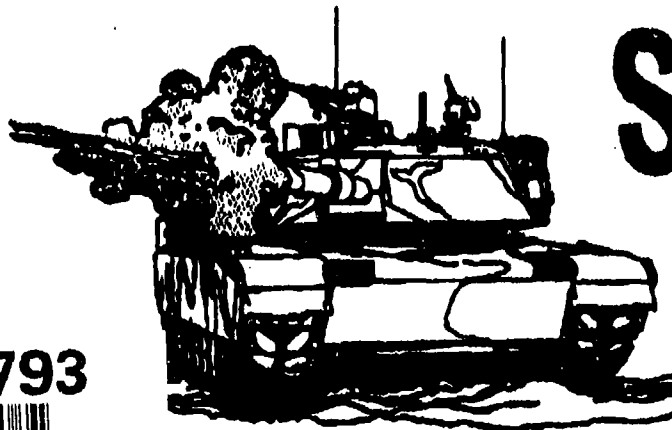


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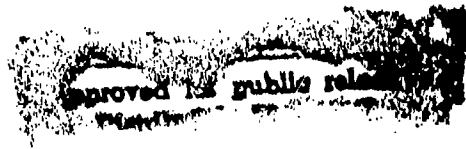
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DESERT SHIELD AND DESERT STORM EMERGING OBSERVATIONS

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DEPARTMENT OF THE ARMY
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2 OCT 1991


TO THE FRIENDS AND MEMBERS OF THE ARMOR FORCE:

The enclosed final report is the culmination of the U.S. Army Armor Center effort to collect Desert Shield/Storm emerging observations and provide them to the Total Armor Force (TAF) and other selected agencies. The report is a compilation of a year long effort with the following objectives:

- a. To gather Armor related information through interviews, surveys, after action reports, and miscellaneous sources.
- b. Compile the information into a usable form that can be easily studied and analyzed to look for trends and consensus on issues and observations.
- c. Draw conclusions from the detailed assessments based upon the five Training and Doctrine Command functional areas of doctrine, organization, training, materiel, and leader development.
- d. Disseminate conclusions to the Total Armor Force and incorporate them into our training.
- e. Record Armor history.

In addition to providing the TAF the conclusions derived from our study of Desert Shield/Storm, this report will also feed the ongoing Armor 2000 effort and the upcoming Armor Functional Area Assessment (FAA). Both of these actions are critically important to the future of the Armor Force.

Finally, after any war, the rush to judgement about lessons learned must be tempered with a scrupulous objectivity. This war documented the emergence of a challenging new era. The effect of high technology on weapons, command and control systems, intelligence, and other areas has revolutionized the nature of war. Despite some weakness revealed during the war, the Armor Force came through Desert Storm with an uncontested "thumbs-up."


THOMAS C. FOLEY
Major General, U.S. Army
Commanding

Enclosure

CHAPTER 1

EXECUTIVE SUMMARY

1-1. Summary. This report is a culmination of the United States Army Armor Center (USAARMC) effort to collect Desert Shield/Storm emerging observations and provide them to the Total Armor Force and other selected agencies. Additionally, the report will feed the ongoing Armor 2000 effort and the upcoming Armor Functional Area Assessment (FAA).

1-2. Discussion.

a. The enclosed chapters represent a coordinated effort by Armor Center staff agencies to consolidate wartime information from sources internal and external to Fort Knox into a useful format for the Total Armor Force.

b. The chapters are broken down into the following areas:

- (1) Executive Summary.
- (2) Battle Summaries.
- (3) Doctrine.
- (4) Organizations.
- (5) Training.
- (6) Materiel.
- (7) Leader Development.
- (8) Source Bibliography.

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1-3. Information.

a. Doctrine.

(1) Airland Battle Doctrine is sound. Our leaders have the offensive spirit. Their ability to focus overwhelming combat power was instrumental to our success.

(2) Need deployment and redeployment doctrine for armored forces. Deployment logistics requirements are enormous and must be better forecasted, staffed and efficiently executed. The U.S. system of dispatching Heavy-Equipment Transporter (HET) support piecemeal does not lend itself to a tight organizational structure that inspires the customers' confidence.

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(3) Need improved acquisition and dissemination of intelligence. The top-down intelligence flow was generally strategically oriented and often did not provide detailed assessments required by front line leaders.

(4) The importance of security operations needs to be revalidated. Due to the enemy's unwillingness/inability to fight, Desert Storm should not be considered as a valid test of our security operations doctrine.

(5) Fire support coordination doctrine must be standardized. The means to rapidly clear fires between adjacent unit zones is needed. If not, long time-lags result and lucrative targets escape. We must improve coordination of air and ground fires.

(6) The commander's intent is the most important element in an order. The rapid pace and high tempo of operations demanded a clear and concise commander's intent.

(7) Battalion and brigade drills were developed and executed in the desert. Simple plans with extensive rehearsal work best. These battalion and brigade drills included action drills, hot refuel drills, ammunition loading drills, and even V-pack cleaning drills. Finally, we must develop standard drills for complex obstacle breaching.

(8) Increased emphasis needs to be placed on combat identification tactics, techniques, and procedures. More discipline in target identification training is needed. Rules of engagement varied from organization to organization. While some units were lax, others required the company/task force commanders to positively identify a target before they could give authorization to engage the target.

(9) Traversing Dual Purpose Improved Conventional Munition/Cluster Bomb Unit (DPICM/CBU) areas needs to be addressed. Proponent schools/combat training centers (CTC's) must increase training awareness of the danger of unexploded ordnance on the battlefield. Vast quantities of unexploded Army and Air Force ordnance were left throughout the theater.

(10) In some companies, the fighting executive officer (XO) appears to have worked well. At battalion level, it appears that the XO was employed as the battle captain and as the battalion senior logistics operator.

(11) Some units experimented with putting the fire support officer (FSO) in the commander's vehicle. A number of units elected to leave the FSO in the fire support team vehicle (FIST V) because of insufficient communications in the commander's tank. Doctrine must support both options.

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(12) Our requirement to rapidly execute orders highlights the need to ensure a complete understanding of common terms between branches, services, and allies.

(13) The Combat Service Support (CSS) push system did not work well. It became a pull system. Most Divisions Support Commands (DISCOMs) had officers posted at Dhahran and/or King Khalid Military City (KKMC) airfields with 40-foot stake and (S&P) trailers. They sorted through mountains of cargo containers looking for familiar Department of Defense Activity Advice Codes (DODAACs) and removed from the supply system those parts they needed. Our doctrine of support organic to the battalion/task force worked well and enabled commanders to maintain the initiative and high tempo of operations.

(14) The multinational nature of the coalition forces reinforced the need for well trained and well equipped Liaison Officers (LOs). Joint Forces Command East (JFCE) LO's are currently constrained by lack of training and equipment: radios, computers, and vehicles.

(15) The excellent performance of weapons systems in Desert Storm mandates a reevaluation of doctrinal weapons planning ranges.

b. Organizations.

(1) Air deployable light armor and light cavalry forces are vital to the effectiveness and survivability of contingency forces. Before the arrival of the 24th Infantry Division (ID), the 82d Airborne Division (Abn) was dangerously vulnerable because of the lack of mobile, survivable, and lethal firepower.

(2) Commanders consistently indicated the need for tanks in the divisional cavalry. Tanks are vital if the cavalry is to be able to fight for information and protect the main force. Most prefer three ground troops and one air troop. The ground troops need to be a mixture of tanks and Bradley Fighting Vehicles (BFVs). In the desert the range and lethality of modern weapons require the current squadron organization to unnecessarily expose its men. In repeated instances enemy tanks were encountered. A mixture of tanks and BFVs enabled the BFVs to survive. Tanks also have better night vision capabilities than BFVs and can withstand more punishment. Finally, tank laser range finders help range enemy equipment.

(3) The effectiveness of four-company armored battalion/task force was validated in South West Asia (SWA). Commanders feel that four companies are needed to fix the enemy, have enough combat power to maneuver against him, and maintain continuous operations. Additionally, the four-company organization facilitates more effective task organization and

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allows commanders to maintain an armor reserve for offensive operations. Reducing battalions to a three-company structure would require revision of tactics and doctrine we know to be sound. The three-company structure would not easily translate into box or diamond formations. Most feel that it is better to reduce the number of battalions than to thin out existing units. Bottom line is that we don't need to fix a force structure that isn't broken.

(4) Armored reconnaissance at all levels from battalion through corps is vital. Brigade commanders agreed that a scout organization at their level is necessary to effectively see and control the battle. Currently, no such organization exists. Additionally, this conflict made it evident that in open terrain the scout platoon equipped with 10 High Mobility Multi-Wheeled Vehicles (HMMWV) will not work. It is clearly too vulnerable. Commanders were reluctant to send HMMWV scouts where enemy contact was imminent. Lethality of the battlefield made using HMMWVs very risky. Scouts must be in a hardened vehicle that must be able to move over all types of terrain, shoot and destroy chance contacts, and move through minefields and artillery fire. Armored, armed reconnaissance worked in SWA. The battalion task force scout platoon summary for Desert Storm units is shown below:

HMMWV	6
M3	33
M3/HMMWV	2
M113/M901	5
LAV 25	1

(5) The results of the high tempo of modern mobile armored warfare indicate that CSS assets should be organic to battalions to be responsive and effective. Fuel consumption over extended distances demands a beefed-up support platoon at battalion level. Additionally, maintenance was and will continue to be most responsive at company and battalion level.

(6) Support organizations must be agile and robust to be able to move supplies quickly to meet demands of the modern battlefield. All units, combat, combat support, and combat service support need more and more capable wheeled vehicles. Organic transportation was not sufficient to move organizations soldiers, equipment, and supplies in a single move. Support units especially felt the crunch hauling repair parts, major assemblies, and the additional life-support supplies needed in the desert. The army has proven winners with the M1A1 and Bradley; however, the full range of their impressive capabilities

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cannot be realized until we develop a fleet that can keep up with and sustain them. Lack of mobility in many units became glaringly obvious during Desert Storm.

(7) The Combined Arms Maneuver Battalion (CAMB) is a viable organization. Many units task organized to build combined arms battalions. The earlier this step was accomplished, the better, as training and support relationships jelled. The 1st Cavalry Division was pleased with the CAMB organization. As one commander stated, "The CAMB is the 80 percent solution for all METT-T situations." He added that, "Unlike task organizing, the logistics in a CAMB was structured to support combined arms and the unit is more cohesive."

(8) The separate brigade is a robust, flexible organization suited for rapid attachment throughout the theater. The Tiger Brigade, a divisional brigade, experienced significant difficulties when attached to the Marine Central Command (MARCENT) because it lacked the additional service support assets, especially a movement control center and materiel management center, organic to a separate brigade. The 1st Cavalry Division had to form an ad hoc support organization from its assets to move with the Tiger Brigade.

(9) The Armored Cavalry Regiment (ACR) proved itself a robust, flexible organization capable of accomplishing all missions. The ACR is a viable organization for contingency missions.

c. Training.

(1) Combat identification training needs more emphasis. Fratricide was a major concern during Operation Desert Storm. With thermal sights and improved optics, tanks and Bradleys were able to detect targets in excess of 4,000 meters. With a multinational force, it is imperative that gunners and vehicle commanders are able to recognize all vehicles through both optics and thermal sights. Too often crews are allowed to pass the Tank Crew Gunnery Skills Test (TCGST) by looking at full figure flash cards. We need to place more emphasis on vehicle identification in less than ideal conditions. Crews often could not identify armored vehicles as friend or foe until they were under 1,500 meters.

(2) Many leaders from both corps have credited rotations at the Combat Training Centers with the success they enjoyed in Operation Desert Storm. However, continuous operations need to be stressed. Now we pause after each scenario to critique, but this is not how we fight. We also need to emphasize battle drills from platoon through battalion level. At the accelerated tempo of modern warfare, everyone must know how to react to situations until orders are received. We have already included

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mass casualty exercises; now we need to look at mass Enemy Prisoner of War (EPW) exercises.

3 (3) Combined arms doctrine works well.

(a) Mechanized infantry and armor complemented each other. While the maneuver forces worked well together, their support did not. Tank company maintenance teams did not have adequate training to support Bradleys, and vice versa. These problems were worked out before the ground offensive, but units might have been in trouble if they had not had the luxury of training in their task force configurations before the ground offensive started. Units need to learn to support each other on a day-to-day basis. Recommend task force organization remain in effect in garrison.

(b) Field Artillery observers had trouble keeping up with maneuver forces because of the FIST-V. This may have had an impact on the amount of artillery fired during the ground offensive that had not been preplanned. More emphasis should be placed on training armor and infantry leaders to call for and adjust indirect fires because the FIST may not be available.

(4) Increase emphasis on light infantry and armor operations. There are some operations in which light infantry and armor must work together. This observation gains increased importance in light of evolving doctrine that envisions increased participation of armored forces, both armored and light, in contingency and rapid deployment operations. Units in SWA had time to train together before the ground offensive, but we may not have this time in future conflicts. Military Operations in Urban Terrain (MOUT) training needs to be more fully integrated.

(5) Most units need more deployment training. Commanders discovered that Standard Operating Procedures (SOPs) were outdated or non-existent. SOPs need to be exercised. Units must also establish a training program for pre-/post-deployment that they can conduct while waiting for their equipment. The Air Force offers a Load Master class and coordination should be made with the Navy to make slots available to unit representatives in its equivalent course. Each battalion should have a team trained at air and sea loading.

(6) Aggressive maintenance was key to the high operational readiness rate achieved. Well trained crews performed Preventive Maintenance Checks and Services (PMCS) and quickly alerted maintenance teams to deficiencies.

(a) Units that conducted M1A1 rollover in SWA experienced unique problems. Most units had M1IPs, but some units transitioned from M60A3s. Crews and maintenance teams lacked the experience necessary to quickly diagnose and fix

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problems. Often units didn't have the necessary publications to conduct boresight or prep-to-fire checks. New Equipment Training (NET) personnel gave away their own manuals to help fill shortages. Technical representatives from various manufacturers also proved invaluable.

(b) Class IX procurement was a problem experienced by all units. Logisticians need a training center similar to the CTCs where they can exercise their systems in a tactical environment.

(7) Training, focused on gunnery, paid off; concepts are sound; major fundamental changes are not needed. Proper boresight by the manual is still the basis for success. Crews shot well; they engaged and destroyed targets well beyond anticipated ranges. Units did experience a "high second round" phenomenon which was attributed to the fact that some M1A1s had not been recoiled in over 2 years. Master gunners discovered that after the first round is fired, the M1A1s boresight would be off. It seems that the first round reseats the recoil mechanism and the tanks needed to reboresight afterward. A simple solution was to conduct a recoil exercise prior to gunnery.

(8) VII Corps units were able to complete predeployment gunnery. This not only increased crew proficiency, but gave soldiers greater confidence in their equipment.

(9) Unit Conduct Of Fire Trainer (UCOFT) was used extensively by most units as a primary predeployment gunnery tool. UCOFT and Simulator Network (SIMNET) proved especially invaluable to the Individual Ready Reserve (IRR) crew train-up conducted on Fort Knox. These training devices can be used even when crews are waiting for their equipment to arrive in theater. With today's budget constraints and reductions in training ammunition allocation, we must train effectively in garrison to make every round count in combat.

(10) Boresighting should be conducted twice daily. Daily boresights often helped identify overlooked deficiencies and increased the crews' confidence in the system. Muzzle Reference System (MRS) update was used almost exclusively during the ground offensive. Tanks kept their boresight, often traveling hundreds of kilometers without losing more than 0.4 mils.

(11) The Master Gunner program paid big dividends. Master gunners not only helped commanders develop gunnery training programs, but served as senior turret mechanics and troubleshooters. The quality of master gunner graduates cannot be overstated.

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(12) Long range gunnery was used by most units. M1A1 equipped units reported kills in excess of 3,000 meters. M1A1s destroyed enemy vehicles before being acquired by the enemy during periods of limited visibility due to our thermal sights. Bradleys destroyed vehicles at 2,500 meters with the 25mm. At these ranges, vehicle identification is much more difficult, as is range estimation. Desert Storm proved that our equipment and ammunition is capable of killing targets at longer ranges than expected. If we plan to take full advantage of our superior technology, we must train our crews in long range gunnery techniques.

(13) The Tank Commander Certification Course/Scout Commander Certification Course served as a good refresher for officers/senior NCOs sent to SWA as replacements who had been away from their equipment.

(14) Abbreviated fire commands worked well, but only because crews were well-grounded in standardized fire commands. Crews must still be thoroughly familiar with full-up commands. Crew members may become casualties, but the crews must be able to incorporate replacements quickly through the use of standardized training.

(15) Many soldiers were more afraid of fratricide than of the enemy. Many units had never conducted battalion-size live-fire exercises. Crews realized that they couldn't depend on gun tube orientation alone. Flank coordination finally received serious attention. Gunnery tables need to incorporate friendly targets. Emphasis should be placed on live-fire exercises at platoon level and above.

(16) The peacetime development of programs of instructions and organizations for mobilization training of reserve component soldiers is vital to the success of the total force. Plans must accommodate all levels of partial mobilization as well as full mobilization.

(17) The 19th Engineer Battalion commander stated that one of the greatest training deficiencies is the identification of scatterable mines. In training, we simulate employment of the Family of Scatterable Mines (FASCAM) and other ordinances for safety. In combat, all soldiers must be able to recognize mines, CBUs, DPICM and other dangerous ordnance.

(18) Overall, institutional instruction was very successful. Soldiers and leaders joining units upon the completion of courses were trained and ready to fight.

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d. Materiel.

(1) The M1A1 performed superbly--well above expectations. It was reliable, lethal, and survivable. There are, however, some improvements that need to be made.

(a) Reliability:

1. Moving over 300kms in the attack, the M1A1s maintained an operational readiness (OR) rate of over 90 percent with some units reporting OR rates of as high as 98 percent.

2. Most fire control systems stayed fully operational during the 100 hours of the campaign.

3. Most vehicles that broke down were quickly repaired and able to join their parent units on the final objective.

4. Batteries are not reliable enough, particularly for use in a desert environment; they need to be improved.

5. A reliable Auxiliary Power Unit (APU) must be procured for the Abrams. The current model tested in SWA was unreliable. It was particularly susceptible to damage from sand. The Garret gas turbine APU received positive comments from VII Corps Master Gunners. The opinion is that the optimal position for the APU is mounted in the hull rather than as an add-on to the rear of the vehicle or mounted in the bustle rack. The external hull mounted APU is too easily knocked off or damaged in areas with trees or in urban areas. The bustle rack mounted version requires additional cables to be run down through the turret which appears to be undesirable.

6. Fuel pumps are also inadequate and need to be upgraded. Crews reported problems with the reliability of in cell fuel pumps and fuel transfer pumps. The immediate impact of this was that because of unreliability of the transfer pump and the time-consuming nature of refueling the forward fuel tanks, commanders refueled more frequently. This disrupted the high tempo of operations and created a greater strain on the logistics system to keep up with the frequent demand for fuel. Train crews in peacetime to use transfer pumps.

7. The V-packs need to be upgraded. Dust and sand accelerated the required intervals for cleaning and/or replacement. Additionally, the need for improved V-pack cleaning equipment has been identified. The technique of using the tank "buddy system" is unacceptable. A tank cannot operate its engine without its V-pack installed so it is dependent upon another tank to provide power for the cleaning wand in order to clean another tank's V-pack. Possible fixes are new V-packs (a self-cleaning

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rotary design is available) or designing the AFJ to power the cleaning wand to allow the tank to service itself.

(b) Lethality:

1. The 120mm gun, coupled with its excellent fire control system and thermal optics, proved devastating against all Iraqi armor. Our current main gun ammunition significantly dominated every tank on the battlefield.

2. Main gun accuracy was good at ranges in excess of 3000 meters. Reports vary as to the average engagement range. Most units report 2,200-2,800 meters as the average engagement range, but some new data suggests that 1,500-2,000 meters may be more correct with 2,500 meter engagements not uncommon. Overall engagement ranges are as close as 100 meters to as far as 3,700 meters, the latter from both U.S. Army and United States Marine Corps sources.

3. The M1 tank performed well, but initial indications are that the accuracy of the 105mm fell off significantly at extended ranges.

4. Units report a need for improved optics. The 120mm round is accurate and deadly at ranges over 3,000 meters, but the current optics do not optimize the round's capabilities. Currently, the power magnification of Thermal Imaging System (TIS) and Gunner's Primary Sight (GPS) are insufficient for long range engagements.

a. The Commander's Independent Thermal Viewer (CITV) is needed. Currently, the commander's sight, the Gunner's Primary Sight Extension (GPSE), does not allow the commander to see the battlefield. Furthermore, because of the inability of the commander to adjust the reticle he is often forced to accept the gunner's perspective of target identification.

b. Need to increase optical magnification of the TIS/GPS and increase the clarity of the thermal image.

(1) Targets were difficult to identify past 1,500 meters with TIS.

(2) The M2/3 was the hardest vehicle to identify with the TIS. At ranges over 2,000 meters, the Bradley appeared as nothing more than a hot spot. This was further restricted during periods of limited visibility to no more than 600 meters.

(3) In inclement weather, positive target identification was extremely difficult at ranges greater than 500-600 meters.

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5. The Muzzle Reference System (MRS) worked well to retain boresight. While units boresighted once or twice daily before initiation of the ground war, they did not boresight after crossing into Iraq and Kuwait due to time constraints. Instead, they relied on only MRS updates to keep their rounds hitting where they aimed.

6. A turret positional locator needs to be incorporated into the GPS.

7. A stadia reticle for the Gunner's Auxiliary Sight (GAS) will facilitate use of the coax and main gun.

8. A wiper/hood for the GPS is a must. An active wiper system, actuated by the gunner (foot pedal), and stows out of the line of sight when not in use, would meet this requirement.

9. A barometric pressure/temperature gauge is needed in the turret. Often the weather data is from stations where the current conditions are significantly different than those at the vehicle's location.

10. The task to make the emergency mode drift adjustment should be a crew level task as opposed to a support maintenance level task.

(c) Survivability:

1. Crews were supremely confident in the overall survivability of the M1A1.

2. Currently, there is only one reported incident of an armored crewman being killed while in an M1A1, and this was only after the tank had been struck by three main gun rounds.

3. The vehicle fire suppression system works superbly. It allowed 20-30 seconds for crew evacuation before secondary explosions reignited fires.

4. Ammunition blowout panels also worked well.

(d) General Comments:

1. The coax ammunition well needs to be modified. Its current configuration does not facilitate maintenance and disassembly of the breechblock.

2. Need to relook at quick-change ammunition packs. The time it takes to reload the ready/semiready storage wells could be critical in a high intensity environment.

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3. Study increased bustle rack storage space. The majority of units felt that it is inadequate for sustained operations.

4. Mine plows, rakes, and the Cleared Lane Marking System (CLAMS) received high praise. Vehicles with mine plows were able to maintain a much higher speed than originally expected. Except for extra strain placed on the number one shock absorbers, the mine plows worked well. While the plows worked well in the soil of SWA, we must continue to improve its capability in other types of terrain. Conversely, units did not like the mine rollers because of the significant degradation in speed and the their inability to effectively deal with double impulse mines.

5. A positional readout is needed at both the driver's and gunner's stations.

6. A driver's thermal viewer system should be included in future vehicle developments.

7. A dismount kit, pistol grip, buttstock, and bipod, should be issued for the loader's M240. The M240 is critical when establishing local security, and if the vehicle is disabled it gives the crew a better chance for survival.

8. Need to incorporate a turret positional locator into the GPS.

9. Initial indications are that commanders prefer DF2 to JP8 because of the on-board smoke capability that DF2 provides and the increased fuel consumption and heat generated by JP8, JET A or JP5.

(2) The M2/J received high marks for its excellent mix of firepower, mobility, and survivability.

(a) Its improved transmission, armor protection, and devastating 25mm gun and Tube-launched, Optically-tracked, Wire-guided (TOW) missile combined to produce an extremely lethal weapon system.

(b) The Bradley's OR rate was comparable to that of the Abrams.

(c) The 25mm Bushmaster auto-cannon was often the weapon of choice with reports of its Armor Piercing Discarding Sabot (APDS) round penetrating all Iraqi tanks at ranges of less than 700 meters.

(d) The M2/J needs a Laser Rangefinder (LRF); the handheld just doesn't fill the bill.

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- (e) Commanders liked the M3 in the reconnaissance role in desert operations.
- (f) Bradleys experienced problems similar to those of the Abrams with their V-packs, but had no cleaning wands as part of the vehicle Basic Issue Items (BII).
- (g) Commanders liked the on-board smoke capability and would have preferred DF2 to Jet A-1/JP8 for this reason.
- (h) Crews were pleased with the 600 hp power plant and its transmission. However, commanders would like to have reverse gear performance similar the one on the Abrams.
- (i) M2/3 vehicle exhaust location is a problem. Its current position blows directly into the Bradley Commander's (BCs) face. BCs find this nauseating; and if the wind is blowing across the vehicle, the heat will wash out the thermal sight.
- (j) Stowage should be improved. There is not enough internal space for either a 9-man infantry squad or a 5-man scout squad's gear. Likewise, crews jury-rigged equipment tie downs to stow gear externally.
- (k) M3A2 Engine Compartment Access Door Pumps are unsatisfactory. Initial reports are that units experienced up to a 50 percent failure rate.
- (l) Scout optics must improve. In many cases, the surveillance equipment of scout platoons could not outrange the systems in the battalion formation.
- (3) Other stellar performers were the High Mobility Multi-Wheeled Vehicle (HMMWV), the Heavy Expanded Mobility Tactical Truck (HEMT-T), and the 900-series 5-ton trucks. One division commander was so impressed with their performance that he recommended that these be the only wheeled vehicles at division level and below.
- (4) We need to retain armed, armored reconnaissance vehicles at all levels. Armed reconnaissance provides the capability to fight for intelligence. Armored vehicles increase survivability which in turn gives scouts greater confidence.
- (5) As well as the Abrams and Bradley performed, it has become obvious that force package modernization is required in other areas. The M113/M577 family of vehicles was unable to keep pace with the Abrams and Bradley and needs to be replaced. The exception to this observation is the M113A3 variant which has received excellent reports from all units that were equipped with it. The M113A3 is the answer for the First Sergeant's (1SG) armored vehicle.

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(6) The M577 was inadequate as a Command and Control (C2) vehicle during the operation. Similarly, the FIST-V was unable to keep up. The need for new, perhaps Bradley/Multiple Launch Rocket System (MLRS) based, Command, Control, Communications, and Intelligence (C3I) and FIST vehicles is clear.

(7) The need for new C2 vehicles applies to both the commander's fighting vehicle and the actual command post vehicle. Both must be able to operate on the move with the commander's vehicle providing an efficient and stable platform from which the commander can control the battle.

(8) Additionally, previously identified shortcomings of the M88 were reconfirmed in the desert. It was consistently unable to perform its vehicle recovery mission. Primary problem areas were:

- (a) It could not keep up with the Abrams and Bradley.
- (b) It could not tow the M1A1.
- (c) It had a low OR rate.

(9) Positive Navigation (POSNAV) systems have proven vital to our ability to mass combat power. However, their use is not only applicable to the combat arms but also to combat support and combat service support units for command and control. For combat units to maintain effectiveness and combat power, CS and CSS units must be able to rapidly support them. Every organization, if not vehicle, should have a POSNAV device. Whether in the Saudi Arabian desert or in densely wooded or jungle terrain, these systems have universal applicability. Not only are they great for navigational purposes and key to massing combat power, but they also proved to be a valuable tool for calling and directing indirect fires. An Abrams could determine its position, laser to a target, and develop an accurate grid for fire support missions. Finally, POSNAV systems aided combat identification.

(10) A combat identification system is badly needed. This system will be beneficial in two key areas.

- (a) Command and control will be enhanced on the high tempo non-linear battlefield.
- (b) It will assist in the Identification of Friend or Foe (IFF) and consequently reduce the possibility of fratricide.

(11) A lightweight standard route marking system will facilitate control of Main Supply Routes (MSR) and enhance CSS operations.

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(12) HETs are absolutely critical for the conduct of mobile armored warfare. Commanders at all levels have indicated the need for HETs.

(13) Countermine equipment (CME) worked well. However, we need some kind of CME for the M2/3.

(14) Our communications capabilities must also be improved.

(a) Our current generation of radios must be updated if we are to fight effectively on high tempo battlefields.

(b) The fielding of new communications equipment should be accelerated. One corps reported that it had three generations of radios.

(c) Command posts also need more OE-254s and quick erect antenna masts (QUEM).

(d) Better long range capabilities are needed. We must enhance the AM capabilities in battalions and above. The AN/VRC/193 performed well and provided tremendous range.

(e) An effective means of producing and transmitting hard copy orders is vital.

(f) Communications equipment for combat service support elements is not sufficient. Support platoons, medics, and maintenance elements require secure radios and navigational devices.

(15) A 1:100,000 scale map should be the standard in the desert.

(16) Soldier Support Issues:

(a) A better flak jacket for the Tank Commander (TC) and loader is needed. The current spall vest does not adequately protect these crew members because of their greater exposure outside the tank. Specific improvements are greater overall ballistic protection and a collar similar to that on the standard issue vest.

(b) While the Combat Vehicle Crewman (CVC) uniform was worn extensively and well liked, a more durable and, if possible, a chemically protective Nomex uniform for armored vehicle crew members is needed. The stitching on the uniform results in it coming apart at the seams, particularly in the seat and on the gloves.

(c) The balaclava needs to be redesigned; it is too bulky and uncomfortable to wear under the CVC.

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(d) The micro-climate vest is uncomfortable. It is too bulky and uncomfortable when worn with ballistic vest and the Nuclear, Biological, and Chemical (NBC) protective gear. Additionally, the cooling tube chafed the neck.

(e) Armored vehicle crewmen need their own Load Bearing Equipment (LBE), preferably something similar to the aviator's survival vest. The current LBE that is standard issue is too bulky to be worn in an Abrams or Bradley and worse, creates a safety problem by easily snagging in the turret.

(f) Ballistic Laser Eye Protection (BLEP) goggles were not widely used. They were uncomfortable and scratched too easily.

(g) It should be SOP that leather boots only are worn by armored vehicle crewmen, to include BFV mounted infantry, or some type of fire retardant/proof boot needs to be developed.

(h) The clothing bag for all soldiers needs to be simplified. Light infantry units have greatly simplified their issue with Gortex items, for example: a Gortex parka with liner(s) can replace the field jacket, wet weather top, and parka. The same is true for Gortex overpants.

(i) We need portable showers for our soldiers.

(j) We must work to make armored vehicles more inhabitable:

1. A sleep restraint system.
2. An onboard capability to heat water and rations.
3. A bustle rack cover to protect items in the bustle rack from catching fire and to protect them from the elements.

e. Leader Development.

(1) Overall, leadership was superb at every level. Company Commanders were prepared for combat and NCOs are technically competent. The high standards maintained in Armor Center schools paid great dividends during this conflict. The fact that leaders were able to work effectively from mission orders and commander's intent was key to the success of the campaign. There were a few comments concerning leader shortcomings, but no trend has developed.

(2) How do you improve upon a leadership training system that appears to be working well? The best way is to look at future challenges. Force reductions and reduced operating budgets will remain a feature of military life through the end of the century. With these cutbacks, the need to incorporate new technologies, materiel, and training will continue. Leaders of

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the future will need to remain tactically proficient, being able to harmonize combat and noncombat operations. Additionally, these leaders will fight on a non-linear battlefield. Future leaders must also be technically proficient in the use of computers, information systems, and the high-tech equipment under their control. Finally, future leaders must be versatile and be able to accomplish a wide variety of missions and assignments.

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CHAPTER 2

BATTLE SUMMARIES

a. The following pages are intended to give a general overview of the pre-Desert Shield situation in SWA, review the events in the Kuwaiti Theater of Operations (KTO) during the 4 days of ground combat, and then finally look at the major engagements that involved armor and cavalry forces. The primary sources for the information displayed on individual battles came from the 1991 Armor Conference. The list below is a table of contents of the slides included.

b. Slides 1 - 2 (Pre Desert Storm Military-Geo/Political situation).

c. Slides 3 - 12 (Ground Campaign Review).

d. Slides 13 - 41 (Major Engagements).

(1) Khafji.

(2) 1st Cavalry Division Deception Operations.

(3) 6th French Armored Division (Light) Screen Operations.

(4) 1st Infantry Division (Mechanized) Breaching Operations.

(5) 1st USMC Division attack to Kuwait International Airport.

(6) 1st Armored Division and the Battle for Al Buzayyah.

(7) 24th Infantry Division (Mechanized) at Tallil and Jalibah.

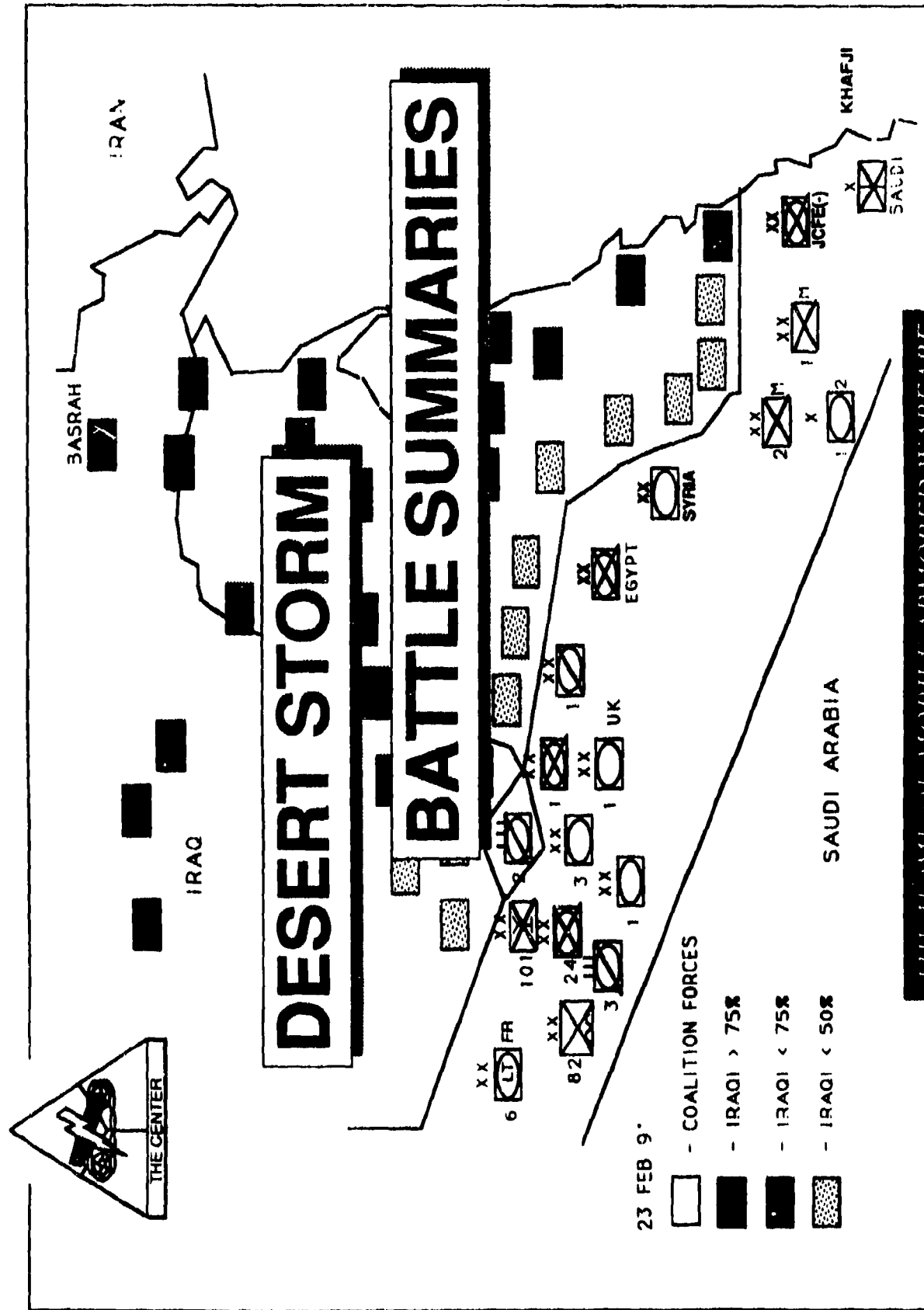
(8) 2nd Armored Cavalry Regiment and the Battle of 73 Easting.

(9) 1st Armored Division and the destruction of the Republican Guard.

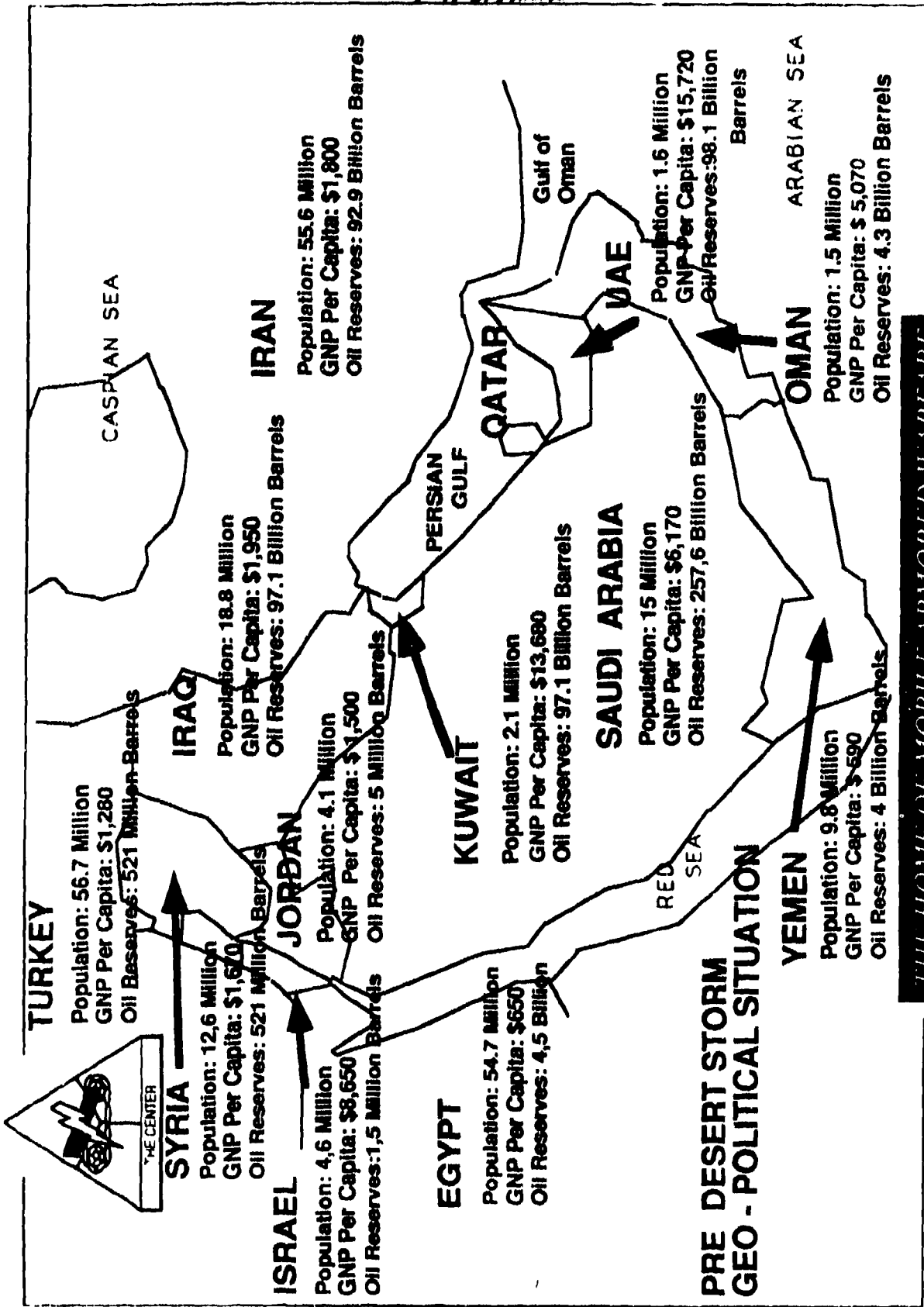
(10) 3rd Armored Division and the destruction of the Tawakalna, 12th AD and 10th AD.

(11) Capture of Safwan Airfield.

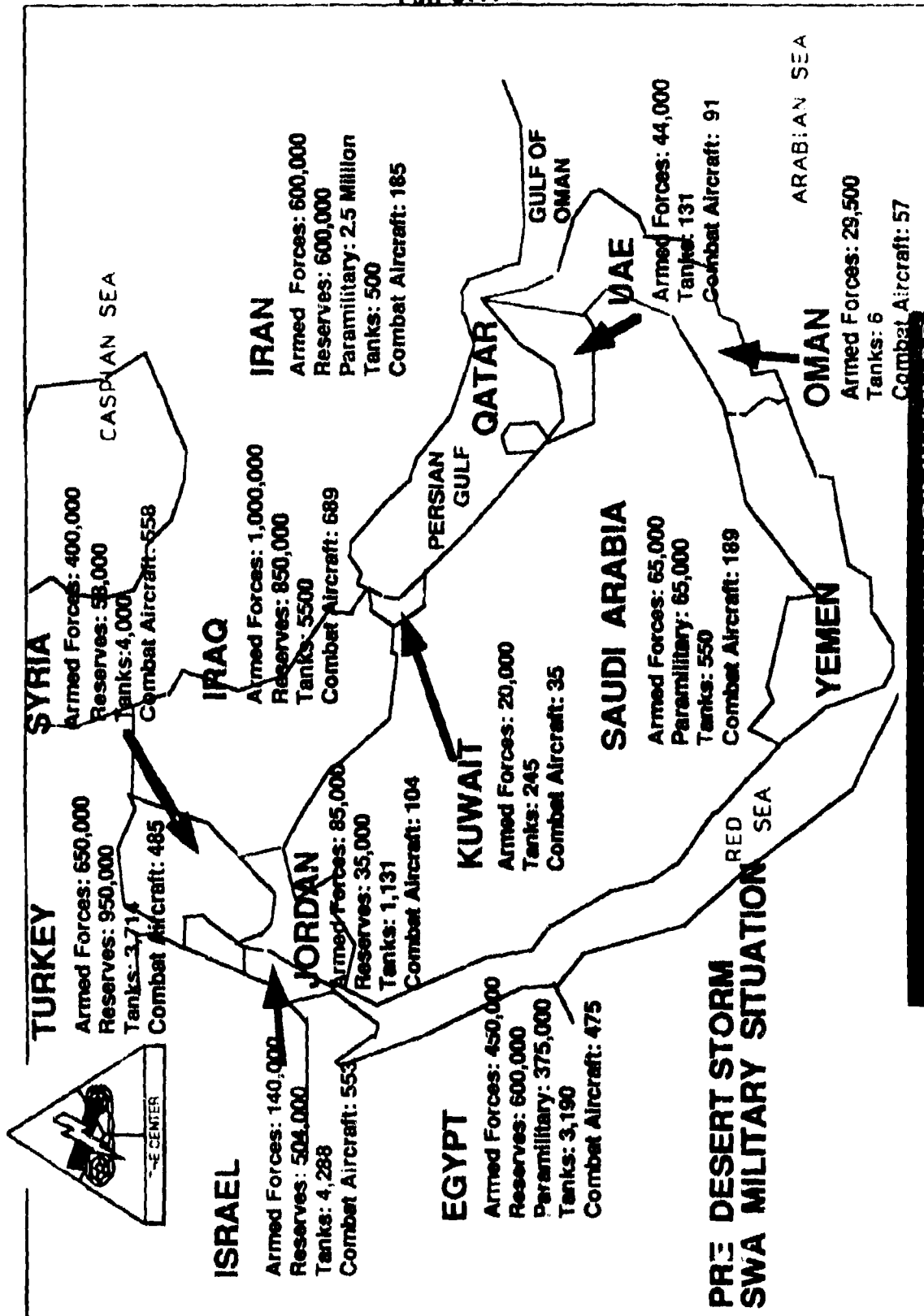
(12) 24th Infantry Division (Mechanized) and the Battle of Rumaylah Oilfields.



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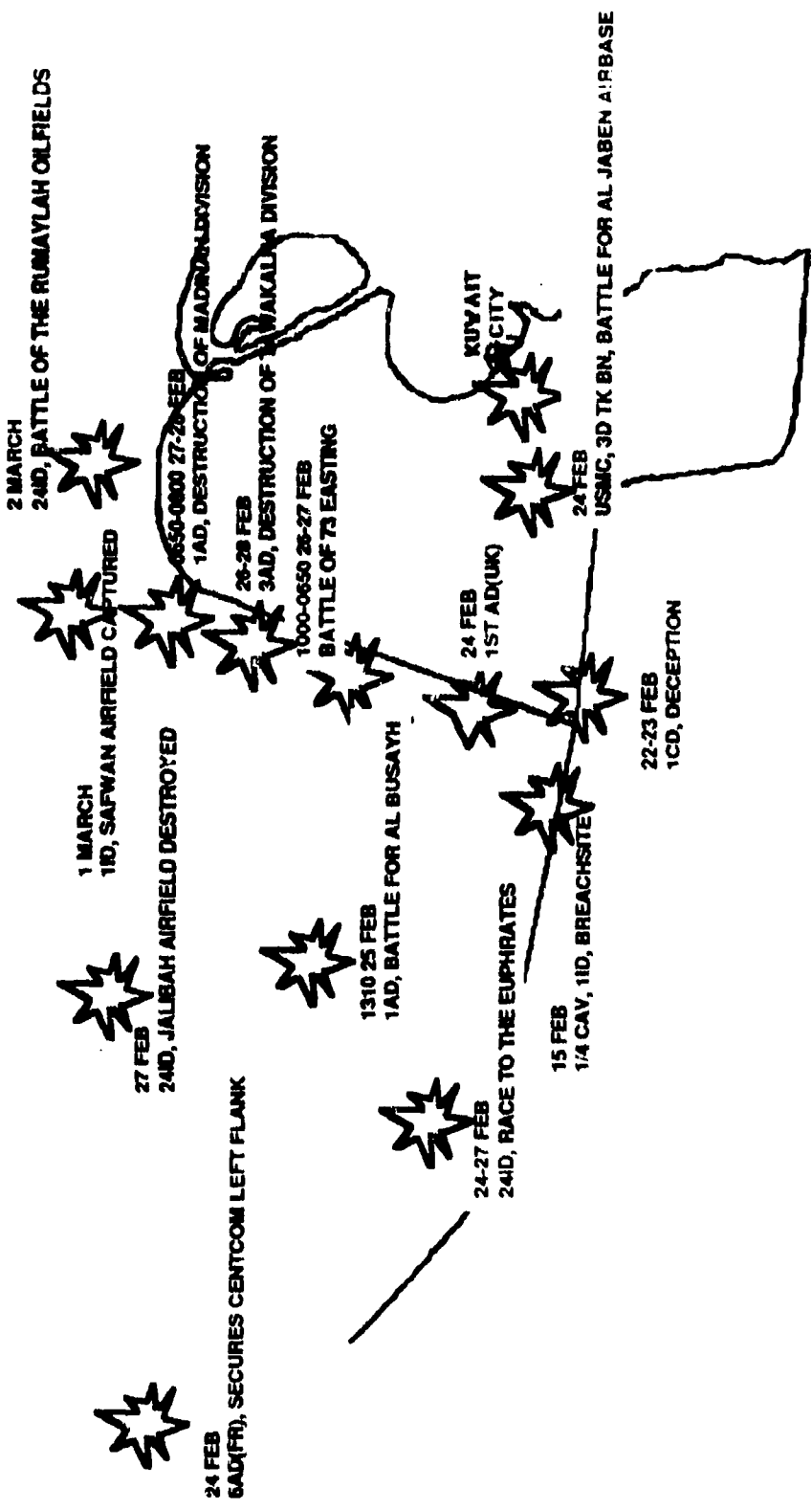
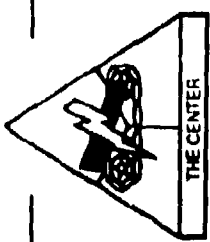
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TOP SECRET

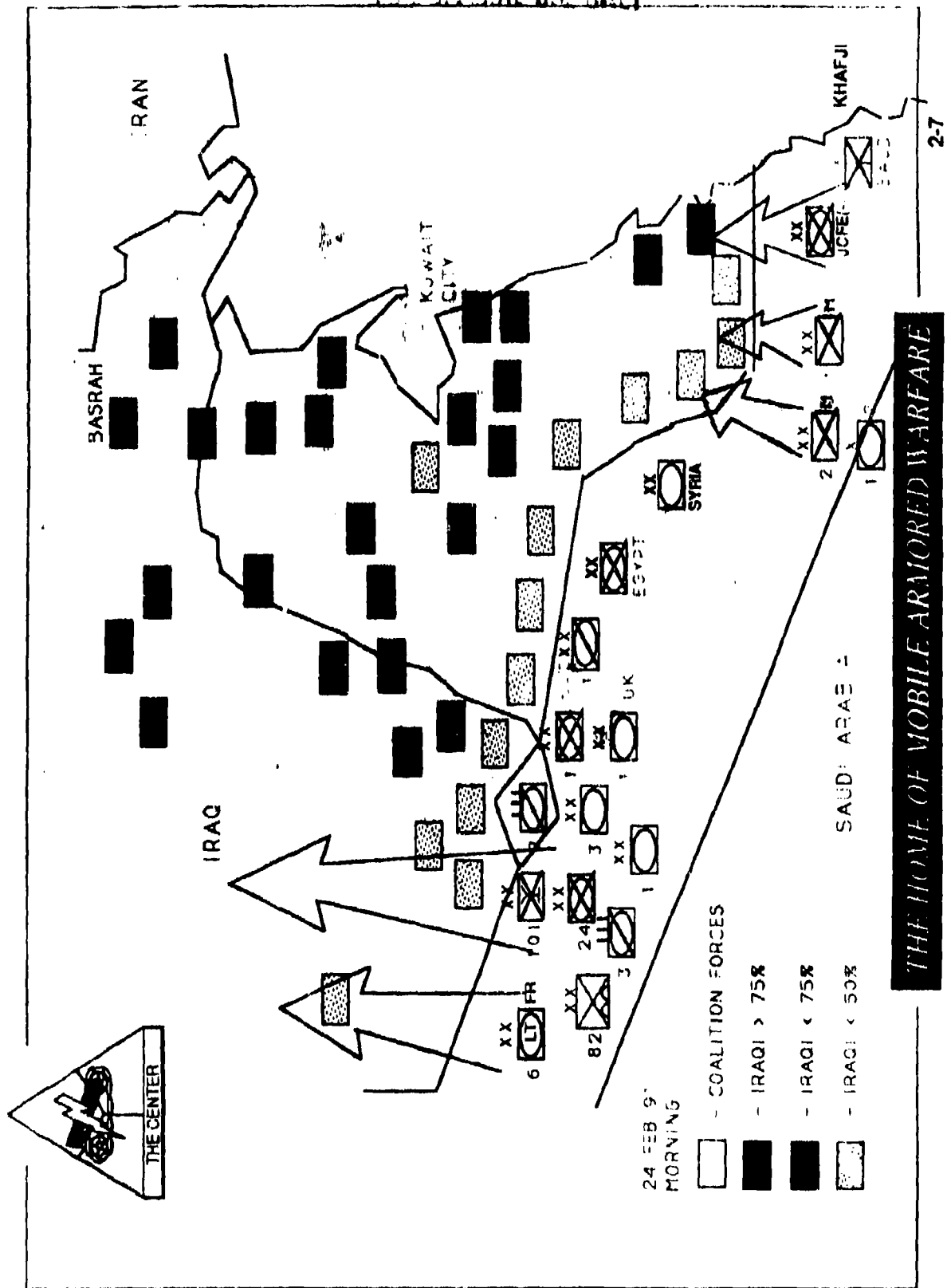
MAJOR EVENTS



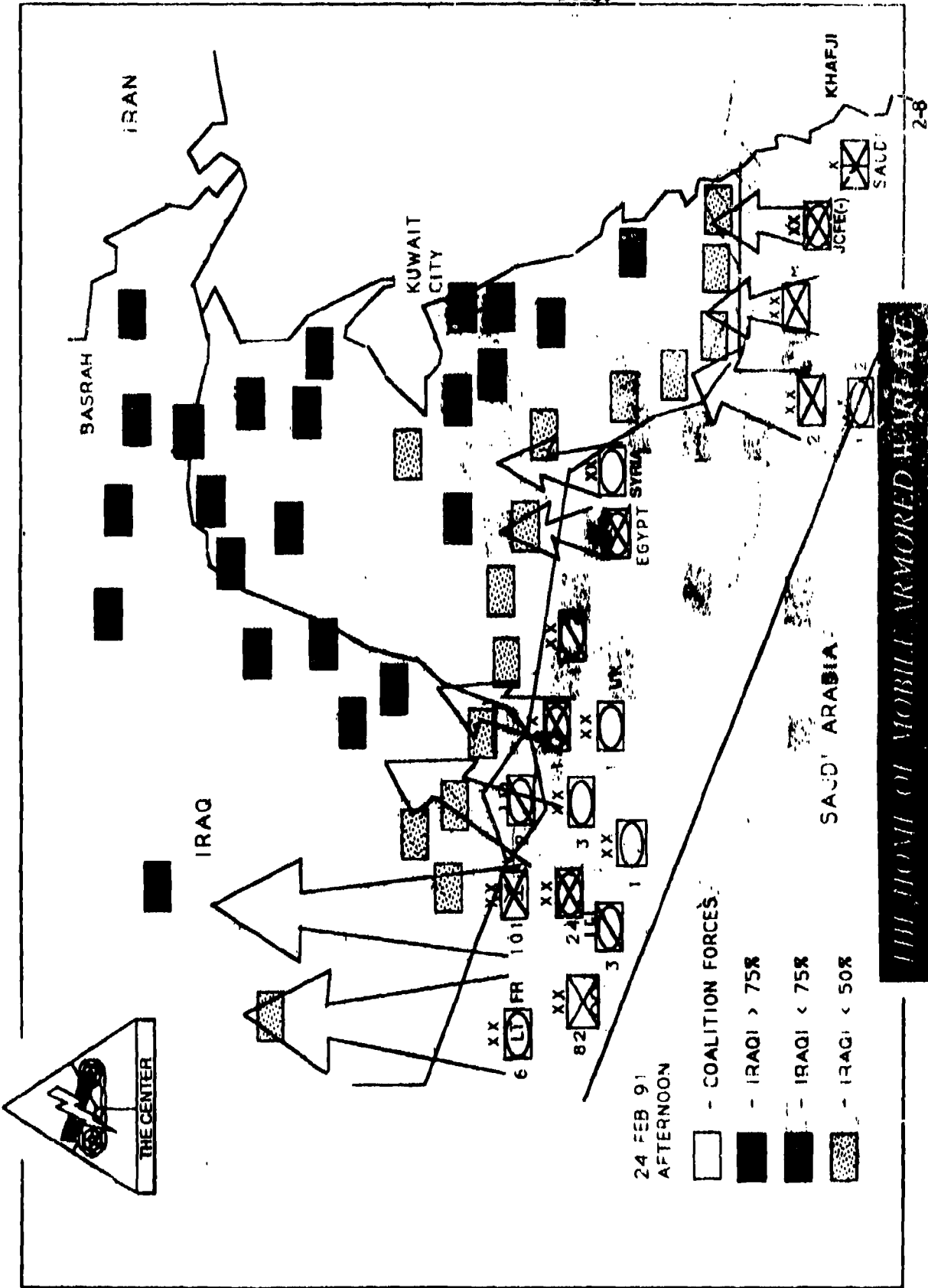
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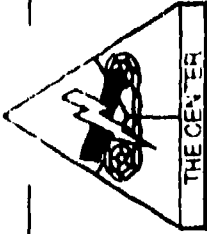
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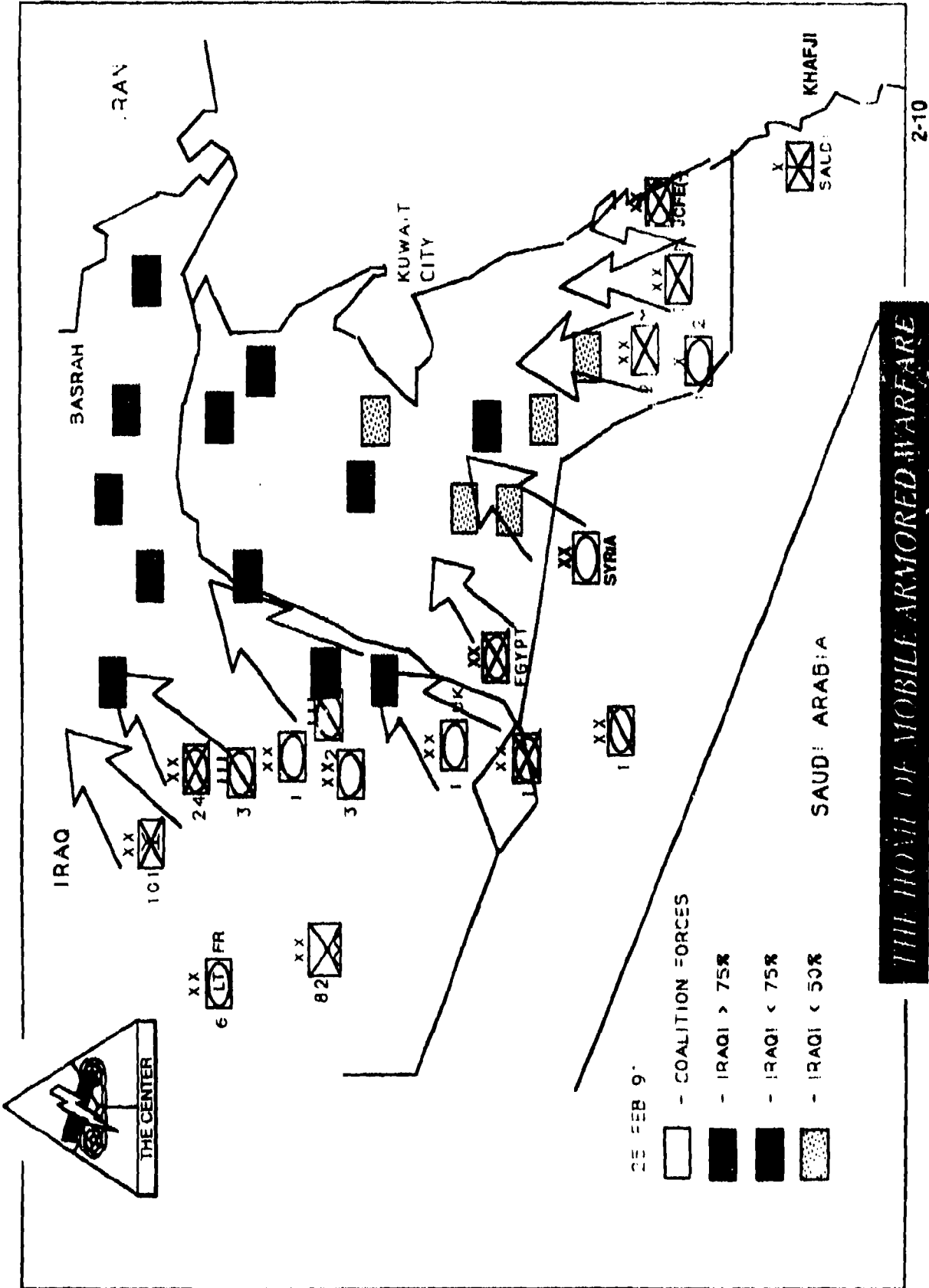
24 Feb 1991 Kuwaiti Theater of Operations

The ground campaign started on 24 February 1991 with a multi-pronged attack. In the west, XVIII Airborne Corps (ABC) launched the 101st Abn Div (AASLT) and the 6th French Armored Division (Light) 60 kms into Iraq to seize the As Salman Airfield and a forward operating base. In the east, the 1st and 2nd Marine Divisions along with the US Army Tiger Brigade, attacked simultaneously, breached the Iraqi defensive line and advanced toward Kuwait City. Along the coast, Saudi-led coalition forces breached defensive barriers and joined the assault.

Taking advantage of early success, and spurred by reports of atrocities in Kuwait, ARCENT ordered VII Corps and elements of the XVIII ABC to attack fifteen hours earlier than planned. The 24th ID (M) and 3rd ACR led a ground assault deep into Iraqi territory to link up with the 101st ABN DIV (AASLT), to establish forward logistics bases, and to move north to intercept Iraqi lines of communication along the Euphrates River. In VII Corps' sector, 1st ID (M) breached Iraqi defensive positions and attacked north, followed by the 1st (UK) Armored Division. 2d ACR, 1st and 3d Armored Divisions, attacked rapidly in zone, by-passing enemy positions. By the end of 24 February, all major coalition forces were engaged.

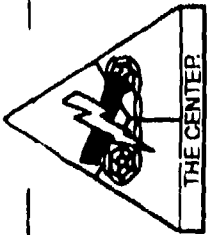
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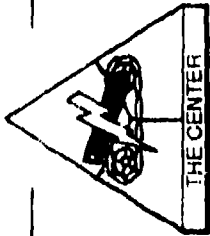
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25 Feb 1991 Kuwaiti Theater of Operations

From the onset, large numbers of Iraqi troops surrendered, allowing rapid advances in all sectors. On 25 February, Saudi and Egyptian forces attacked into Kuwait, fixing Iraqi forces in place along the Saudi-Kuwaiti border. In the west, the 82d ABN DIV conducted operations to secure supply routes and forward logistics bases, while the 6th French Armored Division guarded ARCENT's left flank. The 101st ABN DIV (AASLT) and 24th ID (M) secured blocking positions near the Euphrates River. VII Corps pressed its attack with the 1st (UK) Armored Division, passing forward through the 1st ID (M). 1st and 3d Armored Divisions drove north in preparation for a turning movement to the east. The Tiger Brigade (1st Bde, 2AD) attached to the 2nd Marine Division assumed the spearhead of the Marine attack towards Kuwait City.

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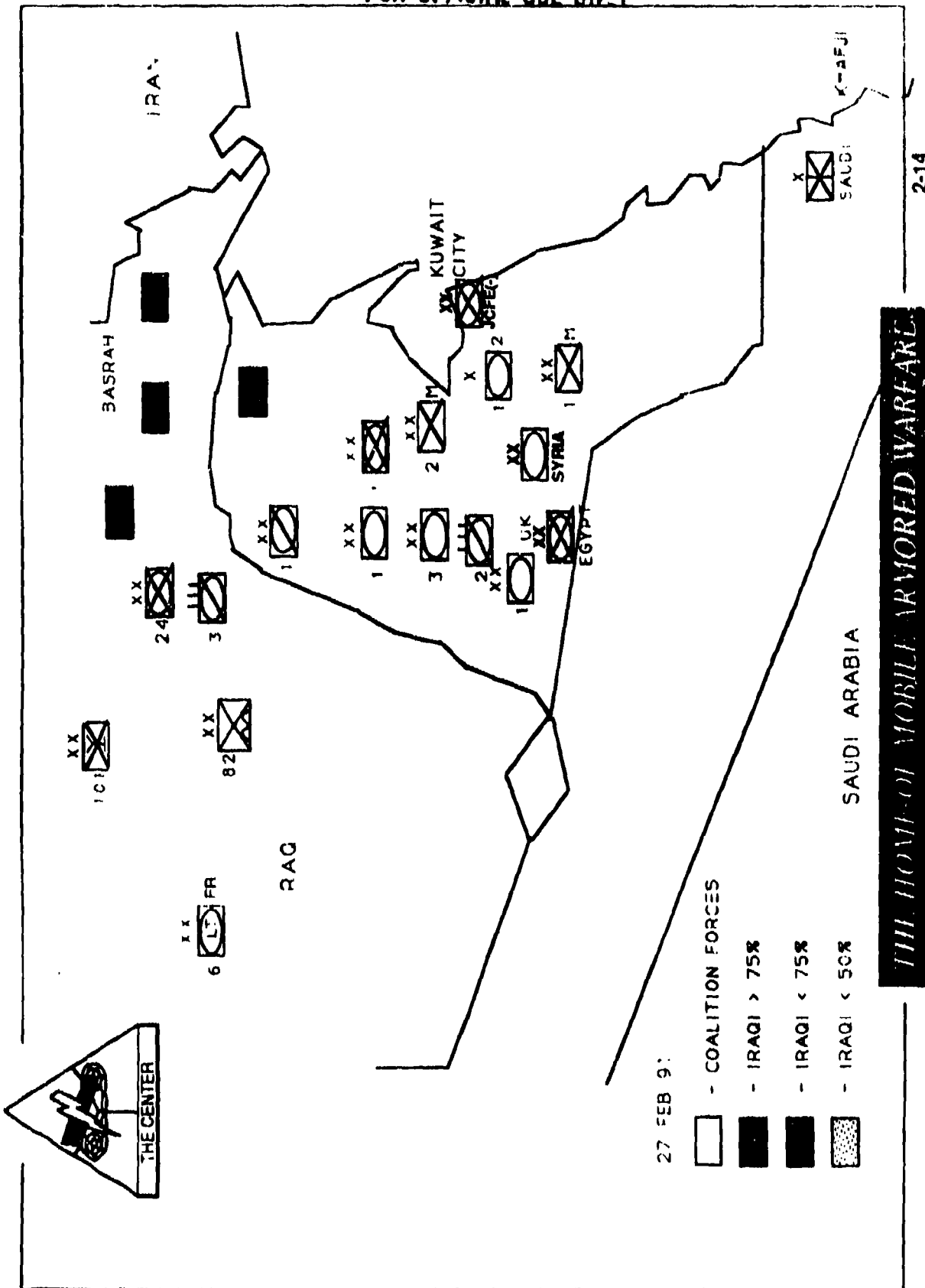
26 Feb 1991 Kuwaiti Theater of Operations

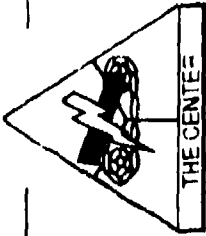
On 26 February, elements of XVII ABC and VII Corps turned to the east to destroy elements of the Iraqi Republican Guard. Having driven 150 kms into Iraq, the 24th ID (M) and 3d ACR turned east toward Basrah to cut off retreating Iraqi forces. VII Corps units turned east to attack the Iraqi theater reserve, composed of Republican Guard units situated southwest of Basrah. During the night, VII Corps conducted a coordinated attack that resulted in the destruction of the Tawakalna and Madinah Republican Guard Divisions. Coalition forces, notably 1st and 2d Marine Divisions, along with the Army Tiger Bde, reached the outskirts of Kuwait City and fought for control of the International Airport.

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27 Feb 1991 Kuwaiti Theater of Operations

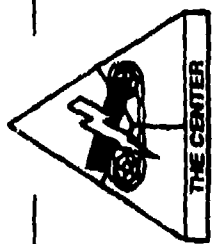
On 27 February, Kuwait City was liberated, almost all Iraqi divisions in Kuwait were defeated, and the Republican Guard was virtually destroyed. The 24th ID (M) drove east toward Basrah, while the 1st and 3rd Armored Divisions attacked east with the 1st ID (M) attacking deep to seize control of northern Kuwait and Iraq south of Basrah. Coalition forces liberated Kuwait City, while the 1st and 2d Marine Divisions secured the outskirts of the city. U.S. and Coalition forces had destroyed or rendered ineffective 43 Iraqi divisions when President Bush ordered a suspension of offensive combat operations at 2100 hours EST, 27 February. After the suspension of offensive operations was implemented, effective 2400 hours EST, 27 February, focus shifted to consolidation of the battlefield, defensive operations, reconstitution, and the reconstruction of Kuwait.

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KHAFJI
29 - 31 JAN 91

IRAN

PERSIAN GULF

KUWAIT

AL WAFRA

KHAFJI

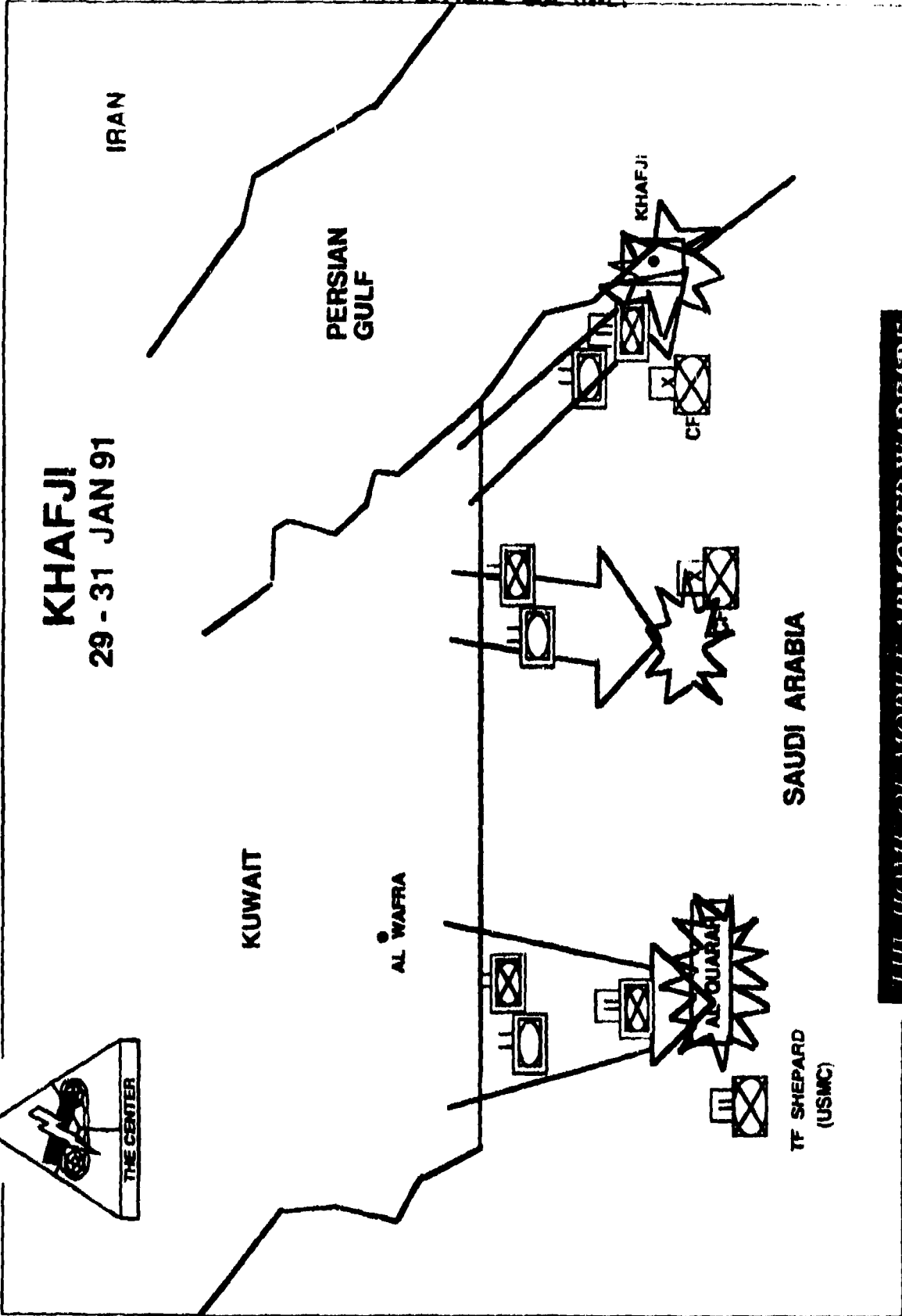
SAUDI ARABIA

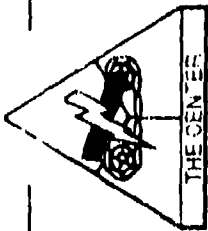
TF SHEPARD
(USMC)

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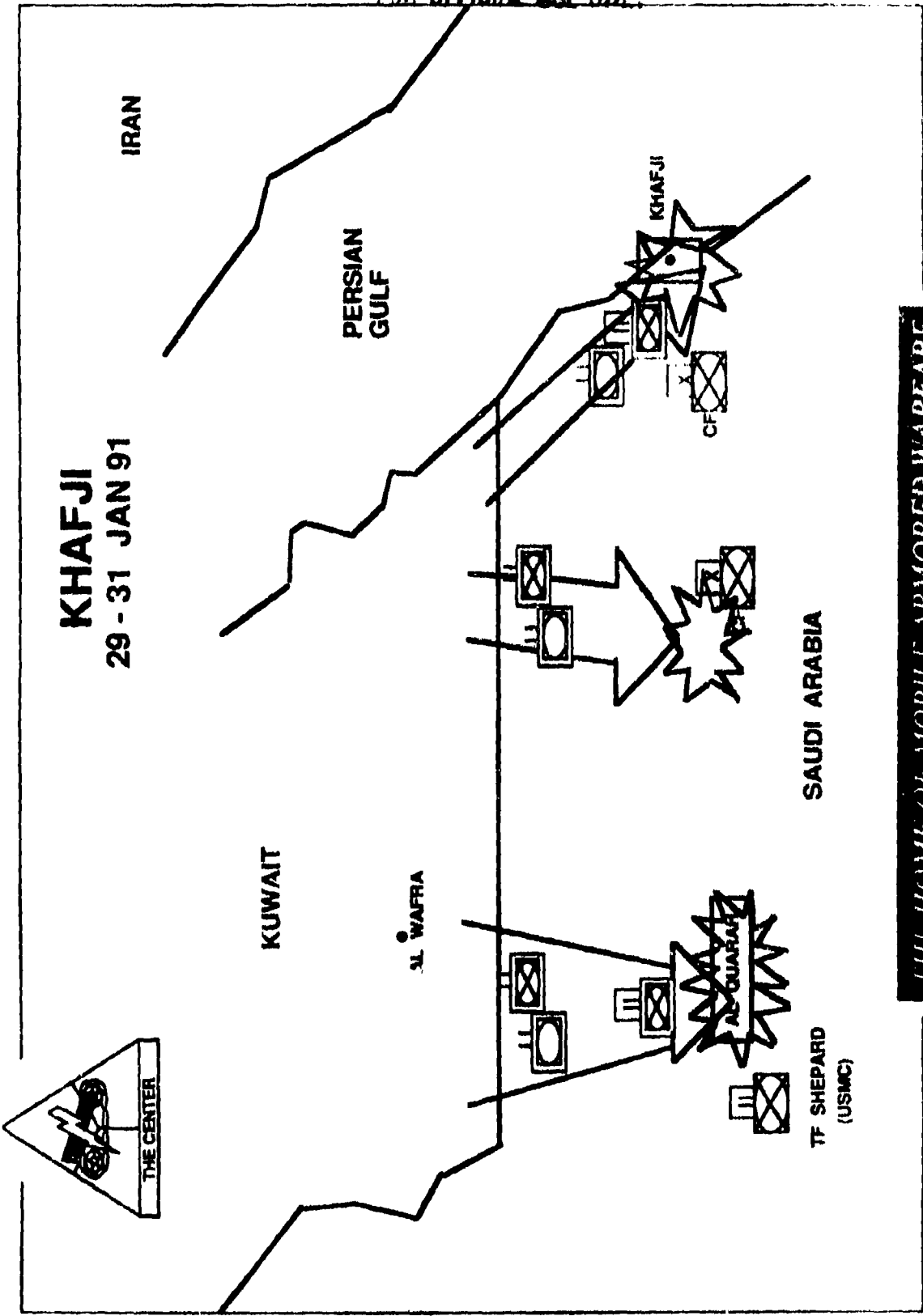


27 Feb 1991 Kuwaiti Theater of Operations

On 27 February, Kuwait City was liberated, almost all Iraqi divisions in Kuwait were defeated, and the Republican Guard was virtually destroyed. The 24th ID (M) drove east toward Basrah, while the 1st and 3rd Armored Divisions attacked east with the 1st ID (M) attacking deep to seize control of northern Kuwait and Iraq south of Basrah. Coalition forces liberated Kuwait City, while the 1st and 2d Marine Divisions secured the outskirts of the city. U.S. and Coalition forces had destroyed or rendered ineffective 43 Iraqi divisions when President Bush ordered a suspension of offensive combat operations at 2100 hours EST, 27 February. After the suspension of offensive operations was implemented, effective 2400 hours EST, 27 February, focus shifted to consolidation of the battlefield, defensive operations, reconstitution, and the reconstruction of Kuwait.

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KHAFJI
29 - 31 JAN 91

IRAN

PERSIAN
GULF

KUWAIT

AL WAFRA

KHAFJI

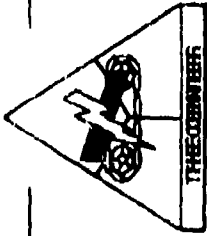
SAUDI ARABIA

TF SHEPARD
(USMC)

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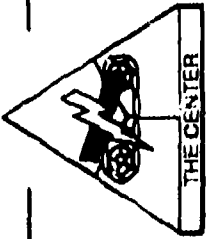
KHAFJI 29 -31 JAN 91

1. Probably due to their inability to gather intelligence information through any other means, the Iraqis launched a series of large attacks beginning late on 29 Jan 91.
2. The first attack, consisted of a mechanized task force, and emerged from the Wafra area of Kuwait at 2300 hrs 29 Jan 91. The Iraqis attacked due south and ran into US Marines of the 3rd Marine Regiment of the 1st Marine Division. The marines called for air and artillery support and engaged the Iraqis with direct fire weapons.
3. Shortly after this first attack (2330 hrs 29 Jan 91) a second Iraqi task force left Kuwait and attacked down the coast road towards Khafji. The lightly defended roadblocks were quickly overwhelmed and the deserted town was soon in Iraqi hands.
4. A third Iraqi assault was launched from the same area as the first and attacked in the same general direction. This force consisted of an armored battalion and a mechanized battalion and attacked at 0900 hrs 30 Jan 91. After an intense battle with US Marines, the Iraqis withdrew, leaving behind 24 tanks, 12 APCs, and over 100 casualties.
5. A final assault emerged from Kuwait in the area between the first three at 1000 hrs 30 Jan 91. This force consisted also of a mechanized battalion and an armored battalion and advanced 15 miles south before confronting Saudi and Qatari defenders. After a short intense battle, the Iraqis withdrew with heavy losses.
6. On 31 Jan 91 Saudi and Qatari forces counterattacked Khafji and after hours of fighting regained the town. The Iraqi force defending the Khafji lost 300 dead and 450 prisoners.

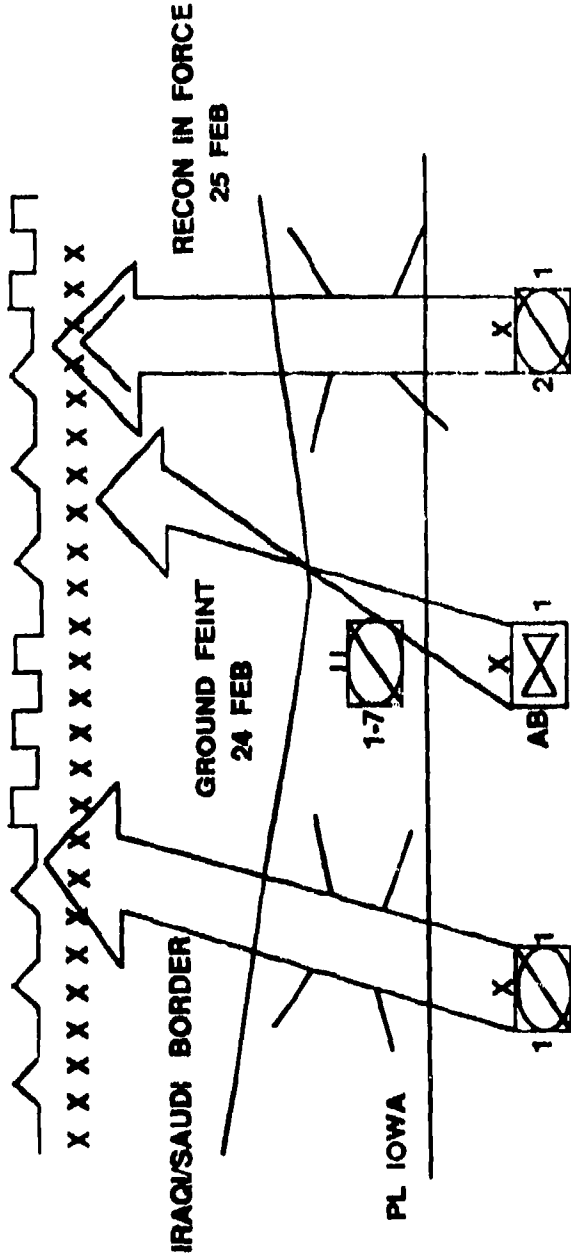
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BORDER SCREEN / DECEPTION OPERATIONS

(1ST CAVALRY DIVISION 7-25 FEB 91)

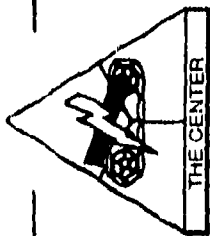


FIRE TRENCHES



PL CALIFORNIA

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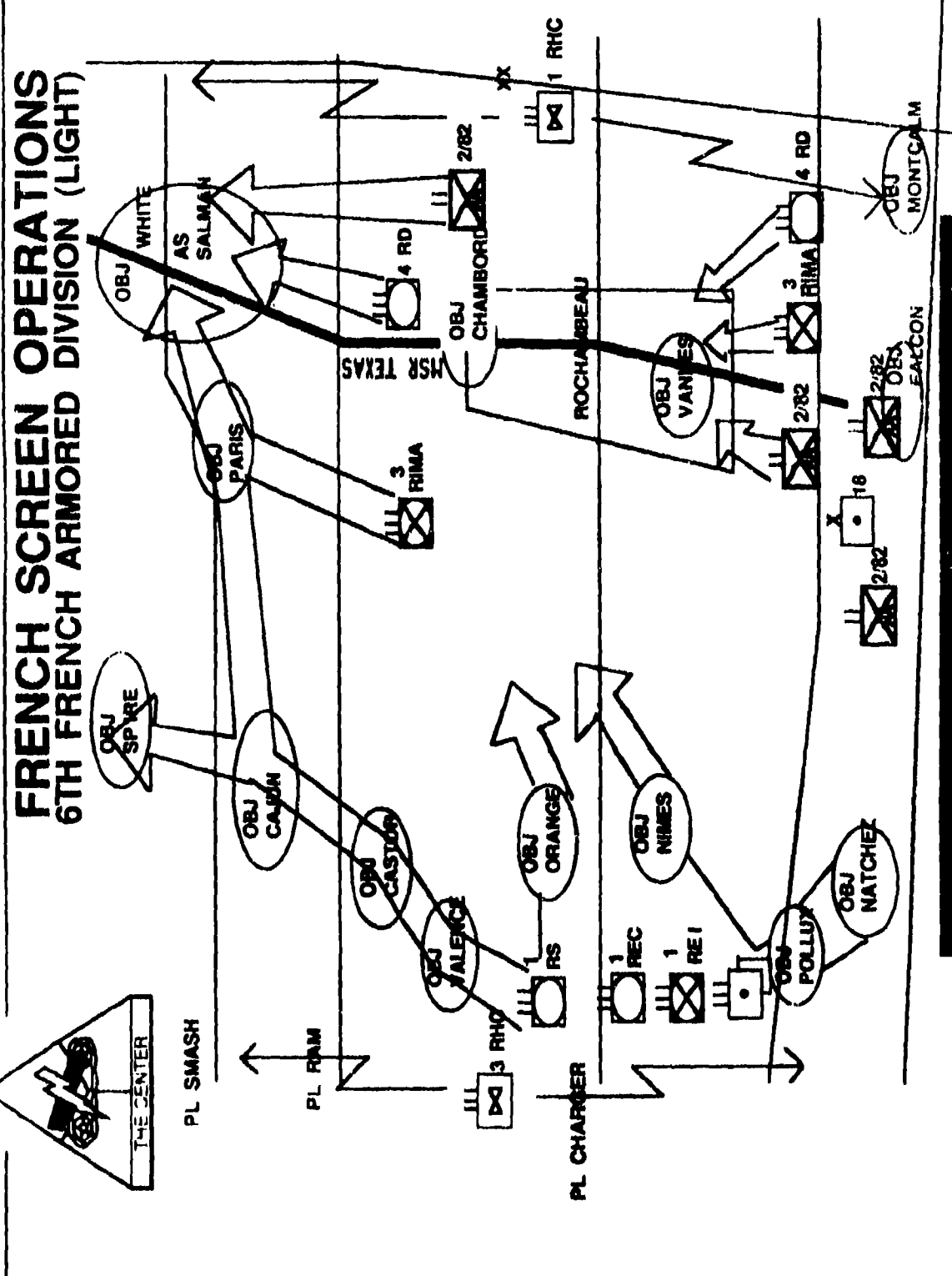
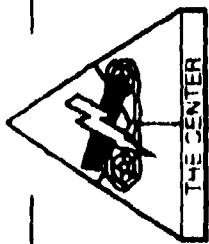
BORDER SCREEN/DECEPTION OPERATIONS

(1ST CAVALRY DIVISION 7-25 FEB 91)

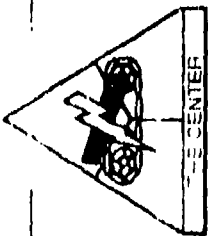
- THEATER DECEPTION
 - ARTILLERY RAIDS
 - OBSTACLE REDUCTIONS
 - RECONNAISSANCE IN FORCE
 - FEINTS AND DEMONSTRATIONS
- DECEPTION RESULTS
 - DESTROYED ELEMENTS OF 2+ DIVISIONS
 - DESTROYED ELEMENTS OF A CORPS ARTILLERY GROUP
 - CAPTURED 1800 ENEMY PRISONERS
 - DECEIVED IRAQI COMMAND

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FRENCH SCREEN OPERATIONS 6TH FRENCH ARMORED DIVISION (LIGHT)



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FRENCH SCREEN OPERATIONS

CHRONOLOGY

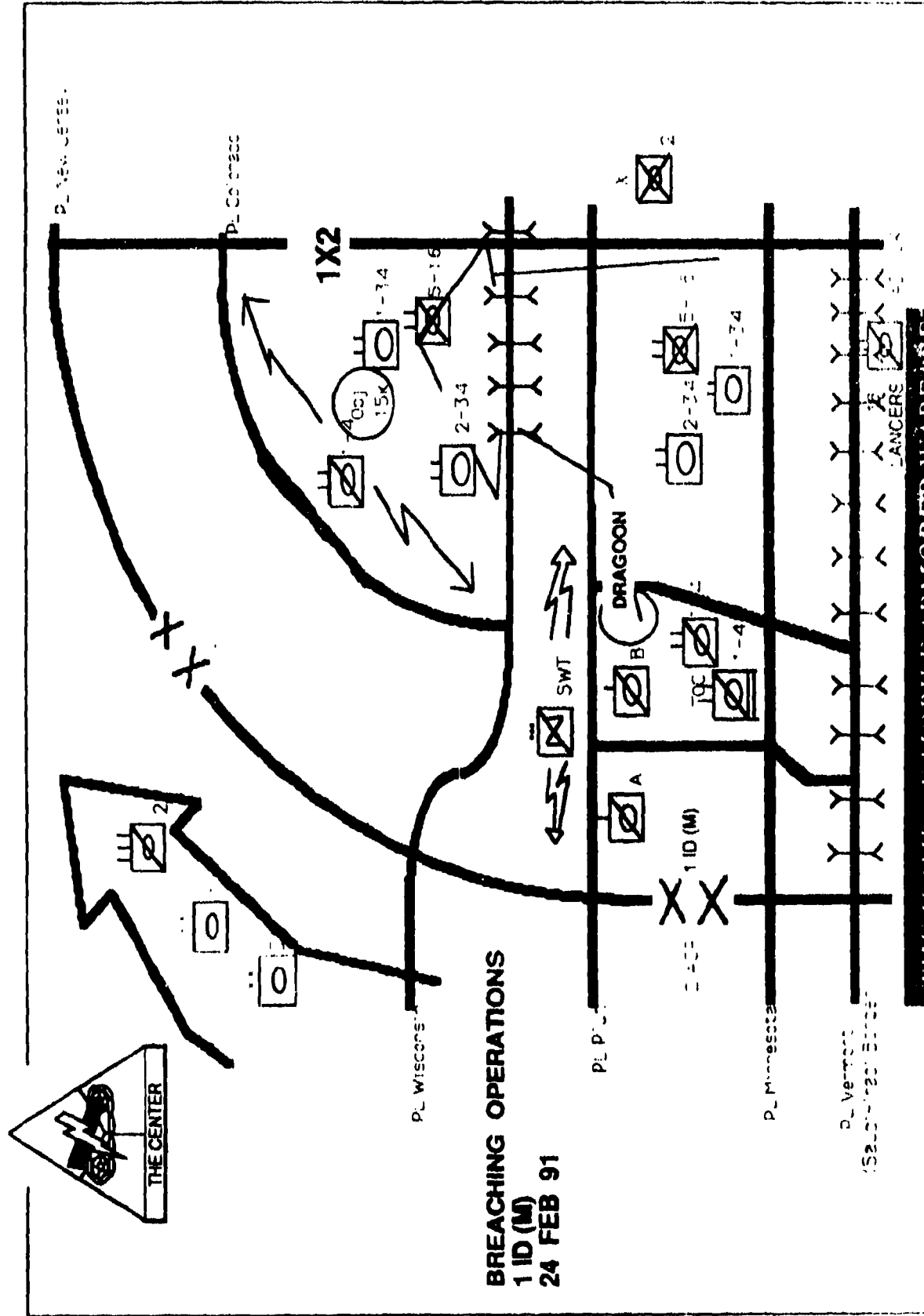
6TH FRENCH ARMORED DIVISION (LIGHT)

- 23 February - The first among all coalition units, the Division Daguet entered into Iraq and took control of the escarpment which dominated the frontier at three points; NATCHEZ (2nd REI), FALCON (2/82 Abn), and MONTCALM (3rd RIMA).
- 24 February - The division jumped off using two task forces. The eastern task force swept the resistance from ROCHAMBEAU by a flank attack in the early afternoon. More than 2000 prisoners were captured by the end of the day. The western task force seized Objectives NIMES, ORANGE SPIRE, CAJUN, CASTOR, and VALENCE.
- 25 February - The eastern task force continued to open up MSR TEXAS while the western task force deployed towards Objective Paris and seized the airfield near As Salman. Around 1730 hrs the Division Daguet notified the XVIII ABC that MSR TEXAS was secured.
- 26 February - Division forces took the village and crossroads at As Salman.
- Having met their objectives, the Division Daguet returned the two OPCON US brigades (282nd Airborne Division and 18th Field Artillery Bde) to XVIII ABC control. The mission of the division after 26 February became one of a covering force for the Coalition's western flank. The Division Daguet kept this mission until relieved by the VII Corps and withdrawal from Iraq on 25 March 1991.

- Key to French units:

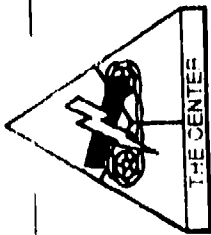
RD - Armor Regiment, RS - Armored Cavalry Regiment, REC - Armored Cavalry Regiment, REI - Infantry Regiment (Foreign Legion), RIMA - Marine Infantry, RHC - Aviation Regiment

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BREACHING OPERATIONS
1 ID (M)
24 FEB 91

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BREACHING OPERATIONS

1ST INFANTRY DIV (MECH)

24 FEB 91

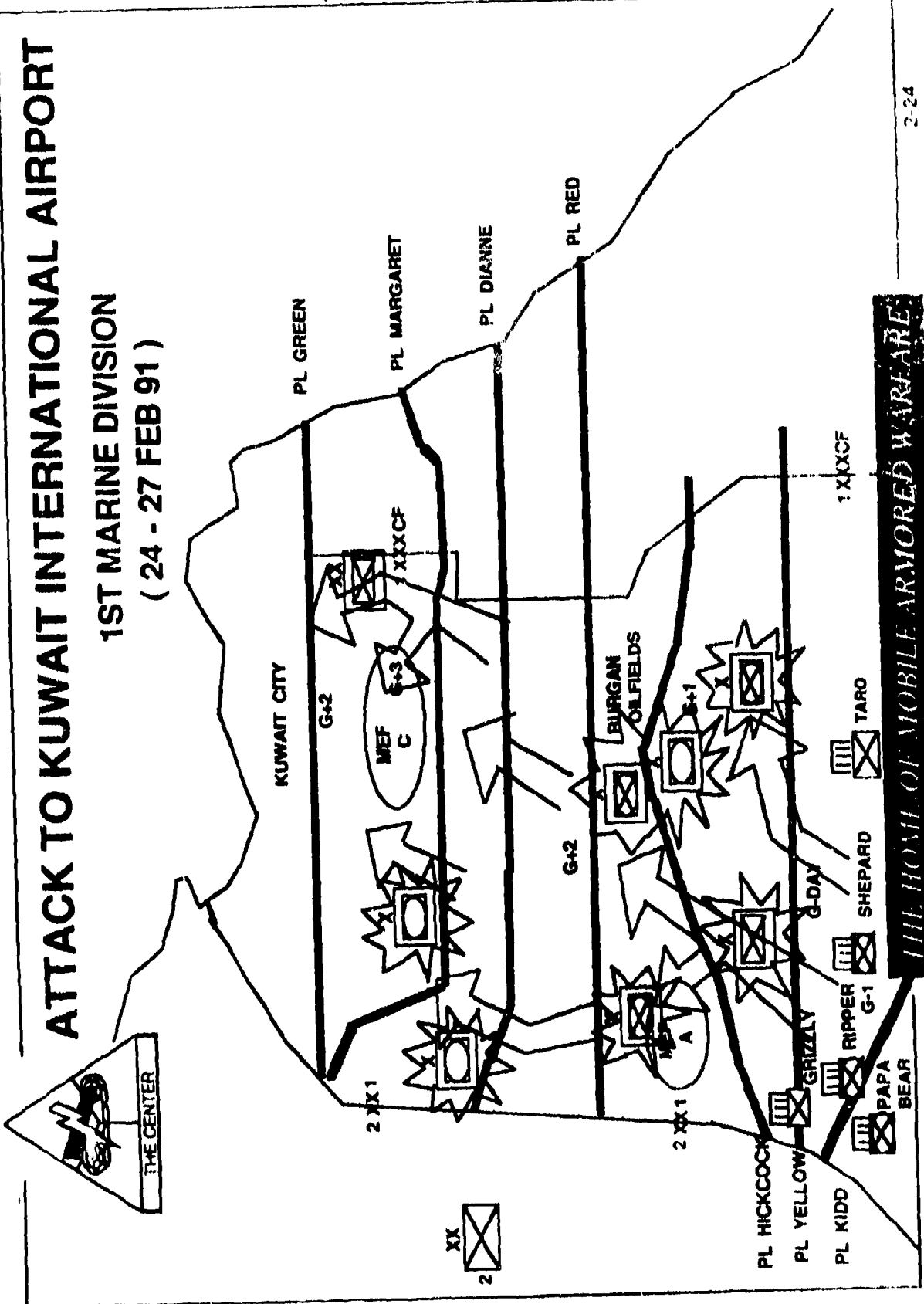
- 1 ID (MECH) mission at the beginning of the ground war was to destroy lead elements of the Iraqi 26th Inf Div, establish a breachhead, pass the 1st UK Armored Division, and on order continue the attack.
- The Division placed its cavalry squadron (1-4 Cav) OPCON to 1st Brigade for the initial phase of the operation.
- 0420 hrs zone reconnaissance initiated north of PL Vermont. 1-4 Cav on the left, TF 2-34 in the center, and TF 5-16 on the right.
- 1000 hrs advanced to PL Plum with no enemy contact. Due to the lack of resistance the Division continued its attack at 1500 hrs when TF 2-34 and TF 5-16 began breaching operations along PL Wisconsin.
- 1-4 Cav consolidated in the vicinity of Attack Position Dragoon in preparation for passage through the breach.
- 1530 hrs 1st Bde ordered 1-4 Cav to follow 1-34 Armor through the breach, clear Objective 15K, and secure PL Colorado.
- 1630 hrs A and B Trps, 1-4 Cav passed through the breach and started taking prisoners who surrendered as soon as their position was approached.
- 1730 hrs 1-4 Cav sat along PL Colorado. The Squadron had captured approximately 135 prisoners traveled 35 kms and destroyed five enemy vehicles and three AT guns (105 mm) during the operation.

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ATTACK TO KUWAIT INTERNATIONAL AIRPORT

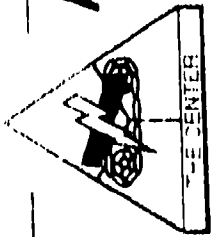
1ST MARINE DIVISION (24 - 27 FEB 91)



2-24

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ATTACK TO KUWAIT INTERNATIONAL AIRPORT

1ST MARINE DIVISION
(24 - 27 FEB 91)

The mission of the 1st Marine Division at the beginning of Desert Storm was to breach both obstacle belts, defeat Iraqi forces in zone, seize Marine Expeditionary Force (MEF) objectives A and C, and prevent Iraqi reinforcement to the west.

Reconnaissance done prior to G Day had identified gaps in the Iraqi obstacle/minefield belt and confirmed disposition of Iraqi forces.

The 1st Marine Division attack began at 0400 hrs 24 Feb 91 and by 1030 hrs that same morning, the Division had 14 lanes cut through the Iraqi first obstacle belt. The second obstacle belt was more heavily defended but was also soon breached. EPWs began surrendering in great numbers.

MEF Objective A, near Airbase, was cleared of enemy and captured by 1500 hrs 25 Feb 91.

During the night of 24 Feb 91 several indications of an impending large scale enemy counterattack were received. Intelligence reports predicted that two Iraqi Mech Bns were preparing to attack south of the Burgan oilfields. At 0800, 25 Feb 91, the battle of Burgan Oilfields erupted. Iraqi counterattacking forces lost nearly 200 armored vehicles during the engagement while marine losses were extremely light.

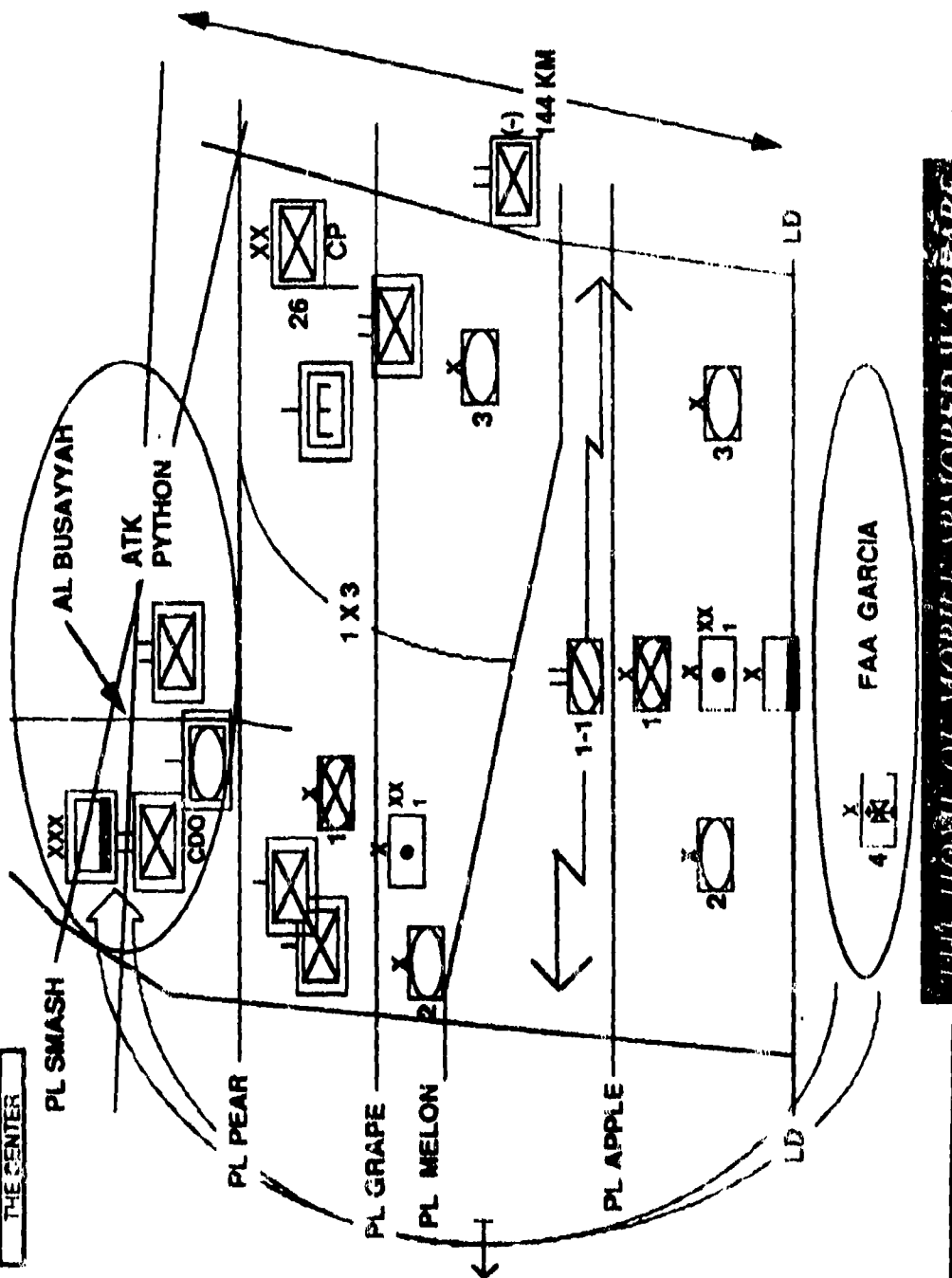
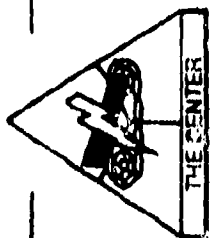
By 0420 hrs Iraqi forces were fleeing. At 1330 hrs that day orders given for seizure of MEF Objective C, Kuwait International Airport. The Commanders intent was to prevent as many Iraqi forces as possible from escaping and isolate MEF Objective B. At 1500 hrs, 26 Feb MEF Objective B secured.

0630 hrs, 27 Feb 91, 1st Marine Division raise colors at Kuwait International Airport.

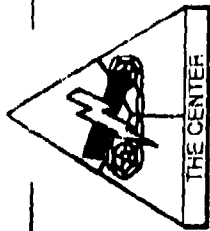
At the calling of the cease fire, the 1st Marine Division had destroyed 320 tanks and 250 APCs. The Division had additionally captured 250 tanks, 250 APCs and 8800 EPWs.

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BATTLE FOR AL BUSAYYAH (1ST ARMORED DIVISION)



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BATTLE FOR AL BUSAYYAH (1ST ARMORED DIVISION)

- 1 AD attacked at 0630 25 Feb with 1st Bde making initial contact with the Iraqi 26th ID. 1st Bde handed off this battle to 3rd Bde at approximately 0730 hrs and shifted west to bypass the pocket and continue attacking north in front of 2nd Bde.
- 3rd Bde quickly destroyed one T-62, eight APCs, and three artillery pieces
- 1st Bde led by 1-1 Cav crossed PL Meion at 0815 and made further contact with elements of the 26th ID.
- 1st Bde reported securing its objective at 1448 hrs after destroying eight APCs, four artillery pieces, several trucks, and capturing 272 prisoners.
- While the ground action was occurring, 4th Bde conducted afternoon deep attacks against Al Busayyah.
- Throughout the night Divisional Artillery fired 960 rounds of 155mm harassing and interdiction fire into Al Busayyah.

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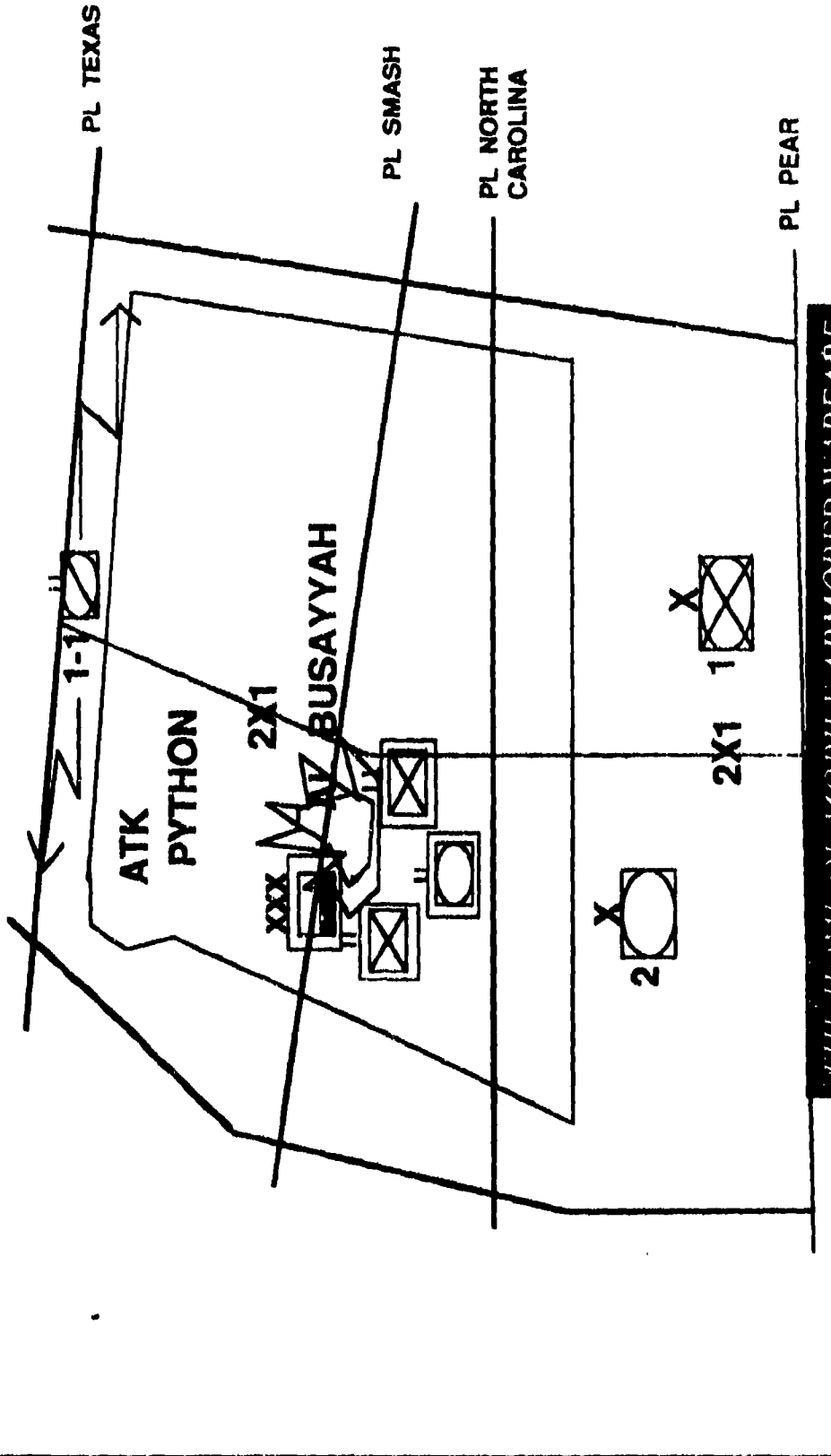
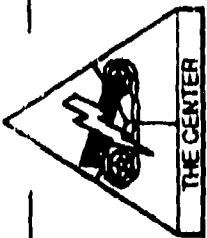
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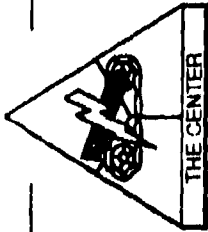
BATTLE FOR AL BUSAYYAH (CONT)

(1ST ARMORED DIVISION)



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BATTLE FOR AL BUSAYYAH (CONT)

(1ST ARMORED DIVISION)

26 FEB 91

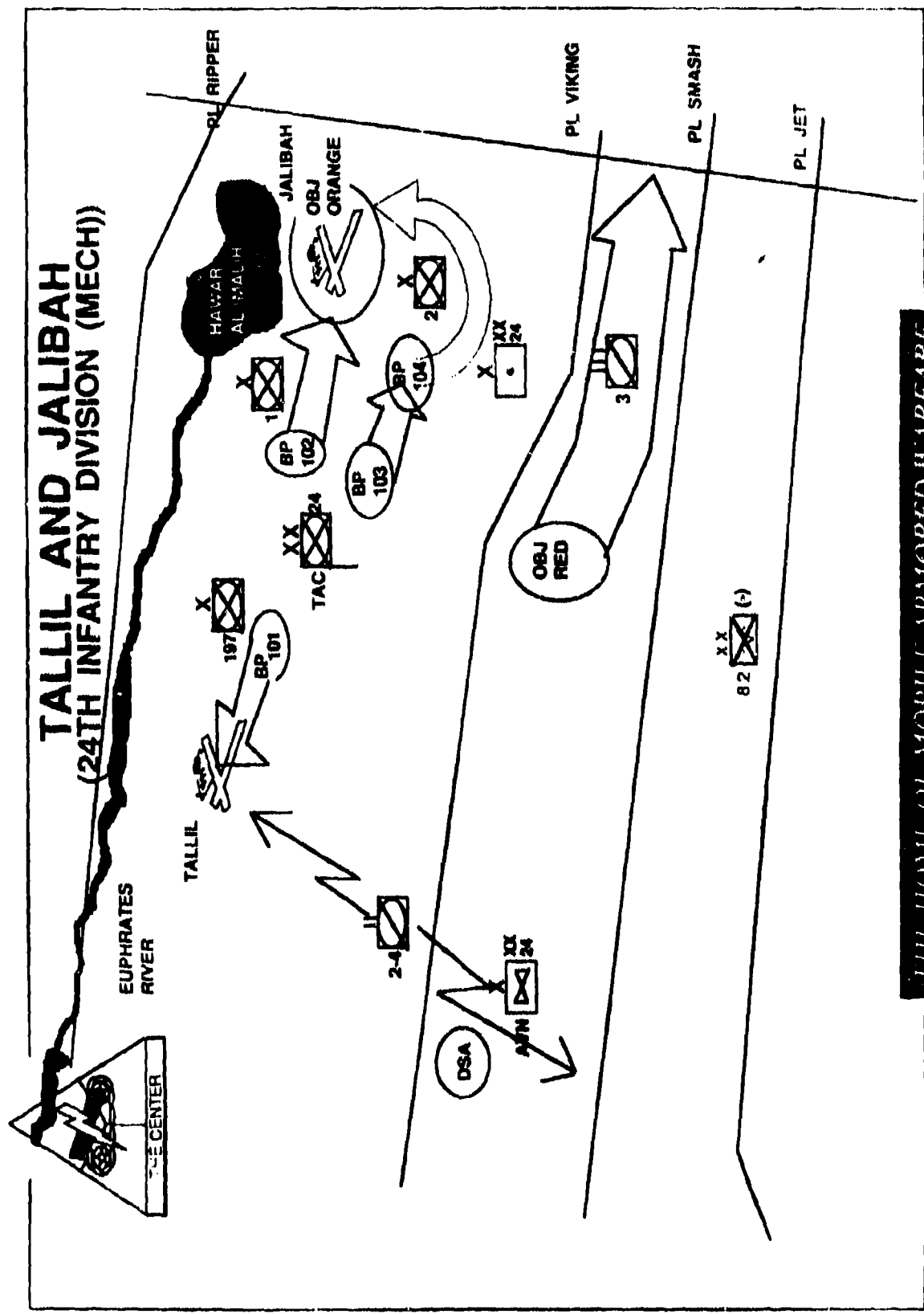
- 0615 26 Feb Divisional Artillery fired a massive combined 155mm and MLRS barrage consisting of 240 rounds and 192 rockets into Al Busayyah.
- Artillery preparation was followed immediately by a deliberate attack with 2nd Bde in the north, 1st Bde in the south, and 3rd Bde following 1st Bde.
- 1st and 2nd Bdes made significant contact with 26 ID forces in and around Al Busayyah, but overcame them rapidly and continued attack north and east.
- 2nd Bde left TF 6-6 with an attached engineer company (A/16 Eng) to mop up.
- TF 6-6 rubbled the town and logistics sites using 155mm HE Fuse delay fires and 165mm from the CEV. Five enemy tanks, numerous wheeled vehicles, bunkers, and arms caches were destroyed.
- The Division completed most action around Al Busayyah by 1200 hrs.

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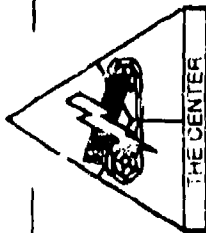
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THE HOME OF MOBILE ARMORED WARFARE

TALLIL AND JALIBAH (24TH INFANTRY DIVISION (MECH))



THE HOME OF MOBILE ARMORED WARFARE



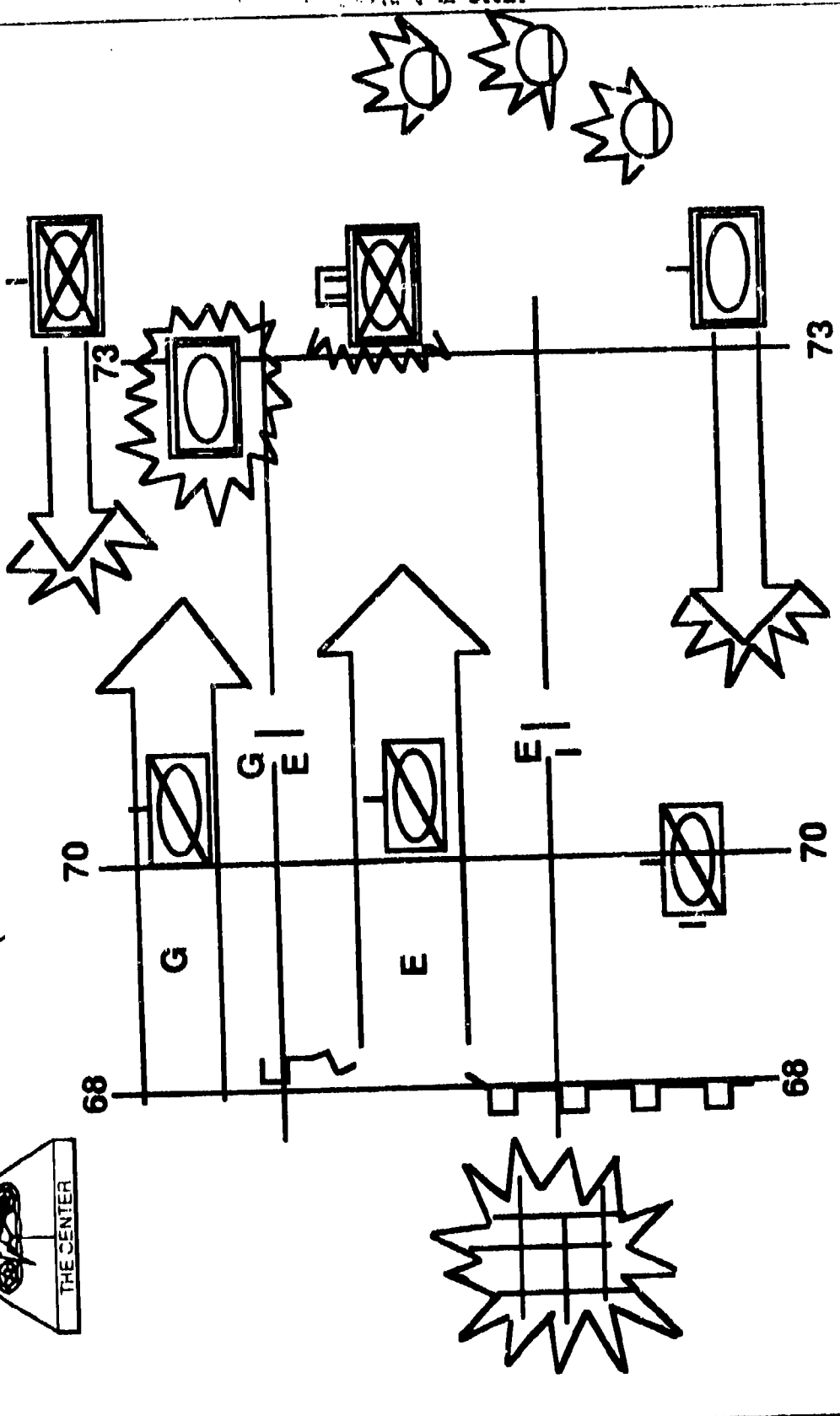
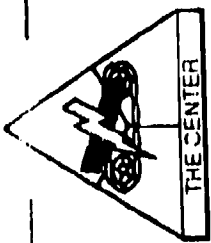
TALLIL AND JALIBAH (24TH INFANTRY DIVISION (MECH))

- After reaching the Euphrates River, the 24 ID refueled to continue the attack east toward Al Basra.
- (270600 Feb) 1st Bde conducted fixing attack from BP 102 against Jalibah Air Base.
- (262400-270200 Feb) 2nd Bde attacked from BP 103 to seize BP 104.
- (270600-271000 Feb) Following artillery prep from 0500-0600 hrs, 2nd Bde conducted division main attack from Jalibah Air Base's southern flank supported by 212th FA Bde - Five artillery battalions.
- (271330-271715) Following 28 CAS sorties and artillery fires, the 197th Bde conducted attack from BP 101 to Tallil Air Base to destroy enemy aircraft, armored vehicles, and ADA.
- 2-4th Cavalry maintained screen of the division's left (west) flank.
- (270600 Feb) 3rd ACR (OPCON to 24th ID) attacked east from Objective Red to screen the division's right (southern) flank and maintain contact with U.S. VII Corps.
- Heavy resistance continued as the division faced the Iraqi 47th and 49th Infantry Divisions, RGFC Nebuchadnezzar Infantry Division, and the 26th Commando Brigade.
- The battle resulted in the destruction of two large Iraqi artillery and air force munitions complexes, 25 fixed and rotary winged aircraft, 300+ armored and wheeled vehicles, 100+ artillery guns, and the capture of 4600+ prisoners.
- All Iraqis captured were well fed, uniformed, had ample water and ammunition, and employed equipment in mint condition.

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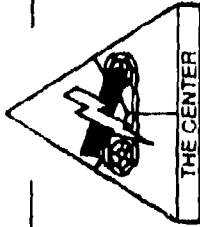
BATTLE OF 73 EASTING (2ND ARMORED CAVALRY REGIMENT)



2-32

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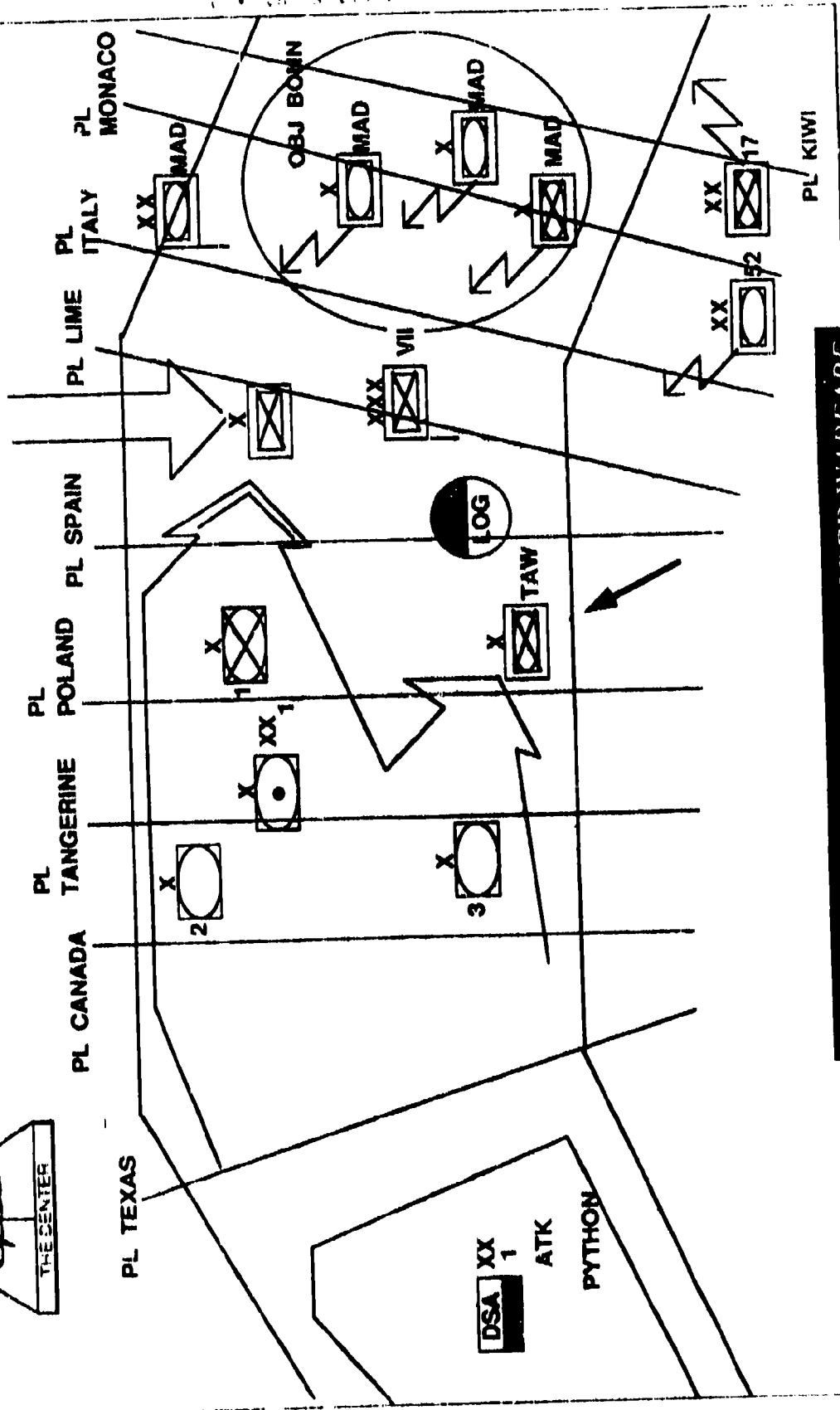
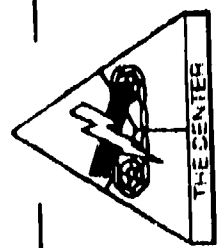


BATTLE OF 73 EASTING (2ND ARMORED CAVALRY REGIMENT)

- The 2ACR crossed the 60 north-south grid line (LOD) at 261530 Feb with the limit of advance being the 70 north-south grid line. Their mission was to find and fix the Tawakalna Division.
- The first major contact with the enemy was by E Troop 2/2 ACR at an uncharted village. The village was suppressed with 120mm HEAT, 25mm, and machine guns.
- E Troop executed a battle drill which put the tanks up front. Upon crossing a small ridge, vicinity of the 685 north-south grid line, E Troop encountered an enemy tank battalion reinforced with infantry and BMPs defending in reverse slope 1400-1500 meters away. E Troop attacked immediately and pressed the attack past the 70 grid line limit of advance. The shock effect of the tanks, supported by the scouts with small arms fire, overwhelmed the enemy.
- G and I Troops, 2ACR, advanced to support E Troop. G Troop encountered an enemy armored reserve force and in conjunction with E Troop attacked this formation. I Troop assaulted past the village south of E Troop destroying every enemy vehicle to their front and taking large numbers of prisoners.
- The northern two platoons of G Troop are attacked by a separate mechanized infantry company supported by tanks.
- E Troop moved forward a PSYOPS Team during a lull and their broadcasts were very effective in encouraging enemy soldiers to surrender.
- I Troop is attacked by a seven tank enemy counterattack. The attack was blunted by 4th Platoon, I Troop, and the enemy withdrew. G Troop additionally forced the withdrawal of the enemy mech forces attacking their position.
- The E Troop Fire Support Officer acting upon information received from prisoners called for fire on suspected enemy reverse slope positions. The artillery fire devastated several major enemy supply bases.

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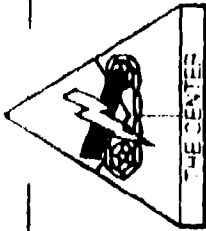
DESTRUCTION OF THE REPUBLICAN GUARDS (1ST ARMORED DIVISION)



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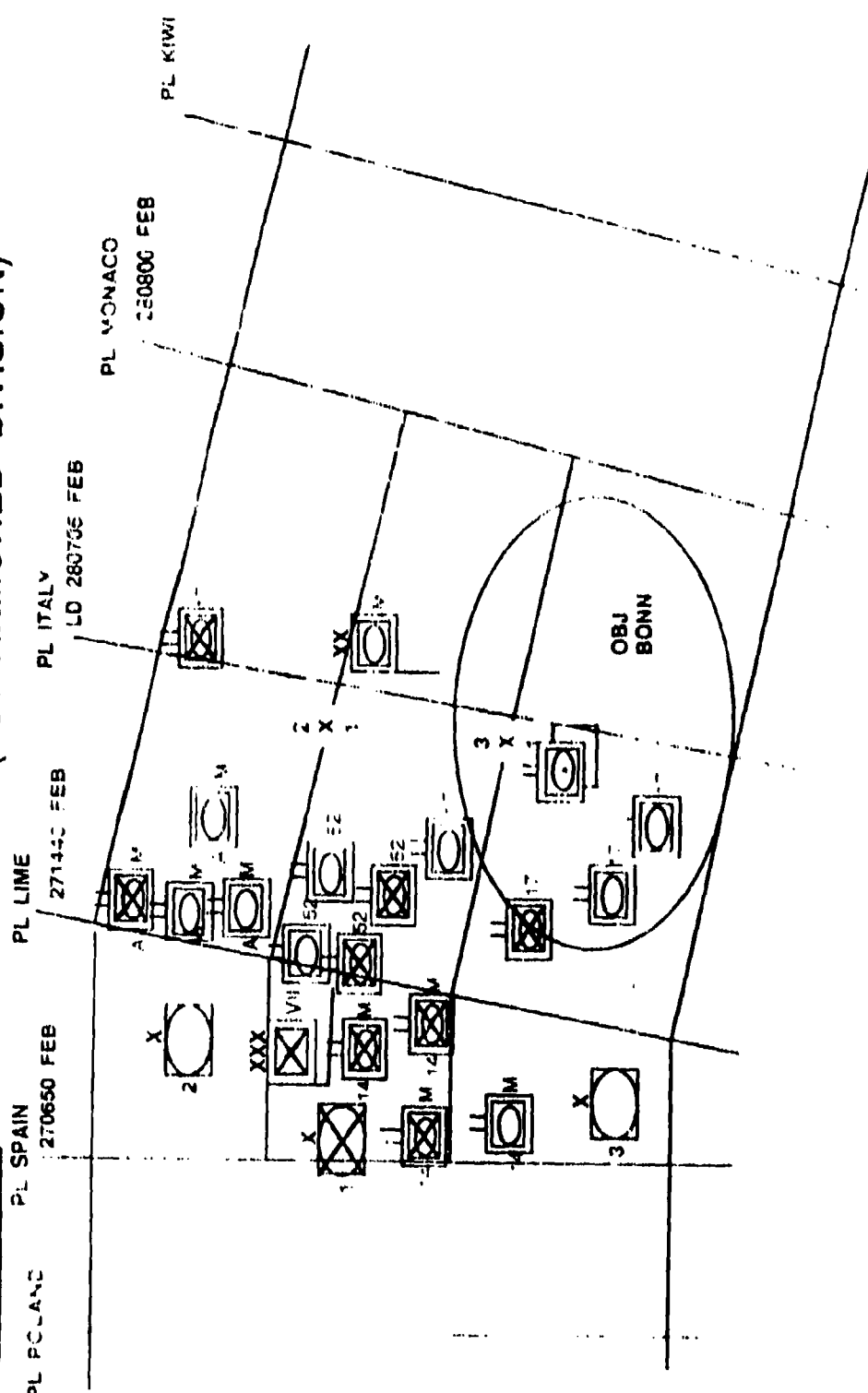
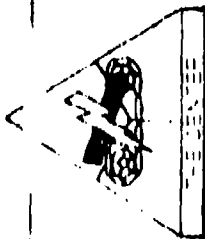


DESTRUCTION OF THE REPUBLICAN GUARDS (1ST ARMORED DIVISION)

- Intelligence reports indicated the RGFC was repositioning mech and armor forces along a SE to NW line to block coalition attacks from destroying withdrawing Iraqi divisions from Kuwait, and to protect major theater and corps logistics sites vicinity Objective Bonn.
- Upon crossing PL Tangerine air scouts reported elements of the Iraqi Tawakalna and 52nd Infantry Division (Mech) to the east.
- 1-1st Cavalry made contact with the two divisions in the vicinity of PL Poland where the unit's scouts identified 52 tanks
- Air scouts and AH-1 Cobras stayed on station while air strikes and artillery fire destroyed 30 enemy tanks. 3rd Bde attacked in the south to destroy 22 more enemy tanks and numerous wheeled vehicles.
- 4th Bde and CAS attacked deeper targets in the vicinity of Objective Bonn later confirmed to be the site of the Madinah RGFC as well as numerous logistics sites.

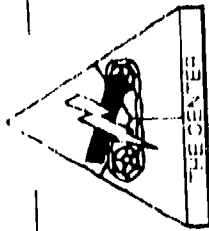
TOP SECRET

DESTRUCTION OF THE MADINAH ARMORED DIVISION (1ST ARMORED DIVISION)



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DESTRUCTION OF THE MADINAH ARMORED DIVISION

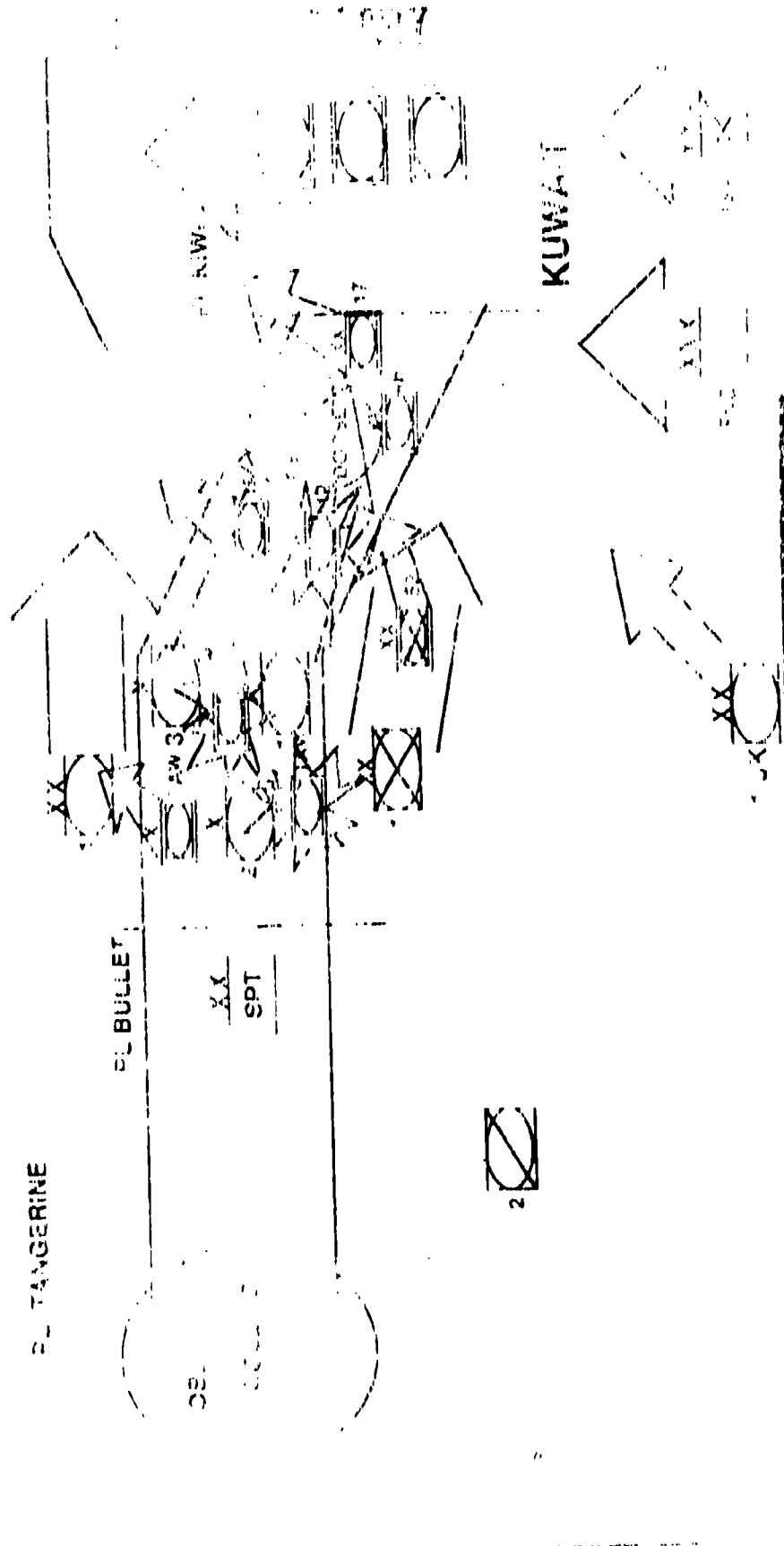
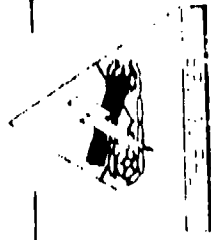
(26-28 FEB 91)

- (0810 27 Feb) 1st and 2nd Bdes began attacking elements of the Madinah Division along PL Lime with 3rd Bde joining in at 0835 hrs.
- 4th Bde sent AH-64s on an armed recon at 1000 hrs destroying a number of withdrawing armored vehicles in the vicinity of PL Monaco.
- The division spent the rest of the day destroying Madinah equipment and halted east of PL Italy.
- (0530 28 Feb) An artillery prep on Objective Bonn began with 72 rockets, 144 rounds of 8", and 1368 rounds of 155mm and lasted until 0615 hrs.
- A series of AH-64 strikes occurred after the artillery barrage which concluded at 0700 hrs.
- Bdes attacked abreast along PL Italy at 0705 hrs. Contact made with Madinah and other Iraqi divisions fleeing toward Al Basra.
- Cease fire went into effect at 0800 hrs with the division consolidating along PL Italy.
- The BDA totals for this final 26 hours of combat were 227 tanks (primarily T-72s), 187 BMP MTLBs, 81 artillery tubes, and 16 ADA systems destroyed. 1120 EPWs were also captured.

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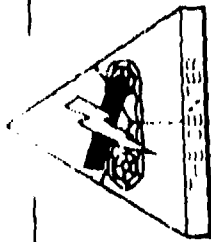
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DESTRUCTION OF THE TAWAKALNA, 12AD, AND 10AD (3RD ARMORED DIVISION)



THE HOME OF MOBILE ARMED BANDITS

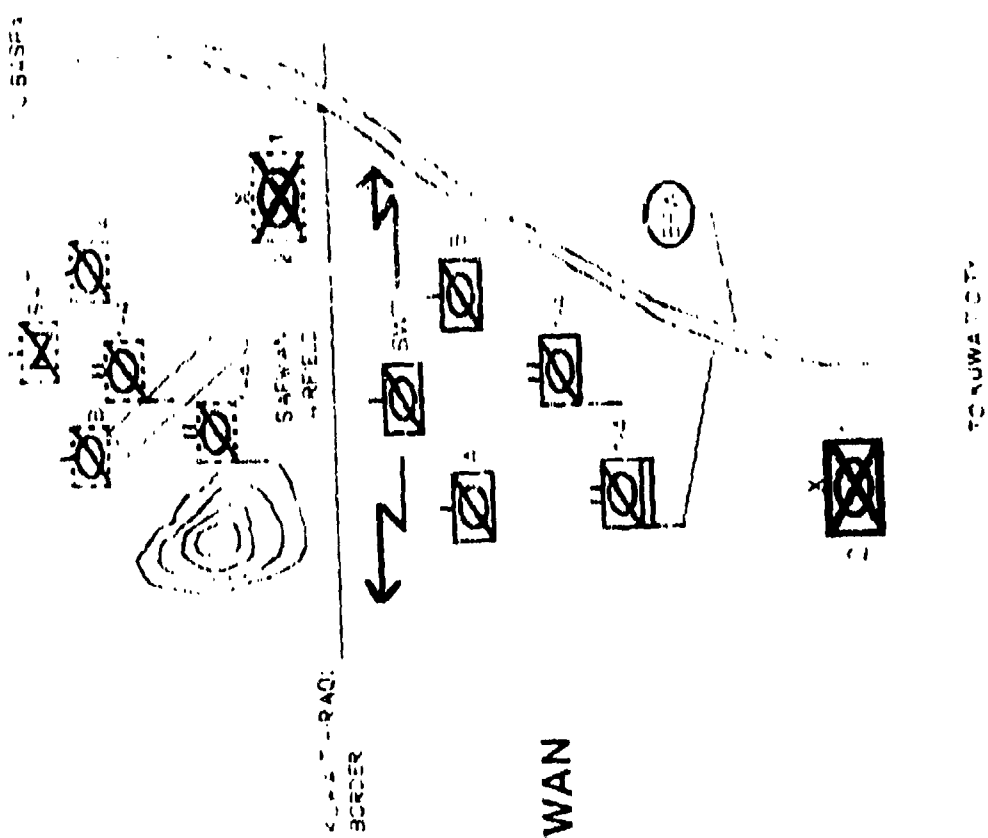
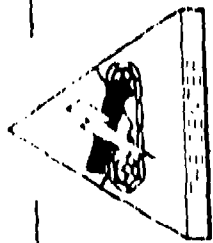
AUGUST 1990 ONLY



DESTRUCTION OF THE TAWAKALNA 12TH AD AND 10TH AD (3RD ARMORED DIVISION)

- On 26 Feb 91 the 3rd AD reached Objective Collins and changed from a northeasterly direction to due east. This direction change kept them in contact with units of the Tawakalna, 12th AD, and 10th AD throughout the next day. There were numerous engagements throughout 27 Feb 91.
- During the night of 26/27 Feb 91, 3rd Bde passed through 2nd Bde in the north of the division sector and along with 1st Bde in the south continued the attack on Iraqi positions.
- At 1540 hrs 3rd Bde after fighting a pitched battle began closing on Objective Dorsett. By 2030 hrs 3rd Bde located vicinity PL Kiwi.
- 1st Bde continued its attack on elements of the Tawakalna near PL Bullet and continued its attack through the 12th AD until reaching PL Kiwi at approximately 2130 hrs.
- Defensive positions dug by the Iraqis faced south and many positions were attacked from the rear.
- By nightfall on 27 Feb 91 intelligence reports indicated that the Iraqi 10th Armored Division had been destroyed and what little remained of the Tawakalna, 17th AD and 52nd Mech were withdrawing.
- At 2330 hrs the 3rd AD received an order from VII Corps to continue the attack in sector to complete the destruction of the Iraqi 17th AD and 52nd Mech. The Division continued its attack throughout the night until the cease fire was called at 0800 hrs 28 Feb 91.
- During the four days of war 3 AD traveled 223 KMs, captured 2,415 prisoners, and destroyed 374 tanks, 404 APC/IFV, and 67 artillery pieces.

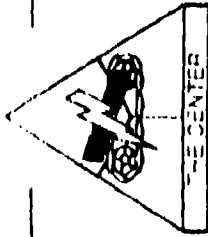
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CAPTURE OF SAFWAN
AIRFIELD
1-4 CAVALRY
1 MAR 91

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CAPTURE OF SAFWAN AIRFIELD

1-4 CAVALRY

1 MAR 91

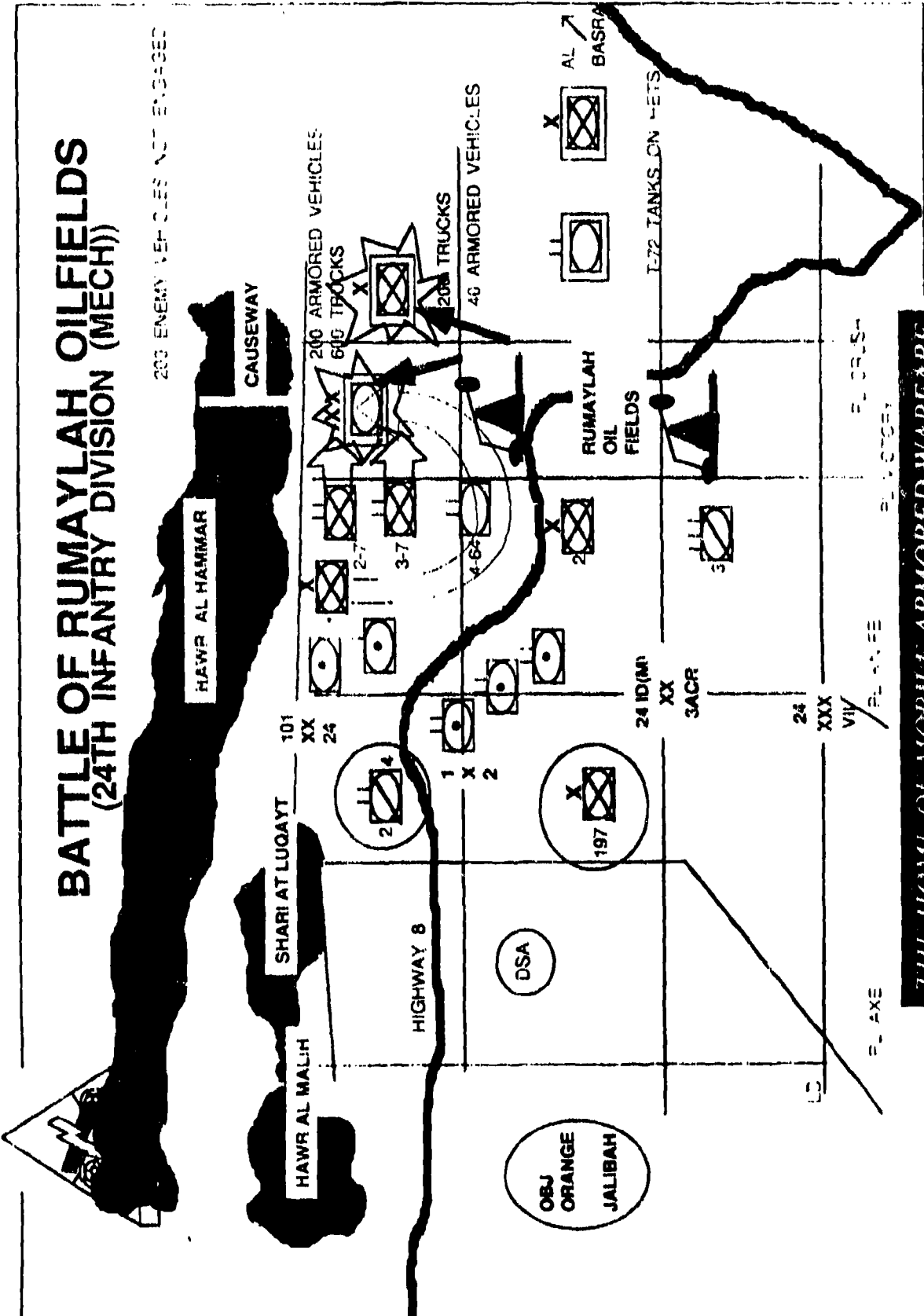
- 0240 hrs 1-4 Cav received orders to move into Iraq and secure Safwan Airfield for the upcoming cease fire negotiations.
- For the mission the Squadron was to cross the LD at 0615 hrs and was given an Apache company OPCON.
- Upon approaching the enemy positions at Safwan Airfield it could be seen that the Iraqis' had an armored brigade in prepared positions with three battalions abreast and one defending in depth north of the objective.
- 0900 hrs an Iraqi Colonel arrived in A Trp's sector. It was explained to him by the Trp Cdr what the Squadron mission was and that the Iraqis must depart the airfield. The Iraqi Colonel said he could not depart without instructions from his higher headquarters.
- 1020 hrs a flight of A-10s flew over and the A Trp Cdr informed the Iraqis that they would attack if the unit did not leave. The Iraqi Colonel finally relented and ordered his unit to depart.
- By 1200 hrs most of the Iraqis in the Squadron sector were on the road moving north towards Basra.
- The Squadron secured the airfield and 2nd Brigade 1ID (Mech) was ordered to move to the airfield to join in its defense.

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BATTLE OF RUMAYLAH OIL FIELDS (24TH INFANTRY DIVISION (MECH))

200 ENERGY VEHICLES NOT ENGAGED



HAWR AL HAMMAR

SHARIAT LUQAYT

HAWR AL MALIH

HIGHWAY 8

RUMAYLAH OIL FIELDS

L-72 TANKS ON HETS

AL BASRAH

101

XX

24

2

4

1

X

2

197

DSA

OBJ ORANGE JALIBAH

24 10 (N)

XX

34 CR

24

XXX

VII

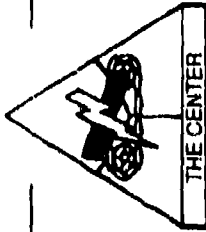
PL AXE

PL AXE

PL CRUSH

PL CRUSH

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BATTLE OF RUMAYLAH OILFIELDS

2 MARCH 1991

(24TH INFANTRY DIVISION (MECH))

- The Presidential call for a cease fire at 280800 Feb 91 found 24th ID 50 km west of the city of Al Basra along PL Knife.
- Hasty defenses were established along PL Victory (5 km west of PL Crush - Limit of Advance). The Division security zone was extended to PL Crush.
- 020630 Mar 91 1st Bde detected large enemy movement approaching division security zone.
- 020800 Mar 91 six Iraqi attack helicopters and 200 trucks were observed by the Avn Bde north of the causeway. They were not engaged since they posed no threat to the Division.
- 020815 Mar 91 2-7 Inf Bn was engaged by Iraqi T-72, RPG, and SAGGER missile fire in the vicinity of the Rumaylah Oil Field.
- An escape attempt was made by a composite Republican Guard division-sized force composed of remnants of the Hammurabi Armored Division and other Republican Guard Infantry divisions.
- 1st Bde orchestrated a combined arms attack employing three battalion task forces, three AH-64 Apache companies, two air cavalry troops, and five artillery battalions (included MLRS and 8-inch).
- (0920-0940 hrs) Artillery fired, (0947 hrs) Apache and air cavalry attack, (1045 hrs) counterattack by TF 4-64 Armor.
- USAF A-10 close air support was on station but not employed. Follow on enemy forces consisting of 200 wheeled vehicles and 40 armored vehicles were not committed.
- Battle results in the destruction of 187 enemy armored vehicles (included 23 T-72s, 7 T-55s, and 65 APCs), 34 artillery guns, 400 trucks and other wheeled vehicles, nine MLRS's, and the capture of over 100 prisoners.

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CHAPTER 1

DOCTRINE

1-1. Summary.

a. The consensus collected by Fort Knox from participating units in Southwest Asia indicates that Airland Battle Doctrine worked. It seems there is no need for a completely new doctrine. However, there are refinements and additions required to make it better. It is evident through many observations that new technology drastically increases higher echelon headquarter's capability to target, attack, and fight deep operations simultaneously with close and rear operations. Subordinate units were able to fight the close and rear battles with minimum direction as intermediate leaders exercised initiative from a clear understanding of the commander's intent at least two levels up. "Mission Orders" found in Field Manual (FM) 100-5, Operations and CD 17-95 Cavalry Operations, were successful. Finally, the subordinates' units were able to execute because of their superb training as individuals and teams. Doctrine, initial training, reliable equipment, and realistic training exercises were key to combat effectiveness.

b. The planning processes (doctrine, battle drills, and tactical SOPs) and a warrior's offensive spirit all contributed to an unprecedented victory by the U.S. led coalition. These and other contributions caused the enemy to fight in more than one direction. They reduced the enemy's capability to mass. We avoided his strengths, and attacked his weaknesses. We maintained our combat power for decisive operations against the enemy's center of gravity. The Army and Marines harassed the enemy's ground capability to keep the enemy from seeing what we were doing. This was accomplished with appropriate security operations (screen, guard, and cover). We kept the enemy forces off balance with an air campaign, continuous ground maneuver pressure, Naval blockade, and deception. Then we massed an overwhelming combat power advantage against him to bring the war to an early conclusion.

c. Now we need to incorporate lessons learned from the SWA experience into our evolving doctrine (Airland Operations). FM 100-5, our capstone manual in the army, is now being prepared. This manual defines the bridge between national military strategy, operations, and tactics. Upon the completion of the coordinating draft of FM 100-5, FM 100-15, Corps Operations, should follow. This demonstrates the "Top Down" approach to manuals to ensure all doctrinal manuals track logically. The rewrite of FM 71-100, Division Operations, would then follow. At the Armor School, we will begin the revision of FM 71-3, Brigade Operations, in October 1992. The revision cycle through the completed FM 71-1, Company/Team Operations, is scheduled for March 1995.

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3-2. List of Issues.

- a. A list of topics from Southwest Asia Emerging Observations is provided below. These issues discussed in detail will comprise the rest of this chapter. The topic discussions will follow the observation, discussion, lesson learned, recommended action, and comment format:
- b. Deployment and redeployment doctrine.
- c. Tactical level acquisition and dissemination of intelligence.
- d. Security operations.
- e. Fire support coordination doctrine.
- f. Commander's intent.
- g. Training doctrine.
- h. Identification friend and foe.
- i. DPICM/CBU duds and Scatterable Mine fields.
- j. Role and responsibilities of liaison officers.
- k. Task Force organic CSS.
- l. Other CSS doctrinal issues.
 - (1) Responsiveness of Forward Support Battalions.
 - (2) Class IX.
- m. Gunnery doctrinal issues.
 - (1) Turret azimuth indicator for M1/M1A1.
 - (2) USAF use of white smoke.
 - (3) Ammunition Transfer.
 - (4) Muzzle boresight device calibration.
- n. Mission oriented protective posture (MOPP).
- o. Bradley Gunnery.

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1. Deployment and Redeployment Doctrine.

a. Observation. Several units had not developed deployment standard operations procedures.

b. Discussion.

(1) Today, there is no formal doctrinal literature available to establish guidelines, tactics/techniques/procedures (TTP), and standard operating procedures (SOP) to conduct land, sea, and air deployment operations similar to that executed in support of Desert Shield/Storm with the exception of select units in 18th ABN (Contingency) Corps. Many Continental United States (CONUS) units were prepared to deploy based on contingencies to reinforce Europe. These units were trained according to the units' mission essential task list (METL). Emergency deployment readiness exercises (EDRE) were practiced periodically as part of Reforger and deployment to the Combat Training Centers (CTC). Other units, such as those in Europe, had more difficulty because their deployment was not on their METL nor practiced. The European-based units did not have deployment SOPs, but they did have some residual experience from deploying to maneuver training areas within continental Europe. Some additional residual training was provided to selected European units as they supported CONUS-based units deploying for Reforger.

(2) Units encountered problems because the main effort for the armored forces deployment was to quickly get maximum combat power on the ground, to close the "window of vulnerability". In many cases, failure to cross-load ships with a units' associated Combat Support (CS) and CSS slices caused serious delays and sustainment problems once the units disembarked in Saudi Arabia. Additionally, many units lacked equipment and preparation for an extended stay in the harsh SWA environment.

(3) In former mobilization plans there has always been a planning assumption that personnel assigned to TRADOC would not be reassigned to combat units until at least 90 days after the initiation of hostilities. During Desert Shield, due to the need for all units to expand rapidly to wartime requirements, soldiers from the 12th Cavalry Regiment were deployed within 72 hours of the initial alert. This was a TRADOC-wide phenomena. The effect of this action was two-fold. First, it degraded the ability of our unit to effectively train the increased numbers of students generated by wartime requirements. Second, it placed soldiers who have not adequately trained recently in combat duties in positions of leadership in combat units. With the reductions in size projected for the Army, TRADOC remains a lucrative pool of trained personnel that is readily accessible for short-notice contingency missions. In light of this, we need to ensure that the go-to-war skills of TRADOC combat MOS soldiers are not allowed to degrade by providing resources to allow for cadre training. Also, a conscious decision must be made concerning

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adherence to the 90-day policy. If it is not, then reserve units charged with assisting in training missions need to be promptly mobilized to make up the shortfall and to prevent degradation of training to either regularly programmed student soldiers or those training for combat.

(4) In the case of the 1st Cavalry Division's redeployment, one maneuver brigade handled the command and control of the Dammam Port Support Activity (PSA), rather than the Division Support Command (DISCOM) or a composite unit. This seemed to work well and cut load times in half. Extensive planning, rehearsals, and coordination with the port officials (MSC, Transportation Units, etc.) will result in a unit's equipment deploying ready to fight, redeploying promptly, and remaining mission capable. There are some excellent publications available through safety channels that help to plan sealift operations.

c. Lesson(s) Learned. None.

d. Recommendation. Appropriate deployment and redeployment doctrine must be written. Deployment and redeployment tasks should be placed on unit METLs and adequately trained. Then deployment/redeployment SOPs and scheduled EDREs can be executed. The Light Armor Battalion (3-73 AR), the 24th IN Div (Mech), and 18th ABN Corps provide a basis as we develop future armored force doctrine. European units deployment TTP which was developed from SWA operations should also be captured to assist in the development of deployment doctrine.

e. Comments. None.

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3-4. Tactical Level Acquisition and Dissemination of Intelligence.

a. Observation. The top-down flow of intelligence inconsistently provided detailed assessments required by the brigade and lower commanders during the ground maneuver war.

b. Discussion. Indications are that modern technology has greatly enhanced our ability to see the enemy at the national and operational levels of warfare. When sufficient METT-T situations exist, this intelligence can be disseminated to lower levels. This is the case that occurred before the ground campaign in SWA. When the ground war began, the higher to lower feed was not able to keep up with the flow of the battle. The use of alternative organic intelligence collectors; such as signal interception, human, radar, and remote sensors at the tactical level; was inconsistent for various reasons. Remotely piloted vehicles (RPVs), although they were limited in number, were used with some success. Experiences in SWA show all-source intelligence integration and timely dissemination to tactical level units was inconsistent. A combination of doctrinal, materiel, and organizational initiatives can fix this problem.

c. Lesson(s) Learned. Corps and divisions held and analyzed information for too long a period of time before dissemination. Information was overcome by events. Therefore, it was not useful to brigade and battalion commanders.

d. Recommendation. There is a need to correct systems and doctrinal guidelines to integrate all-source intelligence at the tactical level. There is also a need to correct intelligence information flow doctrine so that timely, tailored intelligence reaches the brigade and battalion levels to support maneuver commanders. Brigade commanders should consider telling the intelligence community no-later-than times for information to get their best intelligence assessment for decision making.

e. Comments. None.

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3-5. Security Operations.

a. Observation. The Iraqi Army failed to establish appropriate security belts and security screens to support offensive and defensive operations.

b. Discussion.

(1) Both the attack on the Saudi Arabian town of Khafji and the defense of the southern border of Kuwait were examples of inadequate use of ground and air security operations by the Iraqi Army. This lack of security, which is mandated in U.S. doctrine in the framework of both defensive and offensive operations, was a key source of failure to both Iraqi operations. The lack of security operations; such as screen, guard, cover, and adequate reconnaissance; allowed the US Coalition Forces freedom of movement through enemy territory. Additionally, the Iraqis lost their freedom of movement, early warning, ability to avoid the opposing forces' strengths and ability to mass. With the success of the U.S. Coalition air campaign, the Iraqi forces lost their Air Force which was a primary capability for security operations in the Iran-Iraq war. The Iraqi's lack of redundant sources of security was a major weakness which Coalition Forces exploited at the beginning of the ground campaign.

(2) One U.S. corps used its ACR to gain contact with the Republican Guard Divisions. The ACR was able to develop the situation to help the corps commander understand that the enemy was conducting a rear guard to support retrograde operations. The corps commander then brought forward his main body to cut off and pursue the retreating enemy.

c. Lesson(s) Learned. None.

d. Recommendation. The U.S. Army doctrine, as it is refined under AirLand Operations, must not reduce emphasis on ground and air security operations in favor of more popular high tech equipment. In the future, U.S. Forces may have to emphasize offensive security operations rather than defensive. Some refinement in cavalry and scout manuals, training, materiel, and organization may be necessary.

e. Comments. None.

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1-6. Fire Support Coordination Doctrine.

a. Observation. There was a tendency for the Air Force to treat the fire support coordination line (FSCL) as a restrictive control measure rather than a permissive fire control measure.

b. Discussion. A coalition corps was deeply engaged in the deep, close, and rear fights as it attacked north along the coastal highway closing on Kuwait City. An FSCL was established so that supporting U.S. Air Forces could conduct air interdiction against the fleeing Iraqi forces north of Kuwait City. Despite the establishment of a permissive control measure, the Air Force units continued to coordinate as if this control measure was restrictive in nature. This caused additional coordination which interrupted other corps-level deep operations. Similar incidents were also experienced at a U.S. Army Headquarters, so U.S. Army representatives accompanied Coalition Forces as support and liaison teams. They ensured that appropriate terms and graphics were used which coordinated the fight with combined forces. With the evolution of Airland Operations, it will become more important that our doctrine support joint and coalition warfare. Currently, standardized fire support doctrine at joint level is virtually non-existent according to the Artillery School.

c. Lesson(s) Learned. None.

d. Recommendation. Joint and combined forces need to speak a common doctrinal language to successfully fight together. U.S. Army representatives who accompanied Coalition Forces as support and liaison teams performed efficiently. The formation of these teams and their responsibilities should be captured in Army doctrine to ensure that appropriate terms and graphics are used.

e. Comments. None.

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3-7. Commander's Intent.

a. Observation. Although commander's intent is universally addressed in all U.S. doctrine, it is inconsistently defined in different manuals, thus the application was varied in SWA.

b. Discussion. Many units in SWA commented that the commander's intent is the most important element in an order. The rapid pace and high tempo of operations demanded a clear, concise commander's intent. This was needed so that subordinate commanders could effectively fight their units in a rapidly changing environment, using appropriate amounts of initiative and taking appropriate risk.

c. Lesson(s) Learned. Commander's intent is the single most important element of a tactical order.

d. Recommendation. In September 1990, Command and General Staff College (CGSC), Fort Leavenworth, conducted a Commander's Intent Conference to work this issue. A subsequent memorandum for record was produced and approved by General John W. Foss, Commander TRADOC, which standardized the definition of commander's intent and described where it should be placed in the operations order format (Memorandum, HQs TRADOC, ATZL-SWT-C, 14 September 1990, Subject: Commander's Intent). CGSC's approved initiative should be incorporated into the rewrite of all future manuals to standardize the definition and clarify the issue of commander's intent. This doctrine guideline will assist field commanders in training units and executing operations in the field.

e. Comments. None.

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J-8. Training Doctrine.

- a. Observation. In several instances, NCOs and officers commented that the lack of battle-focused training objectives caused training time and effort to be wasted during the first 2 months (October and November) after deployment.
- b. Discussion. There was a relatively short preparation time for units before deployment to the Gulf. European Battle Focus for most U.S. units caused inconsistent training readiness for desert operations. Few units had time to adjust their battle books and modify their tactical standard operations procedures for the desert environment. With the emergence of a war plan at the end of November, units started training in accordance with FM 25-101 and FM 25-100, which provided an effective preparation for war. Repetitive training of critical tasks caused execution to be habitual in nature. Hands-on, performance-oriented methods were used to conduct individual training to appropriate doctrinal tasks, conditions, and standards (i.e., NBC tasks). Units used the crawl-walk-run method of training for collective tasks. Companies through corps conducted mission analysis and developed special plays (similar to a battle book) for different anticipated situations. Simple plans with extensive rehearsals under realistic battlefield conditions worked best. These plans incorporated crew drills, battle drills, missions, refuel on the move, ammunition loading, and even V-pack cleaning. The result was that large maneuver forces were able to methodically conduct complex operations rapidly so that the force could extend its operational range (culmination points) and maintain the momentum of the attack. This is an example of leaders making use of the Army's training doctrine to prepare and train tactical standard operation procedures for war in a limited amount of time.
- c. Lesson(s) Learned. Training doctrine works well.
- d. Recommendation. Continued emphasis is required if we are to maintain the readiness demonstrated in SWA.
- e. Comments. None.

3-9. Identification Friend or Foe.

a. Observation. A high percentage of the U.S. vehicle and personnel casualties in SWA were due to friendly fire.

b. Discussion. Doctrine is already in place to reduce such accidents, but additional improvements can be made in delineating phase lines, boundaries, and emphasizing flank coordinations, and fire control measures. Although modern technology has made great advances in detecting moving and stationary targets at great ranges, the same advances to identify the target as friendly or enemy has not been made. The result is that targets can be destroyed out to ranges in excess of target identification ranges. For the short term, C2 and training techniques are the primary tools to prevent fratricide. Direct fire control measures, tracking enemy and friendly unit locations, adjacent unit coordination, and restrictive control measures to separate helicopter/close air support (CAS) engagements from maneuver units are some examples. Maintaining authority to engage at higher echelons of command is one other technique used to reduce fratricide. However, as the intensity of battle increases, this strict control may infringe on subordinate initiative. An external combat vehicle marking system was used to recognize Coalition Forces who had similar equipment to the enemy. This was a quick fix which could have been exploited by the enemy if they had not already been severely thrown off balance by allied counteractions (air campaign, artillery raids, counter reconnaissance, etc). Most units used a combination of all the above, but still were at risk to friendly fire. This issue can never be perfectly solved, but can be reduced by integrated doctrine, training, materiel solution, and leadership.

c. Lesson(s) Learned. None.

d. Recommendation. Joint doctrine must concentrate on commonality of graphics, control measures, and terminology. We must speak the same language with words and graphics meaning the same thing. JCS PUB 2.0 should be reviewed and refined to ensure SWA experiences and solutions are captured for the future. Then this common language should flow logically through lower level manuals. Develop employment techniques for position location devices (i.e., POSNAV) as they apply to command, control, and communication (C3) enhancements. Development of additional offensive direct fire control measures may be necessary. Engagement criteria should be included in the 5-paragraph field order, i.e., para 3b(4). Engagement criteria, as well as refinement in doctrine and training, is the primary quick fix for this problem. Additional longer term initiatives in the areas of training, materiel, and leadership are also necessary.

e. Comments. None.

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1-10. DPICM/CBU Duds and Scatterable Mine Fields.

a. Observation. Dud munitions and mines were common throughout the battle area. Doctrine does not address these danger areas in planning, tracking, or execution of tactics. This shortfall contributed to unnecessary casualties. Additionally, a lack of doctrinal individual tasks to identify and avoid these types of munitions also contributed to unnecessary casualties.

b. Discussion. These types of danger areas were not tracked or plotted on graphics due to our inexperience with the dud rates of these modern munitions. Therefore, insufficient contingency planning and rehearsals were conducted to prepare for appropriate action when these danger areas were encountered. Soldiers in different units were insufficiently trained to recognize duds and mines. Warnings about the associated dangers of these devices were inadequately disseminated. There were many accidents caused by soldiers picking them up, kicking them, or throwing them around. The Air Force and Artillery units inconsistently coordinated with the ground maneuver forces on the type/location/time these munitions were used. Because armored combat units were less vulnerable to these types of dangerous areas, they often were not detected or reported to the Tactical Operation Centers (TOC). Often, units wandered into these areas without prior warning.

c. Lesson(s) Learned. None.

d. Recommendation. Graphics, requirements to track FASCAM (and other dud producing munitions), and calculating danger zones around these danger areas should be addressed in FM 6-20-30/40, fire support manuals. Appropriate coordination needs to be conducted with the maneuver arms so that their manuals are in agreement with the fire support manuals. FM 101-5-1 needs to be refined for the same purpose. Appropriate CSS doctrine must provide guidelines to conduct breaching or bypass of these areas and cross reference to FM 90-13-1. Combat units manuals must emphasize marking appropriate cleared lanes through these areas. Memory joggers in appropriate armored force manuals should highlight these issues for consideration in the command, control, and communications chapters. Appropriate breaching training, contingency planning, and tactical standard operations procedures should be developed by the CSS and C3 units as well as the combat units. In joint and combined arms operations, use of these types of munitions must be coordinated with the maneuver unit. Finally, all soldiers must receive adequate training on identification, danger, and appropriate safety procedures for these type of munitions. This should be added doctrinally to the common skill tasks required to be trained to all soldiers.

e. Comments. None.

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3-11. Use and Responsibilities of Liaison Officers (LNO).

a. Observation. Liaison officers do not train with units before going to war. Currently, there is very little doctrinal material which provides guidelines on the role, the responsibilities, and the procedures that a LNO needs to efficiently accomplish his tasks in war.

b. Discussion.

(1) Although LNOs are required for combat at all levels of command, they are not authorized by peacetime tables of organization and equipment (TOE). U.S. Army training doctrine tells us that we should train the way we fight. Based on several interviews with returning LNOs from Southwest Asia, they were often used as additional staff rather than LNOs. Their duties were inconsistently defined by the units which they supported. A spirit of cohesion and trust had to be developed with the supported unit before the beginning of the ground assault. Adjacent unit coordination, coordination with higher and lower command, and vertical coordination with helicopter and Air Force units were inconsistent. When LNOs were not available, units had to "pull them out of hide," leaving other staff positions unmanned. This also occurs in training exercises.

(2) LNOs need to understand and "get into the heads" of the commanders who they are supporting. In some cases LNOs are required to answer questions and conduct planning as a surrogate for an absent commander. They must be fully aware of the limitations, capabilities, and Tactical Standard Operating Procedures (TSOPs) of the units that they are representing. They must maintain a knowledge of the current and anticipated friendly/enemy situation.

(3) LNOs must anticipate conflicts and requirements of both commanders whom they represent. They must use appropriate initiative to work out conflicts and request required resources in advance. A second lieutenant is limited by his level of military schooling and maturity to conduct these tasks. A soldier of military education level 4 (CGSC) with a large amount of troop experience is a more appropriate choice. According to the interviews, LNOs can play a major role to reduce fratricide across unit boundaries and in air-to-ground engagements.

(4) In SWA, there was time for newly assigned LNOs to develop the cohesion with the supported units required to perform their duties. In the future, this time may not be available. The Army authorizes equipment to units based on need. If doctrinal responsibilities of the LNO are not captured and realized before the next war, the equipment required by the LNO, such as vehicles, radios, maps, position location devices, etc., will not be provided.

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c. Lesson(s) learned. None.

d. Recommendation. The importance of LNOs, their responsibilities, and procedures must be added in the command and control chapters of all Army doctrine.

e. Comments. None.

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3-12. Task Force Organic CSS.

a. Observation. Contrary to SWA experiences, evolving AirLand Operations is studying consolidation of CSS at brigade level to give more flexibility and agility to the task force organization.

b. Discussion. According to the observations in SWA, task forces retained more agility and flexibility when CSS was organic to the battalion. Battalion level CSS was much more responsive than brigade level CSS. The organic CSS moved, in many cases, within the task forces formation. Routine/emergency resupply, maintenance, and evacuation doctrine worked.

c. Lesson(s) Learned. None.

d. Recommendation. Do not change battalion through platoon level CSS doctrine because it currently works well. However, materiel and organizational fixes are still required (common vehicle chassis, CSS vehicles, more wheels and personnel for support platoon). See Chapter 6 for more details.

e. Comments. None.

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1-11. Other CSS Doctrinal Issues.

a. Responsiveness of forward support battalions (FSBs).

(1) Observation. Most maneuver brigades attacked in excess of 200 kilometers into Iraq and Kuwait, but their forward support battalions could not maintain doctrinal distances from the brigades to maintain adequate support. FSB and division logisticians had to organize and provide support to the brigades with makeshift forward area support teams (FAST).

(2) Discussion. None.

(3) Lesson(s) Learned.

(4) Recommendation. For the short term, capture the makeshift techniques developed in SWA to support the offensive operations and place it in appropriate CSS doctrinal manuals. For the long term, materiel, organizational, as well as doctrinal fixes are required to improve support of non-linear offensive maneuver operations. CSS units must be more self mobile than in the past without degrading support to the maneuver units.

(5) Comments.

b. Class IX.

(1) Observation. The doctrinal inventory, requisition, and distribution system for repair parts was broken in SWA.

(2) Discussion. Different inventory, and requisition systems were used by different units. This caused tremendous problems to units task organized from one division to another. In other more severe cases, units were task organized between services. Automated systems were unreliable. They required exchange of diskettes over long main supply routes (MSRs) in the dusty environment of the desert. The manual requisition system was work intensive. With the complete breakdown of requisitions and inventory, there was no demand created to drive the doctrinal "push" distribution system from the desert stockpiles to the needy units.

(3) Lesson(s) Learned. None.

(4) Recommendation. CSS doctrinal guidelines must be established to facilitate a common class IX system, administratively simple, and reliable in all types of combat environments (desert, European, jungle, etc.).

(5) Comments. None.

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3-14. Gunnery Doctrinal Issues.

a. Turret azimuth indicator on M1/M1A1.

(1) Observation. Lack of turret azimuth indicator on M1/M1A1 tank makes defensive fire planning difficult.

(2) Discussion. Featureless terrain of the desert often provided no usable target reference points (TRP) for tank crews to establish defensive sectors of fire/responsibility. Tank crews used aiming stakes to delineate sectors of fire, or scanned "fender to fender". Development and use of range cards and sector sketches was time consuming and based solely on compass readings. Use of range cards and sector sketches was difficult/impossible during periods of reduced visibility when the thermal sights were obscured. Range cards and sector sketches are basic to developing defensive fire plans. The process of recording data and forwarding up the chain of command is the only way to ensure interlocking fires, etc. This entire process must become a battle drill for all weapon systems. Vehicles must be staked at the specified orientation and limits of fire established using aiming stakes if that is all they have available.

(3) Lesson(s) Learned. None.

(4) Recommendation. Field an azimuth indicator or like device for the M1/M1A1 tank. Continue to stress importance of range cards and sector sketches in training and doctrine for gunners, TC's, platoon leaders, and commanders.

(5) Comments. None.

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b. USAF use of white smoke.

(1) Observation. The U.S. Air Force's (USAF) habitual use of white smoke rockets to designate their close air support kill boxes is unsatisfactory.

(2) Discussion.

(a) The majority of U.S. Army smoke producing systems generate white smoke: vehicle on-board systems, vehicle grenade launchers, mortar delivered, artillery delivered, smoke pots, as well as common hand held HC smoke grenades.

(b) White is the most prevalent because it's easy to produce and is the most effective color for obscuration. Ninety-five percent of the U.S. Army's smoke use is for obscuration. Five percent of our smoke use is for signaling.

(c) The USAF uses white smoke rockets to designate CAS kill boxes because its easily seen from high altitudes.

(d) USAF use of white smoke as a CAS kill box delineator robs ground forces of their only available obscurant.

(e) During Desert Shield/Storm one unit's use of screening smoke during a CAS strike could have resulted in fratricide. The ground unit's resulting retrograde move stalled momentum, delayed continuation of their mission, and wasted much time sorting out.

(3) Lesson(s) Learned. None.

(4) Recommendations.

(a) The Army and Air Force need to deconflict smoke use between the two services.

(b) CAS targets can be marked with ground burst illumination, or at least, smoke other than white.

(5) Comments. None.

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c. Ammunition transfer.

(1) Observation. The Armor Force infrequently trains ammunition transfer from the semi-ready to the ready rack.

(2) Discussion. Tank crews frequently found themselves transferring ammunition from their semi-ready rack to their ready rack during enemy contact without having trained to any standard before Operation Desert Storm. While all tankers knew that their ready rack contains only 17 rounds, they failed to train their crews sufficiently on the ammunition transfer task. To ensure that a task gets trained, the task must be required in doctrine. Transferring ammunition during enemy contact is not an easy task.

(3) Lesson(s) Learned. None.

(4) Recommendation. That units train ammunition transfer on a routine basis. That Weapons Department develop an ammunition transfer drill for incorporation into FM 17-12-1, possibly as a TCGST task. Ammunition transfer should not have been a surprise to the tank crews. There are safety considerations that apply to both training and combat conditions. While crews routinely transfer ammunition during gunnery densities, they rarely consider the task as TRAINING and, consequently, do not concentrate upon the correct procedures.

(5) Comments. None.

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d. Muzzle Boresight Device (MBD) Calibration.

(1) Observation. Muzzle Boresight Device (MBD) Calibration is a problem with many units.

(2) Discussion. MBDs can easily be knocked out of calibration, thus requiring recalibration of the device. MBDs must then be sent to DS level maintenance for collimation and should still be calibrated to the gun tube. Units should have the authority to calibrate their own MBDs. Some units made and carried their own boresight panels for use while in the defense (sand colored on the back).

(3) Lesson(s) Learned. None.

(4) Recommendation. That Weapons Department further refine and publish MBD calibration procedures. The U.S. Army Armor School (USAARMS) should consider adding MBD calibration to the Master Gunner course. Many people confuse the terms collimation and calibration. Collimation refers to the alignment of the sights of the MBD. Calibration refers to the alignment of the MBD to a particular tube to ensure that correct line of sight is achieved.

(5) Comments. None.

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3-15. Mission Oriented Protective Posture (MOPP).

a. Observation. Current MOPP definitions are not descriptive enough.

b. Discussion. Current MOPP definitions address only those procedures taken under NBC conditions. The increasing number of threats and hazards on the battlefield and the evolution of countermeasures require that our definitions of MOPP be expanded.

c. Lesson(s) Learned. None.

d. Recommendation. Definitions and matrices should be developed to incorporate the wear of Ballistic/Laser Eye Protection, Flak Vest, the Nomex uniform, climate cooling vests, and other protective measures.

e. Comments. None.

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1-16. Bradley Gunnery.

a. Observation. Bradley Gunnery.

b. Discussion. Gunnery for the Bradley Scout crews needs to emphasize more on section gunnery than individual crews. Scouts work as sections so that is how we need to train.

c. Lesson(s) Learned. Current Bradley Table VIII does not prepare a scout platoon for combat.

d. Recommendation. Bradley Table X, section gunnery with the tactics, should be the reportable gunnery table for the scouts.

e. Comments. The chances of fratricide in combat could be less of a factor if crews trained the same way they fight.

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CHAPTER 4

ORGANIZATIONS

4-1. Summary.

a. The organizational issues addressed within this chapter cover major subject areas of interest to armor. Information utilized throughout this chapter was identified and condensed from unit after-action reports and personal interviews from soldiers deployed to Southwest Asia during Operation Desert Storm. The information gained from these reports has been arranged into a format which identifies observations, provides discussion of the issue, proposes lessons learned, and then describes any recommendations or ongoing action in the issue area.

b. Initial entry forces remain extremely vulnerable to attack by mechanized enemy. Sufficient light armor/cavalry elements were not available for deployment with initial entry forces despite the availability of airlift assets. The current Total Army Analysis resources formation of two additional Light Armor Battalions in addition to the 3-73d Armor.

c. Many commanders added tanks to their divisional cavalry squadrons in order to protect scouts and provide the needed firepower up front. The Chief of Staff of the Army (CSA) approved the integration of tanks and the addition of the third ground troop to divisional cavalry squadrons. Total Army Analysis has resourced these organizational changes with implementation to begin during fiscal year 1995. United States Army Europe (USAREUR) is currently working to configure its squadrons under a design which provides three M1s and five M3s per platoon.

d. The reduction in size of the tank battalion from four companies to three has been discussed and was proposed as an Airland Operations Base Case. The smaller battalion offered potential for increased deployability and battlefield agility. Based on comments from commanders, USAARMS should continue to oppose reductions in the tank battalion.

e. Commanders at all levels stressed a need for survivable ground reconnaissance. Had the assets been available, many commanders would have formed brigade scouts. Battalion scouts, HMMWV equipped, were perceived as being vulnerable and in some cases not employed in traditional scout missions. USAARMS has recommended that fielding of the HMMWV-based scout platoon be placed on hold pending evaluation of platoon configurations used during Desert Storm.

f. Organic Combat Service Support assets are considered to be less than adequate by many field commanders. Transportation and

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maintenance assets are vital to the overall success of modern armored warfare.

g. Combat, combat service, and combat service support lack sufficient wheeled hauling capability to move organizational assets. The HEMMT proved to be a very capable tactical wheeled vehicle. Several commanders feel this vehicle should replace all commercial forms of transportation below corps level. Units must be equipped to support the offensive mission in hauling capability, this includes fuel and cargo capabilities.

h. Several units task organized to form combined arms battalions early in the operation. The creation of logistic support structure and rehearsal of tactics, techniques, and procedures provided for an organization equipped to operate as a true combined arms unit.

i. The Armored Separate Brigade remains a robust, flexible organization suited for rapid attachment throughout the theater of operation. The Tiger Brigade, a divisional brigade, was operational control (OPCON) to the USMC and given the mission to operate as an armored separate brigade (HSB).

j. The Armored Cavalry Regiment proved itself to be a robust, flexible organization capable of accomplishing all assigned missions.

k. Information provided does not attempt to describe deficiencies in organizational designs or configurations. Rather, it is designed to identify areas of interest to the armor community as a result of current operations and foster additional discussion by the reader.

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4-2. List of Issues.

- a. Light armor/light cavalry needed.
- b. The divisional cavalry squadron needs tanks.
- c. The tank battalion needs four companies.
- d. Ground reconnaissance.
- e. Brigade scouts.
- f. Battalion scouts.
- g. Organic css requirements.
- h. Support organization's mobility inadequate.
- i. Combined arms maneuver battalion has merit.
- j. The armored separate brigade.
- k. The armored cavalry regiment.

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4-3. Light Armor/Light Cavalry Needed.

a. Observation. Initial entry forces were extremely vulnerable to attack by mechanized enemy, and lacked battlefield mobility for either self protection or early warning. Sufficient light armor/cavalry elements were not available for deployment with initial entry forces despite the availability of airlift assets.

b. Discussion. The single battalion of M551 Sheridans available to the 82d Airborne Division was no match for the potential mechanized threat. Though the 82d was well equipped with anti-tank weapons, their paucity of battlefield mobility limited them to the defense of a relatively small area. This defense was hindered by the lack of mobile reconnaissance assets which could provide warning to defending troops of enemy movements.

c. Lessons(s) Learned. Light Armor and Cavalry formations need to be deployed as part of the initial entry force in order to provide protection from mechanized threats and reconnaissance for the initial entry force. Light Armor and Cavalry formations need to be as deployable as light infantry forces.

d. Recommendation. The current Total Army Analysis resources formation of Light Armor Battalions in addition to 3-73 Armor and further explores formation of a Light Cavalry Regiment to support XVIIIth Airborne Corps.

e. Comments. None.

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4-4. The Divisional Cavalry Squadron Needs Tanks.

a. Observation. Integration of M1 tanks into the squadron was fundamental to the success of the squadrons' execution of its demanding mission profile. Adding tanks enabled a faster Reconnaissance tempo and added depth to the security mission. They also allowed the unit an all weather tactical reserve.

b. Discussion. Several commanders added tanks to divisional cavalry squadrons in order to protect scouts and provide needed firepower up front. Most felt that the cavalry needed to be able to defeat any target encountered as well as being able to absorb a main gun hit and continue the mission. The complimentary characteristics of M1 and M3 optics provided cavalry commanders with a more detailed picture of the battlefield he faced. In addition, cavalry commanders observed that two ground troops were insufficient to accomplish the normal missions they were given. Some divisions created a third ground troop in order to address this problem. Several observations added to the growing body of evidence that the integrated platoon is the optimum configuration for accomplishing cavalry tasks. Commanders indicated a willingness to trade an air troop for an additional ground troop creating a three ground/one air squadron.

c. Lessons(s) Learned. None.

d. Recommendation. CSA gave conceptual approval to the addition of tanks and a third ground troop in June 1991. USAREUR is working to organize two squadrons using integrated platoons of three M1s and five M3s. HQDA as part of the TAA process proposed organizing the remainder of the Army around a platoon design of two M1s and three M3s as an interim measure. Movement to the objective (3x5) design would occur as the Army transitions to Air Land Operation structures after 1995.

e. Comments. None.

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4-5. The Tank Battalion Needs Four Companies.

a. Observation. Several commanders were aware of discussions for reducing the size of the tank battalion before Desert Storm. They submitted comments on the proposed reductions in light of their experiences. Since current battalions are organized with four companies, there is no documented example of a battalion operating with three maneuver companies.

b. Discussion. The robustness and flexibility of the four company organization were cited by several commanders as the main strengths of the design. There was no evidence that the four company configuration presented any problems in the areas of agility or synchronization. There was no evidence that commander's were unable to utilize the combat power of the fourth company. The four company arrangement facilitated continuous operations and allowed commanders to maintain continuous pressure on the enemy. Commanders commented that the four company organization offered better, more easily controllable formations during movement than would a three company alternative. Commanders stated a willingness to have fewer four company battalions before reducing the size and capabilities of the battalion.

c. Lessons(s) Learned. Four company battalions are viable organizations that do not overburden the battalion commander. Indeed, they provide him with a robust organization for extended combat operations and a reserve force that provide him much needed flexibility and agility.

d. Recommendation. The only forum in which the three company alternative exists is in the AirLand Operations Base Case. The smaller battalion is presented as offering potential for increased deployability and battlefield agility. USAARMS should continue to oppose reductions of the tank battalion.

e. Comments. None.

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4-6. Ground Reconnaissance. Brigade and Battalion Scouts.

a. Observation. Commanders at all levels from battalion through corps expressed a need for survivable ground reconnaissance assets.

b. Discussion.

(1) Brigade Scouts. Current designs provide commanders at corps, division, and battalion with dedicated reconnaissance elements. Only the brigade commander is without such a capability. Even then, in the Armored Separate Brigade TOE, a Separate Cavalry Troop is included. This leaves only the divisional brigade commander without a reconnaissance capability. While there was no report that brigade scout platoons were organized, several commanders commented on the need for a brigade reconnaissance element. It is clear that, had the assets been available, a number of commanders would have experimented with brigade scouts.

(2) Battalion Scouts. The battalion scout platoon issue revolves around equipment. In March of 1990, the battalion TOE was changed to reflect a 10 vehicle scout platoon based on HMMWVs. This was the result of the Scout Platoon Concept Evaluation Program from the previous summer. The intent was to get more reconnaissance platforms and for these platforms to be able to operate stealthily compared to the M3. The objective vehicle was the Future Scout Vehicle with the HMMWV as an interim platform. Shortages of target acquisition (optics) devices, military motorcycles, and non-dedicated STINGER policy prevented units from transitioning to the winning design from the CEP. However, six battalions employed scout platoons based on the HMMWV and two battalions employed scout platoons based on a mixture of HMMWVs and M3s. None of the battalion scout platoons employed during Desert Storm were organized according to either the approved TOE or the winning design from the CEP.

c. Lessons(s) Learned. During Desert Storm, survivability took precedence over stealth as the driving issue for battalion scouts. Commanders using HMMWV scout platoons were not anxious to risk them to perform traditional scout platoon missions at doctrinal distances from the main body. Therefore, scouts were degraded by their dependence on the less survivable platform. The shortfall was made up using either tank platoons or mechanized infantry platoons in advance of the battalion, with the wheeled scouts being used to facilitate command and control, as couriers, and in traffic control.

d. Recommendation. USAARMS has currently recommended that fielding of the HMMWV-based Scout platoon be placed on hold pending the results of a full analysis of the way

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different scout platoon configurations were used during Desert Storm. USAREUR will continue to transition to the new design.

e. Comments. None.

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4-7. Organic CSS Requirements.

a. Observation. Field commanders continue to stress that organic combat service support assets are less than adequate for combat operations. Two issues include the hauling capability of the Support Platoon as inadequate to support the needs of the M1 battalion and organic water hauling capabilities being less than desirable in a desert environment. Several commanders were aware of an action, Battalion Maintenance System, which would remove organic repair and recovery capability from their units. They stressed the need to retain organic maintenance assets at or below battalion level.

b. Discussion.

(1) The Support Platoon requires increased hauling capability in both fuel and cargo loads. To maintain the pace established in continuous offensive operations, an increase of four fuel and four cargo HEMMTs assigned to the Support Platoon, has been recommended by field commanders. Additional personnel should be added to operate trucks for continuous operations, e.g., two personnel per truck.

(2) Water carrying capabilities of the company/troop are inadequate to support continued operations in a desert environment. The usage rates experienced during desert warfare places a greater demand on the units' organic assets than could be delivered.

(3) The combined efforts of current battalion maintenance and support sections are required to meet the demands placed on them during modern warfare. Several units report OR rates above 90 percent and 97 percent for the M1 and Bradley, respectively. This would not have been possible if maintenance assets were consolidated at Forward Support Battalions. PLL works best at battalion level while recovery and maintenance assets are best served at company level.

c. Lessons(s) Learned.

(1) Logistics continue to be a major determinant in overall warfare success. The fuel and cargo hauling capability of the Support Platoon must be robust enough to support continued operations, especially in the offense.

(2) Organic water carrying capability of the company/troop must support continued operations in a desert environment.

(3) The results of the high tempo of modern mobile armored warfare indicate that CSS assets need to be organic to battalions. Maintenance assets especially, will remain most responsive and effective when organic at company and battalion level. Fix forward is still a legitimate goal.

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d. Recommendation. Battlefield Maintenance System (BMS) is an ongoing action which revises the maintenance system to reduce the levels of maintenance by combining organizational and direct support maintenance into one single level. The most apparent change is the movement of all maintenance personnel into a maintenance company organic to the Forward Support Battalion. All mechanic, recovery, and spare parts support would be derived from platoons sent forward to the battalion. However, this is not an initiative supported by the Armor Center.

e. Comments. The Armor School position is not in concurrence with the Quartermaster BMS initiative.

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4-8. Inadequate Support Organization Mobility.

a. Observation. Combat, combat support, and combat service support lack sufficient wheeled hauling capability to move organizational soldiers, equipment, and supplies in a single move. Support units especially felt this deficiency in hauling repair parts, major assemblies, fuel, and additional life support systems required during desert warfare.

b. Discussion. The fast paced warfare observed during Operation Desert Storm placed a severe strain on logistics support of all units. One divisional unit reported difficulty in uploading ammunition. The units' capability to haul even the minimum acceptable amounts was less than required. The increased resupply distances demonstrated that fuel hauling capability is designed for peacetime operations. The tactical fuel hauling capability of the armored division equipped with M1s is broken. One unit reports that the lack of mobile bulk fuel transportation delayed the unit for a period of over 12 hours. Several commanders report the HEMMT as being the most dependable wheeled vehicle in their fleet. The HEMMT proved to be a very capable tactical wheeled vehicle. Many commanders believe the HEMMT should replace all commercial forms of transportation below corps level. The need for cross-country capability, especially in the early stage of conflict is vital to the offensive operation. The previous wheel studies by the Logistical Center and other agencies do not agree with recent experiences in South West Asia.

c. Lessons(s) Learned. Support organizations must be agile and robust to be able to move supplies quickly to meet the demands of the modern battlefield.

d. Recommendation. The replacement of 2 1/2-ton vehicles with the 5-ton would greatly enhance hauling capability of combat units. An evaluation of cargo and fuel requirements for continuous offensive operations needs to be addressed. Units should be equipped to support the offensive mission. A requirement exists for Heavy Equipment Transporters at Forward Support Battalion level. Each 3,000 gal fuel tanker should be replaced with two HEMMTs at division and below levels to improve mobility.

e. Comments. None.

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4-9. Combined Arms Maneuver Battalion (CAMB) has Merit.

a. Observation. Combined Arms Maneuver Battalions employed during Desert Storm were better prepared to operate over varying terrain, task organize internally as the mission dictated, and provide required support to all organic elements with organic assets.

b. Discussion. Several units task organized to form combined arms battalions early in the operation. The rehearsal of tactics, techniques, and procedures brought about a better understanding of the commanders intent, promoting unit cohesion and ability to work as a team. The 1st Cavalry and 1st Armored Divisions were pleased with the CAMB organization. As one commander stated, "The CAMB is the 80 percent solution for all METT-T situations." Since the battalions were designed to operate as a combined arms unit, logistical assets were structured to support their needs. This reorganization provided better support in less time than organizations which were task organized during operations.

c. Lessons(s) Learned. The Combined Arms Maneuver Battalion is a viable organization.

d. Recommendation. None.

e. Comments. None.

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4-10. The Armored Separate Brigade.

a. **Observation.** The Tiger Brigade was given the mission to operate as a armored separate brigade element. This action required the unit to receive additional service support assets to offset those found organic to the ASB.

b. **Discussion.** The Tiger Brigade, a divisional brigade, was OPCON to the USMC. It was essentially given the mission to operate as a armored separate brigade. Utilizing its assigned battalions, the brigade was organized with, two armor battalions, one mechanized infantry battalion, attachment of an air defense artillery battery (-), engineer company, direct support artillery battalion, multiple launched rocket system battery, military police platoon and a beefed-up 800-man forward support battalion. Support to the brigade was an area of great concern for the commander. The TO&E of the 197th Separate Infantry Brigade was used as a guide to assist the Support Battalion commander during development of his support requirements. Both personnel and equipment assets were pulled from several units to convert the Tiger Brigade into an Armored Separate Brigade. Support was received from, but not limited to, one combat division, United States Army Reserve, Quartermaster School, and leased host equipment. The lack of support structure forced the commander to position liaison teams at theater level to ensure the brigade was resupplied. The unit itself had to carry 95 percent of its own supplies with water being the only commodity the USMC could supply at times. As a whole, the brigade operated as an effective combat unit. The burden of creating an ad hoc support organization did not hamper their success.

c. **Lessons(s) Learned.** The Armored Separate Brigade remains a robust, flexible organization suited for rapid attachment throughout the theater of operation. Support structure must exist for the element to operate at maximum efficiency.

d. **Recommendation.** None.

e. **Comments.** None.

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4-11. The Armored Cavalry Regiment.

a. Observation. The Armored Cavalry Regiment proved itself to be a robust, flexible organization capable of accomplishing all assigned missions.

b. Discussion. None.

c. Lessons(s) Learned. The ACR continues to be a viable organization, well designed for its mission profile.

d. Recommendation. None.

e. Comments. None.

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CHAPTER 5

TRAINING

5-1. Summary.

- a. The purpose of this chapter is to discuss, provide comments and recommend actions to emerging observations from Operation Desert Shield/Storm (ODS/S) that affect training and training development at the Armor School. The Directorate of Training Development (DOTD) collected data in three areas: training, maintenance, and weapons.
- b. Desert Storm validated the Armor School's leader training programs the Armor Officer Basic Course, Armor Officer Advance Course, Advanced Non-commissioned Officer Course (AOBC, AOAC, ANCO, etc.). Armor leaders at all levels were tactically and technically proficient, but most of all aggressive. Missions were executed without hesitation because leaders were trained in the basics. They knew what to do and how to do it. The foundation of that training was the institutional training gained at the Armor School. The Armor School taught "what" to do, leaving the units to determine "how" to do it.
- c. Not only was leader training validated, but individual training was as well. The quality of the soldier produced by the Armor School is excellent. He is disciplined, motivated and well trained. His unit polishes his skills and makes him a member of a combat team. Units continue to improve soldier skills through Common Tasks Tests (CTT), Tank Crew Gunnery Skills Test (TCGST) and mentoring by NCOs. Desert Storm proved disciplined soldiers win wars, and disciplined soldiers are the product of superior training.
- d. Battles are won or lost at the small unit level. The units that participated in Desert Storm had received the finest training available through the Combat Training Centers. The basis for all evaluations and training for armor and mechanized forces are the Field Manuals (FMs) and Mission Training Plans (MTPs) developed at the Armor School. This provides constant validation of the training materials we provide the Armor Force.
- e. The area of greatest concern and requiring special attention is pre- and post-mobilization training. This was a "come as you are" war and was readily apparent in mobilization training. Training packages were not in place initially, and DOTD created them as requirements were identified. This may require full-time staffing to update course packages based on changing missions. Full-time mobilization course development would allow DOTD to be pro-active rather than reactive. When resources are available, this course will be developed. A need for a crew-level training package was also identified. This would give the tank commander

a guide to train his crew to standard and the company commander an additional tool to prepare his unit for combat.

f. How we train Reserve Component (RC) Combat and Combat Support units is an area requiring additional attention. With the downsizing of the Army, a greater emphasis will be placed on Round Out/Up units. Desert Shield/Storm demonstrated that RC units have special training requirements that are difficult to attain on their training cycle. The entire RC approach to training needs to be redeveloped. This is not just an Active Component (AC), RC or DA problem. It is a national problem that must be addressed with DA, AC and RC input. This, and closer integration with active Army units will be necessary to make this system work.

g. There should be more training in combined light infantry and armor operations. This observation gains increased importance in light of evolving doctrine which envisions increased participation of armored forces in contingency and rapid deployment operations. Units in SWA had the luxury of up to six months to train together before the ground war, but we may not have this luxury in future campaigns, given what potential enemies learned from Desert Storm.

h. Not surprisingly, most of the observations under weapons are on crew level training. One that stands out is vehicle identification. Until a suitable Positive Combat Identification (PCI) system is in place, we must develop a program to train gunners and tank commanders to identify vehicles at all engagement ranges under all conditions. More challenging tank tables are needed. We owe it to the crews to design ranges that allow them to train as they will fight.

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5-2. List of Issues.

- a. Vehicle Identification.
- b. Combat Training Centers.
- c. Logistics Training Centers.
- d. Rehearsals.
- e. Use of Mobilization Lesson Plans.
- f. Crew Training.
- g. Boresighting.
- h. Tank Tables.
- i. Muzzle Boresight Device.
- j. Tank Commander Weapon Station.
- k. Mines and Unexploded Ordnance.
- l. Breaching Complex Obstacles.
- m. IRR Refresher Training.
- n. Replacement and Additional Instructors.
- o. Non-qualified Soldiers Reporting for IRR Training.
- p. Need for training in call for fire procedures.
- q. Long range gunnery training.

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5-3. Vehicle Identification.

- a. Observation. Identification of friend or foe, both in daylight and thermal channels, was a problem and probably contributed to the fratricidal problems experienced by armor units during Operation Desert Storm.
- b. Discussion. Much of Operation Desert Storm was conducted under limited visibility conditions. Vehicular identification was also exacerbated by crew problems with focusing their thermal imaging system.
- c. Lesson(s) Learned. The fratricide issue is directly linked to IFF on the battlefield.
- d. Recommendation. Crews must train vehicle identification on the actual vehicles and not just flash cards. Commanders must emphasize this training. IFF should be addressed as a hardware fix as much as possible. Until the hardware fix is in place, individual soldier training must be as realistic as possible. Additionally, when operation with coalition forces, preparation for war must include training with allied equipment, as well as our own for, for recognition purposes.
- e. Comments. While separate issues, IFF and fratricide are linked directly. Correct graphics, positive unit command and control and proper land navigation techniques can all contribute to fratricide reduction without necessarily helping in IFF. Both thermal and daylight IFF must be trained.

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5-4. Combat Training Centers.

a. Observation. Combat Training Centers (CTC) were instrumental in the success achieved during Operation Desert Storm (ODS).

b. Discussion. The various CTCs, the National Training Center (NTC), the Joint Readiness Training Center (JRTC), the Combat Maneuver Training Center (CMTc), and the Battle Commander's Training Program (BCTP), have provided training opportunities to our soldiers, units, and staffs that are unavailable in any other army in the world. However, there are some modifications that need to be made to incorporate experiences gained in Southwest Asia (SWA).

(1) Continuous Operations need to be stressed and incorporated into training. Currently we ENDEX after each operation for a critique.

(2) Battle drills need to be developed, incorporated into training, and evaluated. These battle drills are needed from platoon through brigade level.

(3) Mass Enemy Prisoners of War (EPW) exercises may be needed in light of the huge number of EPWs taken during the war. While we may never again see the number of EPWs encountered in ODS, these drills would be valuable in dealing with civil affairs (CA) problems, i.e. refugees as in Panama.

c. Lesson(s) Learned. We must continue to update and upgrade our training at our CTCs.

d. Recommended or Ongoing Actions. These recommendations have been forwarded to the Center for Army Lessons Learned (CALL) for incorporation into the formal Army Lessons Learned findings.

e. Comments. None.

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5-5. Logistics Training Centers.

a. Observation. Many problems were experienced in logistics areas.

b. Discussion. A wide variety of problems experienced in logistics areas were attributable to a lack of realistic tactical training for logisticians. Logistical operations are complex under the best of circumstances. When the fog and frictions of rapid deployment into an immature theater and war are introduced, these complexities increase dramatically. To help train for these extremely complex and vital operations, logisticians need a CTC similar to those at the NTC, JRTC, and CMTC.

c. Lesson(s) Learned. Logisticians must have means of preparing for the demands of deployment and combat that are made on the logistics system.

d. Recommended or Ongoing Actions. These recommendations have been forwarded to the Center for Army Lessons Learned (CALL) for incorporation into the formal Army Lessons Learned findings.

e. Comments. None.

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5-6. Rehearsals.

- a. Observation. Detailed rehearsals were key to success.
- b. Discussion. The demands and complexities of modern mobile warfare make rehearsals vital to success. An initial concern during ODS was the breaching of the Iraqi defenses. Detailed terrain models and actual fortifications were built to replicate the, then believed, complex and well defended Iraqi defensive belts. Detailed rehearsals were conducted in breaching techniques to ensure that all soldiers knew exactly what to do during these complex operations. These rehearsals contributed dramatically to the success and relatively light casualties suffered by U.S. and Coalition Forces. A second major concern was the movement of large formations long distances over the seemingly trackless desert. Again, rehearsals of up to division-size were key to our eventual success.
- c. Lesson(s) Learned. The need for well prepared, detailed rehearsals was reaffirmed in ODS.
- d. Recommendation. None.
- e. Comments. None.

5-7. Use of Mobilization Lesson Plans.

a. Observation. Already existing lesson plans developed for use in mobilization courses were not extensively used. Refresher training for IRR, RT12 had not been identified before Operation Desert Shield.

b. Discussion. Existing MOB lesson plans were developed to support Skill Level (SL) 1, SL3, and officer courses. These courses were not implemented. These courses, part of the existing mobilization plan, did not meet Desert Shield guidance. RT 12 specific courses were developed. Where possible, existing Reserve Component configured lesson plans were used.

c. Lesson(s) Learned. Standing IRR refresher training packages should be developed and maintained as a part of the entire mobilization training strategy.

d. Recommendation. Maintain requirements to update and keep current all mobilization training materials. Develop new materials as needs are identified. Be prepared to adjust packages based on new or changing missions.

e. Comments. TRADOC must continue to fund mobilization course development. Fort Knox currently has one MOB course developer. This position is scheduled to end after FY 92. The five to eight personnel identified in the IRR Refresher Training issue could help in developing this course.

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4-8. Crew Training.

a. Observation. There is a need to develop Armor and Cavalry crew level training.

b. Discussion. Formal training and supporting training packages for crew training do not exist. FM 17-12 series and FM 23-1 contain crew training drills at the unit level. These could be used as the basis for training packages.

c. Lesson(s) Learned. Crew training packages should be developed.

d. Recommendation. Determine if Personnel Command (PERSCOM) can track soldiers as crews; if so then TRADOC should fund training developer positions to complete this position.

e. Comments. Crew training would be a new mission and require additional personnel authorizations.

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5-9. Boresighting.

a. Observation. Boresighting of tank main guns continues to be a problem for some units.

b. Discussion. Some units continued to have problems boresighting their tanks. A lack of understanding of the tank fire control system contributed to the problem with crewmen incorrectly inputting data into the CCP. Lack of confidence in their ability to boresight correctly caused crews to be reluctant to re-boresight their tanks once they had achieved a good boresight.

c. Lesson(s) Learned. Tank crews must understand the fire control system and follow the correct boresight procedures as outlined in FM 17-12-1.

d. Recommendation. Unit master gunners train their crews in the fire control system and boresighting procedures.

e. Comments. None.

5-10. Tank Tables.

a. Observation. Many tank crews who participated in Operation Desert Storm think that Tank Table's VII, VIII AND XII should be made more challenging.

b. Discussion. Desert Storm crews have asked for more challenging engagements in Tank Table's VII, VIII and XII. They specifically requested that more degraded engagements, longer range engagements and smaller targetry be included in the Tank Table's to better replicate the actual conditions experienced during Desert Storm.

c. Lesson(s) Learned. The success achieved by U.S. tank crews demonstrated the effectiveness of the current tank table; however, many crews fired degraded mode at longer ranges and at less full frontal targets than they currently train to in the tank tables.

d. Recommendation. That Weapons Department take a look at the current tank tables and consider the addition of more degraded mode engagements, longer ranges and smaller targets.

e. Comments. None.

5-11. Muzzle Boresight Device.

a. Observation. Muzzle Boresight Device (MBD) Calibration is a problem with many units.

b. Discussion. MBDs can easily be knocked out of calibration, thus requiring recalibration of the device. MBDs must be sent to DS level maintenance for collimation and should still be calibrated to the gun tube.

c. Lesson(s) Learned. Units should have the authority to calibrate their own MBDs.

d. Recommendation. That Weapons Department further refine and publish MBD calibration procedures. USAARMS should consider adding MBD calibration to the master Gunner course.

e. Comments. None.

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5-12. Tank Commander Weapon Station.

a. Observation. The Armor Force does not routinely train to fire the tank commander's .50 cal offensively, i.e. while moving.

b. Discussion. Many tank commanders fired their .50 cal while on the move during Desert Storm. Collectively, the TCs asked that an offensive .50 cal engagement be included on Tank Table VII and VIII to ensure the task is trained.

c. Lesson(s) Learned. The TCs .50 cal is an effective offensive weapon and TCs should be trained as such vice only defensive as is currently the case.

d. Recommendation. That Weapons Department take a look at including offensive .50 cal engagements in the tank tables or create offensive engagements for the .50 cal for UCFT exercises.

e. Comments. Safety constraints have been the driving factor that have prevented the inclusion of offensive .50 cal engagements on Tank Table's VII & VIII. Offensive .50 cal engagements can be easily trained on the UCFT. TCs can fire the .50 cal while on the move in UCFT at any time without getting a system fault as long as they do not exceed 100 rounds of ammo expended.

5-13. Mines and Unexploded Ordnance.

a. Observation. There is a deficiency in training in the identification of unexploded mines, CBU bomblets, and DPICM munitions.

b. Discussion. ODS saw the use of DPICM/CBU munitions on an unprecedented scale. Numerous friendly casualties were caused by a failure or inability to correctly identify these munitions.

c. Lesson(s) Learned. Training and training devices must be developed to aid in the recognition of DPICM/CBU munitions and other ordnance likely to be found in great numbers on the battlefield, such as FASCAM.

d. Recommended or Ongoing Action. These recommendations have been forwarded to the Center for Army Lessons Learned (CALL) for incorporation into the formal Army Lessons Learned findings.

e. Comments. None.

5-14. Breaching Complex Obstacles.

a. Observation. There is a lack of detailed doctrine and training standards that addresses the breach of complex obstacles.

b. Discussion. Preparations for offensive action in SWA demanded comprehensive, detailed training and the development of Tactics, Techniques, and Procedures (TTP) to overcome the complex Iraqi defensive belts. Our emphasis in Europe over the last 45 years has been on the defense and the establishment rather than breaching of complex obstacles thus creating a problem of training our soldiers how to overcome these obstacles. This problem was exacerbated by a formally stated policy of not counterattacking into Warsaw Pact countries and their considerable obstacle systems.

c. Lesson(s) Learned. Detailed, comprehensive doctrine and training standards must be developed and incorporated into our training at all levels.

d. Recommended or Ongoing Action. Detailed TTP was being developed at Fort Knox, in conjunction with other TRADOC schools, prior to ODS. Some of these TTP were sent to the field. However, work continues on the development of formal doctrine and training based on the ODS experience.

e. Comments. None.

5-15. IRR Refresher Training.

a. Observation. Refresher training for IRR was not available at the start of Operation Desert Shield.

b. Discussion. Need for unique IRR training had not been identified until the decision to call up IRR was made. IRR Recently Trained (discharged within the last 12 months - RT12) training packages were designed by RC3 and CDD - DOTD as soon as the need was identified. These packages used existing and newly developed materials.

c. Lesson(s) Learned. Fort Knox must maintain on the shelf and updated, mobilization training material to support various types of mobilization missions, to include IRR refresher training.

d. Recommendation. DOTD continue to update current Mobilization (MOB) training material and develop standing courses as needs are identified.

e. Comments. MOB course development position in RC3 must be maintained and additional positions created. Two or three IRR training developer positions are needed in RC3, Course Development. In addition, Training Division requires three to five Active Guard or Reserve (AGR) to execute RC tailored training products. In total, DOTD requires five to eight AGR personnel to fulfill RC unique requirements.

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5-16. Replacement and Additional Instructors.

a. **Observation.** Active Component instructors in the school received orders for the war, and no replacements were scheduled to support the Maintenance Department IRR training requirements. Also, additional instructors were not identified in a timely manner to accommodate the student load.

b. **Discussion.** There were 60 additional instructors identified to support the IRR training requirements. We need to identify instructors on our Mobilization (MOB) TDA. These instructors would come from the 100th Division during RC Annual Training. Instructors need to be augmented with the Maintenance Department during MOB exercises for train-up.

c. **Lessons learned.** No plan exists to have RC instructors at training base to support mobilization training requirements.

d. **Recommendation.** Fort Knox coordinate with the 100th Division (Training) to identify the maintenance instructors (63E, 45E, 67T, and 45T) on the MOB TDA and start the augmentation training in FY92.

e. **Comments.** PERSCOM and CPO could help by identifying active component or civilian maintenance instructors to replace active component instructors receiving orders for war or other PCS sites.

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5-17. Non-qualified Soldiers Reporting for IRR Training.

a. Observation. During Operation Desert Shield/Storm Fort Knox received IRR (RT12) soldiers that were not qualified to receive Advanced Individual Training (AIT) or refresher training.

b. Discussion. Quite a few IRR soldiers arrived who were not qualified to receive training and were sent back home. These soldiers had not completed Maintenance AIT or for other reasons, i.e. medical discharge.

c. Lesson learned. RC units and PERSCOM had not identified personnel that were not qualified to receive NOS training during annual MOB exercises.

d. Recommendation. Soldiers be carefully screened during MOB exercises and/or during SRP processing to ensure only qualified soldiers are sent to reclassification or refresher training during mobilization.

e. Comments. None.

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5-18. Need for training in call for fire procedures.

a. Observation. The shortcomings of the FIST-V created a requirement for additional call for fire training.

b. Discussion. Artillery observers were not able to keep up with maneuver forces because of the FIST-V. Artillery observers lagging behind may have had an impact on the amount of artillery fired during the ground offensive that had not been preplanned. Until a replacement for the FIST-V is provided, combat leaders need to be more proficient in call for fire procedures.

c. Lessons Learned. None.

d. Recommendation. More emphasis should be placed on training armor and infantry leaders to call for and adjust indirect fires because the FIST may not be available.

e. Comments. Many commanders put their FSOs in the command tank with them so that the FSO could keep up. This is, at best, an interim solution because the M1A1, as currently configured, could not provide the communications requirements for both the commander and FSO.

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5-19. Long range gunnery training.

a. Observation. Currently, USAARMC does not provide gunnery training to the extended ranges to which M1A1 and BFV crews were able to acquire and kill targets in SWA.

b. Discussion.

(1) Long range gunnery was used by most units. M1A1 equipped units reported kills in excess of 3,000 meters. M1A1s destroyed enemy vehicles before being acquired by the enemy during periods of limited visibility due to our thermal sights. Bradleys destroyed vehicles at 2,500 meters with the 25mm. At these ranges, vehicle identification is much more difficult, as is range estimation.

(2) Gunnery tables need to be reevaluated to establish longer range targets--a problem, given the range of our training ammunition and lengths of our gunnery ranges. However, a reduced size target might be the answer to replicate longer ranges. If we plan to take full advantage of our superior technology, we must train our crews in long range gunnery.

c. Lessons Learned. Desert Storm proved that our equipment and ammunition is capable of killing targets at longer ranges than expected.

d. Recommendation. Teach long range gunnery at the Armor School and in the units. Push the IFF environment by putting a friendly target in a 2 or 3 threat target array.

e. Comments. None.

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CHAPTER 6

MATERIEL

6-1. Summary.

a. Operation Desert Storm was the first opportunity to "combat test" the Abrams, Bradley, and support systems in a high tempo, combined arms, armored force conflict. Approximately 1,956 Abrams tanks and 2,200 Bradley vehicles were deployed to Southwest Asia (SWA).

b. Overall the M1A1 performed well in the vital areas of mobility, lethality, and survivability. The Operational Readiness (OR) of the fleet was over 90%. The 120mm weapon systems dominated the battlefield. Nothing the Iraqis mustered could stand off the Abrams fleet. Crews confidence grew as the war progressed.

c. The ability of the HEMMT, HMMWV, and the M939 Series Trucks amazed even the host nation personnel on their ability to move through the difficult terrain of SWA.

d. Despite the age of the M551A1 fleet they performed well but demonstrated the need for modernization.

e. As in any encounter of this magnitude, problems with equipment were discovered which indicated a need to fine tune some of the equipment we go to war with. Some of the more notable problems were:

(1) A need for a better air filtration system or a self cleaning air filtration system on the MBT.

(2) The Global Positioning System worked well in SWA and needs to be installed on all our combat vehicles. The need for a positioning location system is vital and could not have been better validated than it was in SWA.

(3) Identifying targets out to the maximum range of our weapon systems is a must to eliminate instances of fratricide. This calls for improved sights on our combat vehicles as well as new research into other methods of identifying targets as friend or foe.

f. These subject areas as well as others are addressed in this chapter. The methods by which changes are made to existing equipment are dictated by the availability of funds and the priority given the problem by the user community. In many cases the problems identified in SWA were already being addressed by the Armor Center and are being considered for incorporation in the future tank or retrofitted into the existing tank fleet.

g. Our equipment demonstrated that it is the best in the world. Improvements can always be made and this chapter attempts to explain the changes being considered to make it better.

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6-2. List of Issues.

- a. Batteries.
- b. APU.
- c. Fuel pump.
- d. Air induction system.
- e. 105 MM accuracy.
- f. 120 MM capability and sights.
- g. CITV.
- h. Stadia reticle.
- i. GPS hood.
- j. Barometric/temperature gauge.
- k. Coax ammunition well.
- l. Ammo packs.
- m. Increase bustle storage.
- n. Mine rollers.
- o. Positional readout for driver and gunner.
- p. Driver's Thermal Viewer (DTV).
- q. M240 kit.
- r. DF2/JPS on-board smoke.
- s. BFV LRF.
- t. BFV cleaning wands.
- u. BFV reverse gear performance.
- v. BFV engine exhaust.
- w. BFV load plans.
- x. BFV engine access door.
- y. BVF optics.
- z. M577 command post vehicle.
- aa. FIST/FSO location.
- ab. M88 design.
- ac. Positive combat identification.
- ad. BFV countermine equipment.
- ae. Communications systems for armor and cavalry.
- af. Antenna masts for armor and cavalry.
- ag. Transmitting hard copy orders.
- ah. Clothing and equipment.
- ai. Vehicle Filtering Systems.
- aj. Failure Rate of M1 Engines.
- ak. M1 Tank Fuel Usage.
- al. M1 Track.
- am. Halon Fire Extinguishers.
- an. Oil Changing.
- ao. Vehicle Cooling Systems.
- ap. Grease Usage.
- aq. PLL Computer Use.
- ar. Target Sensing.

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6-3. Batteries.

a. Observation. Many units had problems replacing or obtaining batteries for almost every type of equipment.

b. Discussion. Battery problems seem to develop almost immediately upon entry to SWA. The problems stemmed from:

(1) Batteries being exposed to salt corrosive air, hot temperatures and lack of use.

(2) Lack of replacement batteries/electrolyte.

(3) The inability of units to quickly establish battery shops either because their equipment was not readily available or their equipment was in poor condition.

c. Lesson(s) Learned.

(1) Batteries had to be highly controlled to ensure that essential vehicles received batteries first.

(2) Batteries/electrolyte were locally purchased by organizational and direct support units to fill immediate demands.

(3) In some cases commercial generators were purchased to replace missing or non-operational generators in direct support unit battery shops.

d. Recommendations.

(1) Replacement batteries need to be pre-positioned or shipped with equipment.

(2) Units need to review their battery shops to ensure they have mobile capabilities and adequate amounts of equipment necessary to support the majority of the equipment expected to require their services.

(3) Organizational units need to train and practice charging batteries (including adding electrolyte) at organizational level to enable them to accomplish their war time mission.

e. Comments. The current policy on batteries is that organizational units only fill and charge batteries during actual combat operations. This policy proved to be in error for the following reasons:

(1) Organizational units did not retain distribution charging panels because they never used them.

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(2) As a result of the above, units did not have the expertise to use the equipment even if they had it.

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6-4. APU.

a. Observations. Several units reported a need for APU for use during silent watch operations. The APU should be able to keep the batteries on the main battle tank (MBT) charged while the engine is off and the electrical systems are being use.

b. Discussion.

(1) Many units felt that an APU was useful in a myriad of functions, i.e. silent watch, charge batteries, traversing the turret, operating radios etc., while the main engine is off.

(2) The APU used in SWA was found lacking due to high maintenance requirements, poor reliability and location on the vehicle.

(3) The APU required a high degree of maintenance due to the harsh conditions found in SWA, especially during windstorms. The rear deck location of the APU created problems because it was easily damaged maneuvering through ditches and over sand dunes.

c. Lessons Learned.

(1) APUs had to be serviced frequently to derive any benefit from them.

(2) The majority of the APUs deployed became not mission capable or were removed by the crew of the MBT to avoid further damage caused by maneuvering or the harsh elements.

d. Recommended actions.

(1) Relocate APU to bustle rack on turret as an interim solution.

(2) Development of an under armor APU.

e. Comments.

(1) Currently an APU which can be mounted in the turret bustle rack is being developed as an engineering change proposal.

(2) A mission needs statement has been written that states an under armor APU is needed for the current MBT.

(3) Textron Lycoming has developed an under armor APU as part of their proposal for an Abrams AGT 1500 engine Mobility Enhancement Program.

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6-5. Fuel Pump.

a. Observation. Based on interviews conducted with units deployed to SWA, and in CONUS based units, crews reported problems with the reliability of the in-tank/transfer fuel pumps.

b. Discussion.

(1) Currently, the on-hand stockage of in-tank fuel pumps has a short life expectancy.

(2) The fuel transfer pump problems are attributed to fuel pump oxidation, and contaminated fuel in the front fuel tanks.

c. Lesson(s) Learned.

(1) Units experienced frequent refueling requirements related to clogged fuel transfer pumps preventing transfer of fuel from front to rear fuel tanks.

(2) In-tank fuel pumps demonstrated early failure and created difficulty in providing head pressure to rotary fuel pump and engine.

d. Recommended or Ongoing Action.

(1) The solution to the in-tank fuel pump problem is the fielding of a high reliability, non-repairable fuel pump (P/N: 12285597, NSN 2910-01-083-3153, ECP GDLM9566) as a replacement for the current fuel pump. Procurement is currently in process and old in-tank fuel pumps will be replaced by attrition.

(2) Solution for fuel transfer pump clogging is for units to transfer fuel from front to rear tanks, then refuel front tanks. This would prevent oxidation of the pump, reduce algae growth which contaminates fuel and clogs the pumps.

(3) PM-Abrams is currently working the issue of cleaning forward fuel cells already contaminated. Also, the addition of JPB with anti-algae additive will prevent future fuel contamination problems.

e. Comments. None.

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6-6. Air Induction System.

a. Observation. Current air induction system on the M1 series tank is not reliable in sand and dust environment.

b. Discussion.

(1) The engine air filtration system degrades performance during dusty conditions, constrains maneuver momentum, and imposes an unacceptable maintenance burden on crews/units.

(2) V-packs were serviced by crew members every 6-8 hours of operation, utilizing the cleaning wand. This operation averages 90 minutes per tank.

(3) V-pack cleaning wand is unacceptable due to using another tank's engine to provide bleed air which increases fuel consumption.

(4) Plenum seals, in most cases, were not properly inspected or installed prior to installation of the power pack.

c. Lesson(s) Learned.

(1) Unit maintenance personnel/crew members must ensure V-pack seals and plenum seals are properly installed and checked on a regular basis to ensure serviceability.

(2) Units must ensure that all authorized service kits are on hand and complete.

d. Recommended or ongoing action.

(1) USAARMC has developed a written requirements document for improved air filtration to eliminate frequent cleaning requirements. The requirement was presented to PM-Abrams in July 1991.

(2) Textron Lycoming, in conjunction with Donaldson Corporation, is currently working on a self-cleaning rotating filter/self-cleaning Pulse Jet filter.

e. Comments. None.

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6-7. 105mm Accuracy.

a. Observations. A comparison test between a 120mm and a 105mm round was conducted after the war and it was noted that the 105mm was not as accurate as the 120mm at extended ranges.

b. Discussion.

(1) The test was conducted with real threat targets to verify lethality.

(2) The scope of the test was very limited and the results of the test can only be applied to the 2 different model rounds tested.

(3) The test results did identify a problem with a 105mm round. Circumstances surrounding the manufacturing of the round, and the method of calculating the computer correction factor (CCF) may have contributed to an accuracy problem.

(4) A test is currently being conducted by U.S. Army Armament Research and Development Center (ARDEC) to determine if the 105mm round in question does in fact have a problem.

c. Lesson learned. None.

d. Recommendations. Implement any corrections resulting from ARDECs investigation.

e. Comments. The 105mm weapon systems performed well in SWA. There were no other reports received identifying problems with any 105mm round. The 105mm round in question is a relatively new round and is not representative of the 105mm rounds in use.

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6-8. 120mm Capability and Sights.

a. Observations. Several units reported a need for better optics on the M1A1 MBT.

b. Discussion.

(1) Many gunners reported that they were able to hit targets beyond their capability to positively identify them.

(2) Gunners using TIS at ranges beyond 1500 meters only saw targets as hot spots. The targets could either be fired upon without further identification, or they could be allowed to come in very close in order to obtain positive identification, thus giving away the advantage of long-range lethality.

c. Lessons learned.

(1) Other vehicles or aircraft with better vantage points had to be used to identify targets.

(2) Crews had to see more of the target in order to make a positive identification.

d. Recommended action. Research the various methods available to erase the difference between the ranges at which targets can be detected and those at which they can be identified and engaged.

e. Comments. A second generation Forward-looking Infrared Radar (FLIR) is under development and will provide a clearer image of the target. The degree of clarification provided by the second generation FLIR will determine how much more magnification is required to extend the crews ability to identify targets out to the maximum effective range of the 120mm weapon system.

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6-9. CITV.

a. Observations. Several TCs stated they were not able to see the battlefield clearly through the Commander's GPSE. Furthermore, because the commander is unable to adjust the setting for the reticle and the TIS in the GPSE, he is forced to accept the gunner's perspective of the target identification.

b. Discussion.

(1) TC's stated that their view of the battlefield was limited through the GPSE, because once the gunner acquired the target through the GPS, he would switch to 10 power which narrows the field of view for both the gunner and the TC.

(2) This problem is compounded by the TC's inability to adjust the brightness of the reticle in the GPSE. On occasion the gunner can adjust the reticle well enough for him to see it through the GPS, but the commander may barely be able to see it (if at all) through the commander's sight. If the gunner adjusts it so the TC can see it, it may be too bright for the gunner to see the target.

c. Lesson learned. The TC must scan the battlefield for secondary targets while the gunner is engaging the primary target. With the current system, the TC has to depend upon his vision blocks and .50 caliber sight to scan the battlefield while the gunner engages the primary target.

d. Recommended action. Retrofit the CITV into the M1A1 fleet.

e. Comments. The next generation MBT (M1A2) will have a CITV. The CITV will enable the TC to scan the battlefield independent of the gunner. It will also be able to automatically re-align itself with the main gun to allow both the TC and the gunner to see the same portion of the battlefield.

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6-10. Stadia Reticule.

a. Observations. The issue of adding a stadia (choke type) reticle in the GAS was surfaced by the master gunners during the 7th Corp Master Gunners' Conference.

b. Discussion.

(1) When the laser range finder is not operating, the crews have to estimate the range to the target.

(2) A choke type reticle can provide a more accurate range provided the crew has been trained in its use.

(3) A technical test conducted at Aberdeen Proving Ground (APG) in August 1987 indicates that the addition of a stadia reticle would increase the crews ability to determine range when using the GAS sight.

c. Lesson learned.

(1) Ranges can be quickly estimated using the reticle relationship method found on pages 4-5 to 4-10 of FM 17-12-1. The reticle of either the GPS or GAS can be used.

(2) The present system relies on the crew's experience and training on estimating range. The crew proficiency relies heavily on practice.

(3) The crew only has to estimate range when the laser range finder (LRF) is not operating. The present methods of determining range can be nearly as effective as a choke sight.

d. Recommendation. None.

e. Comments.

(1) When new rounds of ammunition are developed and fielded, a new ballistic reticle will be installed on the MBT and it will include a stadia reticle.

(2) The CITV, currently being considered for installation into the MBT, has a choke type reticle which can be used as a back-up to the LRF should the LRF become non-operational.

6-11. GPS Hood.

a. Observation. Gunners have asked for a device/method to clean the screen of the GPS under battlefield conditions.

b. Discussion.

(1) It has been noted that under severe weather conditions the screen on the GPS gets dirty enough to obscure the battlefield. The only way to clean the screen is for the crew to exit the vehicle and clean it by hand.

(2) Dirt and dust particles even as small as the size of the GPS reticle can prevent gunners from spotting/identifying targets at long ranges.

(3) Crews were forced to stop and exit tanks under battlefield conditions to clean their sights. Because of the war-time conditions, some crews damaged their sights in their haste to accomplish the task which further compounded the problem.

c. Lesson Learned.

d. Recommendation. Research the various methods to clean the GPS from the inside of the tank without damaging the germanium cover on the TIS.

e. Comments: The crew of the future MBT will have the capability of cleaning the GPS from inside the vehicle.

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6-12. Barometric/temperature Gauge.

a. Observations. Many crews stated that they needed more accurate and timely barometric and ambient temperature information for input into the ballistic computer.

b. Discussion.

(1) Many times the current barometric and ambient temperature readings were either omitted or guessed at by crews of the MBTs.

(2) The barometric and ambient temperature readings changed more frequently than they were updated to the crews on the MBTs.

(3) It is not clear how much impact improper barometric and temperature readings did have on the flight of each round. First impressions indicate that little or no effect was felt; however, such impact would probably only be observed at long ranges.

c. Lessons Learned. Utilize the standard inputs for air temperature and atmospheric (barometric) pressure for major geographical areas, by seasons as indicated on pages 2-5 and 2-6 of FM 17-12-1.

d. Recommendation. Research various methods for automatically inputting the temperature and barometric pressure readings into the ballistic computer.

e. Comments. Information is still being analyzed to see how much effect on accuracy (if any) there was due to the lack of precise barometric and temperature readings.

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6-13. COAX Ammunition Well.

a. Observation. Tank crews from SWA have identified the procedure to remove the breech block on the 120mm gun as being unrealistic. Most of the ammunition from the storage well for the M240 coaxial machine gun must be removed in order to drop the breech block.

b. Discussion.

(1) The ammunition well for the M240 coaxial machine gun holds 2800 rounds of 7.62mm ammunition. The approximate weight of the ammunition is 190 pounds.

(2) In order to remove the breech block of the 120mm main gun the extractor pin has to be able to slide through two doors in the ammunition well. This cannot be done unless two-thirds of the 7.62mm coax rounds are removed.

c. Lessons Learned. According to the operator's manual, the breech block of the 120mm should be removed after operation and inspected for damage. This became a lengthy process if the ammo well for the M240 was full at the time.

d. Recommendations. Investigate the possibility of redesigning the ammunition well so the 7.62 rounds do not have to be removed.

e. Comments. PM ABRAMS is being consulted about a possible design change to the ammo well.

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6-14. Ammo Packs.

a. **Observation.** Operation Desert Shield/Storm reconfirmed that our current rearm capability is slow, labor intensive, and vulnerable to enemy indirect fire and NBC systems. The time it takes to reload the ready/semi-ready storage wells could be critical in a high intensity environment.

b. **Discussion.**

(1) This issue is misstated as, "Need to relook quick change ammunition packs." Stated differently, the user needs a faster, less vulnerable, less physically demanding, on the tank crew, rearm capability. Several ways to meet this objective include bulk packaging, smaller 2 to 3 round cassettes, and loading single rounds faster through automation.

(2) All three of these approaches have been analyzed through the Future Armor Rearm System (FARS) and Future Armored Resupply Vehicle Ammunition (FARVA) Programs. The single-round approach was chosen for both its capabilities to interface with projected future autoloader concepts and its ability to be adapt to current combat systems, particularly the M1A1 Abrams tank.

(3) Reasons mitigating against the use of a "quick change" bulk pack include:

(a) Quick change racks would be much more costly than current packaging.

(b) There is no supporting personnel force structure with the mission, time, or equipment to re-stuff ammo racks in theater.

(c) Crew (ammo) protection inside the tank works. It's a "war-winner." We must retain this capability. This would add cost, weight, and complexity to the "quick change" rack. There would also be an associated increase in transportation cost. At unit level, decreased weight/cube efficiency will result in increased truck and driver requirements.

(d) Access plates for the quick change racks may require trading off environments and may degrade ballistic properties of "blow-off" panels.

(e) Getting the proper mix of KE and CE (plus additional AE1 ammo mixes) will be difficult to manage.

(f) All tanks will not be completely empty when racks are exchanged. Retrograde of partial racks will be a complex operation.

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c. Lesson(s) Learned.

(1) Acquisition of a mobile, survivable rearm vehicle is required to provide an "under armor" rearm capability to the maneuver force.

(2) The objective rearm system must be faster and less labor intensive than current manual rearm procedures.

d. Recommended or Ongoing actions.

(1) Continue to support development of the technology base demonstrator Future Armor Rearm System.

(2) Continue to support the Armored System Modernization (ASM) Program's FARVA with emphasis on restructuring the program to provide concurrent funding and fielding of an Armor FARVA with the Block III Tank.

e. Comment. Field Artillery FARVA is the only variant currently programmed for production funding under the existing six-lead vehicle ASM program.

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6-15. Increase Bustle Storage.

a. **Observation.** Crews commented on inadequate space for necessary equipment in the bustle racks on the MBT. The problem was said to be compounded by extended operation.

b. **Discussion.**

(1) Crews were tasked to carry more equipment and supplies than called for in the combat load plan. Some of the more notable items were increased water and rations.

(2) Non-standard SOPs aggravated the situation.

(3) Equipment that was not considered essential was left in holding areas. Some of this equipment was lost because there were not enough unit transportation assets to move excess equipment around the battle field. Personnel assets were required to guard this equipment.

c. **Lesson Learned.** Load plans (ST 17-184-1A1) need to be re-looked at in terms of flexibility and feasibility.

d. **Recommendations.** Research the various methods for increasing the storage space on the tank.

e. **Comments.** None.

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6-16. Mine Rollers.

a. Observation. Units did not use the mine rollers because of the significant degradation in speed and their inability to effectively deal with double impulse mines.

b. Discussion. Use of mine rollers in SWA exposed shortcomings with this equipment during the train up and performance of unit breaching missions.

c. Lesson(s) Learned.

(1) Double impulse mines are an effective countermeasure to the rollers.

(2) The use of mines by the enemy presented a significant degradation in speed, mobility, and fuel consumption.

(3) Transportation and mounting of rollers was a very arduous and burdensome task for units.

d. Recommended or Ongoing Action: A USAARMC prioritization for the Materiel Change Management Plan for the Battalion Countermine Set (BCS) is currently being staffed which addresses shortcomings/lessons learned from SWA. In turn, this action will be provided to PM-MCD in an effort to improve the overall system.

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6-17. Positional Readouts for Tank Driver and Gunner.

- a. **Observation.** A POSNAV positional readout is needed at both the driver's and gunner's stations.
- b. **Discussion.** Current off-the-shelf POSNAV devices display position location readouts on the front of the device. Discussions with many contractors that manufacture Small Lightweight GPS Receivers (SLGRs) for use in the military have indicated that providing separate system displays for any crew member on a combat vehicle can be done quite easily.
- c. **Lesson(s) Learned.** Feedback from soldiers in Desert Shield/Desert Storm indicate that while the myriad of off-the-shelf POSNAV devices purchased for use by ground forces were extremely useful, there are improvements that can be made. Providing combat vehicle drivers with a steer-to indicator that provides directional heading based on waypoints entered by the vehicle commander would significantly reduce the amount of discussion between the vehicle commander and his driver as they move along designated routes. Additionally, by providing a steer-to indicator to the driver that he can use to maneuver the vehicle toward waypoints, the vehicle commander's burden of navigating/directing the vehicle is significantly reduced.
- d. **Recommended or Ongoing Action.** The Directorate of Combat Developments (DCD), USAARMC, has investigated current and near-term emerging technology for both position location devices and directional heading systems. A hybrid system consisting of an off-the-shelf GPS system merged with a directional compass would provide a technologically accurate solution for vehicle position and heading. Currently, the C4 Branch, DCD, is in the process of revising the XM-1 Main Battle Tank Materiel Need Document in order to state the necessary requirements for this type of system for Armor's current fleet of tanks. The changes are in the process of being staffed within the Armor School, and once approved, will be submitted to TRADOC headquarters. The cost-benefit of providing position location information to a combat vehicle's gunner is currently under investigation.
- e. **Comments.** Future tanks (M1A2 and Future MBT) will have a system that provides both vehicle position location and heading.

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6-16. Drivers Thermal Viewer (DTV).

a. Observations. Many drivers were unable to effectively see the battlefield under low light or no light conditions.

b. Discussion.

(1) The problems centered around the current image intensifiers used by the drivers. They do not operate effectively during periods of no light or low light conditions.

(2) The image intensifiers also are a problem if they are exposed to too much light such as city lights or lights mounted along side of highways.

c. Lessons learned.

(1) Many times, crews had to use chemical lights placed along side of convoy routes to prevent them from leaving the road.

(2) If a vehicle was required to re-occupy a position after returning from a refueling or patrol mission, the crew left a light source of some kind (flashlight, chemical light, etc.) at the position.

(3) If a vehicle crew was unable to see clearly enough to navigate, it would stop and take up a defensive position until adequate light was available.

d. Recommendation. A DTV be installed on the vehicle.

e. Comments. The DTV is on the current 1-N list.

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6-19. M240 Kit.

a. Observations. A few requests were received for a ground mounting kit for the loaders M240 machinagun (MG) which is normally mounted on top of the MBT.

b. Discussion.

(1) Some crews felt that a ground mounting kit for the M240 MG would be useful if the crew had to dismount from the vehicle for some reason or provide local security.

(2) It is procedure according to Chapter 12, page 12-35, FM 17-12-1, Tank Combat Tables, to remove the loaders M240 and two boxes of ammo when it becomes necessary to abandon a crippled tank.

c. Lessons Learned. None.

d. Recommendations.

(1) In order to make the M240 more effective while being used dismounted from the loaders position, a kit should be added to the vehicle to ground mount the machine gun.

(2) Consideration should also be given to mounting the M240 on the vehicle with the gun mount kit installed. This will eliminate the problem of where to store the kit plus make the weapon more effective since the kit comes with a sight.

e. Comments. None.

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6-20. DF2/JP8 On-board Smoke.

a. **Observation.** Commanders liked the on-board smoke capability and would have preferred DF2 to Jet A-1/JP8 for this reason.

b. **Discussion.** At the onset of Desert Shield, the use of Jet A-1 fuel (JP8 without three additives) for all diesel-fueled vehicles had been agreed to as this was in consonance with DOD Directive 4140.43, March 1988, Fuel Standardization. However, due to actual or perceived maintenance problems and the requirement of armored vehicles to have the capability to generate smoke in their Vehicle Engine Exhaust Smoke Systems (VEESS). Plans were formulated in September 1990, to provide diesel fuel to applicable vehicles and equipment in lieu of Jet A-1 to those units which wanted it. The 101st Abn Div (AA), 3d ACR, and 1st Cav Div requested Jet A-1. The 24th Inf Div (Mech), 82d Abn Div, and VIIth Corps and attached units requested DF2. There was no known battlefield situation in Desert Storm where VEES smoke played a decisive role or was used to a large degree.

c. **Lesson(s) Learned.** Combat leaders at all levels are unconvinced that JP8 is a drop-in replacement for DF2. Maintenance concerns, whether actual or imagined, and the lack of on-board smoke combined to cause commanders to abandon the single fuel policy.

d. **Recommended or Ongoing Action.**

(1) Senior Army leadership has already determined that the DOD's single fuel policy will not be postponed or canceled. Jet A-1/JP8 will be the OCONUS fuel for all future conflicts.

(2) TRADOC and Army Materiel Command (AMC) are working on a plan to retrofit current VEES-equipped vehicles with fog oil reservoirs, restoring a limited on-board smoke capability to the Force when using Jet A-1/JP8. As of 1 September 1991, the plan awaits DA program approval and funding. The VEES fix has been placed on the Abrams Materiel Change Management (MCM) priority list.

(3) ASM development assumes JP8 as the primary vehicle fuel and, as a result, this deficiency will not affect ASM.

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6-21. BFV Laser Range Finder (LRF).

a. Observation. Install an integrated LRF on BFV System (BFVS).

b. Discussion. A LRF will help with several infantry and cavalry tasks. These include: target acquisition, land navigation, and other ranging tasks to increase probability of first round hit as well as ensuring that TOW targets are not engaged beyond the range of the missile guidance components.

c. Lessons Learned. The M2/M3 needs a LRF. The available hand held LRF is inadequate.

d. Recommended or On-going Action. The LRF is the number 1 priority on U.S. Army Infantry School (USAIS) and USAARMC 1-N list for BFVS material changes. PM Bradley agrees with the observation and proposes to incorporate an eye-safe LRF into the Integrated Sight Unit (ISU). If funding can be made available in FY92 for an engineering program, then PM Bradley estimates that procurement of this eye-safe LRF would begin FY96.

e. Comments. None.

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6-22. BFV Cleaning Wands.

a. Observation. Bradley crews had no "cleaning wands" to clean out air filters.

b. Discussion. The M2/M3 experienced problems similar to those of the Abrams with V-packs (engine air filters), but had no cleaning wands as part of vehicle BII.

c. Lessons Learned. An adequate supply of clean air is essential to the operation of reciprocal engines. Clogged air filters need constant observation and cleaning to produce adequate air flow.

d. Recommended or On-going Action. The PM Bradley does not agree with the above statement. An assessment team from PM Bradley was in SWA after Desert Storm and Bradley crews interviewed stated they had no problems with air cleaners. The air cleaners did get restricted, but not with the frequency of the Abrams. When the air cleaners needed cleaning, the crews used the Abrams wands. Also one of the main problems experienced on Abrams was when the light came on for cleaning air cleaners, the V-packs were so heavy and dirty they were difficult to maintain. Bradley did not have that problem. An air wand for cleaning V-packs on a Bradley would be a nice-to-have item, but the cost considerations for adding an air compressor are not justified.

e. Comments. None.

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6-23. BFV Reverse Gear Performance.

a. Observation. Slow reverse gear performance.

b. Discussion. Crews were pleased with the 600 hp power plant and its transmission; however, commanders would like to have reverse gear performance similar to that on the Abrams.

c. Lessons Learned. Present drive train reverse system is adequate, however, it could be improved.

d. Recommended or On-going Action. PM Bradley is aware of this observation. Current reports from the field do not appear to be sufficient to support any action at this time. A fix to increase reverse speed would be costly; however, the contractor is looking into the programmatic and cost to increase the reverse speed on the BFVS to 20MPH. Until that data is available, PM Bradley will be unable to recommend a solution. USAIS and USAARMC state that this item would have a very low priority on the materiel change request list, and in view of the fact that fewer funds are available over the next few years, this would cause its priority to be at the unfunded priority level.

e. Comments. None.

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6-24. BFV Engine Exhaust.

a. Observation. Poor engine exhaust design.

b. Discussion. The current location of the Bradley's exhaust blows directly into the Bradley Commander's face which causes him to be nauseated. Additionally, if the wind is blowing across the vehicle, the heat will wash out the ISU.

c. Lessons Learned. BFVS engine exhaust location causes safety and health problems.

d. Recommended or on-going action. PM Bradley agrees that this is a problem on A2 Bradleys and has initiated action with the contractor to redesign the exhaust outlet to preclude this problem. Fielded BFVS will require a modification kit to change to the new design.

e. Comments. The new design should consider installation of the new armor tile, the swim barrier as well as heat and infrared signatures.

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6-25. BFV Load Plans.

a. Observation. Present load plan on BFVS isn't being followed.

b. Discussion. Present load plan on BFVS doesn't take in account that crews live in the vehicle as well as fight from it. Stowage all around should be improved. There is not enough internal space for either a nine-man Infantry squad or a five man Scout squad's gear. Likewise, crews jury-rigged equipment tie downs to stow gear externally. The seating needs to be reworked, and the plan should reflect a balance between worst case and METT-T conditions.

c. Lessons Learned. Present BFVS load plans are inadequate, crews tend to make their own.

d. Recommended or On-going Action. TRADOC staffed and initiated a field study on re-stowage with PM Bradley support and participation. The results of this study will be briefed for approval. Once approved, the changes will be incorporated into a re-stowage design effort at the contractor plant. Given new Research & Development funding being available in FY92, the changes would be in FY96 production vehicles and available as a retrofit kit in FY97.

e. Comments. Some ideas/comments received from the field were; Bench type seats, additional ammunition ready boxes, AT-4 stowage area, reworked rear external box stowage, and loops made available outside vehicle for external stowage. Equipment and excess supplies tended to block driver's passageway.

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6-26. BFV Engine Access Door.

- a. Observation. Poor BFVS A2 engine access door design.
- b. Discussion. There is a mechanical pump which the operator uses to raise the present engine compartment access door. Once broken, performance of operator level maintenance becomes extremely difficult and poses serious safety problems. This also contributes to excessive vehicle "down time".
- c. Lessons Learned. BFVS A2 engine compartment access door pumps are unsatisfactory. Initial reports show up to a 50% failure rate.
- d. Recommended or On-going Action. PM Bradley is working a fix to engine access door pumps through design of a new system to raise the engine access door. When a successful design has been completed, plans are to retrofit this design into the field.
- e. Comments. None.

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6-27. BFV Optics.

a. Observation. Less than adequate Scout vehicle optics.

b. Discussion. Scouts need to have superior vision capabilities at all times for reconnaissance, target acquisition, and identification. (MIA2 level at least).

c. Lessons Learned. Scout vehicle optics must improve. In many cases the surveillance equipment of the Scout platoon could not out range systems in battalion formations.

d. Recommended or On-going Action. Presently there are two on-going programs: First, the Tow Sight Improvement Program (TSIP), if funded would solve the optics problem. Second is the Scout Optics Program, which is presently developing requirements for better optics capabilities for Scout vehicles. This program is also currently unfunded.

e. Comments. Some commanders commented on increasing the integrated sight unit magnification to that of 14X or more, and adding AN/CVS-5s with AN/TAS-6s to scouts. The AN/TAS-6 and AN/CVS-5 are currently authorized in scout platoons, but have not been acquired in sufficient numbers to fill the authorizations.

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6-28. M577 Command Post Vehicle (CPV).

a. Observation. The M113/M577 family of vehicles was unable to keep pace during maneuver operations with the M2/3 and M1A1 fleet of vehicles. Also, space was extremely limited on the M577.

b. Discussion. The introduction of the M1 and M3 series of vehicles into the Armor force created a significant disparity in terms of mobility and speed between the new vehicles and the other family of vehicles that typically are used in combat support or service support roles in Armor and Cavalry units. While improvements in mobility and speed have been made in limited numbers to the M113, the same cannot be said of the M577. Potential solutions to this problem lie in either improvements to the power train of the M577 or identification of a more mobile system that will provide the same, or better, space requirements of the current M577 Command Post Vehicle.

b. Lesson(s) Learned. Feedback from soldiers who had to operate out of the M577 during Desert Shield/Desert Storm indicates that the M577 is somewhat limited in terms of space. Much of this can be attributed to the fact that M577 crews were required to perform their functions primarily on the move due to their inability to keep up with the vehicles that they were required to support. As the M577 crews were constantly on the move in order to maintain the pace of M1 tank unit's movements, much of the automated command and control equipment that had recently been fielded had to stay in the M577. This compounded the already recognized space limitations of the M577. Additionally, because the M577 is a member of a much older family of vehicles, its power train makes it significantly less able to keep up with the M1 and M3 family of vehicles. This observation becomes much more apparent over relatively flat terrain.

d. Recommended or Ongoing Action. The M577 CPV is scheduled to go through a system conversion to the XM1068 Standard Integrated Command Post System (SICPS). Improvements to the current M577 will include more adequate racks and shelving for automation and electronic hardware, improved auxiliary power unit, a power/data distribution system, improved operator seating, and a powered extendable antenna mast. The XM1068 is scheduled to go through technical testing in September 1991 and is scheduled for delivery to the field starting in 4QFY93. USAARMC is currently investigating the possibility of the M577A3 as an interim solution to the eventual fielding of the ASM Future Command and Control Vehicle (FC2V). Vehicle performance of the M577A3 would be enhanced by the addition of a "rise" 275 bhp, turbocharged engine and 4-speed hydrostatic transmission. The DCD, USAARMC, is also investigating other possible candidate systems (USMC LAV, BMY's MLRS chassis, etc.) that could provide a midterm solution to the current need for an enhanced command post vehicle for Armor and Cavalry units.

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6-29. Fire Support Officer - Tank Company Commander Collocation.

a. Observation. Some units during Desert Shield/Desert Storm experimented with putting the Company and/or Battalion Fire Support Officers (FSO) in the commander's tank. This significantly degraded the communication capabilities of both the commander and the FSO.

b. Discussion. The Combined Arms Command (CAC), in conjunction with the Armor, Field Artillery, and Infantry Schools, has been investigating the collocation of FSOs in command vehicles for the last 11 months. Both the Armor and Infantry Schools have provided CAC with operational concepts for FSO-Commander collocation in the commander's vehicle. Evaluation of the concept was to take place at the National Training Center (NTC) in July 1991, but was delayed due to revision of the FORSCOM unit NTC rotation schedule mandated by Desert Shield/Desert Storm.

c. Lesson(s) Learned. Many units experimented with FSO-Commander collocation during Desert Shield/Desert Storm. The majority of comments from commanders in the field indicate a universal dislike for collocating FSOs with Armor unit commanders in their command tank. The primary reason cited for dislike of the concept is the difficulty involved in establishing the necessary communications suite for the FSO and commander to have secure, dual net radio communications. Commanders that did come out favorably for collocation did so based on the need to provide enhanced mobility and protection for the FSO, something that the FIST-V does not adequately provide. Many commanders stated that they prefer that their FSO have the capability to maneuver independently on the battlefield and not be forced to collocate with the commander due to mobility and/or survivability considerations. In their comments, commanders stated that collocation should be based on the absolute need for the commander and FSO to maintain face-to-face interaction, this being driven by the factors of METT-T.

d. Recommended or Ongoing action. The DCD, USAARMC, is currently investigating improvements that can be made to the M1 tank's communications layout in order to establish a communications/intercom configuration that will reduce electromagnetic interference and antenna signature while providing the communications necessary for the commander and FSO to perform their C2 functions from the same vehicle. Additionally, the C4 Branch, DCD, is in the process of investigating the Marine Corps concept and requirements for a Forward Observer/Forward Air Controller (FO/FAC) communications suite for the M1A1 tank. An information package on the FO/FAC communications suite is currently being assembled for release to CAC, as well as the Field Artillery and Infantry Schools in order to solicit their input as to the merit of the FO/FAC suite for collocation of FSO and commander.

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6-10. M88 Design.

a. Observation. Operation Desert Shield/Storm reconfirmed previously identified shortcomings that the M88A1 has inadequate power, weight, braking ability, and steering control to safely recover Abrams tanks.

b. Discussion.

(1) The M88A1 could not keep up with M1 and M2/3 formations moving tactically across the desert.

(2) The M88A1 could not tow the M1A1 - lacked power, speed, weight, and braking capability.

(3) The M88A1 experienced low operational readiness rates. Many M88A1s were deployed to Southwest Asia in a low state of readiness. Due to the relatively low density of M88 common systems now in the fleet and the low relative priority for shipping repair parts and major end items to support M88A1s vis-a-vis M1A1s, M88A1 readiness never did get up to acceptable levels. Recovery of 68 (plus) ton M1A1s is simply too great a task for the 56-ton M88A1. Poor design of the air induction system, coupled with poor preventive maintenance practices, lead to massive engine failures due to dust ingestion and operation in the harsh desert environment. Recoveries also covered extremely vast distances, possibly due to the unique nature of this particular conflict, which were far in excess of the anticipated recovery mission profile. (Lack of an acceptable HET capability may also have contributed to the long distance towing requirement.)

c. Lesson(s) Learned.

(1) Material investment (acquisition/conversion) in an improved recovery (primarily towing) capability to support the Abrams fleet is required.

(2) The Operational Mode Summary/Mission Profile for future recovery vehicles should be re-evaluated (primarily towing distances) in light of Desert Shield/Storm experience and Air Land Operations maintenance concepts.

(3) Acquisition of a capable HET system must continue. HETS must be made available at the Forward Support Battalion level to contribute to the long-distance recovery/evacuation mission.

d. Recommended or Ongoing Action.

(1) Establish a viable, funded Improved Recovery Vehicle (IRV) (M88A1 Plus) Program.

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(2) Replace each M88A1 with an IRV in all Abrams equipped organizations.

(3) Support continued development, production, and fielding of HETS.

(4) Support programmed FY 92 Recovery Vehicle Requirements and Technology Base Study.

e. Comments. None.

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6-11. Positive Combat Identification.

a. Observation. A number of U.S. casualties during Operation Desert Shield/Storm were caused by friendly fire. This fact has highlighted many deficiencies in AirLand Operations in regards to situational awareness and combat vehicle identification.

b. Discussion.

(1) The majority of the friendly fire incidents were directly contributed to the combination of poor visibility, battlefield confusion, and lack of coordination between air and ground elements. Additionally, the friendly fire incidents highlighted the urgency for battlefield navigation systems, improved optical sighting devices, and intra-vehicular communication capabilities.

(2) This issue resurfaced efforts to design and field combat identification devices which will provide the sighting vehicle with the capability to positively identify the target as friend, enemy, or neutral/noncombatant.

c. Lessons Learned.

(1) The threat of friendly casualties from friendly fire does have a significant impact on mission effectiveness and mission accomplishment.

(2) Our combat systems have the technology to acquire and kill targets at ranges which exceed our capability to positively identify the targets.

(3) Battlefield navigation systems are a must on the battlefield and in many cases prevented additional friendly fire incidents. Elements of ground units often got out in front of other troops making them very vulnerable to attacks by friendly air/ground platforms.

(4) The nearly featureless terrain of the desert created problems in direct fire engagement zones and close air support missions.

(5) Our training must be realistic to the anticipated wartime operations. Our ground troops were acquiring targets at double the ranges they acquired targets in gunnery training. Our ground offensive troops moved faster and further than trained to do.

d. Recommended or Ongoing Actions.

(1) A joint service task force has been formed by direction of the Vice Chief of Staff of the Army (VCSA) which is

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extraordinarily managed by a Joint Service General Officer Steering Committee (GOSC). The task force is suppose to recommend solutions to protect against friendly fire incidents. The solutions go across all elements of Doctrine, Training, Leadership and Organizational Development, and Materiel (DTLOW).

(2) Quick-fix solutions which are "strap on" to current combat systems are being fielded immediately.

e. Comments.

(1) Battlefield navigation and enhancements to current optic devices in improving resolution and magnification are essential in protecting soldiers against friendly fire.

(2) Friendly casualties resulting from friendly fire will always be present in war. It is imperative that leaders at all levels take into account the tremendous impact that the incidents have on the mission at hand and the outcome of the war.

(3) Friendly fire incidents can and must be minimized at all costs. There are many ways available with today's technology to significantly reduce the probability of friendly fire casualties.

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6-13. BFV Countermine Equipment.

a. Observation. The M2/M3 needs the capability to perform limited breaching and self extraction operations particularly from surface laid or scatterable minefields. This would prevent them from being fixed in place and destroyed by other fires.

b. Discussion. The M2/M3 proved to be extremely lethal and mobile weapon systems. However, in order to preserve their mobility and capability to influence the battlefield, they need an organic capability for limited breaching and self extraction operations from surface laid and scatterable minefields. Their speed and mobility far exceed that of the limited countermine equipment available and make them more susceptible to being fixed in place by hasty minefields and then easily destroyed by other fires.

c. Lesson(s) Learned.

(1) Mines are increasingly becoming more deadly, available, and the weapon of choice for many battlefield applications.

(2) Employment methods for mines/minefields have become extremely fast and efficient.

(3) Mines/minefields can effectively destroy, stop, or slow friendly forces that have no countermine capability and allow the enemy to control the battlefield to his advantage.

d. Recommended or ongoing action. The DCD, USAARMC, is currently preparing a Materiel Need Statement (MNS) to develop a lightweight mine plow for use on the armored family of vehicles. This would give all units a limited breaching/self extraction capability and greatly enhance their battlefield mobility and survivability.

e. Comments. None.

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6-33. Communications Systems for Armor and Cavalry.

- a. **Observation.** Communications systems must be improved. Improvements are needed in FM radios, especially in reliability.
- b. **Discussion.** The majority of tactical units that deployed in support of Desert Storm/Desert Shield were equipped with the AN/VRC-12 series of radios for FM communications. The fielding of the SINGARS family of radios has been limited to very few of the units that were required to deploy. Army forces in Korea and WESTCOM, as well as some units in the 5th Mechanized Division and the 1st Cavalry Division, have been fielded with the SINGARS. Fielding to other Force Package 1 units of the Full-Scale Production Integrated COMSEC version of SINGARS will start in 3QFY91 and be complete by 4QFY98.
- c. **Lesson(s) Learned.** Comments from soldiers who participated in Desert Shield/Desert Storm indicate the reliability of the AN/VRC-12 series of radios was extremely poor. The VRC-12 series radios were extremely susceptible to heat and sand. Those units that deployed with the SINGARS radio were impressed with the durability of the radio. Reports from the field indicate that the system experienced approximately 7,000 hours mean-time-between-failure compared to the 200-300 hours demonstrated by the VRC-12 series. Additionally, SINGARS used at retransmission sites provided approximately 30 percent increased range capability over the VRC-12 series radios.
- d. **Recommended or Ongoing Action.** Fielding of the SINGARS is progressing with no delays anticipated. No additional funding has been provided in order to accelerate the fielding schedule. The DCD, USAARMC, is currently working with the Signal School on the requirements for a hand held version of the SINGARS for Armor and Cavalry units. USAARMC recommendations for desired user improvements and operational capabilities for the SINGARS ICOM radio have also been provided to the Signal School as well.
- e. **Comments.** None.

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6-34. Antenna Masts for Armor and Cavalry.

a. Observation. Command Posts (CPs) need a long range antenna mast such as the Quick Erect Antenna Mast (QEAM) which enhances operational capabilities and mobility.

b. Discussion. The QEAM is a non-developmental item (NDI) which encompasses a family of four masts, one of which is the 10-meter mast. The 10-meter mast is scheduled to replace the RC-292 and OE-254 antennas in Armor and Cavalry units. QEAM provides high mobility with a quick erect/retract time of 2-5 minutes, has stronger mast sections, can be vehicle mounted, and is used with SINGARS radios. The QEAM has an approved Required Operational Capability (ROC) and has received a great deal of attention from the Armor Branch; however, it is currently unfunded.

c. Lesson(s) Learned. During Desert Shield/Desert Storm operations, feedback from command and control elements indicated that the RC-292 antenna mast impeded CP mobility. Although an improvement to the RC-292, the OE-254 antenna is also slow to erect, creating mobility problems. Additionally, the RC-292/OE-254 are non-standard (each system has a unique antenna mast with accompanying logistical/training support needs), are insufficient in number, have mast sections that snap easily, cannot be vehicular mounted, and reduce C3 from displacement to emplacement. Current emplacement times for the RC-292/OE-254 are 10-15 minutes.

d. Recommended or Ongoing Action. As an interim solution, pending acquisition of QEAM, USAREUR developed and fielded its own 10-meter mast. The USAREUR 10 meter mast (UTMM) was used effectively during Desert Shield/Desert Storm operations. UTMM is highly mobile and offers some of the same advantages as QEAM. The Armor School is considering a recommendation to Communications-Electronics Command (CECOM) to type classify the UTMM which would enable units to procure it through normal supply channels. This would provide a near term solution for a mobile 10-meter mast in Armor and Cavalry units. The M577 is scheduled to go through a system conversion to XM1068 Standard Integrated Command Post System (SICPS). The SICPS is equipped with a vehicle-mounted antenna (AE 903) similar to QEAM. The SICPS AB 903 antenna can be erected/retracted in 2 to 5 minutes and is hand-cranked. The SICPS is scheduled for fielding in 4QFY93.

e. Comments. None.

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6-35. Transmitting Hard Copy Orders.

- a. **Observation.** An effective means of producing and transmitting hard copy orders is presently not available to the armor brigade and below commanders.
- b. **Discussion.** Brigade and below command posts were not able to adequately copy mission orders and transmit these orders to subordinate units. The inability to transmit hard copy orders in a timely manner was a problem identified during Desert Shield/Desert Storm. The partially fielded Maneuver Control System (MCS) with software 10.03 did not produce the necessary outputs desired by the maneuver commanders. NDI copiers provided some copying capabilities but the copiers available were not ruggedized for the field environment and not easily moved during a fast paced battle.
- c. **Lesson(s) Learned.** Feedback from Desert Shield/Desert Storm indicates that a better software package for MCS is needed. MCS was fragile, bulky, and a labor intensive system. It failed to produce the needed outputs. NDI copiers taken to the field were not the total solution to hard copy production requirements.
- d. **Recommended or ongoing action.** The MCS is being upgraded with a version 11.0 software package. This software upgrade will provide enhanced decision graphics, situation maps with overlays, intelligence summaries, appraisal maps, etc. The software improvements package is projected to be available starting in 2QFY93. The best near term solution to the subject observation is a mix of NDI copiers and the AN/UXC 7 tactical digital facsimile set. This mix will provide the tactical commander with a means to copy and transmit hard copy messages or copied overlays over combat net radios or the Army Tactical Communications System. The burst transmission feature of the facsimile allows a one page message to be transmitted in under 25 seconds. To be an effective alternative, facsimile sets need to be fielded to at least the company level with facsimile sets and copiers available at battalion and higher. The DCD, C4 Branch, will investigate the feasibility of fielding sets at the company/troop level in order to speed the process of transmitting hard copy orders and paper graphics to the lowest echelon of combat command and control. A mid-term solution to this problem lies in the M1A2 equipped with the Combat Vehicle Command and Control System. This system allows the commander at all levels of tactical C2 (battalion and below) to send and display combat graphics using digital transmissions over combat net radio. The Battalion and Below Command and Control (B2C2) Program will provide the necessary interface with the MCS at battalion level, thereby linking the capabilities of tactical, maneuver-oriented systems within the maneuver task force.
- e. **Comments.** None.

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6-36. Clothing and Equipment.

a. Observation. Many units had unfavorable comments concerning various aspects of the uniform and personal equipment.

b. Discussion. While the Combat Vehicle Crewman's Uniform System (CVCUS) has been well received, numerous problems concerning the uniform and other equipment were revealed during Operation Desert Shield/Storm. Although the CVCUS is a complete system, items need to be addressed on an individual basis. In addition, review and revision of Clothing Bag and OCIE is necessary to eliminate non-essential items that place a burden on the individual soldier and consume critical storage space on combat vehicles.

c. Lesson(s) Learned.

(1) Troops deployed with only one or two sets of the CVCUS. There was no laundry service nor was there any means to mend, repair, or direct exchange. Stitching in the seat came loose early on.

(2) The microclimate cooling vest was bulky and chaffed, especially around the neck.

(3) The Battledress Chemical Overgarment must be worn over the CVC uniform. This causes heat stress and reduces the flame-retardant benefits of the Nomex CVC.

(4) The Balaclava is too bulky and uncomfortable to be worn under the CVC helmet.

(5) Armor crewmen cannot wear Load Bearing Equipment (LBE) while on the tank. The Survival Vest (SRV-21P) has been designated as the appropriate replacement but the CTA does not authorize it for wear.

(6) The Ballistic Laser Eye Protection (BLEP) goggles do not interface well with fire controls or the CVC helmet. Sun, wind, and dust goggle laser protective inserts were not generally available.

(7) There are no desert tanker boots. The canvas desert boot worn by the infantry is flammable and provides no protection for the tanker.

(8) There are too many items that the Armor crewman must wear or carry. The ensemble must be simplified as has been done for the infantry. The Extended Cold Weather Clothing System (ECWCS) (GORETEX rain system) is an example.

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(9) We need a means for personal hygiene in the desert such as portable showers.

(10) Habitability of Armor vehicles must be improved. A means to sleep both on or off the vehicle is needed. A means to heat rations or water on the vehicle is required.

(11) There is insufficient room to carry everything on the tank. Besides reducing the items to be carried, a means to store equipment and still be accessible is required.

d. Recommended or Ongoing Action.

(1) The USAARMC has developed an action plan to deal with the above problems/facts and will implement based on a prioritized list known as the Armor Crewman Modernization Plan. Specific actions in the improvement of clothing and equipment for the armored crewman can be found in Appendix A.

(2) Recommended changes to the Clothing Bag and OCIE issue has been provided to TSM-Soldier. The ultimate goal of this action is the establishment of a MOS specific issue of clothing/equipment to the soldier.

(3) Comments concerning the balaclava, portable showers, and bustle racks cover are new issues. Action will be taken to resolve these concerns.

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6-17. Vehicle Filtering Systems.

a. Observation. Vehicle filtering systems and air filtering systems (M1).

b. Discussion. Air, fuel, and oil filters require more daily servicing in the desert. Ambient air that appears clean is actually laden with fine dust, even on a clear day. Replacement of all filters must be on a more frequent basis than recommended by the manufacturers for U.S. and European operating conditions. Close attention to filters pays in fewer maintenance problems and is especially important during extended field operations. It is not uncommon for an air filter to become completely useless in 3 days time even with daily or more frequent cleaning.

c. Lessons Learned.

(1) General. Greater numbers of all filter types should be stocked for use in desert operations.

(2) M1 Specific.

(a) Cleaning every 6-10 operating hours.

1. On a powdery surface, cleaning interval is every 2-3 hours.

2. In a convoy, cleaning interval may further decrease to every 15-20 minutes for trailing vehicles.

3. Could also control dust contamination by driving in an echelon formation staggered into the wind.

(b) Follow proper cleaning procedures.

1. Use the wand to clean the filter by blowing from the inside out.

2. Use compressed air at no more than 30 psi.

3. After 6-8 cleanings, replace the filter.

(c) Use the correct cleaning equipment.

(d) Follow TM procedures during removal, inspection and installation.

1. In many cases of V-pack failure, it was found that seals were torn by improper handling.

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2. V-packs should be replaced in the same order that they are taken out, especially as the seals age and set.

d. Recommendation. Leaders at all levels should place increased emphasis on maintenance of the air filtration system (V-packs, V-pack seals, and plenum seals).

f. Comments. None.

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5-38. Failure Rate of M1 Engines.

a. Observation. High Failure Rate of M1 Engines.

b. Discussion. There were four main causes of M1 engine failure:

(1) Sand ingestion.

(2) Continued use of unserviceable air filtration components (V-packs, V-packs seals, and plenum seals).

(3) Lack of serviceable FUPPS.

(4) Deviation from M1 engine maintenance doctrine.

c. Lessons Learned.

(1) Ensure serviceable air filtration components are installed and that extra stocks are available.

(2) Ensure that engine modules are available.

(3) Ensure FUPPS are complete and serviceable.

(4) Know M1 engine maintenance concept.

d. Recommendation.

(1) Inspect/service air filtration system frequently and operate only serviceable components.

(2) Follow M1 engine maintenance doctrine.

e. Comments. None.

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6-39. M1 Tank Fuel Usage.

a. Observation. M1 Tank Fuel Usage and Acceptability.

b. Discussion.

(1) Ground vehicles and equipment designed for diesel fuel can satisfactorily operate with JET A-1 as it is an acceptable substitute for diesel fuel. However, because of the prevailing temperatures in Saudi Arabia, JET A-1 should be treated with Fuel Systems Icing Inhibitor (FSII) (i.e., MIL-I-27686 or MIL-I-85470) to ensure against the formation of any microbiological organisms (i.e., bugs, bacteria, fungus, etc.) that will occur in the presence of any separated water contamination. The treatment level for either FSII should be 0.15%.

(2) Diesel fuel originating in the Middle East generally has a high sulfur content ranging in the 0.7% to 1.0% wt. range. Using a diesel fuel having high sulfur values in excess of 0.7% wt. will cause an increase in the wear of oil-wetted engine components. However, increasing the frequency of oil drain intervals will reduce the degree for potential engine component wear problems, and the use of other than MIL-I-2104 or MIL-I-21260 engine oils is prohibited.

(3) Diesel fuels available in the Middle East generally do not have adequate thermal stability or enhanced storage stability. As such, this may cause an increase in fuel-related maintenance problems (i.e., injector/nozzle sticking, increased filter plugging, and/or formation of slime/bugs/emulsions in fuel tanks.

c. Lessons Learned.

(1) To prevent the above mentioned fuel problems, use of diesel fuel stabilizer additive (MIL-S-53021) or (MIL-I-27686 or MIL-I-85470) is strongly recommended.

(2) The diesel fuel stabilizer additive is intended to:

1. Eliminate microbiological organism formation in fuel tanks.

2. Enhance the storage stability of the treated fuel while reducing fuel-related problems.

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(3) The diesel fuel additive comes in either a "one package" or a "two package" system. Treatment levels for each system are as follows:

Diesel Fuel Stabilizer Additive	Treatment Level
One Package	0.03% Vol
Two Package	0.02% Vol

d. Recommendation.

(1) Use of either FSII in diesel fuel is recommended as an alternative to diesel fuel stabilizer additive, but it only controls the formation of microbiological organisms. FSII will not correct any of the other possible fuel related problems previously mentioned. Its treatment levels in diesel fuel are 0.15% Vol for both MIL-I-27686 or MIL-I-85470.

(2) This information be distributed to deploying commanders to allow for better planning.

e. Comments. None.

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6-40. M1 Track.

a. Observation. M1 Track and Track End Connectors

b. Discussion. M1 track and track end connectors showed a high usage rate.

c. Lessons Learned.

(1) Tracks (T156) will last approximately 800 miles (failure will be due to a high rate of bushing failure) if manufactured by Goodyear and approximately 400 miles if manufactured by anyone else.

(2) T158 track is the recommended replacement. It is more durable and does not catch on fire as does the T156 track (T156 track has caught on fire at speeds of 30-35 mph on redballs in 120 degree air temperature).

(3) Roadwheels began failing around 800 miles, starting at the #2 position.

d. Recommendation. None.

e. Comments. None.

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6-41. Halon Fire Extinguishers.

a. Observation. Discharging of Halon Fire Extinguishers.

b. Discussion. Fire extinguishers in the crew compartment may discharge spontaneously in the high heat, especially between the hours of 1500 and 1900.

c. Lesson(s) Learned. Keep them cool by placing wet (not dripping) rags on them.

d. Recommendation.

(1) The fire suppression system is being worked with plans to modify the extinguishers with valve bodies which will withstand 140 degree temperatures.

(2) Commanders must use the field expedient method to prevent spontaneous discharge. (Field expedient method - keep Halon extinguishers cool by placing wet rags on them).

e. Comments. None.

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6-42. Oil Changing.

a. Observations. Engine Oil Changing Requirements

b. Discussion. Oil should be changed about twice as often as under U.S. or European conditions, not only because grit accumulates in the oil pan, but also uncombusted low-octane fuel seeps down the cylinder walls and dilutes the reservoir. Diluted oil lubricates and cools less effectively, and evaporates at high temperatures generated during engine operation, necessitating more frequent topping up. High grade 20W-50 oil has served well in desert conditions.

c. Lesson(s) Learned. Oil changes and lubrication of undercarriage points at more frequent intervals will prolong engine and vehicle life under desert conditions.

d. Recommendation. Concur with Tank Automotive Command (TACOM) and Belvoir Research, Development and Engineering Center recommendations below:

(1) Vehicle/equipment normal oil change intervals should be cut in half (i.e. if an oil change is required at 12,000 miles, change at 6,000).

(2) These intervals may need to be further reduced if more severe conditions exist.

(3) To further reduce oil contamination, it is recommended that increased oil filter servicing be implemented.

(4) Units employed in desert environments should rethink their engine oil requirements and plan accordingly.

e. Comments. None.

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6-43. Vehicle Cooling Systems.

a. Observation. A variety of problems were experienced with cooling systems.

b. Discussion.

(1) Proper cooling system operation is critical in high temp environments.

(2) Check coolant system for serviceability prior to deployment.

(3) Check serviceability of thermostats.

(4) Be sure to use distilled or potable water only.

(5) For optimum performance, use MIL-A-46153 antifreeze in a 50/50 mix.

c. Lessons Learned.

(1) Local water in Saudi Arabia has a high mineral content which will calcify in cooling systems.

(2) Do not mix with any commercial products as they are incompatible.

d. Recommendation.

(1) Use MIL-A-46153 antifreeze in a 50/50 mix. Failure in either system (cooling or engine lubrication) will throw a strain on the other system.

(2) Use antifreeze extender additive MIL-A-53009 to prevent high temperature aluminum corrosion of the engine systems. No more than one treatment at a level of 3% (1/2qt extender to 17 quarts antifreeze solution).

e. Comments. None.

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6-44. Grease Usage.

a. Observation. Grease Usage

b. Discussion.

c. Lessons Learned.

(1) The recently upgraded Grease Automotive Artillery (MIL-G-10924 E/F) should be used as it possesses a significantly higher temperature capability.

(2) If the preferred GAA is unavailable, use of Grease, Aircraft, General Purpose, Wide Temp Range (WTR), (MIL-G-83122) in its place.

(3) Care must be taken to wipe clean any excess grease from equipment, as this will attract sand particles and cause contamination of the grease.

d. Recommendation. Commanders deploying to extremely sandy areas should have their vehicles lubricated in accordance with lubrication order requirements for operation in high temp environments. They should also emphasize keeping grease fittings and equipment clean at all times.

e. Comments. None

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6-45. PLL Computer Use.

a. Observation. Computer Use for PLL Operations in Combat.

b. Discussion.

(1) Computers were not successfully used in Class IX operations during combat operations.

(2) Through deployment, units had problems with PLL computers.

1. Power generator problems.

2. DSU updating problems.

3. Two days prior, during and for two days after combat, ULLS/SAMMS did not exist for 4-64 AR.

4. Everything was manual.

5. Computer repair was difficult due to distances involved.

6. Disk distribution was slow, disk updates were outdated once received.

c. Lesson(s) Learned. Computers are effective for PLL operations during peacetime, but were not effective during war.

d. Recommendation.

(1) A closer look needs to be taken at the role of computers in tactical units in a wartime scenario.

(2) Until support items (generators) and faster means of passing information can be implemented more emphasis must be put on manual procedures as a valuable back-up to the computer systems.

e. Comments. None.

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6-46. Target Sensing.

a. Observation. Target hits difficult to sense with SABOT ammunition.

b. Discussion.

(1) Crews found it difficult if not impossible to sense target hits with SABOT ammunition (120mm and 25mm) at extended ranges or during limited visibility.

(2) This problem was most notable in M1A1 vs T-55 engagements, as the T-55 went catastrophic much less often than did the T-72.

(3) At ranges over 3000m, crews couldn't observe the splash of the round. Sensing "doubtful" or "lost", they immediately re-engaged the target. Inspection of several T-55 wrecks showed that most were hit 2 to 4 times with SABOT ammunition.

(4) Bradley crews experienced a similar problem when engaging Iraqi personnel carrier-type targets (BMP, MTLB, BTR BRDM). 25mm SABOT was also difficult to sense hitting the target at night or at long range (>2000m).

(5) Some M1A1 and M3 crews reported switching to HEAT ammunition, when in range, during engagements because they couldn't tell if they were having target effect with SABOT.

(6) Vehicles hit with SABOT either went high order immediately or slowly caught fire. Smoke from the target was often the only indicator of a kill.

(7) Vehicles hit with HEAT ammunition caught on fire quickly. The splash of HE ammo was visible at all ranges and under all visibility conditions.

c. Lessons Learned.

(1) SABOT ammunition is difficult to sense. Lack of visible "splash" on target is not an indicator of a missed target.

(2) Not all vehicles hit with SABOT are catastrophically destroyed or catch on fire immediately.

d. Recommendation. Build a phosphoric splash signature into SABOT ammunition.

e. Comments: None.

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APPENDIX A TO CHAPTER 6

<u>DEFICIENCY</u>	<u>CORRECTIVE ACTION</u>	<u>STATUS</u>
1. CVC Helmet	Update to PASGT Level	SN-CIE 20 Nov 91
- Lacks Adequate Ballistic Protection	Reviewing Addition of Face Shield	Prototype on Hand
- Inadequate Laser Protection	Improved Sun, Wind, and Dust Goggles	RFP Out for Market Survey
- Lacks Hearing Protection	Linked to Vehicle Intercom System (VIS) Program	RFP Pending
- Old Technology	Continued R&D on Effects of Noise on Performance	HEL CCTB Test
2. Battle Dress Overgarment	NATICK Developing Heads Up Display	Sep - Oct 91
- Flammable	Vapor Protective Flame Resistant Undergarment (VPFRU)	SN-CIE at TRADOC
- Induces Heat Stress	Chemical Protective Undergarment (CPU) (Desert Storm Initiative)	Program Initiation FY 92
		Testing Underway
		Emerging Results Favorable

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Type Classification
January 1992

STATUS

Over 1000
Systems Produced
and Shipped to SWA

Bradley Version in
Development

FUE Sep 92
Based on Contract
Award in Mar 92

Preparing Message

Preparing SN-CIE
(Dec 91)

Redesign Effort
to be Initiated
in Oct 91

IOC Feb 92

Market Survey
to Evaluate
Options (issued
w/MRE)

CORRECTIVE ACTION

Support System
(SSS) (M1 version only)

Five Man Crew Tent in
Production After Extensive
USAREUR Testing

Modernize

CVC Cold Weather Glove

CVC Cold/Wet Outer Garment

PIP on Cooling Vest

Consider Integration

Over 6000 Mobile Ration
Devices (MRHD)
in Production

Flameless Ration Heater

DEFICIENCY

3. Vehicle Habitability

- No Onboard Sleep
Provisions

- Need Rapidly
Erectable Crew
Shelter

4. Cold Weather Items
Not Fielded/Adequate

5. Ballistic Under-
garment/Micro-
climatic Vest

6. Lack of Ration/
Water Heating
Capability

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STATUS
SN-CIE by 15 Feb 92

CORRECTIVE ACTION

Armored Crewman Boots*
with:

All Leather or Fire Resistant

Composite Toe

Winter Version with
PTFE Liner

Finer Tread

Straps

*Intermediate cold weather boot planned to be issued only to Infantry.

DEFICIENCY

7. Inadequate
Footwear

- Canvas Flammable

- No Safety Toe

- Lack of Insulation/
Waterproofing/Oil
Resistance

- Tread Carries Mud

- Lacing Too Slow

8. CVC Ensemble

- Too Many Items

- Difficult to Get

- Flaws

- Incompatibility

- No Desert Version

1993-1995

1992

Underway

August FUE
Projected - 70,000
by July 92

6-A-3

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CTA Change
Being Initiated

STATUS

Prototype
Being Evaluated

SRU-21P

CORRECTIVE ACTION

Tanker's Duffel Bag

9. Load Bearing
Equipment (LBE)

- Bulky
- Dangerous

DEFICIENCY

10. Inadequate Storage
Space

FOLLOW-ON ACTIONS

- Develop and Staff
- Develop Programmatic
Documentation
- Secure Funding
- Implement Plan

MILESTONES

- Sep 91 - Nov 91
- Oct 91 - Mar 92
- Mar 92 - Oct 92
- Oct 92 - Until Complete

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CHAPTER 7

LEADER DEVELOPMENT

7-1. Summary.

a. There are numerous comments collected from units with Southwest Asian experience during Desert Shield/Storm. Eighty percent of these comments stated that leadership was superb at all levels. The other 20 percent of comments were mundane or isolated cases which do not meet the needs of this publication. Unfortunately, with such comments it is difficult to gain specifics. The Armor School opted to address specific issues of leader development in the school environment during the SWA experience. The fact that we won the war, so far away, so quickly, with so few casualties is a strong indicator that leader development is working.

b. The events in the Kuwait Theater of Operation (KTO) displayed our leaders as human beings capable of thinking, deciding, and acting on their own initiative as part of a highly professional team. Open lines of communication allowed directions and guidance to flow downward to the individual soldier. Mission orders and clear commander's intent were key to allow subordinate's use of initiative. This communication link also allowed multi-directional (i.e., up, down and lateral) flow of feedback and recommendations. The leadership skills demonstrated by our units accomplishments astounded our allies and terrorized the enemy.

c. Leaders carefully cultivated and sustained their unit's will to attack ferociously before and during the deployment to SWA. Yet the soldiers of these units had discipline and compassion to treat prisoners of war humanely. The key to this will to fight comes from confidence in soldiers' ability, equipment capabilities, and guidance from higher headquarters. This confidence to fight is a product of sensible management of limited resources to establish unit training programs. These programs are realistic, challenging, and repetitive. They provide sufficient feedback to continue to achieve high standards but also provide an atmosphere for "risk taking". In this All Volunteer Army, the underachievers are weeded out. Units developed a spirit of teamwork/cohesion from this tough training and discipline.

d. Leaders "lead by example" in today's Army which provides standards for future leaders. Outstanding leaders are developed internally from special coaching and mentoring by senior leaders. Additionally, military schools provide the foundation of skills needed with appropriate academic and doctrinal subject matter experts. The fact that new lieutenants and captains, straight out of their courses, could fill leadership positions and perform

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admirably; indicates the school system works well. Both NCOs and officers are developed to identify, question, anticipate, and solve problems on their own. If the problem is beyond that leader's capability, he searches out appropriate help to solve it. Leaders are also encouraged to conduct self development with civilian schooling and professional reading programs. The initiative to bring SWA-experienced leaders back to the Armor Center enables the school house to conduct improved leader development instruction for many years to come.

e. In conclusion, the U.S. Army leadership philosophy of "be, know, do" and its execution creates the best military leaders in the world. This was certainly demonstrated in SWA. We made it happen despite problem areas in training, organization, materiel, and doctrine described in preceding chapters of this report.

f. Another trait developed in U.S. military leaders is resistance to euphoria. The sparseness of identified problems from the field caused the Armor School to focus on internal issues of the school. Leader development problem areas are discussed from a standpoint of the school house for the rest of this chapter.

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7.2. List of Issues.

- a. Maintain quality leadership instruction at the school house during war.
- b. Flexibility of the TRADOC instruction model during war.

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7-3. Maintain Quality Leadership Instruction at the School House During War.

a. Observation. Schools are required to provide replacement personnel during times of crisis.

b. Discussion. The schools provide an excellent base for qualified replacements. The concern is ensuring that instructional quality is maintained when the instructors providing this quality are sent to augment units in the war. Instruction is documented in lesson plans, and reserve replacement instructors are ready to replace current instructors. This works for technical instruction, but in leadership instruction, the instructor is key, demonstrating his professionalism and skills better inspires his students than just talking about the subject. When war begins, a dilemma occurs. How many instructors can be lost to support the war, while the reserve instructors are being trained for the same high quality leadership instruction? At one time, the Scout Platoon Leader Course at USAARMS was in jeopardy of cancellation during war in SWA for this reason. This was due to a high number of scout instructors required by tactical units. This did not have as serious an impact as it could have because the war was short.

c. Lesson(s) Learned. None.

d. Recommendation. The longer the instructors can remain at the school during the train-up of reserve instructors the higher quality of instruction will be available for future leaders that are being trained during the war.

e. Comments. None.

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7-4. Flexibility of the TRADOC Instruction Model During War.

- a. Observation. The TRADOC instructional model is not able to change or adjust instruction in a very short period of time. Being flexible during a war-time situation provides students the latest lessons learned instruction from the war experience.
- b. Discussion. The TRADOC guidance for establishing and maintaining programs of instruction (POI) is designed for execution in a peace-time environment. In this case, requesting and documenting changes has a definite role to control instruction. The problem exists when rapid change is required. Classes were changed in the school house when certain shortfalls of instruction were identified during the preparation for war and deployment. For example, USAARMS identified a possible training weakness to train students on deliberate breaching of a complex obstacle. A sandtable and a 4 hour class were developed by USAARMS for all students during the force deployment to SWA, many of whom would soon depart for to tactical units in SWA. Unfortunately, the current system does not support short notice changes. This is more profound because the system does not allow for this instruction to be justified after the fact.
- c. Lesson(s) Learned. None.
- d. Recommendation. Provide a system allowing schools to quickly modify, establish, reduce, or eliminate various instruction where necessary during time of crisis. Simultaneously, a special streamlined instruction change and approval system is required so that the quality of instruction remains high during these times.
- e. Comments. None.

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CHAPTER 8

BIBLIOGRAPHY

8-1. Unit After Action Reports (AARs).

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- b. XVIII Airborne Corps
- c. 1st Infantry Division (Mechanized)
- d. 1st Armor Division
- e. 3d Armor Division
- f. 1st Cavalry Division
- g. 1st U.S. Marine Corps Division
- h. 1st Brigade, 2d Armor Division
- i. 1st Brigade, 3d Armor Division
- j. 2d Brigade, 3d Armor Division
- k. 3d Brigade, 3d Armor Division
- l. 1st Brigade, 1st Cavalry Division
- m. 2d Brigade, 1st Cavalry Division
- n. 2d Armored Cavalry Regiment
- o. 1st Squadron, 4th Cavalry Regiment, 1st ID(M)
- p. 2d Battalion, 34th Armor Regiment, 1st ID(M)
- q. 2d Battalion, 69th Armor Regiment, 197th SIB
- r. 2d Squadron, 2d ACR
- s. 2d Battalion 16th Infantry Regiment
- t. 1st Squadron, 7th Cavalry Regiment
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- v. 4th Squadron, 7th Cavalry Regiment
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- b. Report on Combat Service Support, Major Donald Michener
- c. VII Corps Report, Captain Kris Thompson
- d. 2d Armored Cavalry Regiment Report, Major Michael Sandridge
- e. 73 Easting Report

8-3. USAARMC Trip Reports.

- a. 1st Infantry Division (Mechanized)
(1) 1st Brigade

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- (2) 2d Brigade
 - (3) 1st Battalion, 34th Armor Regiment
 - (4) 2d Battalion, 34th Armor Regiment
 - (5) 3d Battalion, 37th Armor Regiment
 - (6) 4th Battalion, 37th Armor Regiment
 - (7) 2d Battalion, 66th Armor Regiment
 - (8) 3d Battalion, 66th Armor Regiment
 - (9) 1st Squadron, 4th Cavalry Regiment
 - (10) D Troop, 2d Squadron, 1st Cavalry Regiment
- b. 24th Infantry Division (Mechanized).
- (1) 197th Separate Infantry Brigade
 - (2) 4th Battalion, 64th Armor Regiment
 - (3) 1st Battalion, 64th Armor Regiment
 - (4) 3d Battalion, 69th Armor Regiment
 - (5) 2d Battalion, 69th Armor Regiment
 - (6) 2d Battalion 4th Cavalry Regiment
- c. 1st Armor Division.
- (1) 1st Battalion, 35th Armor Regiment
 - (2) 2d Battalion, 70th Armor Regiment
 - (3) 4th Battalion, 70th Armor Regiment
 - (4) 1st Battalion, 37th Armor Regiment
 - (5) 3d Battalion, 35th Armor Regiment
 - (6) 4th Battalion, 66th Armor Regiment, 3ID (M)
 - (7) 1st Squadron, 1st Cavalry Regiment
- d. 3d Armor Division.
- (1) 2d Brigade
 - (2) 4th Brigade
 - (3) 4th Battalion, 32d Armor Regiment
 - (4) 4th Battalion, 34th Armor Regiment
 - (5) 3d Battalion, 8th Armor Regiment
 - (6) 4th Battalion 8th Armor Regiment
 - (7) 2d Battalion 67th Armor Regiment
- e. 82d Airborne Division - 3d Battalion, 37th Armor Regiment.
- f. 1st Cavalry Division.
- (1) 2d Brigade
 - (1) 1st Battalion, 32d Armor Regiment
 - (2) 1st Squadron, 7th Cavalry Regiment
- g. 2d Armored Cavalry Regiment
- (1) 1st Squadron
 - (2) 2d Squadron
 - (3) 3d Squadron
- h. 3d Armored Cavalry Regiment
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JULIS TITLE LISTING

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32058 67291 (00001)	DESERT STORM	Update of Mobilization Plan	1
32137 24992 (00002)	DESERT STORM	Lack of barracks furnishings	2
32137 94511 (00003)	DESERT STORM	DEH Staffing for Mobilization	3
32138 38940 (00004)	DESERT STORM	Daily changes in programmed troop arrivals.	4
32138 70786 (00005)	DESERT STORM	Inadequate warehouse facilities.	5
32140 55890 (00006)	DESERT STORM	Media inquiries about past tank battles.	6
32145 79050 (00007)	DESERT STORM	G-3 Aviation Division Desert Shield/Storm Activity.	7
32149 02374 (00008)	DESERT STORM	IRR soldiers training of common tasks at airfield.	8
32149 72899 (00009)	DESERT STORM	G-3 Avn Div incorporated into Fort Knox Casualty Assistance Plan.	9
32151 25371 (00010)	DESERT STORM	Increase in Avn Div flights	11
32151 99098 (00011)	DESERT STORM	Flight Simulator use	12
32152 67558 (00012)	DESERT STORM	Manpower drain at Fort Knox	13
32154 40159 (00013)	DESERT STORM	Limited Visibility of Troop Listed Units.	14
32154 01425 (00014)	DESERT STORM	Command and control of mobilized RC units	15
32156 57369 (00015)	DESERT STORM	Equipping NMI soldiers for SMA	17
32237 26134 (00016)	DESERT STORM	Emergency Operations Center Manning	18
32238 09895 (00017)	DESERT STORM	Shortages of WAMCCs personnel	19
32238 49771 (00018)	DESERT STORM	Unit Status Reports of arriving RC units	20
32239 82107 (00019)	DESERT STORM	Property accountability during deployment.	21
32240 18406 (00020)	DESERT STORM	Mob POIs not used.	21
32240 50063 (00021)	DESERT STORM	Lack of proper NOME uniforms	1
32250 10056 (00022)	DESERT STORM	Lack of information on battlefield.	25
32250 62378 (00023)	DESERT STORM	Parts available in SMA	26
32250 94767 (00024)	DESERT STORM	Shortages of maps, sluggers.	27
32250 99470 (00025)	DESERT STORM	Safety on battlefield	28
32251 83928 (00026)	DESERT STORM	Preparation for combat and PMS	29
32531 40156 (00027)	DESERT STORM	Poor leadership, communication, logistics	2
32534 94807 (00028)	DESERT STORM	Boreighting IAW FM 17-12.1	3
32537 64708 (00029)	DESERT STORM	Use of Lenzar/Pye Watson	4
32540 58944 (00030)	DESERT STORM	Common gunnery problems	5
32541 27271 (00031)	DESERT STORM	Mobilization plan deficiencies.	34
32549 58373 (00032)	DESERT STORM	Range maintenance schedules conflict with CRC or IRR training	35
32550 54221 (00033)	DESERT STORM	G-3 Range Division did not have correct targets.	36
32550 63217 (00034)	DESERT STORM	Logistical system responds favorably.	37
32550 69579 (00035)	DESERT STORM	Units and CRC activities equipment and personnel shortages.	1
32550 98316 (00036)	DESERT STORM	Training requirements of mobilizing units.	2
32551 18074 (00037)	DESERT STORM	Peak student/deploying loads.	3
32551 45905 (00038)	DESERT STORM	TRADOC Staff interference in Knox training of armor soldiers.	4
32551 54708 (00039)	DESERT STORM	Command and control of soldiers during processing	5
32551 65204 (00040)	DESERT STORM	Lack of adherence to processing schedules caused trouble for CIIP	6
32551 78699 (00041)	DESERT STORM	ATRS not responsive to partial mobilization	6
32552 13417 (00042)	DESERT STORM	Delay getting RC units into finance system	8
32552 26831 (00043)	DESERT STORM	RC units lack of training in SF 44, purchase order invoice vouche	9
32552 61065 (00044)	DESERT STORM	Telecommunication Center (TCC) Requirements	10
32552 88001 (00045)	DESERT STORM	Mail Support	11
32553 03797 (00046)	DESERT STORM	Unit Information Management Officer (IMO)	12
32553 70226 (00047)	DESERT STORM	STU III/KY68 Compatibility	13
32553 39807 (00048)	DESERT STORM	SRP processing of RC personnel	14
32553 98840 (00049)	DESERT STORM	Professional credentialing	15
32554 11061 (00050)	DESERT STORM	Capstone Mission	16

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32555-61864 (00053)	DESERT STORM	SCCC and ICCS courses	19
32555-80287 (00054)	DESERT STORM	Philosophy and plans for crew training.	20
32555-90882 (00055)	DESERT STORM	Command and control of students	21
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32557-68731 (00061)	DESERT STORM	Manpower shortage	27
32557-96424 (00062)	DESERT STORM	Classification guidance of specific deployment information	28
32558-0610 (00063)	DESERT STORM	Classified documents accompanying mobilizing units	29
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11838-98364 (00086)	DESERT STORM	Army Training Center (ATC) Training Support Brigade	60
11847-11052 (00087)	DESERT STORM	Database for Individual Ready Reserve (IRR) Personnel	61
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12640-56375 (00098)	DESERT SHIELD	Lack of thermal defense equipment of mobilizing units	4
12641-98842 (00099)	DESERT SHIELD	Lack of adequate OCIE stocks of mobilizing units	5
12642-34360 (00100)	DESERT SHIELD	Reserve DS/GS Maintenance units not mobilized for backfill	6

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32654 80954 (00103)	DESERT SHIELD	Privately owned vehicles/weapon brought to Ft Knox by mobilizing	10
32655 78870 (00104)	DESERT SHIELD	Individual Mobilization Augmentees (IMAs)	11
32656 22514 (00105)	DESERT SHIELD	ADP for mobilizing units	12
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32737 45572 (00117)	DESERT STORM	Ammunition movement	24
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32955 57366 (00120)	DESERT STORM	Buildings scheduled for destruction used in mobilization	29
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32956 77999 (00122)	DESERT STORM	RC units arrived without needed ADP equipment.	31
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80254-47440 (00596)	DESERT STORM	Army/USMC interoperability	
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80532-46338 (00598)	DESERT STORM	Brigade-level maps	
00553-20432 (00599)	DESERT STORM	Lack of information in the theater	
80651-17674 (00600)	DESERT STORM	Reproduction of copies at Bn level	50

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80638	84171 (00604)	DESERT STORM	Limited Intel led to unrealistic preparation
80641	91347 (00605)	DESERT STORM	Limitations on reconnaissance of assigned positions
80642	34931 (00606)	DESERT STORM	Identifying sector for night identification
80642	70025 (00607)	DESERT STORM	Maintaining alignment with adjacent units
80643	00721 (00608)	DESERT STORM	Receiving follow-on orders prior to attack
80656	02603 (00609)	DESERT STORM	Baggage created unnecessary friction during deployment
80656	82569 (00610)	DESERT STORM	Piecemeal companies to TAA ROOSEVELT
80731	22316 (00611)	DESERT STORM	ADA unnecessary at company level
80731	57463 (00612)	DESERT STORM	Shortage of M8A1 batteries
80731	81614 (00613)	DESERT STORM	Fratricide via artillery
80731	17845 (00614)	DESERT STORM	Fuel shortage during attack
80734	47049 (00615)	DESERT STORM	Repair parts for the M1
80734	09137 (00616)	DESERT STORM	Consolidated recovery/maintenance assets.
80734	19963 (00617)	DESERT STORM	Receiving non-mission-capable commo equipment
80734	73762 (00618)	DESERT STORM	Morale support
80736	40258 (00619)	DESERT STORM	Ammunition quality assurance inspection
80736	84341 (00620)	DESERT STORM	Uniforms and TA-50
80737	02783 (00621)	DESERT STORM	Painting of vehicles
80737	55389 (00622)	DESERT STORM	Plows available to the breach team
80739	14287 (00623)	DESERT STORM	Attached platoons not ready for combat with company
80740	37820 (00624)	DESERT STORM	Mismanagement of available manpower at HQ
80741	10706 (00625)	DESERT STORM	Company deployed to combat without weapons or radios
80742	52796 (00626)	DESERT STORM	Shortage of repair parts for armored vehicles
80748	70578 (00627)	DESERT STORM	Mortar support of Scout platoon
80752	10841 (00628)	DESERT STORM	On Board Navigation Devices
80759	01771 (00629)	DESERT STORM	Use of TIRs
80759	85159 (00630)	DESERT STORM	Use of Degraded mode gunnery
80760	68481 (00631)	DESERT STORM	Tank Commander personal weapon
80760	93302 (00632)	DESERT STORM	Information on lateral units
80761	46926 (00633)	DESERT STORM	Coordination of Night Passage of Lines
80767	30495 (00634)	DESERT STORM	Base Company
80768	06210 (00635)	DESERT STORM	ALO force Structure
80831	16752 (00636)	DESERT STORM	FOs could not observe enemy targets at night
80836	73284 (00637)	DESERT STORM	Fire Support plan for breach was issued well after the maneuver
80849	33396 (00638)	DESERT STORM	Vehicle for TF FSO
80850	08765 (00639)	DESERT STORM	FIST were unable to accurately determine their position.
80850	60556 (00640)	DESERT STORM	Effective use of satellite imagery.
80851	30834 (00641)	DESERT STORM	Looking ahead to future battles
80851	74124 (00642)	DESERT STORM	Real time intelligence during battle.
80853	63474 (00643)	DESERT STORM	Issue of maps
80854	40260 (00644)	DESERT STORM	Lack of maps
80856	31947 (00645)	DESERT STORM	EPW control
80858	78867 (00646)	DESERT STORM	Use of the ACE
80859	27366 (00647)	DESERT STORM	Repair parts system
80862	02422 (00648)	DESERT STORM	Mine plow straps
80864	11969 (00649)	DESERT STORM	No direct support maintenance available at port
80931	34942 (00650)	DESERT STORM	Repair parts for new and/or special equipment

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80934-33815 (00654)	DESERT STORM	Civilian HET support	
80936-19474 (00655)	DESERT STORM	Telephone service in the port	
80937-55074 (00656)	DESERT STORM	Tier II ammunition carried by the task force	
80938-57010 (00657)	DESERT STORM	Port to IAA recovery/maintenance	
80939-50746 (00658)	DESERT STORM	Sea-transport equipment sequencing	
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80952-61345 (00664)	DESERT STORM	Very limited access to PK facilities	
80954-91719 (00665)	DESERT STORM	Lack of timely mail	
80955-57477 (00666)	DESERT STORM	New arrivals that are missing specific items of equipment	
80956-31164 (00667)	DESERT STORM	Class I cycle	
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81437-70157 (00682)	DESERT STORM	Task organization in the desert came too late	
81633-60143 (00683)	DESERT STORM	S1 has insufficient vehicular assets by MTOE	
81659-13218 (00684)	DESERT STORM	SIMNET Time	
81659-34479 (00685)	DESERT STORM	PCOFT	
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