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IDA PAPER P-2770

73 EASTING BATTLE REPLICATION-- A JANUS COMBAT SIMULATION

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September 1992

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IDA Log No. HQ 92-42581

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1992	

4. TITLE AND SUBTITLE
73 Easting Battle Replication--A JANUS Combat Simulation

5. FUNDING NUMBERS
Central Research Program

6. AUTHOR(S)
W. M. Christenson, Robert A. Zirkle

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Institute for Defense Analyses
1801 N. Beauregard Street
Alexandria, VA 22311

8. PERFORMING ORGANIZATION REPORT NUMBER
IDA Paper P-2770

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Institute for Defense Analyses
1801 N. Beauregard Street
Alexandria, VA 22311

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 words)***

This paper documents the authors' work in creating a replication of the Battle of 73 Easting in the Janus(A) combat simulation. 73 Easting, an engagement in Operation Desert Storm, was significant because it was an Armored Cavalry engagement against a force superior in numbers, and because it provided the occasion for the first effort to gather combat data suitable for combat simulation and battle re-creation using advanced technology. While the original data were used as a basis for battle re-creation in SimNet, the authors replicated that effort using the same data and the Janus(A) Model. Their findings with respect to available data, model characteristics, and the six simulation excursions they conducted are presented in this volume.

14. SUBJECT TERMS
Desert Storm, 73 Easting, battle re-creation, Janus, SimNet, ADST, distributed simulation, combat model, combat simulation, interactive simulation, thermal sight, Armored Cavalry, Republican Guard, Tawakalna Division

15. NUMBER OF PAGES
47

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

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PREFACE

This paper was prepared under the Institute for Defense Analyses' 1992 Central Research Program.

The purpose of the research reported on herein was fourfold: first, to create a replication of the Battle of 73 Easting in the Janus(A) combat simulation; second, to observe the results of this effort and report the measures necessary to calibrate the scenario with reality; third, to gain insight into the model's ability to represent a variety of the more extraordinary battlefield dynamics; fourth, to provide a scenario as a common background for future users exploring the fields of doctrine, tactics, system parameters, and force characteristics, as well as the question of Janus-SimNet interface.

The authors wish to thank Douglas Schultz, Dennis DeRiggi and Edward Kerlin for their careful review of this work, and their helpful comments. We also wish to acknowledge the professionalism, enduring willingness and good humor brought to this task by our word and graphics processor, Bernie Aylor.

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I. INTRODUCTION

Late on the afternoon of 26 February 1991, during Operation Desert Storm, an encounter took place between elements of the U.S. 2nd Armored Cavalry Regiment and one Brigade of the Iraqi Republican Guard Tawakalna Division. The ensuing battle, now widely known as the Battle of 73 Easting, was remarkable in a number of ways other than the simple fact that it was the first major encounter in General H. Norman Schwarzkopf's "Left Hook" single envelopment attack. It was the first significant combat employment of U.S. Armored Cavalry units under concepts developed for mobile armored forces in the last half of this Century. It took place on ground that, while it cannot quite be termed "featureless," certainly was environmentally hostile desert terrain, unlike the hilly, wooded uplands of Central Europe where U.S. Armored Cavalry units had spent their time in the past. Weather conditions, too, played a large role. High winds filled the air with clouds of sand and moisture, reducing visibility and limiting the use of helicopters and tactical fixed-wing air support. And it involved an attack by U.S. forces against a numerically superior opponent. Under these conditions, U.S. technological advantages became increasingly important.

To concentrate on the direct effect of technology in battle under these conditions, however, would be to miss several vital points. For example, the soldiers and their leaders have been quick to point out that they are part of the best trained, best prepared army their country has ever put into the field. While such superlatives are of little utility in evaluating the results of investigations such as the one on which we report here, we need to note their confidence in their ability to use technology under rapidly changing battlefield dynamics which these comments reflect. This confidence stemmed from their experience in dealing with simulated combat situations presented in numerous training exercises at places such as the National Training Center and, for leaders, in working through scenarios in a variety of simulations.

One must say that Advanced Distributed Simulation Technology (ADST) generally has provided a means for taking a large step forward in this regard, particularly if a system such as SimNet is used in conjunction with other simulations, the utility of which is currently established.

The progress which these developments represent should permit members of the armed services of this country to experience many of the vagaries of combat in a near virtual mode without the risk and expense (human as well as fiscal) normally associated with battle and preparation for it. We should be able to prepare future generations of soldiers, airmen, sailors and marines to an extent as yet unforeseen.

In the case of 73 Easting, however, ADST has provided means, method and stimulus for another activity which would appear to offer potential for pay-off far in excess of the investment made in it: that is, the collection of data from the field of battle immediately following the event for the purpose of creating an after-action battle replication. The results of this endeavor, culminating in the SimNet 73 Easting Battle Re-creation, are becoming widely appreciated. It was the existence of these data, as well as the potential for tapping the experience of those who used it as a basis for the SimNet re-creation, that led us to ask why we should not replicate this event using another medium, such as the Janus Combat Simulation, to seek insight into battle replication; into the utility of the Janus simulation; into the Battle of 73 Easting itself; and finally into the potential for relating Janus Conflict Simulation to ADST.[1]

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[1] At the same time, we would seem to commit a grave error were we to allow ourselves to believe that a single human-devised concept, revolutionary as it may seem, can provide all the experiential phenomena needed to appreciate, visualize and prepare for future crises. On one level, for example, we should not expect to use this system to teach the loader in a tank crew what it is like to reload the main gun while the vehicle moves rapidly across rough terrain. Likewise, one is aware that a commander or staff officer — or an analyst — prepares an operational concept not by plotting moves of individual tanks and aircraft, but by conceptualizing the operation at some level of abstraction. There are locii and times when great detail is desirable and necessary, but the reverse is also true. At such times, simulation tools that assist the human mind in the conceptualization process provide not only a desirable, but an essential, element to the planner, operator and analyst. The same statement should be made in favor of tools that provide means for rapid, after-action retrieval of data which may be used to quantify and analyze results; or for those tools that facilitate economies of time and human effort in replication of simulation tasks. Janus and the associated series of conflict simulations provide such an element.

II. APPROACH

A. PURPOSE

Our purpose in performing this work was founded on four ideas. First, we believed that the Battle of 73 Easting, the data collection effort that followed, and the subsequent re-creation of the battle in SimNet provided a unique opportunity to calibrate Janus with reality, and with SimNet. Second, while we did not intend that the results of this activity would be used to "verify" any version of the Janus model, we did believe that we would be able to gain some insight into the Janus model's ability to deal with a variety of the more extraordinary battlefield dynamics and permit observation of areas where model improvement recommendations could be formulated. Third, given that some future activity would take place in the area of creating a Janus-SimNet interface, we believed that the creation of a Janus 73 Easting scenario, in conjunction with the existing 73 Easting re-creation in SimNet, would provide a common background for those activities. And finally, we believed that such a scenario, preserved and made available to other potential users in the future, would permit excursions into the "what-if" realm where changes in doctrine, tactics, system parameters and armed force characteristics could be postulated and evaluated.

Additionally, we became aware of the interest of other organizations in performance of like tasks, and we resolved to investigate the opportunity for cooperative efforts. Therefore, we contacted The United States Military Academy at West Point, New York (USMA); The U.S. Army TRADOC Analysis Command activity at White Sands, New Mexico (TRAC-WSMR); and the Combat Simulation Laboratory of Lawrence Livermore National Laboratories (LLNL), Livermore, California to determine the level of interest in some type of cooperative or combined effort.

Authorities at LLNL, while expressing interest, had to decline participation on a basis of lack of available assets, both personnel and funding. TRAC-WSMR expressed limited interest, in that they had put together a 73 Easting scenario based entirely on open sources and they wanted access to the SimNet data. Major George Stone of the Department of Systems Engineering at USMA agreed to a cooperative concept, wherein they would provide two personnel for one week at the IDA facility to assist in the development of the

Janus 73 Easting scenario from the SimNet database, and thereafter to participate in a program of results comparison. They also offered the digitized terrain database for Janus(A), which they had already obtained from TRAC-WSMR.

Our professed purpose, then, was:

- To create, as accurately as possible, a portrayal of the Battle of 73 Easting in Janus(A) (Army).
- To use for this activity the same data from which the battle was re-created in SimNet. The digitized Janus(A) version of the same terrain common to both the historical battle and the SimNet re-creation also would be used.
- To discover and define factors important to battle outcome, simulated and historical, including human factors.
- To assess our Janus performance vis-a-vis other 73 Easting efforts.

It is important to note that IDA has available both major versions of the Janus model, Janus(A) and Janus(L), as well as the Janus-like model UCCATS (Urban Combat Computer Assisted Training System). Given that the funding level for this task would permit creation of a 73 Easting scenario in only one model, Janus(A) was chosen because it was the model available to other organizations engaged in 73 Easting simulations. We also believe that we will be able to move the scenario from Janus(A) data files to Janus(L) scenario files with relative ease, as opposed to the opposite process. UCCATS was not a contender because it was not available when we began this project.

B. METHODOLOGY

We approached this task with a clear idea of what was to be our methodology. It was to consist of the following steps:

- Create a 73 Easting scenario in Janus(A), using the SimNet 73 Easting re-creation data and the same terrain, digitized and formatted for use in Janus.
- Perform initial simulation runs, noting anomalous model dynamics or behavior.
- Introduce and record changes to data and the values set for model performance parameters, and thereby,
- Bring base case results into line with historical battle outcome.
- Formulate and conduct excursions, based on observation of the initial simulation efforts.
- Perform comparative analyses of simulation results as a basis for conclusions.

The battlefield data were obtained through the IDA Simulation Center from Illusion Engineering, Inc., a California firm responsible for compiling and "scrubbing" the data after collection from the battlefield, and before application in SimNet. Illusion Engineering also was responsible for entering changes into the database based on the the SimNet scenario building process, wherein battle participants were shown the re-creation and were interviewed in conjunction with the viewing. Inconsistencies discovered during this process were resolved to as great a degree as possible, and the database appropriately revised. These data, which held position, movement and orientation information by time period, were provided in printed paper form, and needed to be entered manually, there being no automated method of entering such data into a Janus(A) scenario. For those who are not familiar with Janus scenario construction, a few words about this process will be found in the following chapter.

III. SIMULATION EFFORTS

A. JANUS BATTLE REPRESENTATION

Janus(A) is a two-sided, brigade-level, interactive combat simulation, with weapon system representation at the single item level, and was therefore a good candidate for the type of task we visualized. We could have adopted Janus(L) for this purpose with equal facility, and we hope to move the scenarios we have produced for this task to that model when funding and time permit in the future. A similar future effort involving UCCATS would then permit a four-way comparison between results from these three models with those of a SimNet Semi-Automated Forces (SAFOR) excursion.

While there are on-going efforts to convert various versions of Janus so that they are capable of being run under different forms of UNIX operating systems on a variety of hardware, the Janus version used for this task was of the original type. Specifically, we had access to Janus(A) version 2.0, instead of the later 2.1 version of the model used in other 73 Easting replication efforts (e.g., TRAC-WSMR and USMA). These models are designed to run on any DEC VAX computer, with high resolution graphics being displayed on Tektronix 4225 Workstations. While this arrangement does not fit the current definition for distributed simulation, it does qualify as being "partially distributed" in that the graphics computation and operator interactivity occur at the Tektronix workstation, which has its own CPU. The combat and associated calculations are performed on the VAX, under the VMS operating system, a multi-tasking and multi-user system in its own right.

Creating a Janus scenario involves assembling a number of computer files containing the terrain, symbol, combat system, lethality, and force definition data which define the combat environment and forces that will oppose each other. The combat elements are then displayed on the Tektronix screen, with between one and fifteen items being assigned to a display icon, which are given "orders" by the operator in the form of a system of movement tracks and time nodes. These instructions are applied through the use of a digitizing tablet. Other scenario-specific data are applied at this stage as well, e.g., vehicle or weapon orientation, firing fans, and unit array orientation if more than a single item is being represented by a screen icon. In this task, icons represent single weapon systems, that is, a single tank, artillery piece, etc. With each icon being able to hold up to

fifteen similar items, each icon could represent up to about a company of military equipment.

Initially, we used the data obtained from Illusion Engineering to create the files described above, and then, in conjunction with the two USMA personnel who came to IDA, we created the movement tracks for each of the icons representing each piece of 2nd ACR equipment which participated in the battle. Likewise for each piece of equipment belonging to the Iraqi Tawakalna Division which had been observed on the battlefield, the position and orientation of the weapons were plotted. Additionally, artillery and mortar fires which had been noted were added to the scenario.

In spite of the great effort that had been dedicated toward eliminating obvious contradiction, missing items, and erroneous data, some anomalies still existed. For example, there is still some question concerning how many of the destroyed tanks whose positions were recorded actually had been destroyed by air prior to penetration of the U.S. ground forces into the area. While it has been agreed that there were at least three air kills, exactly which of the destroyed T-72s fall into this category remains somewhat of a mystery.

Additionally, it has become generally known that in the 73 Easting Battle, Iraqi armored vehicle fighting positions were not "dug-in" as we normally think of that concept. They were, instead, protected by a berm which had been scraped up in front and to the sides of the vehicles, and consisted of loosely packed earth and sand. Such positions provided more concealment than protection. When this was discovered by commanders of U.S. tanks and vehicles equipped with TOW, they began to fire at the berms as soon as they were detected. This resulted in a number of kills where vehicles were not detected until they exploded or burned behind the berm. At the same time, a significant number of berms concealed no vehicles. How many of these empty positions were engaged with how many rounds, and their exact locations, is something that is only a matter of estimation.

Two final concerns remain. These revolve around the question of the role played by dismounted infantry employing shoulder-fired anti-tank weapons, and how many Iraqi vehicles were destroyed during the minor efforts amounting to counterattack toward the end of the day. No accurate information was available to quantify these efforts, with the result that the analysts were required to make assumptions with respect to these numbers.

B. SCENARIO: BASE CASE AND EXCURSIONS

The major effort of this project was to create a base case scenario on Janus matched as closely as possible to the historical battle. We begin here by describing the base case scenario and the way in which it was constructed. Despite the efforts of Illusion Engineering, IDA, and others, a number of uncertainties regarding the battle itself remain. We will describe how these uncertainties were dealt with in the scenario below, as well as point out discrepancies between our scenario and other efforts to simulate 73 Easting. A description of the general operational context within which the battle was fought is presented as Appendix A.

1. Base Case Scenario (Figure III-1)

The Iraqi Republican Guard brigade was generally arrayed along a north-south line, between 69 and 75 Easting, in approximately three defensive positions. One position was in the north portion of the battlefield, between the 10 and 07 Northing lines. A second, smaller position was established slightly to the south, between the 04 and 05 Northing lines.[2] The third, and largest, defensive line stretched for nearly four kilometers, centered just to the east of a small village or cantonment (located along the line dividing Eagle and Iron's sectors at the 01 Northing line). Dismounted forces were located in and around this cantonment. A few vehicles and dismounted units were arrayed in front of these defensive positions, intended, perhaps, to act as scouts.

Three troops of the 2nd ACR participated in the Battle of 73 Easting: Ghost, Eagle, and Iron troops, arrayed from north to south. These troops, although near to one another, fought separate, uncoordinated battles against the Iraqi brigade. Ghost troop raced on-line across the desert from west to east. The troop halted, having detected the Iraqi defensive position in the north, about one kilometer away from this position. With the remainder of the troop in support, one platoon of tanks passed through the troop's lines to engage this Iraqi force.

Eagle, also moving rapidly to the east, swung around the northern edge of the cantonment along its right flank, receiving fire from scattered dismounted forces in the area. The troop then plunged south-southeast about one kilometer, where it ran into the

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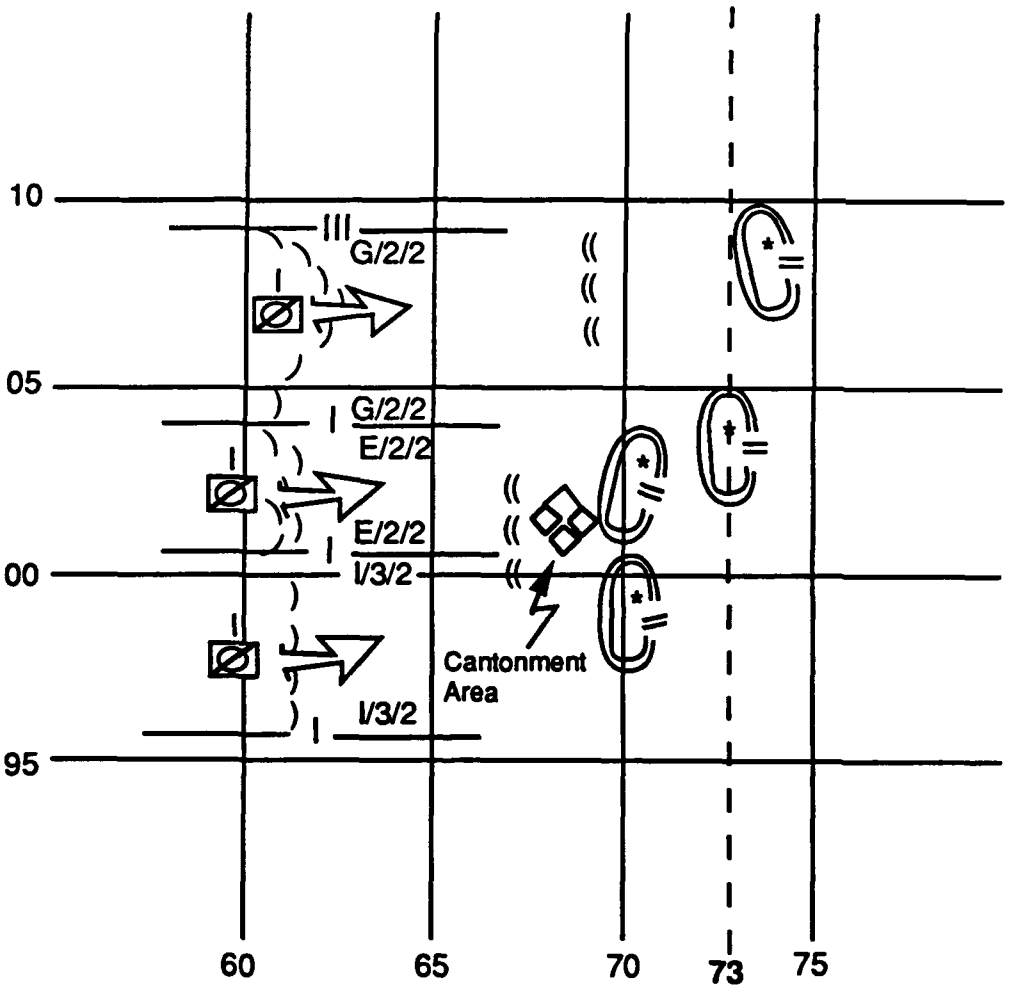
[2] This position contains the majority of the disputed air kills. TRAC-WSMR, in its 73 Easting study, claimed that all vehicles located within this area had been killed by air-delivered weapons prior to the start of the ground battle. We have seen no evidence to back up this claim, so all these vehicles were considered "live" at the start of the ground battle in our scenario.

Iraqi defensive line located there. The troop quickly swept through this position on a northeasterly heading, and soon made contact with the Iraqi defenses in the center.



* Approximate Battalion positions, 18th Brigade, Tawakalna Division, 1530 hrs, 26 Feb 91.

Figure III-1. 73 Easting Battle Area Sketch Map

Iron troop, again moving from west to east, attacked more slowly, remaining several kilometers behind Eagle throughout the battle. After taking fire from the area around the southern portion of the cantonment, the troop drove directly into the southern Iraqi position recently attacked by Eagle.

The three U.S. ACR troops contained a total of 28 M-1A1 tanks and 37 Bradley fighting vehicles. In addition, each troop possessed a combat train, one FIST-V fire support vehicle, and two 4.2" mounted mortars.

Ghost Troop	Eagle Troop	Iron Troop
9 M-1A1	10 M-1A1[3]	9 M-1A1[4]
12 Bradleys	12 Bradleys	13 Bradleys[5]
1 FIST-V	1 FIST-V	1 FIST-V
1 COLT	2 x 4.2" Mortars	2 x 4.2" Mortars
2 x 4.2" Mortars	Combat Train	Combat Train
Combat Train		

To match the reported U.S. artillery missions during the battle, two batteries of artillery (a total of 16 pieces) and a single MLRS launcher were added to the Janus scenario on the U.S side.

Although the three troops in the actual battle were equipped with the newest M-2 Bradley vehicle, the M-2A2, and only a handful of M-3s, we were forced to make all the Bradleys in our scenario the M-3 version. This substitution was necessary as we had no access to data on the M-2A2's combat characteristics for insertion into the Janus combat data files. While the M-2A2 provides greater protection against incoming rounds than the M-3, we felt that the substitution would make little difference given the relatively crude nature of some of the combat data provided for this project on Janus(A)[6] Furthermore, the absence of reactive armor on Iraqi tanks permitted us to substitute the TOW-2 anti-tank missile (for which data were available on Janus) for the M-2A2's new tandem-warhead

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[3] Includes a tank occupied by the 2nd ACR's Sgt Major, although this tank did not participate in the engagement.

[4] Includes a tank occupied by the 2nd Squadron S-3.

[5] Includes an M-3 occupied by the troop commander, Cpt Miller, whose own command tank threw a track prior to the battle.

[6] More accurate combat data for Janus(A), in particular, probabilities of hit and kill for various weapons against a variety of targets, have been derived under the direction of TRAC-WSMR. Unfortunately, we were unable to obtain these data in time for this study.

TOW-2A (for which no data were available). As in the actual battle, M-1s and M-3s were provided with thermal sensors; all other U.S. vehicles were equipped with optical sensors.

Based upon material presented by Illusion Engineering, Iraqi equipment holdings were as follows:

55 T-72 Tanks	3 T-55 Tanks
33 BMP-1 APCs	1 BTR-70 APC
1 M-113 APC	9 MTLB Command Vehicles
2 SA-13 Air Defense Missiles	7 ZSU-23-4 Air Defense Guns
12 152mm Towed Artillery	7 81mm dismounted mortars
1 ACRV Command Vehicle	1 Ambulance
1 BAT-M Earth Mover	2 POL Trucks
4 Utility Trucks	4 Cargo Trucks

Note that the Iraqi brigade possessed nearly 50 percent more armored fighting vehicles than did the U.S. cavalry regiment (91 versus 65). As in the actual battle, the BMP-1s were armed only with 73mm guns. Sanger anti-tank missiles, with which BMP-1s are typically armed, were not observed on the Iraqi BMPs during 73 Easting, although the rails for the weapons frequently were present.[7] For the base case, all Iraqi vehicles were equipped with optical sensors, again in line with the actual battle situation.

Although there have been reports that some Iraqi vehicles were unmanned or killed by air-delivered weapons prior to the start of the battle, the number and location of these vehicles is unknown. For the Janus scenario we assumed that all Iraqi vehicles were manned and in fighting condition prior to the start of the ground engagements. Also, owing to the lack of reliable data, no Iraqi counterattacks were staged during the scenario.

There were a number of dismounted Iraqi soldiers present during the actual battle, although their exact number, type, position, and significance are matters of dispute. Nonetheless, through a variety of sources, we were able to put together a credible dismounted force for our scenario. First, based upon interviews with U.S. participants, Illusion Engineering derived preliminary positional data for some Iraqi dismounted infantry. Unfortunately, no details of the armament carried by these soldiers were included in these data. Their numbers suggested, however, that they might have constituted one motorized rifle company plus one motorized rifle platoon. We assumed, therefore, infantry armament totals appropriate for such a force, i.e.:

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[7] Interview with S-3 2nd ACR and S-3 3rd sqn/2nd ACR (during Desert Storm), 9 April 1992.

13 x RPG-7 rocket-propelled grenades
24 x 7.62mm light machine guns
4 x 12.7mm heavy machine guns
100 x riflemen.

The Illusion Engineering data also indicated that dismounted troops were organized into teams of three soldiers each. This led us to assume further that, with one group of exceptions, each RPG and machine gun was accompanied by two riflemen apiece, with excess riflemen organized into homogeneous three-man rifle teams. The exceptions to this three-man rule were the six RPGs reported by Illusion Engineering to be stationed within the southern half of the cantonment. Finally, because accounts indicated that RPG fire was also received by U.S. vehicles from the northern portion of the cantonment, we added six additional RPGs (not included in the Illusion Engineering data) to the Iraqi forces, for a total of 19 RPG-7s and 147 dismounted soldiers.[8] Again, all Iraqi dismounted forces were equipped solely with optical sensors.

There also were a number of unoccupied berms scattered across the battlefield. Although their exact number remains uncertain, we were able to position some of these berms, based upon SimNet and Illusion Engineer data. A total of 21 such empty berms, or false targets, were included on the Iraqi side in our scenario.

Illusion Engineering furnished us with data sets containing the movement tracks for 2nd ACR vehicles at particular times over a six-hour period, as well as the position of individual Iraqi vehicles and dismounted soldiers, all with an accuracy of one meter. Movement and position nodes were subsequently put into our Janus scenario with an accuracy of about ±5 meters.[9] U.S. movement tracks were arranged in such a manner that, with a handful of exceptions, each vehicle was at its correct location at the recorded time.

The Illusion Engineering data also included the hull angle (and in few cases turret angles) of many of the Iraqi vehicles, down to a one degree level of accuracy. These hull (or turret) angles were used in our scenario to orient the sensor fans of the Iraqi vehicles,

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[8] On Eagle receiving fire from the cantonment, see Col. Michael D. Krause, "The Battle of 73 Easting, 26 February 1991: A Historical Introduction to a Simulation," draft (US Army Center of Military History and DARPA, 2 May 1991). The TRAC-WSMR 73 Easting replication doubled the size of the dismounted force, to 310 soldiers, based upon the number of personnel carriers present on the battlefield. Janus Gaming Division, TRAC-WSMR, "The Battle of 73 Easting" briefing slides, 30 March 1992.

[9] In undertaking this task, one requiring accuracies at such small scales, an anomaly was noted in Janus(A) 2.0: In theory, vehicles can be placed within five meters of their true position, 10 meters being the smallest interval possible in Janus(A). Unfortunately, the 100-meter grid squares can vary by +10 meters on a side; i.e., some squares are 100 meters by 100 meters, while others are 110 meters by 100 meters or

with an accuracy of ±5 degrees. Where these data were unavailable, we assumed that the vehicle was oriented due west, the general direction of the 2nd ACR attack. Interestingly, although the hull angles ranged across the compass, the majority of these angles were 20 to 60 degrees either side of due west, as shown in Figure III-2.[10]

Most of the battle was fought in the midst of a severe rain and sand storm. As a result, visibility in the optical range was generally limited from 600 to 400 meters, and occasionally dropped as low as 100 meters.[11] Thermal visibility, on the other hand, was as great as 1500 meters or more. While weather conditions analogous to the rain/sand storm conditions of 73 Easting have been developed by TRAC-WSMR for Janus(A), we discovered that the relevant weather parameters would not run on the 2.0 version of the model.

As a result, we had to derive our own means for simulating these conditions. To do so, we chose a Janus-provided weather option ("3-kilometers visibility, clear day" option) which gave the appropriate maximum values for thermal sensor ranges. Meanwhile, we limited the maximum range of all optical sensors, a parameter accessible in the Janus combat data file, to 400 meters. We recognize that, although the thermal and the optical sensor ranges appear to approximate conditions described on the actual battlefield, this approximation may not completely replicate the full sensor acquisition versus range profiles, especially given the artificial 400-meter optical cut-off. We hope that this can be improved upon through the use of the TRAC-WSMR weather parameters in Janus(A) version 2.1. Nonetheless, as will be seen shortly, our results agree fairly well with the historical battle results.

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100 meters by 110 meters. This variation limits the accuracy with which units can be placed on the terrain map.

[10] Several hypotheses have been advanced for the unusual orientation of the Iraqi vehicles. Some have suggested that the Iraqi forces were simply caught by surprise, unprepared for a U.S. attack, and consequently out of position. To back this interpretation, they cite that interrogations of captured Iraqi officers suggest that the Iraqis felt an attack across the open desert in the very poor weather conditions present was highly unlikely. Alternatively, these orientations may have been caused by the nature of the berms: their height often making it impossible for vehicles to fire directly over them. It also has been suggested that this orientation may have been intentional, with the Iraqis hoping to limit engagements to flank attacks against U.S. vehicles at short range.

[11] Interview with S-3 2nd ACR and S-3 3rd sqn/2nd ACR, 9 April 1992.

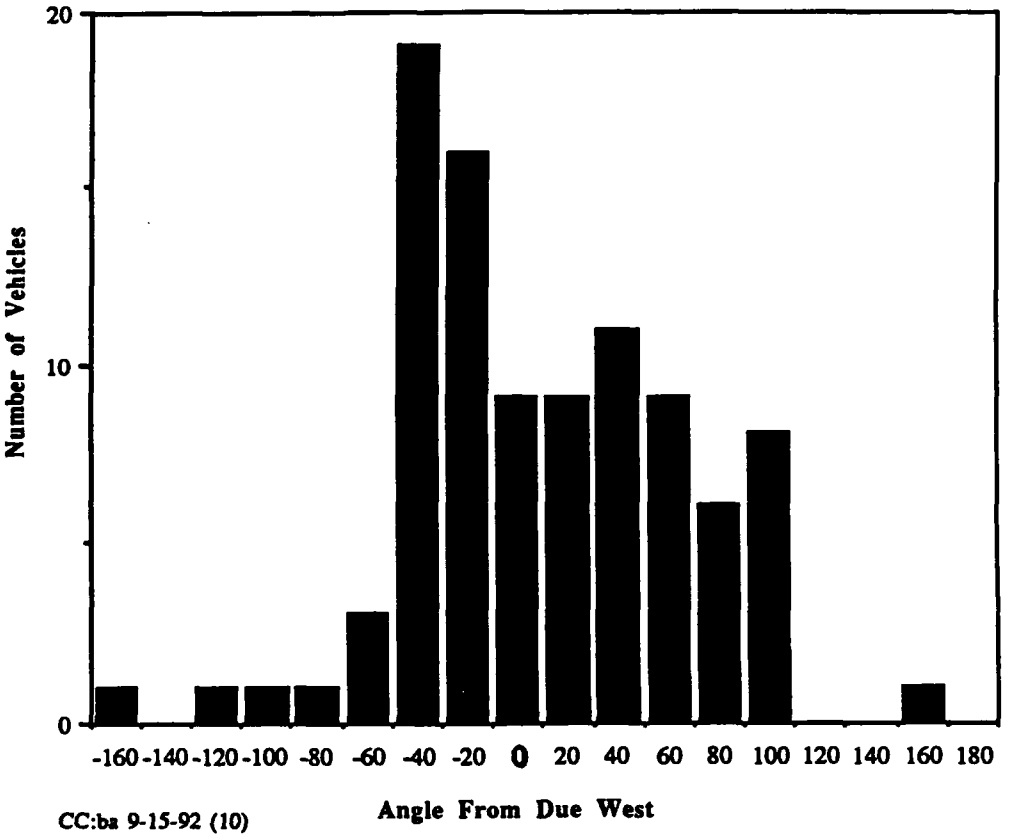

Figure III-2. Iraqi Hull/Turret Angles

Finally, we must add one other note of caution regarding the base case and subsequent excursions: Due to the way in which Janus(A) deals with stationary vehicles, both stationary U.S. vehicles and Iraqi vehicles behind berms were provided more protection than likely was the case in the actual battle. The Iraqi vehicles were in a partial defilade mode, meaning that only their turrets (approximately 30 percent of the vehicle) were exposed to U.S. sensors and direct fire weapons. In reality, the Iraqi vehicles were likely much more vulnerable than this behind their berms. Likewise, if U.S. vehicles were stationary for more than 30 seconds in the simulation, they too went into partial defilade. It is unlikely that U.S. vehicles would have been fortunate enough to find some cover before stopping. Unfortunately, to re-create this situation with greater fidelity requires that Janus be "tricked" into leaving vehicles exposed. While an extensive examination was not undertaken, tests of the 73 Easting scenario with vehicles exposed on both sides suggests little difference in the battle results.[12]

2. Excursions

Having constructed the base case scenario and confirmed some correlation between the results of the historical battle and the Janus(A) simulation, we developed a set of excursions intended both to illustrate some of the capability of Janus(A) and to begin testing a set of preliminary hypotheses regarding battle dynamics. These tests are far from exhaustive. Much work remains to be done; but the tests do suggest some interesting tentative observations.

The first excursion was developed to examine the effects of Iraqi defensive tactics on the battle outcome; in particular, the effect of the Iraqi vehicle orientations. Perhaps, a better, or more organized, individual vehicle positioning (i.e., all vehicles oriented in the direction of the U.S. attack) would have resulted in an outcome more advantageous to the Iraqis. To test this, all Iraqi vehicles were reoriented to face due west, the general direction of the 2nd ACR attack. All other parameters, including sensor types and weather were held constant.

A second excursion was formed to examine the effects of the weather on the simulated battle outcome. Were the observed results dependent upon limited visibility

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[12] In undertaking this test, we discovered another anomaly of Janus(A): If a vehicle only moves 10 meters, the smallest movement possible in Janus, it never leaves the partial defilade state. In effect, the vehicle moves the 10 meters under cover. A vehicle must move 20 or more meters before it becomes fully exposed.

conditions due to weather? To test this, we chose the Janus-supplied "5-kilometer, clear day" weather option. We then set sensor parameters so that the range of both thermal and optical sensors were limited only by the weather conditions (i.e., the maximum range for both types sensors was set to five kilometers). Both the historical and "westerly" Iraqi vehicle orientations were examined. Again, all other parameters, including U.S. and Iraqi battle tactics, were held constant.

A third set of excursions examined the effects of U.S. superiority in sensor technology, embodied in the thermal sensors, on the battle's outcome. Specifically, did U.S. technological superiority in this area heavily influence the battle results? Here, we returned to the original, poor weather conditions, and reset the optical sensors to the 400-meter maximum detection range limit. But now, technological parity was created by equipping both U.S. and Iraqi vehicles with thermal sensors, limited only by the "3-kilometer, clear day" weather conditions. Again, both the historical and "westerly" Iraqi vehicle orientations were examined, and all other parameters were held constant.

IV. RESULTS

A. DATA ANALYSIS

1. Base Case

Figure IV-1 compares the total number of U.S. and Iraqi armored vehicles destroyed, as well as the number of tanks and infantry fighting vehicles lost by both sides, during the actual battle, with their corresponding values obtained in the base case Janus runs.[13] Figure IV-2 compares U.S. tank, TOW, and 25mm rounds expended between the actual battle and the Janus base case. As can be seen, the base case values for vehicle losses track closely with the historical combat results.

We found this to be especially surprising, because we had anticipated that adjustments would need to be made in the Janus scenario to bring it in line with the historical results. In particular, we expected to see greater U.S. losses in the Janus runs than those observed, given the Iraqi advantage in AFVs. To compensate, we anticipated, for instance, that we might have needed to represent some of the Iraqi armored vehicles as being unmanned in the base case scenario (as they were in the actual battle). That such adjustments were not required can perhaps be understood by examining the two sides' average armored vehicle sensor ranges (Figure IV-4). The great difference between the ranges at which detection occurred — that is, the difference between the average thermal and optical sensor detection ranges — allowed the U.S. forces to acquire and kill targets generally before the Iraqi vehicles could see their opponents. A similar phenomenon reportedly took place during the actual battle.

While combat losses obtained in running the base case are similar to those of the actual battle, there is a discrepancy between the simulated and actual battle results in terms of ammunition expended. While the predicted number of TOW missiles fired in the simulation is close to the number actually expended during the battle (107 vs 80), nearly four times as many tank rounds were fired in the simulation (477 vs 125). While the

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[13] These values are averages over three runs, as are the other Janus values presented in this section. Unfortunately, available funding levels prevented us from undertaking additional runs at this time.

greater number of tank rounds expended requires explanation (other Janus efforts predicted a closer fit),[14] we do not view this variance along one dimension of combat results as cause for concern, for several reasons.

Our results are generated, in the first place, from the nature of the combat database used in our Janus(A) scenario, in particular from the fact that our simulated M-1 tanks were armed only with HEAT and AP rounds, not with the more deadly depleted uranium round found in Desert Storm (and TRAC-WSMR Janus) M-1A1 tanks. Evidence also suggests that the tank rounds in our database had a much lower probability of hit and kill against all Iraqi vehicle types than would have been the case in other simulation efforts or, in fact, real life,[15] leading to larger numbers of tank rounds being fired to achieve similar vehicle loss results. Requisite information on the characteristics of the depleted uranium round were unavailable to us at the time the study was undertaken. Additionally, we included false targets for the M-1 (in the form of empty berms) and allowed the tank to fire at vehicles other than Iraqi tanks and BMPs. Other 73 Easting re-creations excluded false targets. Moreover, it is unclear what target limitations were placed on M-1 tanks in other simulations. Both of these latter factors also would result in more tank rounds being expended. Over 25 percent of the M-1 tank rounds in our base case runs were fired at targets other than tanks and BMPs.

[14] TRAC-WSMR's simulation efforts produced 102 tank rounds expended.

[15] Evidence includes a comparison of similar probability of hit and kill curves in Janus(L).

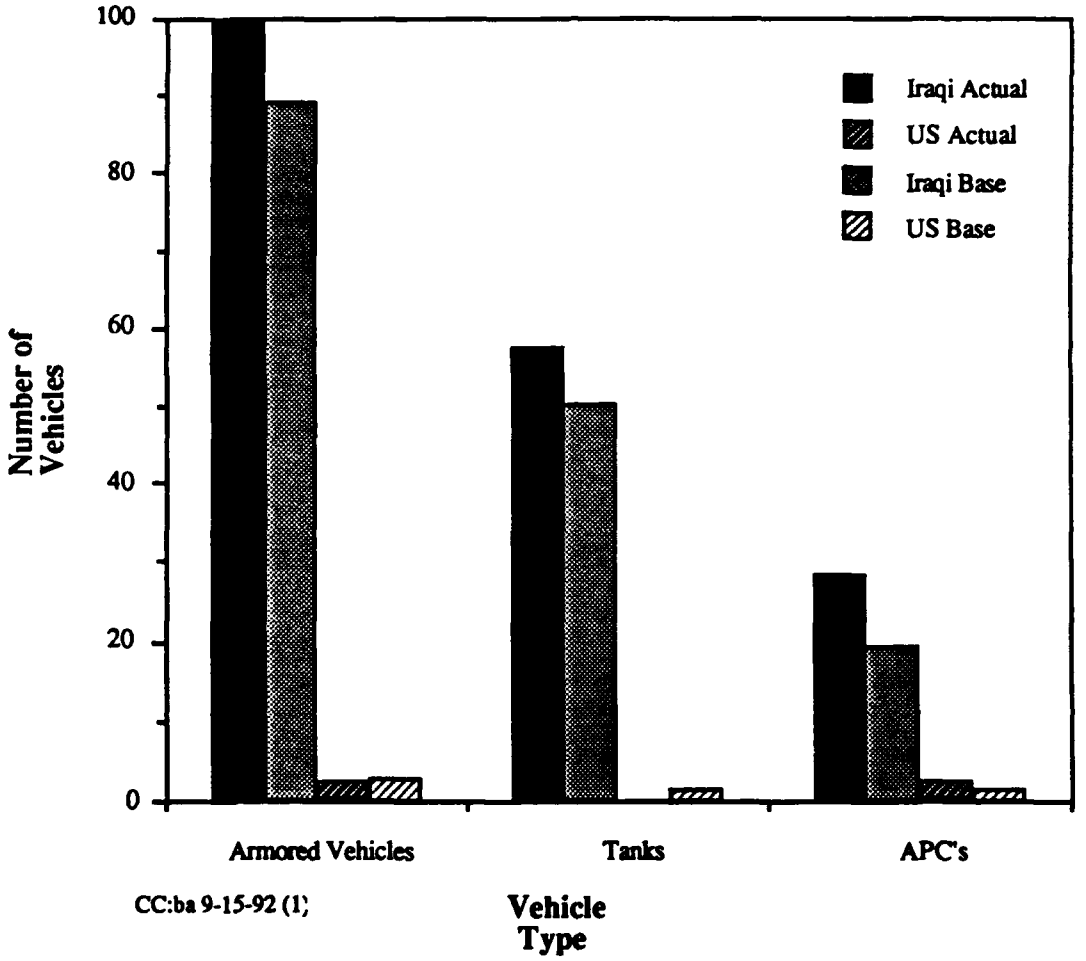

Figure IV-1. Armored Vehicle Losses, Actual Battle and Base Case with Historical Orientation

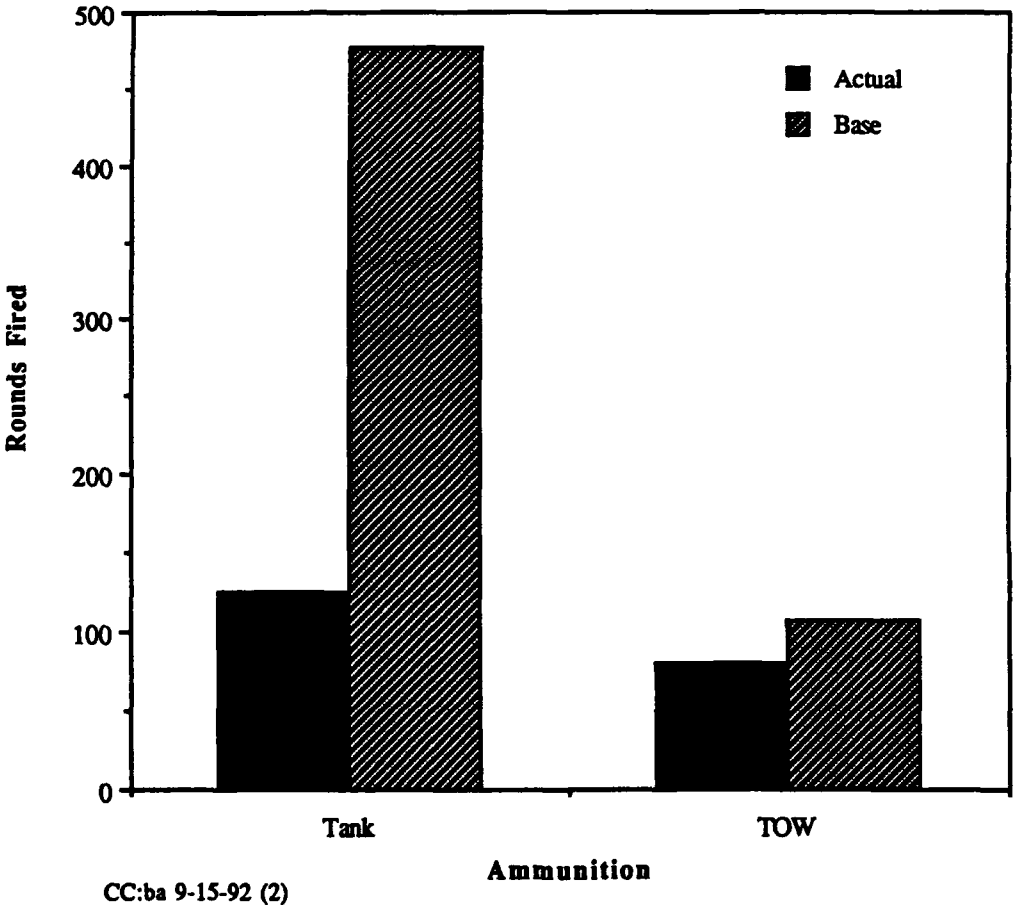

Figure IV-2. Ammunition Expenditure, Actual Battle and Base Case with Historical Orientation

2. Excursion 1

Figure IV-3 depicts the results of the base case with historical vehicle orientation and the case where Iraqi vehicles were reoriented due west in the direction of the U.S. attack. This single improvement in Iraqi tactics alone had seemingly little effect on the simulation outcome — the armor exchange ratio remains very strongly in the U.S. favor. Again, comparing detection ranges in the two cases (Figure IV-4) indicates continued U.S. advantage. The sensor ranges appear to dominate changes in this aspect of Iraqi battle tactics.

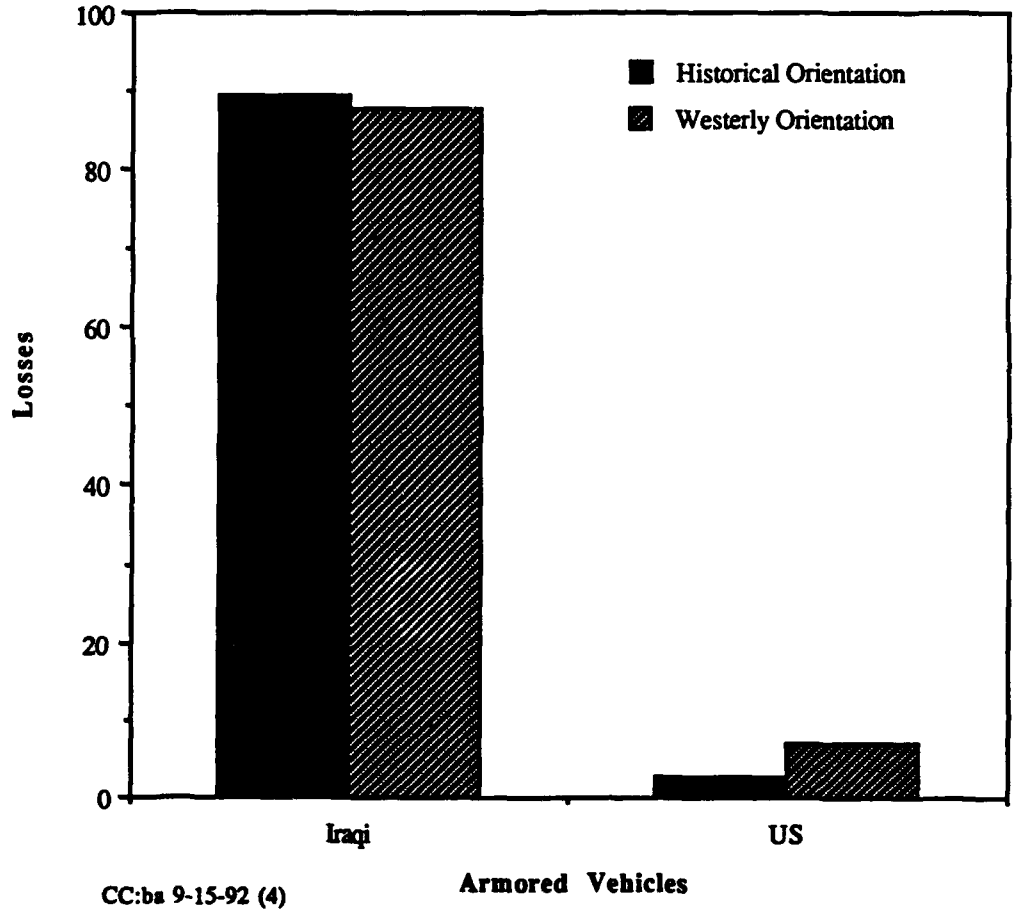

Figure IV-3. Armored Vehicle Losses, Base Case with Historical and Westerly Vehicle Orientations

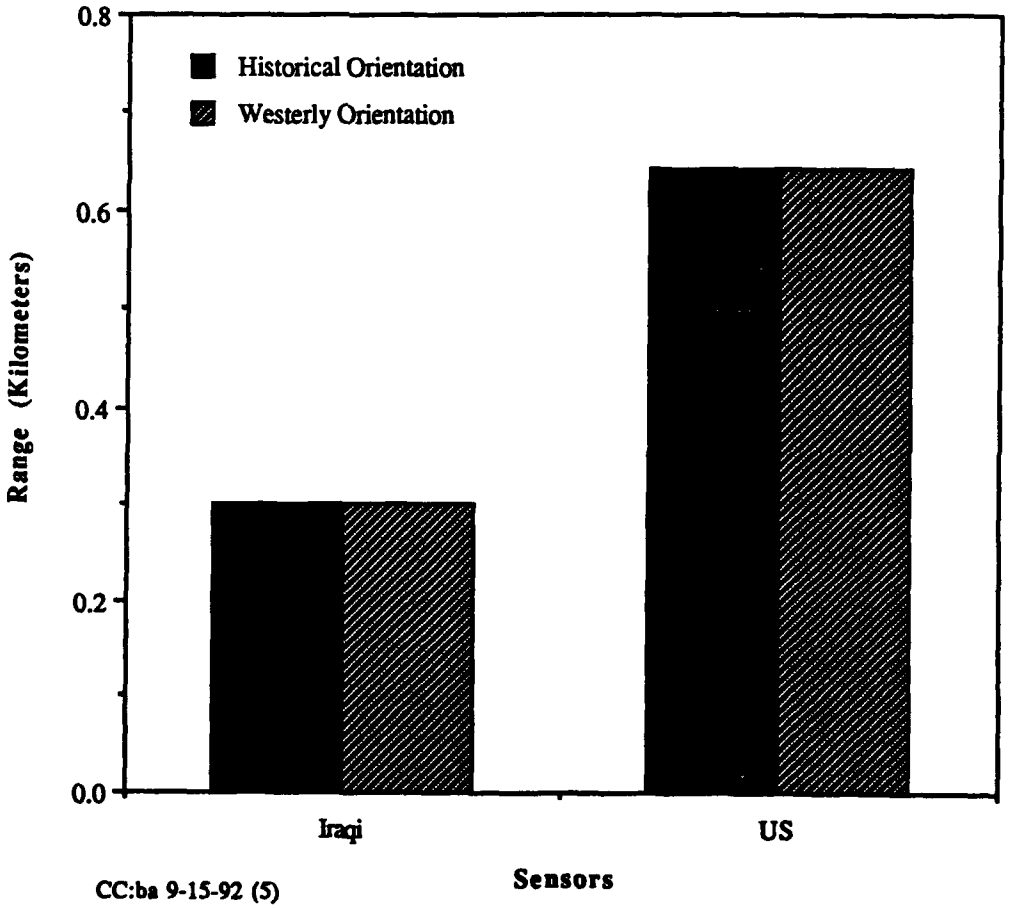

Figure IV-4. Average Sensor Acquisition Range, Base Case with Historical and Westerly Vehicle Orientations

3. Excursion 2

A very different result was obtained when the battle was re-fought under clear weather conditions (Figure IV-5), with the Iraqi's achieving a nearly one-to-one armored vehicle exchange ratio, under clear weather, with the historical Iraqi vehicle orientations. In addition, there was now a noticeable increase in the armored exchange ratio to the Iraqi's advantage when their vehicles were provided better positioning (reoriented west); nearly 20 fewer Iraqi vehicles were lost, while U.S. losses held constant. Although the U.S. thermal sights continued to retain a slight advantage in sensor range over their Iraqi optical counterparts (Figure IV-6), this was not apparently enough to compensate for the Iraqi numerical advantage. These results suggest that, all else being equal, the weather conditions did influence the combat results. The authors recognize, however, that had weather conditions improved at the time of the actual battle, commanders would have employed air power (which was unavailable during the actual engagement owing to the bad weather) and other battlefield measures such as smoke. These additions to the scenario have not been done here, as the point of this excursion is to illustrate the advantage that the U.S. enjoyed during bad weather, using thermal sights.

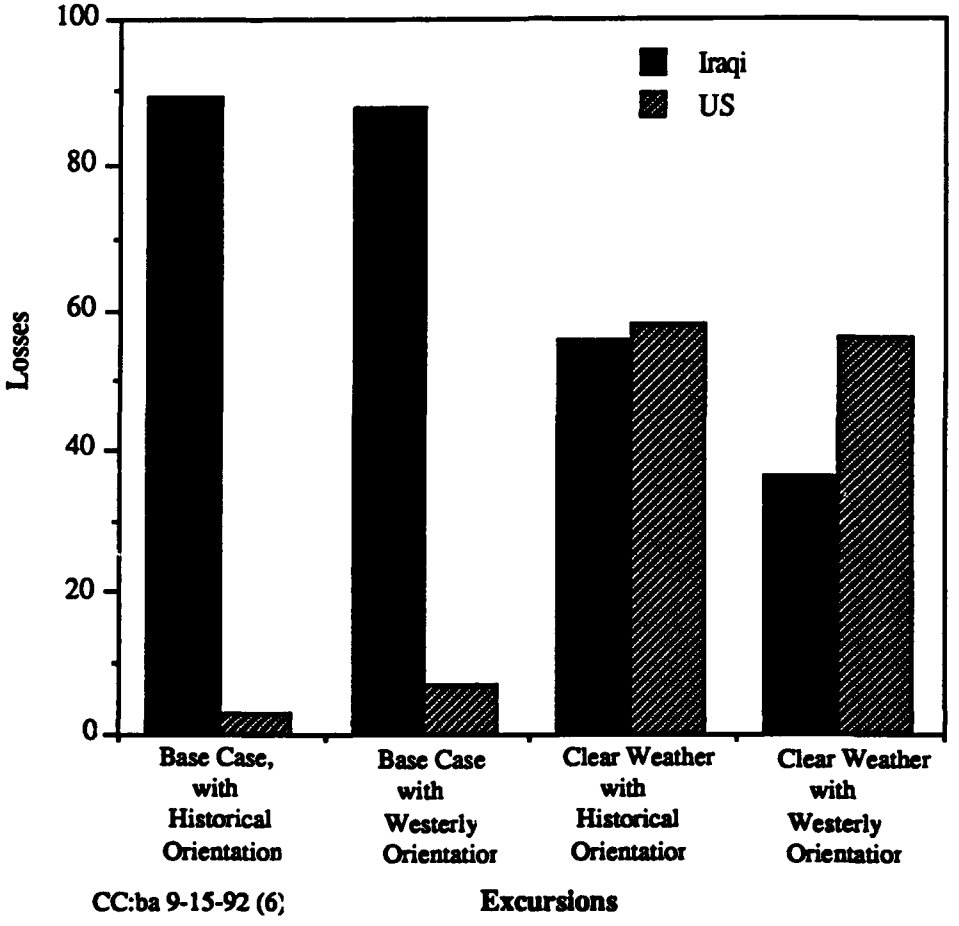

Figure IV-5. Armored Vehicle Losses, Base Case and Clear Weather Comparison

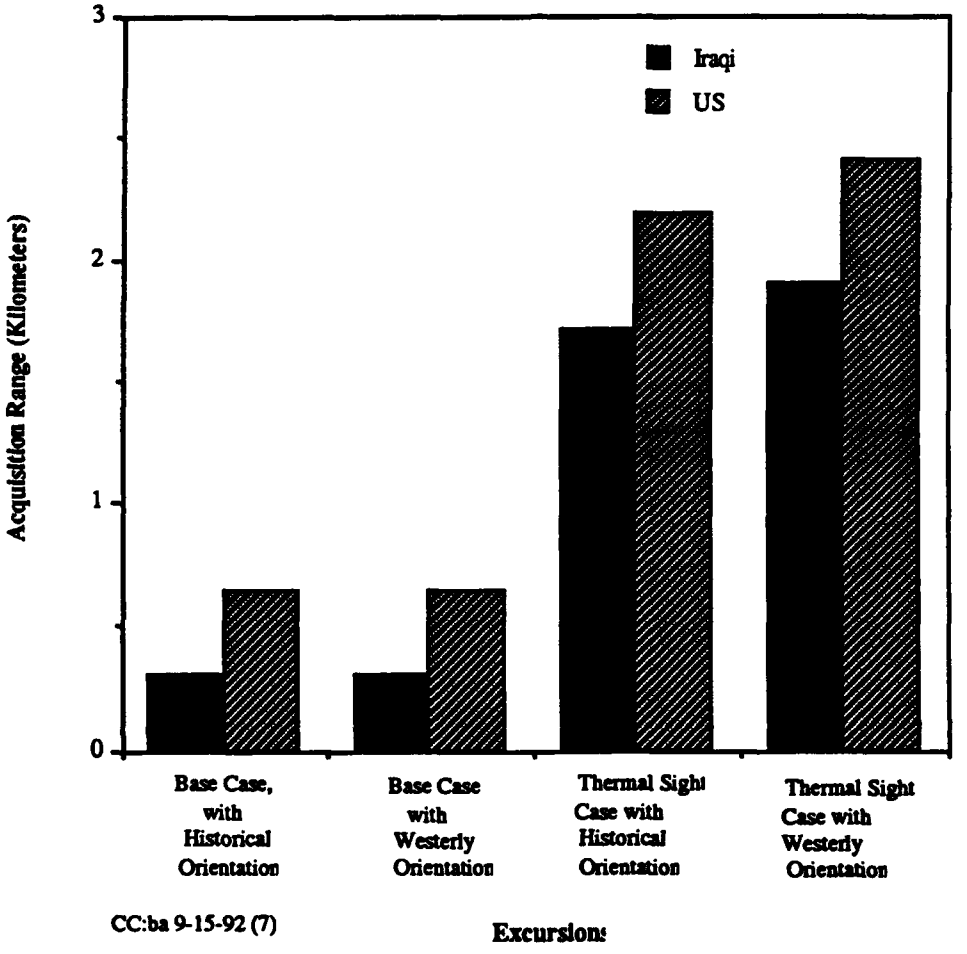

Figure IV-6. Average Sensor Acquisition Range, Base Case and Thermal Sight Case Comparison

4. Excursion 3

As suggested by the earlier excursions, U.S. superiority in sensor technology had the greatest effect on the combat results of the three factors examined in this study. As illustrated on Figure IV-7, the elimination of this technological advantage produced a nearly two-to-one exchange ratio in favor of Iraqi forces with the historical, ill-positioned Iraqi vehicle orientations. As expected, the sensor acquisition ranges now clearly favor the Iraqis (Figure IV-8); both have the same sensors, but U.S. forces are generally moving and exposed, while Iraq's are stationary and in partial defilade.

Elimination of U.S. sensor superiority also allows the advantages of better Iraqi defensive positions to be seen. There is a slight improvement in Iraqi sensor acquisition range; but this is translated into a tremendous loss-exchange advantage for Iraq, nearly reversing the historical loss-exchange ratio (note that, on average, about 65 U.S. vehicles are destroyed out of 67 vehicles participating in the attack).

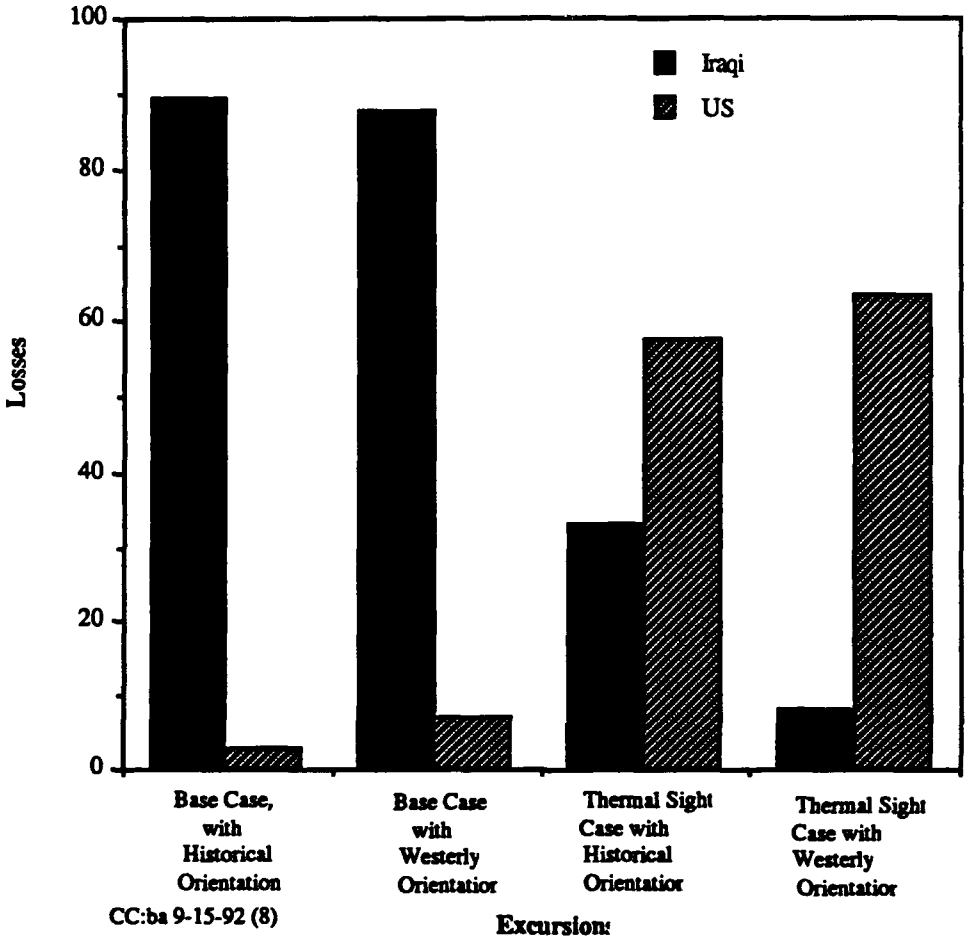

Figure IV-7. Armored Vehicle Losses, Base Case and Thermal Sight Case Comparison

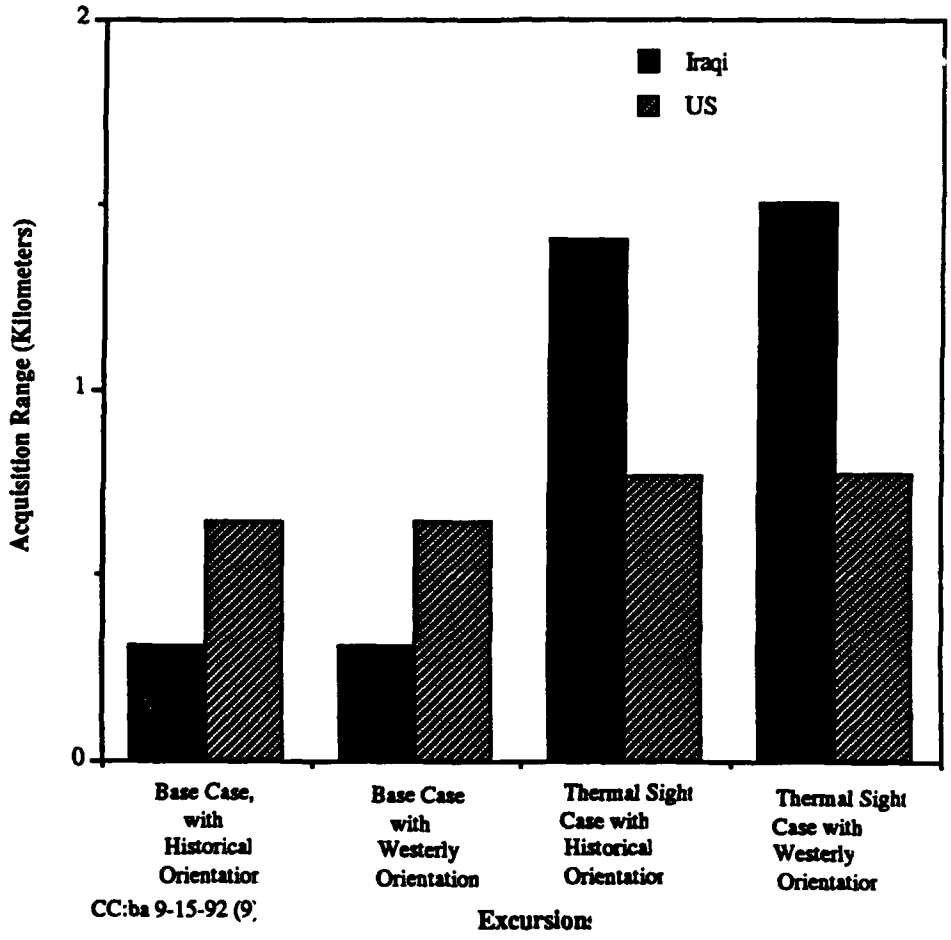

Figure IV-8. Average Sensor Acquisition Range, Base Case and Thermal Sight Case Comparison

B. OBSERVATIONS AND CONCLUSIONS

We have successfully completed the main task of the study: the replication of the Battle of 73 Easting in Janus(A). The predicted results from our Janus(A) simulation base case track quite closely with those of the actual battle. Improvements can be made to the scenario for a better fit with the actual battle, especially with regard to weather and combat data (see footnote 6 and page 10), but a comparison of the results suggests that no significant adjustments are necessary.

The excursion results suggest that U.S. superiority in sensor technology was a major driver of the simulation outcome. Indeed, the influence of thermal sights appears so strong as to nearly overwhelm the effects of many other types of model dynamics. Weather, however, also determined the relative ranges at which the two sides could acquire one another, and hence the simulated combat outcomes. In good weather, the U.S. advantage provided by the thermal sights disappeared, resulting in a one-to-one loss exchange ratio.[16] We further conclude that, given these poor visibility weather conditions *and* the capability of the ACR soldiers and leaders to recognize and exploit the situation, U.S. technological superiority strongly influenced combat results highly favorable to U.S. forces.[17]

Finally, as we have noted throughout this report, there are anomalies exhibited by Janus(A) that need to be more closely examined and corrected. For example, there are simulation shortcomings when the model is used on a very small scale (see footnote 9), such as in this study. Moreover, reflecting its origin and continued use as a training tool, there are elements of the overall Janus(A) software architecture that make it awkward to use as an analytic tool. Overall, however, and despite these shortcomings, the model is a

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[16] Note that this result says nothing about an actual battle outcome. This excursion was conducted using U.S. tactics identical to the "bad weather" case and with the continued absence of helicopter or fixed-wing aircraft close-air support. Both of these factors would have likely changed if the actual Battle of 73 Easting was re-fought under fair weather conditions.

[17] There are other ways, however, to affect sensor acquisition ranges and thereby influence the combat results. Janus work carried out under a separate project (but utilizing, as a starting point, the base case scenario created for this study) examined additional improvements in Iraqi defensive tactics. Specifically, these tactics were designed to negate the advantages of greater U.S. sensor acquisition ranges afforded by the thermal sensors by putting Iraqi vehicles in a "pop-up" mode. Vehicles in pop-up mode remain in full, or hull, defilade (hence, difficult to detect except at very short range) until they acquire a target. Only after a target has been detected do they come out of this full defilade state, to a fully exposed one, to fire. Re-running a modified base case scenario, identical to the original except with all Iraqi vehicles in pop-up, led to results much more favorable to Iraqi forces. For more on this scenario and other excursions on our 73 Easting base case, see Steve Biddle, "Determinants of Victory in Desert Storm: An Analysis and Implications for U.S. Defense Policy," IDA Paper, forthcoming.

powerful analytic tool for deriving useful insights into battlefield dynamics at a relatively low cost in both time and resources.

Appendix A

73 EASTING BATTLE CONTEXT

73 EASTING BATTLE CONTEXT[1]

While the purpose of this appendix is to provide a general description of the situation which on 26 February 1991 became the battle of 73 Easting, it would be well to consider how the forces involved came to be there. It is important to recall that the period of ground combat during Operation Desert Storm was preceded by a prolonged air campaign, during which Iraqi ground units and fixed positions were pounded with a volume of aerially delivered ordnance, both "high-tech" and "low-tech," on a scale seldom seen on the field of battle. That the effect of this bombardment was profound is an uncontested statement, although it may be a long time before we know the extent of its consequences. We will note during this brief discourse several aspects of the air effort that were of *particular* significance to the battle of 73 Easting.

The first of these has to do with the fact that the battle took place at all. It is important to recall that General H. Norman Schwarzkopf, the Allied Commander for the theater in the Persian Gulf, had come to the conclusion very early on that to limit Allied casualties following the extended air campaign, he would need to avoid a frontal attack into Kuwait from allied positions in Saudi Arabia. He therefore visualized a Single Envelopment, a classic form of maneuver, which has since been characterized as his "Hail Mary," or "Left Hook" operation. In it, he visualized committing sufficient force to fix in position the weaker but more numerous Iraqi divisions in Southern Kuwait and, using a wide sweep to the West, move against the Iraqi "center of gravity," the stronger, but less numerous Republican Guard Divisions. These Saddam Hussein had held back, to the North. While the wisdom of the Allied concept has been the focus of attention since the advent of the success which it brought, the skill, operational planning, and care in detailed execution required to make it reality have been the cause of much less notoriety. We should consider here several points necessary for the goals of this concept to have been realized:

- The relative position of two Corps, the XVIII Airborne Corps and the VII Corps, had to be reversed. That is, with respect to their location relative to the

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[1] The primary reference for material in this Appendix is IDA Document D-1110, "73 Easting: Lessons Learned for Desert Storm...," Conference Proceedings.

enemy, they had to be "flip-flopped" while, at the same time, moving their general locations laterally 300 to 400 kilometers to the West.

- A level of supply sufficient to sustain the force for 60 days had to be transported not only with the force but, to a degree, in advance of it, so that advance supply bases could be established for the force to "drive into," and pass on, so that momentum could be maintained.
- A double line of earth works, referred to as "the berm," located at the Saudi Arabian/Iraqi border had to be breached in sufficient locations by Army Engineers for the ground transported elements of the force, as well as the logistics vehicles, to pass through. This involved having the Cavalry establish what could be visualized as a "bridge-head" in the vicinity of the crossing sites so that the Engineers could move in behind them to cut passage lanes through the obstacle. This berm, as opposed to the one located along the Southern border of Iraq, was located to the West, along the Saudi Arabian/Iraqi border, and was apparently built by Saudi Arabia long before the war as a measure to control smuggling and cross-border movement.
- All of this was to be done in a period of 21 days. A column of heavy transport vehicles was thereby created long enough that at a fixed point on their route, one vehicle would pass every minute, 24 hours a day, for 21 days.
- And, most significantly, this all had to be done without detection by the enemy; hence, the importance of the air effort to the mounting of the operation. Not only could no Iraqi air activity be allowed to interfere, but Iraqi means of detection, mobile and fixed, air and ground, had to be neutralized.

As a result, by the 23rd of February, XVIII Airborne Corps had moved to the North and West (Figure A-1), and VII Corps was passing Northward, through the area of the berm, in a formation which the Corps commander believed gave them the best options for dealing with a developing enemy situation. General Franks, VII Corps Commander, had been given the mission of finding and destroying the Republican Guard.

The main body of the VII Corps consisted of four divisions, and was to move with two armored divisions (AD) abreast, the 1st AD (US) on the left and the 3rd AD (US) on the right. These were followed by two more divisions, the 1st Infantry Division, Mechanized, (US) following the 1st AD on the left and the 1st AD (U.K.) following the 3rd AD on the right. The First Cavalry Division, not in the VII Corps main body, was to create a diversion by attacking straight up the Wadi Al Batin, a huge cut or valley running parallel to the Western border of Kuwait. Across the front of the main body of VII Corps, leading the advance, was the 2nd Armored Cavalry Regiment. It had been given the typical

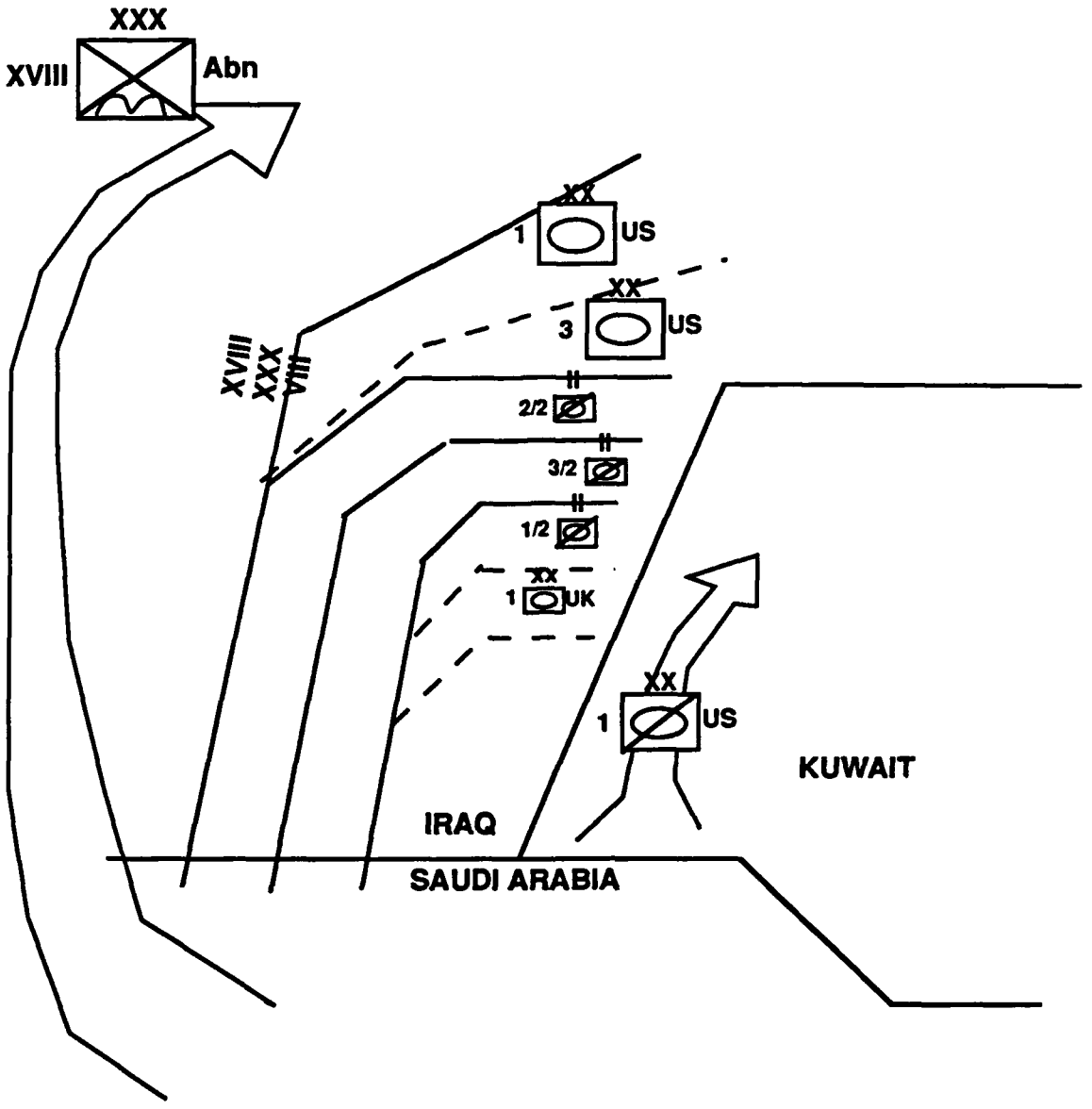

Figure A-1. Desert Storm Single Envelopment

Armored Cavalry mission of screening the advance, finding and fixing the enemy, and passing the divisions through on order. The Divisions were to destroy the Republican Guard once they were found. An additional task, inherent in the mission assigned to the 2nd ACR, was to find the most trafficable terrain, the best route for the armored vehicles of VII Corps to follow. The desert terrain in that part of Iraq has been called "flat desert,"

from which one might be lead to believe that this movement was done like so many balls on a billiard table. That mental image is not correct. For a start, the whole area for perhaps 200 kilometers is a vast watershed which slopes gently down toward the Euphrates River, with the surface ranging from gently rolling to sharply cut. Moreover, while much of the surface material is hard-packed dirt and rock, there are large areas of sand where tanks, once breaking through the crust, can become mired and immobile.

Therefore, as in any Cavalry covering force role for the advance, the 2nd ACR mission involved finding the best route through the area. While the ground could not be accurately called featureless, navigation was nevertheless difficult because most terrain features looked similar. In this environment, the hand-held Global Positioning System (GPS) devices provided hurriedly to units upon commitment of forces to the Persian Gulf were not only welcome, but essential. With GPS, troops could obtain the UTM grid coordinates of their positions instantaneously and accurately. Use of this device is what gave rise to the convention of naming actions for an "Easting." With no "Hill 968" or "Bull Run" to give a place a name, the UTM coordinate grid lines, which run East-West (a Northing), and North-South (an Easting), were used as place names. North-South grid lines are called Eastings because their numerical designations increase in that direction. Hence, the battle of "73 Easting" took place along the North-South grid line 73 on the maps issued to the troops.

Armored Cavalry Regiments are assigned five Squadrons, according to their Tables of Organization and Equipment. Three of these are Armored Cavalry Squadrons comprising tanks, scout vehicles, and infantry reinforced with mortars and artillery. The fourth squadron is an Air Cavalry Squadron, sometimes referred to in the 2nd ACR as the "Dragoon Air Force," to which the scout, utility, and attack helicopters belong; and, fifth, the Regimental Support Squadron, which looks after administration and logistics for the Regiment. The weapons and combat vehicles assigned to this organization are shown in Table A-1.

The formation chosen by the Regimental Commander when moving into combat is determined by his estimate of the situation, and his assigned mission. In this case, Col. Don Holder, who was the Regimental Commander, chose a generally adaptable formation by deploying two Cavalry Squadrons forward, with the Second Squadron on the left and the Third Squadron on the right. First Squadron followed in reserve, and the Support Squadron was tucked close up behind. Fourth (Air Cavalry) Squadron was in general support, with Scout Helicopters moving forward as weather permitted. While First Squadron would be committed forward later on, the relative positions of Second and Third

Squadrons in this initial formation pre-ordained their involvement in the Battle of 73 Easting, as we shall see.

Table A-1. 2nd Armored Cavalry Regiment Combat Assets

M-1A1 Tanks	123
M-2A2/M-3A2 Bradley Fighting Vehicles	116
AH-1 Helicopters	26
* OH-58C/D Helicopters	34/5
* AH-64 Helicopters	18
* 155mm Howitzers	72
* MLRS	9

* Numbers include weapons and equipment from Reinforcing Units: one Aviation Battalion and one Field Artillery Brigade.

This initial formation for the Corps advance was maintained from the time of the breaching of the berm, throughout the 23 and 24 February move Northward. Then, at 0841 hours on the 25th, General Franks ordered 1st Armored Division to move around and to the left to pass Second Squadron in preparation for his turning of the Corps to face Eastward, where he knew the Republican Guard must lie. At 0216 hours 26 February, Franks issued the order for the whole Corps to "orient to the East," and the 3rd Armored Division to pass the 2nd ACR on the left so that it would be located between 1st AD and 2nd ACR. 1st (U.K.) Armored Division and 1st Infantry Division would follow 2nd ACR. This maneuver took place so that the new VII Corps alignment, North to South, of 1st AD, 3rd AD, and 2nd ACR (which was now moving with 2nd, 3rd and 1st Squadrons abreast), would take shape, moving East at about the 55 Easting.

Around mid-day at the 60 Easting, a scout helicopter of 4th Squadron, 2nd ACR, spotted a T-72 Iraqi tank, part of a platoon-sized outpost. This outpost the 2nd Squadron quickly destroyed. 2nd ACR had obviously made contact with the Republican Guard, as they were the only Iraqi Divisions equipped with T-72 tanks. Col. Holder now wanted to find their positions and to pass the 1st Infantry Division through to make the attack when the time came.

While this massive movement had been taking place, the Republican Guard was on the move. They were moving Southwest along a hard surface asphalt road, called the Ipsa

Pipeline road, which was not indicated on the operational maps provided to the combat units. After the war, it was found that this road was shown on new maps provided by the Engineer Topographic Laboratory, but these had not yet found their way into the hands of the troops.

This movement was being covered by the 12th Armored Division, and consisted, in order, of the Tawakalna Division, followed by Medina, and then the Hammurabi Division. 18th Armored Brigade, one of three brigades assigned to Tawakalna, had been moved toward the location of one of the Iraqi Army's training areas which, as we now know, was located in the vicinity of 73 Easting. Its mission in moving there was to protect the Division flank during its move. This is why the 18th Armored Brigade was in position between the 70 and 75 Eastings as the 2nd ACR approached at 1500 hours.

At that time, the Regiment was in the process of coordinating the passing through of the 1st Infantry Division, and was moving forward with the three ground squadrons abreast at an average ground speed of about 18 kilometers per hour. While the weather was generally poor throughout the period of the advance, it had taken a particularly nasty turn on the 26th. The wind was blowing at about 40 mph, the sky was dark, and the air was filled with blowing moisture and sand. As a result, optical range visibility was below 800 meters, and at times as low as 100 meters, and neither fixed nor rotary wing aircraft were available for support of ground troops.

An Armored Cavalry Squadron has three troops and a tank company as part of the organization. Second Squadron, on the left, was moving with two troops, "G" and "E" (or "Ghost" and "Eagle" according to their radio call signs) in front. They were followed by "F" troop and "H" Company, the tank unit. Third Squadron, in the center, had three troops abreast, with Iron or "I" troop on the left, the other two troops to the right of Iron, and the tank company following. First Squadron, on the right flank of the Regiment, mirrored the formation of Third Squadron. It was in the area of Ghost and Eagle troops of Second Squadron, and Iron troop of Third squadron, that the battle of 73 Easting took place.

At 1530 hours, as contact was about to be made, troop dispositions were configured both for security and flexibility in an uncertain situation. In the North, Ghost troop was deployed with a scout platoon on the left flank, echeloned to the left to protect their own, and the regiment's, left flank. CPT Sartiano, the troop commander, had placed his two tank platoons in a 'Vee' formation, and his own tank was at the point, for a total of nine tanks in the formation. He had pulled his 4.2-inch mortars up close for rapid reaction.

On his right, and on the right flank of Second squadron, the Eagle troop commander, CPT McMaster, had deployed a scout platoon all across his front, a distance of about five kilometers. He had brought the mortars up close behind and placed another scout platoon on his right flank to maintain contact with Iron troop of Third Squadron. In Iron troop, CPT Miller placed his scouts across the front, and he had his tanks in a 'Vee.'

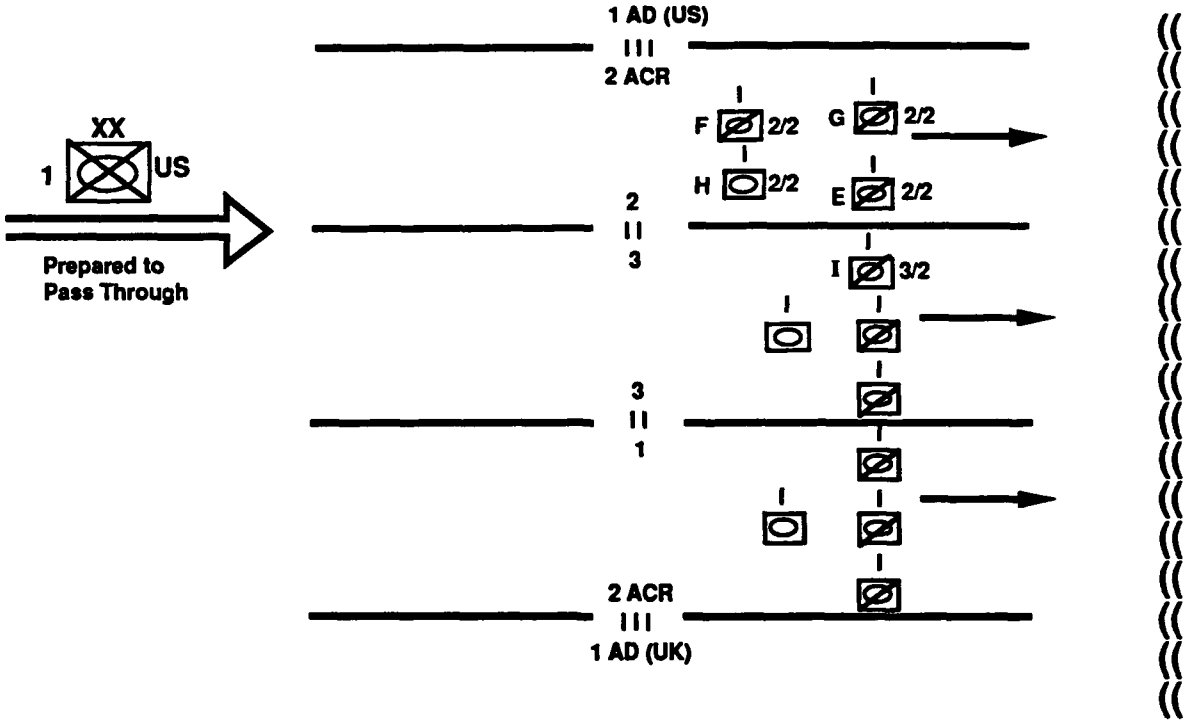

Figure A-2. 2 ACR Deployment Prior to Contact, 26 February 1991

It was with these formations that initial contact was made, at 1605 hours, with Iraqi security elements by Ghost and Iron troops. Heavy contact was made by Eagle troop at 1615 with dismounted elements in the vicinity of a training area cantonment complex. Almost immediately, CPT McMaster also sighted tanks, and began taking them under fire, while maneuvering. The main part of this battle lasted 90 minutes, with some fighting continuing for six hours. The first few minutes, however, appear to have been decisive. We have said that no close air support was available at the time of the engagement. However, due to the intense application of air during the first phases of the war, the Iraqi

units had been careful to build bunkers close to the armored vehicle fighting positions, and apparently were in the bunkers instead of in the tanks when the engagement began. There is some discussion as to how many of the crews this involved, and how long they may have stayed there before discovering that they actually were under ground attack, not air attack, as some assert they believed. Apparently, they did not believe that a ground force could be attacking from the West under such poor weather conditions.

In any event, the 2nd ACR benefitted not only from surprise and the advantage of the thermal sights with which the U.S. tanks were equipped, but also from the conditioning the Iraqis had received at the hands of air elements, as well. Moreover, the confidence and aggressiveness with which the leaders and soldiers reacted permitted their exploitation of the advantage they apparently saw as theirs. Ghost, Eagle, and Iron troops lost only two M2 Bradley Fighting Vehicles (one to friendly fire), and no tanks. Iraqi losses are summarized in Table A-2.

Table A-2. Iraqi Losses, Battle of 73 Easting

Tanks	57
BMPs	28
MTLB	11
Trucks	45
ADA	3

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