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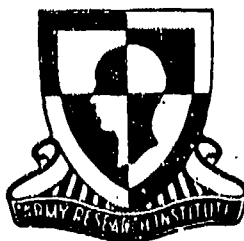
Research Report

DIRECT. FIRE FRATRICIDE
AT THE
NATIONAL TRAINING CENTER

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Presidio of Monterey Field Unit
Training Research Laboratory

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report describes direct fire fratricide data at the National Training Center (NTC) and examines factors likely to impact on fratricides. Direct fire fratricides were measured using digital data from the NTC instrumentation system on 39 battalion task forces and 206 missions in Fiscal Year 1985-86. The data were compared with reported historical fratricide data and the effect on fratricides of mission, range, and training period were also analyzed. Results indicate that over five percent of all Blue Forces (BLA FOR) pairings are on friendly units and about three percent result in actual loss. The NTC data are high in comparison to historical data. Range and mission had an effect on the probability of a fratricide. Factors contributing to fratricide were identified and training recommendations are applied to these findings and targeted to respective echelons. Keywords:					
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FOREWORD

The Army Research Institute has a major research program in support of the National Training Center (NTC) sponsored by the Training and Doctrine Command and the Deputy Chief of Staff for Personnel. One of the principal goals of this program is the development of Lessons Learned methodologies for training, doctrine, organization, personnel, and equipment.

This report describes direct fire fratricide data on rotating battalion task forces at the NTC and examines factors likely to impact on fratricides. The NTC data were compared with historical fratricide data. Some probable contributory factors of fratricide are identified and training recommendations for reducing fratricidal incidence are discussed.

The research effort described in this report was conducted by ARI's Presidio of Monterey Field Unit whose mission is to increase Army unit combat performance capabilities by improving unit performance measurement and evaluation methods, unit training programs and management tools, and the NTC and home station data base.

The Program Task which supports this mission is entitled Unit Performance Measurement and Field Feedback from the Combat Training Centers (CTC), and is organized under the "Maintain Force Readiness" program area. This research effort was sponsored by the Combined Arms Training Activity (CATA) under the Letter of Agreement entitled National Training Center (NTC) and Unit Home-Station Training and Feedback System, dated 16 September 1985. The CATA Lessons Learned Division was briefed on the information in this document in August 1987, and indicated their intention to make use of the results as part of their lessons learned program. This report was utilized in the development of a Center for Army Lessons Learned (CALL) issue regarding direct fire unit performance at the NTC. Furthermore, the results of the study were incorporated into the NTC trendline analyses report entitled Commandants' NTC Data Digest prepared at General Thurman's request.



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DIRECT FIRE FRATRICIDE AT THE NATIONAL TRAINING CENTER

EXECUTIVE SUMMARY

Requirement:

The Army Research Institute is conducting research on various data that have been collected at the National Training Center (NTC) during each training rotation in order (1) to support development of NTC Lessons Learned, and (2) to identify ways of improving training at NTC and Home Station. Fratricide incidence have been identified, from historical data, to have detrimental effects upon combat performance. This report describes the seriousness of fratricides at the NTC and examines some of the conditions in which they occur.

Procedure:

Fratricides by direct fire weapons were measured using digital data from the NTC instrumentation system. The data were compiled from records on 39 battalion task forces and 206 missions in Fiscal Year 1985-86. These data were compared with historical fratricide data. The effect of training period, mission, and range on direct fire fratricide were analyzed. Frequency distributions and percentages were obtained.

Findings:

Over five percent of all Blue Forces (BLUEFOR) pairings (near miss, hit, or kill) were on friendly units and three percent inflicted damage. Fratricides at the NTC are seven times higher than historical data. Fratricides were found to occur more frequently in offense missions and in close ranges (1-500M) as well as ranges beyond 2000 meters.

Utilization of Findings:

As part of the NTC Lessons Learned program, the findings of this report contribute to the Combined Arms Training Activity's major effort of assessing fratricides and fire control as part of unit combat performance. Training emphasis on identified factors contributing to incidence of friendly fire is targeted to respective echelons and suggests possible implications for training management.

DIRECT FIRE FRATRICIDE AT THE NATIONAL TRAINING CENTER

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DIRECT FIRE FRATRICIDE AT THE NATIONAL TRAINING CENTER

INTRODUCTION

Throughout history, armies have always suffered casualties from friendly fire. 'Friendly casualties inflicted by friendly weapons' have been referred to as amicide (Shrader, 1982) or, more commonly, fratricide. Studies of fratricide have reported detrimental effects upon troop morale, combined arms cooperation, and combat power. While, ideally, no fratricides should occur, some are probably inevitable. The National Training Center (NTC), located at Fort Irwin, CA, is the U. S. Army's largest and most realistic training ground. Data on rotating battalion task forces can be used to assess major systemic strengths and weaknesses. The purpose of this report is to determine the extent to which fratricides occur at the NTC, the level of significance, and possible contributory factors.

METHODOLOGY

Fratricides by direct fire weapons were measured using digital data from the NTC instrumentation system. The data were compiled from records on 39 battalion task forces in 206 missions in Fiscal Year (FY) 1985-86. Fifty-eight percent of the battles were fought by armor-heavy task forces and 42 percent by mechanized infantry-heavy task forces. These data were compared with reported fratricides in World Wars I and II, the Korean Conflict, and the Vietnam War.

Direct fire fratricide, as measured here, was friendly fire by vehicular mounted mechanized-infantry and armor weapon systems on friendly tanks, tube-launched optically-tracked wire-guided missile systems (TOWs), and Armored Personnel Carriers (APCs). Only the Multiple Integrated Laser Engagement System (MILES) pairing data were represented. A MILES pairing refers to a firing which results in a 'near miss,' 'hit,' or 'kill' by a known firer-target. Historically, fratricides pertain to losses or casualties (kills). Since the NTC serves as a training support facility and identifies unit strengths and weaknesses, assessment of unit performance requires identification and analysis of potential training problems. Fratricides will be analyzed by measuring incidence of friendly fire inflicting damage (hits and kills). In addition, near-misses are also considered to be intentional efforts to destroy the target fired upon, and will be used in an overall assessment of fratricide.

The NTC fratricide data, for the period examined in this report, do not distinguish among near miss, hit, and kill MILES pairings of friendly targets. Therefore, the proportions of fratricides in these three categories were estimated from comparable proportions in pairings inflicted on the opposing forces (OPFOR). The effect of mission type (offensive or defensive), range (100-meter bands), and training days (1st period versus 2nd period) were also analyzed.

Currently, the NTC instrumentation system does not track all player systems and record all battle events, as a consequence of terrain factors. Therefore, some firer-target pairings are not 'captured' in the digital data record. However, such data losses are probably not different for fratricides than for other kinds of pairings. The size of the database (number of task forces and missions) is sufficiently large to reduce any random error and the data do not contain known systematic bias.

The data were visually inspected and erroneous data eliminated. Four decision rules were established to ensure that data more accurately reflected actual performance:

1. Fratricides must occur within +/- 30 min. of a pairing event to eliminate pairings due to borsighting of weapons systems.
2. Multiple pairings on the same target must have a 10-second elapsed time to eliminate multiple telemetry transmissions from the same pairing incident.
3. Multiple pairings inflicted by same player must have a 10-second elapsed time to simulate gun loading.¹
4. Range data must be within 3000 meters, the maximum range for direct fire weapons.

Frequency distributions and percentages of fratricide data and other MILES pairing events (near miss, hit, and kill) for each variable were obtained.

¹The NTC instrumentation system only requires a 6-second elapsed time period. However, in this study, four additional seconds were allotted for human factors, reflecting a more realistic period of time.

RESULTS

Over five percent of all Blue Forces (BLUEFOR) pairings (near misses, hits, and kills) were on friendly forces; over three percent of pairings inflicted actual damage (hit or kill) (Table 1).

Table 1

Percentages and Number (N) of All
BLUEFOR Pairing Events

PAIRING		PERCENT	N
On OPFOR	KILL	41.2	1337
	HIT	13.2	430
	NM	40.3	1307
On BLUEFOR	FRAT	5.3	172
TOTAL		100.0	3246

For fratricide incidence, the 105MM tank main gun fired most frequently on friendly tanks followed by APC's as the next most frequent target (Appendix A).

Training Period has No Significant Impact on Fratricide

Task Forces normally had about ten days of Force-on-Force exercises--five days each from the two training phases. The interest here is on the effect of training period on the probability of fratricides, rather than the absolute level; therefore, the ratio of fratricides to pairings on the OPFOR was calculated (Table 2). (The number of fratricides were divided by the number of pairings on the OPFOR.) The percent of fratricides to total pairings for both periods is about 5.5 percent. The relationship between fratricides and pairings did not change appreciably from the first training period to the second.

Table 2

Proportion of Fratricides, by Training Period

Trng Period	Percentage
1st half	5.7
2nd half	5.2

Mission and Range have Some Impact on Fratricide.

The effect of mission on the probability of fratricides were analyzed by computing the ratio of fratricides to other pairings on the OPFOR, by mission. A significantly greater proportion of fratricides occurred in offense missions (.12) than in defense missions (.03) (Appendix B).

Ranges were clustered into 500-meter bands to examine for trends. The ratio of fratricides to pairings on the OPFOR (or non-pairing events) was calculated for each range band (Table 3). The distribution of fratricide and non-fratricide events by range band was examined. Because range has an effect on the number of firings (i.e. higher volume of fire in close ranges than in mid ranges), the proportion of fratricide to non-fratricide events were considered, rather than the absolute value. In using a chi square analysis to examine the effect of range on fratricide, the proportion of non-fratricides, per range band, by the total number of fratricides was used to calculate the expected value. Range had a statistically significant effect on the distribution of fratricides (chi square = 13.61, $p < .05$). Further analyses indicate that fratricides were significantly fewer in the mid range bands (2, 3) than in the near range band (1) and in the far range bands (5, 6) (Appendix B). Figure 1 displays the data in a curvilinear form and illustrates that the rate of fratricides at the close range band (1-500M) is greater than the mid ranges (500-2000M) and increases again beyond 2000 meters.

Table 3

The Percentage of Pairings Resulting
From Fratricides, by Range

<u>Range Band</u>	<u>Percentage</u>
1 1-500M	7.0
2 500-1000M	4.0
3 1000-1500M	4.0
4 1500-2000M	6.0
5 2000-2500M	8.0
6 2500-3000M	9.0

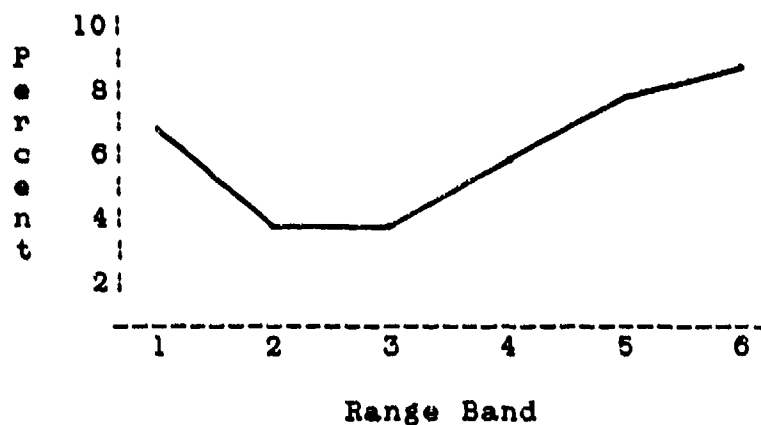


Figure 1. Percentage of fratricides by range band.

DISCUSSION

Over five percent of all BLUEFOR pairings were on friendly units with about three percent inflicting actual damage. Units did not change in fratricide percentage over time. More fratricides occurred in offensive than in defensive missions, perhaps because mistaking the location of friendly units for the enemy may be more likely in the dynamic offensive situation. Fratricides occurred more often at far and near ranges than at middle ranges. Greater distance makes target identification more difficult, leading to genuine misidentification of friendly for enemy vehicles. But one would expect target identification to improve at closer ranges. Identification may actually become more difficult due to greater obscuration (smoke and dust).

A report by Goldsmith (1986) included an analysis of direct fire fratricides at the NTC. With a sample size of 83 battles, involving 15 battalion task forces, he found 18 fratricides. The total number of BLUEFOR vehicles killed were not measured. His estimates of the percent of fratricides (one to three percent) were based on a series of assumptions and estimates of the number of total vehicular kills in his sample (pp. 6, 13). In a footnote, Goldsmith references the results of another analysis conducted by the Observer/Controllers (OCs) using Take Home Package (THP) data. They reported 2.5 percent of all recorded kills, from 40 battles, were fratricide. The present report, with a larger sample size (206 battles involving 39 battalion task forces), found approximately 2.7 percent of pairings are kills from friendly fire. The results of all three analyses are, therefore, consistent.

To assess the seriousness of three percent fratricides, we translated this abstract percentage into an actual number of weapons systems. A battalion task force at the NTC typically contains 50-60 armored vehicles, and about 28 task forces rotate to the NTC per year. Therefore, per year, approximately 48 armored vehicles--the equivalent of almost a full task force--are damaged or destroyed by friendly fire.

The NTC data described here were compared with historical fratricide data. Historical fratricide data have been scattered but, for the first time, LTC Shrader has compiled a sample of 269 extracted examples of friendly fire involving U. S. ground forces from World Wars I and II, the Korean Conflict, and the Vietnam War. He categorized them as types of incidents--artillery, air, antiaircraft, and ground. Shrader calculates approximately two percent of all casualties from the four wars sampled were from friendly fire (p. 105). (In World War II alone, the equivalent of one full infantry division was destroyed by friendly fires.) However, only 0.4 percent fratricides were caused from direct fire. Therefore, fratricides at the NTC are roughly seven times higher than would be expected from historical data. The increase in firepower and greater engagement distance employed in modern warfare may account for some of the observed differences.

Implications of NTC Findings

Shrader asserts that historical data clearly identify one major cause of most fratricide incidents--human error. He concludes:

Only rarely were such incidents due to mechanical failure, but in innumerable cases the incident resulted from some identifiable human failure. The nervousness of green troops, a lack of control or of fire discipline imposed by calm and decisive leaders, the lack of adequate coordination of operations by commanders and staff officers, and disorientation, confusion, and carelessness of pilots, gunners, or crewmen were the predominant causes of most incidents. Fear and the fog of battle have conspired to produce the amicide incidents described in this study. Surprisingly few incidents can be traced to a genuine misidentification of friendly for enemy troops. Almost always a lack of coordination or some more direct human error was responsible for the engagement of friendly forces by their supporting air, ground, or artillery weapons. (p. 107)

For direct fire, he concludes:

By far the most significant causative factor in all ground amicide incidents appears to have been some lack of adequate coordination between units. . . . The misidentification of friendly for enemy troops was also a frequent cause. . . and it was an element in many of the incidents attributable mainly to faulty coordination as well. . . . The employment of green troops and lack of fire discipline and proper control of firing by leaders were also an important factor. (p. 102)

Shrader's conclusions appear equally valid for the fratricide losses at the NTC. In armor/antiarmor direct fire, the gunner must see and deliberately aim at his target. If obscuration (smoke and dust) makes target identification difficult, then other methods must be used to reduce fratricides. Possible implications for training are:

Crew level training must further stress the importance of target identification, particularly at near and far ranges.

Platoon leader training must further emphasize fire control and distribution to insure that crews shoot where they should.

Company level training must increase communication and coordination between adjacent elements.

Command and staff level training must insure the dissemination of information down to the platoon leader and crew levels.

CONCLUSION

Shrader concluded that fratricides in the four wars were not a technology problem, but rather a human problem. This does not appear to have changed. The findings here demonstrate that fratricide at the NTC has a rate of occurrence which results in substantial loss of capability. Training at various echelons might decrease fratricides and the concomitant degradation of our military capability. These findings warrant continued effort toward identifying factors contributing to fratricide and further methods for reducing such incidents.

REFERENCES

Goldsmith, M. (1986). Applying the National Training Center experience--Incidence of ground-to-ground fratricide (Contract No. MDA903-86-C-0059). Santa Monica, CA: Rand.

Shrader, C. R. LTC (1982, Dec). Amicicide: The problem of friendly fire in modern war (Combat Studies Institute Research Survey No. 1). Fort Leavenworth, KS: U. S. Army Command and General Staff College.

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APPENDIX A

DISTRIBUTION OF WEAPONS SYSTEMS ENGAGED IN FRATRICIDE

The table below identifies the number and percentage of weapons systems inflicting fratricides as well as those targeted.

Table A-1

Number and Percent of Weapons Systems Engaged in Fratricide

Weapon	Target		
	105MM	APC w/ TOW	Other
TOW	13 .076	3 .02	-- --
105MM	104 .61	15 .09	27 .16
COAX	-- --	-- --	9 .05

Note: Top = N; Bottom = Percent; reflects percent of total fratricides (5.3%) and not total pairings.

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APPENDIX B

RESULTS OF PROPORTIONS TEST FOR MISSION AND RANGE

A hypothesis test of two proportions from independent groups was used to test the significance between the proportion of pairings resulting from fratricides for the three variables mission, range, and training period. (No significant difference was obtained for training period.) The data are presented for mission and range in the tables below:

Table B-1

Proportion of Pairings Resulting
From Fratricides, by Mission

Mission	Ratio	Z
Offense	.12	
Defense	.03	10.128*

* $p < .001$

Table B-2

Proportion of Pairings Resulting
from Fratricides, by Range

Range Band	Ratio	Z
1 1-500M	.07	
2 500-1000M	.04	2.590*
3 1000-1500M	.04	2.468*
4 1500-2000M	.06	
5 2000-2500M	.08	2.666*
6 2500-3200M	.09	2.660*

* $p < .01$

Note: The significant Z scores pertain to range bands 1 & 2, 1 & 3, 3 & 5, and 3 & 6.

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