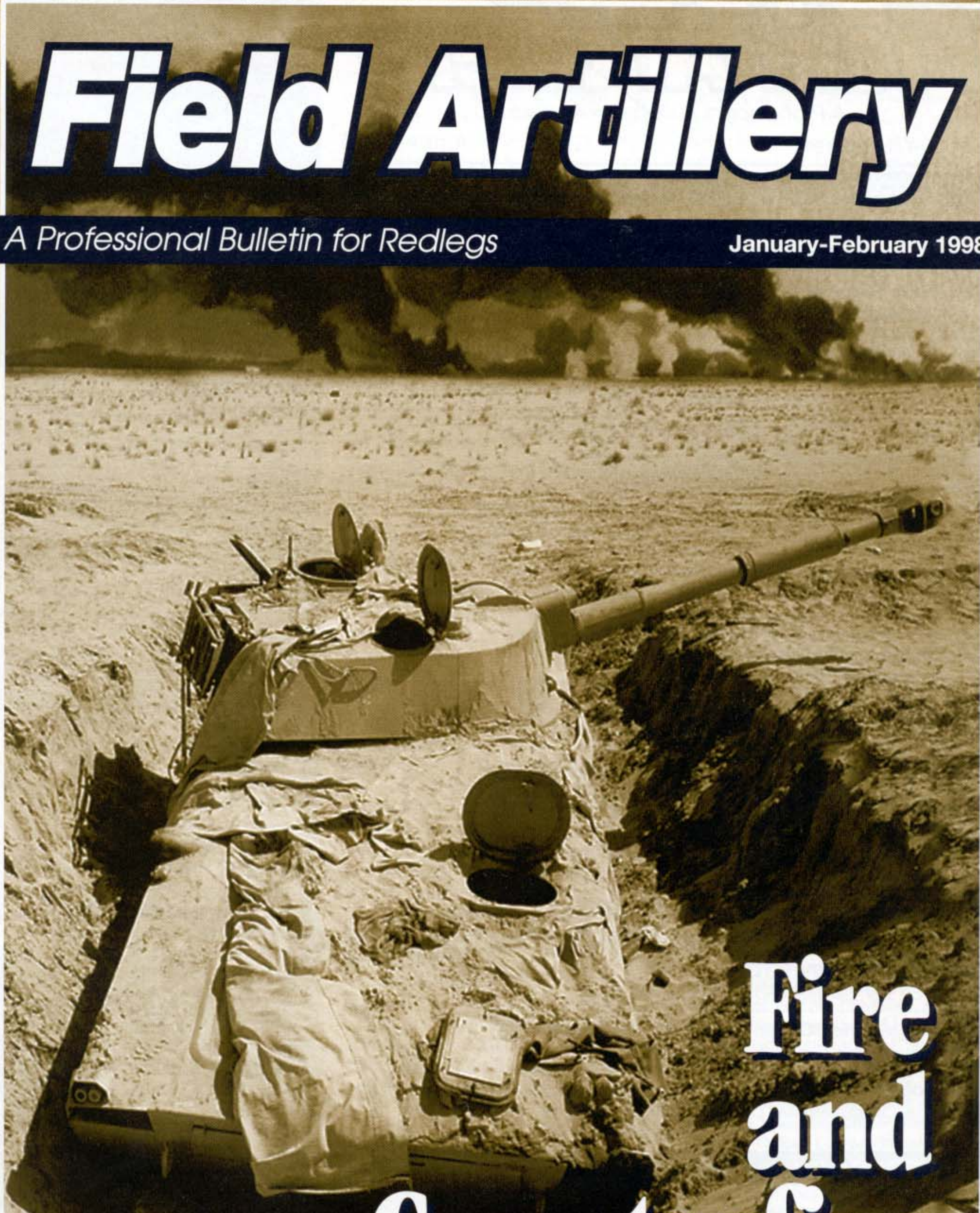
Field Artillery

A Professional Bulletin for Redlegs

January-February 1998



Fire and Counterfire

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ARTICLES—Fire and Counterfire

DEPARTMENTS

Cover: Iraqi 122-mm howitzer in 1991 that had seen better days.

PURPOSE (as stated in the first ***Field Artillery Journal*** in 1911): *To publish a journal for disseminating professional knowledge and furnishing information as to the Field Artillery's progress, development and best use in campaign; to cultivate, with the other arms, a common understanding of the power and limitations of each; to foster a feeling of interdependence among the different arms and of hearty cooperation by all; and to promote understanding between the regular and militia forces by a closer bond; all of which objects are worthy and contribute to the good of our country.*

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MAJOR GENERAL LEO J. BAXTER
Chief of Field Artillery

Cutting Edge Options for the Commander's Kit Bag

The Division Advanced Warfighting Experiment (DAWE) at Fort Hood, Texas, concluded in November, and the operational implications were tremendous. Force XXI fires were decisive in enabling the division to dominate a larger enemy in an expanded battlespace. The success was due largely to the division's leveraging its greater battlefield knowledge to focus combat power at the critical time and place.

As part of the combined team of Army attack aviation, joint air and a supporting intelligence architecture, Field Artillery fires played a central role in the division's destruction of four world-class opposing force (OPFOR) enemy armies–some 16-plus divisions–during simulated combat operations. Ground commanders now have more options in their "kit bags."

We Wait No More

Enemy fire support has long been the Achilles heel of friendly forces–but no more. Force XXI sensors and improved situational awareness brought unprecedented clarity to the battlespace, maximizing opportunities for preemptive, focused fires. We no longer must wait for the enemy to fire to kill his fire support assets. Today, we can strip a preponderance of his most cherished asset before he fires, seizing the power to maneuver freely.

Proactive counterfire executed by the 4th Infantry Division Artillery and its two supporting FA brigades, the 214th from III Corps Artillery and the 138th from the Kentucky Army National Guard, obliterated the OPFOR's center of gravity–his fire support. Timely, targetable intelligence enabled this success early and often...and before they fired. Such proactive fires accounted for more than half of the counterfire missions, preserving friendly combat power and setting the conditions for maneuver to engage.

Magnifying the Synergy

The division employed a number of innovative techniques to optimize the potential of the Force XXI fires-based combined arms team. In one such technique, the division's multiple-launch rocket system (MLRS) battalion, 2-20 FA, served in direct support of the divisional aviation brigade with a quickfire channel to the division cavalry squadron. Teaming MLRS with aviation assets in the form of an MLRS-Comanche sensor-to-shooter link proved devastating to the OPFOR. This lethal partnership capitalized on the strengths of each system.

For example, during the division's fight against the enemy's 15th Tank Division, Comanches routinely passed requests to 2-20 FA to suppress enemy air defenses as the helicopters maneuvered to their designated battle positions. Once in the objective area, the Comanches initiated and controlled 2-20's fires, destroying a tank regiment with MLRS smart tactical rockets (MSTARs). In similar engagements against the 15th Division, Comanche-MLRS destroyed much of the division's supporting artillery.

Maximizing information-age technology and exploiting its collective capability, the fires-based combined arms team was devastating. In the words of the divisional cavalry's Lieutenant Colonel Joe Moore, Jr., 1-10 Cav Commander, "The synergy of the Cav and the artillery was tremendous....Pretty Cool!" This combined arms team held the enemy at absolute risk. Yes, Colonel Moore, "Pretty Cool," indeed.

Logisticians Rejoice...or Maybe Not

Crusader and MLRS demonstrated in spades that emerging munitions will allow the Field Artillery to "reach out and touch" *all* enemy assets with decisive results and do so very efficiently. Although, we haven't reached our "one-round-one-kill" goal yet, we're close. Fewer rounds to kill targets means less resupply-that is, of course, unless the ground commander wants us to kill even *more.*

The new Field Artillery smart family of munitions-155-mm sense and destroy armor (SADARM), MSTAR and others-shattered all previous expectations for munitions effectiveness and magnified the killing power of the 21st century force. For example, in the division's offensive covering force operations, the Field Artillery killed 100 BMPs with 220 rounds of SADARM. That's an enormous reduction from the number of conventional rounds required to destroy the same 100 vehicles in our current munitions effects manuals. MSTAR had similar success during the engagement. The "secondary effects" of this efficiency is exponential: fewer rounds fired per kill means more fires means more kills...truly Cutting Edge warfare.

New Options for the Kit Bag

The DAWE demonstrated that fires can shred the enemy's combat power in depth and shape the battlefield for a quick, decisive close fight at minimal cost to friendly forces. This experiment was not merely a success for the Field Artillery-all battlefield operating systems (BOS) performed superbly, contributing to the unparalleled success the 4th Infantry Division enjoyed. But, merging situational awareness and decisive fires gives the commander new Cutting Edge options for his kit bag.

Senior Fire Support Conference: 9-13 February

The Senior Fire Support Conference at the Field Artillery School, Fort Sill, Oklahoma, is 9 through 13 February 1998. The conference theme is "Joint Fires for the 21st Century...The Cutting Edge."

Conference attendees will include Army corps and Marine expeditionary force (MEF) commanders; Reserve Component (RC) and Active Component (AC) Army and Marine division commanders; selected retired general officers; Training and Doctrine Command school commandants; AC and RC corps artillery, FA brigade, division artillery and Marine regimental artillery commanders and their command sergeants major; and US Field Artillery Association corporate members.

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Response to "Eliminating Unwanted Targets"

In reviewing the article "Firefinder Radars: Eliminating Unwanted Targets in Low-Intensity Conflict" by Sergeant First Class Scott E. Rogers [in this edition], three key thoughts captured my attention and are worth emphasizing.

(1) Our experience with the radars in Bosnia have taught us that the targets generated by the radar are *not* "clear-cut." Sergeant Rogers' observation is that we have not yet implemented the radar lessons learned in current training. Eight US Army Firefinder radars and six other Firefinder radars from The Netherlands, Spain and Turkey continue to support the NATO Implementation Force in Bosnia and cope with this phenomena daily. We should update the training accordingly.

(2) In all operations, but low-intensity operations in particular, Firefinder targets need to be confirmed. This can be easy if explosions are occurring at the impact points identified by the radar's tracks. However, in a stability operation situation, it is usually *not* easy. The procedures spelled out by Sergeant Rogers work.

(3) The target analysis process, although followed carefully and using all available information, *still can be wrong.* There is a risk, here, that commanders should understand.

Since 1990, we have deployed Firefinders to locations to perform hostile fire missions: Desert Storm, Somalia, Haiti and Bosnia. Because of this focus on hostile fire mission, as opposed to prior emphasis on friendly fire, we have learned many lessons about using these sensors and coping with the false and unwanted targets generated in certain situations. Sergeant Rogers is commended for his success in developing procedures to deal with this phenomena.

CWO5 Michael W. Courson
Target Acquisition Division, FSCAOD
FA School, Fort Sill, OK

Response to "WW II Artillery at Sea"

I was interested to read Sergeant First Class John C. Barry's piece on "WW II Artillery at Sea-First Strike Against the Japanese Navy" in your September-October 1997 edition. It reminded me of a similar, albeit less dramatic, situation during the Falklands War of 1982.

I was the Operations Officer of a 105-mm light gun battalion and the commander of troops on the MV Baltic Ferry, an unarmed truck ferry that normally sailed on routes across the North Sea. We carried half of a brigade's equipment, including a battery of guns. Until the last few hours before landing at San Carlos Water, we sailed without naval escort from the United Kingdom.

Political events were unfolding during the voyage and possible options for our employment included an opposed landing, an unopposed landing or an administrative landing to form part of a garrison. There was also a threat from submarines and aircraft, and we armed the vessel by placing Blowpipe handheld air defence weapons on the top deck.

Our ship had no landing craft or means of lifting equipment into such craft, yet clearly if there were to be an amphibious assault, the Royal Artillery would need to make an appropriate contribution. I remembered reading how in the Second World War Field Artillery had fired from landing craft to support amphibious operations in Burma and Normandy and thought we should prepare for the same.

The ship had a large flat deck with several vehicle decks below with no bulkheads and all packed full of equipment and stores. We managed to manhandle a gun onto the top deck and chained it down. We fired a low charge to test the arrangement. The ship reverberated like a base drum, but fortunately the gun did not break free and disappear into the Atlantic-although the shot, no doubt, surprised the Soviet "trawlers" nearby, which had been following us since we left Sierra Leone. We tested six guns in turn on all charges and made plans to position them together on the deck for battery missions, although the inaccuracy of firing from a moving deck would have made our efforts more of a tonic for morale than a battle winner.

We conducted an unopposed landing at San Carlos on the western side of the East Falklands and our "artillery from the sea" was not required. Operations thereafter to retake the Falklands were well supported by naval gunfire. But had the MV Baltic Ferry been required to support the landing, it would have done so with more guns than any ship in the Royal Navy at that time.

BG J.B.A. Bailey, Commander
ACE Rapid Reaction Corps Arty,
Germany

AFATDS and the Task Force AWE

Insights for Fire Support Leaders

by Lieutenant Colonel Douglas G. Beley

LCU-Lighweight Computer Unit

In 1997, the Army conducted two of the largest and most complex experiments since the Louisiana Maneuvers of the 1940s. At the National Training Center (NTC) at Fort Irwin, California, and Fort Hood, Texas, soldiers from the 4th Infantry Division (Mechanized), in close cooperation with American industry, conducted operations on a future battlefield with weapons and command, control and communications systems that previously only had been imagined. Born out of these experiments was the US Army's Digitized Division and Corps—and the advanced Field Artillery tactical data system (AFATDS) was there every step of the way (see Figure 1).

In the first experiment, the Task Force Advanced Warfighting Experiment (TF AWE) focused on the digitized brigade of 2003. It consisted of two heavy battalions, a light infantry battalion, direct support (DS) artillery battalion, reinforcing artillery battalion, Q-36 radar, meteorology section and associated brigade "slice" elements. The AWE consisted of live and constructive simulations and culminated with a brigade TF rotation at the NTC in March.

The second experiment, the Division AWE (DAWE), was the digitized division of 2003 fighting the world-class opposing forces (OPFOR) of the Battle Command Training Program (BCTP) as part of III Corps. The simulated DAWE battle was fought at Fort Hood for 10 days in November, providing massive amounts of data. (As I write this article, the Army is analyzing the results of the DAWE.) In the TF AWE, we identified AFATDS problems and incorporated many "fixes" before the DAWE.

Because the AWEs focused on the battlefield of the 21st century, they were glimpses of the future. While AFATDS will be part of that future battlefield, it isn't an experimental system-we're fielding it *now*.

This article uses the context of the TF AWE to discuss AFATDS software and training lessons for fire support leaders as they prepare to receive the most significant digital fire support tool ever: AFATDS. With the advent of AFATDS, I also posit a paradigm shift in the "fire support center of gravity" for the digital battlefield–a shift from the fire direction center (FDC) to the fire support element (FSE) with the maneuver commander.

Software Development Lessons. In an age of computers and digitization of military forces, the most difficult challenge for combat developers is integrating software, which is very different than in the days of the tactical fire direction system (TACFIRE). Under the AFATDS development and fielding concepts, we deliver a complete hardware package to the unit at fielding: computer, monitor, uninterrupted power source, modem, cables, etc. We schedule this delivery to conclude just before new equipment training.

However, we deliver AFATDS software through a series of incremental and integrated software "builds" that units see in annual software versions. The final (objective) version of AFATDS isn't delivered at fielding but in incremental increases of functionality as we develop, test and, eventually, certify for material release each new software version.

This process creates a continuous training challenge for units that must not only train and qualify operators at fielding, but also sustain skills and train new functions annually with each software release. This is exactly the challenge the FA battalion in the March TF AWE faced.

AFATDS is an Army and Marine Corps automated command and control system for fire support operations. It comes as a ruggedized laptop lightweight computer unit (LCU) or ultra-sparc computer unit (UCU) and automates the integration and control of fire support assets in both horizontal and vertical continuous operations. AFATDS provides tools to-

- Integrate all fire support assets into the commander's operational plan (OPLAN) and Field Artillery support plan (FASP).
- Process targets, provide attack analysis and assess battle damage.
- Manage and coordinate the movement of Field Artillery weapons systems and sensors.
- Provide Field Artillery updates on weapons, units and ammunition status for fire direction operations.

Figure 1: Advanced Field Artillery Tactical Data System (AFATDS) Objective Capabilities

The TF XXI version of AFATDS software was immature and untested. In an effort to optimize this experimental software, combat developers and software engineers continued to issue improvements right up until the start of the exercise at the NTC. The battalion, literally, loaded new software as it prepared for battle in the "Dust Bowl." Consequently, operators and leaders neither fully understood nor were trained on the new software.

Even though we designed the software changes to be seamless and transparent to the operators, the changes were, in fact, very visible. Subtle updates tend to have many links or "threads" throughout software. Simple fixes may affect other processes or actions by decision makers.

During the TF AWE, AFATDS operators lost precious time fixing or working around unexpected occurrences due to the late, untested software changes. Understandably, such occurrences tended to erode operator confidence in the system.

Just as in previous warfighting experiments, the first software lesson we "relearned" was that we must establish a "good-idea cut-off time" to allow the unit time to train with the exact system it will use to fight. In the 60 days preceding the DAWE, no software changes were issued to the unit. This enabled the unit to lock in its tactics, techniques and procedures (TTP) and build confidence in its ability to digitally execute fires with AFATDS. Given our plan for annual releases of new functionality, this software update scenario will occur many times in many units over the next several years as will the need to protect time for soldiers to train and build confidence in the new software.

As currently planned, AFATDS software will reach its objective state with the January 2002 software release. At that time, AFATDS will automate all 321 specified fire support tasks developed at the Field Artillery School and listed as baseline requirements (see Figure 2).

A second lesson learned is we need to expeditiously integrate many fixes identified by commanders into the software and get the software to units sooner. We are just beginning to do this through a promising new acquisition process known as "spiral development." Spiral development uses the Army experimentation process to shorten the acquisition cycle. This ensures that combat developers stay abreast of constantly changing computer hardware and software technology and the needs of units to responsively deliver the best possible capabilities at every opportunity.

Categories	Functions	Automated Tasks
Planning	1. Develop fire support planning guidance.	57
	2. Develop fire support plan.	37
	3. Determine FA commander's concept of the operation.	11
	4. Determine target acquisition support capability.	8
	5. Conduct meteorological operations.	3
	6. Coordinate survey support.	3
	7. Develop FA support plan.	12
Execution	8. Perform target processing.	22
	9. Perform fire support status reporting.	4
	10. Perform fire support attack system analysis.	19
	11. Perform target damage assessment requirement analysis.	3
	12. Develop order to fire.	5
	13. Perform target damage assessment reporting.	6
	14. Perform FA status reporting.	6
	15. Perform FA attack system analysis.	20
	16. Prepare fire order.	2
	17. Conduct FA sensor operations.	9
Movement Control	18. Perform FA movement control.	6
	19. Prepare FA movement request(s).	10
	20. Perform fire support movement coordination.	3
FA Mission Support	21. Perform FA supply control.	21
	22. Perform FA maintenance control.	6
	23. Perform FA personnel control.	2
Fire Direction	24. Determine fire unit capability.	16
	25. Perform fire mission processing.	27
	26. Perform fire mission status reporting.	3
		Total: 321

Figure 2: AFATDS Functions. Current AFATDS software automates 224 of the 321 fire support tasks that the objective system will automate by 2002. (Note: In addition to the 321 tasks, other emerging requirements will help define the objective system.)

For example, we'll include several of the functional improvements identified during the 1997 TF AWE in the March 1998 AFATDS software release—a turnaround time of just under a year. This period compares favorably with the previous AFATDS development cycle requiring several years to integrate the same capabilities. Using data from hands-on testing during the AWEs, combat developers now have the flexibility to greatly increase response time for some of the most troublesome software concerns of soldiers in the field.

However, spiral development is not a panacea for AFATDS' growth and developmental pains. We can't insert *all* newly identified functional improvements because adding requirements to the annual software "build plan" is essentially a zero-sum gain. As the AWEs help identify urgent needs for rapid assimilation into AFATDS software, we must delete or reprioritize the development of previously identified functions. Scheduling and budget constraints notwithstanding, the total number of required functions grows.

As we field AFATDS, commanders must make their software needs known to the TRADOC System Manager for AFATDS (TSM-AFATDS) in the Field Artillery School as early as possible for analysis, prioritization and developmental planning (beleyd@usafas.army.mil).

Training Lessons. In addition to the "training delta" associated with fielding new software versions, we learned many important AFATDS training lessons during the TF AWE. This article discusses two of the more significant ones: using intervention points (IPs) and sustaining digital proficiency.

With the advent of AFATDS, using IPs is a new capability. Based on AFATDS intervention rules, the fire support coordinator (FSCOORD) can ensure the fire support system responds rapidly to the maneuver commander's guidance. The intervention rules identify which fire missions require an operator's manual review (intervention) vice fire missions that automatically flow through AFATDS unimpeded directly to a delivery system. For example, the FSCOORD can limit IPs to link sensors directly to shooters.

An IP works as follows. When a mission that meets established intervention criteria enters the system, it stops and is presented to the operator in the AFATDS "Mission Monitor" window. The mission remains stopped until the operator manually processes it. IPs can be set by battle area (close, deep, rear), by mission type (fire-for-effect, immediate suppression, coordinated illumination, etc.), by target type and by attack option.

The TF AWE taught us that, although the IP is a useful tool, it requires solid digital communications and we must use it judiciously. Leaders, not just AFATDS operators, must understand the consequences of applying the intervention rules and their impact on responsive fire support.

The FSCOORD must select IPs consistent with the commander's intent for fires. This usually translates into getting the right munitions on the right target at the right time to influence the battle. Fire support leaders must find a balance between relinquishing total control of fires to the computer and centralizing control of fires (establishing too many IPs). Leaders must understand AFATDS commander's guidance functions to most effectively exploit IPs.

With training and time, units can reduce the number of IPs to a minimum. Like the 4th Infantry Division Artillery (Div Arty) did after the TF AWE, units must develop standing operating procedures (SOPs) and high-payoff target (HPT) and attack guidance matrices (AGMs) that articulate and promulgate the standard for the commander's guidance. The 4th Div Arty developed and trained to a common standard that included detailed fire support annex matrices that listed HPTs with weighting, attack system preferences, triggers, sensors, operational facility (OPFAC) IP nodes and remarks.

This detailed planning enhanced training and increased the entire division's awareness of AFATDS ability to increase fire support responsiveness. Additionally, it increased soldier confidence in AFATDS as a fire support command and control system.

The second training lesson is that it takes frequent, regular digital sustainment training to provide effective fire support on the battlefield. If this seems like a statement of the obvious, the news is that AFATDS units have more computer operators who must be sustained at a higher level of proficiency.

The DS battalion now has more digital devices than ever before. The number of artillery soldiers who perform their missions by sitting at a keyboard is also significantly larger. Additionally, fire support leaders now must look at, interpret and act based upon AFATDS screen displays. They no longer have the luxury of relying on a few experienced well-placed digital "experts." Every soldier, every leader, in every OPFAC-tactical operations center (TOCs), fire support teams (FISTs), FSEs and FDCs-must be AFATDS proficient.

The level of proficiency required of operators is significantly greater than in the past. To illustrate, TACFIRE automated 147 fire support tasks; AFATDS current software automates 224 tasks, and this number will increase with each software release until all 321 tasks are automated. More computer operators working with more functions call for more sustainment training-and always to standard.

Paradigm Shift. The old Paradigm: "The key to success in massing the battalion and focusing fires to support the brigade commander is a well-trained battalion FDC supported by well-trained FSEs." In the IFSAS or TACFIRE artillery battalion, the FDC was the center of gravity for planning and delivering fires. But in AFATDS-fielded units, the fire support officer's (FSO's) role expands to focus the artillery fight during both planning and execution.

The brigade FSO orchestrates the artillery battle using AFATDS fire support tools. Many activities and, more importantly, fire support decisions traditionally expected of the fire direction officer (FDO) become the FSO's. Decisions to modify attack guidance and priority of fires now can be made and implemented at the brigade FSE. New fires management tools, such as IPs, expand methods for the brigade FSCOORD to control and influence fires through the task force and brigade FSOs. This lesson has significant impact on selecting and training FSOs/FDOs and on manning the FSEs.

New Paradigm: "The keys to success in massing the battalion and focusing fires to support the brigade commander are well-trained brigade and battalion FSEs supported by a well-trained battalion FDC." This shift is not subtle in either focus or training. In AFATDS battalions, the FSE directs fires.

AFATDS gives fire supporters new tools to plan and execute fires. The lessons we learn today will apply on the digitized battlefield of the 21st century.

While the breadth and depth of automated fire support functions open new doors to FSCOORDs as they plan and execute fires, they also present new challenges as FSCOORDs prepare training plans. AFATDS is an extremely capable system. However, it requires a significant amount of collective training to reach the proficiency needed on the digitized battlefield.

Although AFATDS has broad implications for our concept of fire support and is challenging some of our fundamental ways of doing business, it's the next logical step in digitizing fire support. AFATDS is here-are you ready?

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For their contributions to this article, the author wishes to thank Colonel David P. Valcourt, Commander of the 4th Infantry Division (Mechanized) Artillery; Lieutenant Colonel Richard G. Cardillo, Jr., Commander of the 4th Battalion, 42d Field Artillery; and Major Brian T. Boyle, Brigade FSO–all players in the Task Force Advanced Warfighting Experiment (TF AWE).

Deep Battle and Interdiction

Twin Sons of Different Mothers

by Major Kevin M. Woods, AV

The modern American way of war is characterized by high-tech weapons systems, fast-paced execution, controlled violence and casualty avoidance. Recent trends in technology and doctrine at the strategic and operational levels of war are efforts to avoid the traditionally large casualty rates of the tactical level.

These realities coupled with a relentless pursuit of the technological "high-ground" focus attention on the doctrine of deep battle and interdiction. Current Army and Air Force doctrine and emerging joint doctrine disagree on the definition and purpose of attacking the enemy in the area bounded by the fire support coordination line (FSCL) and the outer limit of the land component commander's (LCC's) area of operations (AO).[1]

This article examines the services' doctrinal disagreement and the joint force commander's (JFC's) dilemma in determining who is responsible for deep battle and interdiction and, finally, offers recommendations for modifying existing and emerging joint doctrine.

Although I've limited my discussion to the Army and Air Force disagreement on deep battle and interdiction, the same issues exist for the Marines as part of a joint force land component (JFLC) or for the Navy when significant Air Force assets exist in a maritime theater. Additionally, this article limits the discussion to mid- to high-intensity battle. From a force integration perspective, clearly the challenges are more complex on a mechanized battlefield.

The Twins' Doctrinal Disagreement

Commanders normally seek to conduct operations to gain maximum advantage at minimum risk to their forces. For example, ground commanders stress counterfire and maneuver operations while air commanders stress strategic attack, counterair and interdiction; yet all seek to attack deep targets and enemy air defenses to provide maximum flexibility for their forces. Such operations are not always mutually supportive, especially when resources are scarce.[2] (Quoted from a recent article co-authored by the Chiefs of Staff of the Army and Air Force.)

The ongoing debate between the Army and Air Force over deep battle and interdiction doctrine is similar to a competition between twins. The services' doctrine are like twins because they share a common patriarch (joint doctrine) but, at the same time, are colored competitively by the service from which they were born.

Current service and joint doctrine has left the JFC in the position of making doctrinal decisions about deep battle and interdiction. Doctrine, both service and emerging joint doctrine, disagree on the definition and purpose of attacking the enemy beyond the FSCL but within the LCC's AO. The outcome of the debate will drive service doctrine development, have an impact on weapons system procurement and, possibly, determine the success or failure of the next war.

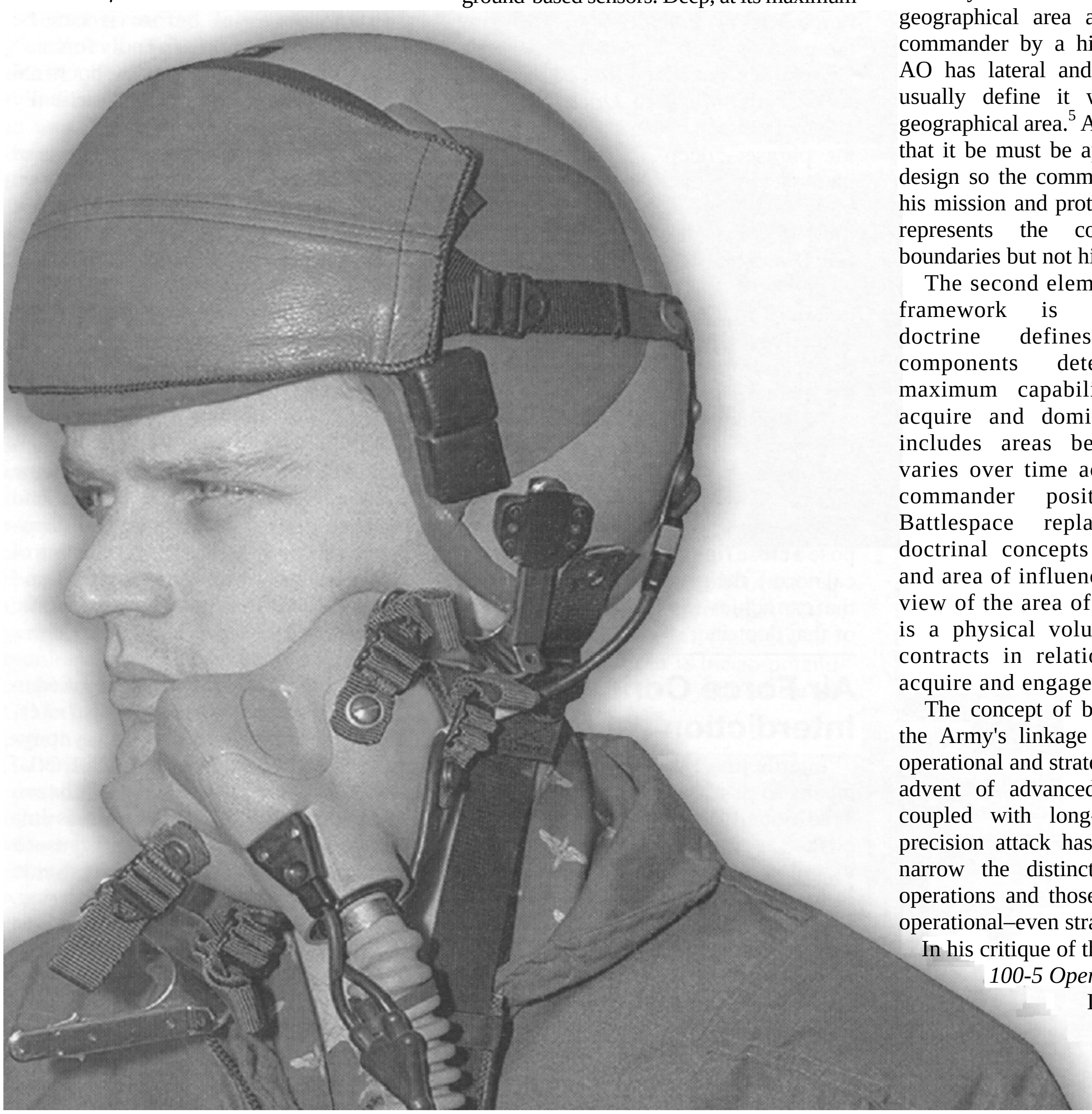
At its core, the debate is about primacy of doctrine. Air doctrine tends to emphasize the wide-ranging flexibility of power delivered from aircraft as the key ingredient in war. Land warfare doctrine usually assumes the ultimate need to exert some degree of control over the ground and tends to see air power as a useful, and at times even a necessary, supporting force in the performance of this ultimate mission.[3] The dilemma for the JFC is how to meld these sometimes divergent philosophies into a coherent joint operation.

The philosophical foundations of the disagreement can be understood by comparing the basic service doctrine of the Army (*FM 100-5 Operations)* and the Air Force (*AFM 1-1 Basic Aerospace Doctrine)*. The joint doctrine on this issue is predominately found in *Joint Pub 3-0 Doctrine for Joint Operations* and the third draft of *Joint Pub 3-03 Doctrine for Joint Interdiction Operations.* The lack of clear joint doctrine leaves the JFC in the position of establishing doctrine to execute an operation rather than executing an operation with established doctrine.

To begin with, I must define doctrinal terms. Doctrinally, "depth," "deep battle," "deep attack," "interdiction" and "air interdiction" are used interchangeably to the confusion of all.

Army Concept of Deep Battle

The dictionary defines "deep" as both a noun and adjective.[4] In practical military terms, the word "deep" refers to an area of the battlefield in relation to a friendly surface force. At its shallowest point, "deep" can be viewed as just outside the range of the surface force's organic direct fire weapons and ground-based sensors. Deep, at its maximum point, is normally defined as the outer boundary of an assigned AO.



When used as an adjective, "deep" describes the primary focus of the weapons effect or action. Deep weapons systems, for instance, focus on targets that ground-based direct fire weapons can't engage. Similarly, deep attacks refer to attacking enemy forces before they are within the range of ground-based direct fires.

However, deep battle is more than a mission or a range of systems; it's an integral part of the Army's framework for combat. Army doctrinal concepts for combat operations are organized in terms of a battlefield framework consisting of three elements; the AO, battlespace and operations in depth. Understanding the Army position of deep battle requires a basic understanding of the framework in which Army commanders view the battlefield.

Army doctrine defines an AO as a geographical area assigned to an Army commander by a higher commander—an AO has lateral and rear boundaries that usually define it within a larger joint geographical area.[5] A key facet of the AO is that it be must be appropriate in size and design so the commander can accomplish his mission and protect his force. The AO represents the commander's physical boundaries but not his limits.

The second element of the battlefield framework is battlespace. Army doctrine defines battlespace as components determined by the maximum capabilities of a unit to acquire and dominate the enemy; it includes areas beyond the AO and varies over time according to how the commander positions his assets.[6] Battlespace replaces the previous doctrinal concepts of area of interest and area of influence with an integrated view of the area of combat. Battlespace is a physical volume that expands or contracts in relation to the ability to acquire and engage the enemy.[7]

The concept of battlespace is a key in the Army's linkage between the tactical, operational and strategic levels of war. The advent of advanced acquisition systems coupled with long-range targeting and precision attack has enabled the LCC to narrow the distinction between tactical operations and those normally considered operational–even strategic.

In his critique of the 1993 version of *FM 100-5 Operations*, Major General Leonard D. Holder, Jr., Commander of the

3d Infantry Division (who also had been on the 1982 and 1986 FM 100-5 writing teams), wrote–

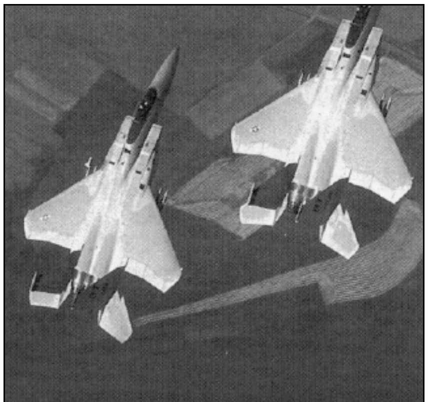
Its [FM 100-5] *addition of battlespace establishes a logical progression of operational areas from the theater of war to the theater of operations into the tactical realm. This adds consistency to our doctrinal view of physical divisions of the areas of combat. This is important because it stakes out Army interests in a contested area of joint and service doctrine. Without such an explanation, we would abandon a vital dimension of operations to air theorists who are inclined to limit the land offensive to the fight between committed forces and claim everything beyond the range of organic fires to the air commander's responsibility*.[8]

Battlespace does not represent a new set of restrictive boundaries. In fact, battlespaces may overlap, especially on a rapidly changing battlefield.

The final element of the battlefield framework is operations in depth. Operations in depth is defined as the totality of the commander's operations against the enemy—composed of deep, close and rear operations which are usually conducted simultaneously in a manner that appears as one continuous operation against the enemy.[9] The Army places enormous emphasis on depth and simultaneous attack as the key component of maintaining the initiative over an enemy. The application of depth and simultaneous attack blurs the boundaries among tactics, operations and strategy.[10] It is important to remember that operations in depth includes deep battle but is not synonymous with it.

The purpose of deep battle, when conducted simultaneously with close and rear, "is to deny the enemy freedom of action and to disrupt or destroy the coherence and tempo of operations."[11] Equally important to the purpose of deep battle is the range of options available to conduct it. Army doctrine identifies the following operations in support of deep battle: interdiction by ground and air maneuver and fires, either singly or in combination; deep surveillance and target acquisition; and command, control and communications countermeasures (C^3CM).[12] Deep battle includes interdiction as an element of firepower that, based on its intended effect, may constitute a significant element of a LCC's operational firepower.[13]

The Army concept of deep battle is central to its warfighting doctrine. The popular impression of an Army concerned about a battlefield defined by limited direct and indirect weapon ranges has dramatically changed during the past 10 years. For example, Major General Holder noted that in the 1986 version of *FM 100-5 Operations*, the concept of deep battle was limited with the phrase: "deep operations supplemented close operations; the tie was direct and unbreakable."[14] However, in the 1993 version of *FM 100-5 Operations*, deep battle's importance was elevated with the concept that "...commanders may pursue separate battle objectives by using deep and close combat operations, either of which may be the main effort."[15]



The Air Force's practical application of its tenet of centralized control of interdiction–not the definition of interdiction itself–is what causes friction with Army doctrine.

This view of the deep battle as a potential main effort is surprisingly in line with basic Air Force doctrine on interdiction. Although most references to deep battle in Army doctrine presuppose a close fight will occur (the historical norm), the concept that a deep battle that can achieve an objective is now part of that doctrine.

Air Force Concept of Interdiction

"Interdiction" is defined as a verb that means to destroy, cut off or damage.[16] Traditionally, interdiction is accomplished at ranges beyond the immediate vicinity of a ground force. The concept of immediate vicinity is relative to the force, terrain and weapon systems used.

Interdiction operations can have a strategic, operational or tactical impact, depending on their location and (or) effects. Just as the Army's concept of battlespace gives relevance to deep battle, the Air Force's basic roles of air power gives interdiction its relevance.

Air Force doctrine delineates four basic roles of air power: aerospace control, force application, force enhancement and force support. Aerospace control is universally accepted as the most important role of the Air Force. Force enhancement and force support are enabling roles that support the Air Force and the JFC across a wide spectrum of missions.

Within the role of force application there are three missions: strategic attack, interdiction and close air support. When viewed from a level-of-war perspective, interdiction falls naturally into the operational niche between strategic (strategic attack) and tactical (close air support).

Air Force doctrine defines "interdiction" as the application of force to delay, disrupt, divert or destroy an enemy's military potential before it can be brought to bear against friendly forces.[17] The Air Force, in the broadest doctrinal terms, views interdiction as practically synonymous with air power.

Underpinning the roles of air power are the seven tenets of aerospace power: centralized control with decentralized execution, flexibility and versatility, priority, synergy, balance, concentration and persistence. Interdiction reflects elements of all seven of these aerospace tenets.

The Air Force's practical application of its tenet of centralized control of interdiction–not the definition of interdiction itself–is what causes friction with Army doctrine. Air Force doctrine states that to achieve efficiencies and enhance effectiveness, the air component commander (ACC) should control all forces performing interdiction and integrate interdiction with surface force operations to achieve the theater commander's objectives.[18]

Then the question arises: As applied to the joint battlefield, are the terms "interdiction" and "air interdiction" synonymous? No–air interdiction is a subset of interdiction. The distinction between interdiction and air interdiction is important in a practical sense because it highlights the sometimes great divide between Army and Air Force doctrine. The Army views interdiction as a means to an end; the Air Force holds the view that interdiction can be an end in itself and operationally is usually synonymous with air interdiction.

One of the most important concepts in Air Force interdiction doctrine is the dilemma created for the enemy commander when interdiction is combined with surface maneuver. If the enemy attempts to counter surface maneuver (actual or potential) by massing or moving rapidly, he exposes himself to losses from air interdiction; if the enemy employs measures to reduce the losses caused by air interdiction, he loses or reduces his ability to maneuver fast enough to counter the maneuver of friendly surface forces.[19] Air Force doctrine promotes the concept that ground force maneuver can, and in some circumstances, should support the application of air interdiction.

Air Force doctrine states that air interdiction provides the JFC an important means for creating friction for an enemy whose surface forces are beyond the range of the *majority* of friendly surface weapons. The doctrine further states that because synchronization is usually vital to effectiveness, the theater commander should make the joint force air component commander (JFACC) responsible for controlling the overall interdiction effort when aerospace forces provide the preponderance of interdiction capability.[20]

Joint Doctrine

Clearly, the Army and Air Force have divergent views of the battlefield when it comes to deep battle and interdiction operations. The Army sees interdiction as a subset of the deep battle while the Air Force sees interdiction as a distinct theater-wide function best executed under centralized control.

The joint force commander's obvious solution is to refer to the *authoritative* joint doctrine. As stated in the Preface to *Joint Pub 3-0 Doctrine for Joint Operations*–

The guidance in this publication is authoritative; as such, this doctrine will be followed except when, in the judgment of the commander, exceptional circumstances dictate otherwise. If conflicts arise between the contents of this publication and the contents of service publications, this publication will take precedence...[21]

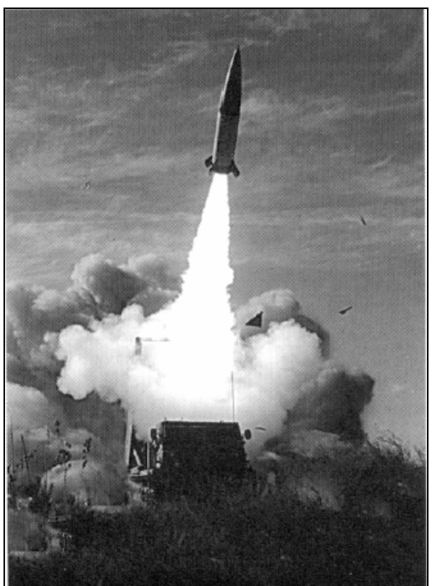
Each service is required to align its doctrine with joint doctrine where appropriate. In the debate over deep battle and interdiction, the Army and Air Force each has declared its doctrine is consistent with joint doctrine.

Joint Doctrine: Deep Battle. The term "deep battle" is not specifically defined in joint doctrine. A JFC's joint operations area (JOA) has several subordinate AOs, each with distinct boundaries and each with different baselines from which to measure "deep."

The concept of "depth" is discussed in joint doctrine as an operational characteristic.[22] Joint doctrine defines simultaneity and depth as bringing force to bear on the opponent's entire structure in a near simultaneous manner to overwhelm and cripple enemy capabilities and the enemy's will to resist.[23] The term "entire structure" is a physical description of space (close and rear), level of war (strategic, operational and tactical) or a combination of both.

Joint Pub 3-0 also describes depth as a concept that "seeks to overwhelm the enemy throughout the battle area from multiple dimensions, contributing to its speedy defeat or capitulation."[24] The term "multiple dimensions" refers to types of attacks (air, direct, indirect, lethal, nonlethal, etc.) or attacks across the strategic, operational and tactical levels of war.

Finally, depth is described in terms of using time and space to shape future conditions and contribute to the protection of the force by disrupting enemy potential before it can be utilized.[25] "Time" refers to attacking an enemy's decision cycle and removing the time required to plan and execute operations. "Space" refers to the physical space within a given AO or available for enemy use.



The Army views interdiction as a means to an end; the Air Force holds the view that interdiction can be an end in itself and operationally is usually synonymous with air interdiction.

Joint Doctrine: Interdiction. Interdiction is defined by joint doctrine as an action to divert, disrupt, delay or destroy the enemy's surface potential before it can be used effectively against friendly forces.[26] This definition, like the Air Force's, does not indicate a particular service or weapon system that is generally involved. Joint doctrine identifies interdiction-capable forces as including land- and sea-based fighter and attack aircraft and bombers; ships and submarines; conventional airborne, air assault or other ground maneuver forces; Special Operations Forces (SOF); amphibious raid forces; surface-to-surface, subsurface-to-surface and air-to-surface missiles, rockets, munitions and mines; artillery and naval gunfire; attack helicopters; electronic warfare (EW) systems; anti-satellite weapons; and space-based satellite systems or sensors.[27] Clearly, all contributors to the JFC's operation are potentially interdiction forces.

The interdiction dilemma faced by an enemy commander, as described in Air Force doctrine, is highlighted in joint doctrine as one of the most dynamic concepts available to the JFC.[28] The JFC may use the various combinations of forces described in combination with surface maneuver to achieve the desired objectives. The JFC is left to sort out the tradeoff and the tension between competing doctrine, based on the specific conditions of his theater. Joint doctrine also recognizes that, under certain circumstances, the JFC may choose interdiction as the principal means to achieve the intended objective.

The JFC's Dilemma

To coordinate and deconflict joint action, the JFC must determine the structure of the theater and organize the forces available. In a theater where functional component commanders are established, a key question for the JFC becomes: Who is responsible for deep battle and interdiction?

Air Force doctrine declares the JFACC is responsible for interdiction, based on clear doctrinal guidance from Joint Pub 3-0. The Army, also using Joint Pub 3-0 as a reference, sees the designated JFLCC as responsible for interdiction along with all other operations in the assigned AO. This kind of confusion hardly supports the concepts of unity of command and unity of effort. Keeping in mind the sometimes vague interpretation of interdiction versus air interdiction, the following *authoritative* statements of doctrine from Joint Pub 3-0 highlight the JFC's dilemma.

• "Land and naval force commanders designate the target priority, effects and timing of interdiction operations within their AOs."[29]

• "The JFACC will use these [apportionment decision] priorities to plan and execute the theater-wide interdiction effort."[30]

• "The JFACC is the supported commander for the JFC's overall air interdiction effort."[31]

• "JFCs may choose to employ interdiction as a principal means to achieve the intended objective with other components supporting the component leading the interdiction effort."[32]

• "Within the AOs [designated by the JFC], land and naval operational force commanders are the supported commanders and are responsible for the synchronization of maneuver, fires, and interdiction."[33]

The draft version of *Joint Pub 3-03 Doctrine for Joint Interdiction Operations* continues the vagueness about interdiction responsibility.

• Numerous subordinate commanders possess resources that can contribute to interdiction. However, since there rarely will be enough of those assets to meet all demands, a single commander can best ensure the unity of effort required to enable optimum use of joint interdiction assets.[34]

• Components supporting the overall theater interdiction effort or the joint effort as a whole may also conduct interdiction operations as part of their specific missions.[35]

So, who is responsible for interdiction? The only commander who clearly can claim the mission doctrinally is the JFC. The JFACC and the JFLCC can simultaneously claim responsibility as long as both are supporting or executing the JFC's interdiction priorities. Lacking an authoritative joint doctrine and considering the divergent service doctrine, the JFC must, as stated in the preface to Joint Pub 3-0, treat deep battle and interdiction as an "exceptional circumstance."

Sir Michael Howard, a military historian and prolific writer on doctrinal issues, made the following observations on doctrine:

First, that [doctrine] would always be wrong since it could never be based on a completely accurate prediction of combat conditions; second, that flexibility of mind and organization was the sine qua non *for military institutions in the opening phases of war; and third, that the standard for doctrine developers in peacetime was to be as little wrong as possible.*[36]

With an emphasis on being as "little wrong as possible," joint doctrine has left the doctrinal issues of deep battle and interdiction largely up to the JFC. The current state of joint and service doctrine on the subject of deep battle and interdiction leaves critical battlefield issues unresolved.

The reason the debate over deep battle and interdiction is so contentious is because it pits the fundamental Air Force tenets of centralized control and decentralized execution against the Army tenets of depth and synchronization. For the Army, its tenets represent basic truths. *FM 100-5 Operations* describes the tenets as characteristics of successful operations and as essential to victory.[37] The Air Force is equally dedicated to the tenets of aerospace power as described in *AFM 1-1 Basic Aerospace Doctrine*. The Air Force sees its tenets as important guidelines and considerations for commanders in addition to the principles of war. They (the tenets of aerospace power) highlight important ways aerospace forces differ from surface forces and reflect a specific understanding of the aerospace medium and current aerospace capabilities.[38]

Current joint doctrine pays homage to both services' concepts while providing no clear guidance to the JFC. The use of the joint targeting control board (JTCB), modifications to the purpose of the FSCL and joint precision interdiction initiatives are examples of accommodations to service doctrine without establishing authoritative joint doctrine.

Joint doctrine should establish principles that a JFC can apply to most situations in any theater. Joint doctrine established on a theater-by-theater basis is not authoritative and does not provide a common perspective. Theater-derived joint doctrine does not provide a framework adequate enough for acquiring and prioritizing new systems or determining which capabilities are critical for which missions.

Joint Pub 3-0 and draft Joint Pub 3-03's approaches to deep operations and interdiction doctrine has reached the point of not being doctrine at all–merely a series of disjointed compromises.

Fixing the Twins' Dilemma

Any recommendation for solving the deep battle/interdiction problem is unlikely to satisfy both services because the issue goes beyond basic doctrine into operational tenets. Additionally, the rapidity at which technology is changing the basis of long-held doctrinal norms makes selecting "best qualified" to accomplish the mission a temporary solution.

My three-part recommendation attempts to resolve the disconnects in joint doctrine and strike a doctrinal balance between the historical dominance of surface forces and the modern promise of air power.[14]

First, the services must establish truly authoritative joint doctrine that unambiguously defines the space and responsibility between the FSCL and the outer limit of the LCC's AO. Second, the services must define the space beyond the limits of the LCC's AO as the joint deep battle area (JDBA). Finally, we must broaden the terms used in joint doctrine to be more inclusive and representative of the forces available to the JFC.

1 Unambiguous Joint Doctrine

The confusion over who is responsible for operations between the FSCL and the outer limit of the LCC's AO should be eliminated. Theater responsibility for air interdiction should be defined as distinct from the LCC's deep battle, which includes elements of interdiction.

The Army and Air Force have no debate over the nature of the close battle and the requirement to maintain unity of command to achieve unity of effort. Likewise, the evolution of advanced systems is expanding the requirement to maintain unity of command over a greater battlespace to achieve objectives and protect the force.

2 Joint Deep Battle Area

Joint doctrine should designate a JDBA beyond the AOs assigned to surface commanders. The doctrine for operations within an LCC's AO should be clarified with respect to supported and supporting relationships. A single commander should be designated as the supported commander for the joint deep fight to ensure unity of command and to provide for unity of effort.

A JDBA would give the JFACC a theater focus at the operational to strategic levels of war while preserving the LCC's flexibility within his AO to conduct integrated operations at the tactical and operational levels. A new boundary is not necessary, just a simplification of guidance provided in Joint Pub 3-0 and Joint Pub 3-03. Current procedures for air apportionment and theater target priorities are adequate to support the needs of the land force without destroying the flexibility inherent in air power. The placement of the outer limit of the LCC's AO would be dependent on all the same factors used to delineate the FSCL: placement of enemy forces, anticipated rates of movement, weapons capabilities and tempo of operations.[39]

The JFC will have many variables to deal with in delineating the battlefield; placement of the FSCL–the definition of it–should not have to be one of them. The value of the FSCL is in its developing and synchronizing the LCC's operations, not the joint battlefield. As long as an LCC has the responsibility to achieve objectives within his AO, the need for measures, such as the FSCL, will exist. The placement of the outer boundary of the LCC's AO is a key factor in coordinating the JFC's operations and is a point of friction between the services. Separating the LCC's deep battle from the joint deep battle is the challenge facing the JFCs.

The concept of a joint deep battle beyond the LCC's AO supports the operational vision described in the Chairman of the Joint Chiefs of Staff's *Joint Vision 2010*. In Joint Vision 2010, the future of joint warfare will hinge on four operational tasks: dominate maneuver, precision engagement, full-dimensional protection and focused logistics—all enabled by information superiority.[40] Achieving the operational tasks of Joint Vision 2010 will require centralized control and decentralized execution across a defined battlespace. Functional solutions that take preeminence over integrated solutions will not take advantage of the emerging technologies and doctrines.

3 Broaden Joint Terms

Joint doctrine should readdress the use of the term "interdiction" to describe actions beyond the close battle. Interdiction has become narrowly defined in terms of subsequent actions and is too closely associated with only one service.

A more appropriate term and one that is more representative of the multidimensional systems involved is deep battle. The services' contribution to deep battle may include, for example, interdiction, air interdiction, deep maneuver, information warfare and precision interdiction. Deep battle doctrine would emphasize integrating the emerging system-of-systems across a battlespace to achieve tactical, operational and strategic objectives. Deep battle doctrine could be applied at either the operational or strategic levels of war. Assigning responsibility for deep battle execution would simplify the supported and supporting relationships because interdiction (all forms) are included in deep battle.

Just as twins cannot change the bonds of nature, the doctrine of the Army and Air Force are bound together on the joint battlefield. It is up to joint doctrine to provide the discipline necessary to work as a team-without the confusion of terms and doctrine that leaves the JFC to solve the dilemma as he goes into battle.

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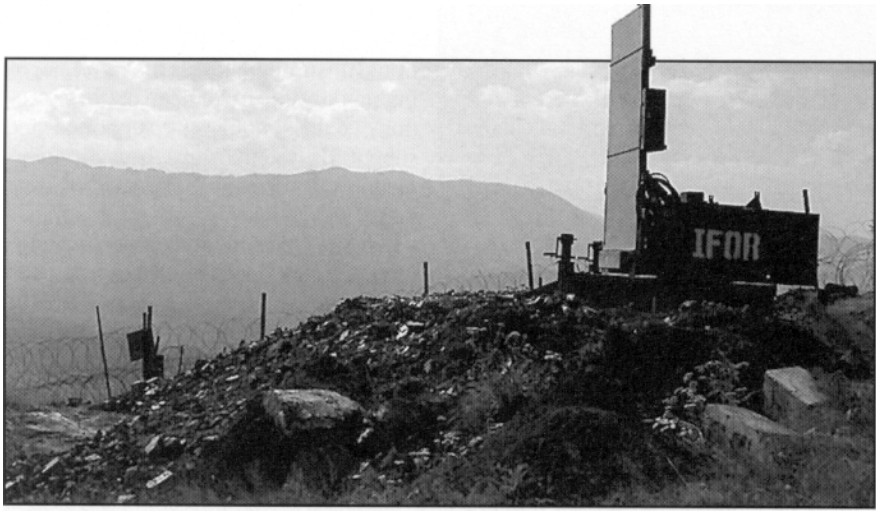
Notes:

1. The debate over deep battle and interdiction is only one of several emerging in the same area of the battlefield. The emerging joint doctrine for air and missile threats, theater missile defense, joint fire support and even command and control all have similar problems in Army and Air Force doctrine.
2. General Dennis J. Reimer, Chief of Staff of the Army, and General Ronald R. Fogleman, Chief of Staff of the Air Force, "Joint Warfare and the Army-Air Force Team," *Joint Forces Quarterly* (Spring 1996), 11.
3. Harold R. Winton, "Reflections on the Air Force's New Manual," *Military Review* (November 1992), 29.
4. *The Merriam Webster Dictionary* (Springfield, MA: Merriam-Webster, Inc., 1994), 202.
5. *FM 100-5 Operations* (Washington, DC: Department of the Army, June 1993), Glossary 0.
6. Ibid., Glossary 1.
7. Ibid., 6-12.
8. Major General Leonard D. Holder Jr., USA, "Offensive Tactical Operations," *Military Review* (December 1993), 51.
9. *FM 100-5*, Glossary 6.
10. *FM 100-7 Decisive Force:* "The Army in Theater Operations" (Washington, DC: Department of the Army, May 1995), 1-8.
11. *FM 100-5*, 7-13
12. Ibid.
13. *Joint Pub 1-02*, 16.
14. Holder, 51.
15. *FM 100-5*, 7-12.
16. *The Merriam Webster Dictionary*, 391.
17. *AFM 1-1, Vol. I, Basic Aerospace Doctrine of the United States Air Force* (Washington DC: Headquarters Department of the Air Force, 1992), 6.
18. Ibid., 12.
19. *AFM 1-1, Vol. II, Basic Aerospace Doctrine of the United States Air Force* (Washington DC: Headquarters Department of the Air Force, 1992), 164.
20. Ibid.
21. *Joint Publication 3-0 Doctrine for Joint Operations*, (Washington DC: US Department of Defense, 1 February 1995), i.
22. Ibid., xi-xii, Other operational characteristics include: synergy, anticipation, balance, leverage, timing and temp, operational reach and approach, forces and functions, arranging operations, centers of gravity, direct versus indirect, decisive points, culmination and termination.
23. Ibid., xi.
24. Ibid., III-12.
25. Ibid.
26. *Joint Publication 1-02 Dictionary of Military and Associated Terms*, (Washington DC: US Department of Defense, 23 March 1994), 192.
27. *Joint Pub 3-0*, IV-11.
28. Ibid., IV-13.
29. Ibid., xiii.
30. Ibid.
31. Ibid., IV-11.
32. Ibid., IV-14
33. Ibid., IV-15
34. *Joint Publication 3-03 Doctrine for Joint Interdiction Operations* (Third Draft), (Washington DC: US Department of Defense, 28 November 1994), IV-3
35. Ibid.
36. Sir Michael Howard, quoted in Harold R. Winton's "Reflections on the Air Force's New Manual," *Military Review* (November, 1992), 20.
37. *FM 100-7*, 2-6.
38. *AFM 1-1, Vol. I, 8*.
39. *Joint Pub 3-0*, III-34.
40. Major General Charles D. Link, USAF, "21st Century Armed Forces-Joint Vision 2010," *Joint Forces Quarterly,* (Autumn 1996), 70.



Firefinder Radars:

Eliminating Unwanted Targets in Low-Intensity Conflict

by Sergeant First Class Scott E. Rogers

"Red Rain, Red Rain!" This is the code alerting the battalion tactical operations center (TOC) that the Q-36 radar covering Brcko, Bosnia, had received an acquisition. The FA TOC begins the counterfire battle drill to engage and destroy the offending enemy weapons system.[1] The enemy systems are highly mobile; time is of the essence.

Clearance is given to fire and the cannons fire at...what? Is it a family out for a Sunday drive in their automobile? A US Army helicopter conducting a routine patrol? A wedding party on the Sava River? Or is it a mortar firing on an opposing faction or NATO force or facility?

When I deployed with C Battery, 333d Field Artillery (Target Acquisition), 1st Armored Division Artillery, to Bosnia in December 1995 for Operation Joint Endeavor, the battery faced this situation every day and several thousand times over the course of 10 months. The question was: In low-intensity conflict or stability operations, how can a target analyst determine whether a Firefinder radar has generated a valid target or an invalid, unwanted one? Correctly answering that question means we can engage a valid target in a timely manner, protect the force, prevent collateral damage and fratricide and maintain the peace.

The fact is that the Firefinder radar has a propensity to track "unwanted" targets.[2] These are acquisitions that are not artillery, mortar or rocket rounds. During a stability operations training exercise in mid-1997 at the Combat Maneuver Training Center (CMTC) in Hohenfels, Germany, radar acquisitions were treated as clear-cut events. Yet experience has shown that there's a high degree of ambiguity with each acquisition obtained in an environment where the radar is either radiating continuously or there are a large number of moving objects (a city, aircraft, airfield or road). In such an environment, the number of unwanted acquisitions may be so high as to necessitate the unit's changing the target selection standards matrix to make radar acquisitions non-targets without independent confirmation by another source. The problem, then, is to develop a method to determine, initially, the credibility and, eventually, the validity of a Firefinder radar-produced acquisition.

In Bosnia, we developed the target processing battle drill for low-intensity conflict to help determine the credibility of radar acquisitions. The procedures are not a clearance of fires drill but the initial stages of one. These procedures help the battle captain responsible for determining the acquisitions' credibility and initiating the clearance of fires drill; target production section; and S2 section determine which acquisitions to just record and watch and which to pursue.

A "credible" acquisition is one that all the evidence points to as being a mortar, artillery or rocket round. This doesn't mean the acquisition has been confirmed as such, but that it has a high probability of being confirmed as such and needs to be pursued rapidly. If additional confirmation is received, the acquisition becomes a valid target and is handled according to the rules of engagement (ROE). Otherwise, the acquisition is logged and observed.

Target Processing Battle Drill

The first step in the target analysis process is to receive the acquisition (see the flow chart in Figure 1). All operations are digital using the initial fire support automated system (IFSAS). The

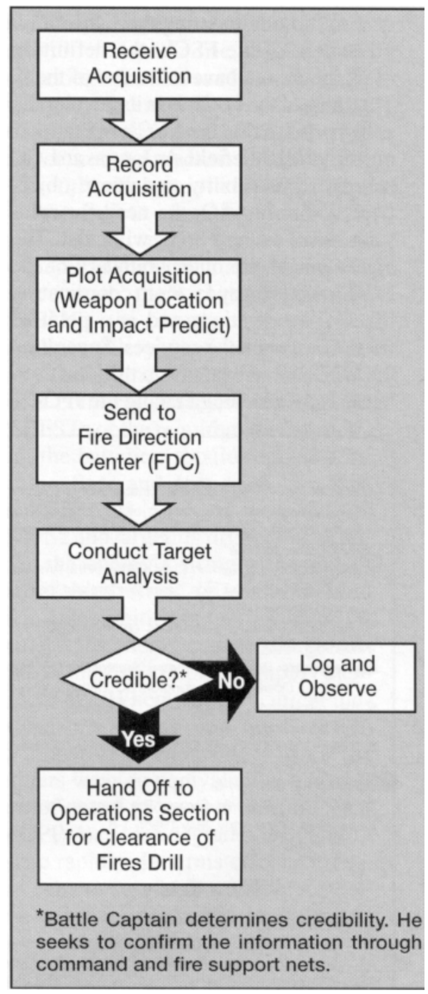


Figure 1: Target Processing Battle Drill (Low Intensity)

advantage of IFSAS is that it makes the procedure accurate (no recording errors), fast and automatic; the data can be transferred automatically to interested parties using message of interest (MOI) files. The acquisitions are in the ATI;CDR format because it has all the data required: weapons location, impact predict and predicted target type. The IFSAS operator yells "Red Rain!" to alert the TOC to a new acquisition.

The next step is to record the acquisition. It's recorded both on the computer line printer and the target acquisition log. The TA log gives the acquisition's date-time group, a "target" number, weapons location, impact grid, type of round, type of radar, unit acquiring the potential target and any special remarks.

Next, the acquisition is plotted on the map. We use a system of colored adhesive dots instead of target symbols. The dots are color coded according to the time the acquisition was received. This gives us the ability to see an emerging pattern. Conventional target symbols tend to blend in with map markings and are difficult to see from a distance.

The weapons location is plotted using the appropriate colored dot. Then the impact prediction is plotted using a black dot. The two dots are connected with a line using a black pen and the target number written on top of the line.

Next, the IFSAS operator toggles the "Record as Target" selection and enters the acquisition. The computer then automatically enters the acquisition into its target file and begins sending it to other subscribers according to the MOI setup. The MOI system is very flexible and can be tailored to send the data only to those who have an interest in it. At this point, target analysis begins (see Figure 2).

Target analysis is a joint effort between the battle captain, target production section, S2 section and maneuver fire support elements (FSEs). Target acquisition and counterfire is a combined arms process and includes input from *every* soldier in the area of operations (AO) who has any knowledge of a firing incident. All soldiers contribute to the determination of acquisition credibility. Shelling reports (Shelreps) are essential.

The first thing to look at in analyzing the target is whether or not the acquisition makes sense in terms of the current military and political situation in the AO. Have there been reports of riots, demonstrations, snipers or other tensions in the area from which the acquisition originated or where the round impacted? Is a US facility or troops in the vicinity of the impact or a disaffected faction in the vicinity of the weapons location? If an acquisition plots as going from a sparsely occupied area to another sparsely or unoccupied area, the credibility is lowered. If, on the other hand, it goes from an area with a disaffected group to an area of high tensions, then credibility is enhanced. The battle captain immediately seeks confirmation over the various radio nets.

Another factor to look at is whether or not the acquisitions are "unwanted." These are often incorrectly labeled "false" acquisitions. They are not false because, in each case, the radar actually did track a moving object.

Most unwanted acquisitions can quickly and reasonably be ruled out. But caution is in order. An acquisition that looks unwanted could turn out to be a real target and deadly. A detailed knowledge of the mission, enemy, terrain, troops and time available (METT-T) in the AO is essential to help determine if the acquisition is unwanted or valid. Unwanted acquisitions fall into four general categories: aircraft, side lobe, unknown and small arms.

Aircraft Acquisitions. In determining whether an acquisition is an aircraft, the target analyst must know flight operations in the area. During the initial stages of Operation Joint Endeavor in January 1996, the battery tracked a lot of acquisitions over high power lines. We quickly learned that due to the low cloud deck, aircraft were following the power lines and using them as navigational aids. As the weather improved, these type of acquisitions declined. We also picked up our own jet aircraft as they circled Joint Military Commission meetings as a "show of force."

A good example of the anxiety an acquisition can create is when we received an acquisition that originated from near a faction weapons storage site. Everything made sense about the acquisition. The weapons location was near the weapons storage site where the type of weapon the radar predicted was stored. The impact was near a sensitive town. The weapons range fit the weapons type. The target analyst determined the acquisition was credible, and the brigade headquarters began trying to confirm the target. After an anxious half hour, the brigade confirmed the acquisition was one of our helicopters hovering over the site of a NATO inspection. With this example, one can see how ambiguous these type of acquisitions can be.

Side Lobe Acquisitions. These are usually within about 2,000 meters of the radar. The Firefinder radar was designed for use with a screening crest and tunneling. Not all radar energy is focused into the main beam; some "leaks" out the sides, bottom and top. By having a slight rise in front of the radar (a screening crest) and buildings or woods to the side of it (tunneling), this stray radiation is deflected or absorbed and a negligible amount returns to the radar.

If there is no screening crest and a large, solid object passes in front of the radar (like an automobile) within about

1. The impact of the acquisition–
   - Is in or across the zone of separation (ZOS)?
   - Affects friendly troops?
   - Affects non-governmental agencies (NGOs) or protected civilians?
2. Type of acquisition is–
   - Aircraft? Check for flight operations in known air corridors.
   - Side-lobe? Acquired on road within 2,000 meters.
   - Small-Arms? Acquisitions came from a similar/same weapon location with scattered impact.
3. Confirmed credible or non-credible by–
   - Explosions, reports of impact or firing.
   - Observer sees firing or impacts.
   - Weapons characteristics (range) or target make/do not make sense.
   - Friendly unit receives incoming.
   - Acquisition coming from known weapons location/storage site.
   - Similar/same weapon location/impact predict by multiple radars.
   - Report of friendly unit firing.

Figure 2: Target Analysis Process. The target production section coordinates target analysis with the battle captain and S2. The target analyst determines the credibility of the acquisition as a target, based on the criteria listed in this figure.

2,000 meters, the radar will receive a large enough return from the side lobe for the radar computer to confuse it with the main beam and then track it and generate an acquisition. The indicator for a side lobe acquisition is the relatively short range to the weapons location, the fact that the target is on or near a road and, usually, the distance between the weapons location and the impact is short. Acquisitions of this type will tend to be received repeatedly.

This type of acquisition can be significantly reduced by extending the minimum range of the Q-36 radar beyond 2,000 meters. This should only be done if the area the radar no longer covers can be observed by other means. (The Q-37's minimum range is 3,000 meters.)

Unknown Acquisitions. Some acquisitions just don't make sense. There are a lot of moving objects out there. The Firefinder radar is a powerful device that sees almost everything in the air the size of a .50-caliber bullet or larger. When it radiates continuously, it has to make millions of decisions about moving objects every hour.

Occasionally, the radar gives an incorrect solution. This happens in areas with a lot of movement, such as cities like Sarajevo. These are frustrating acquisitions because there's no explanation for them. The best the battle captain can do is attempt to determine that no firing event took place by querying units in the AO by radio or requesting a patrol visit the impact site.

Small Arms Acquisitions. Small arms are the last type of unwanted acquisitions. They are actually desirable to obtain as this is useful information; local celebratory or undisciplined small arms firing is very dangerous. During Operation Joint Endeavor, a small child in Odzak was wounded by celebratory firing originating in Croatia.

A small arms acquisition is characterized by the weapons locations grids' being identical or very close together. The impacts will be widely scattered. This becomes obvious very quickly.

Midnight on New Year's Eve of December 1995 in Croatia prompted a huge roar of celebratory gun fire, and thousands of tracers crossed the sky. Another example was in Brcko along the Sava River where a wedding occurs almost every Saturday night, prompting celebratory small arms fire.

In determining the credibility of an acquisition, the target analyst looks at the context of the acquisition and if it can reasonably be ruled out as unwanted. If it cannot be ruled out, the battle captain uses his radio nets to seek confirmation. He determines if there have been any reports of explosions, firing or impacts. Have there been any observer reports of muzzle flashes or flashes from impacts? Is any element receiving incoming fires? Has a friendly unit fired? To battle track friendly unit locations and activities censor zones should surround friendly firing units, where feasible.

While the battle captain is seeking confirmation, the target analyst may have further indication as to whether or not the target is valid by the pattern of the weapons location and the impact predict. Because indirect fire weapons are relatively heavy, the weapons location should remain the same for at least a couple of volleys. The impact predicts also should be relatively close together if multiple volleys are fired at the same target. If two radars independently obtain the same data, the acquisition is most likely credible. However, a couple of people driving a light truck with a small mortar in the back could be dismissed as a side lobe acquisition.

The battle captain takes all the data available about an acquisition to determine its credibility. Obviously, if an acquisition and an "eyes-on" observer report are received at the same time, credibility and validity are established. The clearance-of-fires drill can then begin. If confirmation is not received but the battle captain still deems the acquisition to be credible based on other evidence, then outside agencies must be called upon to obtain confirmation before the clearance-of-fires drill begins. If the battle captain determines the acquisition isn't credible, then a notation is made on the staff duty log and the TA log as to the reason it lacks credibility. The area from which the acquisition was tracked then remains under observation for confirming data.

Conclusion

After hundreds of unwanted acquisitions, a real one can get lost in the clutter. Additional data must continually be sought to verify an acquisition's credibility and validity. TOC personnel can't become complacent about acquisitions even after several hundred false alarms. Each type of unwanted acquisition can mimic the characteristics of a valid one, so every acquisition must be treated with thoroughness.

In the future, FA units will deploy with Firefinder radars in low-intensity conflict and stability operations scenarios. Soldiers assigned as counterfire officers; radar operators; targeting officers, NCOs and specialists; intelligence officers and analysts; and TOC battle captains must understand how to analyze Firefinder radar acquisitions rapidly.[3] When an acquisition is valid, the battle captain must initiate the clearance-of-fires process to protect the force and stop enemy fires. Using these procedures, Firefinder will remain a powerful tool for the commander.

Sergeant First Class Scott E. Rogers has been the Section Chief and Senior Targeting NCO for C Battery, 25th Field Artillery (Target Acquisition) (formerly, C Battery, 333d Field Artillery), 1st Armored Division in Germany for more than four years. During that time, he served in Bosnia in Operation Joint Endeavor for 10 months and processed hundreds of Firefinder radar acquisitions. He has participated in two Battle Command Training Program Warfighter Exercises with the 1st Armored Division. In other assignments, Sergeant Rogers was a Gold Badge Recruiter with the US Army Recruiting Battalion Sacramento in California for three years and as a Company Fire Support Sergeant with the 4th Battalion, 1st Field Artillery, part of the 5th Infantry Division (Mechanized), Fort Polk, Louisiana. He's a Distinguished Honor Graduate of both the Basic and Advanced NCO Courses at Fort Sill, Oklahoma.

Notes:

1. For an excellent method of clearing targets in low-intensity conflict, see the article "Put Out the Fire: Countering Mortars in Operations Other than War," by Captain Keith R. Yoder and Chief Warrant Officer Four Luke M. Thompson, *Field Artillery,* February 1995.
2. For a description of this problem, see the articles "False Targets: Mirages in the Desert," by Captain Michael D. Farris and First Lieutenant Peter A. Catanese; "Mirages in the Desert: Opportunity Knocking," by Major John Dornstadter, Captain Maurice E. Posmanick and Major David M. Patterson, both in the February 1992 *Field Artillery*; and the letter-to-the-editor "TA Successes and Challenges in Bosnia," by Second Lieutenant Richard Brunner and Sergeant First Class Scott E. Rogers in the May-June 1996 *Field Artillery.*
3. The article "Red Rain-Counterfire Operations in Bosnia-Herzegovina" by Captains Brian T. Hodges and Jay W. Hallam and Major Brian T. Camperson in the September-October 1996 *Field Artillery* also explains a target processing battle drill and procedures for determining if a Firefinder radar acquisition is valid.

The Scud Battery

An Inside Look at the Threat

During the April 1997 Exercise Roving Sands, I had the unusual opportunity to command a Scud Battery in northern New Mexico. Roving Sands is an annual joint and combined training exercise for theater-level tactical air operations, air defense and missile defense, the latter conducted under the auspices of Central Command (CENTCOM).

The Army bought 29 Scud launchers through the foreign military sales program to use to improve the US military's theater missile defense capabilities. This ongoing research and training was motivated by Iraq's Scud missile attacks during the Persian Gulf War.

Artillerymen from the 1st Battalion, 12th Field Artillery, (Multiple-Launch Rocket System), 17th Field Artillery Brigade, Fort Sill, Oklahoma, operated six of these Scud launchers for four weeks as members of the Roving Sands opposing force (OPFOR). The battalion organized the Scud launchers into three batteries of two Scuds each-I commanded one of them for 10 days and a Service Battery with six ZIL-131 support trucks for the remaining two weeks of the exercise. (The ZIL-131 is the old Soviet version of the Army five-ton truck.) This article is about our potential enemies' deep strike Scud batteries and how they function day-to-day.

Scud Launchers. The Scud is an area fire munition, not a precision weapon. Its launchers, called transporter-erector-launchers (TELs), are slow, bulkier than MLRS launchers and wheeled rather than tracked. Although the TELs are highly mobile and fairly easy to hide, their wheeled feature limits their trafficability.

The cab accommodates a crew of four, each sitting in a separate compartment with dividers. Thus, crew members must use radio headsets to talk to each other inside a moving Scud, which uses a loud diesel engine. The four compartments are more cramped than the area for the MLRS crew.

The Scud requires a lot more time to launch than a missile from an MLRS launcher-about 45 minutes to one hour as compared to just a few minutes for a skilled MLRS crew of three. The MLRS can "shoot and scoot," but the Scud launcher must pull into position, raise the missile, shoot, lower the missile and then scoot. (We never actually fired a missile during Roving Sands; we simulated launches or dry fired.)

Even though the Scud launcher is wheeled, its inferior engine, transmission and aerodynamics make its road speed comparable to the MLRS (a maximum speed of about 40 kilometers per hour). The Scud launcher's overland speed is generally slower then the MLRS launcher, depending on the roughness of the terrain.

We used desert camouflage nets to hide the Scud in the stark New Mexico landscape. The Scud launchers easily could be hidden in terrain with more vegetation, such as that used in training at Fort Sill. Like an MLRS launcher, the Scud launcher can be backed into a tree line and hidden from radar and aircraft.

Our battalion's six Scud launchers had more mechanical problems than our MLRS launchers. These problems ranged from transmission troubles to exhaust systems blowing out sparks and starting grass fires. (The latter was easily corrected with makeshift spark arresters.) In contrast, the hydraulics for raising and lowering the Scud were reliable and rarely broke down.

It's possible that the Soviet-made Scud launchers bought through foreign military sales were old and neglected after the end of the Cold War–our American mechanics constantly had to work on them. Although our Scud launchers rarely broke down completely, they had far too many routine mechanical problems.

ZIL-131 Support Trucks. My experience with the ZILs was similar: they were slow and bulky and had lots of mechanical difficulties.

The ZILs were supposed to have a maximum speed of around 50 to 60 kilometers per hour. But in practice, the average maximum speed was 30 to 40 kilometers per hour. My best-running ZIL reached a speed of 55 kilometers per hour on the blacktop–once. The other five typically puttered along at about 30 to 35 kilometers per hour. The ZILs use leaded gasoline (old "regular gas").

The ZILs were not only slow, but also broke down routinely, even without hauling a payload. On any given day, we had at least one ZIL out of action. The unreliability of the Russian ZIL would certainly have an impact on Scud battery resupply.

Conclusion. After Roving Sands, many of our soldiers felt better prepared to fight an enemy equipped with Scuds and ZILs. The old adage of "Know your enemy" certainly applies, and it is comforting to know the Scud launcher and its support vehicle are inferior.

Of course, regardless of how slow and unreliable the system is, once fired, Scud missiles can be very deadly. A look at the threat "from the inside" is instructive.

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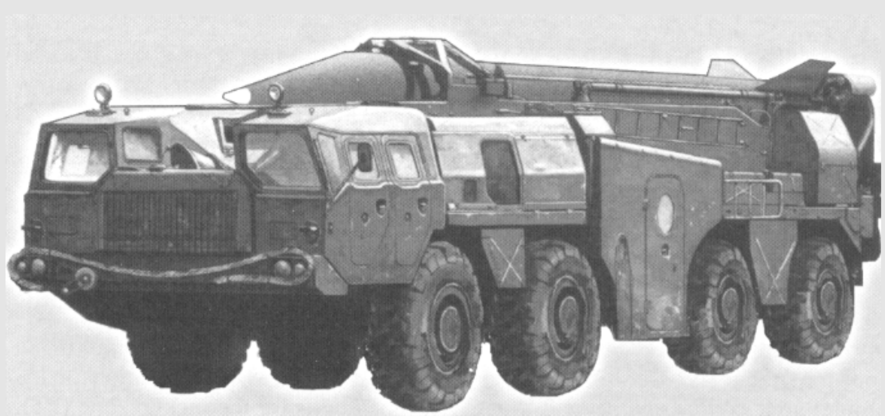

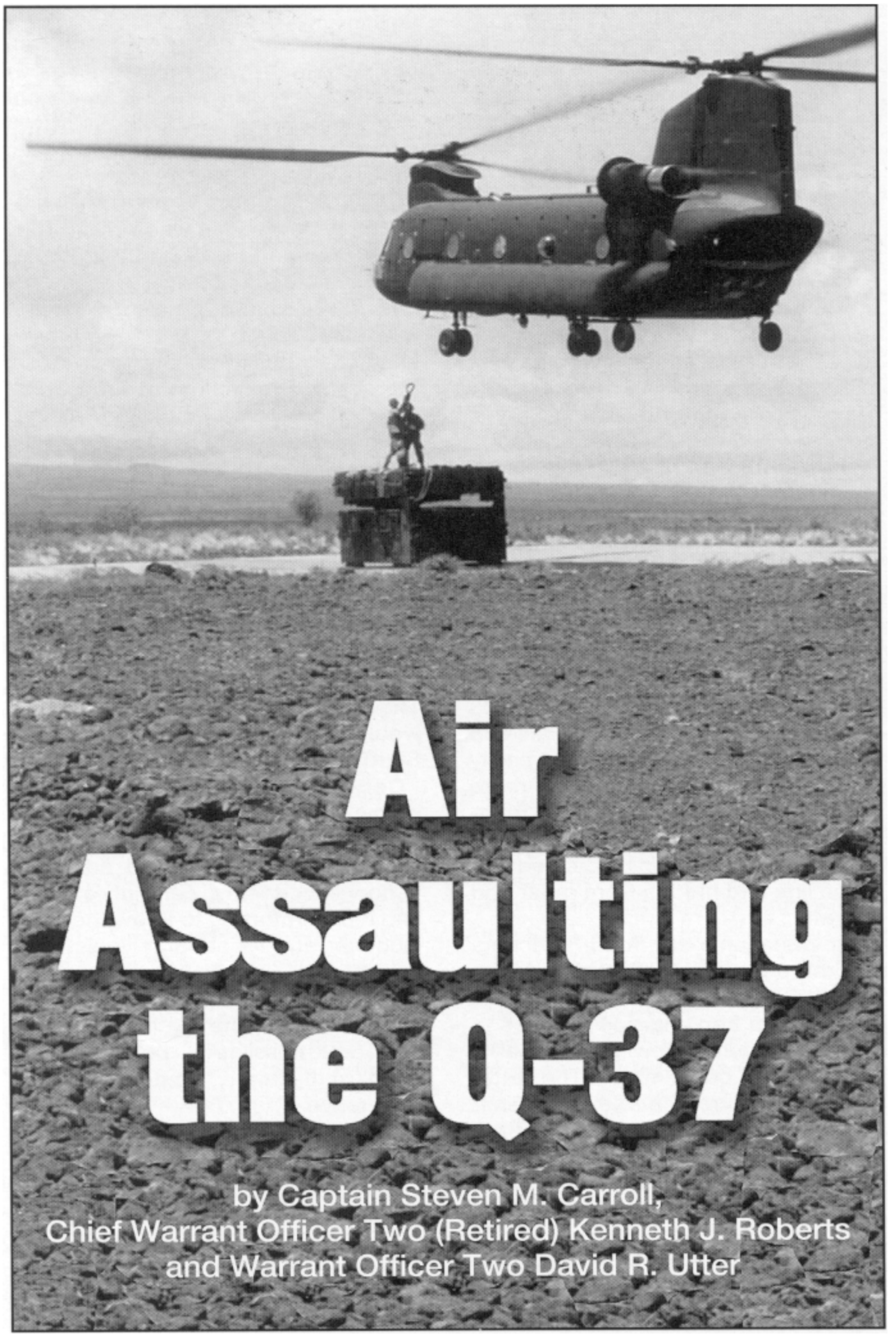

Air Assaulting the Q-37

by Captain Steven M. Carroll,
Chief Warrant Officer Two (Retired) Kenneth J. Roberts
and Warrant Officer Two David R. Utter

In October 1996, the 25th Field Artillery Detachment (25th FAD), Schofield Barracks, Hawaii, air assaulted an AN/TPQ-37 radar section to a remote hilltop in the Koolau Mountain Range on the Island of Oahu. We emplaced and sustained our Q-37 Firefinder radar for 72 continuous hours.

The purpose of the exercise was to prove the system can be air assaulted to any location that meets the specifications for a radar site. Our rationale was simple: after conducting several War-fighter Exercises with the 25th Infantry Division (Light) Artillery, we realized that mountainous terrain offered few locations that optimize the Q-37's counterfire capabilities. Lack of adequate main supply routes (MSRs), congested roads and fast-moving operations demand radar positioning flexibility that air assault operations can provide. So, we set out to test methods of air assaulting the system.

This article discusses how we rigged the Q-37 for air assault operations, made preparations for the pickup zone (PZ), emplaced the radar at the landing zone (LZ), selected and prepared the LZ and conducted continuous operations after the radar was positioned.

Rigging the Radar. There were several disadvantages in the single-point hookup as prescribed in *FM 55-450-1 Army Helicopter External Load Operations*. Our primary concern was the advised limited air speed of 90 knots. Lower speeds create a higher risk from enemy air defense artillery (ADA) and limit the methods of flight available to aircraft pilots.

Using the single-point hookup, the antenna load was unstable, continually pivoting and oscillating, which proved quite labor-intensive for the pilots. The pilots found it difficult to position the equipment on the LZ properly; once the load was on the ground, the radar section had to "live with" the radar's position. (The radar crew normally prefers to have the antenna positioned on an azimuth line as it is emplaced so the crew can quickly site in on the far stake). Tactically, it wasn't feasible to hover and then stabilize and orient the load in the desired direction due to the time and risk involved. The dual-point hookup solved these problems.

There are several additional materials and procedural changes required with a dual-point hookup of the antenna-transceiver group (ATG). An additional 25,000-pound apex is required with the 25,000-pound sling set along with two 4 x 8-foot sheets of three-quarter-inch plywood and six air assault ratchet straps. We also use two 25,000-pound reach pendants as required by the 25th Division Air Assault standing operating procedure (SOP).

The antenna transport cover is removed and stowed in the antenna well to preclude the cover from tearing away when the aircraft reaches speeds in excess of 100 knots. Plywood placed on the face of the antenna (secured with a minimum of three ratchet straps for each sheet of wood) protects the antenna face from damage during hookup and sling release operations. The antenna tie-down bolt ratchet handles should be rotated to face out from the trailer to prevent them from being damaged or interfering with the sling legs. The link count for Rear Sling Legs 3 and 4 changes from 5 to 15 in the grab-hook while the link count of 68 remains for Front Sling Legs 1 and 2.

Because the antenna transport cover is not used, all vents and panels must be secured by permanent cord or tape. To prevent damage to the beam steering unit (BSU) when the reach pendant is released by the crew chief, sandbags are secured over the BSU with strong ("100-mile-per-hour") tape. However, the best way to avoid damage to the BSU and antenna face during sling load cutaway is to instruct the air crew to move to either side of the load before releasing the slings.

These dual-point procedures for the Q-37 radar were certified by the Mobility Directorate, Systems Integration Branch, US Army Soldier Systems Command of the Natick Research, Development and Engineering Center, Natick, Massachusetts, on 1 January 1997.

The dual-point hookup stabilizes the load in flight, increases the airspeed to speeds in excess of 130 knots, reduces flight control work for the pilots and allows the aircraft to fly tactical "nap of the earth" and contour. Additionally, it facilitates positional control. The pilot hovers, pivots to establish positional control, sets the load down and clears the area quickly. We used one CH-47 helicopter to make four lifts for the entire operation; the advance party, ATG, S250 shelter and the 60-kilowatt-generator each was a single lift.

PZ Preparations. Shelter preparation by current methodologies requires nearly an hour on the PZ. To reduce time and eliminate the need for a crane to lift the ATG off the Eidal trailer, we examined the feasibility of lifting the antenna directly off its trailer with the aircraft.

We identified three key elements to lifting the ATG off the Eidal trailer via the helicopter. First the crew must ensure the shims are flush to the trailer and the ATG jacks are completely stowed. Second, the aircraft should lift the load straight up a minimum of two feet before flying forward to ensure the ATG does not drag across the Eidal trailer. (Fortunately, the aircraft naturally centers itself above the ATG as it takes on its weight.) Finally, the crew must ensure a crane or a 10-ton forklift (utilized by attaching sling legs to the forks) is available to restore the antenna to the Eidal trailer as its placement must be precise.

The lift was a complete success. Time on the PZ was reduced. The crew only had to stage, disconnect and prepare the trailer for separation. Rigging can be performed in a secure area such as the last radar site or a tactical assembly area (TAA) before moving to the PZ.

However, thorough preventive maintenance checks and services (PMCS) must be conducted on the ATG jacks to ensure they are in working order. Additionally, the spirit levels on the ATG must be aligned and operable (leveling the antenna is no longer done with the Eidal trailer transport jacks but with the ATG jacks).

LZ Emplacement. There is no certified dual-point hookup for either the shelter or the generator. In our emplacement, we prefer the S250 shelter positioned with the door facing the antenna, and the generator emplaced so the exhaust faces away from the enemy (see Figure 1).

To achieve this alignment, we made an arrow with masking tape on the top of each piece of equipment and informed the air crew of their positioning on the LZ. In lieu of masking tape arrows, we used infrared chemlites during night operations. They worked perfectly.

LZ Selection and Preparation. The technician must rely heavily on his map and aerial analysis skills and, once on the ground with the advance party team and force protection assets, select the best possible site to accomplish the mission. Several sites should be identified in case the primary location is untenable. Once the technician marks the actual ground location, the rest of the equipment is marked in accordance with the air mission briefing diagram shown in Figure 1.

The advance party establishes a far stake and obtains directional control by either the Hasty Astro program with the back-up computer system (BUCS) or a "Simo" (simultaneous observation of a celestial body) with the detachment survey party or division artillery (Div Arty) survey. Directional control is transferred to the radar once the ATG is emplaced and the sail raised. Accurate grid location for the ATG is obtained from the section's precision lightweight global positioning system receiver (PLGR).

The order of emplacement tasks also changes. The crew must dig beneath the jacks so the jack pads can be connected and the ATG leveled. Additionally, all cables must be connected and power applied before site survey is completed. The crew does not have to "de-rig" the shelter or the generator, but it must be careful to keep rigging equipment away from the exhaust on the generator and vents on the shelter.

Continuous Radar Operations. Fuel is the most critical logistical consideration for an air assaulted radar. By stacking fuel cans in the ATG aisle, the radar can operate for 24 hours radiating continuously (see Figure 2 on Page 18). (The fuel consumption rate is eight gallons per hour.)

One option to lengthen the time between resupply lifts might be to have a fuel blivet flown in during the initial

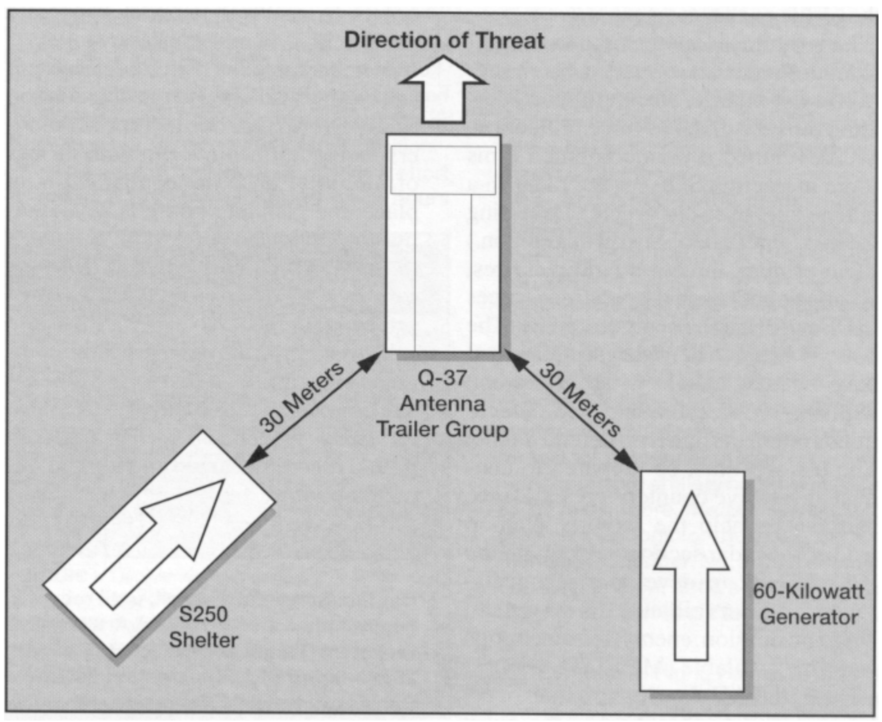

Figure 1: Q-37 Air Assault Site Layout. Arrows represent the markings (masking tape) on the equipment so the crew chief of the CH-47 can position the equipment correctly.

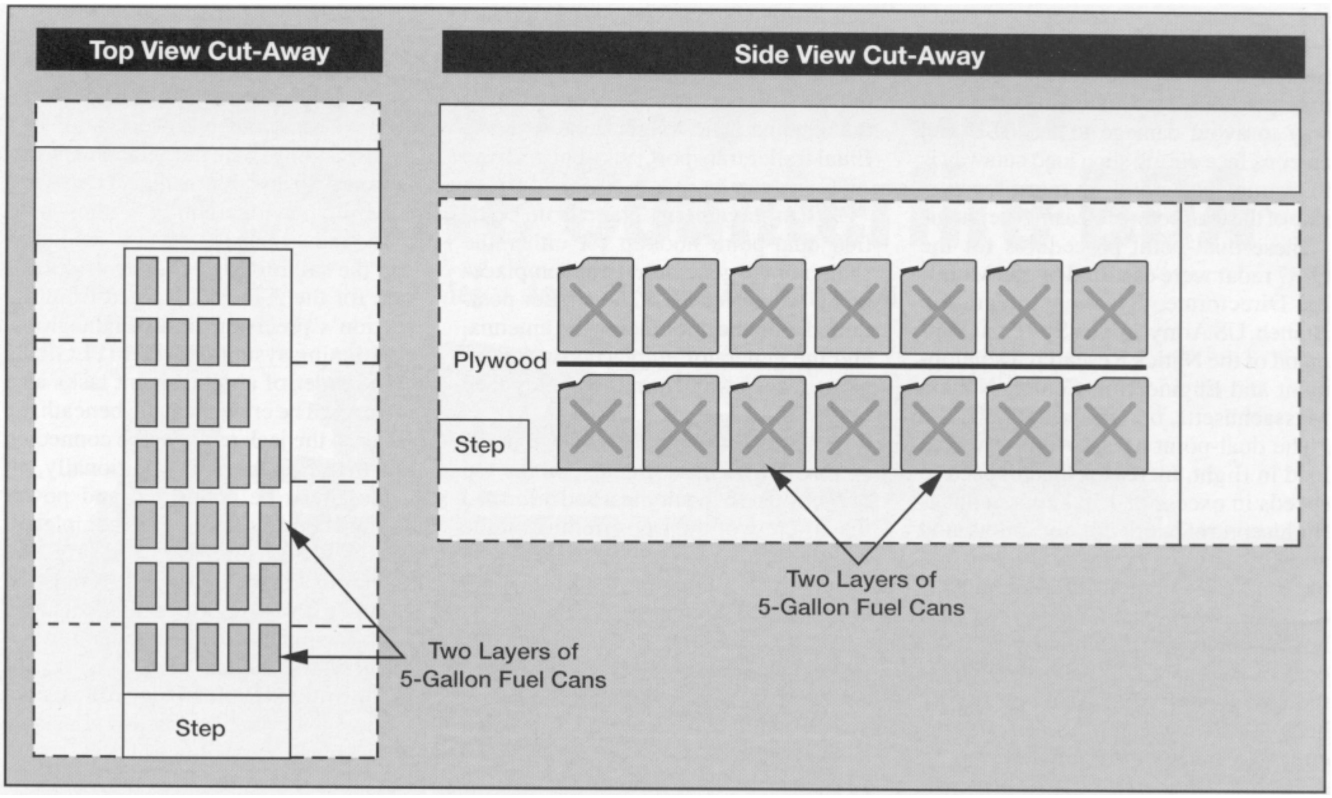

Figure 2: ATG Aisle Stacked with Fuel Cans. The most critical consideration for an air assaulted radar is fuel.

lift. However, we never solved how to feed the fuel from the blivet directly into the generator. Another option is to upload fuel cans on a cargo trailer or palletized load in a cargo net as part of the airlift package.

Survivability is another important consideration. An air assaulted Q-37 section is not mobile, so careful consideration must be given to force protection. We developed a joint/combined arms force protection SOP for the radar in a remote site. (See our article "Protecting the Q-37 Firefinder," also in this edition.)

Our primary threats are indirect fires, air attack and special operations forces (SOF) infiltration or sniper activity. The bottom line is the radar section must have at least a light infantry platoon with organic weapons and communications systems assigned to defend its site. The platoon must be prepared to conduct aggressive counterreconnaissance patrols. To help the infantry platoon leader, the radar section works with the Div Arty S2 to develop a reconnaissance and surveillance (R&S) plan, based on mission, enemy, terrain, troops and time available (METT-T).

The 25th FAD developed a map overlay or template that defines the outer limits of the noise signature produced by the generator in various types of terrain. This defines the minimum boundaries for the counterreconnaissance patrols. The protection force leader coordinates with the radar technician at first linkup and the two co-author operations orders to ensure personnel cooperate and the final plan is cohesive.

Conclusion. The Firefinder system can be air assaulted with no degradation to its performance due to its prime movers' being left behind. But with its loss of mobility, once the equipment is in place, the planning phase is key. Having the option to air assault the Q-37 radar outweighs a lack of mobility if careful consideration is given to force protection.

Air assaulting the radar gives the commander flexibility when long-range radar coverage is critical, yet untenable locations, inadequate MSRs and congested roads appear to limit his deployment options.

Captain Steven M. Carroll, until recently, commanded the 25th Field Artillery Detachment (Target Acquisition) (25th FAD), 25th Infantry Division (Light) at Schofield Barracks, Hawaii. Currently, he commands a Basic Training Company at Fort Leonard Wood, Missouri. He began his career as an 11B Infantryman in 1986 stationed with the 25th Division at Schofield Barracks, receiving his commission in 1992. Also with the 25th Division, he served in the 1st Battalion, 8th Field Artillery as a Fire Direction Officer and Firing Battery Platoon Leader.

Chief Warrant Officer Two (Retired) Kenneth J. Roberts was the Radar Technician and Detachment Executive Officer for Section 2 of the 25th FAD for three years until his retirement in October 1997. Entering the Army in 1977, he was a 17C Target Acquisition Specialist for eight years until he changed to 13R FA Firefinder Radar Operator. In 1989, he became a Warrant Officer 131A Targeting Technician. Among other assignments, Chief Roberts has served with the 6th Battalion, 8th Field Artillery, 7th Infantry Division (Light) at Fort Ord, California, where he participated in Operation Just Cause as a Radar Technician, and the 26th FAD, 2d Infantry Division, Korea.

Warrant Officer Two David R. Utter is the Section 1 Radar Technician in the 25th FAD. His prior service was as a Radar Technician in the US Navy on the *USS Nimitz, USS Constellation, USS Forrestal, USS Eisenhower*, and at Naval Air Station, Whidbey Island, Washington. He received his commission as a US Army Warrant Officer 131A Targeting Technician in 1995. He is serving his first Army tour at Schofield Barracks.

Protecting the Q-37 Firefinder

by Captain Steven M. Carroll, Chief Warrant Officer Two (Retired) Kenneth J. Roberts and Warrant Officer Two David R. Utter

The 25th Infantry Division (Light), Schofield Barracks, Hawaii, designed aggressive force protection measures for its Q-37 Firefinder radars with great success during its corps Battle Command Training Program (BCTP) Warfighter Exercise. Marine infantry, Engineers, Air Defense Artillery (ADA) and Military Police (MP) assets worked together to safeguard this valuable corps asset. The computer simulation proved how effective the radars could be for counterfire if allowed to operate unimpeded by enemy forces.

As a result, we wrote a force protection standing operating procedure (SOP) that incorporated the combined arms forces and reconnaissance and surveillance (R&S) plans we used in the exercise. We then set out to refine and validate our SOP force-on-force at the Pohakuloa Training Area on the Big Island of Hawaii.

This article discusses the tactical and logistical requirements for deploying, emplacing and hardening a radar section in coordination with joint and combined arms units at a site subject to aggressive enemy reconnaissance and infiltration. We developed a checklist for coordinating with combined arms assets and a time line to serve as a template for division artillery (Div Arty) tactical operations center (TOC) planning. We also identified additional maintenance required to sustain extended radar operations in the unusual conditions.

Force Protection FTX

In April 1996, the 25th Field Artillery Detachment (Target Acquisition) conducted a field training exercise (FTX) to validate our force protection annex of our SOP. Our protection package included a platoon of Marines from the 3/3 Marine Regiment, a platoon of Avengers from the 1-62 ADA, excavation assets from the 65th Engineers and a platoon from the 58th MP Company. The opposing force (OPFOR) was a four-man team from the 25th Division's long-range surveillance detachment (LRSD). The scenario began with the radar in a tactical assembly area (TAA) with the radar technician's receiving a radar deployment

Day*	Night*	Event
0 - 10.5	0 - 12.5	Radar section receives Green 3 and RDO instructing it to send an advance party to a new location. The Radar Tech begins troop leading procedures.
0 - 10	0 - 12	Support element reps arrive at current radar site. Radar Tech conducts initial coordination IAW the TACSOP.
0 - 9.5	0 - 11.5	Radar Tech issues movement and OPORD to key leaders and slice elements IAW TACSOP.
0 - 9	0 - 11	Radar advance party leaves the SP and consists of Radar Tech, Section Chief, SRO and Driver; EN LNO/Rep (in radar recon vehicle); 1/2 the attached IN slice in a 5-ton truck; and 1 Avenger fire unit, if available.
0 - 8.5	0 - 10.5	Advance party arrives in the vicinity of the new site. All efforts are made to observe the site from standoff distance using binoculars, FLIR, etc. IN slice sweeps the area and establishes initial security. Avenger displaces to the site while remaining vehicles begin closing on it. Radar advance party marks the site positions and briefs the EN LNO.
0 - 7	0 - 9	Excavation party arrives and consists of 2 SEEs, 2 dozers and FAD survey.
0 - 6.5	0 - 8.5	EN excavate; IN slice begins implementing R&S plans (METT-T).
0 - Travel Time		Radar Tech calls main body forward, which consists of 3 radar 5-tons with trailers, 1 IN 5-ton and 3 each MP/ADA vehicles, if available.
0 - .5	0 - .5	EN complete tasks to TACSOP standards. Survey completes mission prior to the radar's closing on the site. Radar arrives and starts emplacing. Survey departs for the TOC.
0 - Hour		Radar IPRTO, Green 1 and 2 reports sent to Targeting Cell via digital net.
0 + .5		Radar equipment is 100 percent camouflaged. IN slice sends R&S plans to radar to forward to the Targeting Cell. All begin deploying Class IV supplies to construct a defense/obstacles.
0 + 2		Overhead cover for crew-served weapons complete. IN OIC forwards perimeter sketch to radar. Commo land line emplaced between Radar Tech and IN OIC.
0 + 3		Radar Tech establishes/marks Casualty Collection Point and MEDEVAC sites and disseminates the info to the IN slice and Targeting Cell.
0 + 4		Overhead cover for remaining fighting positions complete. All positions "hot-looped" for communications.
0 + 12		Radar changes shifts and implements rest plan.

*Times are indicated in minutes and considered "not later than" times.

Legend:

ADA = Air Defense Artillery
EN = Engineer
FAD = Field Artillery Detachment
FLIR = Forward-Looking Infrared
IAW = In Accordance With
IN = Infantry
IPRTO = In-Place-Ready-to-Observe
LNO = Liaison Officer
MEDEVAC = Medical Evacuation
METT-T = Mission, Enemy, Terrain, Troops and Time Available
MP = Military Police
OIC = Officer-in-Charge
OPORD = Operations Order
RDO = *Radar Deployment Order*
R&S = Reconnaissance and Surveillance
SEEs = Small Emplacement Excavators
SP = Start Point
SRO = Senior Radar Operator
TACSOP = Tactical Standing Operational Procedures
TOC = Tactical Operations Center

Figure 1: Time Line for Protecting Q-37

order (RDO) to link up with our protection assets and move to a position of approximately one grid square. We tested the technician's ability to use the site selection criteria and employ mission, enemy, terrain, troops and time available (METT-T) and observation, cover and concealment, obstacles, key terrain and avenues of approach (OCOKA) for site selection. This began the time line sequence we were validating (see Figure 1). After conducting troop leading procedures and initial coordination with the joint/combined arms unit leaders, the advance party departed to reconnoiter the new position.

Organization for Combat. The original organization broke the force into two parts: the advance party and the main body. The advance party consisted of radar advance party personnel, all engineer assets, half the Marine platoon and one Avenger team. The main body consisted of the Q-37 and its two support vehicles, the other half of the Marines, the remaining ADA assets and three MP vehicles for convoy security.

The advance party had 10 vehicles in a convoy that stretched for three-quarters of a kilometer. When the convoy stopped to sweep and secure the position area, the convoy was exposed on the road for nearly two hours. Moreover, the convoy was devoid of leadership during this time. The intent was to secure and harden a site hidden from enemy attack, but before we could even establish the site, we were giving away our position with the cumbersome advance party convoy.

Our solution was to divide the force into three moving pieces instead of two. First, the advance party consisted of the radar advance party personnel (radar technician, senior radar operator and driver) and a representative from the engineers in one high-mobility multipurpose wheeled vehicle (HMMWV) and the Marine sweep/security team following in a 5-ton truck. The advance party visually reconnoitered the proposed site from a standoff distance and then swept and secured the area. During the sweep, the radar technician conferred with the engineer rep on the site layout and last-minute changes. This way the engineers could begin digging as soon as the excavation team, the second moving part of the force, arrived.

The excavation team consisted of the engineer assets, radar survey team and MP escort, if available. The excavation team departed the TAA two hours after the advance party (or when called forward). Breaking the advance party into two parts reduced the force's exposure to enemy detection and fire and simplified command and control.

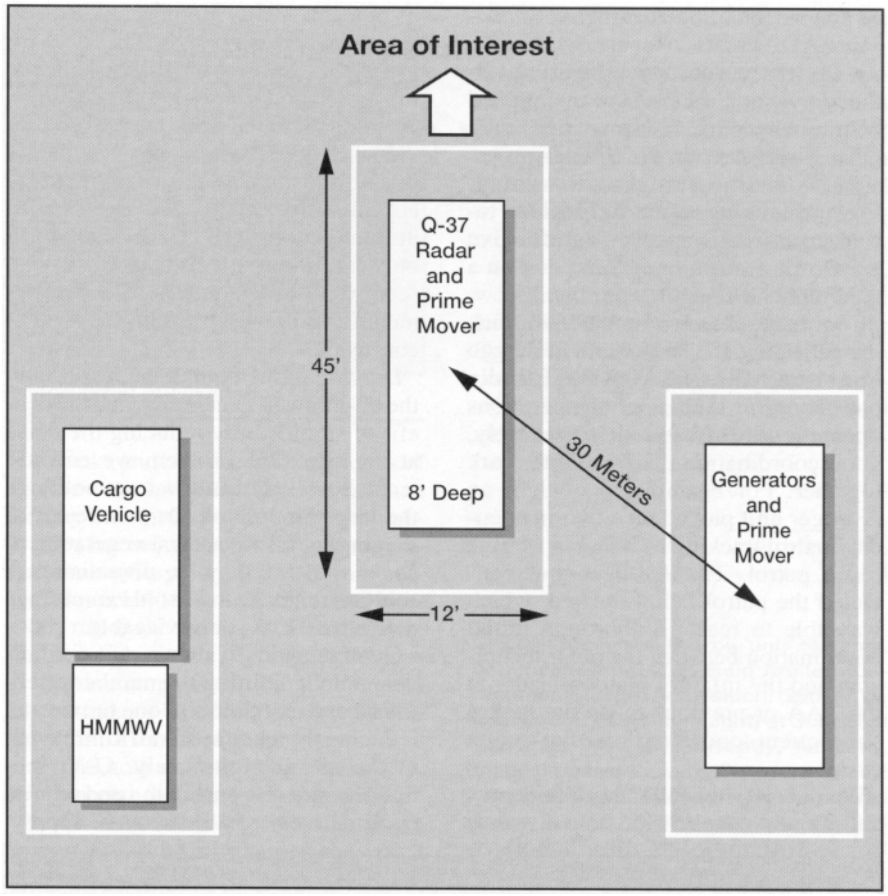

Figure 2: Radar Section Position. The radar's entry-exit slope must be no more than five percent. Once the radar is in place, the front is bermed to the bottom of the antenna. Crew-served weapons positions are dug by the small emplacement excavators (SEEs) with their positioning determined by the radar warrant and infantry officer. This operation requires four hours in normal conditions. Individual fighting positions are dug, as time permits and as determined by the engineer section leader.

Of course, the final part of the force was the main body, which arrived at the site just as the trenches were complete.

Site Excavation. The engineers took four hours to dig three trenches for the Q-37 and its equipment (Figure 2) and two more hours to dig crew-served and individual fighting positions. The engineers would have needed a total of eight hours in limited visibility or rough terrain.

We learned several lessons about how to dig the Q-37 trenches. First, the exit point glide slopes for the three trenches have to be no greater than five degrees. Second, the connecting trenches dug by the small emplacement excavators (SEEs) between the three larger trenches must be dug first or the last 10 feet or so will have to be done manually. This is because the walls of the large trenches are not strong enough to support the weight of the SEE within 10 feet. Last, although the excavated dirt must be spread out somewhat to preclude a large pile, it should be localized enough so that it's easily camouflaged.

During the excavation, the noise and dust clouds made us susceptible to enemy detection. So we began counter-reconnaissance patrols as soon as possible. Because manpower to build the perimeter is decreased by patrolling, we had to extend the time to complete the defense.

Site Defense. The Marines began executing counterrecon patrols based on the platoon leader's METT-T analysis and the reconnaissance and surveillance (R&S) plan sent from the counterfire headquarters. The MPs conducted R&S

on the surrounding road network. Because ADA assets cover areas, not units, we did not co-occupy a position (although we could have) but maintained communications and provided each other situation updates. Whenever possible, we had the Avenger units use their forward-looking infrared (FLIR) to locate enemy movements—an effective way to find warm bodies moving on a cold night.

Coordination and communication during patrolling are paramount. Failing to inform the MP or the ADA that friendly patrols are in their area of operations opens the door to fratricide. Conversely, good coordination ensures units work together. For example, one night an Avenger unit picked up a two-man enemy patrol tracking a five-man Marine recon patrol. The Avenger unit contacted the patrol being tracked, which was able to react. A thorough initial coordination between the radar technician and the infantry platoon leader at the TAA or previous radar site makes subsequent coordination that much easier.

We developed a joint/combined arms coordination checklist to help the radar technician identify the other units' readiness status (see Figure 3). The checklist is a part of the force protection annex in the SOP and, among other things, prompts the radar section chief to provide the slice leaders a current situation update and meld security activities into cohesive operations. We once had a problem during an extended halt when only half the units dismounted to pull security. Coordination and a good movement briefing will prevent this type of confusion.

Digging in the equipment, especially the 60-kilowatt generators, had the benefit of significantly reducing the noise at the site. One problem we encountered, however, was how to camouflage the large amount of dirt as a result of digging in. Using natural vegetation to cover the dirt may be unrealistic. A solution might be to use old camouflage nets turned in as unserviceable.

Other methods of keeping the site hidden include limiting the number of entrance and exit points to one or two and reducing the amount of traffic in and out of the site. Unfortunately, Q-37 sections are not self-sustaining and require point delivery of all classes of supply. The only solution seems to be to restrict resupply efforts to times of limited visibility.

Despite our efforts to hide the radar site, the enemy LRSD located and observed us. During the FTX after-action review (AAR), we discovered that our movement to and from the site gave away our location. The LRSD was able to hide and observe us because they used gilly suits and restricted their own movement to a minimum. It wasn't until they began probing that we detected them. (The LRSD had an unrealistic advantage of knowing the approximate location and size of the site.)

In the next exercise, we'll move more to see if our reorganization for movement hinders the enemies ability to find the unit when it relocates. Last, we will stress the importance of hiding the site in conjunction with hardening efforts, emphasizing map and ground reconnaissance as part of site selection.

Enemy special forces were a primary threat to Q-37s during the Warfighter exercise, and, therefore, we set up to defend against a dismounted ground attack. This included crew-served and individual fighting positions, triple-strand

1. Personnel
- Unit OIC and NCOIC
- Number of Personnel (Get an Alpha Roster)
- Attachments (Medics, FOs, etc.)

2. Weapons and Ammunition
- Type Weapons-M2 (.50 Cal), M60 Machinegun, M249 (SAW), M203, M16A2, AT/4 Antitank, M18A1 Claymore and/or M67 Grenade
- Number of Weapons
- Type and Amount of Ammunition

3. Vehicles and Class III Status
- Vehicle Type
- Fuel Status
- Maintenance Status

4. Class I Status
- Water
- MREs

5. Other
- Maps
- Current Situation

6. Communications
- Commo Equipment Type
- Number of Each
- Battery Status/Requirement
- Call Sign(s)
- Briefing Topics: Pyro Signals, Running Password, Challenge Password, CEOI in Effect, Methods of Communication in Priority

7. Special Unit Coordination
- *Engineers:* (Brief TACSOP Excavation Requirements)
  - Proposed Digging Terrain
  - Slope of Land
  - Time Requirements
  - Advance Party LNO
  - Route Constraints
- *Infantry:*
  - Concept of the Defense
  - R&S Worksheet(s): Distribute and Explain
  - Det. Weapon Systems, Ammo, Pyro, Class IV Available
- *Military Police:*
  - Proposed Route of March
  - Order of March and Composition of Columns
  - Key Assets
- *Brief All:*
  - TACSOP Priorities of Work (Defense)
  - De-Conflict Immediate Reaction Drills
  - Radiation Hazards and Precautionary Measures

8. Time and Place for the Movement Order

Legend:

CEOI	=	Communications-Electronics Operations Instructions
FOs	=	Forward Observers
MREs	=	Meals Ready to Eat
NCOIC	=	NCO-in-Charge
OIC	=	Officer-in-Charge
TACSOP	=	Tactical Standing Operating Procedures

Figure 3: Combined Arms Coordination Checklist

Class IV Item	Basis Load Quantity	Additional Required	Total
Sandbags	300 Bundles	1,000 Bundles	1,300 Bundles
Concertina Wire	45 Rolls	270 Rolls	315 Rolls
Large Pickets	100 Each	500 Each	600 Each
Small Pickets	24 Each	100 Each	145 Each
Tangle-Foot Wire	N/A	10 Rolls	10 Rolls
4′ x 8′ Plywood	6 Sheets	24 Sheets	32 Sheets

Figure 4: Class IV for a Radar Section with a Platoon-Sized Augmentation Force

concertina wire, antipersonnel mines and preplanned indirect fires.

In the process, we realized we did not have enough concertina wire for the extended perimeter when a platoon of infantry co-occupied with us. Figure 4 lists the Class IV needed to construct an adequate perimeter defense with a platoon-sized augmentation force. The key is to keep the enemy special forces teams from encroaching any closer than small arms range, given that several rounds through the antenna transceiver group (ATG) or antenna will seriously degrade operations. The radar technician must carefully weigh the benefits and risks of a well-hidden and well-hardened site.

The radio frequency (RF) radiation hazard zone will affect the construct of the defense perimeter. This area is defined as extending to 40 meters out from the radar and between the search azimuth limits in a narrow sector scan and seven meters out from the radar and between the search azimuth limits in a broad sector scan. (In 1997, the US Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, Maryland, changed the danger zone for human exposure to RF for the Q-37 from 141 meters to 40 meters in a narrow sector scan and seven meters in a broad sector scan.) The danger zone cannot be occupied by soldiers for any extended period and may, in some cases, preclude directly covering likely enemy avenues of approach. If METT-T does not support a defensive perimeter with a frontal radius from the radar of greater than 40 meters, you may not be able to place fighting positions in this area. Therefore, the radar technician and infantry platoon leader have to be creative in defending this area.

One of the best solutions is to use concertina wire to channel the enemy to the flanks and into the primary zones of the crew-served weapons. The unit can deploy channeling wire and other obstacles in conjunction with antipersonnel mines (Claymores) and 40-mm grenade launchers to defend this area. However, the Q-37 radar can inadvertently detonate electronically armed devices if they are emplaced within 268 meters of the radar's antenna face for the full 1,600 mils sector of scan.

A final note on defending a radar site. We learned that a position in defilade with close-in screening crests that don't impair the radar's coverage may be a good opportunity to employ a reverse-slope defense. Moreover, against superior odds, the reverse slope defense gives the defender an advantage.

Additional Maintenance. Maintenance on the radars and support generators is more intensive when the equipment is dug in. For example, the filters on the radar had to be cleaned every 12 hours rather than the 24 hours as recommended in the technical manual (TM). Moreover, we decided it would be better to bring an extra set of filters to switch them out and clean the old set with soap and water. The compartments in the shelter and the ATG also needed to be cleaned with alcohol and lint-free cloth every 12 hours.

Our most important maintenance discovery was that for every 12 hours of operation, the radar had to be shut down one hour for maintenance. Though this would seem to impede our accomplishing the mission, the alternative was to lose the radar to catastrophic failure. For example, the collection of dust in the high-voltage compartment combined with the condensation created by cooling temperatures underground at night could cause arcing of the traveling wave tube (TWT) or other critical components in the compartment. Such a situation could deadline the radar for days.

Additionally, we suggest that the signal processor be cleaned out as much as possible–the compartment blown out using an air line from the 5-ton-and that the circuit cards are inspected. We had to execute an analog-to-digital alignment because of degraded performance.

In this joint/combined arms exercise, we refined and validated our SOP while learning how to make the most of our Q-37s forward on the battlefield. As a combat multiplier for the corps commander, the Firefinder must be protected from an enemy who sees the radar as a high-payoff target. And he's right.

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Chief Warrant Officer Two (Retired) Kenneth J. Roberts was the Radar Technician and Detachment Executive Officer for Section 2 of the 25th FAD for three years until his retirement in October 1997. Entering the Army in 1977, he was a 17C Target Acquisition Specialist for eight years until he changed to 13R FA Firefinder Radar Operator. In 1989, he became a Warrant Officer 131A Targeting Technician. Among other assignments, Chief Roberts has served with the 6th Battalion, 8th Field Artillery, 7th Infantry Division (Light) at Fort Ord, California, where he participated in Operation Just Cause as a Radar Technician, and the 26th FAD, 2d Infantry Division, Korea.

Warrant Officer Two David R. Utter is the Section 1 Radar Technician in the 25th FAD. His prior service was as a Radar Technician in the US Navy on the *USS Nimitz, USS Constellation, USS Forrestal, USS Eisenhower,* and at Naval Air Station, Whidbey Island, Washington. He received his commission as a US Army Warrant Officer 131 Targeting Technician in 1995. He is serving his first Army tour at Schofield Barracks.

Planning and Computing FASCAM

by Major David A. Vindich, USMC

There's some confusion among field units about the procedures to plan and compute family of scatterable mines (FASCAM) minefields. Although not difficult, planning FASCAM minefields is time-consuming; and the firing data must be computed manually.

This article addresses the tactical considerations for employing FASCAM and the procedures to compute FASCAM firing data. When planning a FASCAM minefield, the fire support officer (FSO) must be able to advise the maneuver commander about FASCAM concepts. If he advises the commander incorrectly, the FSO may not be able to fire the minefield in the density or size desired or in the time allotted. After the FSO's initial planning, the battalion fire direction officer (FDO) plans the minefield in detail followed by the battery FDO's computation of FASCAM technical firing data.

FSO Planning. Before the commander decides to employ FASCAM, the FSO provides guidance on the availability of FA munitions and delivery units. The planning starts with the Minefield Planning Sheet, DA Form 5032-R (*FM 6-40 Tactics, Techniques and Procedures for Manual Cannon Gunnery*, Figure 13-27 on Page 13-63).

At this point, the FSO must be aware of not only the tactical considerations in employing FASCAM, but also the technical computations required. The FSO and battalion FDO must be aware of the considerations outlined in Figure 1.

The FSO and battalion FDO have a tool to help them plan FASCAM missions–the initial fire support automated system (IFSAS). In the planning mode, IFSAS can segment the proposed minefield, determine the required number of aim points for a minefield and allocate the appropriate resources to fire the mission. (The IFSAS operator must select the commander's Mod File for target segmentation.) IFSAS conducts this planning via a software package based on the Mine Employment Tables in Chapter 13 of FM 6-40.

Battalion FDO Planning. If the FASCAM mission is preplanned, the battalion FDO receives the minefield coordinates on the Minefield Planning Sheet (Section A, Lines 4, 5 and 6). If the mission is a target of opportunity initiated by a forward observer (FO) or fire support team (FIST), the grid coordinate given or target location determined becomes the minefield center.

In a nutshell, here's the process the battalion FDO uses to plan FASCAM. When he receives the mission to fire FASCAM, he plots the target and determines the minefield center and the number

- Width of the FASCAM Minefield. This varies according to the mine type and angle of fire.
- Angle of Fire (High- or Low-Angle).
- Desired Density (Low, Medium or High).
- Duration of the Minefield (Short or Long).
- Timing of When the Minefield must be in Place.
- Artillery Support Available to Fire the Minefield.
- Time for the Artillery to Fire the Minefield.
- Number of Artillery Rounds Available to Emplace the Minefield. This includes the logistics of getting more rounds in time, as necessary.

Figure 1: FASCAM Considerations. The FSO and FDO must consider these factors in FASCAM planning.

Entry	Employment Table							
	1	2	3	4	5	6	7	8
Transfer or Met + VE	X	X	X	X				
Observer Adjust					X	X	X	X
M718/741 (RAAMS) Low-Angle	X	X			X	X		
M718/741 (RAAMS) High-Angle			X	X			X	X
M692/731 (ADAM) Low- or High-Angle			X	X			X	X
BMA ≤800 mils	X		X		X		X	
BMA > 800 mils		X		X		X		X

Legend: **ADAM** = Area Denial Artillery Mission **BMA** = Battery Minefield Angle **RAAMS** = Remote Anti-Armor Mine

Figure 2: Mine Employment Matrix (FM 6-40, Page 13-49). Following the example in the article, the one table that all three answers have in common is Table 1 (as highlighted in this figure).

Delivery Technique: Transfer or Met + VE					Trajectory: Low Angle					
Shell: M718/741 (RAAMS)					BMA: Equal to or less than 800 mils					
Range Meters	**Desired Minefield Length (Meters)**									
	100	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1,000**
4,000	2	3	3	4	4	5	5	6	6	7
6,000	2	3	3	4	4	5	5	6	6	7
8,000	2	3	3	4	4	5	5	6	6	7
10,000	3	3	4	4	5	5	6	6	7	7
12,000	3	4	4	5	5	6	6	7	7	8
14,000	4	4	5	5	6	6	7	7	8	8
16,000	4	4	5	5	6	6	7	7	8	8
17,500	4	5	5	6	6	7	7	8	8	9

Figure 3: Mine Employment Table 1 (FM 6-40, Page 13-50)

of aim points required. Then he passes the information to the battery FDO who computes the firing data.

To begin planning, the FDO plots the target to determine the chart range and battery minefield angle (BMA). The BMA is defined as the smaller interior angle formed by the intersection of the minefield center line with a line drawn from the battery center to the center point of the minefield. The minefield center line traverses the minefield *width* through its center point. The FDO puts a target grid on the minefield center point and orients the target grid to reflect the attitude (direction) of the minefield. He uses the range-deflection protractor (RDP) to determine the BMA from the battery or platoon center to the minefield center.

The FDO also can calculate the BMA mathematically by subtracting the average unit direction of fire from the minefield attitude, which always will be less than 1,600 mils (BMA = Attitude - Direction of Fire).

The FDO then determines which Mine Employment Table in FM 6-40 to use. To determine the appropriate table, he uses the Mine Employment Matrix from Page 13-49 of FM 6-40 (Figure 2) based on the answers to three questions:

(1) What is the delivery technique–transfer or meteorology (Met) plus velocity error (VE) or observer adjust?

(2) What is the shell and trajectory–remote anti-armor mine system (RAAMS) or aerial denial artillery munition (ADAM) at high or low angle?

(3) What is the BMA-less than/equal to 800 mils or more than 800 mils?

To illustrate the process, say the FDO answered the questions as "Met + VE using RAAMS at low angle and the BMA will be less than or equal to 800 mils." Referring to the Mine Employment Matrix in Figure 2, he looks down the "Entry" column to find each answer and then across the "Employment Table" rows to find "Xs" indicating the numbers of the Mine Employment Tables he can use for that answer.

Using the sample answers to the questions, the matrix says that for the Met + VE technique, the FDO can use any one of Tables 1 through 4; firing RAAMS at low angle allows him to use Tables 1, 2, 5 or 6; and a BMA of less than or equal to 800 mils calls for Tables 1, 3, 5 or 7. The one table that all three answers have in common is Table 1. This is the table the FDO must use to determine the number of aim points required for the example minefield. The heading of Table 1 in FM 6-40 restates the answers to all three questions (see Figure 3).

The FDO now addresses the minefield module concept. A RAAMS minefield module for planning is 200 x 200 meters for low-angle firing and 400 x 400 meters for high-angle. The planning module for ADAM is 400 x 400 meters, regardless of the trajectory.

The FDO must remember the rule that *the width of a planning module cannot change; only the length of the module can change*. For example, if the FDO plans a battalion-sized low-angle RAAMS minefield of 800 x 800 meters, he segments the minefield by modules. Knowing that the planning module for low-angle RAAMS is 200 x 200 meters and that the width cannot vary, the FDO determines that it takes four 200 x 800-meter modules to cover the 800 x 800-meter minefield (Figure 4).

Using Mine Employment Table 1 (Figure 3), the FDO determines the number of aim points *per module*. In this example, the FDO has four modules of 200 x 800 meters each. If the range from the battalion center to the center of the 800 x 800-meter minefield is, say, 10,500 meters, the FDO uses a range of 10,000 meters and a minefield length of 800 meters to enter Table 1 and determine the number of aim points per module-in this case, six. Given the example, each planning module will use six aim points and, with four modules, the FDO needs 24 aim points for the 800 x 800-meter minefield.

The FDO then determines where to emplace the aim points. He segments the minefield into 200 x 800-meter modules and establishes a center line for each module. FM 6-40, Pages 13-53 and 13-54, provides guidance for emplacing the aim points based on the standard planning module size, type of round being fired and either an even or odd number of aim points. According to FM 6-40, for an even number of aim points, the initial aim points are placed

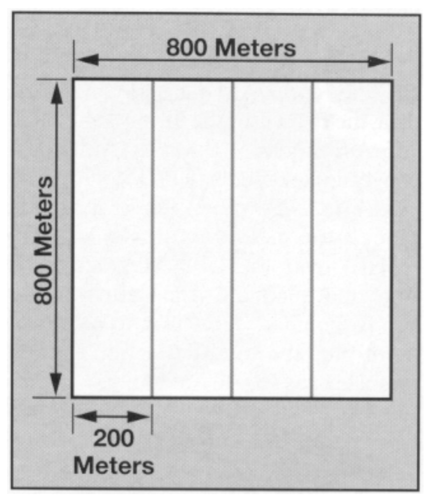

Figure 4: Sample Minefield Segmentation

100 meters left and 100 meters right of the center point along the center line of the module (see Figure 5). The remaining aim points are placed at 200-meter intervals from the initial aim points until all are emplaced. Figure 5 illustrates the concept using the example six aim points

After establishing the 24 aim points, the FDO determines the grid coordinates for each. In the absence of IFSAS in the planning mode, he can determine the grid coordinates using a firing chart and target grid or an M17 plotting board.

The next step is for the FDO to determine the number of rounds to be fired at each aim point, based on the density of the minefield (low, medium or high). For the example, the commander needs a medium-density minefield. The FDO refers to the Desired Density Rounds Per Aim Point Table listed in the FM 6-40 (Table 13-21, Page 13-55). The table states that for a low-angle, medium-density RAAMS minefield, 12 rounds must be fired per aim point. Therefore, 288 rounds must be fired to emplace the 800 x 800-meter minefield.

An M109A5/A6 or M198 howitzer firing at the maximum rate of fire for the first three minutes followed by the sustained rate thereafter requires a six-gun battery to fire for 42 minutes to emplace the minefield. The battalion FDO would fire this mission as a battalion due to the size of the target and assign each firing battery one or two modules to execute.

Once the battalion FDO determines the number and location of the aim points, the battery FDO computes the technical firing data.

Battery FDO Computations. The battery FDO has all the information he needs to calculate the technical firing data. He determines the technical fire direction by using dual-purpose improved conventional munition (DPICM) graze burst data and then converts it to RAAMS or ADAM data. To convert the data, the FDO uses the Firing Table (FT) 155-Addendum-N-1 for RAAMS data conversion and Addendum L-1 for ADAM.

RAAMS Data Conversion. the FDO places the manufacturer's hairline (MHL) over the DPICM graze burst time and quadrant. The deflection-to-fire is the chart deflection to each aim point plus the total deflection correction. He uses FT Addendum N-1 in conjunction with Tabular Firing Table (TFT) AN-1/AN-2 to determine firing data for shell RAAMS and Table A, Column 1 of the N-1 Addendum to determine the correction-to-quadrant.

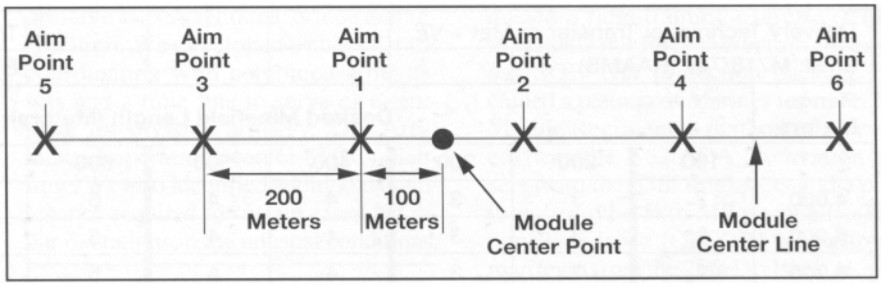

Figure 5: Aim Point Emplacement

The entry argument is the DPICM graze burst quadrant elevation (QE). The FDO finds the correction-to-quadrant in Column 2 and adds it to the graze burst data.

The FDO also determines the fuze setting. He uses Table B of the N-1 Addendum for fuze corrections. The entry argument is the DPICM graze burst fuze setting listed in Column 1. The correction to the fuze setting is found in Column 2 and is added to the graze burst fuze setting. Subsequent corrections for quadrant are determined from Table A, Columns 3 and 4 and Table B for fuze corrections, Columns 3 and 4.

ADAM Data Conversion. The computation for ADAM rounds are slightly more complicated. Because low-level winds can blow ADAM away from the intended aim point, the FDO must modify or correct the aim points. The FDO offsets the aim points in meters.

ADAM has a 600-meter height of burst that corresponds to Line 02 of a meteorological (Met) message. The FDO uses Line 02 to determine the wind speed and direction to help offset the ADAM aim points.

FT 155 Addendum-L-l, Table A, provides correction factors for low-level winds. The entry argument to Column 1 is the DPICM graze burst quadrant from the firing unit to the center point grid. The correction factor is extracted from Column 5 for a one-knot wind speed. The FDO multiplies the correction factor by the wind speed indicated on Line 02 of the Met message to compute the total correction. This procedure determines the number of meters (expressed to the nearest 10 meters) needed to offset each aim point.

Then the FDO places the target grid over the module center point and plots the offset aim point into the direction of the wind. He reorients the target grid over the new offset point, resets the minefield attitude and determines the new module center line. He uses the new chart range and deflection to determine the new offset aim point. But he uses the original aim point to calculate the vertical interval and site. The battery FDO follows these correction procedures for each aim point.

He then determines the DPICM graze burst times, deflections, elevations and quadrant elevations for the offset aim points and computes the data using the same procedures as for RAAMS.

BCS Firing Data Computations. The battery computer system (BCS) can determine technical firing data for RAAMS and ADAM. But the BCS can only compute data for each individual aim point. Firing units assigned multiple aim points must execute each as if it were an individual mission. In the BCS autonomous mode, the battery FDO performs the steps outlined for the battalion FDO to segment the minefield and identify the aim point as well as compute the technical firing data.

Chapter 13 of FM 6-40 outlines the steps to execute a FASCAM mission. Although the steps take time and can appear complicated, in fact, they are not difficult. Fire supporters must master the procedures to ensure FASCAM minefields are emplaced when and where their maneuver commanders need them.

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FASCAM

An "UNconventional" Munition?

An enemy 82-mm mortar has been engaging our forces with great success for the last hour. The Q-36 radar has tracked the mortar and all fire support assets available have counterfired the general position three times, including as a priority target on the last known position, to no avail. No air or ground forces are available to vector to this position. So, how do we destroy this mobile mortar?

Although the fire supporter must attack the enemy using any available means to meet the commander's intent, he also must consider munitions abilities and residual effects in and around the ground that friendly forces or innocent civilians may move through or occupy. The services felt the effects of using high dud-producing munitions during the Gulf War. The Air Force CBU-87 and multiple-launch rocket system (MLRS) submunitions caused some injuries to allied forces as they moved to their objectives.

Lightfighters are especially concerned with dud-producing munitions. During a recent training exercise with the 10th Mountain Division, we discussed using dud-producing munitions. The result: the FA was unable to service the objective. The issue was the risks the duds pose to friendlies versus the desired effects on the enemy positions.

FASCAM Advantages. We contacted the Army's experts on munitions at the Armament and Chemical Acquisition and Logistics Activity (ACALA), Rock Island Arsenal, Illinois, who informed us of the unclassified dud rates shown in the figure.

This information was shocking, to say the least. Dud rates for the 105-mm armor-piercing improved conventional munition (APICM) range from 18 percent up to 50 percent; the dud rate for the 155-mm APICM is about five percent. The dualpurpose improved conventional munition (DPICM) round is much better with dud rates of 1.5 percent for the 155-mm and 0.2 percent for the new 105-mm round that begins fielding in 1998. Even with the improved dud rates of DPICM, commanders may be unwilling to accept the risk.

Family of scatterable mine (FASCAM) rounds have a comparably lower dud rate (classified), self-destruct mechanisms and a computed safety box. However, we must plan FASCAM minefields in excruciating detail and receive release authority to use them. Is it any wonder we don't use FASCAM more frequently? FASCAM may provide some "unconventional" answers to the perplexing dud problem.

Unconventional Employment. Well planned, placed and timed FASCAM minefields have devastating effects on enemy mechanized and armor formations at the Combat Training Centers (CTCs). But FASCAM also can be employed effectively against known enemy positions. If accurately fired, FASCAM can deter or stop all enemy defensive position improvements. The enemy's engineers have to reorient to either clear FASCAM from the position or cease work. The enemy can't resupply or even evacuate the "FASCAMed" position.

The enemy has four hours with a short duration FASCAM minefield or 48 hours with long duration to react to this "time bomb," and react he must. FASCAM buys the friendly commander at least four hours to maneuver his forces to the objective and the artillery commander four hours to reposition the unit after firing FASCAM. If the enemy stays in position, he must clear the minefield to regain his position's tenability. If he leaves, he must start over again in a new location with less time and, hopefully, fewer assets. Time-on-targets (TOTs) may be fired in conjunction with FASCAM detonation to further incapacitate the enemy and signal the attack.

Other employment options are to shoot FASCAM on known infiltration routes and landing zones to shut them down for specific times. FASCAM even can be incorporated into the last volleys of counterfire missions on enemy artillery units.

There's no specific number of rounds required to employ FASCAM in these unconventional ways. Our FMs and safety diagrams fail to give information to compute anything less than a 400 x 400 aerial denial artillery munition (ADAM) minefield with a large safety box surrounding it. Realistically, we could shoot FASCAM at a point target (a single aim point) with as many rounds as we deem necessary. We then can use the appropriate single aim point safety box for FASCAM missions to report the minefield to friendly units.

So, how do we destroy that mobile 82-mm mortar? First, both the S2 and S3 sections battle track friendly forces and keep a detailed log on enemy actions. The mortar crew fired three times with a 400-meter radius within 45 minutes. Our radar tracked the firing each time, yet our counterfire efforts were unsuccessful. We used all organic assets, several different shell and fuze combinations, naval gunfire and priority targeting, but the resilient mortar persisted six times.

We fired a 400 x 400 medium-density ADAM minefield and received no more incoming from that area. The next morning (well after the four-hour mark), we sent a small maneuver force to confirm or deny our success. The force discovered one all-terrain vehicle (ATV) damaged and three enemy personnel killed in action. The 82-mm mortar tube had been recovered by another enemy element but was not used for lack of personnel to man it.

Engineer and artillery communities need to develop more flexible minefield employment options for the maneuver commander to consider. No, FASCAM isn't the end-all munition, but it's one answer right there in our unit basic load.

Weapon	Nomenclature	DODIC	Submunition Dud Rate	Notes
105-mm Howitzer	M444 APICM	C462	>18%	Phasing Out
	XM915 DPICM	Unassigned	<0.2%	Field in 1998
155-mm Howitzer	M449A1 APICM	D562	≈5%	Phasing Out
	M483A1/864 DPICM	D563/D864	<1.5%	
	M718/741 RAAMS	D514/D515	Classified	
	M692/731 ADAM	D501/D502	Classified	Comparable to DPICM

Legend:

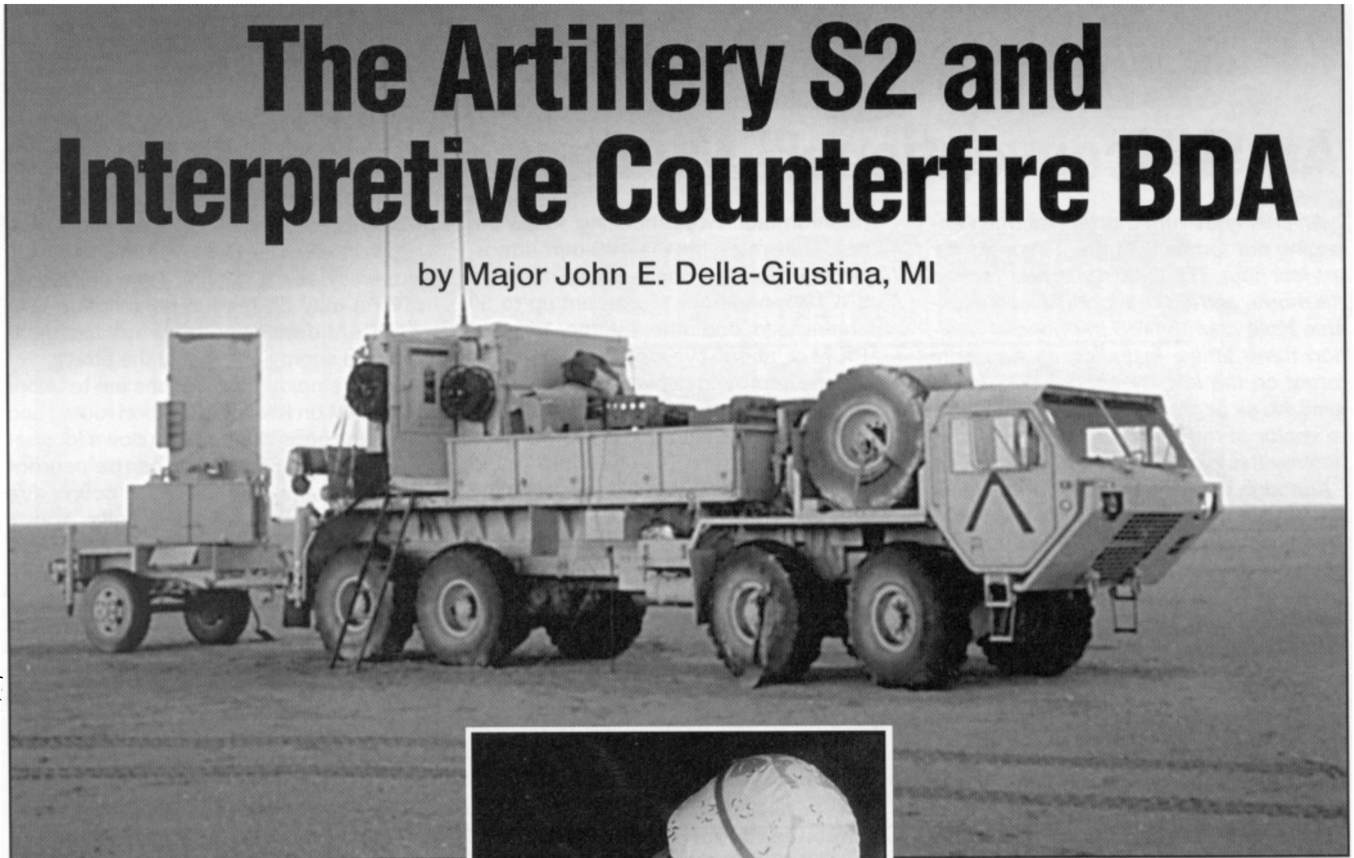
APICM = Armor-Piercing Improved Conventional Munition
ADAM = Aerial Denial Artillery Munitions
DODIC = Department of Defense Indentification Code
DPICM = Dual-Purpose Improved Munition
RAAMS = Remote Anti-Armor Mine System

Dud Rates for Various Artillery-Delivered Munitions

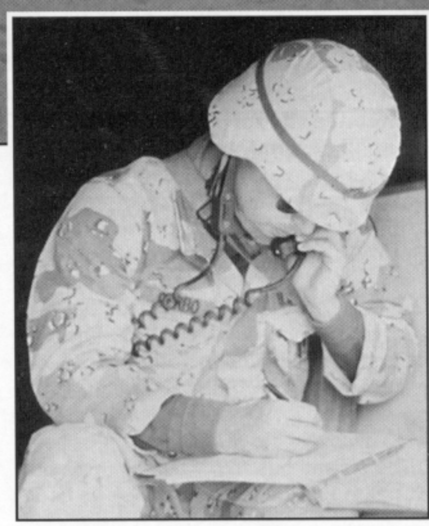
CPT William B. Hight, Former Assistant S3
LTC Frank J. Grand III, Commander
3-6 FA, 10th Mountain Division (Light)
Fort Drum, NY

The Artillery S2 and Interpretive Counterfire BDA

by Major John E. Della-Giustina, MI



F/333 FA's Firefinder, Operation Desert Storm



Battle damage assessment (BDA) has become one of the Army's most important doctrinal issues of this decade. In February 1991 during the Gulf War, the estimated amount of battle damage to the Iraqi army triggered the start of the Allied Coalition's ground campaign. Since then, the US military has been developing better procedures to evaluate the results of all fires on the enemy's military. However, specific doctrine on how to analyze and calculate BDA and combine BDA reports from multiple sources is still evolving.

This article describes how the direct support (DS) artillery battalion or division artillery (Div Arty) S2 determines BDA from reactive counterfire using Firefinder radar acquisitions and fire mission logs–BDA interpreted from data, not from observed damage. The article also explains how the artillery S2 fuses the information to report enemy artillery concentrations on the battlefield.

Counterfire BDA Assumptions. Where direct, observed BDA cannot be conducted on enemy artillery units, the artillery S2's mission is to estimate BDA based on interpreting the physical damage caused by counterfire missions. He uses this and other intelligence information to determine the enemy artillery's organization, location, strength and status and predict the enemy artillery's successive operational phases of fire. By continually conducting BDA, the S2 integrates himself into the counterfire mission cycle and is better able to recommend the most effective way to neutralize or destroy the enemy artillery.

Because this assessment is based on interpreted damage, not observed damage, the accuracy of the BDA estimate is contingent upon certain assumptions.

• *The BDA attrition tables are accurate.* These tables are based on the Joint Munitions Effectiveness Manuals (JMEMs). This includes the assumption that the artillery rounds fired at the target impacted at the desired aim point in the manner in which the rounds were designed.

• *When the counterfire rounds were fired, the enemy artillery target was still located where the intelligence asset reported it.* Firefinder radars provide timely responses for reactive counterfire targets. But when using other intelligence sources for proactive counterfire missions, the FA intelligence officer at the division analysis and control element (ACE) or the maneuver brigade S2 must use target selection standards (TSS) to determine if the information can be passed to fire support channels for targeting. The average time it takes to get the information from the intelligence sensor to the shooter in conjunction with enemy artillery windows of vulnerability must be analyzed to determine if each intelligence asset is going to be responsive enough to influence enemy artillery targeting.

• *The artillery S2's original information about the size, strength, location and status of enemy artillery systems on the battlefield is accurate and, therefore, a valid basis from which to attrit enemy systems.* ("Status" refers to what operations the enemy artillery is conducting and what its defensive posture is.) The S2 combines his knowledge of enemy artillery doctrine and tactics with a detailed intelligence preparation of the battlefield (IPB) and continuously tracks the enemy situation while simultaneously developing targets.

• *The S2's information about the radar acquisitions and friendly missions fired and munitions employed are accurate and timely*. This means he must receive complete and timely fire control log information from the fire direction center (FDC) or fire control element (FCE) and radar acquisition data from the radar target processing section.

Unobserved Counterfire BDA Analysis. BDA analysis for reactive counterfire based on an interpretation of data has two major steps. The first step is based on intelligence analysis and determines the correct enemy artillery units to attrit for specific counterfire missions. It answers the question, "What unit did we damage?"

The second step is based on the application of BDA physical damage assessment tables to determine how many artillery systems to attrit for each mission. It answers the question, "How many artillery pieces did we destroy?"

Step 1—Determining What Unit was Damaged. Identifying which enemy artillery unit to assess counterfire losses against is the more difficult of the two main analysis steps. The S2 first determines if intelligence reports on the enemy situation map have specific artillery units in the vicinity of the targeted location. If only one unit is in the area, the S2 assesses that the artillery acquisitions were from that unit and that reactive counterfire missions attrited the unit's systems.

However, the enemy can have multiple battalions and separate batteries in the same general area. Then, as time permits, the S2 must analyze Firefinder and intelligence data and other factors to try to determine which unit to attrit. The additional factors analyzed include the terrain, the enemy's doctrine and tactics and equipment capabilities. For example, an analysis of the terrain around the targeted area can reveal possible artillery position areas and help determine what type and size of enemy artillery units can fire from that location. The terrain analysis is compared with the artillery order of battle and situation templates developed during the planning process to identify the enemy unit.

The bottom line is the artillery S2 must do a thorough IPB during planning and then track enemy units throughout the battle to accurately attrit the right units in BDA analysis.

Firefinder radar acquisition reports provide valuable information that can help determine what type of enemy unit is conducting artillery operations from a given location. Radar data used in BDA include the time of acquisition, point-of-origin (target location), point-of-impact and type of round, such as mortar, artillery or rocket. (If the radar's impact predict function is disabled or the acquisition violates a call-for-fire or critical friendly zone, the impact predict grid coordinates will not appear on the radar's digital format; the radar section must report the coordinates by other means, such as over the FM net.)

For BDA purposes, the most important data the radar provides is the point-of-origin–the location from which the enemy fire originated. The point-of-impact of the enemy round tells us what the enemy artillery was targeting and can help us determine the type of enemy artillery system that fired. This information is fused with the enemy artillery IPB on the situation template. The analysis can confirm, deny or adjust the maneuver element's situation and event templates. The DS artillery battalion S2 gives the information to his commander and maneuver brigade S2. Figure 1 shows two examples of how to use Firefinder radar data to determine which enemy artillery unit fired.

In a high-intensity battle with hundreds of radar acquisitions in a short time, the S2 may not have time to conduct this type of analysis. But he must do the analysis initially and periodically thereafter to understand how the enemy artillery is arrayed on the battlefield and what type of artillery tubes should be attrited in counterfire missions.

Step 2: Determining How Many Artillery Pieces were Destroyed. This second step of BDA analysis depends on several variables. Much of the data comes from the fire mission control logs and radar acquisition reports.

The key data the S2 uses from the fire mission control logs includes the time of the counterfire mission, targeted location, number and type of round or rocket fired and target number. The S2 uses this information in combination with the radar data to calculate three pieces of information required to assess enemy artillery losses.

• The S2 calculates the time between the intelligence report or radar acquisition and the fire mission. He does this to verify the likelihood of the target's still being in the location the acquisition or report said it was. When a firing unit and the radar are in the sensor-to-shooter mode, the counterfire mission will be timely enough to assess battle damage. However, that will not be the case for all missions. Most fire missions against enemy artillery will be based on intelligence reports or radar acquisitions. Except for preparation and preplanned fires, few missions will be shot against templated enemy artillery positions.

• The S2 calculates the range to the target from the shooter.

• He also determines what the enemy artillery system is and whether or not it's dug in or exposed.

Given these calculations, the S2 uses the JMEMs or a BDA formula modified to replicate as closely as possible the algorithm used by simulation computers to account for the damage incurred from US artillery missions. (The simulation BDA formulas developed by various units also are built loosely on JMEMs data; JMEMs data is classified.)

(1) Distance Between Point-of-Origin/Point-of-Impact
- Round originated from templated motorized rifle (MR) regimental artillery group (RAG).
- Distance between the point-of-origin and point-of-impact is 16.5 kilometers.
- RAG's organic 2S1 battalion only has a range of 15.3 kilometers.
- *Therefore:* A 2S3 battalion or battery was pushed down from the divisional artillery group (DAG).

(2) Comparison with Type of Artillery Round
- Round originated from templated MR DAG.
- Distance between point-of-origin and point-of-impact is 18 kilometers.
- Type of artillery is rocket.
- *Therefore:* a BM-21 battalion or battery fired.

Figure 1: Deducting the Type of Enemy Artillery. Using Firefinder data, this figure shows two ways to deduce what enemy artillery is firing. The examples are based on "Krasnovian" threat artillery at the National Training Center, Fort Irwin, California.

Firing Unit	# Rds/Rkts Fired	Target	Range to Tgt	% BDA	# Attrited	Strength
(1) US 155mmHow Bn	Bn 6 (144 Rds)	2S3 Bn 152mmHow	12 kms	.33	6 Tubes	12/18 66%
(2) US MLRS Plt	Plt Volley (36 Rkts)	BM-21 Btry 122mmMRL	30 kms	.17	1 System	5/6 83%

Legend:

Bn = Battalion **How** = Howitzer **MLRS** = Multiple-Launch Rocket System **Plt** = Platoon **Rkts** = Rockets
Btry = Battery **kms** = Kilometers **MRL** = Multiple Rocket Launcher **Rds** = Rounds **Tgt** = Target

Figure 2: Calculating Battle Damage Assessment (BDA). These two examples of BDA calculations are loosely built on JMEMs data (actual data classified as "Confidential").

Unit	Type Arty	Grid	Strength	Status	Est Damage
64 MR DAG	152mmHow Bn 2S3	WJ364721	18/14	Firing in Open	IIIIII (6)

Figure 3: Artillery Order of Battle/BDA Tracking Chart. This example is of a motorized rifle (MR) divisional artillery group (DAG).

Arty Group	# Bns	# Systems	# Est Destroyed	# Remain	% Strength
1 RAG	2	36	12	24	66
2&3 RAG	5	90	36	54	60
55 MR DAG	4	72	26	46	64

Figure 4: Counterfire BDA Report

Figure 2 uses fictitious JMEMs data to calculate BDA in two examples.

Counterfire BDA Tracking and Reporting. The artillery S2 can use several techniques to track BDA. The most common format is an Excel spreadsheet or a similar table.

Figure 3 shows the technique of combining enemy artillery order of battle information with BDA attrition on a work sheet. The key part of any BDA work sheet is the column that allows the S2 to subtract artillery tubes as he analyzes counterfire missions. As the battle continues, he tracks the number of artillery systems destroyed in each enemy artillery unit and, periodically, issues a counterfire BDA report.

Counterfire BDA reports from the DS FA battalion S2 are sent to the Div Arty S2 and brigade S2. The brigade S2 consolidates BDA from all units in the brigade combat team (BCT) and forwards it to the division G2. (To prevent redundant reporting, the Div Arty S2 uses the DS battalion S2's report for informational purposes and does not report it to G2.) If the Div Arty is the force FA headquarters, the subordinate FA unit S2s calculate and collect BDA from their units' counterfire missions and report the information to the Div Arty S2 for analysis.

All general support (GS) or general support reinforcing (GSR) units report BDA to the Div Arty S2, who consolidates the BDA and sends it to the division G2. Units reinforcing (R) a DS FA battalion report counterfire BDA to the maneuver brigade S2, either directly or through the DS FA battalion S2, depending on standing operating procedures (SOP).

The BDA report format, like the format for tracking counterfire BDA, must be kept simple. Both contain similar information. The BDA report conveys the current estimated strength of the artillery concentrations or units directly opposing the supported maneuver force. For the DS FA battalion S2, this could be several regimental artillery groups (RAGs) and a division artillery group (DAG). For the Div Arty S2, this might be several DAGs and reinforcing corps or army artillery. Figure 4 shows a sample BDA report.

The 2d Infantry Division Artillery in Korea has had success using this counterfire BDA process in several exercises, including Ulchi Focus Lens, a Battle Command Training Program Warfighter and the Joint Precision Strike Demonstration. Overall, the aggregate numbers for estimated counterfire BDA were close to the actual amount of enemy artillery destroyed.

However, in comparing the estimated and actual numbers destroyed from each specific unit, there were some discrepancies. The estimates were too high for some units and too low for others. This confirms that the more difficult analysis step is determining which enemy unit had its artillery destroyed rather than how many systems were destroyed.

Although counterfire BDA is primarily an estimate, S2s and commanders can use it effectively. It not only helps them understand artillery effects on the enemy, but also aids in tactical intelligence analysis to provide a common understanding of the battlefield and help predict enemy actions.

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New Ammo Update

As the modern battlefield changes rapidly with the advent of new technology, the need for new ammunition that increases our power and flexibility in support of the maneuver commander is at an all-time high. This article outlines the capabilities of some new or unfamiliar ammunition.

M913 105-mm RAP. The new M913 105-mm rocket-assisted projectile (RAP) increases range by 40 percent and lethality significantly over the standard M1 projectile. In contrast to the older M548 105-mm RAP, which uses the low-end M176 propellant, the M913 uses the M229 maximum propelling charge (Charge 8, high end). The increased range is obtained by using the M229 propellant coupled with a modern rocket motor designed to survive a high-"G" and high-spin environment.

The rocket motor will function approximately 15.5 seconds after leaving the tube to maximize range extension. With the rocket on, the M913 provides a range of more than 19.5 kilometers. (When the M119 fires the M913 with Charge 8, the howitzer's quadrant elevation, or QE, is limited to 800 mils, producing a maximum range of 19.5 kilometers.) Additionally, the high-fragmentation steel body of the M913 provides an 80 percent increase in lethality over the M1.

Multiple lots of the M913 already have been produced and fielding, originally scheduled for the second quarter of FY 98, awaits minor changes to the battery computer system (BCS) Version 11 software.

Although the M913 is a war-reserve only projectile, proposals are underway to allot a small amount per FY for unit training. The projectile's Department of Defense Ammunition Code, or DODAC, is 1315-C546.

M915/M916 105-mm DPICM. Lightfighters soon will have a dual-purpose improved conventional munition (DPICM) with self-destructing submunitions as a means of accomplishing their missions. This projectile will provide the light infantry divisions extended range-out to 14.1 kilometers-and enhanced lethality against both personnel and armored targets.

The increased range is obtained by firing the M119A1 howitzer using the M200 maximum propelling charge (Charge 8, high end). (When the M119 fires the M915 with Charge 8, the howitzer's QE is limited to 800 mils, producing a maximum range of 14.1 kilometers.)

The M916 is the same projectile as the M915 but will be fired with the M67 propellant (low-end charge).

Both projectiles payloads consist of 42 new M80 submunitions, which incorporate a self-destruct device for non-functioning munitions. The self-destruct feature allows friendly force maneuvering flexibility on the modern battlefield.

The submunition either detonates or self-destructs within seven minutes (plus or minus one minute) from impact. Recent testing of more than 4,000 M80 grenades proved that 99.8 percent detonate or self-destruct within the time frame.

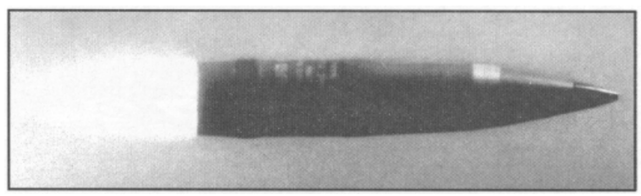
Firing tables were produced for both projectiles in April 1997. Currently, both projectiles have no DODAC numbers; initial operational capability is scheduled for the fourth quarter of FY 98.

M795 155-mm HE. This high-explosive (HE) projectile will augument the standard M107 HE shell. The M795 increases range by 32 percent–out to 22.5 kilometers–due to its compatibility with the M203A1 propelling charge and increases lethality with high-fragmentation steel. Ballistically similar to the M483A1, the M795 will provide low-cost registration data for the M483 family of projectiles and head the ballistic family.

The Field Artillery is restricted in its ability to obtain muzzle velocity variation (MVV) and registration data for the DPICM family of projectiles because of the limit on using M825 smoke projectiles and restrictions concerning high dud rates when firing the M483A1. With the fielding of the M795 in the third quarter of FY 98, determining registration data for DPICM will be easier. The M795 projectile's DODAC is 1320-D529.

M864 Base-Burn DPICM. Approximately, 30,000 of these rounds were shipped to the Gulf in Operations Desert Shield and Storm. But, at that time, BCS didn't include the M864 in its software and the round required units to use unfamiliar provisional tabular firing tables (TFTs) to compute its firing data. Consequently, units didn't fire the M864. In addition, because the M864 has the same training restrictions as the M483A1, the M864 is still a mystery to many Redlegs.

The M864 complements the M483A1, increasing range to 28.2 kilometers and area coverage by 200 percent. Additionally, the base burner unit achieves its extended range through a solid propellant non-propulsive base drag-reduction system–not through added propulsion as in RAP. The reduced drag is the result of gases being expelled from the base burner unit.



M864 Base-Burn Round in Flight

As Redlegs we must not only be tactically and technically proficient with current ammunition, but have a solid understanding of new ammunition that will play an integral role in future conflicts.

If Redlegs have questions about 105-mm ammunition, contact Bill Sanville, 105-mm Deputy Project Officer, Fire Support Armament Center (FSAC), Picatinny Arsenal, New Jersey, at DSN 880-6128 or (973) 724-6128. For questions about 155-mm ammunition, contact Dominick Demella, 155-mm Project Officer, FSAC, at DSN 880-4422 or (973) 724-4422. For general questions, call the Officer Instruction Section of the Gunnery Department, Field Artillery School, Fort Sill, Oklahoma, at DSN 639-6379/4973 or commercial (580) 442-6379/4973.

Captain Daniel J. Ladrech, USMC
Officer Instruction Section, Gunnery Department
Field Artillery School, Fort Sill, OK

TOC Counterfire Battle Drill

by Captain Robert D. Kirby and
Chief Warrant Officer Three Robert A. Nelson, Jr.

The opposing force (OPFOR) 120-mm mortars fired on the brigade's breaching force, violating an active critical friendly zone (CFZ). Five minutes later, Paladin battery fire suppressed the mortars and destroyed two tubes.

While the first mission was being processed, the Q-36 Firefinder radar acquired a battery of 2S1 howitzers firing, violating a call-for-fire zone (CFFZ). The direct support (DS) battalion tactical operations center (TOC) cleared the mission and passed it to the reinforcing (R) artillery battalion. Minutes later, multiple-launch rocket system (MLRS) launchers destroyed the 2S1s.

In this scenario, the DS battalion executed the brigade's essential fire support task (EFST) of suppressing the enemy's artillery to protect the breaching force. The battalion's success was, in large part, due to a counterfire battle drill in its TOC that dramatically reduced acquire-to-fire times.

This article summarizes the counterfire tactics, techniques and procedures (TTP) employed by successful units at the National Training Center (NTC), Fort Irwin. California. We discuss the TOC's counterfire battle drill within the context of the targeting process, from planning through execution. The TTP work equally well in DS and R battalion TOCs.

The Counterfire TOC

To succeed in the counterfire battle drill, the battalion TOC must set the conditions to function quickly and efficiently. The battalion establishes conditions in terms of the TOC's physical layout, communications, computer setup, information management and TOC training.

Iraqi 122-mm Howitzers, 1991

Target Number	Point-of-Origin	Point-of-Impact	Time Acquired	Time Mission Fired	Acquire-to-Fire Time	Rounds Fired	Probable Target Type	Estimated BDA
AD8004	28522214	—	1401	1403	2	12 Rkts	2S19	4
AD8005	28532165	46321478	1402	1406	4	Bn 3 DP	2S1	3
AD8006	28582170	46321478	1402	—	—	—	2S1	Did Not Fire

Legend: **BDA** = Battle Damage Assessment **Bn** = Battalion **DP** = Dual-Purpose Improved Conventional Munition **Rkts** = Rockets

Figure 1: Sample Counterfire Log

TOC Layout. The layout must facilitate rapid information flow and crosstalk among staff members, particularly the S3 and battalion fire direction officer (FDO). The fire direction center (FDC) vehicle should be centrally located in the TOC. The FDO's battle station, the place where he sits or stands during the battle, should be where he can easily talk to the S3 yet supervise the FDC.

The TOC's operations situation map (SITMAP), the focal point of activities, also should be centrally located. If other sections maintain working maps, such as the intelligence section, TOC personnel must update the SITMAP in accordance with the unit's standing operating procedures (SOP).

Communications. The TOC's commo net structure depends on the mission and equipment available. The seven inherent responsibilities of a Field Artillery tactical mission establish the nets for the four standard missions. However, in addition to these nets, the S2 section should monitor the maneuver brigade operations and intelligence (O&I) net if a radio is available.

Another useful net is the division artillery (Div Arty) counterfire net. On this net, the S2 can coordinate zone coverage with radars supporting the Div Arty when the DS battalion's Q-36 is moving or not mission-capable. Again, using this net depends on the equipment available.

Computer Setup. This setup assumes the TOC has two computers: a lightweight computer unit (LCU) with initial fire support automated system software (IFSAS) in the operations section and one in the FDC. MLRS battalions have an LCU with fire direction system (FDS) software.

Two factors have an impact on how radar acquisition information should flow into the TOC. First, the FDC should process only voice and digital calls-for-fire—not operational or intelligence messages, such as movement orders and spot reports. Second, the Q-36 and Q-37 radars only can send messages to one subscriber at a time. To send messages to multiple subscribers, the radar crew must switch its communications system to each subscriber, increasing the time to send an acquisition. Considering these two factors, the radar should send all messages to the operations section.

The radar messages stop at this computer, with the exception of FM;CFFs. The operations section computer can be set up to automatically route FM;CFFs to the battalion FDC. This computer should be hard-wired to the FDC's LCU to prevent competition with other messages on busy FM digital nets, which could delay the information flow between the two computers.

Information Management. For the counterfire battle, the S2 maintains a counterfire log (see Figure 1). Similar to a fire mission log, this log records the information produced during the counterfire battle, including radar acquisitions tracked by the S2 or targeting officer. In addition to normal fire mission data, the log has entries to record the predicted point-of-impact and time of acquisition. In the *assess* function of the *decide-detect-deliver-assess* targeting process, this log is an invaluable tool for the S2 to determine the effectiveness of the counterfire fight.

Decide: EFSTs

During the tactical decision-making process, the brigade commander decides what he wants to achieve with counterfire and when he wants to achieve it. He states this as part of his intent and force protection priorities, which are translated by the fire support coordinator (FSCOORD) and brigade fire support officer (FSO) into EFSTs. The EFSTs, in turn, drive the positioning of the radar and placement of radar zones.

Counterfire against a regimental artillery group (RAG), for example, is typically the DS battalion's responsibility. The DS battalion may be assisted by an R or general support reinforcing (GSR) unit in the artillery organization for combat.

The brigade fire support element (FSE) and artillery battalion staff consider several factors in organizing for the counterfire fight (see Figure 2). The bottom line for the staff is to establish a responsive counterfire system that can achieve the brigade commander's intent–accomplish the EFSTs.

- Who will be responsible for firing counterfire in the brigade zone or sector—the direct support (DS) or reinforcing (R) unit?
- To whom will the Q-36 radar send acquisitions?
- Who will receive this information message-of-interest (MOI)?
- Who will analyze the data from the acquisitions to determine and refine the template for the enemy artillery?
- Who will he report this data to, and will it be in raw or analyzed form?
- What information does the division artillery counterfire cell need to provide?
- Who will be responsible for planning, refining and cueing radar zones?

Figure 2: Factors to Consider in Organizing Artillery for Counterfire. The answers to these questions are based on the mission, enemy, terrain, troops and time available (METT-T).

Standard Fire Order. In the artillery battalion TOC, the staff should determine a standard fire order for counterfire targets. This is primarily the work of the S3, battalion FDO and S2. The fire order must be based on analysis of the expected target type and the Joint Munitions Effects Manuals (JMEMs). The S4 also should be involved in this process to determine if any ammunition shortfalls or restrictions exist. A standard fire order determined during planning greatly speeds the delivery of fires during battle.

EFST Format. The brigade commander's intent for counterfire is stated in a force protection EFST, using the task, purpose, method and end-state format.

A well-defined end state is particularly helpful in planning for the counterfire fight. The end state should be expressed as a number of enemy artillery and (or) mortar systems destroyed. If the commander wants these systems destroyed by a certain point in the battle, this should be stated in the end state.

For example, the commander may desire an end state of "18 weapon systems of the RAG destroyed prior to Phase III breaching operations" in an offensive operation. This also could be expressed as a percentage-say, 50 percent of the RAG-with the staff computing the exact number of systems based upon the expected composition and strength of the RAG. Figure 3 is an example of a counterfire EFST.

A specific end state does two things for the battalion staff. First it helps define when the artillery battalion has succeeded in the counterfire fight. The S2's analysis of acquire-to-fire times and the volume of fires delivered against the enemy's artillery helps him estimate the number of weapon systems destroyed at any time during the battle.

Q-36 Firefinder Radar Setup at the NTC

But a specific end state defines more than success. During the staff planning process, the required end state is the start point for determining the amount of ammunition the battalion must dedicate to counterfire. Using the number of systems to be destroyed and a standard fire order for counterfire, the staff does the battlefield calculus to determine how much ammunition is needed to accomplish the task.

For force protection, the brigade commander should state his priorities in terms of assets, functions or positions critical to the brigade's mission, and when they are critical. Because the radar only can have nine zones active at a time, the brigade commander must provide his protection priorities, based on critical locations or events. His priorities could include, for example, the breach site or zone of penetration, the main effort's battle position or a refuel-on-the move site. By stating where he wants the priority for counterfire radar coverage, he helps ensure the coverage plan will achieve his intent.

Detect: Focusing Assets

During this function of the targeting process, the battalion staff and FSEs focus the assets that will acquire and attack enemy artillery systems. The driving force in this step is the brigade commander's intent for counterfire. The staff's intelligence preparation of the battlefield (IPB) and the radar zone plan are the critical elements in the *detect* function.

IPB. The S2 is a key player in counterfire. He must be able to answer several key counterfire questions during IPB process (see Figure 4). The last question in the figure is the most important. The S2 must be able to portray how, when and where the enemy artillery will fire against friendly forces. It isn't enough for him to restate the definitions of the enemy's phases of fire; instead, he must answer the question in terms of time and space on the battlefield.

A useful technique is to develop a time line that depicts when the enemy artillery will move, set and fire in relation to the friendly scheme of maneuver. When briefed with the situation template (SITEMP), the time line shows when friendly artillery must be in position ready to fire and when the radar must cue. If conflicts arise between competing EFSTs or the requirement to reposition, the battalion should request reinforcing fires and (or) zone coverage from Div Arty.

The S2 and targeting officer must consider the enemy's firing of family of scatterable mines (FASCAM) and chemical munitions. Just as with our artillery, the enemy must fire large volumes of these munitions to employ them effectively. When firing chemical munitions, the enemy unit must stay in position to fire the volleys while its soldiers wear an equivalent to our mission-oriented protective posture gear (MOPP-4), which degrades their ability to fire rapidly. In terms of counterfire, this equates to a high-volume acquisition and is a prime opportunity to kill enemy artillery systems.

The radar won't acquire a "high-volume acquisition," as such. The targeting personnel determine what constitutes a high-volume acquisition. The S2

Task:	Destroy the RAG
Purpose:	To provide force protection to the brigade's support-by-fire and breaching force during Phase III breaching operations.
Method:	DS fires Bn 6 volleys DPICM per acquisition. MLRS fires 12 M26 rockets per acquisition. Q-36 is positioned to acquire the templated RAG. Supplemental Q-37 coverage is coordinated for.
End State:	18 systems/50% of the RAG destroyed before Phase III starts; RAG is suppressed during breaching operations.

Legend:
Bn = Battalion
DPICM = Dual-Purpose Improved Conventional Munition
DS = Direct Support
MLRS = Multiple-Launch Rocket System
RAG = Regimental Artillery Group

Figure 3: Sample Essential Fire Support Tasks (EFSTs) for Counterfire

should recognize this when the predicted impacts of a large number of acquisitions are at the same grid or in its vicinity. Based on the enemy template for FASCAM and chemical strikes, he can assess what munitions may have been fired.

The S2 can use this data to inform friendly forces of the danger and, in conjunction with spot reports from other units, to confirm or refine his assessment of the enemy's plans. If he has accurately templated these strikes in time and space during the IPB, both the radar and firing units will be in position to respond effectively and destroy the weapon systems firing the munitions.

Radar Zone Plan. A good zone plan–one based on the enemy situation and friendly scheme of maneuver that has been wargamed, rehearsed and properly linked to a firing unit–is the critical element in the counterfire fight.

The zone plan, just like the fire plan, is a top-down process, starting with the brigade FSO and ending with zone refinement from the bottom up. (This article doesn't cover the TTP for zone planning in the close fight. For such a discussion, see the article "Radar Zone Management in the Close Fight" by Chief Warrant Officer Two Donald F. Cooper in the "National Training Center's Fighting with Fires" Center for Army Lessons Learned (CALL) Newsletter, Number 95-6, May 1995.)

A good zone plan has several characteristics. First, the plan satisfies the brigade commander's intent. Each zone has a clear purpose and a cueing agent who can best determine when to turn on and off the radar or refine that zone. The zones have a clear trigger based on a friendly or enemy event. Communications are established among the sensor, shooter and cueing agents. The fire support plan identifies clear attack guidance for the designated shooter when the zone is violated by enemy fires. Finally, the zone plan has been *wargamed* and *rehearsed*.

- What is the disposition, composition and strength of the RAG and (or) DAG, including the number of systems by type of weapon?
- What are the capabilities of these weapons (emplacement and displacement times, range and type of munitions they can fire)?
- What is the counterfire threat against friendly artillery (how the enemy will acquire and attack us)?
- What is the ELINT threat (enemy's systems that can locate and target the radar)?
- How will the enemy commander employ his artillery (phases of fire, possible position areas and any special munitions, such as FASCAM or chemical fires)?

Legend:

DAG = Divisional Artillery Group
FASCAM = Family of Scatterable Mines
ELINT = Electronic Intelligence
RAG = Regimental Artillery Group

Figure 4: Counterfire Considerations During the Intelligence Preparation of the Battlefield (IPB) Process

Deliver: The Counterfire Battle Drill

The counterfire battle drill is executed as a reaction to an acquisition sent to the TOC by a counterfire radar. The TOC receives an acquisition via two methods. The first is when enemy fires violate a CFFZ or a CFZ, generating a digital call-for-fire message (FM;CFF). The second method results from enemy fires violating an artillery target intelligence zone (ATIZ) or when those fires are detected in the radar's search fence but do not violate an active Firefinder radar zone. This second method generates an artillery target intelligence message (ATI;CDR). Both methods result in the execution of similar procedures.

Ideally, the TOC processes the call-for-fire or ATI message within one minute-a tough standard. The time starts when the TOC receives the acquisition and ends when the FDC transmits the call-for-fire to the unit to fire. Many actions must occur in this time, but units can meet the standard with enough training.

FM;CFF Processing. This call-for-fire message enters the TOC through the operations section computer. The message is automatically routed to the FDC LCU. When the call-for-fire is displayed on the screen, the FDC computer operator announces, "Fire Mission!" This alerts the remainder of the TOC to start the counterfire battle drill. The FDC operator then reads aloud the following data: target number, target grid location, target type and time of receipt. The designated recorders enter the data in the FDC fire mission log and counterfire log.

As the operator reads off the target location, the battle captain, battalion S2 and FDO check and plot it simultaneously. The battle captain plots the grid on the operations SITMAP to check for any fire support coordinating measure (FSCM) violations. If the target does not violate an FSCM, he announces, "Target number ________, clear!" If the target violates an FSCM, he announces, "Target number ________, not clear; violates FSCM [the reason why it isn't]." He then tries to clear the target through doctrinal channels.

The S2 also plots the target on the SITEMP to determine where the enemy fires originated and what weapon system or unit may have fired. He then announces the result as, "Target number ________, RAG [or specific type of weapon]." He can have the recorder enter this determination in the counterfire log for battle tracking and periodically assessing the results of the battalion's counterfire efforts.

The FDO also plots the grid to conduct two checks. The first is a backup clearance-of-fires check. (The battle captain's clearance check is the primary check.) The second check determines which unit(s) can range the target. He then determines which unit is available to fire. If a unit is in range and is available to fire, the FDO announces "Target number ________; A Battery [the unit]."

The FDO then formulates his fire order. A standard fire order greatly expedites this process. The FDC computer operator can make the appropriate entries in the message format and await the command to send it to the unit to fire. If the battalion can't attack the target, the FDO announces, "Target number ________; out of range [the reason why]."

The reason for announcing the results of the three checks is to provide the S3 the information he needs to approve or disapprove the fire mission. If the target meets the attack guidance, is cleared, a firing unit is available and no other EFSTs have priority, the target is approved. The S3 then commands, "Fire target number ________!" If the S3 disapproves the target for attack, he must issue guidance to the FDO concerning what to do with the mission (e.g., send it to a reinforcing unit).

The FDC takes the appropriate action by sending the mission to the unit to fire (or wherever the S3 directs). Recorders update their respective logs and await the mission-fired report.

ATI;CDR Processing. The battle drill procedures for processing the artillery target intelligence message are similar.

The ATI;CDR arrives at the operations section computer. When the message is displayed on the screen, the IFSAS operator announces, "Acquisition!" This alerts the remainder of the TOC to start the counterfire battle drill and that ATI;CDR data will follow.

The operations section computer operator then reads aloud the data from the message format: target number, point-of-origin location, point-of-impact location, time of acquisition and target type. Recorders make the appropriate entries on their forms.

The battle captain, S2 and FDO make the same checks and announce the same information as described for an FM;CFF. In addition, the S2 and battle captain plot the point-of-impact to determine what friendly units are affected by the enemy. This can help in prioritizing which acquisitions to fire first. Clearance of fires is especially critical in processing an ATI;CDR. These acquisitions can occur anywhere in the radar's search fence without regard to coordinated radar zones or FSCMs.

The S3 also must approve the acquisition as a fire mission. He uses the same criteria listed before. If approved, he directs the FDO to fire the target; if not, he issues guidance to the operations section computer operator. If the mission is disapproved the operator sends the ATI;CDR to the appropriate unit or ends the mission.

If approved, the operator processes the ATI;CDR, sending it to the FDC. When the acquisition, now an FM;CFF, is displayed in the FDC computer, the operator and FDO verify the target number as the same as the ATI;CDR just cleared and approved. (New FM;CFFs could come into the FDC that start the counterfire battle drill or that may be calls-for-fire against maneuver targets.)

If the target number matches the approved ATI;CDR number, the FDO issues his fire order. The FDC computer operator makes the appropriate entries and then transmits the mission to the unit to fire. Recorders then update their logs.

MFR Processing. In MLRS units, the mission-fired report (MFR) ends the counterfire battle drill for a specific target. When the MFR is displayed or reported to the FDC, the computer operator announces "MFR, target number ________; A Battery fired at 1403 12 rockets [time the unit fired and any changes to the fire order originally sent to the unit, particularly the number of rounds, or rockets fired]."

For cannon battalions, a report from the battery FDCs that the target was fired will end the counterfire battle drill. Recorders complete the entries in their logs for that target. The FDC updates the battalion's ammunition status. The TOC reports in accordance with its SOP. If the firing unit must move or reload, the FDO notes when that unit will be available to fire again.

Assess: Counterfire Effectiveness

The staff *assesses* the effectiveness of the counterfire fight, starting with a review of the counterfire log. Assessment is an ongoing process, not something done only after the battle. To estimate the damage to the enemy's artillery systems, the staff must have several pieces of information: the friendly force acquire-to-fire times (time of the acquisition to the time the unit fired), enemy weapons emplace and displace times, JMEMs predicted effects on enemy artillery, an assessment of friendly artillery fires accuracy, and enemy fires points-of-origin and points-of-impact.

The time of the acquisition is determined two ways. It's an entry in the ATI;CDR format that shows when the radar actually acquired the target. For an FM;CFF, the S2 uses the time the radar sent the message to the operations section computer in the FM;CFF format. (The FM;CFF message does not have a time of acquisition.) The time won't be exact because the radar crew has processed the zone violation before sending it to the battalion to fire. The targeting officer or radar section chief can tell you how long it takes his crew to process an acquisition. You can add this time to the time the message was sent to determine an approximate time of acquisition.

Using the counterfire log, the S2 can keep a running count of how many enemy systems may have been destroyed by counterfire. He can periodically update the commander and staff. Unless the S2 can confirm the battle damage assessment (BDA) through "eyes-on" reports, this is only an estimate.

Armed with this knowledge, the S3 can assess whether or not the battalion has succeeded as defined by the EFST. He may advise the FSCOORD on whether to continue the counterfire fight or shift priority to other EFSTs that compete for limited resources. The staff also uses this data to refine the radar zone plan. The S2 uses the information from the counterfire log to confirm or refine the SITEMP. If the CFFZs have not been properly placed, the staff can coordinate and refine their locations to account for the updated enemy situation. This also is a continual process during the battle. If the enemy has moved, so must the CFFZs.

When a Field Artillery TOC sets the conditions that allow for a fast, efficient battle drill and trains to standard, the effects on the enemy can be devastating. The goal is to provide rapid force protection through a focused counterfire battle that meets the brigade commander's intent.

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The BOC–The Battery's Command Post

by Captain C. James Ekvall and Captain Richard M. Fenoli

The battery operations center (BOC) serves "as an alternate fire direction center (FDC) and as the battery command post (CP)," according to *FM 6-50 Tactics, Techniques, and Procedures for The Field Artillery Cannon Battery*. Unquestionably, the BOC backs up the FDC.

FM 6-50 continues: "In a battery-based (3x6) unit....the BOC serves as a focal point for internal battery operations, to include command and control, battery defense, coordinating logistics and all other operational functions normally performed by a headquarters." Those also are unquestionably the responsibilities of a CP. But FM 6-50 does not provide guidance on how the BOC fulfills those responsibilities. In fact, no Field Artillery publication does.

Our observations at the Joint Readiness Training Center (JRTC), Fort Polk, Louisiana, is that this lack of guidance results in units' using the BOC unproductively. This article examines the role and organization of the BOC and focuses on techniques and procedures for the BOC to function productively as a CP.

The Role of the CP. To determine the BOC's role as the CP, the commander must consider doctrine from outside FA manuals. *FM 7-10 The Infantry Company* is a great starting place. It states, "It [the CP] consists of the commanding officer (CO) and other personnel and equipment required to support the command and control (C^2) process for a specific mission. It is located where the CO determines it can best support his C^2 process. Its purpose is to provide communications with higher, lower, adjacent and supporting units; to assist the CO in planning, coordinating and issuing the company operations order (OPORD); and to support continuous operations by the company." Among other duties listed, CP personnel provide input or recommendations during planning, and receive and send situation reports (SITREPs) and other reports.

Another source of guidance for the commander on BOC functions is the "TOC Functions" in Section II of the "Center for Army Lessons Learned (CALL) Newsletter 95-7." The section describes the basic functions of the battalion tactical operations center (TOC): receive and distribute information, submit recommendations to the commander, and integrate and synchronize resources.

Although these references discuss infantry company CPs and battalion and brigade TOCs, one can draw parallels for the BOC. Clearly the role of the BOC includes serving as a battery's information management center and operations monitor/communications hub.

Equipment and Manning. The first question is what makes up the BOC. The best configuration for the BOC is in the back of a cargo high-mobility multipurpose wheeled vehicle (HMMWV). The addition of a trailer is also helpful.

Usually, the BOC consists of the executive officer's (XO's) vehicle equipped with two single-channel ground and airborne radio systems (SINCGARS). We recommend mounting or remoting these radios into the cargo compartment. The BOC also needs an AN/GRA 39 with DR-8 and WD-I wire, electric lights, a TA-312 telephone, an OE-254 antenna, information boards, maps, office supplies and applicable training and field manuals (TMs and FMs) and standing operating procedures (SOPs).

Personnel for the BOC is the next issue the commander must solve. With no table of organization and equipment (TO&E) for BOC personnel, the battery commander configures his BOC knowing that the personnel also will have to perform their other jobs (see Figure 1).

Successful BOCs have an NCO-in-charge (NCOIC). The NCOIC is responsible for the accuracy and timeliness of reports, obtaining required and (or) requested information, battery situational awareness and keeping the battery leadership informed.

Assisting the NCOIC is at least one radio/telephone operator (RTO). The

NCOIC	**RTO/Assistant**
Supply Sergeant	Wireman
Communications Section Chief	Armorer
NBC Sergeant	Medic
Maintenance Sergeant	Uncommitted Driver

Legend:
NCOIC = NCO-in-Charge
NBC = Nuclear, Biological and Chemical
RTO = Radio/Telephone Operator

Figure 1: Suggested Battery Personnel for the BOC

RTO must do more than merely monitor the radio. He gathers and documents information, posts graphics, submits reports and passes messages to the appropriate agencies in and outside the battery.

The BOC uses shifts to implement continuous operations. The NCOIC conducts thorough shift-change briefings that cover the current status of reports, enemy and friendly situations, the commander's critical information requirements (CCIR) and future operations.

To man the BOC, the commander must take into consideration that the soldiers must accomplish their primary responsibilities while serving in the BOC. For example, pairing the supply sergeant with a wireman in the BOC is better than pairing the supply sergeant with the armorer; this keeps two men from the same section from working in the BOC at the same time. The battery commander must clearly articulate to these individuals what he expects of them in the BOC–what the BOC must do for him and the battery.

BOC Operations. The BOC must be the one-stop location for all information important to continuous operations and tactical decision making. All operational information flowing to and from the battalion must pass through the BOC. The BOC analyzes information passed down from the battalion and sends it to the battery in a usable format.

For example, intelligence and operational summaries describing grid coordinates and phase lines are difficult for sections without maps to understand. The BOC should translate such information into "down-to-earth" terms. Reporting "the enemy was sited at grid VQ 456432 and moving south" means little to the sections. The BOC rewords the information to tell the battery that "the enemy was sighted about 30 minutes ago three kilometers north of and moving toward the battery."

It is not enough to simply post the locations of the firing units on a map. The graphics must be current, locations updated and the general scheme of maneuver understood. The BOC must post all minefield locations and mark secure routes. It must legibly present all information critical to the commander in an accurately, timely manner.

A proven technique to post information is on status charts and information boards. The charts and boards must be large enough to read from a distance, usually from the tailgate to the cab, and must be easy to update. One method is to mount these boards on Velcro for easy removal and to make duplicates of the boards for easy updating.

Not all information coming into the BOC needs to be posted on graphics or status boards. The commander tells the BOC what information he wants posted, which is usually the information most helpful to him. The posted information ranges from the brigade commander's intent for fire support to charts depicting the number of operational, manned and available howitzers (see Figure 2).

Any information important to the battery, but not posted on charts, still requires recording. Maintaining information on DA Form 1594 Daily Staff Journal (Duty Officer's Log) is a proven technique. As a general rule, you cannot record too much information or be too specific in the duty log. (The BOC supplements the duty officer's log with a forms and publications library.) It's especially important for the BOC to record in the log the sending of reports, the reception of orders and the contents of change-over briefings.

The BOC is the battery commander's staff. The information posted and recorded in the BOC is what enables him to conduct predictive analysis and be proactive (as opposed to reactive). The following scenario shows how BOC operations allow the commander to be proactive.

As the battery commander enters the BOC, the NCOIC hands him a report that B Company, 2d Battalion, 345th Infantry just discovered what the brigade S2 believes is the enemy's company supply point (CSP). Indications are that the brigade commander will make 2-345 IN's attack on the CSP his main effort.

With the help of the posted and updated information in the BOC, the battery commander analyzes the current azimuth of fire, the ammunition on hand and the number of crews available. He then determines if the battery needs to lay on a new azimuth of fire, request ammunition or change its howitzer readiness status. He decides if the battery can support the brigade's effort and makes recommendations to the S3, as necessary.

This simplistic example illustrates key points. The BOC must be keenly aware of the brigade and battery situations. The BOC must keep the graphics current so the commander has the correct picture of the battlefield. With the most up-to-date info, the battery commander knows which decisions he can implement on his own and which he must check with higher headquarters.

As simple as these procedures appear, BOC operations require training and the battalion and battery commanders to articulate their expectations for the BOC. Knowing what information is important to continuous operations is

- Brigade Commander's Intent for Fire Support
- Unit Locations
- Enemy Time Line
- Call Signs/Frequencies
- Air Defense Artillery (ADA) Warning Status
- Fire Support Plan
- Clear Routes
- Change-Over Briefings
- Communications Status
- Downwind Status
- FA Battalion Commander's Intent
- Friendly Mortar Locations
- 9-Line Medical Evacuation Request
- Perimeter Defense Sketch
- Listening Post (LP)/Observation Post (OP) Guard Locations
- Target List
- Aid Station Locations
- Air Items Status
- Maintenance Status
- Mission-Oriented Protective Posture (MOPP) Level
- FA Battalion Mission
- Known Minefields
- Fire Order Standards
- Current Graphics
- Personnel Graphics
- Logistics Status
- Guard Rosters
- Fuel Status
- Current Operations
- Services Schedules
- Battery Mission
- Enemy Situation
- Ammunition Status
- Howitzer Availability
- Personnel Alpha Roster
- Nitrogen Availability
- Leaders Roster
- Water Status
- Future Operations
- Current Jumpmasters

Figure 2: Suggested BOC Information Requirements

difficult for personnel if they haven't deployed as part of a BOC for extended periods. Some suggestions are to list the CCIR for the personnel and identify information or events that require the commander's immediate attention, even if he's sleeping.

Communications. Information enters the BOC from various sources. Much of the information comes through on the Field Artillery battalion command net. But considerable information also comes from the gun line, FDC or various other agencies linked to the BOC.

Most units maintain two FM communications nets in the BOC: the command net and the administrative/logistics (A&L) net. It is our observation that dedicating a radio to the A&L net has little benefit. However, monitoring the brigade's operations and intelligence (O&I) net or the brigade command net instead yields a greater profit.

Techniques for the BOC to stay abreast of the logistical situation are for the administrative and logistics operations center (ALOC) to call the BOC on the command net and direct it to the A&L net, when necessary, or set times for BOC radio checks on the A&L net as part of the battalion battle rhythm. This allows the BOC to monitor reports and orders that impact the brigade's current and future operations while still staying on top of logistics.

One common lament of soldiers gathering all this information in the BOC is that different battery leaders issue contradictory instructions. Often, these instructions result in wasted man hours and counterproductivity. If the BOC issues instructions to sections, then section personnel can inform their leaders when the leaders' orders interfere with previously issued instructions.

This aspect of information flow proves to be difficult for units to accomplish because it's far easier to make on-the-spot corrections instead of going back to the BOC and having it issue the corrections battery-wide. Obviously, some events require immediate correction, such as safety violations. However, taking the extra time to issue instructions from the BOC, regardless of how mundane these instructions may appear, prevents soldiers from trying to execute conflicting instructions.

Alternate FDC. The BOC's role as an alternate FDC is an important one that has an impact on its role as a CP. In order for the BOC to perform as the alternate FDC, it must have the tools to receive fire missions, compute data and issue fire commands.

At the JRTC, we've observed two techniques units use to give the BOC an FDC capability. One is for an extra fire direction computer to be present in the BOC. Occasionally, this is a battery computer system (BCS) or lightweight computer unit (LCU). Normally, however, the backup computer system (BUCS) is the second means of computation. If a BUCS or other computer is not available, then the BOC computes the data manually.

Updating this "FDC" system with meteorological (Met) information, position changes and the five requirements for accurate and predicted fires is a challenge. Some units assign a Military Occupational Specialty (MOS) 13E Fire Direction Specialist to the BOC. He is responsible for updating the firing information in the computer or on the manual sticks. Normally, he computes the fire missions.

If a battery has enough personnel in the FDC to conduct continuous operations, then using a 13E in the BOC won't hinder primary FDC operations. For example, the battery commander can require off-shift FDC personnel to sleep near the BOC. If a situation arises where the FDC becomes incapable of computing data, the off-shift personnel can be awakened to answer calls-for-fire in the BOC.

Commanders should develop an occupation drill for the BOC. The occupation drill should be based on the battalion's expectations.

Training. Training BOC personnel is difficult. We often observe BOCs not trained in their duties and responsibilities. Often, they haven't worked together before rotations at the JRTC. Again, the result is an unproductive BOC.

Once the battery commander determines who will man his BOC and what he expects of it, he must dedicate time to train it. One technique is to set the BOC up in the motor pool and conduct a command post exercise (CPX). The BOC sets up in its normal configuration with its assigned personnel. The commander issues an OPORD. A remote radio operator sends scripted orders SITREPs, intelligence summaries (INTSUMs) and operational instructions. The BOC updates graphics, records information and passes instructions to other elements of the battery. The "other elements" could simply be one or two leaders who replicate the gun line, FDC or supply section. These leaders also send information to the BOC.

The scenario can be as simple or complex as the battery commander feels beneficial. During live-fire operations, the BOC routinely conducts fire missions in addition to tracking the current (scripted or real-time) brigade situation.

Most 3x8 battalions deploying to the JRTC send only one platoon. This presents a dilemma for the platoon-based battery commander: how does he have an alternate FDC and what elements serves as his CP with only one platoon present? A solid technique is to deploy a BOC to the JRTC to provide more realistic training.

The suggestions in this article for a battery-based BOC also work for a platoon-based battery. The BOC as the CP is especially useful in the platoon-based battery often employed in stability operations. Such operations bear a remarkable resemblance to the low-intensity conflict phase of JRTC rotations.

The BOC is an element of the battery that's critical for keeping the commander informed and proactive, helping to ensure faster, more effective fires where they can do the friendly force the most good.

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M109A6 Paladin at NTC

The BOC at the NTC

by Staff Sergeant Robert M. Castillo

Perhaps the least understood and most underutilized element of the self-propelled battery is its battery operations center (BOC). Trends at the National Training Center (NTC), Fort Irwin, California, show direct support Field Artillery battalions must emphasize the BOC during their NTC train-ups. The training efforts are to ensure the battery can handle the massive amount of information that must flow through it during fast-paced mechanized operations. The challenge is only magnified by the fielding of Paladin with its semi-autonomous operations and increase in fire support tempo. This article discusses the mission and general operations of the BOC and provides several checklists to help the BOC accomplish its mission.

BOC Operations. The BOC collects all the information flowing between the platoon operations center (POC), the battery commander and his higher headquarters. It's the commander's tool to gauge the logistical status of his battery and his center for battle tracking the assets of both the battery and his battalion.

Normally under the control of fire direction center (FDC) personnel, the BOC is more than an alternate FDC. The BOC should be able to take control of battery FDC duties, (i.e., firing chart) in the event the main FDC is destroyed; however, its primary function is as the battery's activity center.

A detailed section of the unit's standing operating procedures (SOP) must outline the manning status for the BOC during normal operation. The personnel for the BOC come from the FDC; communications; maintenance; nuclear, biological,

I Personnel

- List of soldiers assigned to the battery by section with battle-roster numbers.
- Authorized number of soldiers in accordance with the table of organization and equipment (TOE).
- List of soldiers who are assigned to other duties or not currently deployed.
- Personal information on all soldiers ranging from clothing sizes to next of kin.

II Logistics

- Status of supplies (Class I-IX) updated at least twice a day.
  - List of next delivery or logistical resupply point (LRP) time and grid location.
  - Ration cycle.
  - Petroleum, oil and lubricants (POL) status.
- Maintenance.
  - List of 5988E or preventive maintenance checks and services (PMCS).
  - List of all vehicles not fully mission capable.
  - Prescribed load list (PLL) status with job number or order number.
- Communications.
  - List of PMCS for all radios, OE254s antennas and digital equipment.
  - List of all equipment not fully mission capable.

III Battle Tracking

- Operational situation or phase of operation.
  - Map with graphics.
  - Enemy situation and suspected enemy locations, strengths and understanding of who he is and what he looks like.
  - Scheme of fires with assigned targets, purpose and end state.
  - Battalion's and battery's critical Field Artillery tasks.
  - Battery's defensive plan with listening post (LP) and observation post (OP) locations and sectors of fire.
  - Friendly unit locations plotted on a map as well as aid stations or ambulance exchange points, decon tamination sites and supply routes.
  - Scheme of movement for the battery.
  - DA Form 1594 Daily Staff Journal with all traffic sent to the BOC via FM radio or digital.
  - Battery precombat checks (PCCs) and precombat inspections (PCIs) with times to be completed.
  - Rehearsal times, which are posted.
  - Battery casualty collections points, which are posted.
  - Battery order, which is posted.
- Maintenance of Radio Nets (per SOP).
  - Battalion command.
  - Battery internal.
  - Administration and logistics operations center (ALOC) if possible.
  - Wire communications to LP/OP, if possible.

Figure 1: Suggested Information for the BOC to Track

- Maintain at least two personnel per shift: radio/telephone operator (RTO) and runner.
- Maintain FA Form 1594 Daily Staff Journal.
- Conduct radio checks with the battalion tactical operations center (TOC) and ALOC once an hour.
- Update all data on the BOC boards twice daily.
- Conduct communications checks with battery listening and observation posts once an hour.
- Check the generator/vehicle power hourly.
- Plot enemy/friendly locations and NBC updates plus post the air threat and precombat checks (PCC) checklist, as relevant.

Figure 2: Radio Watch Guidelines for BOC Personnel

chemical (NBC); supply and the medic. These soldiers provide a good mix of military occupational specialty (MOS) expertise to provide the commander information he needs to wargame his battery's role in any operation.

The commander assigns a section chief or NCO-in-charge (NCOIC) to the BOC. Too often, battery commanders at the NTC don't understand that, like the gun line, the BOC must have a section chief and personnel assigned. The BOC section chief is responsible for all BOC activities and training and updating the commander daily on the battery's status.

The soldiers' and section chief's skills are important to ensure the BOC can accomplish its mission.

(1) Fire Direction. The BOC assumes control of the battery fires, if necessary. The FDC supplies the BOC the required materials and field manuals.

(2) Communications. The BOC tracks battery communications as well as communications maintenance and trains the radio/telephone operators (RTOs) for the BOC.

(3) NBC. The BOC maintains the battery mission-oriented protective posture (MOPP) status, chemical downwind messages (CDMs) and ensures the correct emplacement of all chemical warning devices.

(4) Supply. The BOC maintains the logistical status of the battery and the status of all future logistical resupply points (LRPs).

(5) Maintenance. The BOC tracks the daily status of the battery vehicles and trains personnel in conducting preventive maintenance checks and services (PMCS).

The commander and section chief determine the information needed in each of the categories the BOC is responsible for. The BOC's tracking requirements can be broken into three information areas: personnel, logistics and battle tracking. Listed in Figure 1 are suggestions for the BOC to track in the three areas. The information in the first area, personnel, ensures the battery's accountability of its soldiers and makes the information readily available to the commander in the event of any emergency.

The information in the logistics category must be available to the commander at any time, but the BOC provides him a daily logistical summary so he has time to react to any situation. This is particularly critical during the mission-analysis phase of an operation; if the BOC updates the information in a timely manner, the commander should have enough time to address problems that could interfere with the battery's completing its mission.

1. Establish voice with higher and lower elements.
2. Establish firing capabilities for handoff to the fire direction center (FDC).
3. Establish 100 percent accountability of all personnel and sensitive items.
4. Send the howitzer locations, ready-to-fire status and tube strength to battalion.
5. Establish a defensive plan for the battery.
6. Prepare for all incoming and outgoing reports to be sent to higher headquarters.
7. Update the graphics on the map.

Figure 3: BOC Priority of Work

The BOC must track the battle, the third information area, at all times with the information provided to the commander based on the phase of the operation. Battle tracking is the BOC's most critical task.

When not on the move, the BOC tracks the information listed in Figure 1, a challenge in continuous operations. Figure 2 suggests some guidelines for BOC radio watch personnel to keep the battery's status listings current.

The BOC can distribute all the information to the commander in two ways. The first is to create a BOC book. The alternative is to make slides that can be laminated and posted on the wall of the BOC vehicle. The BOC should be prepared to distribute the information both ways to accommodate any situation.

BOC Training. As seen at the NTC, training the BOC crew is, perhaps, where the battery leadership fails the most. For the commander to establish a crew drill for BOC personnel, he first must determine the BOC's priority of work, beginning with site occupation. Figure 3 outlines a BOC's priority of work. The time line for accomplishing the work can vary from situation to situation, but all must understand the commander's priority of tasks. In addition to the priority of work, the commander establishes a training plan with clearly defined guidelines and end states.

NTC trends show that a well-trained BOC gives the commander the information that's critical for planning battery operations or transitioning into a different phase of an operation. The BOC can make the difference between the battery's success or failure.

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The Marine BOC on the Mechanized Battlefield

by Captain Robert J. Terselic, USMC

Although Field Artillery doctrine on the missions of the battery operations center (BOC) is generally sufficient, descriptions of tactical employment are scarce and firing batteries struggle with doctrine's practical application. Yet, an effective BOC increases the battery's capabilities and flexibility on the battlefield–especially important during fast-paced operations on the mechanized battlefield. Unfortunately, many battery commanders either don't recognize the BOC's potential and allow asset or manpower restrictions to prevent its viability or fail to experiment with the BOC to determine its optimum employment.

BOC missions found in our doctrinal manuals (see Figure 1) are limited and provide few details on the BOC's equipment and manning. The new commander with little BOC experience could assume the BOC doubles as the executive officer's (XO's) vehicle, his own vehicle or the wire vehicle. Personnel and vehicle constraints may even convince him that he can survive without a BOC. Until the commander sees the value of a BOC in operations, it often is relegated to the "next time we go to the field."

This article suggests revised missions for the BOC and discusses how a Marine BOC can organize and operate in a mechanized environment. Although I focus on the BOC in mechanized operations, the information generally applies to BOCs in any environment.

BOC Mission Revised. The BOC has a threefold mission: advance party operations, tactical and technical fire direction and miscellaneous tasks.

Advance Party Operations. This mission is executed using one of two approaches. The BOC either leads and conducts advance party operations independently or links up with the battery commander to conduct advance party operations. The battery commander determines which approach to use based on the tactical situation and operations tempo.

In mechanized operations, the battery commander must be able to roam the battlefield from his battalion's fire direction center (FDC) to the supported battalion's combat operations center (COC) to his forward observers. For him to stay in the battery's firing position is a waste of a skilled professional.

In addition, the XO and fire direction officer (FDO) are fully capable of controlling the battery's fires. As such, the BOC, lead by the assistant XO, needs to be in or near the firing position ready to push out to the next position or prepare an alternate position at a moment's notice.

Tactical and Technical Fire Direction. The BOC tracks the battle and can control the battery's fires. It has a situation map, communications assets and a means of computing technical firing data. Because the battery has two lightweight computer units (LCUs) with battery computer system (BCS) software, it can compute and communicate technical firing data. The backup computer system (BUCS) is a secondary means of computing the firing data and is required for hasty survey. A chart with graphic firing tables (GFTs) provides a manual backup. Two radios and two OE-254 antennas provide voice and digital capabilities (see Figure 2).

With voice and digital communications, the FDC can transfer all targets, schedules and control measures in effect or added while the BOC is on the road. While staged in the firing position and during occupation and displacement, the BOC exchanges data continuously with the FDC.

Miscellaneous Tasks. These BOC tasks facilitate battery operations and provide the battalion tactical and technical fire direction redundancy.

- The BOC conducts hasty survey and has aiming circles, communications equipment and a precision lightweight global positioning system receiver (PLGR). This equipment helps the battery transfer directional control, conduct simultaneous observation and prepare an alternate position.
- The BOC conducts hasty decontamination. The battery must maintain centralized command and control of the decontamination site, follow standard procedures and maintain continuous communications with higher headquarters, all while continuing to fire. The assistant XO, who is the gun's platoon commander and the battery's nuclear, biological, chemical (NBC) officer, is trained to conduct hasty decontamination.

FM 6-50 The Field Artillery Cannon Battery

- Facilitate command and control of the firing battery.
- Serve as the focal point for operations, such as movement orders from the S3, logistics and nuclear, biological and chemical (NBC).
- Backup the fire direction capability with the backup computer system (BUCS).

FMFM 6-9 Marine Artillery Support

- Serve as an alternate fire direction center (FDC) and (or) assist the FDC.
- Serve as the battery command post (CP) for command and control.
- Control local security.
- Participate in advance party operations.

Joint Regimental Order P3000.1 Standing Operational Procedures for Tactical Operations (or "Combat SOP")

- Control battery operations/local security and serve as a backup FDC.
- Be assigned to the battery executive officer's pit.
- Participate in advance party operations.
- Establish a technical firing capability forward.

Figure 1: Battery Operation Center (BOC) Missions Listed in Doctrinal Publications

To minimize the reduction in firing capability, the battery moves in two-gun platoon echelons through the decontamination site to the next firing point, ideally, with two platoons firing while the third is undergoing decontamination.

• The BOC must be capable of assuming control of the battalion–a Marine Corps combat readiness evaluation standard. Continuing to deliver timely, accurate fires while assuming control of the battalion is, obviously, a challenge for any battery. The BOC enables the battery's FDC to assume control of the battalion while the BOC assumes responsibility for computing the battery's technical fire direction.

Challenging Tradition. Doctrine lists two missions that are inappropriate, even in a defensive posture: providing local security and serving as a battery COC.

The BOC should not provide local security because, when the advance party (BOC) launches forward with the local security chief, the battery's security plan must remain intact. When the BOC is in a firing position, it has to monitor the tactical situation and assist the FDC, which means it's either rotating Marines for rest or helping to compute technical firing data. The XO should manage local security.

1 High-Back HMMWV
1 M101 Trailer with Mounted Antenna Mast*
Two SINCGARS Radios: MRC 145, VRC 92, VRC 88 or PRC 1 Manpack
3 H200s or 3 ANGRA-39s
2 ANGRA-39s**
1 BCS/LCU
1 BUCS
1 PLGR
2 Aiming Circles
1 Situation Map, Mounted
2 OE-254 Antennas
1 Firing Chart and 1 GFT Set

*A OE-254 mast section for digital communications is mounted on the side of the trailer with exhaust clamps.

**Used for H200 wire link to the operating system and voice net.

Legend:

BCS =	Battery Computer System
BUCS =	Backup Computer System
GFT =	Graphic Firing Table
HMMWV =	High-Mobility Multipurpose Wheeled Vehicle
LCU =	Lightweight Computer Unit
PLGR =	Precision Lightweight Global Positioning System Receiver
SINCGARS =	Single-Channel Ground and Airborne Radio System

Figure 2: BOC Communications Equipment

The BOC doesn't need to serve as a battery COC because, on the constantly changing mechanized battlefield, the battery commander has little use for a designated COC– he's rarely in the firing position. If he is in the firing position, the FDC, XO's pit or BOC suits his requirements for situational awareness and command and control.

Manning. At a minimum, the BOC includes the assistant XO and two fire direction controlmen (0844/13C). One FDC man helps the assistant XO at the orienting station while the other (the driver) stages and sets up the BOC. A digitally proficient radio operator with elementary BCS skills can replace the driver if the battery is short an FDC man.

The FDO initially may think that using one of his FDC men in the BOC is a "painful" loss. But once he recognizes how to fall in on the BOC upon arrival and rotate BOC Marines through the FDC, he too will become a believer.

Operational Example. For purposes of the following scenario, the BOC's designated approach is to lead and conduct advance party operations.

The battery commander is forward with the supported maneuver battalion. The BOC is in a firing position monitoring the battle on the situation map, maintaining some method of backup technical fire direction. When the movement order is issued, the assistant XO musters and briefs the advance party and launches for the next firing position within 15 minutes of notification.

At the firing position, the local security chief secures the area and the assistant XO selects the orienting station, lays and safes the aiming circles and positions wire communications. Simultaneously, the BOC ties off its wire at the junction box and drives to its position, usually about 150 meters behind the junction box. The assistant XO verifies the location of the orienting station, orients the lay circle, verifies the safety circle and determines the distance, direction and vertical angle to each gun.

Meanwhile, the BOC driver sets up the upper three masts of the OE-254 on the trailer's antenna mast for the digital net and switches the vehicle's radio(s) to the voice conduct of fire net. He then confirms wire communications with the lay circle and gun positions and establishes digital and voice communications with the main, battalion, liaison section and forward observers. The BCS/LCU is updated with orienting station and gun data except final lay deflection. (In times of conflict, initial lay deflection could be input into the computer to expedite firing when the battery arrives.)

With communications established, the FDC then forwards any updates to target lists, schedules, control measures, etc., that have occurred since the BOC displaced.

As the battery occupies the firing position, the FDC occupies a position within 20 meters of the BOC (negating a need for a ground guide). The FDO then assumes control of the BOC and commences operations while the FDC sets up. When the FDC is fully operational, all changes to the situation are transferred to the FDC and the FDO returns to the FDC to fight the battle. The BOC then breaks down, displaces to its position 75 meters from the FDC and prepares alternate firing positions or mounts up for the next displacement.

Conclusion. As the basis for this article, we experimented with BOC operations during two major field exercises: the February 1997 Advanced Warfighting Experiment Hunter-Warrior and the spring 1997 Desert Firing Exercise (DESFIREX), both at the Marine Corps Air Ground Combat Center (MCAGCC) at Twentynine Palms, California. We found that the BOC offers flexibility, survivability and expanded firing capability for a six-gun battery. We truly did more with less.

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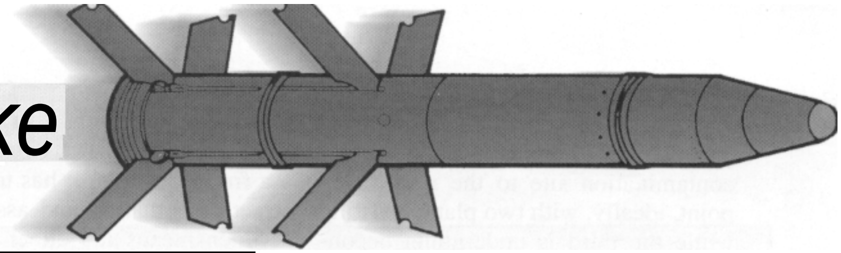
Copperhead Strike



by Captain Samuel C. Cook, USMC

> ***"Copperhead is frequently ineffective out [at the NTC]." These are the words spoken by then National Training Center Commander, Brigadier General William S. Wallace, in his interview "The Challenge: Synchronizing Fires, Maneuver and Intel" in the July-August edition. These are not exactly the words Field Artillerymen like to hear.***

Yet, those words are hardly surprising. No other projectile in the cannon artillery inventory demands as much coordination, practice and preparation from the eyes, brain and muscle of the Field Artillery team than Copperhead. But if used correctly, Copperhead allows the commander to shape the battlefield by removing high-payoff targets early without revealing direct fire weapon locations.

Although the projectile has been around for many years, it will be with us until it's phased out in 2007. So, the problem, then, and the focus of this article, is to determine what the difficulties are in firing Copperhead missions and how units can overcome them.

The major errors in employing Copperhead tend to occur at the tactical level of planning–for example, in the S3 shops of both the maneuver and artillery units. Although there are also difficulties in the technical aspects of firing Copperhead, those difficulties would be reduced considerably with proper tactical planning.

Copperhead Projectile. Copperhead is a 155-mm fin-stabilized, laser-guided projectile that has a 14.75 LB-shaped charge with an explosive filler of Composition B. At about the midpoint of its trajectory and based on the time set, the projectile deploys four wings to guide it onto the laser energy being reflected from the target.

The observer must designate the target for 13 seconds for Copperhead to acquire the target, arm and guide onto the target. The pulse repetition frequency (PRF) code set for the projectile must match the PRF code set on the laser designator exactly. The laser energy is provided by the ground/vehicular laser locator designator (G/VLLD) or the Marine Corps' modular universal lasing equipment (MULE).

The fire direction center (FDC) transmits the command, "Designate," digitally or "Laser On" by voice 20 seconds prior to impact. This allows for a seven-second reaction time between the FDC and observer.

Gunnery Solution. The technical gunnery solution will result in Copperhead's being fired with either a ballistic or shaped trajectory. The battery computer system (BCS) determines the trajectory based on observer visibility, cloud height and gun-to-target range. The preferred solution is a ballistic trajectory that produces a higher angle of fall and, thus, a higher probability of a catastrophic kill.

A shaped trajectory is used when cloud cover, range-to-target and observer visibility require a lower maximum ordinate to acquire the reflected laser energy. The shaped trajectory has a more shallow angle of fall that reduces the effectiveness of the Copperhead's shaped charge.

BCS determines its firing solution based on FT 155 AS-1. This solution yields a ballistic trajectory for targets from a range of 3,000 to 8,800 meters under standard conditions. At ranges from beyond 8,800 to 16,300 meters, a shaped trajectory is computed unless high angle is the method of engagement.

Because Copperhead costs $40,000 per round, it's seldom fired in training areas, so the fire direction officer (FDO) rarely has muzzle velocity variation (MVV) data for Copperhead. At the NTC, most FDOs use standard firing table (FT) muzzle velocity (MV) when computing data. Firing standard MV potentially introduces large errors into data calculations.

The FDO must know how to predict the MVV of the projectile using equivalent full charge (EFC) values and pullover gauge readings in propellant efficiency. Although only an estimate, this technique is better than firing standard MV. In addition, each round fired should be used to calibrate the MV with the data stored in the MVV logbook for future use.

The FDO also must determine if the trajectory will cause the round to impact with any intervening crests. This is especially important in mountainous areas, such as Korea.

The difficulty is that the addendum for Copperhead doesn't have trajectory charts like the ones in the FTs. The FDO has to refer to the maximum ordinate provided by the BCS and the gun target line on his situation map (SITMAP) to see if the projectile can make it to the target area.

Copperhead Planning. Considerations for employing Copperhead include the placement of forward observers (FOs), limitations of their equipment and determination of trigger points.

Observer Location. One element of observer location affecting accuracy is angle-T. When the S3 determines an observer location, the observer must have an angle-T of less than 800 mils with the unit or gun firing the round.

The larger the angle-T, the less laser light is reflected toward the trajectory of the projectile and might be insufficient for acquisition. For Copperhead, 800 mils is the maximum angle-T that will produce a high probability of target acquisition.

In older versions of the BCS (Versions 7 and 9), the computer would yield "No Solution" in "Priority Mission Buffers 4 and 5," if the angle-T was greater than 800 mils. In the current Version 10, the computer computes the data but provides a warning message if angle-T exceeds 800 mils.

The S3 can plan the location and coverage area of an observer and battery firing Copperhead using the Copperhead Coverage Template. It tells the FSO if Copperhead can be used in an engagement area from a potential observation post (OP) with a greater than 50 percent probability of hitting the target. Instructions for using the Copperhead Coverage Template are found in *FM 6-20-40 Tactics, Techniques and Procedures for Fire Support for Brigade Operations (Heavy)*, Appendix H.

The template tells where the observer has a greater than 50 percent probability of hitting the target based solely on observer location, battery location and range to the target area The coverage area designated does not take into account terrain, visibility or survivability. Too often, OPs are planned based on a map spot and coverage template when they are inaccessible or unsuitable for the observer on the ground. Reconnaissance is still necessary to ensure the planned OP is useable.

Copperhead Footprint. Once the OP has been selected, the FO determines how much of his area Copperhead can engage. Although Copperhead can be maneuvered, there's a limit to how much. The FO uses the Copperhead footprint templates to determine the limit. These templates are in FT-155-AS-1 or units can order them. (Instructions for using the footprints are in *FM 6-30 Observed Fire Procedures*.)

The edge of the footprint is how far from a grid aim point the projectile can be maneuvered and maintain a 50 percent probability of hitting the target. The closer the round hits to the center of the footprint, the higher the probability of impacting on the target. Outside the footprint, the FO may be able to maneuver the round, but its chance of impacting on the target is severely degraded.

Selecting the footprint is a function of cloud height, weapon system and observer visibility. The FO selects, orients and traces the footprint on his map. He then visualizes the footprint on the terrain via terrain association or by lasing the direction and distances to landmarks.

Trigger Point. The FO selects a trigger point to initiate the Copperhead mission. The observer first must estimate the speed and direction the target will be moving (see FM 6-30, Pages 5-23 to 5-26). He adds the call-for-fire transmission time, mission processing time and Copperhead time-of-flight and multiplies the result by the predicted target speed. (If the FO doesn't know how much lead time to factor in, a good estimate is 200 seconds for a target of opportunity.)

When determining the location of the trigger point and the predicted impact point, the FO must keep in mind the distance his laser can designate the target. A G/VLLD can designate a stationary target to a range of 5,000 meters and a moving target up to 3,000 meters. The MULE can designate stationary targets at 3,500 meters and moving targets out to 2,000 meters. Beyond these ranges, the amount of reflected energy is insufficient to guarantee the projectile will lock onto the target.

The S3 must consider these ranges when planning observer locations and engagement areas. The coverage template can represent both 5,000- and 3,000-meter ranges when drawn on a map, allowing the S3 to visualize the area that can be lased from a potential OP.

PRF Code. Copperhead seeks a particular PRF when trying to acquire the target. This allows a specific projectile to be guided by a specific designator using a three-digit decimal code. This code allows inter-service use of designators and weapons systems.

The code is broken down into two bands of either 10 and 20 pulses per second, respectively, as shown in *ST 6-30-30 Copperhead Firing Procedures*, Page 45. Although either band code can be used for Copperhead missions, Band 2 with its higher pulse rate and 256 possible settings is preferred. (Band 1 codes are usually reserved for use by the Air Force.)

One major error occurring frequently is the wrong PRF code is being applied to the G/VLLD, which results in the round's missing the target. There is no excuse for this error. The PRF code for the projectile is included in the message to observer (MTO).

Because the codes must match exactly, the fire support element (FSE) manages and assigns the PRF codes. The lowest level for managing the switch settings for both the designator and FDC is the brigade FSE. Most units have standing operating procedures (SOP) that assign PRF codes in blocks similar to target blocks. ST 6-30-30, Pages 45 to 48, gives an example of corp-, division- and battalion-level assignments for PRF codes.

Command and Control. When setting Copperhead guidance, several factors must be considered. The first is ammunition availability and distribution. The basic load of Copperhead is usually no more than three rounds per tube. A 3x6 battalion has 54 rounds available. Therefore, the commander can't make every tank or armored personnel carrier (APC) a Copperhead target. Copperhead only should engage targets that can affect the battle tactically, such as command, control and communications vehicles.

Also, each Copperhead mission is a two-round mission–even with only one predicted target. This ensures the target is engaged, but it also means at least two howitzers in the battery must be loaded with Copperhead.

The second consideration is the response time for Copperhead missions and the number of priority missions that can be assigned. Only priority and on-call missions have response times of 60 seconds or less. Using Copperhead for targets of opportunity can result in processing times of more than five minutes because the observer must determine and orient the footprint and determine the trigger point and angle-T.

The commander should plan priority Copperhead targets to allow the observer to orient the footprint and the FDC to predetermine data for the gun line. Priority missions are stored in BCS in "Mission Buffers 4 and 5." The BCS can store one final-protective-fire (FPF) mission and one Copperhead priority mission or two Copperhead priority missions. In a 3x6 battalion, a total of six Copperhead priority missions can be stored. When the howitzer isn't engaged in other missions, the Copperhead data is set on the howitzer.

Finally, a primary and secondary FO and firing unit must be assigned to each Copperhead target area planned. Also, the artillery battalion S3 must incorporate firing Copperhead targets into his movement order so the battery with the mission isn't displacing or in the wrong position when the target needs to be fired.

Although firing Copperhead is a complex mission, it offers the commander the opportunity to shape the battle with a single round. The key to success with Copperhead is simple: practice, practice and more practice.

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