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AD No. ____________

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PENTANA TYPE COMPANIES IN MOBILE OPERATIONS (U)

1

FINAL REPORT

AD No. ____________

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Form 1473

US ARMY COMBAT DEVELOPMENT EXPERIMENTATION CENTER
Fort Ord, California

(9) FINAL REPORT, 23 Oct – 20 Dec 57.

(6) PENTANA-TYPE COMPANIES IN MOBILE OPERATIONS.

(CDCG, CDEC 56T5)

(11) 11 July 1958

(12) 57p.

STATEMENT #2 UNCLASSIFIED

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ROBERT E. CONNOR
Colonel, Infantry
Chief of Staff

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US ARMY COMBAT DEVELOPMENT EXPERIMENTATION CENTER
Fort Ord, California

PREFACE

1. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) The PENTANA-Type Companies in Mobile Operations Experiment was completed 20 December 1957 and an Interim Evaluation Report was submitted 1 March 1958. This Final Report, as well as the Interim Evaluation Report, contains conclusions and recommendations based on evaluation of data collected within the framework of the tactics utilized and the very limited number of low yield atomic weapons employed during the conduct of the experiment.

2. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) Certain conclusions and recommendations, although valid in the tactical environment and weaponry of the Mobility Experiment, have been subjected to invalidation when put in context with the current Controllability Experiment which is now in the final execution stage. Use of more numerous and lower yield atomic weapons in the Controllability Experiment has had a significant impact on tactics and the utilization of conventional artillery and mortar fires.

3. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) Tactics of the Mobility Experiment involved the movement and emplacement of platoons as platoons. Although the platoons were widely separated (1500 - 2500 yards), the vehicles within the platoons were relatively close together. Improved tactics, developed in the Controllability Experiment, separate the vehicles of the platoons in pairs with the distance between pairs averaging 500 to 1000 yards. This tactic resulted from relatively free usage of low yield atomics which dictated a requirement to obtain maximum observation of the enemy and a requirement for appropriate dispersion to avoid destruction from enemy atomics. The advent of this new tactic eliminated the requirement for the development of new techniques for maintaining contact with and disengaging from the enemy. Further, this tactic, with greater area coverage by individual platoons, facilitated the maintenance of all around security. Therefore, the following conclusions and recommendations as outlined in the Abstract of this report are not applicable in the changed tactical environment indicated above.

a. Conclusion 4d: None of the organizations were capable of maintaining contact, primarily due to lack of effective techniques for this type of action.

b. Conclusion 4e: None of the organizations were capable of effectively maintaining all around security with platoons dispersed 1500 to 2500 yards.

c. Conclusion 4f: None of the organizations were capable of disengaging from the enemy to permit delivery of atomic weapons due to inadequate techniques f r such action.

d. Recommendation 5d: That techniques relative to maintenance of contact with an enemy who withdraws rapidly and with surprise to permit delivery of atomic weapons be developed for further experimentation.

4. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) The Controllability Experiment has also revealed the emergence of low yield atomic weapons as the dominant and controlling influence on the battlefield and the ineffectiveness of conventional artillery and mortar fires in attacking mechanized targets. Therefore, in light of the foregoing, the following additional conclusions and recommendations as outlined in the Abstract of this report are not applicable:

a. That portion of Conclusion 4j relating to inadequacy of artillery support in numbers of firing units and timeliness.

b. That portion of Recommendation 5e(1) that additional organic indirect fire capability be afforded the company.

c. Recommendation 5j: That additional combat group artillery and divisional artillery be included in future experiments with a view toward determining an appropriate amount of artillery for the PENTANA division.

WARNING

The material contained in the Experimentation Report is classified "CONFIDENTIAL - MODIFIED HANDLING AUTHORIZED" under the provisions of AR 380-5 and will be accorded the protective measures prescribed therein.

This material contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, USC, Sections 793 and 794, the transmission of which in any manner to an unauthorized person is prohibited by law.

Regrading Data may not be pre-determined.

ACKNOWLEDGEMENT

Experimentation at the US Army Combat Development Experimentation Center (USACDEC) is conducted as a joint military scientist team effort. Scientists and scientific support are provided by the Research Office of the Experimentation Center (ROEC) staffed and operated by Technical Operations, Incorporated under Department of the Army Contract Number DA 04-351-AVI-1228.

ABSTRACT

1. (UNCLASSIFIED) GENERAL: This experiment was conducted at Hunter-Liggett Military Reservation from 23 October to 20 December 1957. Three rifle companies participated, being organized differently for each particular experimental run, and operating on three different terrain courses. A comprehensive Interim Evaluation Report was submitted 1 March 1958. This Final Report supplements the Interim Report by presenting results of analysis conducted since submission of the Interim Report.

2. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) PURPOSE: The purpose of the experiment was to determine the relative combat effectiveness of three rifle company organizations varying in organic and/or attached transportation, i.e., armored personnel carriers and wheeled vehicles, in operations over extended areas, as part of a PENTANA type combat group.

3. (UNCLASSIFIED) ANALYSIS SINCE THE INTERIM REPORT: Analysis of data collected during the experiment which has been accomplished since submission of the Interim Report has been mainly in three areas; mobility systems, indirect fire support and atomic fire support. This analysis has not refuted any of the conclusions of the Interim Report, four of the Interim conclusions were confirmed, and one new conclusion was derived.

4. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) FINAL CONCLUSIONS: The final conclusions are listed below. Explanatory notes are indicated in these conclusions as they differ from those in the Interim Report.

a. (Objective One) The relative combat effectiveness of the three organizations is in the order listed below:

(1) M3 organization (APC's organic).

(2) M2 organization (APC's attached).

(3) M1 organization ($2\frac{1}{2}$ ton trucks attached).

This conclusion, tentatively arrived at in the Interim Report, was confirmed by additional analysis.

b. (Objective Two) No additional conclusions pertaining to logistics have been reached at this time. Additional analysis of

logistical data is in progress and will be presented in a separate report.

c. (Objective Three) None of the organizations considered was capable of conducting adequate reconnaissance. This conclusion, contained in the Interim Report, was confirmed by additional analysis.

d. (Objective Four) None of the organizations were capable of maintaining contact, primarily due to lack of effective techniques for this type of action. Analysis since the Interim Report has not affected this conclusion.

e. (Objective Five) None of the organizations were capable of effectively maintaining all around security with platoons dispersed 1500 to 2500 yards. Analysis since the Interim Report has not affected this conclusion.

f. (Objective Six) None of the organizations were capable of disengaging from the enemy to permit delivery of atomic weapons due to inadequate techniques for such action. Analysis since the Interim Report has not affected this conclusion.

g. (Objective Seven) The single artillery forward observer provided for the PENTANA rifle company is inadequate. He cannot effectively operate in the additional role of an antitank guided missile controller. Analysis since the Interim Report has not affected this conclusion.

h. (Objective Eight) The capability of the units to organize and defend effectively after helicopter lift is in direct proportion to the payload of the helicopters utilized. Analysis since the Interim Report has not affected this conclusion.

i. (Objective Nine) The experiment was successful in generating numbers and types of artillery fire missions. This conclusion, contained in the Interim Report, was confirmed by additional analysis.

j. (Objective Ten) Artillery support, as provided in the PENTANA Division, is adequate in accuracy and range characteristics but inadequate in numbers of firing units and timeliness. The conclusion as to inadequacy of numbers of firing units and timeliness was derived from analysis since the Interim Report.

k. (Objective Eleven) Adequate basic data in preparation for subsequent artillery experiments were collected. This conclusion, contained in the Interim Report, was confirmed by additional

analysis.

l. (Objective Twelve) The improved anti-personnel mine, due to its military characteristics, was ineffective against the mechanized Aggressor force and therefore had no significant impact. Analysis since the Interim Report has not affected this conclusion.

m. (Objective Thirteen) Communications utilized by the experimental organizations were inadequate in the areas of maintenance, range and number of radio sets. Analysis since the Interim Report has not affected this conclusion.

n. (Objective Fourteen) Tactical utilization of the cargo helicopter for troop lift proved feasible. Analysis since the Interim Report has not affected this conclusion.

o. (Objective Fifteen) The experiment was successful in developing the logistic requirements generated by using helicopters for resupply. Analysis since the Interim Report has not affected this conclusion.

5. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) FINAL RECOMMENDATIONS: The final recommendations are listed below. Explanatory notes are indicated in these recommendations as they differ from those of the Interim Report.

a. (Objective One) That organic armored vehicles be considered the most effective type of mobility system for rifle companies operating in the 1962 period. No recommendation was made in the Interim Report, pertaining to relative combat effectiveness of mobility systems.

b. (Objective Two) No recommendation on logistics is made, pending completion of the logistical study, now in progress.

c. (Objective Three) That a reconnaissance capability be readily available to the company when it is operating on semi-independent missions over extended distances. This recommendation, contained in the Interim Report, has been confirmed by additional analysis.

d. (Objective Four) That techniques relative to maintenance of contact with an enemy who withdraws rapidly and with surprise to permit delivery of atomic weapons be developed for further experimentation. Analysis since the Interim Report has not affected this recommendation.

e. (Objective Five) (1) That additional organic anti-

tank, indirect fire and surveillance capabilities be afforded the company.

(2) That an antitank guided missile with improved characteristics for use in highly mobile operations be developed.

(3) That a full tracked vehicle be developed, having a direct fire weapon with a tank kill capability, a low silhouette, air transportability and requiring but a small crew.

Analysis since the Interim Report has not affected the above recommendations.

f. (Objective Six) That techniques of disengagement from the enemy to permit atomic delivery be developed for further experimentation. Analysis since the Interim Report has not affected this recommendation.

g. (Objective Seven) That additional artillery forward observers and an artillery liaison officer be habitually attached to the company. That antitank guided missile controllers be separate and distinct from mortar and artillery forward observers. Analysis since the Interim Report has not affected these recommendations.

h. (Objective Eight) That improved communication means, additional payload capacity, better navigational instruments and techniques of employment be developed for helicopters and using troops. Analysis since the Interim Report has not affected this recommendation.

i. (Objective Nine) That fire mission data, generated in this experiment, be utilized in future studies, war games, and experiments. No recommendation pertaining to fire mission data was made in the Interim Report.

j. (Objective Ten) That additional combat group artillery and divisional artillery be included in future experiments with a view toward determining an appropriate amount of artillery for the PENTANA division. No recommendation pertaining to capability of artillery support was made in the Interim Report.

k. (Objective Eleven) That the basic artillery data collected be utilized for further study, experimentation, and evaluation of the PENTANA artillery system. This recommendation, contained in the Interim Report, has been confirmed by additional analysis.

l. (Objective Twelve) That the improved anti-personnel

mine be considered as an ineffective weapon to provide local security against an enemy employing principally mechanized units and warfare.

m. (Objective Thirteen) That improved communication means be developed for all echelons within the PENTANA organization with emphasis on ruggedness and range. Analysis since the Interim Report has not affected this recommendation.

n. (Objective Fourteen) The recommendation in paragraph h, above, that improved communication, instrumentation, payload and techniques of employment be developed applies also to the tactical utilization of cargo helicopters. Analysis since the Interim Report has not affected this recommendation.

o. (Objective Fifteen) That the logistics requirements generated by using helicopters for resupply be utilized for further study, experimentation and evaluation. Analysis since the Interim Report has not affected this recommendation.

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CONTENTS (CONTINUED)

US ARMY COMBAT DEVELOPMENT EXPERIMENTATION CENTER
Fort Ord, California

FINAL REPORT
PENTANA-TYPE COMPANIES IN MOBILE OPERATIONS(U)
(CDOG, CDEC 58T5)

SECTION I

GENERAL INFORMATION

1. (UNCLASSIFIED) GENERAL: This is the Final Report of Experimentation with PENTANA-Type Companies in Mobile Operations, CDEC 58T5, conducted by USACDEC during the period 23 October 1957 to 20 December 1957. The Interim Evaluation Report, submitted 1 March 1958, included the Detailed Plan of Experiment, the details pertaining to conduct of the experiment, and the conclusions and recommendations which could be derived from military evaluation, plus the scientific analysis and a presentation of raw data completed and compiled at that time. This Final Report, therefore, is limited to a presentation of the additional data which has been analyzed since submission of the Interim Report, along with conclusions and recommendations derived from that data.

2. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) PURPOSE: As stated in the Interim Report the purpose of the experiment was to determine the relative combat effectiveness of three rifle company organizations varying in organic and/or attached transportation, i. e., armored personnel carriers and wheeled vehicles, in operations over extended areas, against an Aggressor force, as part of a PENTANA-type combat group assumed to be operating in the 1962 period.

3. (UNCLASSIFIED) SCOPE: The Mobility Experiment employed three units, varied in organization, engaging in day and night simulated combat operations under atomic and non-atomic conditions, over three varying and extended terrain courses against a live Aggressor. Measurements were taken of friendly and enemy casualties, time and degree of mission accomplishment, movement and reaction time to command/or enemy stimulus, nature of battlefield targets generated, logistic implications, i.e., POL consumption, maintenance requirements, ammunition expenditure, resupply and medical evacuation requirements. The effectiveness of the different organizations were evaluated by using scientific methods and military judgment

to study the comparative data collected. The capability of the PENTANA-type artillery organizations to support the combat group was also studied.

4. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) CONCLUSIONS OF THE INTERIM REPORT WERE AS FOLLOWS:

a. A significant difference cannot be determined in the relative combat effectiveness of the three rifle company organizations from the preliminary scientific analysis which has been made. However, based solely on a consideration of mission accomplishment times, friendly casualties and enemy casualties, the relative combat effectiveness was, in decreasing order of effectiveness, as follows:

(1) M3 organization (APC's organic).

(2) M2 organization (APC's attached).

(3) M1 organization (2½ ton trucks attached).

The organic antitank and indirect fire capability provided the PENTANA rifle company is inadequate.

b. The logistical data collected on company level requirements is valid for use as basic data in future experiments examining the PENTANA logistical system.

c. None of the organizations were capable of maintaining contact, primarily due to lack of effective techniques for this type of action.

e. None of the organizations were capable of effectively maintaining all around security with platoons dispersed 1500 to 2500 yards.

f. None of the organizations were capable of disengaging from the enemy to permit delivery of atomic weapons due to inadequate techniques for such action.

g. The single artillery forward observer provided for the PENTANA rifle company is inadequate. He cannot effectively operate in the additional role of an antitank guided missile controller.

h. The capability of the units to organize and defend effectively after helicopter lift is in direct proportion to the payload of the helicopters utilized.

i. The experiment was successful in generating numbers and

types of artillery fire missions.

j. No conclusion can be made as to the capability of the artillery to provide adequate, timely, and accurate fire in support of the combat group pending further analysis. The characteristics of the artillery simulated as pertains to range and accuracy were adequate.

k. Adequate basic data in preparation for subsequent artillery experiments were collected.

l. The improved anti-personnel mine, due to its military characteristics, was ineffective against the mechanized Aggressor force and therefore had no significant impact.

m. Definite communications requirements of the three organizations have not been determined. Present communications within the unit were inadequate in the areas of maintenance, range, and numbers of sets.

n. Tactical utilization of the cargo helicopter for troop lift proved feasible.

o. The experiment was successful in developing the logistical requirements generated by using helicopters for resupply.

5. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) RECOMMENDATIONS OF THE INTERIM REPORT WERE AS FOLLOWS:

a. No recommendation on the relative combat effectiveness of the three organizations can be made at this time pending further analysis.

b. That the logistics data obtained be utilized for further study, experimentation, and evaluation of the PENTANA logistical system.

c. That a reconnaissance capability be readily available to the company when it is operating on semi-independent missions over extended distances.

d. That techniques relative to maintenance of contact with an enemy who withdraws rapidly and with surprise to permit delivery of atomic weapons be developed for further experimentation.

e. That additional organic antitank, indirect fire and surveillance capabilities be afforded the company. That an antitank guided missile with improved characteristics for use in highly mobile operations be developed. That a full track vehicle having a

direct fire weapon with a tank kill capability, a low silhouette, air transportability, requiring but a small crew, be developed.

f. That techniques of disengagement from the enemy to permit atomic delivery be developed for further experimentation.

g. That additional artillery forward observers and an artillery liaison officer be habitually attached to the company. That anti-tank guided missile controllers be separate and distinct from mortar and artillery forward observers.

h. That improved communication means, additional payload capacity, better navigational instruments and techniques of employment be developed for helicopters and using troops.

i. No recommendations can be made on the number and types of fire missions generated pending further analysis.

j. No recommendation can be made at this time on the capability of artillery support.

k. That the basic artillery data collected be utilized for further study, experimentation, and evaluation of the PENTANA artillery system.

l. That the improved anti-personnel mine be considered as an ineffective weapon to provide local security under concepts of mechanized dispersed warfare.

m. That improved communication means be developed for all echelons within the PENTANA organization with emphasis on ruggedness and range.

n. The recommendation in "h", above, applies also to the tactical utilization of cargo helicopters.

o. That the logistics requirements generated by using helicopters for resupply be utilized for further study, experimentation, and evaluation.

SECTION II

CONDUCT OF THE ANALYSIS

6. (UNCLASSIFIED) COMPILATION OF DATA:

a. Data Cards: Data cards and forms were assembled in the field, checked for clerical accuracy, and forwarded to the Research Office for statistical analysis.

b. Reduction of Data: To determine rates of advance, routes were plotted on a map, distances were determined with a map-measurer device, and rates were computed, using the measured distances and time intervals derived from data cards. Other data, including direct and indirect fire data, casualties, and atomic data were compiled in the form of graphs and tables.

7. (UNCLASSIFIED) ANALYSIS:

a. Mobility Systems: Analysis of variance tests were performed on materiel and personnel casualties and on various times associated with the accomplishment of missions in order to determine whether or not real differences existed among the organizational units. These tests were mathematical procedures wherein differences between the average performance of the three organizations were compared to differences between successive performances of the same organization, as well as differences introduced by other variables, i.e., terrain, troops, and phase of the experiment. Differences between organizations could be considered significant if these differences were large in relation to performance differences within organizations and those differences caused by the other variables. Except for the obvious differences in casualties presented in the Interim Report, no significant differences between organizations were observed (Annex A).

b. Indirect Fire Support: An analysis of artillery requirements and capabilities was conducted to determine adequacy and timeliness of artillery (Annex A).

c. Atomic Fire Support: During the conduct of the experiment, atomic weapons were employed in three situations and concluded these actions. Casualties were not assessed at the time, as both Blue and Red forces began the new situation at full strength. An analysis of atomic casualties was conducted wherein the weapon yields and ground zeros selected by Blue forces were compared to the locations of all Red and Blue forces at the instant of weapon delivery. An analysis was also made to determine the effect of various yields (Annex C).

SECTION III

DISCUSSION

8. (UNCLASSIFIED) GENERAL:

a. As indicated in the Interim Evaluation Report, further scientific analysis was required to refute, support or add to the conclusions reported therein. Resultant action did not refute any of the interim conclusions but did in effect support those where analysis was possible and provided the required information on one objective not covered in the Interim Report.

b. Conclusions pertaining to the following objectives were further supported by the analysis.

(1) Objective One - Relative Combat Effectiveness of the Three Organizations.

(2) Objective Three - Reconnaissance Capability.

(3) Objective Nine - Number and Types of Fire Missions.

(4) Objective Eleven - Basic Artillery Data.

c. No conclusion was reached in the Interim Report pertaining to adequacy of artillery (Objective Ten); however, additional analysis made discussion and the drawing of conclusions possible for this report. (Annex B).

d. Discussions of experimental objectives, together with comments on the effect of analysis, are outlined in the succeeding paragraphs.

9. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) DISCUSSION:

a. Objective One: To determine the relative combat effectiveness of three rifle company organizations varying in organic and/or attached transportation, i.e., armored personnel carriers and wheeled vehicles, in operations over extended areas, against an Aggressor force, as part of a PENTANA-type combat group assumed to be operating in the 1962 period.

(1) Discussion: Additional analysis indicates that the M1 organization (2½ ton trucks attached) achieved the highest rates of advance in most cases; however, inspection of the military evaluator position and route overlays reveals that this organization utilized existing road nets whereas the M2 and M3 organizations travelled more

cross country. Rates of advance, averaged over 54 situations were as follows (Annex A):

M1 organization (2½ ton trucks attached)	6.6 miles per hr.
M2 organization (APC's attached)	4.8 miles per hr.
M3 organization (APC's organic)	5.4 miles per hr.

Rates of advance for Situation 3 were not included in the above averages because Situation 3 was a defensive situation where little or no movement was involved.

Although the M1 organization achieved the best rates of advance, overall mission accomplishment time and approximately the same as for the other mobility systems. Because of its greater vulnerability and limited fighting capability, the M1 organization consumed more time in dismounted actions.

The M1 organization because of its vulnerability, incurred significantly more casualties than the organizations employing APC's. Ratios of friendly to enemy casualties for the three organizations were (Annex A):

M1 organization (2½ ton trucks attached)	2.7 : 1
M2 organization (APC's attached)	1.7 : 1
M3 organization (APC's organic)	1.7 : 1

The large number of casualties incurred by M1 makes it the least effective of the three organizations. Although there was little difference between M2 and M3, the M3 organization scored better in mission accomplishment time, rates of advance, and friendly casualties while achieving the same ratio of friendly to enemy casualties. M3 is therefore considered to be the most effective organization.

(2) Conclusion: The relative combat effectiveness of the three organizations, tentatively arrived at in the Interim Report, remains unchanged and is in the order listed below:

(a) M3 organizations (APC's organic).

(b) M2 organization (APC's attached).

(c) M1 organization (2½ ton trucks attached).

(3) Recommendation: That organic armored vehicles be

considered the most effective type of mobility system for rifle companies operating in the 1962 period.

b. Objective Two: To determine logistical requirements to include POL consumption, medical evacuation, maintenance and resupply requirements in actions over extended distances.

(1) Discussion: Logistical data, collected in the experiment is presented in Volume II of the Interim Report. Additional analysis of this data is in progress. Results of the analysis will be presented in a separate report.

(2) Conclusion: At this time - none.

(3) Recommendation: At this time - none.

c. Objective Three: To determine the capability of each of the experimental companies to conduct reconnaissance.

(1) Discussion: Additional analysis indicates that an inordinate number of casualties occurred in each of the three experimental organizations during the two reconnaissance situations. More friendly casualties occurred in these two situations than in any other situation except the delaying action. Furthermore, the ratio of friendly to enemy casualties was greater in the reconnaissance situations than in the other situations, excepting the night movement (Annex A). It appears therefore, that the experimental companies could expect a short life on the battlefield while executing reconnaissance missions and that their reconnaissance capability is inadequate from a standpoint of vulnerability as well as the considerations enumerated in the Interim Report, which were; lack of special training and equipment, insufficient tank killing capability and too many men, per vehicle, committed unnecessarily to the reconnaissance mission.

(2) Conclusion: The conclusion of the Interim Report is confirmed. None of the organizations considered was capable of conducting adequate reconnaissance.

(3) Recommendation: That a reconnaissance capability be readily available to the company when it is operating on semi-independent missions over extended distances.

d. Objective Four: To determine the capability to maintain contact with the enemy.

(1) Discussion: Additional analysis had no impact on determination of the capability to maintain contact with the enemy. The conclusion of the Interim Report, therefore, remains unchanged.

(2) Conclusion: None of the organizations were capable of maintaining contact, primarily due to lack of effective techniques for this type of action.

(3) Recommendation: That techniques of maintaining contact with an enemy who withdraws rapidly and with surprise, to permit delivery of atomic weapons, be developed for further experimentation.

e. Objective Five: To determine the capability to maintain all around security.

(1) Discussion: Additional analysis had no impact on determination of the capability to maintain all around security. The conclusion of the Interim Report, therefore, remains unchanged.

(2) Conclusion: None of the organizations were capable of effectively maintaining all around security with platoons dispersed 1500 to 2500 yards.

(3) Recommendation:

(a) That additional organic antitank, indirect fire and surveillance capabilities be afforded the company.

(b) That an antitank weapon with improved characteristics for use in highly mobile operations be developed.

(c) That a full tracked vehicle be developed, having a direct fire weapon with a tank kill capability, a low silhouette, air transportability and requiring but a small crew.

f. Objective Six: To determine the capability to disengage from the enemy to permit atomic delivery.

(1) Discussion: Additional analysis has had no impact on determination of the capability to disengage from the enemy to permit atomic delivery. The conclusion of the Interim Report, therefore, remains unchanged.

(2) Conclusion: None of the organizations were capable of disengaging from the enemy to permit delivery of atomic weapons due to inadequate techniques for such action.

(3) Recommendation: That techniques of disengagement from the enemy to permit atomic delivery be developed for further experimentation.

g. Objective Seven: To determine the capability to request

supporting fires.

(1) Discussion: Additional analysis had no impact on determination of the capability to request supporting fires. The conclusion of the Interim Report, therefore, remains unchanged.

(2) Conclusion: The single artillery forward observer provided for the PENTANA rifle company is inadequate. He cannot effectively operate in the additional role of an antitank guided missile controller.

(3) Recommendation:

(a) That additional forward observers and an artillery liaison officer be habitually attached to the company.

(b) That antitank guided missile controllers be separate and distinct from mortar and artillery forward observers.

h. Objective Eight: To determine the capability to organize and defend effectively after landing by helicopter.

(1) Discussion: Additional analysis had no impact on determination of capability to organize and defend effectively after landing by helicopter. The conclusion of the Interim Report, therefore, remains unchanged.

(2) Conclusion: The capability of the units to organize and defend effectively after helicopter lift is in direct proportion to the payload of the helicopters utilized.

(3) Recommendation: That improved communication means, additional payload capacity, better navigational instruments, and techniques of employment be developed for helicopters and using troops.

i. Objective Nine: To determine the number and type of fire missions generated by experimental units, including atomic missions.

(1) Discussion: Complete analysis of the data generated, which was unavailable for inclusion in the Interim Report, confirms the conclusion of that report and makes a recommendation possible. Numbers of indirect fire missions are listed in Annex B. Numbers of missions requested are included as well as numbers of missions fired. Types of artillery targets generated by both Red and Blue forces are also listed in Annex B. Atomic fire missions, requested and delivered, are included in Annex C, along with an analysis of atomic casualties.

(2) Conclusion: The experiment was successful in generating numbers and types of artillery fire missions.

(3) Recommendation: That fire mission data, generated in this experiment, be utilized in future studies, war games, and experiments.

j. Objective Ten: To determine the capability of artillery to provide adequate, timely and accurate fire in support of the combat group.

(1) Discussion:

(a) The Interim Report concluded that the PENTANA artillery, simulated in the experiment was adequate as to range and accuracy, but no conclusions could be drawn pertaining to adequacy and timeliness. Therefore, an analysis was made of Phase II of the experiment to determine adequacy and timeliness of PENTANA artillery in support of the combat group (Annex B). Capability of the supporting artillery was compared to requirements generated by the experimental companies. During the conduct of Phase II of the experiment, 15% of the missions requested were not fired for various reasons, i.e., conflicts in timing of fire requests among platoons, artillery out of range, and artillery displacing to new positions. The remaining 85% of the missions requested were fired. After completion of the experiment, the fire requests of the three separate experimental runs in Phase II were combined to simulate the requirements of a combat group with three companies committed simultaneously. Each request was timed as it occurred in the experiment, with zero time at the beginning of each situation. It was found that 25% of the missions, assumed to have been fired in the experiment, conflicted with one another to some degree in timing among the three companies. Therefore, if conflicting missions are cancelled, only 64% (75% x 85%) of the missions generated could be fired, as requested, under the conditions of this experiment. If conflicting missions are delayed rather than cancelled, an even greater number of conflicts will evolve and vice versa, the more conflicts, the more delays. Thus, timeliness is tied to adequacy.

(b) Although artillery, regardless of amounts, cannot be expected to fire all missions requested, it appears that the capability of firing only 64% of missions requested is inadequate. Placement of artillery forward observers with each platoon probably caused the experimental companies to generate more fire missions than would be anticipated for a PENTANA-type company with only one forward observer. However, additional target acquisition capability, as well as increased fire support, appears to be justified in view of the larger area for which the company is responsible and the decreased mutual

support among widely separated platoons.

(2) Conclusion: Artillery support, as provided in the PENTANA Division, is adequate in accuracy and range characteristics but inadequate in numbers of firing units and timeliness.

(3) Recommendation: That additional combat group artillery and divisional artillery be included in future experiments with a view toward determining an appropriate amount of artillery for the PENTANA Division.

k. Objective Eleven: To collect basic data in preparation for subsequent artillery experiments.

(1) Discussion: Data pertaining to observer target ranges and casualties resulting from simulated artillery fire were compiled prior to submission of the Interim Report and were presented in Volume II of the Interim Report. Additional basic data on numbers and types of fire missions generated in the experiment are contained in this report in Annexes B and C, respectively, for non-atomic and atomic missions.

(2) Conclusion: Adequate basic data for use in future artillery experiments were collected.

(3) Recommendation: That the basic artillery data collected be utilized for further study, experimentation, and evaluation of the PENTANA artillery system.

l. Objective Twelve: To determine the impact of the use of an improved anti-personnel mine in defensive situations.

(1) Discussion: Additional analysis has not contributed toward determination of the impact of the improved anti-personnel mine. The conclusion of the Interim Report, therefore, remains unchanged.

(2) Conclusion: The improved anti-personnel mine, due to its military characteristics, was ineffective against the mechanized Aggressor force and therefore had no significant impact.

(3) Recommendation: That the improved anti-personnel mine be considered an an ineffective weapon to provide local security against an enemy employing principally mechanized units and warfare.

m. Objective Thirteen: To determine the communication requirements generated in all actions.

(1) Discussion: Additional analysis had no impact on

determination of communication requirements and did not indicate any deficiencies in communication other than those covered in the Interim Report.

(2) Conclusion: Communications utilized by the experimental organizations were inadequate in the areas of maintenance, range and number of radio sets.

(3) Recommendation: That improved communication means be developed for all echelons within the PENTANA organizations with emphasis on ruggedness and range.

n. Objective Fourteen: To determine the tactical utilization and feasibility of helicopters in support of each of the three experimental companies.

(1) Discussion: Additional analysis had no impact on determination of the tactical utilization and feasibility of helicopters.

(2) Conclusion: Tactical utilization of the cargo helicopter for troop lift proved feasible.

(3) Recommendation: The recommendation in paragraph h, above, that improved communication, instrumentation, payload and techniques of employment be developed, applies also to the tactical utilization of cargo helicopters.

o. Objective Fifteen: To develop logistical and maintenance support requirements generated by using helicopters in support of each of the experimental companies.

(1) Discussion: Additional analysis to date has had no impact on development of logistical and maintenance support requirements, generated by using helicopters. A logistical study which analyzes logistical requirements and support capabilities is now in progress and will be contained in a separate report. It is doubtful, however, if this analysis will alter the logistical and maintenance support requirements presented in Volume II of the Interim Report.

(2) Conclusion: The experiment was successful in developing the logistic requirements generated by using helicopters for resupply.

(3) Recommendation: That the logistics requirements generated by using helicopters for resupply be utilized for further study, experimentation and evaluation.

US ARMY COMBAT DEVELOPMENT EXPERIMENTATION CENTER
Fort Ord, California

ANNEX A, ANALYSIS OF MOBILITY SYSTEMS
TO
FINAL REPORT
PENTANA-TYPE COMPANIES IN MOBILE OPERATIONS(U)
(CDOG, CDEC 58T5)

1. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) CRITERIA: Criteria applicable to evaluation of mobility systems are:

a. Casualties.

b. Time.

The organization which performed through a lengthy series of two-sided combat situation and which emerged with the best time score and the least number of casualties, or the best ratio of friendly to enemy casualties, could thereby be presumed to be, relatively, the best organization or mobility system. Where one system showed superior mobility and incurred a relatively large number of casualties in comparison with another, the margin of scoring could be presumed to be doubtful and subject to military judgment in accordance, for example, with such factors as the urgency of the mission and acceptability of casualties by reason of the importance of the mission. This analysis is therefore subject to the interpretation of these factors by the reader.

2. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) ENVIRONMENT:

a. Definition of Mobility: The purpose of the experiment is recalled as that of determining the relative combat effectiveness of the units and not that of judging solely the mobility characteristics. As indicated above, both casualties and time were selected as criteria. The measure of mobility is defined as the degree to which a given organization can overcome various deterrents to the rapid negotiation of all kinds of terrain under combat conditions. Deterrents are those accidents of terrain such as rough ground, streams, mud, hills, forests and man-made obstacles, plus enemy defensive or delaying activities expressed by fire, or fire plus physical assault. Thus, we are concerned with what has been known as battlefield mobility rather than the mobility associated with movement not in the presence of the enemy.

b. Effect of Tactics: The experimental companies were placed in an atomic environment, where the principal objective of the company was that of advancing on a broad front in dispersed formation affording passive defense against atomic weapons operating to determine the location and configuration of enemy forces preparatory to employing atomic weapons. Units employed fluid defense systems, also at distances widely separating platoons within the company. Helicopters were employed during the experiment to move portions of the company to seize critical terrain pending the arrival of the remainder of the company. The traditional meeting engagements and protracted fire fights between friendly and enemy platoons were a lesser consideration. Where contact occurred, the commanders were motivated by the need for by-passing resistance to seek more remunerative targets unless the unit in contact itself offered a remunerative target. The problem then became one of breaking contact skillfully enough to utilize an atomic weapon without endangering friendly troops. Thus, a high degree of initiative was warranted on the part of experimental company commanders to employ great speed until contact and thereafter to by-pass with the greater part of their units. In these circumstances, it is reasonable to expect somewhat higher rates of advance than are considered conventional.

3. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) TIME AND CASUALTY DATA: Figures A1 through A7 sum up the time and casualty data for all experimental runs. Figure A1 is a comprehensive arrangement intended to provide immediate comparison. For each situation, Figure A1 shows the average rate of advance of Blue forces and the ratio of Blue to Red casualties. Rates of advance were computed for actual movements. Halts were not considered. Mission accomplishment times, to include movements, halts and actions, were present in the Interim Report.

Figure A1

Comparison of Mobility - Casualty Effectiveness
F/E = Ratio Friendly/Enemy Casualties

Situation	Terrain Course / Mobility System	T_1			T_2			T_3			Average		
		M_1	M_2	M_3	M_1	M_2	M_3	M_1	M_2	M_3	M_1	M_2	M_3
1	Rate of Advance (mph)	8.3	3.9	3.4	6.3	4.1	3.9	3.9	4.2	3.9	6.2	4.1	3.7
	Casualties F/E (Recon in Force) open terr	*49.0	2.43	2.64	4.4	4.0	2.14	12.5	2.57	3.38	10.0	3.7	2.5
2	Rate of Advance (mph)	5.9	5.0	4.2	6.2	5.2	6.8	6.5	5.4	4.1	6.2	5.2	5.0
	Casualties F/E (Offensive-By Pass)**	.38	.75	11.5		.33	2.38	5.0	1.00	2.50	2.0	.6	3.9
3	Rate of Advance (mph)	No mvmt	5.0	1.8	No mvmt	4.8	No mvmt	No mvmt	No mvmt	4.9	0	3.3	1.6
	Casualties F/E Mobile Defense	1.23	.60	.78	2.23	1.20	1.0	.18		1.58	1.0	.9	1.1
4	Rate of Advance (mph)	7.4	3.2	5.7	11.1	5.3	6.5	5.7	6.0	7.2	8.1	4.8	6.5
	Casualties F/E (Recon in force) close terr	8.57	.83	.74	23.25	5.7	1.61	1.79	7.17	2.77	4.8	4.8	1.4
5	Rate of Advance (mph)	4.3	1.9	5.6	8.4	4.0	3.7	2.7	5.9	6.4	5.1	3.9	5.2
	Casualties F/E (Offensive) Close Terr	3.42	1.06	16.00	12.57	4.00	.14	.98	3.92	11.33	2.8	2.5	1.8
6	Rate of Advance (mph)	9.7	4.4	7.6	6.9	5.2	8.4	4.1	3.7	5.2	6.9	4.4	7.1
	Casualties F/E (Tactical) Night mvmt*		28.0	3.00	2.00		0	6.19	.13		6.2	3.4	1.2
7	Rate of Advance (mph)	8.7	5.2	4.0	9.2	7.0	4.6	3.5	7.2	6.1	7.1	6.5	4.9
	Casualties F/E (Mobile Delaying Action)	2.23	.81	1.51	.98	.53	2.35	1.70	2.52	2.57	1.5	1.1	2.0

* Casualty ratio was high in this situation because Red sustained only 2 casualties.
** Helicopter move of 1 platoon included.

Average Rate of Advance (less Sit #3	6.6	4.8	5.4
Overall Casualty Ratio Friendly/Enemy	2.7	1.7	1.7

[redacted]

Figure A2 indicates, by situation, the number of times that each mobility system scored first, second or last in achieving the best rate of advance over the three terrain courses. For example, in Situation 1 over the three terrain course, Mobility System 1 ranked first on two occasions, tied for second on one, Mobility System 2 ranked first on one terrain and second on the other two and Mobility System 3 tied for second on one terrain, and ranked third on the other two. There was no basis for comparison in Situation 3 because there was little or no movement involved.

Figure A2

Occasions on Which Given Systems Achieved Best Rates of Advance

System	M_1			M_2			M_3		
Order of Merit (Rate of Advance)	1	2	3	1	2	3	1	2	3
Situation									
1 (Recon)	2	½	½	1	2	0	0	½	½
2 (By-Pass)	2	1	0	0	2	1	1	0	2
3 (Defense)	No Basis of Comparison								
4 (Recon)	2	0	1	0	1	2	1	2	0
5 (Offense)	1	1	1	0	2	1	2	0	1
6 (Nite Move)	1	2	0	0	0	3	2	1	0
7 (Delay)	2	0	1	1	2	0	0	1	2
Total	10	4½	3½	2	9	7	6	4½	7½

[redacted]

Figure A3 shows the number of Blue casualties occurring in each situation of each run of the experiment.

Figure A3

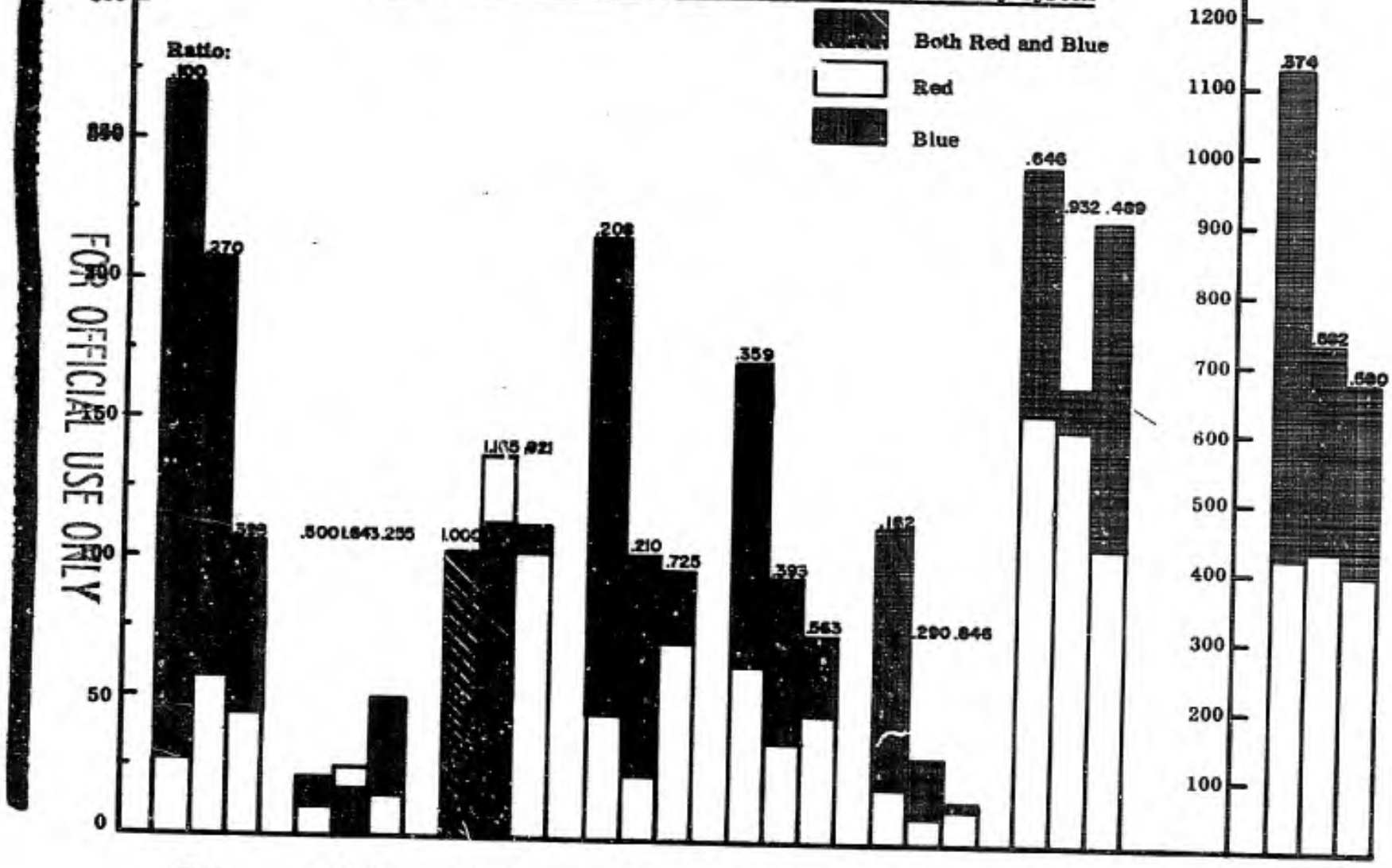
Friendly Casualties by Situation All Causes

Situation	Terrain Course / Mobility System	T1 M_1	T1 M_2	T1 M_3	T2 M_1	T2 M_2	T2 M_3	T3 M_1	T3 M_2	T3 M_3
1	Reconnaissance in Force Open Terrain	98	68	29	75	84	59	88	47	27
2	Offensive - by-pass of Aggressor	3	9	23	10	2	19	5	5	5
3	Mobile Defense	49	42	40	29	67	36	28	6	38
4	Reconnaissance in Force Close Terrain	60	5	26	93	57	29	59	43	36
5	Offensive-Close Terrain	41	18	32	88	24	5	41	47	34
6	Tactical Night Movement	12	28	12	6	2	0	99	1	1
7	Mobile Delaying Action	96	46	71	64	32	83	80	80	72
	Total	359	216	233	365	268	231	400	299	213

Figures A4, A5, A6 and A7 indicate the ratio of Red casualties to Blue casualties for each situation. Figure A4 is arranged according to mobility system, Figure A5 according to terrain course, Figure A6 according to experimental companies and Figure A7 according to phase. These figures also portray the numbers of casualties on both sides by bar graphs.

Figure A4

Ratio Red Casualties/Blue Casualties By TOE (Mobility System

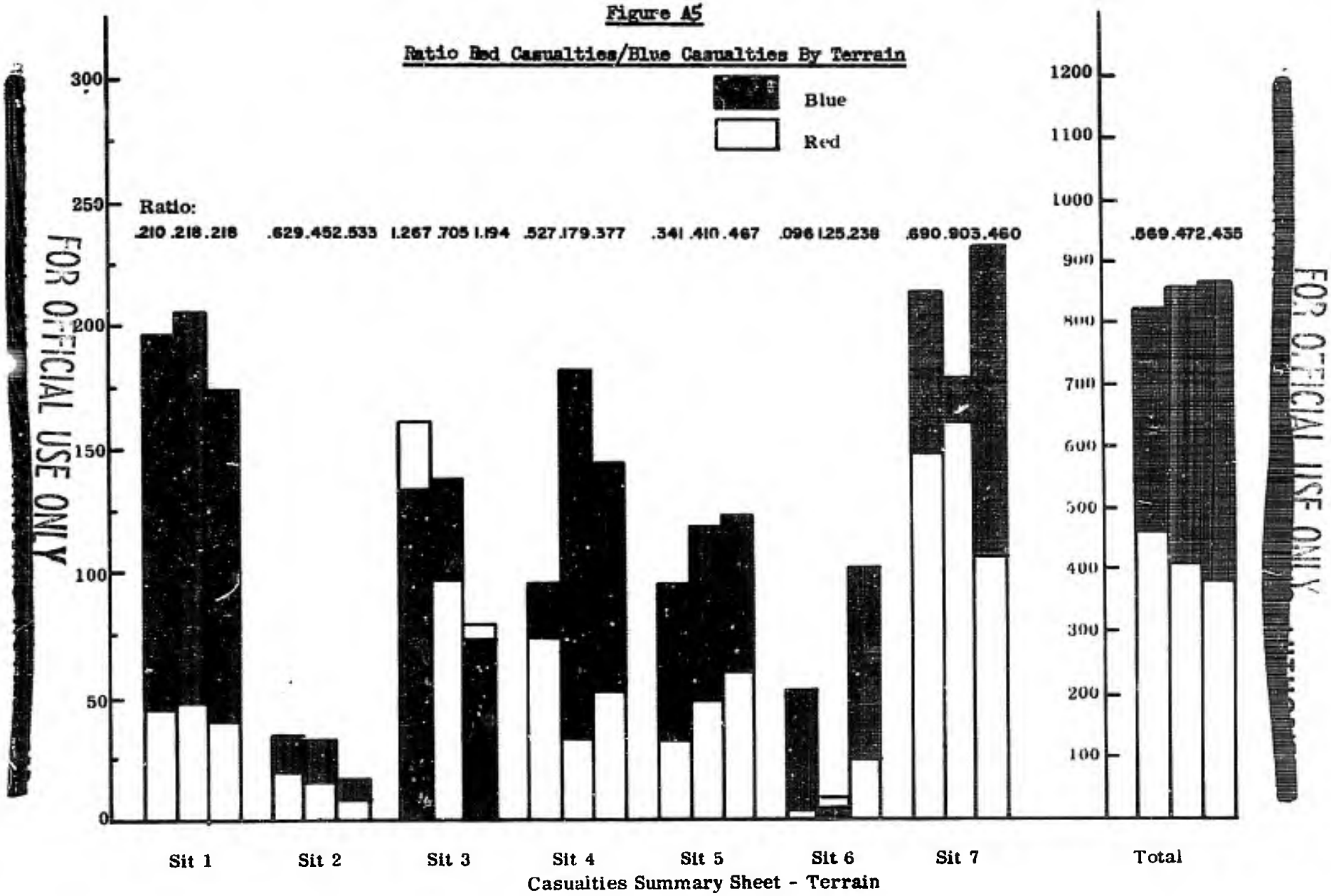


Casualties Summary Sheet - TOE

FOR OFFICIAL USE ONLY

Figure A5

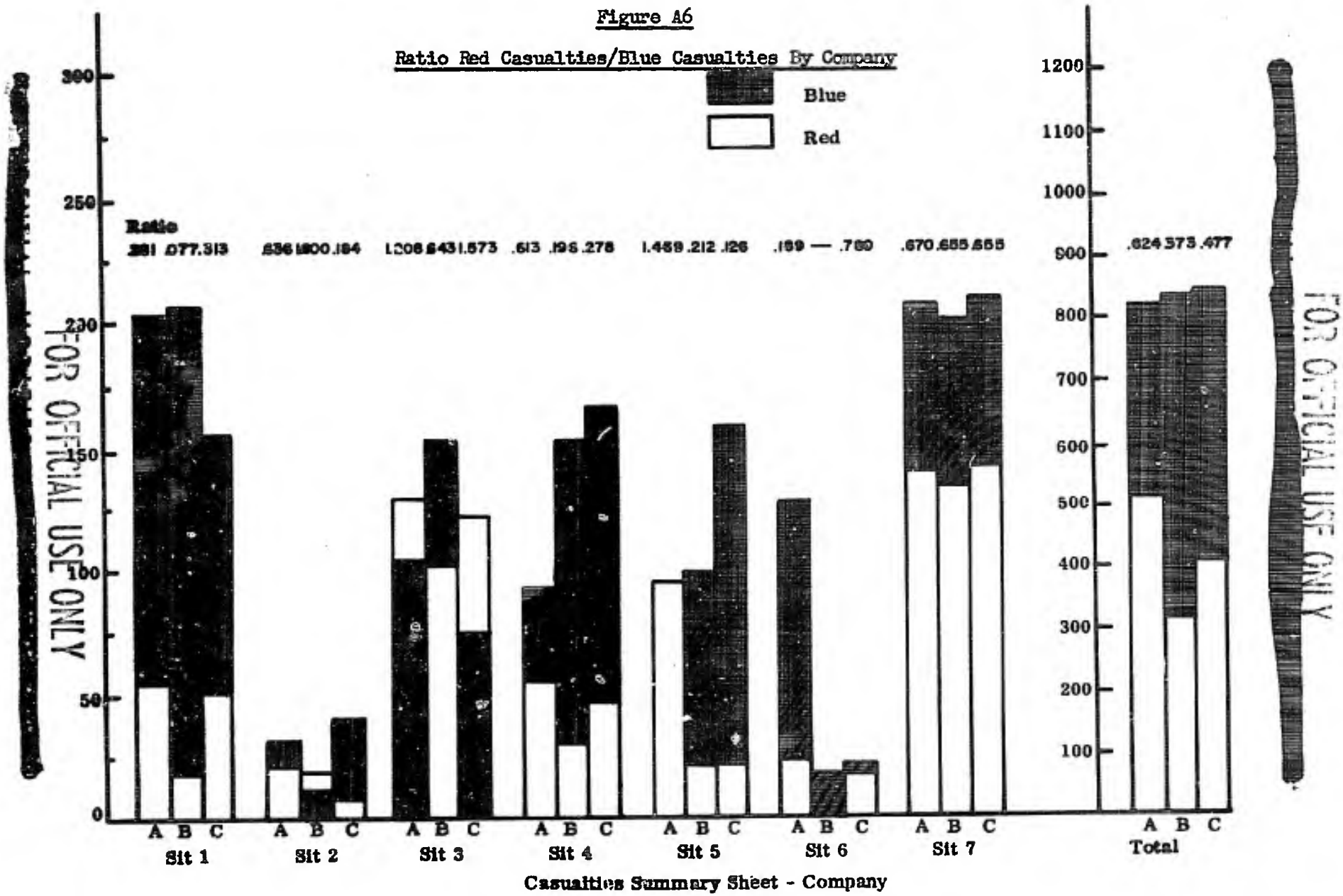
Ratio Red Casualties/Blue Casualties By Terrain



Casualties Summary Sheet - Terrain

Figure A6

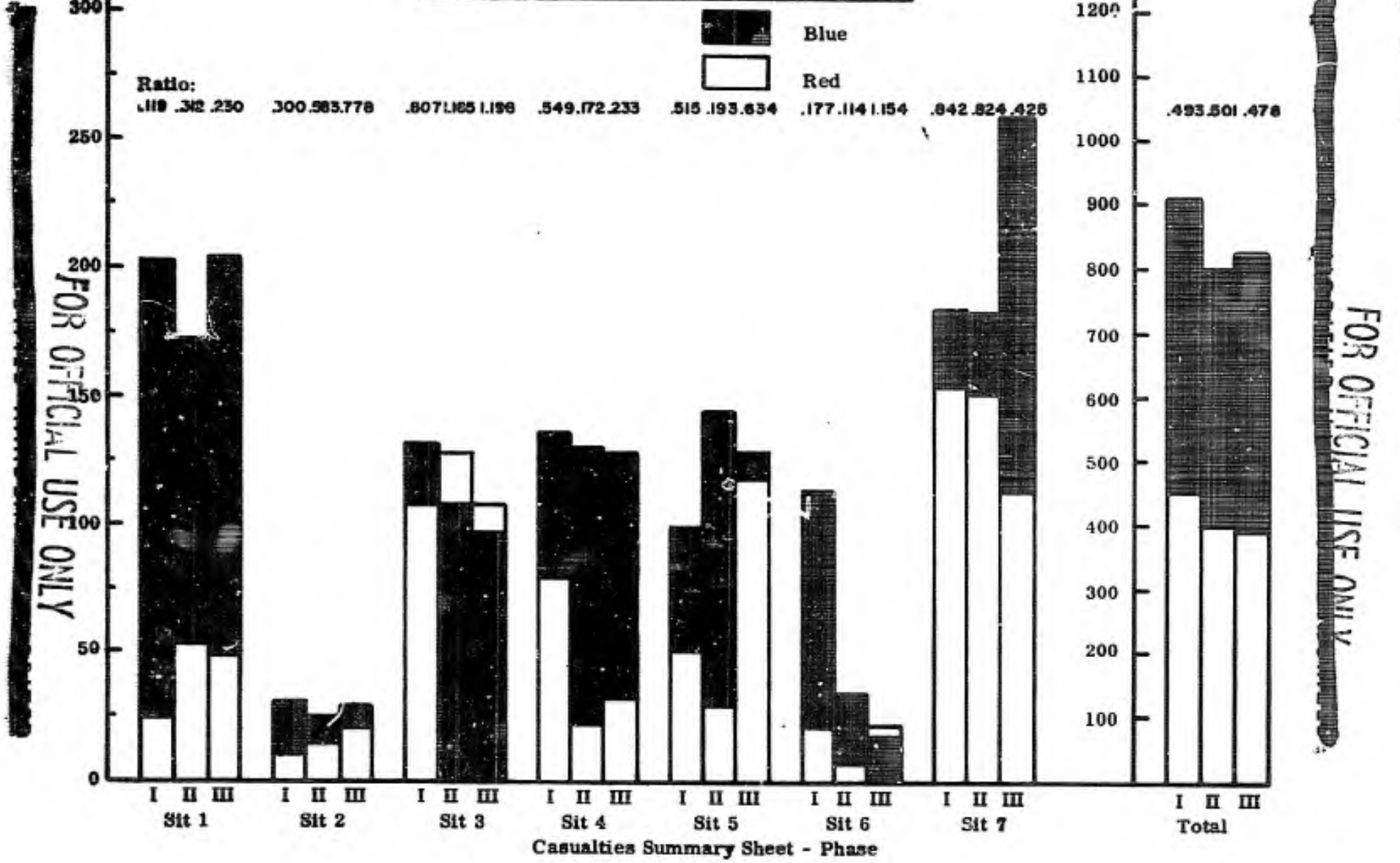
Ratio Red Casualties/Blue Casualties By Company



Casualties Summary Sheet - Company

Figure A7

Ratio Red Casualties/Blue Casualties By Phase



4. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) ANALYSIS:

a. Time and Casualty Comparison: Examination of Figures A1 and A2 discloses that the M1 mobility system achieved the greatest rate of advance generally throughout all runs, with some exceptions. Higher rates were principally found in the reconnaissance and by-pass type of action. There is little difference seen in the M2 and M3 systems. Although the M1 system scored the highest rates of advance, it should be noted that overall mission accomplishment time was not significantly different from the other two mobility systems (Interim Report). This is explained by the fact that the M1 system, being more vulnerable, required more extensive dismounted actions. Table 5 indicates that the casualties incurred by the M1 organization was significantly greater than either of the other two, with the M3 organization displaying the least vulnerable characteristics. The rating given the organizations in the Interim Report appears to have been justified, thus,

Best system . . . . . M3 (APC's organic)

2nd Best system . . . M2 (APC's attached)

3rd Best system . . . M1 ($2\frac{1}{2}$ ton truck attached)

The rating of the M1 system below that of the M2 is considered justifield by the significantly higher number of casualties incurred.

b. Rates of Advance Before and After Encountering Fire: An attempt was made to determine whether a material change in the rate of advance was noted after the unit came under direct fire of the enemy. To do this the rates of advance of each platoon were considered within each company. While it might have been expected that under conditions of closing with the enemy a significantly slower rate would have been produced, the atomic environment under which the experiment was conducted frequently produced occasions where an actual increase of rate of movement occurred as a result of enemy fire, chiefly through the employment of by-pass tactics against small enemy forces. This study was not carried beyond the stage necessary to establish a trend and the data is not included herein.

c. Attached APC's vs Organic APC's: There was little difference in these two types of mobility systems in either casualties or rates of advance. Although the M2 organization incurred a larger number of casualties, the ratio of friendly to enemy casualties for the two organizations was the same. The M3 organization scored slightly better than the M2 organization in mission accomplishment time, as well as in rates of advance.

US ARMY COMBAT DEVELOPMENT EXPERIMENTATION CENTER
Fort Ord, California

ANNEX B, ANALYSIS OF INDIRECT FIRE SUPPORT
TO
FINAL REPORT
PENTANA-TYPE COMPANIES IN MOBILE OPERATIONS(U)
(CDOG, CDEC 58T5)

1. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) ADEQUACY OF ARTILLERY:

a. Simulated Artillery: The friendly artillery simulated as being within supporting range of the experimental company was of the type conforming to the Pentana organization. It consisted of the Moritzer Battery, which was organic to the Combat Group containing the experimental company, one battery of the divisional general support battalion, One Honest John platoon of Corps Artillery, and one LaCrosse platoon of Corps Artillery. Aggressor artillery consisted of a comparable number of units and pieces, but different calibers.

(1) The Moritzer Battery was organized into two platoons of four moritzers each. It was assumed to be supporting three companies of the Combat Group, committed to action simultaneously, one of which was the experimental company.

(2) The 156mm Howitzer Battery: The Combat Group which included the experimental company was considered to be isolated from the remainder of the division to the extent that medium artillery with the remainder of the division could not, without displacement, support the experimental company. Therefore, only one battery of the divisional support artillery battalion was assumed to be capable of operating within supporting range of the experimental company. It was further assumed that any support fires from this battery must be divided between the three companies of the Combat Group. Although the PENTANA organization does not specify the caliber of the divisional general support artillery, it was assumed for the purposes of this experiment to be the 156mm Howitzer.

b. Requirements and Availability: To determine the adequacy and timeliness of support artillery, the requirements for fire missions which were generated in the experiment were compared to the capabilities of support artillery to deliver fire. Requirements were represented by all requests emanating from the experimental company or from artillery

observers present with the company. The capability to meet the requirements was dependent upon the artillery being in position and ready to fire, being within range, the timing of the requests and the duration of the various missions.

c. Conflicts: Conflicts in fire requests occurred within the experimental company and also between the companies of the Combat Group with which the experimental company was assumed to be operating.

(1) Conflicts Within the Company: During the conduct of the experiment, certain requests for fires were denied for a variety of reasons, such as the presumption that artillery was displacing at the moment, the engagement of other targets requested by the company, or that the target was out of range. All other targets were fired on. Time duration of each mission was taken from tables based on gunnery performance data obtained in a side experiment.

(2) Conflicts between Companies: To determine the number of conflicts in the fire requests of three companies, the requests of the three experimental companies during the separate runs of the experiment in Phase II were combined. In addition to the three companies, three mobility variations and three terrain courses were considered. Phase II of the experiment was selected for this replay because of the expressed scientific opinion that the most valid fire data had been obtained in Phase II. Fewer missions were fired in Phase I and more were fired in Phase III. The fire requests of the companies were arranged chronologically and timed exactly as they occurred in the three experimental runs. The time of beginning of each situation was adjusted to depict all companies as starting simultaneously. Some requests were for massed fires of howitzers and moritzer, according to a prearranged table based on target characteristics, but most requests were for a single platoon of moritzers or a single battery of howitzers. A fire mission was considered to be conflicting if it overlapped in time with missions for other companies, creating more simultaneous missions than could be fired. Conflicting missions were either cancelled or fired with less artillery than desired. A summary of conflicting fire missions is presented in Figure A1.

Figure B1

Conflicting Fire Missions, Phase II

	Situation 1	2	3	4	5	6	7	Total
Total missions requested by 3 companies	47	9	46	17	15	12	82	228
Requests denied during experiment	1	2	6	2	2	1	20	34
Percent requests denied	2%	22%	13%	12%	13%	8%	24%	15%
Missions fired during experiment	46	7	40	15	13	11	62	194
Missions fired involving one or both moritzer platoons	24	4	25	13	8	10	48	132
Missions fired involving the 156mm How Btry	24	13	26	8	8	1	40	120
Total missions fired, considering moritzers and howitzers on same target as separate missions	48	17	51	21	16	11	88	252
Conflicts between companies in missions involving moritzers	3	0	8	2	1	0	17	31
Percent conflict, moritzers	12%	0	32%	15%	12%	0	35%	23%
Conflicts between companies in missions involving 156mm howitzer	10	0	10	3	1	0	8	32
Percent conflicts, howitzers	42%	0	38%	37%	12%	0	20%	27%
Total conflicts in missions between companies	13	0	18	5	2	0	25	63
Total percent conflicts in missions between companies	27%	0	35%	24%	12%	0	28%	25%
Percent of original fire requests resulting in fire missions without conflicts	72%	78%	57%	67%	77%	92%	55%	64%

(3) Conflicts and Delays if All Missions Must be Eventually Fired: In preparing the foregoing table, it was assumed that missions which conflicted would be cancelled, or fired with less artillery than desired, as stated above. It is recognized that if the three companies had been run in the experiment simultaneously, some missions would have required cancellation, while others, not requiring immediate action, could have been delayed without impairing effectiveness. However, there was no means of obtaining valid data to show, after the conduct of the experiments, which target could logically have been delayed. It appears certain that these would have been in the minority because most targets proved to be of a fleeting nature. Nevertheless, an analysis was made to determine the impact on the number of conflicting missions if all requests were eventually fired. It is evident that a requirement of this nature would have a cumulative effect on the number of conflicts. Once support fire elements had got behind two or three missions, every new mission would become a conflict. The number of conflicts was approximately 75% and the average delay was approximately 25 minutes.

d. Adequacy of Simulated Artillery:

(1) Combat Group and Divisional Artillery: Any determination of adequacy and timeliness of artillery is, of course, dependent upon a subjective definition of adequacy and timeliness. However, it appears logical that, regardless of the amount of artillery provided, some missions must inevitably be denied and others delayed. The tactics employed in this experiment, where platoons were too widely separated for effective mutual support, placed prime emphasis upon artillery support for both atomic and conventional fires. It developed during the experiment that an artillery forward observer was required with each isolated platoon if individual platoons were to receive effective support. Added forward observers increased the target acquisition capability of the company and of the other two assumed companies in the Combat Group well above the level of operations involving only a single forward observer, thus placing a much heavier burden upon the available artillery. It seems reasonable to conclude that if dispersed tactics are to be utilized, the company must be provided with the necessary increased target acquisition capability because of the greatly increased area of company responsibility over the hitherto associated with normal company operations. To be effective in the new environment, artillery should evidently have the capability of firing on a reasonably large percentage of the targets requested. The data for this experiment indicates that the support visualized permitted the firing of only 64% of the missions called for. It would thus appear that the artillery support assumed as provided for by PENTANA is inadequate under the conditions noted.

(2) Corps Artillery: The simulated Honest John and La-Crosse platoons were used for only the delivery of atomic weapons. The atomic fire requests which were denied were so denied for tactical reasons rather than because of the non-availability of fire units. The two platoons, therefore, can be considered as adequate.

2. (UNCLASSIFIED) NUMBERS AND TYPES OF FIRE MISSIONS GENERATED BY EXPERIMENTAL UNITS:

a. General: Data pertaining to casualties resulting from indirect fire and data pertaining to observer-target ranges were presented in Volume II of the Interim Evaluation Report. Data on numbers and types of targets are listed in the following sub-paragraphs.

b. Number of Indirect Fire Missions: Figure B2 lists the numbers of indirect fire missions requested by Blue and the number of missions fired, as well as the percentage of requests which resulted in fire missions, for each of the nine experimental runs. In Figure B3, the artillery missions requested and delivered are arranged according to TOE, phase, company and terrain. The mortar missions requested and delivered are similarly arranged in Figure B4.

Figure B2

Indirect Fire Support - All Types
Blue Forces Requests and Deliveries
By Phase

		M1	%	M2	%	M3	%
Phase I	Artillery	57-44	77.2	23-22	95.7	62-61	98.4
	Mortar	35-18	51.4	16-11	68.8	11-9	81.8
	Atomic	2-1		2-1		1-1	
Phase II	Artillery	80-69	86.3	81-71	87.7	67-54	80.6
	Mortar	13-9	69.2	12-12	100	8-7	87.5
	Atomic	3-1		1-1		3-1	
Phase III	Artillery	92-81	88.0	82-73	89.0	84.81	96.4
	Mortar	12-11	91.7	3-3	100	4-3	75.0
	Atomic	5-2		1-1		2-1	
All Phases	Artillery	229-194	84.7	186-166	89.2	213-196	92.0
	Mortar	60-38	63.0	31-26	83.9	23-19	82.6
	Atomic	10-4	40	4-3	75	6-3	50

Figure B3

Supporting Fire - Artillery Missions
Blue Forces Requests and Deliveries

TOE	M1	229-194	84.7%
	M2	186-166	89.2%
	M3	213-196	92.0%

Phase	I	142-127	89.4%
	II	228-194	85.1%
	III	258-235	91.1%

CO	A	218-196	89.9%
	B	182-157	86.3%
	C	224-203	90.6%

Ter-rain	T1	235-213	90.6%
	T2	187-172	92.0%
	T3	206-171	83.0%

Figure B4

Supporting Fire - Mortar Missions
Blue Forces Requests and Deliveries

TOE	M1	60-38	63%
	M2	31-26	84%
	M3	23-19	83%

Phase	I	62-38*	61%
	II	33-28	85%
	III	19-17	89%

CO	A	51-33-	65%
	B	36-29	81%
	C	27-21	78%

Ter-rain	T1	35-32	91%
	T2	33-23	70%
	T3	46-28*	61%

Note: The first week's run fired an unusually large number of missions possibly biasing the numbers marked with an asterisk.

c. Types of Artillery Fire Missions: The following figures indicate the type of targets generated in the experiment. This data was taken from the Artillery Mission Data Cards and reflects the observer's estimates on the nature of the targets. Figure B5 shows the types of targets fired on by Blue artillery during the entire experiment and Figure B6 shows the types of targets fired on by Red during the entire experiment. Figures B7, B8, and B9 shows the types of targets represented by the three Blue TOE's fired on by Red artillery. All tables are arranged to indicate the types of targets generated, by situation.

Figure B5

Types of Targets Fired on By Blue Artillery During Entire Experiment

Target Type	Situation 1	2	3	4	5	6	7	Total
Dismounted Troops								
One squad	5	3	5	1		4	2	20
Two squads	3			1			3	7
Platoon	10		4	12	2	3	15	46
Undetermined Number			1	6	9		26	42
Suspected troops	3		2	4		8	9	26
Vehicles								
One 1/4 ton truck	2		2		1		5	10
Two or more 1/4 ton trucks		1			1		4	6
One APC	1		3					4
Two or more APCs			2				1	3
One tank	10	1	2	6	3		5	27
Two or more tanks	10	1	14	6	3		13	47
Suspected vehicles	2						1	3
Crew Served Weapons								
One or more machine guns	8		1	4	4		6	23
One or more 3.5 RL	1				1		3	5
Combinations								
One or more wheeled vehicles with troops		1	1		1		13	16
One or more APCs with troops	1	2	2	1	2		2	10
One or more tanks with troops	6		7	1	4			18
Two or three mixed vehicles	2		3	2	1		1	9
More than three mixed vehicles	1	1	18	5	5		27	57
Mixed vehicles with troops	1		7	1	3		6	18
Crew served weapons and vehicles	1		1		1		2	5
Crew served weapons and troops			1			1	3	5
Crew served weapons vehicles and troops	1							1
Helicopters and troops							4	4
Installations								
Observation post	12	1	3		1		2	19
Assembly area			2			3	1	6
Command post		1						1
Special Missions								
Preparatory fires	1						1	2
Harrassing fires		1	5	2	7	7		22
Protective fires			9			3	13	25
Smoke	14			7	7		12	40
Totals	95	13	95	59	56	29	180	527
Targets of Unknown Description								29
Total Targets Fired on by Blue								556

Figure B6
Types of Targets Fired on by Red Artillery
During Entire Experiment

Target Type	Situation							
Dismounted Troops	1	2	3	4	5	6	7	Total
One squad		3	4	4	4	3		18
Two squads	2							2
Platoon	46	2	7	9	7		34	105
Undetermined Number	7	3	12	7	5		17	51
Suspected troops	21	16	9	10	2	23	30	111
Vehicles								
One 1/4 ton truck	10	1	1	4	4	1	10	31
Two or more 1/4 ton trucks	12	1	3	8	2	2	1	29
One or more 3/4 ton trucks	1							1
One 2½ ton truck	2			2	1		2	7
Two or more 2½ ton trucks					1		1	2
One or more mechanical mules	1						1	2
One APC	3	3	6	5	4	2	2	25
Two or more APCs	4	1		11	1		3	20
Suspected vehicles	2			1	4			7
Crew Served Weapons								
One or more machine guns	1		2				1	4
One or more 106mm RR	2	2	5	3	1		2	15
One or more mortars	2				1			3
Combinations								
One or more 1/4 ton trucks with troops	4		1		1		2	8
One or more 2½ ton trucks with troops	1							1
One or more APCs with troops	1	1	3	1	1			7
Two or three mixed vehicles	4				2		4	10
More than three mixed vehicles	22	3		9	2	2		38
Mixed vehicles with troops	2							2
Crew served weapons and vehicles	6	2	1		1		2	12
Crew served weapons and troops	2		1	2			1	6
Crew served weapons, vehicles and troops							2	2
Helicopters and troops	3	1			1	4		9
Installations								
Observation post	2		4	1	1		4	12
Minefields			3					3
Special Missions								
Preparatory fires		2	67	1		6	100	176
Harrassing fires	9	16		1	11	6	1	44
Protective fires					3	12		15
Smoke			6	1			3	10
Totals	172	57	135	80	60	61	223	788

Figure B7

Types of Targets Fired on By Red Artillery,
All Phases, Against TOE M1 (2½ Ton Trucks Attached)

Target Type	Situation							
Dismounted Troops	1	2	3	4	5	6	7	Total
One squad			1	1		3		5
Two squads	1							1
Platoon	22			4	3		28	57
Undetermined number	2						6	8
Suspect troops	16	1	1	6		15	3	42
Vehicles								
One 1/4 ton truck	3		1	3			4	11
Two or more 1/4 ton trucks	4			5	1			10
One or more 3/4 ton trucks	1							1
One 2½ ton truck	2			2	1		2	7
Two or more 2½ ton trucks					1		1	2
*One or more mech mules	1						1	2
Suspect vehicles					4			4
Crew Served Weapons								
One or more 106mm RR	2		2				2	6
Combinations								
One or more 1/4 ton trucks with troops	3		1				1	5
One or more 2½ ton trucks with troops	1							1
Two or three mixed vehicles	4						2	6
More than three mixed vehicles	6			1	1	1		9
Mixed vehicles with troops	1							1
Crew served weapons and vehicles	1	2					1	4
Crew served weapons and troops	1			1				2
Crew served weapons, vehicles and troops							2	2
Helicopter and troops	1					1		2
Installations								
Observation post					1			1
Minefields			3					3
Special Missions								
Preparatory fires			24				31	55
Harrassing fires	9	10		1	11		1	32
Protective fires					3			3
Smoke			4					4
Totals	81	13	37	24	26	20	85	286

Figure B8

Types of Targets Fired on By Red Artillery, All Phases, Against TOE M2 (APCs Attached)

Target Type	Situation							
Dismounted Troops	1	2	3	4	5	6	7	Total
One squad		1	3	2				6
Platoon	12			5	3		4	24
Undetermined Number	1		5				3	9
Suspected troops	4	13	1	3			9	30
Vehicles								
One 1/4 ton truck				1	2		3	6
Two or more 1/4 ton trucks	8	1	3	2	1	2	1	18
One APC	2		1	5	4	2	2	16
Two or more APCs				7	1		2	10
Suspected vehicles	2							2
Crew Served Weapons								
One or more machine guns	1		2					3
One or more 106mm RR		2	3	2	1			8
One or more mortars					1			1
Combinations								
One or more 1/4 ton trucks with troops					1			1
One or more APCs with trps			1		1			2
Two or three mixed vehicles							1	1
More than three mixed vehicles	6	2		8	1	1		18
Crew served weapons with vehicles	5			1				6
Helicopters and troops	1					1		2
Installations								
Observation post			2	1			2	5
Special Missions								
Preparatory fires		1	27				42	70
Harrassing fires						6		6
Protective fires						4		4
Smoke			2	1			2	5
Totals	42	20	50	38	16	15	71	253

Figure B9

Types of Targets Fired on By Red Artillery, All Phases, Against TOE M3 (APCs Organic)

Target Type	Situation							
Dismounted Troops	1	2	3	4	5	6	7	Total
One squad		2		1	4			7
Two squads	1							1
Platoon	12	2	7		1		2	24
Undetermined Number	4	3	7	7	5		8	34
Suspected troops	1	2	7	1	2	8	18	39
Vehicles								
One 1/4 ton truck	7	1			2	1	3	14
Two or more 1/4 ton trucks				1				1
One APC	1	3	5					9
Two or more APCs	4	1		4			1	10
Suspected vehicles				1				1
Crew Served Weapons								
One or more machine guns							1	1
One or more 106mm RR				1				1
One or more mortars	2							2
Combinations								
One or more 1/4 ton trucks with troops	1						1	2
One or more APCs with troops	1	1	2	1				5
Two or three mixed vehicles					2		1	3
More than three mixed vehicles	10	1						11
Mixed vehicles with troops	1							1
Crew served weapons with vehicles			1		1		1	3
Crew served weapons with troops	1		1				1	3
Helicopters and troops	1	1			1	2		5
Installations								
Observation post	2		2				2	6
Special Missions								
Preparatory fires		1	16	1		6	27	51
Harrassing fires		6				8		14
Smoke							1	1
Totals	49	24	48	18	18	25	67	249

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ANNEX C, ANALYSIS OF ATOMIC FIRE SUPPORT
TO
FINAL REPORT
PENTANA-TYPE COMPANIES IN MOBILE OPERATIONS(U)
(CDOG, CDEC 58T5)

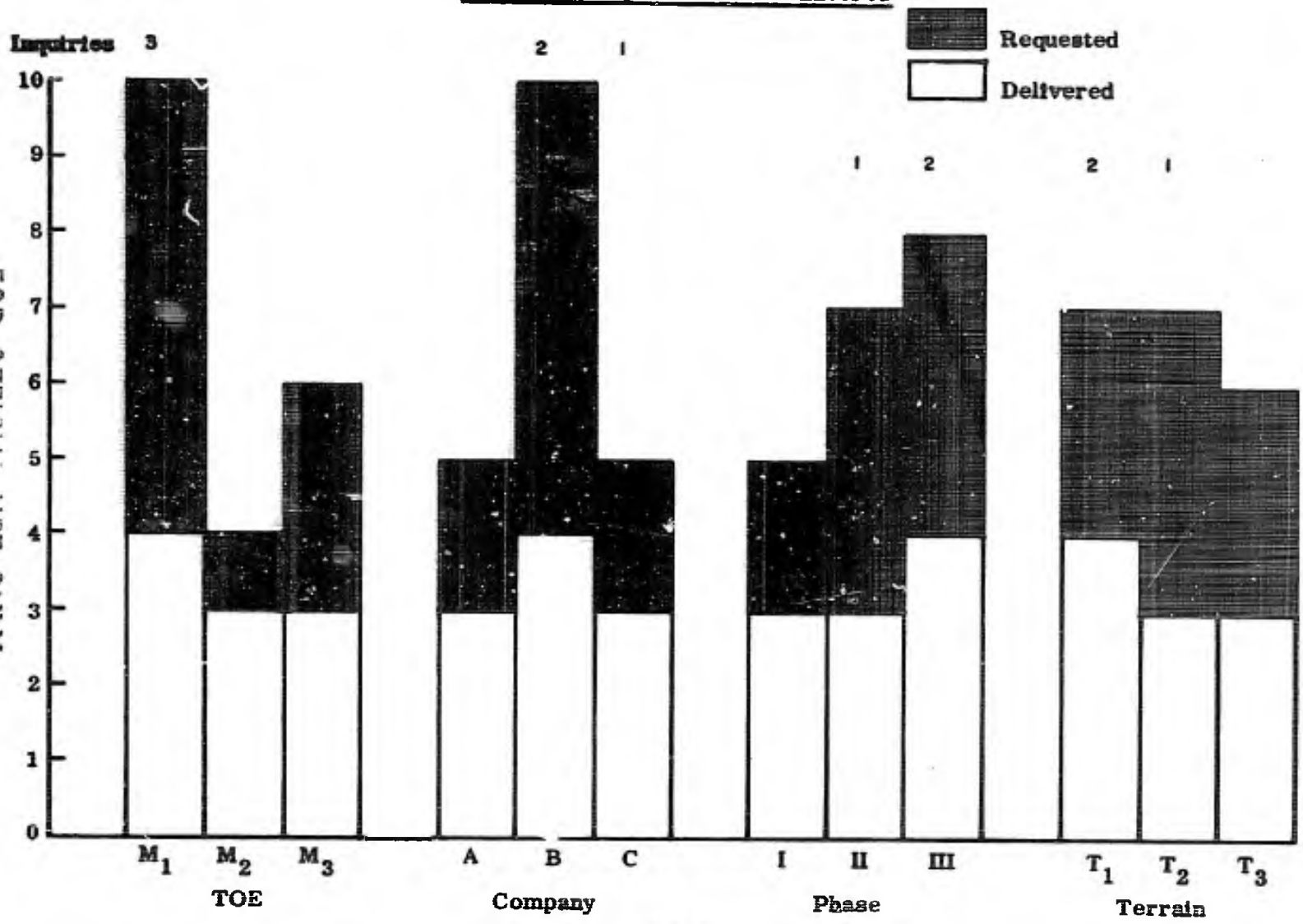
1. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) INTRODUCTION: Atomic weapons were employed by Blue Forces once during each week of the experiment, either in Situation 1 or Situation 4, in accordance with scenarios. One additional atomic weapon was employed in Situation 7 during the eighth week. Yields of the weapons assumed for employment are referred to in figures as yields A, B, C and D. Delivery means consisted of one Honest John platoon of Corps Artillery and one LaCrosse platoon of Corps Artillery. No atomic weapons were employed by Red.

2. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) ATOMIC REQUESTS AND DELIVERIES:

a. General: All Blue requests for atomic weapons were recorded, whether delivered or not. Figure C1 shows the requests and deliveries arranged according to TOE, Company, Phase and Terrain. Figure C2 shows the requests and deliveries by Situation.

Figure C1

Atomics - Requested and Delivered



Atomics - Requested and Delivered

Figure C2

Requests and Deliveries by Situation

Note: Those A weapons requested also include inquiries about weapon availability (there are three of this type*) when weapon is unavailable.

Situation

Week	Recon in Force-Open Terr.	Offen Action	Mobile Defense	Recon in Force Wooded-Hilly Terrain	Offen Action	Night Tact Move-Offense	Mobile Defense Delaying Action	
1	1-1						1-0	M1 A) T_3
2				2-1				M2 B) I T_2
3	1-1							M3 C) T_1
4	1-1							M2 A) T_1
5	1-1			1-0			1-0	M3 B) II T_3
6			1*-0	1-1			1-0	M1 C) T_2
7	1-0			1-1				M3 A) T_2
8	1-1		1-0		1*-0		2*-1	M1 B) III T_1
9	1-1							M2 C) T_3
All	7-6		2-0	5-3	1-0		5-1	

Total: 20* requests 10 deliveries 50%
17 requests 10 deliveries 58.8%

b. Schedule of Atomic Deliveries: Figure C3 shows the times requested and delivered, as well as the time delay, delivery means, yield and range, of each weapon employed. The ranges of employment are considered to be near the upper limit of range but the delay in time of delivery would appear to be wholly acceptable within the limits of current abilities to coordinate troops movement with the delivery of atomic weapons

Figure C3

Schedule of Atomics Deliveries
(From Assumed Positions)

Week and Situation	Weapon	Yield	Time Requested and Delivered	Firing Range (Kilometers)	Delay (Minutes)
1-1	HJ	C	1350-1405	26.5	15
2-4	Lac	A	1215-1225.5	14.2	*10.5
3-1	Lac	B	1154.5-1156	15.2	* 1.5
4-1	HJ	C	1120-1130	22.1	10
5-1	HJ	C	1206-1241	26.5	35
6-4	Lac	A	1210-1214	14.2	4
7-4	Lac	B	1310-1322	15.9	12
8-1	HJ	D	1121-1133	21.3	12
8-7	HJ	C	1105-1120	25.1	15
9-1	HJ	C	1205-1222	26.5	17

*On Call
All Bursts calculated as low air bursts.

c. Reliability of Troop Position Information: Figure C4 shows the Blue Forces knowledge of the location of both friendly and enemy units at the time atomic weapons were delivered. This table is signiiicant mainly because it indicates that weapon delivery was in many cases predicated on the disclosure of position of artillery and mortar forward observers in the mistaken idea that the main hostile positions had been located. In the first experimental run, the location of the target was completely in doubt. Thence, forward improvement was noted, however, the reconnaissance and surveillance system was inadequate to insure a reasonable location and identification of suitable atomic targets.

Figure C4

Reliability of Troop Position Information

Week and Situation( )	Total of Blue Units in Area of Drop	Blue Units Positions Uncertain	Total of Red Units in Area of Drop	Red Units Positions Uncertain	Percentage of Uncertainty Blue	Red
1 (1)	0	0	1	1	0	100
2 (4)	0	0	8	2	0	25
3 (1)	0	0	6	0	0	0
4 (1)	1	1	6	0	100	0
5 (1)	0	0	5	1	0	20
6 (4)	0	0	7	0	0	0
7 (4)	1	0	6	0	0	0
8 (1)	0	0	2	0	0	0
8 (7)	1	0	6	0	0	0
9 (1)	0	0	5	0	0	0
Total	3	1	52	4	33	8

NOTE: The red units indicated as "uncertain" were entirely either mortar or artillery forward observers which apparently were mistaken for main elements.

3. (CONFIDENTIAL, MODIFIED HANDLING AUTHORIZED) ATOMIC CASUALTIES:

a. Casualties Resulting from Weapons Employed in the Experiment: Both Red and Blue casualties which would result from the yields and ground zeros selected by Blue Forces for the weapons employed in the experiment are shown in Figure C5. All Blue personnel casualties occurred among artillery or mortar forward observers.

Figure C5

Atomic Casualty Assessments

Week and Situation ( )		Casualties Men	Equipment
1 (1)	Red Blue	0 0	0 0
2 (4)	Red Blue	8 0	1 Jeep
3 (1)	Red Blue	8 0	1 Tank
4 (1)	Red Blue	14 2	2 APCs, 3 JPs, MGJP, 2-3.5 RL 1 Jeep
5 (1)	Red Blue	11 0	
6 (4)	Red Blue	16 0	3 APCs, 3 JPs, MGJP, 3-3.5 RL
7 (4)	Red Blue	10 2	2 JPs 1 Jeep
8 (1)	Red Blue	8 0	1 Jeep
8 (7)	Red Blue	0 1	
9 (1)	Red Blue	11 0	3 Tanks
Total	Red Blue	106 5	5 APCs, 10 JPs, 2 MGJPs, 5-3.5 RL 4 Tanks 2 Jeeps

b. Casualties for Various Yields: Figure C6 summarizes the casualties which would have resulted through the entire range of experimental runs if weapons of each of the four yield strengths, A, B, C and D had been employed. It should be noted that the damage increases with each yield as added target items are included within the circle of effectiveness. Although the totals are far below what might be

hoped for in a weapon of such power, it must be remembered that the entire Red Force, against which casualties could be assessed, consisted of only one rifle company plus two tank platoons.

Figure C6

Comparative Yield Results - All Experimental Runs

Yield		Men	Equipment - Moderately Damaged
A	Red	73	5 APCs, 5 Jeeps, 4-3.5's, 1 MGJP
	Blue	5	1 Jeep
	Total	78	
B	Red	97	5 APCs, 6 Jeeps, 5-3.5's, 1 MGJP, 1 Tank
	Blue	6	1 Jeep
	Total	103	
C	Red	137	5 APCs, 9 Jeeps, 5-3.5's, 1 MGJP, 4 Tanks
	Blue	6	3 Jeeps
	Total	143	
D	Red	177	8 APCs, 18 Jeeps, 5-3.5's, 2 MGJPs, 10 Tanks
	Blue	6	3 Jeeps
	Total	183	

The casualties for each yield would have been those casualties produced by using that yield for all ten drops. The desired Ground Zero and Burst Height were used. This was done to make possible a comparison of the use of different yields.

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ANNEX D, DISTRIBUTION
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FINAL REPORT
PENTANA-TYPE COMPANIES IN MOBILE OPERATIONS(U)
(CDOG, CDEC 58T5)

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13. ABSTRACT

A field experiment was conducted to determine the relative combat effectiveness of three rifle company organizations with varying organic or attached transportation. These organizations engaged as part of a PENTANA-type combat group in tactical operations under simulated combat conditions against a mechanized Aggressor force. The conclusions cover use of tracked vs. wheeled vehicles and helicopter lift, tactics for nuclear weapons employment, and the additional requirements for reconnaissance and security, for PENTANA-type combat units. An improved antipersonnel mine also was evaluated for use against a mechanized force.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
PENTANA-type organization						
Mobile operations						
Rifle Companies						
Tracked and wheeled vehicles						
Helicopterslift						
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