rates of fire which have been furnished in Table 16, of the Annex to Appendix A, Intelligence. [redacted]

(2) Utilizing the above information, the estimated Soviet rate of fire per army Front per day is estimated as:

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[redacted]

(3) The rate of fire capability developed above indicates that the rates of fire imputed to the Soviets in the foregoing examples are constrained.

[redacted]

[redacted]

g. End-Of-Engagement Criteria

(1) The criteria used for determining the outcome of the land battle is the measure [redacted] The criteria, therefore, for the end of the engagement will be based upon a level-of-casualties figure which result from nuclear casualties alone. No attempt is made to consider the intangibles of battle that history has proven crucial such as leadership, morale, exposure to continuing combat, maneuver and surprise. The following three factors are pertinent in determining the end of an engagement:

[redacted]

[redacted]

(2) Therefore, in this study, the engaged battle ends when:

[redacted]

21. The Analysis of the Ground Combat Model

a. The Campaigns. Four force ratios have been analyzed in this study. Details regarding inputs, calculations and data are given in Appendix C. The forces and troop densities considered are outlined in Figure 12.

Figure 12 - Campaign Situations

b. Firing Rate and Effectiveness. In the model nuclear firepower of each side varies directly with its numerical troop strength, and the effectiveness [redacted] The firing of weapons at the [redacted] outlined in the situations above represent a plausible range of densities.

c. Results. The results of the analysis are shown on Figure 13.

Figure 13 - Over-all Summary of Situations

Pages 41 & 42 are denied in total

For each situation the first column indicates the estimated rate of fire based upon the equipment now forecast to be [redacted] The second column of figures in each case is the [redacted] during the time that they are still utilizing nuclear weapons. Calculations are explained in Appendix C, Annex 2.

d. Desirability of a High Unit Firing Rate. In Situation A (Figure 13) [redacted] Under rules established for the end of the game criteria, the outcome, even though [redacted] In the case of the derived rate of fire with the Soviets [redacted] during the period of the first phase (the period when the Soviets are still [redacted]). This illustrates the value of a high rate of fire. NATO losses were less, and the loss inflicted on the Soviet was slightly greater, than in the same case for the estimated rate of fire.

22. Short-range Nuclear Weapons

a. Thus far, this study has analyzed the implications of the relationship of the [redacted] the zone of contact. The next step is to investigate a basis for the requirements [redacted] of contact and have relatively [redacted] A method of determining the relative [redacted] is to establish the areas into which the various [redacted] may be fired. After these areas have been established a relative [redacted] required for coverage using random fire can be determined. The areas or zone of fire for each [redacted] are based on troop [redacted] for friendly troops assumed [redacted]

b. The results from calculating the [redacted] for hard and soft targets are shown in Figure 14.

Figure 14 - Areas and Yields for the Engaged Battle

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23. [redacted] Redundancy. The analysis in the preceding paragraph and Figure 14 indicates a coverage of target zones with [redacted] Additional case studies utilizing the Bendix computer were made with selected weapon systems and their weapon mixes. Based on computer simulations of ground combat the total [redacted] required to achieve success in [redacted] If the effectiveness of various middle-range ground delivery systems is analyzed utilizing the success probabilities charts in Figure 15,

Figure 15 - Probability of Success in Attack

and the Weapons Effects table, Figure 11, the conclusion [redacted] are required.

24. The Use of [redacted] in Support of the Land Battle.

a. The foregoing analysis has been confined to the area [redacted] the zone of contact. An examination was also made of the capabilities of [redacted] in this same area. This evaluation was made in an effort to answer the question as to whether or not external forces alone could do the job and to determine the impact of the [redacted] on the engaged battle. In this analysis, consideration was given to the following:

(1) The technical capability and feasibility of these systems in the interdiction role.

(2) The [redacted] of the weapons systems in the light of troop safety and command and control.

b. Analysis

(1) On the basis of the [redacted] for various long-range systems are shown in the following table:

[redacted]

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[redacted]

It is possible to use the [redacted] In addition, the [redacted] would provide a capability to attack those targets which are suitable for the [redacted] and which are beyond the range capability of other programed [redacted] However, responsiveness for any system would differ appreciably depending upon the number of command echelons processing the fire requests.

[redacted]

(2) In the examination of the capability of external forces to support the engaged battle, consideration was given to the most [redacted] These systems could be employed very effectively under an area fire doctrine assuming adequate warning and protection is provided to NATO ground forces and assuming the zone of contact would remain stabilized during the pre-planned attack. This is a low confidence assumption particularly if the war starts conventionally. If the conditions of the assumptions are met, [redacted] the line of contact. When the time required to transmit fire requests through command channels to the external forces and the uncertainties of priority of fires are considered together with the requirement for warning and stabilization of the zone of contact, it does not seem feasible to plan the use of external forces in the close combat area.

25. Alternative [redacted]

a. Total Engaged Battle Requirements. Within the engaged battle, estimates have been given in terms [redacted] and weapon requirements have been stated using various deployments and densities. The inclusion of the [redacted] firepower can be computed using the rate-of-fire analyses that have been outlined above. An estimate of the relative percentages of [redacted] was previously made using random fire within the areas of high [redacted]

(2) Model results were checked against the actual war game results and close similarity between the outcomes was obtained. Therefore, it is believed that the results from employing the [redacted] in order to defeat opposing Soviet Bloc forces. The mixes and results are shown in Figure 16.

Figure 16 - Distribution of Yields

(3) Figure 16 shows that as the [redacted] however, these results were obtained on the assumption that [redacted] This was done for the purposes of this analysis in order that the [redacted] could be obtained. It is also evident from the analyses that the [redacted]

c. Conversion to Actual Weapons. As has been emphasized in the foregoing analysis, [redacted] is merely a convenient unit of measure for the aggregate of effects (casualties) required, but it offers no insight into a tactically [redacted] The conversion of [redacted] to actual weapons depends upon the [redacted] effectiveness of the mix of [redacted] for the actual weapons relative to that of a [redacted] weapon. As explained in the footnotes in Figure 17,

Figure 17 - [redacted]

the conversions shown are based upon the effectiveness factors relative to [redacted] shown in Figure 11. The latter are based upon the effectiveness of weapons in random fire. Therefore, the actual weapon numbers shown in Figure 17 are those which would be required for delivery under random fire. As such, these actual weapon mixes [redacted] range in Central Europe. They also constitute a sound point of departure for further analysis of [redacted] as discussed in paragraph 26 below.

[redacted]

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[redacted] Warheads in these numbers could probably be made available but it is doubtful whether the appropriate delivery potentials could be maintained under operational conditions with the units on the present and planned orders of battle. The implications of this conclusion should be urgently examined."

26. Analysis of [redacted] Alternatives.

a. Design of Stockpile Alternatives. The alternative stockpiles computed in Figure 17 must be judged on their ability to fulfill the objectives for allocating nuclear weapons to the NATO Central Region. The [redacted] selected are intended to meet engagement criteria in two of the three target areas previously developed, i.e., from [redacted] Requirements for interdiction weapons have not been included. The alternative [redacted] have been weighted differently in [redacted] to illustrate the variations that can be obtained. As previously pointed out, these alternatives have been computed on the basis of random fire requirements. To permit a uniform comparison, the alternatives will be compared in this form. Subsequently, other factors influencing a realistic stockpile determination will be discussed.

b. Comparison of Stockpile Alternatives. When compared to the objectives for weapon allocations and the requirements for yield mixes, the alternative stockpiles offer the following advantages and disadvantages:

[redacted]

(2) Alternatives II, III and IV. Alternatives II, III and IV differ from I and V primarily by adding

[redacted]

c. Selection of Situation for Stockpile Computation. Of the situations examined, Situation B uses more probable [redacted] barring a radical change in deployment doctrine by NATO or Soviet forces. The kind of change in doctrine that would require the greatest adjustment by either side would be a large increase in mobility. The type of mobility envisaged under such a change would be reliance on vehicles that would be essentially independent of soil trafficability; however, because of the time required to develop and acquire the vehicles, it is unlikely that such doctrinal change could be realized by 1967.

d. Stockpile Computation. Under the conditions of Situation B and for [redacted] Alternative NATO stockpiles II, III and IV have been computed. Results are shown in Figure 18.

Figure 18 - Situation B NATO Stockpile

It should be pointed out that [redacted] does not require a corresponding [redacted]

e. Advantages of Alternative IV Stockpile. Alternative IV offers the highest assurance that ground commanders can effectively engage and destroy the targets in the [redacted] from the zone of contact. The reasons are:

(1) This stockpile matches the areas into which different yields can be fired as developed in

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Figure 14, Areas and Yields for the Engaged Battle. In addition, the stockpile matches the expected troop density developed in Figure 2, Pre-Attack Distribution of Soviet Forces, and target density shown in Figure 4, Pre-Attack Distribution of Targets.

(2) There are sufficient weapons to effectively engage targets in the high density zone [redacted] with quick kill, quick response weapons [redacted]

(3) There are sufficient high yield weapons to permit the ground commander to employ effective area fire in [redacted] consistent with troop safety requirements.

(4) There are sufficient weapons to permit effective distribution to all [redacted] to permit the defensive engagement of heavy ground attacks and to provide suitable levels of resupply. The numbers of weapons in Alternatives II and III are insufficient for these purposes.

f. Implications Associated with Preferred Stockpile

(1) At the first reading, the numbers of weapons suggested appear to be unreasonably high. However, these weapons are the requirements for [redacted] and the delivery units organic to the [redacted] as well as for delivery units provided by the supporting tactical air forces for the land battle.

(2) One example of a possible distribution of weapons that might be fired from various types of delivery units is derived in Figures 19 and 20:

Figure 19 - Estimated Number of Nuclear Weapon Delivery Systems

Figure 20 - Possible Distribution of Weapons

Tactical air is indicated for several weapon yields with no number associated with the tactical air delivery system. Any use of tactical air would reduce the number of weapons per launcher shown. For the purposes of this display, weapons have been

pages 56 & 57 denied in total

divided into company support, battalion-brigade support and division corps and army support on the basis of yield and delivery system range. This relationship is consistent with weapon employment concepts developed elsewhere in the report, in that shorter range delivery systems have smaller yields because troop safety is involved and because a better target acquisition capability at shorter range permits a lower yield to accomplish the desired casualty effect.

(3) The planned US division (ROAD) will have varying numbers of battalions in a division. For purposes of computation, ten battalions of three combat companies each is a reasonable assumption. Other NATO divisions will have approximately the same structure [redacted] The US Army has also established a requirement for a nuclear round for the 155 mm howitzer. This tube artillery piece exists throughout NATO and has been assumed to be available on the basis of [redacted] Considering the length of the entire Central Region front, the number of forces deployed and the very limited range of the delivery system, the [redacted]

(4) In summation, if NATO forces are to be [redacted] In no case does the rate of fire capability of the launcher preclude the delivery of this number of weapons. However, the pre-hostilities distribution of weapons and the logistic system to

provide resupply of weapons to launchers would have a distinct bearing on the total delivery capability. The delivery problem has not been examined in detail for the same reason that delivery system effectiveness was not examined. Accordingly, this is simply a rough estimate of the capability of total delivery systems that could be available to deliver total number of weapons provided for in the stockpile.

g. Factors Affecting a Realistic Determination of [redacted] Requirements

(1) A realistic determination of [redacted] requirements is a complex task involving a large number of factors, many of which [redacted] The analysis presented thus far has [redacted] to Soviet Bloc capabilities. In addition, the analysis has taken account of [redacted] to be inflicted on the enemy. Finally, the analysis has drawn upon earlier analyses of [redacted] The result is a requirement for [redacted]

(2) Other factors affecting total [redacted] The first three factors lead to [redacted] requirements. In view of the relatively

small percentages of [redacted] However, it is considered unlikely that constraints restrictions would modify the requirement in this case. The effect of target acquisition will be examined below.

(3) Additional factors, [redacted] and delivery systems in being or planned, will influence the translation of [redacted] This subject requires further study.

h. Effect of Target Acquisition Capability on Requirements

(1) As pointed out earlier in this study and in Appendix J, there is uncertainty as to target acquisition capability beyond [redacted] the zone of contact. The questionable target acquisition capability creates a doubt concerning the ability to reduce yield requirements for the delivery systems with ranges over [redacted] Moreover, target drift will further reduce the effectiveness of acquired target fire [redacted] longer range ground delivery systems (see Figure 8 of Annex 3, Appendix J).

(2) On the other hand, there is a relatively high probability of acquiring targets within the [redacted] Direct employment against visible targets can be expected to be the rule, and acquired target fire will predominate in this area. The degree of improvement of acquired target fire over random fire has not been examined in detail in this study.

i. Possible Reductions Resulting from Target Acquisition Improvements. Two separate investigations suggest that an appreciable refinement is possible in the area covered by an assured target acquisition capability. In reviewing these comparisons, it should be borne in mind that troop density factors, weapon availability and rate of fire were not the same as those used in the model that was analyzed. This comparison simply points up the necessity for a continuing exploration and for development of additional factors that can be used confidently.

(1) An analysis of the employment of the [redacted] The ratio of improvement in acquired target fire can be assumed as approximately four to one. Prompt casualties are considered more valid as the basis than delayed casualties in this case because of the immediacy of the threat.

(2) For the [redacted] a computation of the casualty expectancy per weapon fired has been made in Annex 3, Appendix C (see Figure 8). The delivery system in this case is the 8-inch Howitzer [redacted] Other systems with approximately the [redacted] would be comparable. This computation indicates that over the range spectrum of the 8-inch Howitzer, [redacted] considering a mix of moving and stationary targets. This figure is in reasonable agreement with data from the Leavenworth map exercises. The corresponding random fire effectiveness from Figure 11 is 21 casualties per weapon. For this examination the ratio of improvement for acquired target fire can be assumed as about two to one.

(3) Based upon the improvements over random fire estimated above, the on-target tactical nuclear weapon requirements of Alternative IV could be modified as follows:

page 62 denied in total

27. Weapon Design

[redacted]

Dr. Edward Teller reinforces this point when he states,* "The United States does not have the possible arms and does not have the military organization that would be needed for the successful waging of a limited nuclear war. . . We have concentrated on big weapons for big nuclear conflicts. Some good work has been done on small, lightweight nuclear weapons of the type that would be used in limited warfare, but in this field the future possibilities greatly exceed the present accomplishments."

[redacted]

* Page 287, The Legacy of Hiroshima, Edward Teller and Allen Brown, Doubleday and Company, Garden City, NY, 1962

[redacted]

(2) A second useful application of buried weapons would be against targets close to the zone of contact. A deep underground burst could be employed closer to unwarned friendly troops than any other type burst of the same yield. This is because the effects (thermal and radiation) that endanger friendly troops are suppressed. However, ground shock from the buried detonation is sufficient to cause casualties to enemy troops and damage to enemy installations. Figure 22 compares weapon effects for various heights (depths) of burst.

Figure 22 - Comparison of Effects - [redacted]

For below ground bursts the two crater radius line marks the area of severe damage. Figure 22 shows that air blast, thermal and nuclear radiation are severely attenuated even by moderate depths of burst.

page 66 & 67 denied in total

DUAL CAPABILITY

28. Problem Areas. The Study Group is unable to present any quantitative evidence directly related to alternative solutions of the problems associated with designing dual-capable ground forces. Certain problem areas have been isolated and considered in a subjective manner. These problem areas are presented in the paragraphs that follow to assist in further study of this subject. For the purpose of examination, a dual-capable force is defined as a force that can employ either nuclear weapons or non-nuclear weapons or engage in either nuclear or nonnuclear combat with equal facility.

a. Nuclear and Nonnuclear Combat. The principal difference between nuclear and nonnuclear combat is the devastating damage of nuclear weapons in contrast to conventional explosives. However, [redacted] Consequently, nonnuclear weapons will be required to compensate for the [redacted] as well as to engage targets that do not warrant the expenditure of a nuclear round.

b. Survival. A major requirement for any military force is to survive under enemy attack. Damage to equipment and static or semi-static installations will be much more severe under nuclear attack than under conventional attack. Thus, redundancy in facilities and equipment becomes a requirement to compensate for higher loss expectancy. Extensive damage is expected to reduce the number of items of major equipment, such as tanks or trucks that can be restored to operating condition by repair. Thus, in nuclear war a higher equipment replacement rate can be expected.

c. Personnel Losses. Personnel losses will likely occur [redacted] and are expected to require [redacted]

d. Troop Density. The requirement to survive creates a demand to reduce exposure of troop units which can be accomplished by dispersal. Conversely, some degree of

troop density must be maintained in selected parts of the battlefield in order to stop the enemy from gaining his objectives or in order to overcome the enemy so that friendly objectives can be attained. These two requirements are almost diametrically opposed. It is doubtful if there can be a complete reconciliation. There are two methods by which a partial reconciliation can be accomplished. First, forces can be provided with an improved mobility so that mass or necessary troop densities can be provided at places and at the time they are required to accomplish specific tasks and subsequently dispersed in order to improve the ability to survive. A second method, compatible with the first, is to practice operational procedures that will require moving with irregular frequency and forming irregular patterns at stopping places so that the unit is difficult to identify and to engage as a target.

e. Required Capabilities. In the ground forces it is highly questionable that there could be a force that is limited to a nuclear capability alone. There are delivery units that have only a nuclear capability, but they are not forces by themselves. Other units having only conventional capability are required to engage targets not suitable for nuclear attack. Some units are capable of delivering nuclear or conventional fire with equal facility depending solely on the presence of proper types of ammunition. Consequently, the Study Group has been unable to visualize the type of force that would offer a practical comparison between nuclear and nonnuclear forces. Each ground combat force must have a capability to engage in both nuclear and nonnuclear ground combat because nuclear combat is not expected to be limited to the employment of nuclear weapons alone.

f. Procedures. Procedures governing the security, safety and employment of nuclear weapons, coupled with inherent military discipline in organized units, should provide a high level of assurance that [redacted] will be withheld from conventional combat. Generally speaking, procedures usually are established that could [redacted]

g. Conflicts in Requirements. These conflicts between the requirements for conventional and nuclear combat appear to require:

(1) Survivability in a nuclear environment while maintaining a degree of mass that will assure defeat of the enemy.

(2) Improving mobility with a vehicle or vehicles that can survive in a nuclear environment.

(3) Providing replacement supplies in quantities that will satisfy the [redacted] without creating large static and semi-static installations required to accommodate supplies pending requests for their use.

(4) Providing [redacted] that will accommodate [redacted] short periods of time.

(5) Improving active defenses against any form of [redacted] attack, which will probably result in an increase in resources committed [redacted]

(6) Providing an appreciable overlap in delivery capability to insure availability in the event of loss of [redacted]

(7) Providing extensive [redacted] It would be desirable to provide augmentation to headquarters to permit sustained operations while being prepared for losses of some headquarters and an attendant capability to assume control by standby headquarters.

AREAS FOR FURTHER STUDY

29. General. During the development of the study, a number of uncertainties developed that appear to be possible of resolution. In addition, Study Group examinations indicate possible areas of exploration that should add to the depth of knowledge of the general subject of nuclear war. These topics will be discussed in turn.

30. Improved Data Base

[redacted] was intended, under the terms of the Secretary of Defense directive of 23 May 1962, to be a subject for separate study. Rather than a separate study, [redacted]

b. Soviet Bloc Ground Force Survivability. The Study Group was [redacted]

c. War Game Factors. A more comprehensive set of war game factors for the land battle is required. Land battle war game results actually relate to the single factor of index of combat effectiveness which in turn is based primarily upon manpower or unit strength. A comparison of the indices of combat effectiveness of the two sides results in a force ratio which is the basis for rate of movement allowed in a game. Actual mobility considerations are not included in the factors that make

up the index of combat effectiveness, such as air mobility, airborne mobility or agility resulting from a capability to respond quickly. Factors currently in use do not permit a confident assessment of the contribution of close air support. It is recognized that this problem has been the subject of intensive study that has resulted in some slow improvement over the years. The effort requires a renewed emphasis.

[redacted]

31. Future Study. Areas for future study that will increase knowledge concerning nuclear warfare include the following specific subjects:

a. Combat Surveillance and Target Acquisition. This should be a joint as contrasted to a separate service study in order that capabilities and limitations of all contributing agencies can be weighed. More timely information is [redacted]

b. Dual Capability. One approach that might be profitable would be [redacted] This mission might be to [redacted] For the purposes of this exploration, there should be no ceiling on troop strength or in equipment. Comparison between capabilities and limitations of these forces might disclose alternatives that are not now apparent.

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GLOSSARY OF TERMS

1. AREA FIRE

Fire delivered on a prescribed area*.

2. RANDOM FIRE

Firing at random locations without specific reference to target information and in no particular pattern.

3. TERRAIN FIRE

Fire based on analysis of the terrain and deduced enemy dispositions, but without specific target information.

4. BLANKET ATTACK

An attack delivered against an area in a geometrical pattern without regard for specific target locations.

5. TACTICAL WARNING

A notification that the enemy has initiated hostilities. Such warning may be received any time from the launching of the attack until it reaches its target. Generally thought of as 15-minute warning.

6. STRATEGIC WARNING

A notification that enemy initiated hostilities may be imminent. The time element may vary from minutes to hours, to days, or more.

7. SURPRISE ATTACK

To attack suddenly and without warning.

8. LWSR

Light Weight Strike Reconnaissance Aircraft developed for common usage among NATO nations.

9. V/STOL

Vertical/Short Take-off and Landing aircraft.

* AR 320-5 Dictionary of United States Army Terms, HQ Department of the Army, January 1961

10. VTOL

Vertical Take-off and Landing capability for aircraft

11. ZEL

Zero Length Launching. A technique in which the first motion of the missile or aircraft removes it from the launcher

12. COLLATERAL DAMAGE

Damage in an area adjacent to or surrounding a target system that has been attacked.

13. TACTICALLY DESTROYED

A unit is tactically destroyed and not combat effective for an indefinite period when one-third or more of the personnel are killed.

14. TACTICALLY NEUTRALIZED

A unit is neutralized and not combat effective for a matter of hours or days when 30 percent casualties are incurred.

15. DISARMING ATTACK

A counter-force attack directed against an enemy offensive attack system for the purpose of neutralizing or destroying that system before it can be effectively used.

16. FEBA

Forward Edge of Battle Area.

17. TACTICAL NUCLEAR WEAPONS

Theater based nuclear weapons.

18. TROOP SAFETY CRITERIA

a. DEGREES OF TROOP RISK:

(1) Negligible Risk - Distance from nuclear burst where troops are completely safe, with the possible exception of temporary loss of night vision or dazzle.

(2) Moderate Risk - At this distance from nuclear blast, anticipated effects levels are tolerable, or at worst a minor nuisance. In rare instances, some individuals may require evacuation be cause of radiation sickness. This risk is considered acceptable for close support operations.

(3) Emergency Risk - The anticipated levels may cause some temporary shock, a few casualties, and may significantly reduce the units combat efficiency. This risk is acceptable only when absolutely necessary.

b. PERSONNEL VULNERABILITY:

(1) Unwarned Exposed - Personnel are assumed to be standing in the open at burst time, but have dropped to a prone position by the time the blast wave arrives. Some personnel may have temporary dazzle.

(2) Warned Exposed - Personnel are assumed to be prone on open ground, with all skin areas covered, and with an overall thermal protection at least equal to that provided by a two-layer summer uniform.

(3) Warned Protected - Personnel are assumed to be "buttoned up" in tanks or crouched in foxholes with improvised overhead thermal shielding.

19. ACE - Allied Command Europe.

[redacted]

23. QUICK REACTION FORCE SYSTEM

A specific number of strike aircraft and air force missiles under SACEUR's special operational control, maintained at a

degree of readiness that will insure their survival and effective utilization, even under conditions of surprise attack.

[redacted]