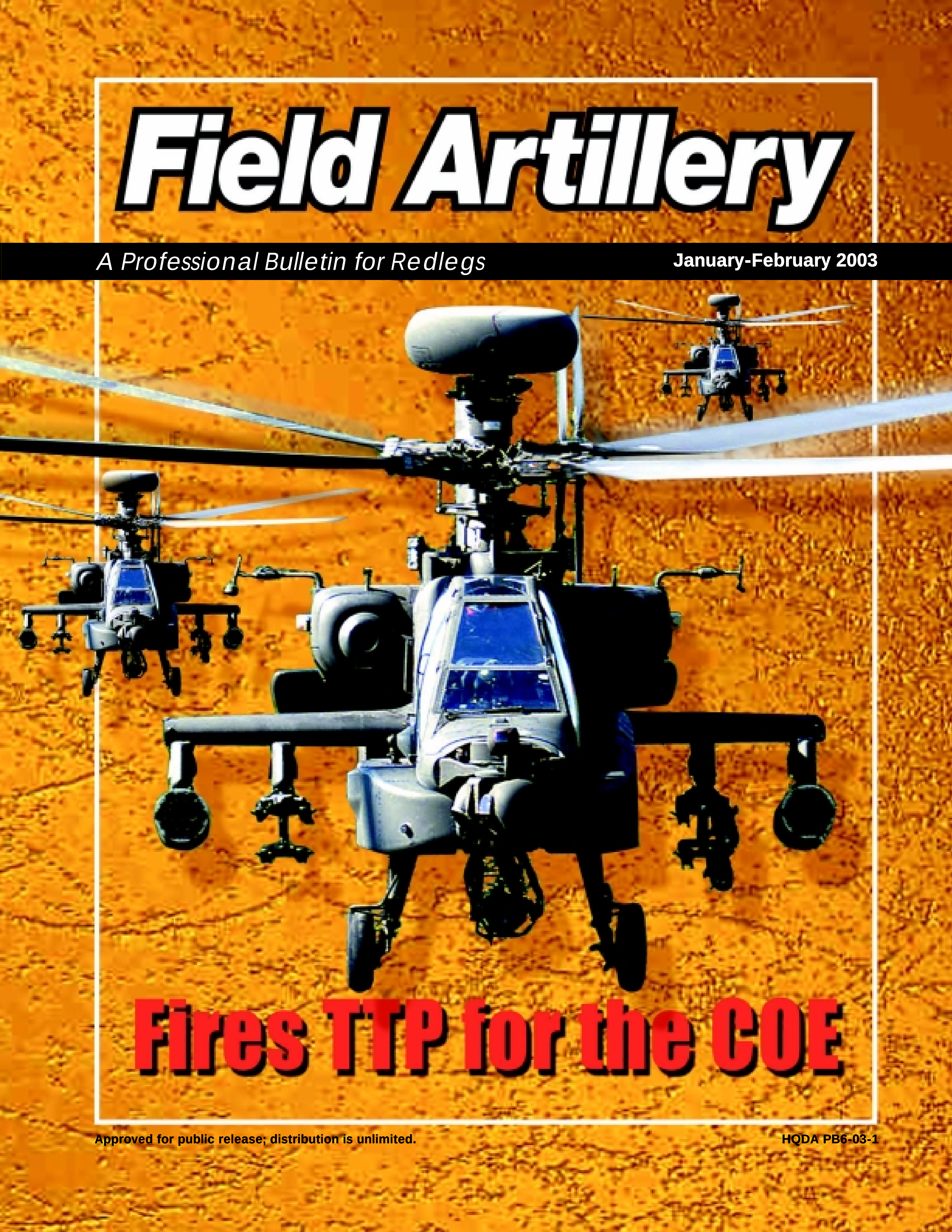
Field Artillery

A Professional Bulletin for Redlegs

January-February 2003



Fires TTP for the COE

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Fires TTP for the COE

The world has changed. The United States is the sole remaining superpower with the world's most powerful military. Today's Army, however, continues to operate with doctrine, equipment and training methodologies developed in the Cold War era to counter large massed armored formations in open rolling terrain. Given the military superiority of the United States, it is unlikely that our potential adversaries will present this type of threat.

When regional operations draw the United States into conflict, it is most likely that those who oppose us will adjust their military capabilities. They will employ available high technology and adaptive, asymmetric tactics to avoid the strengths of our armed forces.

To counter this change, the Field Artillery community is developing tactics, techniques and procedures (TTPs) that ensure success in dealing with the challenges of the contemporary operational environment (COE).

Changes in the Operational Environment. Future opponents will attempt to deny US forces access to ports of debarkation and operating bases by employing long-range air and missile precision strike systems. We require sensors and counterstrike capabilities together with responsive techniques of employment to shield our initial entry forces.

Adversaries will use terrain and weather to negate US military advantages. Our tactics, sensors, weapons and munitions must be effective in all environments, including in complex, urban, mountainous and jungle terrain. Weather will continue to impact operations; all-weather fire support remains an imperative.

Threat operations will be less patterned within an asymmetrical battlespace. Instead of massed, linear offensive formations and echeloned defenses, we are likely to face small units, including dismounted infantry employing high-technology and adaptive tactics. This type of adversary will be difficult to predict, thus complicating our targeting process.

To be proactive, we will have to analyze enemy systems and attack their critical links, nodes, seams and vulnerabilities. We also must develop procedures to make our reactive fires system more responsive.

Adversaries may attempt to employ military capabilities in the immediate presence of civilian populations or in close proximity to potentially sensitive sites. This, too, complicates targeting and dictates we develop automated target recognition systems and discriminating lethal capabilities as well as nonlethal effects that can be delivered by the Field Artillery.

Enemy forces may seek to operate in closer proximity to friendly units to reduce the effectiveness of our indirect fire systems. We must counter that tactic by being able to deliver fires more precisely against both point and area targets in close support of our formations.

To protect their own high-value indirect fire systems, the enemy will employ mortars and artillery in a distributed manner, attempting to mass fires from dispersed locations while avoiding preparatory fires of long duration. We require omni-directional sensors that are capable of accurately acquiring indirect fire systems and that are linked directly through the command and control system to the shooters who can kill them.

The Training Centers. Elements of the COE have been introduced into our training regime in our Battle Command Training Program (BCTP) Warfighters, in our dirt Combat Training Centers (CTCs) and into Training and Doctrine Command (TRADOC) instruction.

Today, when units arrive at the National Training Center (NTC), Fort Irwin, California, they are subject to attack from guerrilla organizations attempting to disrupt their access. The NTC experience now provides a wider range of missions and threats and a less predictable, more freethinking enemy.

The opposing force (OPFOR) has changed from a Soviet-style enemy who could be templated and predicted to smaller, more dispersed units relying on greater initiative.

Field Artillery units are experiencing these same warfighting conditions in all major training events and independently developing TTPs that are producing successful outcomes. It is important we capture these innovative approaches for the benefit of the entire force.

Field Artillery Knowledge Online. One means of rapidly capturing and disseminating the most effective TTPs is by leveraging information technology. The Field Artillery School has been selected to become the proof-of-principle site for a Knowledge Management Center initiative. We are in the process of designing a knowledge site to enable total information sharing.

The site will include three core functions: a communities of practice capability that will enable information exchange; a structured search capability designed specifically for fire support and the Field Artillery; and a system that enables soldiers and leaders to request information and provide feedback to the Field Artillery School.

The military complexities of the 21st century require that we adapt our current capabilities to meet a different form of threat and at the same time prepare for the challenges of the future. The intricacies of the COE have served as the basis for developing the Objective Force concepts and future combat system (FCS) requirements.

Our present imperative is to record and disseminate the successful TTPs being developed by the current force to deal with the challenges of the COE, using this magazine and, in the near future, the FA Knowledge Online.

Artillery—*Never* Leave Home Without It (And Don't Forget the "Dumb" Rounds)

I found your interview with MG Franklin L. Hagenbeck ["Afghanistan: Fire Support for Operation Anaconda"] and the article on "Joint Coalition Fire Support in Operation Anaconda" by LTC Christopher F. Bentley [both in September-October 2002] very interesting yet somewhat troubling. Both did a good job of discussing the good and bad points of the fire support they had available during Operation Anaconda. The one thing that troubled me was that neither seemed to be bothered by the fact that they had no artillery support available because no artillery units were allowed to deploy with them to Afghanistan. I find that *appalling.*

I'm an old airborne- and ranger-qualified infantryman. As you probably know, Infantrymen don't have much respect for folks who aren't infantrymen. However, I learned one very important thing from two years of combat as a rifle platoon leader and rifle company commander in Vietnam—*never* go into combat without artillery support and lots of it. So I always had a healthy respect for Artillerymen because I could rely on them to put the balls where I wanted them when times were tough, and times were tough everyday.

As a rifle platoon leader, I adjusted 105-mm, 155-mm and 8-inch artillery nearly daily and 175-mm on occasion. In those days, there was no forward observer (FO) at the platoon level, so I had to do it. Quite frankly, I doubt seriously that there are many people alive today who have adjusted more artillery in combat than I have.

In addition, I am troubled by this fascination that our Secretary of Defense and many others appear to have with "precision weapons." They seem to think that all it will take to win the next war is a handful of SF [special forces] guys with laser designators and a bunch of "smart" bombs.

Secretary of the Navy Gordon England said in an address to the Precision Technology Symposium in Laurel, Maryland, on 16 October 2002, "For the future, mass will be precision." Yeah, well, maybe. Obviously, he has never been in a real firefight with real bad buys in the jungle.

An SF guy with a laser designator would have been useless in 90 percent of the firefights I had as an infantryman, unless he had an M16 or knew how to adjust "dumb" artillery. Rarely in jungle or forest combat can you see exactly where the bad guys are, so you can have "eyes on the target," as these precision weapons' gurus like to say.

Hell, all I ever knew was that the bastards were "over there between 12 and 3 o'clock" or often between 12 and 12 o'clock. But I sure as Hell could get my butt down and get my men to shoot back with M16 and M60 fire while I "got on the horn" with the Redlegs and made a call-for-fire using my PRC-25 radio and my trusty compass. Using this late 1960s high technology, I usually could get HE [high-explosive rounds] on the target with devastating effects in five to 10 minutes, and I adjusted it by ear ("ears on the target"?) because I couldn't see the stuff exploding unless it was at night or the rounds were as close as 50 meters.

I doubt Fort Sill even teaches FOs to adjust by ear. That was the most valuable skill I had as a rifle platoon leader in combat. It was what stood between living and dying day in and day out. How would a laser designator or smart bomb have helped me?

Had I had to live without artillery support, like one of MG Hagenbeck's battalions did for about 24 hours, my men and I would not be here today. Dumb artillery adjusted by a smart infantryman made the difference between living and dying daily.

I also found that dumb artillery worked well day and night. It worked well in the rain, in the sun, in the wind and in cloudy weather. It didn't matter if the ceiling was high or low. No matter what the weather was, it was there when you needed it. It always worked.

I also used a lot of close air support [CAS] and attack helicopters in combat. They were great and useful to have. But, they were a scarce resource. It appears that they are still a scarce resource, based on MG Hagenbeck's and LTC Bentley's reports. They always will be a scarce resource. Anyone who thinks differently is not being realistic—to include our Air Force brethren.

An hour or so waiting for close air support or attack helicopters while being shot at by a determined enemy is a very, very long time. Twenty-four hours is an eternity. When I had to wait for it, I could always blow the Hell out of them with artillery. When the fighter jocks showed up like the cavalry of old, it was easy to hold the artillery [fire] until they finished their work, then I could bring it back in.

That old artillery was dumb, but it was very, very effective. Regrettably, it appears that we have some folks in high places in our government and military who don't understand the importance of artillery support in combat. It would seem to me that the responsibility of reeducating these folks would fall on our Artillerymen. I would urge you all to do all that is humanly possible to train the "powers that be" that Field Artillery was, is and always will be the biggest killer on the battlefield.

We might need precision weapons for "snoop and poop," such as SF/CIA [Central Intelligence Agency] behind the lines—covert sorts of stuff. But anybody who thinks that snoop and poop is the only "face of battle" in the future is badly mistaken. Afghanistan and Kosovo are models for future conflicts, but they aren't the only models. If we ever have to fight the Chinese, Russians, Vietnamese or North Koreans, the Afghan model won't work.

No doubt, precision weapons will be very important to our success on the battlefield, but dumb weapons will still be necessary and valuable. We are kidding ourselves and putting the lives of our soldiers at risk to think otherwise.

On the future battlefield, when a rifle platoon leader finds himself under heavy enemy fire, he should be able to get the indirect fire support he needs in five to 10 minutes. Sometimes the situation will be such that he can have eyes on the target and precision weapons from the Artillery, Air Force or Navy will be what he needs, assuming the weather will allow support by such weapons.

But more often than not, he will not be able to see exactly where the bad guys are and he'll need dumb weapons that he can control by ear or eye. And with practice, he'll learn how to do that with great precison.

Only the Artillery can provide that kind of support. Failure to organize for and to provide such support for that rifle platoon leader is nothing short of *criminal.*

LTC(R) John M. Jenkins, IN
Aiken, SC

One Air Force Pilot's Response to "Afghanistan: Joint and Coalition Fire Support in Operation Anaconda"

I am a retired USAF colonel with 22 years experience flying fighters. I served as a forward air controller (FAC) flying OV-10s in SEA [Southeast Asia] with 165 combat missions in North and South Vietnam, Laos and Cambodia. I flew A-10s as a flight examiner and instructor pilot (IP) and F-16s as an IP and squadron commander. On the Air Staff, I helped plan the Desert Storm Air Campaign and later helped organize the Gulf War Air Power Survey, the most comprehensive review of the role of air power in Operation Desert Storm.

I am writing in response to LTC Christopher F. Bentley's suggestions for Air Force improvements in his article "Afghanistan: Joint and Coalition Fire Support in Operation Anaconda" (September-October 2002).

AC-130 Squadron in Light Infantry Divisions. In light of joint doctrine calling for air power to be centrally controlled by an airman, I suggest LTC Bentley reconsider his statement that "Every light infantry division needs an AC-130 squadron." Doctrinal precepts are often arrived at through costly wartime lessons; the Kasserine Pass during World War II provided lessons in applying air power.

USAF Major Shawn Rife's article "Kasserine Pass and the Proper Application of Air Power" in the Autumn/Winter 1998-99 *Joint Forces Quarterly* reviews those lessons. The essence is captured in Field Marshal Bernard Montgomery's statement, "Air power is indivisible. If you split it up into compartments [i.e., assign it to a division], you merely pull it to pieces and destroy its greatest asset—its flexibility."

In summation Major Rife wrote, "There were many reasons for the American debacle at Kasserine Pass, but perhaps the most significant…was the poor handling of the combat air assets….Most of the principles of war were ignored. The treatment of air power as flying artillery to be parceled out in support of ground formations at the point of attack squandered aircraft on costly and frequently inconsequential missions, ensured that other aircraft were underutilized in the midst of disagreements over priorities, and left many more lucrative targets untouched."

Granted, air power's primary mission in Operation Anaconda was supporting ground forces, but doctrine shouldn't be rewritten from one experience. LTC Bentley might see his statement in a different light if I used the 1996 Khobar Tower bombing to make a similarly inappropriate assertion: "Every fighter wing needs a light infantry battalion defending its base."

The following comments respond to his remark that the "inabilities of aircraft to break self-imposed USAF altitude restrictions, slow their strike speed down or strafe the battlefield restricted [their] ability to deliver timely munitions in close support of troops [CAS] on the ground."

Altitude Restrictions. The threat is the primary reason altitude restrictions are imposed. The early FACs in SEA could fly at 500 to 1,000 feet above ground level (AGL) as the threat was principally small-arms fire, heavy machine guns and RPGs [rocket-propelled grenades]. My generation of FACs had a "floor" of 10,000 feet mean sea level (2,000 to 9,000 feet AGL) based on radar-guided anti-aircraft artillery (AAA), ranging in size from 23- to 100-mm, and surface-to-air missiles (SAMs). Whenever friendly ground forces were in a tight spot in Vietnam, FACs and attacking aircraft frequently ignored altitude restrictions; such actions increased aircraft losses, but often helped save "friendlies."

Safe separation from bombs is another reason for altitude restrictions. Airplanes carry bombs in a "safe" condition; once dropped, the bomb's "safing" wires are pulled, allowing the fuzes to arm it after it falls a minimum distance—you don't want a bomb "hot" immediately after it's dropped because multiple bombs dropped on a single pass sometimes bump into one another and could explode *prematurely*.

Bombs dropped too low won't arm, which is not a bad thing because if they detonated, they could "frag" an airplane as substantial bomb fragments are hurled *thousands* of feet AGL. While not used in Operation Anaconda, drag devices provide safe separation by rapidly slowing bombs to keep delivering aircraft out of the frag pattern.

Additionally, smart bombs require high-altitude releases. Precision-guided munitions (PGMs) use laser energy or global positioning system (GPS) inputs

AC-130 Gunship

to "get smart" and steer to a target using small fins that can only alter their ballistic trajectory to a limited degree. PGMs must be dropped into an imaginary funnel-shaped basket that narrows near the ground; drop a PGM outside the basket and it can be smart but physically unable to fly to the target.

Once released, laser-guided bombs get smart by first finding and then guiding to the laser energy illuminating the target. Similarly, an airplane talks to a GPS-guided bomb before releasing it so the bomb knows where both it and the target are located. After release, a GPS-guided weapon must acquire its own GPS lock-on to remain smart. Thus, higher release altitudes increase the probability of PGMs' falling into the basket and getting smart.

Without laser or GPS guidance, PGMs are ballistic projectiles; the inertia imparted from the delivering aircraft and the effects of wind and gravity determine where they fall.

Friendlies may be reassured when they can *see* the aircraft providing them CAS, but smart bombs are as accurate when dropped from high-flying bombers as when dropped from low-flying fighters. PGMs provide CAS when dropped in the basket with time to get smart.

Slow-Flying Aircraft. Regarding slowing aircraft over the battlefield, it helps pilots see what is unfolding on the ground, but aerodynamics require that aircraft maintain speed to remain maneuverable. F-16s can operate at 200 knots, but maneuverability at that speed is limited. Pilots couldn't adequately react to AAA and SAMs, especially when carrying bombs.

Slow flight is further limited by the high pressure-altitudes at which Operation Anaconda took place; pressure-altitude influences both the airspeed and engine thrust available.

Strafing Missions. Finally, having employed strafing against enemy troops, I would like to disabuse LTC Bentley of any belief that it greatly influences battles. Strafing is a psychological weapon at best; a determined enemy often will keep attacking despite it.

Further, strafing from even a slow-mover, such as the A-10, is challenging (ever try to hit someone with a snowball thrown from a moving car?) and the volume of firepower is not that great.

Effective strafe involves an approximate two-second burst of fire that sends 120 to 180 rounds down range. Longer bursts are counterproductive as strafing fighters traverse the ground at speeds of 500 to 1,000 *feet per second*, creating bullet dispersal that is further exacerbated by the heating of gun barrels. Also, pilots who "press" the target are likely to overfly it and the associated threat while risking flight through their own ricocheting bullets.

Further, asking pilots to strafe is like asking troops to charge a bunker; both will do it but the pay-off may not be justified by the expected losses. There is a direct correlation between the number of strafing passes made and the likelihood of getting shot down as strafing or dive-bombing aircraft present enemy gunners with a somewhat stable target—just as charging troops would if they slowed their advance to raise and sight their weapons.

As impacting the ground has a near-perfect probability of kill ($P_{k)}$ against aircraft, there is little margin for error as pilots make strafing or bombing passes and they face small arms fire, AAA and SAMs. Further, they can only try to get out of range of any threat, whereas ground troops can take cover.

Also, attacking airplanes will continue to close on a target as their inertia must be overcome before any pullout appreciably increases the distance from a threat.

Finally, strafing accuracy is not outstanding—pilots qualify with 25 percent hits on the controlled range where they shoot at a 28-foot parachute canopy suspended between two telephone poles with a cease-fire at 2,000 to 3,000 feet from the target. Top Guns in the F-16 score in the high 50 percent range while A-10 Top Guns score more than 80 percent; hitting tank-sized targets *is* easier than hitting human-sized targets.

"Bunting" (pushing the nose of the aircraft down while strafing) will concentrate the strafe pattern and increase scores on the range—but also the likelihood of getting shot down in combat.

In closing, LTC Bentley's article is an opportunity to demonstrate the utility of joint live-fire training in peacetime, so all members of the joint team understand one another's capabilities and limitations when the real shooting starts.

Col Dale C. Hill, USAF, Retired
Burke, VA

Not All PGMs Unresponsive to Troops in Close Contact

I read with interest the interview and article debriefing Operation Anaconda in your September-October 2002 issue and will publish them to the pilots in my squadron. I have two points to bring up regarding the larger fire support issues in those pieces.

First, neither mentioned the support given to Army forces by Marine AH-1W Super Cobras flown in from the 13th MEU [Marine Expeditionary Unit] after many of the Apaches were damaged in action. None of the AH-1Ws was put out of action by enemy fire, and by all accounts, they provided effective CAS [close air support].

Given the push in the interview and article for "Universal Observers" who would call in joint CAS, the abbreviated 6-line attack brief would work well for attack helicopters with their fast response times. The brief is not system-intensive, and the observer and helicopter have similar visual perspectives.

Second, both pieces generalized "PGM" [precision-guided munitions] to mean "GPS [global positioning system]-guided" munitions. JDAM [joint direct attack munition] is GPS-guided and does have limitations for timely CAS.

However, PGMs also can be radar-, wire-, TV-, and laser-guided. Hellfire, Maverick, laser-guided bombs, air- and ground-mounted TOWs [tube-launched, optically tracked, wire-guided missiles] and Javelin are all PGMs that do not have the same limitation as JDAM—they do not need highly accurate target coordinates [desired mean point of impact, or DMPI] before being dropped or fired.

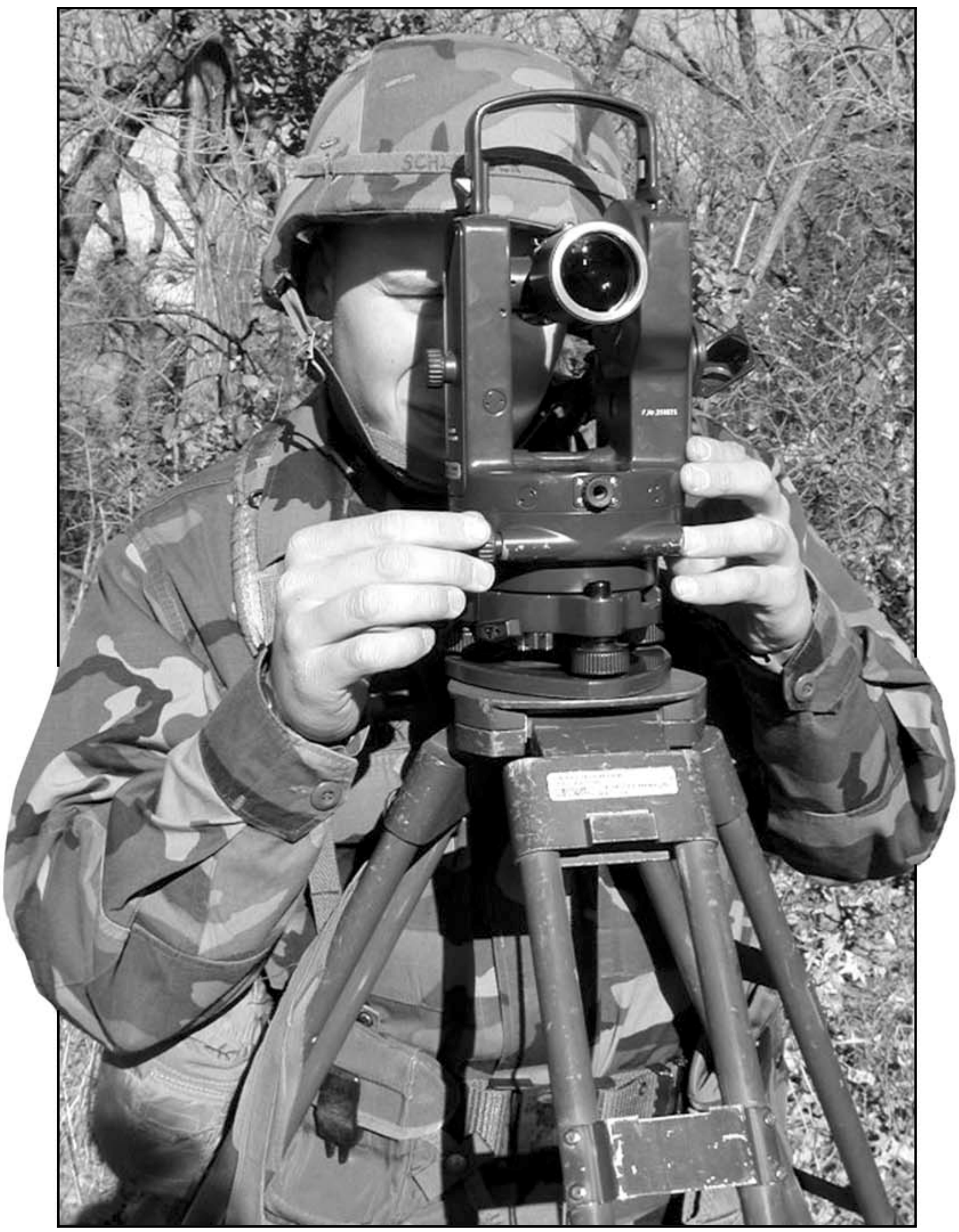
In addition, many US fighter-bombers can achieve very responsive, near-precision effects with unguided ordnance by cueing on a laser designation with their onboard laser spot trackers.

Each PGM has its own targeting peculiarities (especially laser-guided systems) that must be dealt with prior to launch, but it does a disservice to your readers who may need to call in CAS with minimal training to imply that all PGMs are unresponsive.

Capt Erik J. Bartelt, AH-1W Pilot
Lt/Atk Helicopter Squadron 267
MCAS, Camp Pendleton, CA

The Bottom Line for Accurate Massed Fires: Common Grid

By Chief Warrant Officer Three Xavier Herrera, USMC



Since the introduction of the global positioning system (GPS) and its integration with inertial navigation systems (INS), many of today's Field Artillery weapons and target acquisition (TA) platforms can quickly and accurately perform self-location and orientation without relying on external survey support. Fielding of systems, such as the gun laying and positioning system (GLPS), modular azimuth positioning system/hybrid (MAPS/H) and the position navigation unit (PNU), have dramatically reduced the number of survey personnel and equipment assets in the Army's FA. US Marine Corps artillery units seemingly will follow suit.

This transformation has redefined the role survey personnel play on the modern battlefield. The primary function of the survey section for many years had been to provide common grid. Under normal operating conditions, platforms with self-location systems no longer require a surveyed firing position to emplace, but they still must maintain a common grid with each other to mass fires and achieve the desired effects on target.

The fire support community must be careful not to dismiss the need to maintain common grid based on platforms' self-location capabilities. With the introduction of digital maps and other digital products into our automated command, control and communication systems, it is imperative that warfighters understand common grid to employ FA and TA systems globally. Without common grid, units can't achieve the desired effects without wasting ammunition and manpower or inflicting damage to the wrong target.

This article discusses common grid and common survey and their targeting issues and provides references and recommendations to ensure accurate, massed fires—time-on-target.

Why is common grid required? *Common Grid is required to permit the massing of fires, delivery of surprise observed fires, delivery of effective unobserved fires, and transmission of target data from one unit to another in order to aggressively neutralize or destroy enemy targets*. (Quoted from the "Field Artillery Position and Navigation Plan" written by the Field Artillery School, Fort Sill, Oklahoma, Page 1. It is online at http://sill-www.army.mil/famag in the "Go-to-War Primer.")

Common grid is the foundation upon which the success of the artillery is built. However, until Operation Desert Storm, most fire supporters never concerned themselves with common grid. During ground combat operations in Desert Storm, rounds missed some targets by up to 750 meters. The culprit was the lack of common grid, specifically due to multiple datums, ellipsoids and grid zones referenced by the maps our joint forces were using.

In once instance in Desert Storm, an aerial observer located an enemy unit and transmitted a request for fire to the supported artillery headquarters for processing. The target coordinate was transmitted to a Navy ship positioned off the coast for prosecution. The ship fired two salvos (rounds) only to have the aerial observer report that the rounds missed the target by 527 meters. Why? They missed because the aerial observer and the artillery headquarters were operating on one datum (Nahrwan Datum) while the ship was operating on another datum (WGS84 Datum). This is known as a "datum shift."

As the result of many similar incidents, the Target Acquisition Department of the Field Artillery School investigated the datum-to-datum capabilities in Field Artillery systems in 1991. Those findings determined that our datum-to-datum capabilities were inadequate, that Field Artillerymen did not understand the subject, that the FA had no standard position navigation (POS/NAV) system requirements and that datums needed to be included as part of *any* position coordinate description.

Today, many of these same common grid issues continue. To gain an appreciation for common grid, Field Artillerymen must first review the five requirements for accurate predicted fire. (See Figure 1.) These five requirements are equally important; however, three of the five *must* be referenced to a common grid to be of value: accurate target location, accurate weapon location and accurate meteorological data.

1. Accurate Target Location and Size
2. Accurate Weapon Location
3. Accurate Computational Methods to Solve the Gunnery Solution
4. Accurate Meteorological Data
5. Accurate Weapon and Ammunition Data

Figure 1: Five Requirements for Accurate Predicted Fire

Common grid allows synchronization of geographic information between all sensors, scouts and forward observers (FOs); weapons locating radars; meteorological measuring systems; delivery systems; and automated command, control and communication systems to mass fires. As our weapons achieve greater ranges, inaccuracies caused by not having a common grid become greater.

What is common grid? Common grid is the sum of several components: the geodetic system, coordinate/grid system, map projection and common or relative survey.

Geodetic System. Within the geodetic system are the datum and ellipsoid. A datum is a mathematical model for the surface of the earth used in mapping a region. There are horizontal datums and vertical datums. All maps do not reference the same datum or ellipsoid (to which the datum is referenced); in fact, there are still more than 1,000 different datums in use around the world today. No single operating system is programmed to operate in all datums; however, some allow the user to define datum entries.

A datum can be local or global. A local datum covers only certain geographic regions. The North American Datum of 1927 (NAD27) is an example of a local datum and is still used in the United States, Canada and Mexico.

Global datums provide worldwide use. Examples include the World Geodetic System of 1972 (WGS72) and the newest, World Geodetic System of 1984 (WGS84).

The National Imagery and Mapping Agency (NIMA), Fort Belvoir, Virginia, considers the WGS84 the preferred datum, which is the datum most of us are familiar with today. NIMA predicts it will take up to 10 years to completely reference the world to the WGS84 Datum, but NIMA will only produce new topographic land maps (TLM) in the 1:100,000 scale.

Many of the existing 1:50,000 scale TLMs could remain referenced to one of several local datums still in use around the world. In some parts of the world, the accuracy error caused by using two different datums can be as much as 750 meters.

When combining the use of TLMs, digital maps or self-location systems, it is *critical* we know what datum we are operating on. Vertical datums are used as references for elevation; the most common is mean sea level (MSL).

The ellipsoid is basically a mathematical model for the size of the earth and is described as an oblate sphere: a sphere that is flattened at the poles. The ellipsoid was once called a "spheroid," and the term is still found on some of the older maps. There are more than five ellipsoids used around the world with WGS84, again, being preferred.

The introduction of GPS technology in the late 1980s made WGS84 the preferred datum because GPS receivers compute all positions on WGS84 latitude and longitude and then convert them to display what datum and coordinate system the user needs.

Coordinate/Grid System. Another component of common grid is the coordinate/grid system. US forces use different coordinate systems. The Army and Marine Corps use the Universal Transverse Mercator (UTM) Grid and Military Grid Reference System (MGRS), while the US Navy uses latitude and longitude expressed in degrees, minutes and seconds. The Air Force uses latitude and longitude expressed in degrees and decimal degrees.

Imagine having an Air Force pilot checking in on station and requesting Army coordinates in latitude and longitude. Too many Field Artillerymen can't plot latitude and longitude on their maps or don't know enough about their handheld GPS receivers to convert coordinates into latitude and longitude. Today's joint operational environments require the warfighter be familiar with all these coordinate systems and know how to convert between the different formats. (See Figure 2.)

1. In the PLGR, store the coordinate as a "Waypoint."
2. Use the "Set-up" menu to view the coordinate in the format needed.
3. Refer to the PLGR operations and maintenance technical manual, TM 11-5825-291-13, Pages 3-66 through 3-73, for further instructions.

Figure 2: AN/PSN-11 Precision Lightweight GPS Receiver (PLGR) Procedures for Converting One Coordinate/Grid System Format to Another. Conversion must take into account the map projection of a particular area of operations.

Map Projection. A map projection portrays all or part of the round earth on a flat surface. This cannot be done without some distortion; therefore, many different projections are used to produce maps. The most common projection is the Transverse Mercator Projection, the standard for NIMA-produced maps.

Many countries use other map projections unfamiliar to our forces that would necessitate their conversion. Fortunately, datum, ellipsoid, grid system and map projection information is found in the margins of all NIMA-produced TLMs. Digital maps and other digital products reference the WGS84 datum/ellipsoid and can be displayed in MGRS, UTM or Geographic grid coordinates using the joint mapping tool kit (JMTK) built into systems, such as the advanced Field Artillery tactical data

GEOTRANS is the Department of Defense conversion software available at NIMA's web site: http://164.214.2.59:80/GandG/geotrans/geotrans.html. The software includes an easy-to-use Users Guide.

Figure 3: National Imagery and Mapping Agency (NIMA) Geodetic Translator (GEOTRANS) Software. This free software converts datums, ellipsoids, coordinates/grids and map projections easily on a personal or laptop computer.

Survey data must be converted to higher echelon data when the two differ by two mils or more in azimuth, 10 meters or more in radial error or two meters or more in elevation. Procedures for converting to the higher echelon data are in *FM 6-2, Tactics, Techniques and Procedures for Field Artillery Survey,* Pages 14-2 through 14-4, or for Marine users, *MCWP 3-16.7, Marine Artillery Survey Operations,* Pages 1-13 through 1-18.

Figure 4: Criteria and References for Converting to Common Survey Data

system (AFATDS). Figure 3 gives the website for the NIMA geodetic translator (GEOTRANS) free software to convert datums, ellipsoids, coordinates/grids and map projections.

Common Survey. Common survey is the final component of common grid and is primarily provided by our artillery survey sections using the position and azimuth determining system (PADS), conventional means or, in the case of the Marine Corps, differential GPS equipment.

Common survey serves two purposes. First, it provides the basic requirement of accurate weapon location in the form of survey control points (SCPs), orienting stations (OS) and known directions, commonly called the end-of-orienting line (EOL). Second, common survey facilitates common grid requirements by ensuring all fire support and targeting assets are oriented the same with respect to azimuth, position and elevation to a prescribed accuracy.

This function has been the mainstay of our survey sections for more than 15 years. In order for two locations to be considered on common survey, they must be referenced to the same datum, ellipsoid and grid system and must meet the prescribed survey accuracies or be converted to meet them.

The highest echelon survey element is responsible for ensuring subordinate units operate on a common grid and common survey network. Subordinate survey elements must establish their survey networks without waiting for higher survey echelon coordination. These elements convert to common survey by comparing higher and lower survey data and converting the lower echelon data to the higher echelon data. Figure 4 outlines the criteria and reference for converting survey data to ensure common survey.

Does GPS provide common survey? GPS and its integration with the inertial navigation system have reduced the need for survey sections to provide primary location and orientation data but have not replaced the need to validate common survey.

Understanding GPS is critical if we are to use it to meet common survey requirements. GPS is a space-based radio navigation system designed to provide continuous accurate position, navigation, velocity and time (PNVT) coverage worldwide to an unlimited number of users in both the civilian and military sectors.

When loaded with crypto keys, the precision lightweight GPS receiver (PLGR) provides acceptable horizontal and vertical position accuracy for cannons, rocket launchers and radar systems but *not* the azimuth accuracies required for any FA platform. The PLGR, or any currently fielded GPS receiver, provides a 10-meter circular error probable (CEP) with a 50 percent confidence rate, but it cannot establish fourth or fifth order SCPs or be used for precise targeting. Unless otherwise stated, a 10-meter CEP is defined as the 50 percent probability that a calculated position of a point is within a circle containing a radius of 10 meters from the true position (see Figure 5).

NATO Standardization Agreement (STANAG) 2934 specifies user requirements for position and navigation (POSNAV) accuracies. Figure 6 shows a condensed version of these requirements. As shown in the figure, horizontal position is expressed in terms of CEP in meters, vertical position in probable error (PE) in meters and direction (azimuth) in PE in mils.

Position/direction accuracies and munitions effectiveness are considered parts of the "error budget" for indirect fire weapons and TA systems. An error

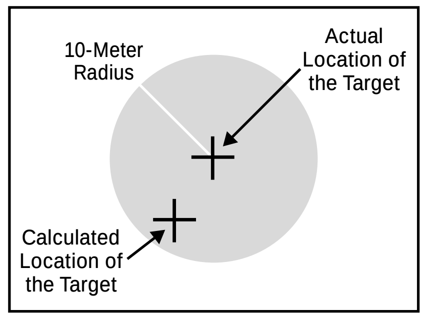


Figure 5: 10-Meter Circular Error Probable (CEP). This CEP has a 50 percent probability that the calculated point will be located in a circle containing a 10-meter radius from the true position of the point.

System	Horizontal Position (Meters) CEP (50%)	Vertical Position (Meters) PE (50%)	Direction (Mils) PE (50%)
105 Towed Howitzer	17.5	10	0.4
155 Towed Howitzer	17.5	10	0.4
155 Self Propelled Howitzer	17.5	10	0.4
MLRS	8	3.6	1
BFIST/Striker	30	20	2
Q-36 Radar	10	10	0.4
Q-37/Q-47 Radar	10	10	0.4
Q-25A/Q-58 Radar	43.7	10	3
MMS	114	10	9

Legend:
BFIST = Bradley Fire Support Team Vehicle
CEP = Circular Error Probable
MLRS = Multiple-Launch Rocket System
MMS = Meteorological Measuring Set
PE = Probable Error

Figure 6: FA Position/Navigational (POS/NAV) Operational Requirements from NATO Standardization Agreement (STANAG) 2934 (A Artillery P-1, "Artillery Procedures," Chapter 11, Annex A, Tables 1-7)

budget encompasses all errors that contribute to the total system accuracy or probable error of the rounds under nonstandard conditions, such as errors incurred by inaccuracies in weapons location, target location, Met data, etc.

Because GPS provides a 10-meter CEP with 50 percent confidence and STANAG 2934 allows for a higher CEP with the same 50 percent confidence rate on many systems, too many Field Artillerymen think the GPS exceeds the standard and they can skip the verification step. That is incorrect—50 percent confidence is not enough to mass fires effectively.

When properly employed, GPS can provide the accuracies to meet common survey requirements, but the user must validate it with an independent means as soon as possible. Sergeant First Class Joseph G. Jacobs, a Fire Support Observer/Controller at the Joint Readiness Training Center (JRTC), Fort Polk, Louisiana, wrote the article "Field Artillery Survey Sections in the New Millennium: New Equipment—Old Requirements" published in the "Combat Training Center (CTC) Quarterly Bulletin" in the First Quarter of FY01 (No. 01-16, July 01) that discusses the use of the GPS and GLPS. He states, "All too often at the JRTC, that crucial second check is not taking place." In other words, commanders often are assuming incorrectly that all positional data produced by GPS-aided systems are correct and accurate.

In combat operations, an independent verification of position and (or) azimuth may not be practical, but in built-up areas where the effects of our fires must be closely maintained, it may be critical. The most important reason to validate any GPS-aided system is due to GPS' vulnerabilities.

What are GPS' vulnerabilities? GPS signals are vulnerable to jamming, spoofing and masking interference. Jamming is the interruption of the GPS signals, and spoofing is GPS signals that have been deliberately duplicated with the intent to fool GPS receivers into using the manipulated data. Masking occurs in built-up areas or in heavy tree cover. Satellites also may be affected by either solar flares or meteors that can cause GPS errors or interrupt GPS signals.

Jamming may be produced by hostile means or accidentally by friendly forces or introduced intentionally in the form of selective availability to prevent adversaries from using our GPS service.

There are valid reasons to be concerned. GPS jammers are easy to build or acquire and would be relatively easy to employ against our forces.

The recent introduction of the selective availability anti-spoofing module (SAASM) will make GPS less vulnerable to hostile jamming and spoofing but will not make GPS foolproof. Modernization plans call for a more robust and less vulnerable GPS service, but the system is not projected for fielding for at least a decade.

GPS vulnerabilities result in many unfavorable possibilities to the user: delays in service, positional errors or complete loss of signals.

What if GPS becomes unavailable? If GPS becomes unavailable, all self-location system platforms can continue to meet mission requirements by using SCP or update point data. SCPs and update points are established by survey teams to provide horizontal and vertical reference. In the event of GPS signal loss, the platforms can continue to use their internal INS along with SCP or update point data to fulfill common survey requirements. These points also provide a means to validate self-location system accuracy and conduct a second independent verification of the positioning data.

Establishing these SCP/update points is the primary task of today's survey teams. The article "Artillery Surveyors: Nomads of the Battlefield" by Chief Warrant Officer Three W. Mark Barnes (January-February 2001) provides additional information regarding GPS vulnerabilities and the criticality of units' training to operate without GPS.

How do units avoid common grid and common survey issues? Training to compensate for our vulnerabilities should be part of every exercise—to include operating without GPS. Most leaders would concur that their units lack skills in basic map reading, use of compasses and terrain association. The PLGR was designed as a navigational aid, yet units commonly train with the PLGR and no map.

Gaining a basic understanding of common grid, common survey and GPS vulnerabilities is the first step in preventing common grid issues. Military planners must account for common grid during the intelligence preparation of the battlefield (IPB) to avoid disrupting the targeting process. To avoid problems with common grid, planners at all levels should ask the questions in Figure 7, and units should use the references in Figure 8.

Conclusion. Despite the enhancements of systems using digital maps and GPS technology, the requirements of common grid remain as valid today as ever. The probability that our forces will operate in areas where the components of common grid will differ between maps and weapons, TA and command and control systems remains high.

1. What are the operational datums and ellipsoids used in the region? There will be many different datums and ellipsoids used during joint operations. Depending on the scale, paper maps may be referenced to one datum and digital maps of the same area may be referenced to a different datum.

2. Have the standard operational datum and ellipsoid been established? The highest echelon survey element should recommend which datum and ellipsoid to use and provide the differences between coordinates that users of topographic land maps (TLMs) should apply to their maps when reporting coordinates. Users must pay attention to the operational datum in use.

3. What are the system capabilities in regards to common grid—is there a workaround established, as necessary, and disseminated to the force? No single system or platform is programmed for all datums, ellipsoids, grids or projection systems.

4. Do we have a backup for the global positioning system (GPS)? GPS has vulnerabilities that may not be apparent to the user until it's too late. Users always should use crypto keys. Users also should validate data, whenever possible—at a minimum with a map spot.

5. Has the signal and communications plan integrated GPS signal frequencies to prevent unintentional jamming by friendly forces?

6. Does the survey plan employ its assets proactively enough to establish common survey requirements and backup capabilities?

7. Have we identified where and who can transform coordinates, if needed?

Figure 7: Questions for Planners to Ask to Prevent Common Grid Issues

Resource	Application
TM 11-5825-291-13 AN/PSN-11 Precision Lightweight Global Positioning System Receiver (PLGR)	Covers and supports all software and hardware versions of the PLGR.
PLGR White Paper Dated 4 December 2000	Addresses the use of PLGR in Field Artillery. Paper is online at http://sill-www.army.mil/gunnery/CourseInfo/courses_download_page.htm#infodoc.
FM 6-2 TTP for Field Artillery Survey *MCWP 3-16.7 Marine Artillery Survey Operations (USMC)*	Manuals that cover Army and Marine survey operations.
NIMA TR8350.2, Third Edition	A National Imagery and Mapping Agency (NIMA) technical report that defines WGS84 and provides deltas and parameters to convert or define local datums and ellipsoids. It is online at http://mac.usgs.gov/mac/nimamaps/dodnima.html.
The Field Artillery Master Position and Navigation Plan	Provides plans for the current and objective POS/NAV systems architecture. It is online at sill-www.army.mil/famag in the "Go-to-War Primer."
NIMA VHS Film "The Danger Zone"	Excellent 23-minute training film that provides fundamental information on datums, ellipsoids, grids and the global positioning system (GPS). NSN: 7643-01-476-1509
Geodetic Translator (GEOTRANS) Software	Free software used to perform conversions. Runs on Windows-based PC or laptop. Available online at NIMA via http://164.214.2.59:80/GandG/geotrans/geotrans.html.
Backup Computer System (BUCS)	Uses the datum-to-datum coordinate transformation (DDCT) program to perform conversions.
Forward Entry Device Meteorological/Survey (FED MSR) Hand-held Terminal Unit (HTU)	Use forward observer software (FOS) to perform conversions and other survey calculations.

Figure 8: Useful References for Training on and Solving Problems with Common Grid

Somewhere out on the horizon, technology will bring a more accurate and reliable GPS service to merge with systems operating in a globally unified datum, ellipsoid, grid/coordinate and projection system, thus eliminating the need to understand the attributes of common grid or common survey. But until that time, Field Artillerymen must understand the fundamentals of common grid to plan for vulnerabilities and limitations and ensure nothing prevents the delivery of accurate, responsive fires—time-on-target.

Chief Warrant Officer Three Xavier Herrera, US Marine Corps (USMC), has been the Chief of the Survey Branch of the Cannon Division in the Gunnery Department of the Field Artillery School, Fort Sill, Oklahoma, since April 2001. In his previous assignment, he was the Survey Officer for the 5th Battalion, 11th Marines and Radar Officer for the 11th Marines at Camp Pendleton, California; and Mortar Platoon Sergeant for the 2d Battalion, 4th Marines, also at Camp Pendleton. Among other schools, he is a graduate of the Target Acquisition Warrant Officer Advanced Course at the Field Artillery School and the Advanced Geodetic Survey Course at the Defense Mapping College, Fort Belvoir, Virginia.

Recognition of Combat Vehicles (ROC-V) Training

ROC-V is a Windows-based thermal/sight computer training program developed by the Communications and Electronics Command (CECOM) Night Vision Electronic Sensors Directorate (NVESD). The ROC-V interactive software helps soldiers identify combat vehicles by sight and their thermal signatures. In addition, ROC-V provides practical experience in thermal sensor image controls—soldiers adjust thermal images to find targets and bring out thermal identification cues.

ROC-V software features high-resolution imagery; a large vehicle set, including helicopters; expanded tactical vehicle descriptions; occluded target views; samples of vehicle sounds; and a separate "iron sight" day-view version. The training modules can display US vehicles with or without their combat identification panels (CIPs). In addition, tutorials explain how the CIPs work and what their identification effects are. The interactive software also includes training and testing for the proposed Soldier's Manual Common Task: Identify day-visual vehicles (Skill Level 1).

The Simulation, Training and Instrumentation Command (STRICOM), Redstone Arsenal, Alabama, has configured ROC-V software for institutional US government users to download. For user name and password to access the website, contact Mike Day at mxregistrar@redstone.army.mil. The ROC-V website is https://rocv.army.mil/ROCV/.

Future versions of ROC-V will include low- and high- angle rotary and fixed-wing aviation and tactical unmanned aerial vehicles (UAVs) for identification training, Potential users and sight system developers, such as project managers who want to discuss the development of ROC-V features to support their missions, should contact the author at commercial (850) 882-6700, Extension 7515 or DSN 872-6700, Extension 7515.

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Attack Aviation Fires for the Close Fight:

A New Approach

By Major Brooke H. Janney, USAR

Divisional employment of attack aviation is changing. For almost 15 years, the employment of divisional attack helicopters has focused on striking deep at second-echelon forces. While retaining the ability to attack deep, this focus has begun to emphasize the AH-64 Apache helicopter in the close fight alongside brigade combat teams (BCTs).

The new structure of the opposing force (OPFOR) for the contemporary operational environment (COE) is in Battle Command Training Program (BCTP) exercises and National Training Center (NTC) rotations at Fort Irwin, California. This COE OPFOR increases the value of employing aviation in the close attack while simultaneously reducing the high-value targets in the division's deep attack battlespace of 15 to 30 kilometers beyond the forward-line-of-own-troops (FLOT). Army aviation now faces OPFORs with more air defense systems of higher quality, increasing the risks of employing aviation beyond the FLOT.

Fire support doctrine for supporting aviation operations has not kept pace with changes in aviation operations, equipment or threat. Changes in the means and objectives of divisional deep attacks, the advent of aviation close attack operations and the fielding of the AH-64D (Longbow) alter both the missions assigned to attack helicopter battalions and aviation brigades and the tactics, techniques and procedures (TTPs) they employ. Fire support TTP also must evolve to account for these changes and leverage the increased capabilities of the advanced FA tactical data system (AFATDS).

The 3d Infantry Division (Mechanized), Fort Stewart, Georgia, recently experienced all these changes. The 1st Battalion, 3d Aviation Regiment (Attack) fielded the AH-64D Longbow in March 2001. The division artillery fielded AFATDS in the fall of 2001. The division participated in a BCTP Warfighter exercise facing the COE OPFOR in January 2002. These changes enabled a substantial shift in aviation operations and demanded a similar shift in our fire support planning and execution in support of those operations.

AH-64D Longbow. The AH-64D is a remarkable weapon that brings a new suite of capabilities to the attack helicopter battalion. Its multi-functional displays, active fire control radar (FCR) and passive radar emission detection systems provide a quantum leap forward in situational awareness (SA) and target attack options. Its digital communications equipment enables the AH-64D to exchange information with other Longbow helicopters and link with its battalion fire support element (FSE) via AFATDS. This enhanced SA fundamentally alters the way the attack battalion fights. (See Figure 1.)

Lacking these on-board SA capabilities, AH-64A battalions conduct detailed planning before execution to compensate for its inability to detect changes in the threat and adapt the plan significantly while en route. The battalion's standard tactics for near-FLOT and cross-FLOT operations center on high-speed flight down an established air corridor under radio listening silence to minimize its emissions signature.

Fire support for these tactics reflected this approach. Suppression of enemy air defenses (SEAD) was conducted at the time of attack along the ingress and egress routes using a time-driven fire plan. Deception SEAD was recommended doctrinally but rarely conducted, usually because of limitations in the number of firing units available.

In contrast, the AH-64D Longbow leverages its increased SA in ways that significantly alter such tactics. Extensive planning is still conducted before launch, but flexibility is built into the

AH-64A Helicopter

- Speed is life.
- It moves at high speeds at low altitude between air checkpoints (ACPs).
- Its routes are aligned by terrain and air defense threats to maximize protection.
- It has a relatively fixed schedule for movement supported by suppression of enemy air defenses (SEAD) and based on an H-Hour or F-Hour time line.

AH-64D (Longbow) Helicopter

- Knowledge is power.
- It moves at moderate speeds at low-altitude maneuver between ACPs and can support infiltration by a team, platoon or company.
- Its routes are aligned by terrain and air defense threats to maximize protection while taking advantage of its fire control radar (FCR) and increased situational awareness (SA) to conduct traveling overwatch and bounding overwatch maneuvers.
- It has less of a fixed time schedule for movement as the unit will respond to new information acquired en route to its target area. This requires an alternative form of SEAD fire planning: event-driven SEAD (single targets or groups of targets) vice a fixed, time-driven SEAD plan.

Figure 1: Air Movement vs Air Maneuver: The AH-64A vs the AH-64D (Longbow)

plan, reflecting the anticipated increase in SA. Scout aircraft teams move ahead of the main body of aircraft. Aircraft with the FCR are in the formation to ensure all-around scanning and early warning. Designated teams identify and attack air defense threats acquired en route. Lead elements "paint" the engagement area (EA) before the main body arrives and pass the EA digital picture back to the rest of the attacking unit, complete with assigned sectors of fire and target priorities. In effect, the unit transforms what was once an air movement into an air maneuver.

These tactics alter the standing operating patterns of the battalion. Elements move from air checkpoint (ACP) to ACP using formations similar to traveling overwatch and bounding overwatch. Aircraft speed up and slow down in response to the changing tactical situation. Air corridors now must be wider to enable teams to conduct air maneuver.

Operating under radio listening silence reduces combined arms coordination capabilities and flexibility. This is no longer as important because the AH-64D aircraft's signature already has been increased by its millimeter-wave radar emissions and digital radio transmissions.

Because attack aviation units no longer move using a rigid time line, time-driven SEAD techniques become too inflexible. Digital fire plans using only a time line cannot be altered once they are activated. An event-driven fire plan using separate targets and target groups provides the required flexibility. The SEAD plan retains a time line but is structured as discreet targets and target groups to maintain flexibility. En route communications are not required to keep the fire support plan synchronized with the movement of the attacking element.

Airspace Management. Fire support TTPs for airspace management require changes. Units conducting offensive and defensive air maneuver need broader and more flexible airspace management and fire support coordinating measures (FSCMs). These FSCMs enable air maneuver while protecting and deconflicting operations with the rest of the combined arms and joint team.

The aviation brigade's airspace is of interest to the fire support community. Preventing the simultaneous use of the same airspace by rotary- and fixed-wing aircraft and artillery rockets, missiles and projectiles is as critical a deconfliction function for the aviation FSE as FSCM management and clearance of fires is for the ground maneuver FSE. While there is a formal process and channel for divisional airspace command and control (AC^2) planning and execution, the aviation FSEs play a critical role in execution. The ground maneuver and aviation FSEs enable both forces to establish and revise airspace management measures and deconflict airspace rapidly during execution.

AFATDS provides a means of rapidly building and disseminating supporting FSCMs that help airspace management. For each air route, restricted operating zone (ROZ), forward arming and refueling point (FARP), hold area (HA), battle position (BP) or attack-by-fire position (ABF), the FSEs must enter an appropriate FSCM.

Doctrinally, several airspace management measures have no clear impact on fire support operations. A ROZ, for example, deconflicts airspace between aircraft but is not doctrinally recognized as a FSCM. A BP or ABF can be entered into AFATDS as a graphic control measure and will appear on the display screen. However, they do not generate a requirement message to deconflict fire missions into that area.

This oversight must be countered by translating airspace management measures and graphic control measures into appropriate FSCMs. Aviation ROZs become airspace coordination areas (ACAs) established at the same locations and altitudes as the ROZs. Air routes become air corridors segmented at each set of ACPs to align the affected airspace with the exact length, width and altitudes of the route. FARPs, BPs and ABFs all have ACAs established from one foot above ground level (AGL) to the maximum altitude at which the aviation unit expects to operate for the mission; this creates a three-dimensional "buffer" within the airspace and applicable ground battlespace used by the aviation unit that signals the need for a coordination requirement before executing fire missions in that battlespace.

These measures are built and disseminated in a planned status. The FSEs activate them as required by aviation operations, and the FSEs deactivate them as soon as possible to minimize the impact on FA fires. AFATDS makes dissemination and activation/deactivation faster and simpler than older, analog methods, particularly when operating in a tactical local area network (LAN).

A review of firing table data for multiple-launch rocket systems (MLRS) and 155-mm cannons reveals that as long as aviation units remain 2,200 meters from the firing point and impact point of a fire mission, the ordnance will pass above the aviation unit operating at 200 feet AGL and below. This careful application of FSCMs supporting aviation operations, when paired with proactive deconfliction of position areas for artillery (PAAs) with airspace control measures during operations planning and execution, results in minimal impact on either community. (See Figure 2.)

Battle Position (BP) or Attack-by-Fire Position (ABF) Airspace Coordination Area (ACA)

- It is at least 1 foot above mean sea level (MSL) to 200 feet above ground level (AGL).
- The ACA dimensions match the BP or ABF.
- Rule of Thumb: The ACA is 2 x 2 kilometers with an attitude along the orientation of the BP or ABF to the engagement area (EA).

Air Corridor and ACA Activation

- The air corridor is segmented by air checkpoints (ACPs).
- The advanced FA tactical data system (AFATDS) only allows segmented air corridors, so they are used in lieu of ACAs.
- The width of the air corridor matches the route's actual maneuver space.

Route and Air Corridor

- The altitude must be at least 1 foot AGL and up to 200 AGL.
- The width must be a minimum of 3 kilometers (1.5 kilometers from the center line); the preferred width is 4 kilometers wide (2 kilometers from the center line).

Figure 2: Airspace Management for the AH-64D (Longbow). The use of these measures and required altitudes reduces the amount and duration of airspace restricted during aviation operations. Artillery is only restricted when/if aircraft fly across the gun-target line within 2,200 meters of the multiple-launch rocket system (MLRS) or 155-mm howitzer firing point or the target area and only when the airspace/fire support coordinating measure (FSCM) is activated.

Fire Support for Attack Aviation in the Close Fight. Army aviation is returning to its roots with its doctrinal move toward employing attack helicopter in attacks close to or in support of a BCT. This type of mission harks back to the advent of the armed helicopter and maximizes several of its characteristics that make it uniquely qualified for this role.

One approach to these close attacks is to employ the attack battalion or company in an operational control (OPCON) relationship to a BCT. While reducing the aviation brigade's role in planning and execution, this relationship is critical to greatly simplify mission planning and on-the-ground coordination. Working through the aviation brigade liaison officer (LNO) assigned to each BCT, the attack battalion or company commander coordinates the unit's role in the BCT's scheme of maneuver. Attack battalion tactical command posts (TACs) can collocate with ground maneuver brigade tactical operations centers (TOCs) or TACs, further improving coordination.

Attack helicopter units generally continue to operate from the aviation brigade assembly area for protection and maintenance support. They frequently establish FARPs and occasionally HAs in the brigade support area or an area nearby to ensure more responsive support to the BCT commander if a second or third turn of aircraft is required.

Each BCT FSE and its direct support (DS) FA battalion integrate the attack battalion's fire support requirements and essential fire support tasks (EFSTs) into the fire support plan. The BCT's DS and reinforcing (R) artillery are the primary units to provide SEAD while division artillery general support (GS) assets remain prepared to fire SEAD if the DS assets are insufficient or over-tasked at the time aviation is committed to the close fight. (See Figure 3.)

The attack battalion FSE becomes a subordinate maneuver FSE to a BCT FSE when fighting close. The aviation brigade FSE provides continuous air defense artillery (ADA) targeting support, airspace coordination and FSCM support, and planning assistance to the BCT and attack battalion FSEs.

There are several considerations associated with planning fire support for attack aviation in the close fight within minimal time. If a current ADA picture is available and pre-established air routes meet mission requirements, the attack battalion and FSE still require 30 to 45 minutes notification before launching aircraft. This allows the FSEs to refine the final SEAD target list, allocate firing units to the fire plan, finalize the situational and mission briefings for the aircrews, and coordinate for and clear the airspace and battlespace.

The maneuver forces must refine the target list before the aircraft are launched

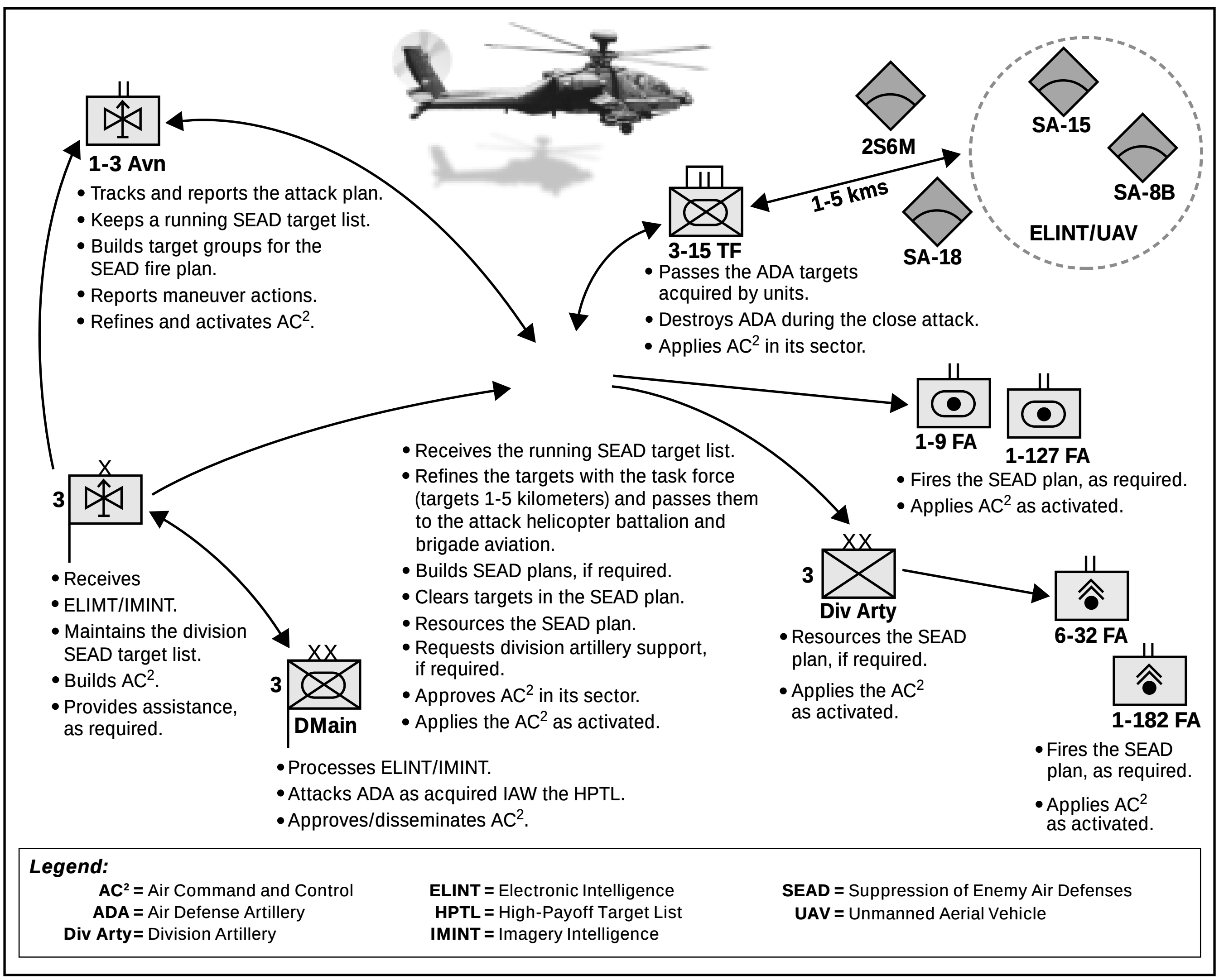

Figure 3: Fire Support for SEAD in the Close Attack

in the close fight. Electronic intelligence (ELINT) and imagery intelligence (IMINT) provide a relatively accurate picture of the ADA threat five kilometers behind the FLOT and beyond. ADA located beyond the five-kilometer zone move less often and, therefore, can be located and engaged with high confidence using intelligence that is one to two hours old. ADA elements at or near the FLOT (up to about five kilometers) move constantly and are time-sensitive targets that cannot be accurately engaged by intelligence that is one to two hours old. This area also contains the vast majority of man-portable air defense systems (MANPADS) with infrared (IR) homing that are the most difficult to locate using ELINT/IMINT. When the BCT FSE and attack battalion FSE use the aviation brigade FSE ADA target list and target updates as a start point and refine it with bottom-up additions and corrections, units have their best effects.

The usual targeting process is to have the attack battalion FSE build the SEAD target list from aviation brigade and BCT FSE target lists and then transmit a finalized target list to the BCT FSE for target clearance, firing unit allocation and execution. The BCT FSE clears all targets and sends it to the DS FA battalion to resource as much of the fire plan as it can. Targets that cannot be fired by DS and R units are transmitted to the division artillery for engagement by GS units.

Execution is a combined effort by all parties. The attack battalion FSE establishes triggers for executing the SEAD plan and announces when the attack battalion meets the triggers. The FSE also activates and deactivates airspace control measures and FSCMs. The BCT FSE and DS battalion fire direction center (FDC) control the execution of SEAD fires and synchronize any close air support (CAS) employed in concert with the attack helicopters, passing CAS terminal guidance responsibility to the air mission commander, if appropriate. The aviation brigade FSE monitors the operation and relays any immediate ADA threat indicators that develop in the area of the operation.

SEAD in this type of environment is not a one-time event. The suppressive effects of a SEAD plan are temporary unless a sufficient volume of fire is generated to neutralize or destroy ADA systems. This is the appropriate approach if target location is accurate and sufficient firing units are available. ADA systems are thin-skinned vehicles with delicate exterior armament and equipment and do not require large quantities of munitions to neutralize or destroy them.

Air defense systems are highly specialized and a limited commodity. There is little likelihood the OPFOR can replace these assets rapidly, if at all.

If an FSE elects to fire suppressive effects only, that FSE will have to repeat the SEAD in the general area of the operations every five minutes. As the engagement continues, additional firing requirements begin to build as functional ADA systems have moved quickly after taking indirect fire and are firing again.

A partially effective or an ineffective SEAD plan usually results in either aircraft losses or mission failure. Even if aircraft are not shot down or damaged, ADA threats that remain operational force aircrews to divert ordnance to killing ADA rather than the tanks, infantry fighting vehicles (IFVs) or artillery they were sent to kill.

The AH-64D is quite capable of conducting self-SEAD or, as the aircrews call it, destruction of enemy air defenses (DEAD). The drawback of self-SEAD is that aircrews expend their time and ordnance on targets that do not directly help the ground maneuver commander achieve his mission.

Daytime missions are particularly dangerous as ADA gunners can acquire their Apache targets visually and orient MANPADS IR missiles and air defense guns to those targets. Daytime missions require more detailed SEAD plans and more firing units to achieve even suppressive effects.

Issues Ahead. The Army's use of aircraft and airspace is currently undergoing transformation. The Army Aviation Transformation Plan will alter attack, assault and general support aviation operations and tactics. The reduction in the number of helicopters in an attack and lift company, for example, will have a direct impact on the number of aviation units or sub-units required to complete mission profiles. Further proliferation of unmanned air vehicles (UAVs) will increase the type and quantity of management measures needed to deconflict a more crowded airspace.

Air defense measures continue to develop. These already formidable weapons and networks will continue to rise to the challenge presented by US air dominance and our expanding use of Army aviation for attack, intelligence surveillance and reconnaissance (ISR) and movement. Ultra-modern ADA surface-to-air systems, such as the SA-11 and SA-12, are already being upgraded and replaced by new systems, such as the SA-17 and SA-20. The deadly game of action, reaction and counteraction continues.

With every change in air maneuver operations and the threats to them, fire support TTPs must evolve similarly. Tactics that support today's operations against today's threats will inevitably fail to optimally support those of tomorrow. Just as Field Artillerymen constantly reevaluate TTPs to support ground maneuver operations, we must constantly reevaluate our TTPs to support air maneuver operations.

The combination of lethal and nonlethal indirect fires paired with fixed- and rotary-wing observation and attack aircraft remains one of the Army's most potent joint/combined arms teams. The proper employment and synchronization of this team has become one of the lynchpins of division operations and is becoming more crucial to brigade operations. The fire support community must maintain its effectiveness in support of that lethal team.

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Paving the Way for Air Maneuver:

Defeating COE OPFOR Air Defenses

By Major Brooke H. Janney, USAR

The world witnessed the devastating effectiveness of US air power and the ruthless efficiency of attack aviation during Operation Desert Storm in the Gulf. The US rapidly defeated Iraq's air defenses, considered some of the best in the world. Operations in Iraq and then Bosnia and Kosovo have hammered home the same lesson to nations opposing the United States: nothing less than a first-class air defense network will do. In the decade following the Gulf War, nations around the world have spent significant time and treasure upgrading and improving the quality and quantity of their air defenses.

The Battle Command Training Program (BCTP) contemporary operational environment (COE) opposing force (OPFOR) replicates these worldwide improvements in air defenses. The air defense artillery (ADA) capabilities of the COE OPFOR are designed to blunt the American military's superior fixed- and rotary-wing aircraft advantage.

The COE OPFOR's air defenses are an ultra-modern, high-density integrated air defense system (IADS) using a dangerous mix of infrared (IR) man-portable air defense systems (MANPADS), guns, gun-missiles and medium- and long-range missile systems all tied into a substantial air surveillance radar system. Now more than ever, fire supporters must enable the US air power advantage with prolific and effective suppression of enemy air defenses (SEAD).

COE OPFOR ADA Order of Battle. While the exact composition of the COE OPFOR varies with each exercise or rotation, the COE OPFOR has a structure that forms the basis for understanding the nature of the threat. (See Figures 1, 2, 3 and 4 on Pages 15, 16, 17 and18.)

The OPFOR has brigade tactical groups (BTGs) and division tactical groups (DTGs) within an operational strategic command (OSC). Each BTG has a battalion of ADA. Each DTG has a brigade or regiment of ADA, usually

SA-11 (3 Kms Min/32 Kms Max)

a mix of mobile medium-range systems and, possibly, some long-range systems allocated from the OSC.

The OSC retains control of two to three brigades of additional ADA, usually a mix of MANPADS units and long-range theater air defense systems. This creates a 3:1 quantitative increase in air defense assets when compared to the old OPFOR—in addition to a dramatic qualitative increase in the types of ADA weapons systems and in their effective ranges and capabilities.

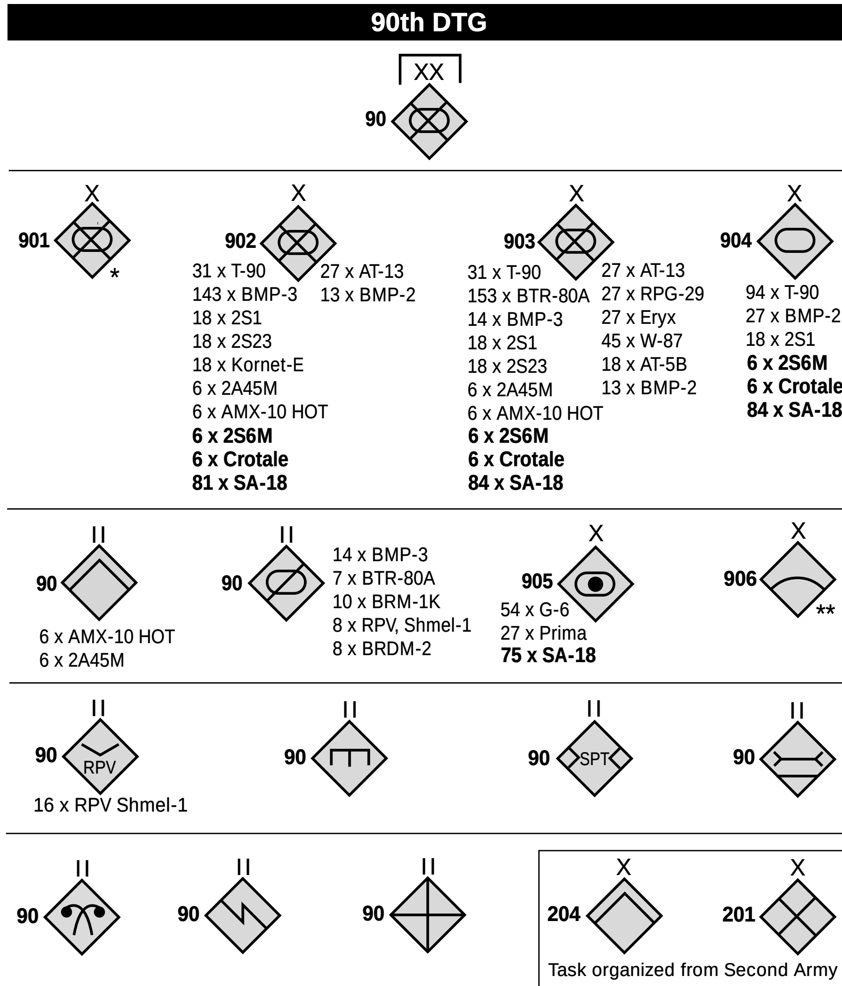
COE ADA OPFOR Strengths. The weapons systems mix creates a difficult challenge for US aircraft and SEAD planners. The mix is a combination of low-, medium- and high-altitude coverage of the long-range radar-equipped SA-10/11/12 systems; low- to medium-altitude coverage of the medium-range radar-equipped 2S6, Crotale and SA-8b of the divisional and brigade ADA assets; and the low-altitude IR MANPADS threat found in OPFOR maneuver units. This creates an overlapping and redundant threat of mobile long-range systems, mobile medium-range systems and point-defense MANPADS, the latter unseen from an intelligence collection and targeting perspective.

Quantity. The sheer number of ADA systems increases the number of artillery firing units required for SEAD. Where SEAD plans used to have a maximum of 10 to 12 targets, US forces now routinely deal with SEAD plans with 20 to 30 targets.

Quality: Integrated Radar-Based Systems. Targeting ADA used to focus on destroying separate radars that enabled rapid neutralization of the entire gun-based air defense system. We used to find the Dogear radars and destroy them, severely degrading the S-60- and SA-13-based air threat.

Now, the majority of weapon systems in the ADA order of battle have their own integrated radar or on-board radar. This requires the SEAD planner to target every ADA weapon system rather than a few carefully selected critical nodes. This is another key factor in driving up the number of targets in a SEAD plan and the artillery firing units required to execute it.

Quality: Increased Range and Mobility. The air defense network is more lethal and mobile than its predecessor. Frontline ADA systems have an excellent combination of range and mobility—some systems can fire on-the move. The COE OPFOR equivalent of direct



*See the unit organization of the 901st Mech BTG in Figure 2.
**See the unit organization of the 906th ADA Brigade in Figure 3.

Legend/Threat:

AMX-10 HOT = Anti-Tank Guided Missile (Vehicle-Mounted/Tripod)
AT-5B = Anti-Tank Guided Missile (Vehicle-Mounted/Tripod)
AT-13 = Anti-Tank Guided Missile (Tripod)
BMP-2/3 = Tracked Infantry Fighting Vehicle
BRM-1/1 = Tracked Armored Reconnaissance Vehicle
BRDM-2 = Wheeled Light Armored Reconnaissance Vehicle
BTR-80A = Wheeled Armored Personnel Carrier
Crotale = Self Propelled Surface-to-Air Missile (10 kms)
Eryx = AT Guided Missile Launcher (Tripod/Shoulder-Fired)
G-6 = 155-mm Self Propelled Gun-Howitzer (30 kms/39 kms Base Bleed/up to 50 kms with VLAP)
HE = High Explosive
Kornet-E = (AT-14) AT Guided Missile Launcher (BMP-3-Mounted/Tripod)
MANPADS IR = Man-Portable Air Defense System Infrared
Prima = (9A51) 122-mm Multiple Rocket Launcher (MRL) (20.5 kms)
RAP = Rocket-Assisted Projectile
RPG-7V/29 = Rocket Propelled Grenade
RPV Shmel = Remotely Piloted Vehicle
SA-18 = MANPADS IR Surface-to-Air Missile (6 kms)
SP = Support
T-90 = Main Battle Tank
VLAP = Velocity Enhanced Long-Range Artillery Projectile
W-87 = Chinese-Made 35-mm Automatic Grenade Launcher (1,500 m)
2A45M = 125-mm Towed AT Gun (Direct Fire 2.1 kms/Laser-Guided Round 5 kms/Indirect Fire HE 12.2 kms)
2S1 = 122-mm Self Propelled Howitzer (15.3 kms/21.9 kms with RAP)
2S6M = Self Propelled Air Defense with Quad 30-mm Guns and Four SA-19 Missile Launchers (Gun 3 kms/Launchers 8 kms)
2S23 = 120-mm Self Propelled Gun-Mortar Combination (8.8 kms/12.9 kms RAP)

Figure 1: 90th Division Tactical Group (DTG) of the Contemporary Operational Environment (COE) Opposing Force (OPFOR). Note: The air defense artillery (ADA) assets are bold.

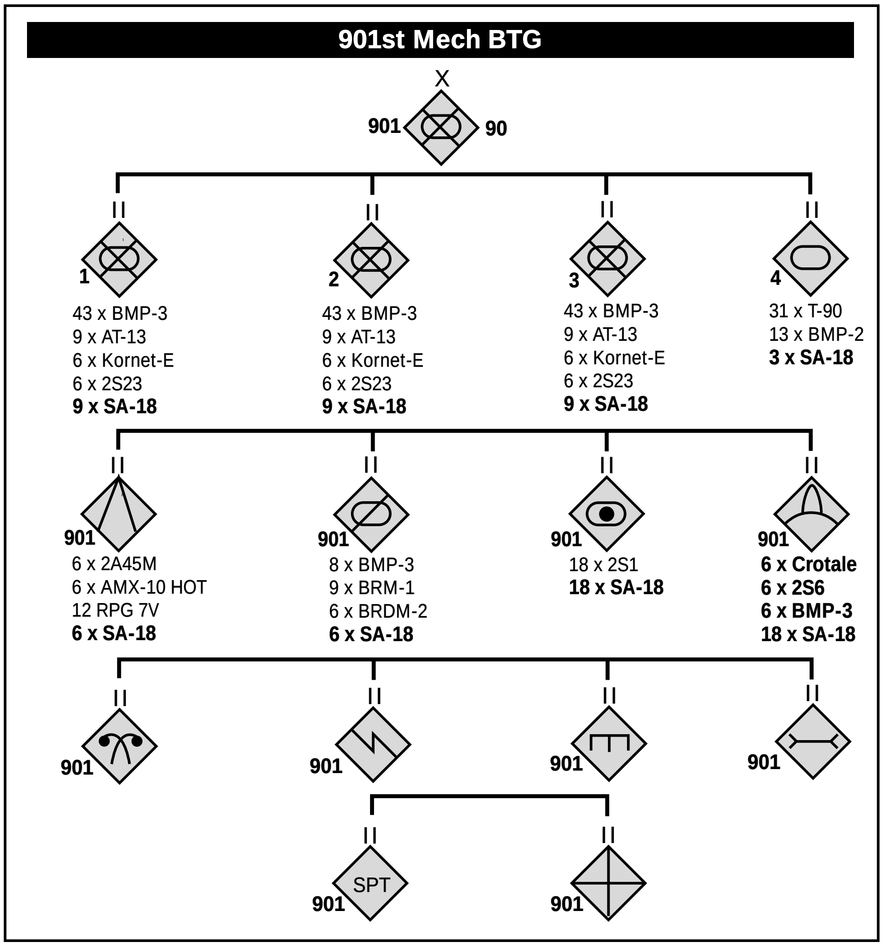
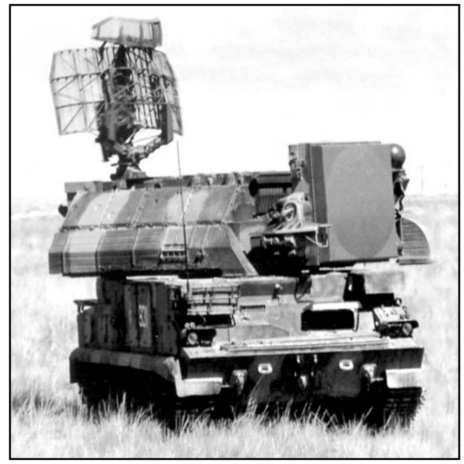


Figure 2: The 901st Mechanized Brigade Tactical Group (BTG), 90th DTG. Note: The ADA assets are bold.



SA-15 (Max 12 kms; Fires on the Move)

2S6M (Quad 30-mm Guns/4 SA-19 Missile Launchers)

support (DS) ADA (2S6 and Crotale) can range out to 10 kilometers, and its DTG ADA brigade assets (2S6, Crotale, SA-8b and SA-15) can often extend out to 15 kilometers. Because of the weapons' longer ranges and overlapping area coverage, more ADA systems can attack aircraft at one time and at standoff ranges from the AH-64D Apache helicopter's self-SEAD capabilities. The mobility of these air defense systems also creates a requirement for near continuous intelligence collection to maintain a relevant targeting picture.

Exploiting COE ADA OPFOR Vulnerabilities. Aspects of the COE ADA threat can be exploited, however. While the OPFOR has acquired a substantial increase in range and all-weather, all-aspect capabilities, his ADA is now primarily radar-equipped, and he relies on those radars for tracking and engagement. This allows the US to conduct proactive targeting using electronic intelligence (ELINT) collection assets by streamlining the ELINT processing time from acquisition to targeting team to shooter.

SA-10 (Launch Range 5-90 Kilometers; Altitude Range 25-27,000 Meters)

Lethal SEAD: Counter-ADA Fire. In fighting the COE OPFOR during a BCTP Warfighter, the 3d Infantry Division (Mechanized), Fort Stewart, Georgia, found the COE ADA capabilities created a requirement for a focused counter-ADA fight that closely resembles the artillery counterfire fight.

The 3d Division's analysis and control element (ACE) reduced this time to a 30-minute cycle, enabling the division FA intelligence officer (FAIO) and the aviation brigade fire support element (FSE) to conduct targeting drills similar to those used to assess and process Q-37 acquisitions. This enables a proactive counter-ADA plan that kills threat systems as acquired, if the ELINT target location error (TLE) is within acceptable accuracy levels.

Nonlethal SEAD: JSEAD and Deception. The OPFOR's radar-based ADA also increases the effectiveness of joint SEAD (JSEAD)—for example, EA-6B Prowler jamming and high-speed anti-radiation missile (HARM) engagements of the OPFOR ADA.

The OPFOR ADA systems are networked to some degree. At a minimum, the OPFOR uses his long-range radar-equipped systems and air surveillance radars to cue other ADA systems to incoming aircraft. Identifying and jamming these communications nets at critical times can degrade the system and force individual ADA systems into fighting a piecemeal, rather than integrated, battle. It is important to remember, however, that the individual component systems are still very capable of destroying aircraft and must be dealt with as well.

While the COE OPFOR has a large number of capable systems, he arrays them in depth across his battlespace. By deceiving the ADA network and isolating portions of it, US forces can overwhelm specific sectors and conduct air operations with relative success.

This is particularly true in close operations by attack helicopters at night. By operating on the friendly side of the forward-line-of-own-troops (FLOT), the helicopters minimize the number of medium- and long-range ADA systems that can engage aircraft. By operating at night, the helicopters negate the primary short-range threat (MANPADS IR) significantly.

Deception of the network can be achieved via a mix of false attacks using UH-60s or AH-64s along the width of the division's battlespace. The use of USAF and USN target drones and aircraft-towed decoys can augment this deception effort. Deception may be required to force the frontline ADA threat to activate its radars so friendly forces can acquire the systems with ELINT collectors.

Combining these jamming and deception efforts with lethal SEAD and JSEAD attacks greatly complicates the tactical problem for the OPFOR ADA and its decision-makers.

Repeated lethal and nonlethal attacks along multiple avenues of approach paired with deception operations using other aircraft, ideally simultaneously conducted with close air support (CAS) attacks from a different direction, will dilute and degrade the network. Use of these tactics destroys key frontline ADA assets, reduces the ADA threat at the critical point or sector and forces the threat to replace them with other systems previously arrayed in depth.

Over several days, this process opens gaps in the IADS and, eventually, allows friendly forces to overwhelm the threat. To execute this type of operation, however, requires a systematic approach to SEAD rather than the single-mission or single-event approach we currently use. In effect, it requires a detailed SEAD campaign fought over days or weeks and waged at the division and corps levels.

SEAD Campaign Planning. SEAD campaign planning is not a new idea, but it may be a new concept for Army planners and targeting teams at the division level.

The USAF has designed and fought SEAD campaigns for several decades as part of its "counterair" and "air superiority" campaigns. While the scope and tools employed in Air Force campaigns cannot all be employed directly by tactical-level organizations, the concepts and approaches are applicable.

The 3d Division adopted and modified many of those tools and tactics to attack the COE OPFOR ADA. Most of the planning occurred at the aviation brigade. The division main command post (DMAIN) and the division targeting team provided extensive intelligence support and resources for the plan.

Early on in SEAD campaign planning, units must accept that they face an integrated system rather than a large number of independent threat systems. The comparison is similar to the difference between a large number of individual howitzers and rocket launchers and a division artillery. The former has a quantitative value as a potential capability that is only realized when it's paired with a command and control system for planning and executing operations. The latter has that organization, communications and expertise that allows it to create effects greater than the sum of its parts.

In recognizing the nature of the threat, decision makers also must commit to conducting detailed and resource-intensive operations to negate and destroy the IADS threat. Without their commitment, no amount of planning will matter. Their support will be required to enforce the allocation of scarce resources and fight for the joint assets needed to wage this kind of campaign.

SEAD and the Military Decision-Making Process (MDMP). SEAD campaign planning follows a logical thought pro-

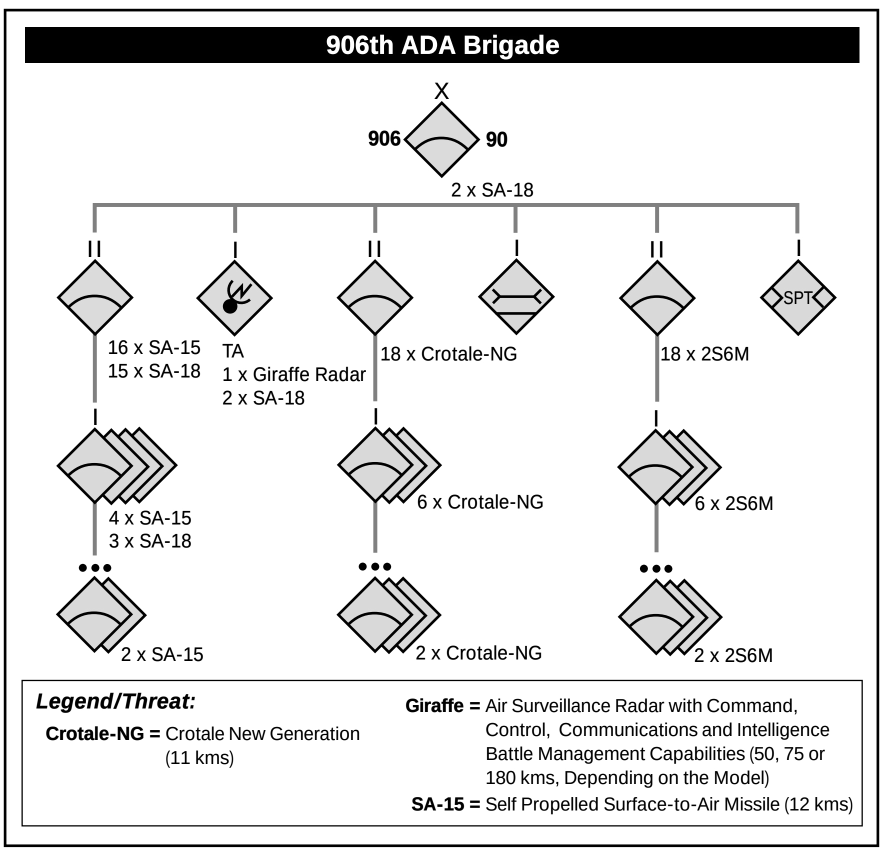


Figure 3: The 906th ADA Brigade of the COE OPFOR

cess similar to the MDMP. First is the intelligence preparation of the battlefield (IPB) of the ADA network. The intent is to identify how the system operates; its strengths and weaknesses; and the actions, capabilities or equipment the system requires to operate in an integrated form. The critical nodes, actions and processes are identified as high-value targets (HVTs). These form the basis for high-payoff targets (HPTs) and the HPT list (HPTL) as in any other targeting process.

While each IADS is different, there are several key areas that targeting teams should analyze to begin their assessment. (See Figure 5.)

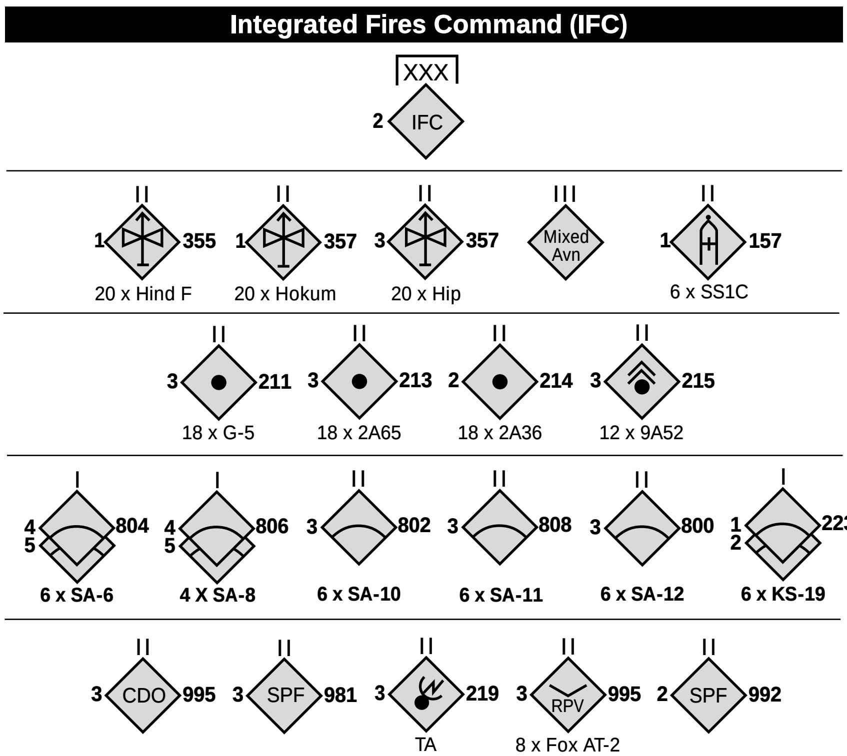
First planners look at the objectives to support the commander's goals. Mission analysis for the operation usually identifies particular tasks for fire support. These usually identify air freedom of maneuver as an essential task for the division and aviation brigade.

It is important to refine the essential task statement of "what to achieve" into discrete tasks and effects that must be accomplished to meet the objective. Is destruction required to achieve the objectives or will suppression suffice? Is the entire IADS the focus or will specific sectors or air defense systems at given times and phases be adequate? By determining these requirements early, planners can enable a more focused approach in developing courses of action (COAs) later.

The SEAD campaign planning process next looks at what intelligence collection assets are available to locate and monitor the HVTs within the IADS. The ability to find and track specific IADS HVTs is the limiting factor in the ability to target and engage these HVTs. Those found by collection assets are nominated as HPTs. At this point, HVTs/HPTs should not be limited by engagement capabilities. JSEAD assets, if made available, allow engagement throughout the division's area of operations.

Each COA is tailored to the operational plans and time line of the division or corps. A SEAD campaign has some general requirements and phases that help structure the overall campaign plan.

The first phase develops a picture of the strength, locations and disposition of the ADA threat. This is a collection-heavy phase that identifies the type, quantity, locations and operating patterns of the air defense network. This phase may require the SEAD planner to take measures to force the network to activate its radars so friendly forces can acquire and attack them. This phase often initiates the campaign's deception operations and sets the stage for early efforts to degrade the network with lethal attacks. It is a shaping operation designed to set the conditions for rotary-wing attack assets along or beyond the FLOT.



Legend/Threat:

- **Avn =** Aviation
- **C³I =** Command, Control, Communications and Intelligence
- **CDO =** Commando
- **Fox AT-2 =** Remotely Piloted Vehicle
- **G-5 =** 155-mm Towed Gun-Howitzer (30 kms/39 kms Base Bleed/50 kms with VLAP)
- **KS-19 =** Towed 100-mm Air Defense Gun (4 kms without Radar/12.6 kms with Radar)
- **SA-6 =** Self Propelled Surface-to-Air Missile (24 kms)
- **SA-8b =** Self Propelled Surface-to-Air Missile (15 kms)
- **SA-10 =** Self Propelled Surface-to-Air Missile (25 kms for Targets 25 m and Below/ 47 kms for Targets 2,000 m and Above)
- **SA-11 =** Self Propelled Surface-to-Air Missile (32 kms)
- **SA-12 =** Self Propelled Surface-to-Air Missile (SA-12a 75 kms/SA-12b 100 kms, Both Against Aircraft; and SA-12b Ballistic Missile Target 40 kms)
- **SPF =** Special Purpose Forces
- **SS1C =** Surface-to-Surface Missile (300 kms)
- **TA =** Target Acquisition
- **2A36 =** 152-mm Towed Gun (27 kms/40 kms RAP)
- **2A65 =** 152-mm Towed Howitzer (24.7 kms/ 28.9 with RAP/29 kms Base Bleed/ 20 kms Krasnopol Laser-Guided)
- **9A52 =** 300-mm Multiple Rocket Launcher (70 kms)

Figure 4: Corps-Level Integrated Fires Command (IFC). Note the ADA assets are in bold.

IADS Target Features Include—

- Air surveillance and early warning radar systems.
- On-board radars versus remote radar "hubs" that control a number of firing units.
- Communications systems, particularly transmission means (UHF, VHF, FM, telephone, wire, etc.).
- Command and control nodes or headquarters that exercise engagement decision-making authority.
- Operating patterns and tactics (rotating radar coverage among medium-range systems, silent cuing by air surveillance radars, air defense ambush tactics, etc.).

Figure 5: Key Areas of the Integrated Air Defense System (IADS)

As operational requirements dictate the employment of aviation assets and CAS along and beyond the FLOT, the SEAD campaign shifts its focus to specific sectors and (or) threat systems that must be negated to enable rotary-wing and CAS attacks within the division's overall scheme of maneuver. This phase is generally characterized by continued active and passive measures to acquire, track and engage ADA weapon systems along with rotary-wing feints and decoy operations to disorient and dilute the ADA coverage and achieve air freedom of maneuver in selected sectors. Artillery-delivered SEAD fires increase in this phase both to reduce the selected threats to Army aviation and fixed-wing forces and to conduct lethal deception on targets in and out of the key sector. Electronic attack by jamming FM communications on ADA command and control nets just before actual and decoy rotary-wing attacks reduces the integration of the network and forces individual ADA systems to acquire threats and fight independently.

The use of JSEAD assets to attack long-range ADA weapons systems, air surveillance radars and target acquisition radars begins to increase in this phase. This phase continues division shaping operations with a new focus on disrupting and destroying key ADA network integration nodes that threaten friendly air maneuver in a sector.

The effects of SEAD campaign actions begin to accumulate and generate confusion, causing the OPFOR to reshuffle air defense assets. The OPFOR will replace destroyed ADA systems by repositioning his remaining assets. He also will alter his operational patterns to try to compensate for previous weaknesses in the integrated network.

These enemy countermeasures generate a renewed requirement for focused intelligence collection and analysis. As the collection process identifies changes in the network's disposition and operational patterns, immediate attack by lethal and nonlethal assets should be directed. The key is to respond faster than the network can react. These actions will disrupt the ADA network further and force acquisition and engagement gaps to appear in the IADS. Air defense assets will begin to fight separate, piecemeal battles against air threats, reducing their effectiveness and increasing their vulnerabilities.

As gaps appear and ADA threats are destroyed, the IADS will disintegrate. The network will disappear, leaving individual weapon system operators and small units afraid to activate their radars or engage aircraft after seeing the repeated danger in doing so. The amount of airspace each node is supposed to cover will have increased to the point where overlapping fields of fire across both the width and depth of the division sector will no longer exist. At that point, friendly rotary- and fixed-wing aircraft will be able to conduct relatively unrestricted air maneuver that requires only local suppression efforts.

Photo by Christopher J. Varville, DoD civilian, Fort Hood, Texas

Because of the longer ranges and overlapping area coverage of the OPFOR's ADA, more ADA systems can attack at standoff ranges from the AH-64D Apache helicopter's self-SEAD capabilities.

Effects-Based Approach. The 3d Division used an effects-based approach for COA development in SEAD campaign planning. Having identified the HPTs within the air defense network, the targeting team examined the effects needed on both the network and HPT sets to achieve objectives.

There are several reasons to focus on the effects rather than targets. First, it is the effect rather than the target or target set that achieves an objective. A unit can engage and even destroy specific targets without achieving its objective if the targets require additional effects to achieve the objective. In addition, physical suppression or destruction may not be necessary to achieve the desired effect.

By focusing on desired effects, SEAD planners can husband scarce resources. By focusing on effects, they can identify the requirements in time and space and in their proper order and linkage.

Second, there are often several ways to create a desired effect. If the goal, for example, is to prevent medium-range air defense systems from attacking Army aviation assets as they cross the FLOT to engage enemy armor in a specific engagement area at a specific time, there are several ways to achieve this. There is the more traditional lethal SEAD plus jamming and deception means already discussed. But if the OPFOR ADA node requires permission from its higher headquarters to fire before it can launch missiles, disrupting its FM communications by ground or air assets may achieve the effect.

Planners should consider all possible ways to create the desired effect. This approach allows the targeting team to use the maximum number of means to achieve its goals.

By identifying the required effects in the proper sequence and by linking them to the various methods available to create the effects, the targeting team begins developing COAs. As options for achieving the effects are chosen in a COA, the resources and positioning or range requirements are identified and sequenced for lethal and nonlethal JSEAD, CAS, artillery, deception aircraft/decoy/drone missions and FM communications jamming. As these resources are committed, other options are identified to achieve concurrent or near-concurrent effects.

The specific intelligence collection requirements to achieve these effects are similarly identified, sequenced and correlated in time and space. This begins a "wargaming" process that assesses the options that best achieve the desired effects and develops an integrated plan that executes the *decide, detect, deliver* and *assess* phases of the targeting process.

Unlike traditional wargaming in the MDMP, however, the 3d Division iteratively reviewed each required effect and its chosen method, sequenced in time and space, to develop the plan in detail. Like the MDMP, it results in a synchronization tool we called a SEAD campaign execution matrix. (See Figures 6 and 7.)

We found that other targeting priorities and requirements must be interwoven with the SEAD planning process. If other target sets are of higher priority, their requirements for intelligence collection and engagement assets are factored into the SEAD COA first, and then the means to create the desired SEAD campaign effects are chosen from the remaining options. If other target

	SUN 271800 JAN (D+2) to MON 282400 JAN (D+2) – ATO C	MON 280001 JAN (D+3) to MON 280600 JAN (D+3) – ATO C
TOT/Replicated TOT	None	Replicated TOT: 0500
UH-60s Req'd	None	9 (Optimal); 5 (Adequate – single RT); 4 (Minimum – single RT)
Routes & Times	None	H-1 (0400) C^2 A/C established in ROZ H-0:30 (0430) RT Georgia, RT Iowa
UH-60 Actions	None	Fly the routes at 90 kts, 200 ft, echeloned by team. At RP, fire Chaff, drop to 100 ft. Return along same RTs, 90 kts, free cruise trail formation.
Lethal SEAD (Arty)	None	H-1 (0400) 2 x ATACMS attack suspected SA-10/11/12 positions VIC airfields west of Matmata Mtns. H-0:20 (0440) 6-8 Target Deception SEAD fired at identified ADA targets, possible inclusion of templated targets. Time-driven SEAD with TOT at 0440.
Lethal SEAD (Air)	None	H-0:10 (0450) 2 x sorties F-16 CJ attack suspected SA-6/11 positions VIC Gabes, El Hamma, Tabaga Ridge.
EW (Ground)	None	H-0:20 (0440) Jam ADA C^2 nets NLT 0440.
EW (Air)	None	None
CAS	None	H-0:10 (0450) 2 x sorties attack 903 BTG VIC PL Pittsburg (Div CAS or AI/Div target)
ACAs/Air Corr/ NFAs	Air Corr Falcon 1 – PT 1: PC100750 PT 2: NC530750 PT 3: NC530800 PT 4: NC950800 Min ALT: Max ALT:	Air Corridors Georgia and Iowa Air Corridor Falcon 2 – PT 1: PC200500 PT 2: PC030500 PT 3: NC500500 PT 4: NC500700 Min ALT: Max ALT: Air Corridor Falcon 3 – PT 1: PC200500 PT 2: PC030500 PT 3: NC500500 PT 4: NC500700 Min ALT: Max ALT: ACA Knighthawk 1 – PT 1: PT 2: PT 3: PT 4: Min ALT: Max ALT:
Drones/Decoys	H-6 (2300) Sortie 1 – IP over Gulf of Gabes, proceed west along PL Miami to Western Div Boundary. Turn north for 15 km, turn east to Div Eastern Boundary, RTB.	H-4 (0100) Sortie 2 – IP over Gulf of Gabes, proceed east along PL Tampa to Western Div Boundary. Turn north for 20 km, turn east to Div Eastern Boundary, RTB. H-0:30 (0430) Sortie 3 – IP over Gulf of Gabes, proceed east along PL Tampa to Western Div Boundary. Turn north for 20 km, turn east to Div Eastern Boundary, RTB.
Drone Routes	RT 1 – IP: PC100750 PT 1: NC530750 PT 2: NC530900 PT 3: NC950900 – RTB	RT 2 – IP: PC200500 PT 1: PC030500 PT 2: NC500500 PT 3: NC500700 – RTB RT 3 – IP: PC200500 PT 1: PC030500 PT 2: NC500500 PT 3: NC500700 – RTB
ISR Systems	ELINT Focus/Target Set: SA-8b (Landroll – H Band), 2S6M (Hot Shot – E Band), Crotale (Mirador IV – E Band), SA-15 (H Band) VIC Gabes, El Hamma, Tabaga Ridge. (1700) JSTARS On Station	ELINT Focus/Target Set: SA-8b (Landroll – H Band), 2S6M (Hot Shot – E Band), Crotale (Mirador IV – E Band), SA-15 (H Band) VIC Gabes, El Hamma, Tabaga Ridge. (0001) UAV On Station (0500) JSTARS Off Station

Legend:

ACAs = Airspace Coordination Areas
ADA = Air Defense Artillery
AI = Air Interdiction
ALT = Altitude
ATACMS = Army Tactical Missile System
ATO = Air Tasking Order
CAS = Close Air Support
C^2 = Command and Control
ELINT = Electronic Intelligence
EW = Electronic Warfare
IP = Initial Point
ISR = Intelligence, Surveillance and Reconnaissance
JSTARS = Joint Surveillance and Target Attack Radar System
kts = knots
NFAs = No-Fire Areas
PL = Phase Line
PT = Point
ROZ = Restricted Operating Zone
RP = Release Point
RT = Route
RTB = Return to Base
TOT = Time-On-Target
UAV = Unmanned Aerial Vehicle
VIC = Vicinity of

Figure 6: Suppression of Enemy Air Defenses (SEAD) Campaign Execution Matrix Day 1, Phase IIIC2 (Attack in Zone)

	MON 280600 JAN (D+3) to MON 281200 JAN (D+3) – ATO D	MON 281201 JAN (D+3) to MON 281800 JAN (D+3) – ATO D
TOT/Replicated TOT	None	Replicated TOT: 1730
UH-60s Req'd	None	5 (Adequate – single RT); 4 (Minimum – single RT)
Routes & Times	None	H-1(1630) C^2 A/C established in ROZ H-0:10 (1720) RT Iowa
UH-60 Actions	None	Fly the routes at 90 kts, 200 ft, echeloned by team. At RP, fire Chaff, drop to 100 ft. Return along same RTs, 90 kts, free cruise trail formation.
Lethal SEAD (Arty)	H+3 (0800) 4-6 Target SEAD plan fired at ADA targets acquired during last operation	None
Lethal SEAD (Air)	None	None
EW (Ground)	None	H-0:10 (1720) Jam ADA C^2 nets NLT 1720
EW (Air)	None	None
CAS	None	None
ACAs/Air Corr/ NFAs	None	Air Corridor Iowa Air Corridor Falcon 4 – PT 1: PC300500 PT 2: PC200320 PT 3: NC750320 PT 4: NC750550 PT 5: NC990550 Min ALT: Max ALT:
Drones/Decoys	None	H-Hr (1730) Sortie 1 – IP over Gulf of Gabes, proceed west along PL Oakland to center of Matmata Mtns (75 Easting). Turn north for 23 km, turn east to Div Eastern Boundary, RTB.
Drone Routes	None	RT 1: - IP: PC300500 PT 1: PC200320 PT 2: NC750320 PT 3: NC750550 PT 4: NC990550 – RTB
ISR Systems	ELINT Focus/Target Set: SA-8b (Landroll – H Band), 2S6M (Hot Shot – E Band), Crotale (Mirador IV – E Band), SA-15 (H Band) VIC Gabes, El Hamma, Tabaga Ridge. (0400) UAV on station	ELINT Focus/Target Set: SA-8b (Landroll – H Band), 2S6M (Hot Shot – E Band), Crotale (Mirador IV – E Band), SA-15 (H Band) VIC Matmata Mtns, Internment Camps, Mareth. (1600) UAV Off Station (1700) JSTARS On Station

Figure 7: SEAD Campaign Execution Matrix Day 1, Phase IIIC2 (Reconnaissance)

sets are of lower priority, the process helps to prevent the dilution or diversion of collection assets and engagement means in the overall targeting process.

The DMAIN plays a critical role here. It provides the "sanity check" on the SEAD plan and confirms the campaign meshes with the division's scheme of maneuver and meets the commander's intent and priorities.

A SEAD campaign execution matrix allows all members of the targeting team to visualize the resources employed in the campaign, the interrelationships between different actions, the effects they are designed to achieve, the nesting of the SEAD campaign in air tasking order (ATO) cycles and the division's operational phases and time line. It is, in effect, a blueprint or roadmap of how the IADS will be identified and attacked.

This visualization is critical because, inevitably, some resources, particularly JSEAD assets, will not be provided or provided in the quantities requested. Intelligence collection means will be diverted or the collection plan altered in some fashion. Rotary-wing asset availability could be reduced by maintenance issues, combat losses or unanticipated missions. Each of these potential changes will have an impact on the plan. The SEAD campaign execution matrix allows staff officers and decision makers to assess the second and third order impact of these changes.

The SEAD campaign reflects a series of linked collection, deception and lethal and nonlethal attack actions to create a set of effects to defeat the COE OPFOR ADA, enabling friendly aviation air maneuver. The combination of lethal and nonlethal indirect fires with fixed- and rotary-wing observation and attack aircraft remains one of the Army's most potent combat teams. Neutralizing threats to our air assets is a key targeting function. The Army's fire support community must employ the entire spectrum of joint and combined arms assets to pave the way for air maneuver.

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AH-64D Photo by CW3 Dan McClinton, 4th Bde, 4th ID

Artillery Fires in Support of Aviation in the Close Attack

By Lieutenant Colonel Richard S. Richardson

Original implementation of the armed helicopter during the Vietnam War saw utility (UH-1) and attack (AH-1) helicopters employed as aerial rocket artillery providing close supporting fires. During the 1980s, the fielding of the AH-64 Apache and the implementation of AirLand Battle doctrine focused attack helicopters almost exclusively on deep shaping operations well beyond the mechanized ground maneuver fight.

The recent evolutions in equipment and tactics have resulted in the "re-emergence" of the attack helicopter employed in close proximity to ground maneuver forces. In today's contemporary operational environment (COE), several factors contribute to the ascendancy of the close aviation fight: expanding battlespace, increasingly lethal air defenses and the battlefield environment.

The enhanced capabilities of the digitized 4th Infantry Division (Mechanized) at Fort Hood, Texas, have increased the Force XXI Division's battlespace from 10,000 to 24,000 square kilometers. Commanders and battle staffs have found that traditional ground armored reserves do not have the speed to rapidly cross the breadth and width of this expanded battlespace. Instead, the attack helicopter has become the reserve of choice, given its speed, lethality and range.

In addition, threat air defenses have improved at a rate faster than air countermeasures, significantly increasing the risk to deep operations that extend far into enemy battlespace. Attack helicopter operations are more often conducted relatively close to ground troops, usually within the range of supporting multiple-launch rocket systems (MLRS).

Finally, weather effects in some theaters of operation often limit the range in which attack helicopters can operate successfully.

These factors are important—not that close attack operations have replaced deep attack operations, but that close attack operations have significantly increased in frequency in the COE.

While the Army shifted to employing attack helicopters more frequently in close support of the ground-mechanized fight, aviation and fire support doctrine have not addressed fires for close attack operations adequately. This doctrinal shortfall was clear during the 4th Division Battle Command Training Program (BCTP) Warfighter exercise in December 2000 at Fort Hood and Phase I of the Division Capstone Exercise held in March 2001 at the National Training Center (NTC), Fort Irwin, California.

Close aviation fire support during these exercises was problematic for two main reasons. There was no established doctrine or standing operating procedures (SOP) at the division or brigade level. Furthermore, indirect fires, close air support (CAS) and Army aviation with ground maneuver forces required extensive synchronization due to the close proximity of these operations to the forward-line-of-troops (FLOT).

After-action reviews (AARs) from these exercises resulted in tactics, techniques and procedures (TTPs) to increase the effectiveness of fires in support of close attack operations during Phase II of the 4th Division Capstone Exercise at Fort Hood in October 2001. These close attack TTPs are for command and control options for aviation forces and planning and executing the attack. See Figure 1 for considerations for fires support for close attack operations.

Command and Control. During close attack operations, there are typically four command and control options for aviation forces: under the operational control of (OPCON to) a ground brigade combat team (BCT), OPCON to a ground task force (TF), under aviation brigade control (organic) or under division control, usually by the division tactical command post (DTAC) (organic by higher headquarters).

Command and control relationships for close attack operations provide the framework for the command and support relationship of supporting fire support assets. Typically in the 4th Infantry Division, attack helicopter companies or battalions are employed either OPCON to the ground BCT or under the control of the DTAC.

Planning and Executing Close Attack Fire Support. Within the command and control framework, there are three areas of concern when planning fire support for close attack operations. These are assigning planning and execution responsibilities to fire support elements (FSEs), allocating fire support assets to the mission and determining clearance of fires procedures. The key to effective planning is to design and plan a mission package of artillery and aviation instead of merely sending the aviation unit on the mission.

Planning Responsibilities. First, the division planners determine which FSE will plan the fires for the aviation close attack. The ground BCT FSE takes the lead in planning the fires for the aviation element because it has the best understanding of both the enemy situation and the ground tactical plan in its zone of operations.

Typically, the ground BCT already has an ongoing suppression of enemy air defenses (SEAD) program in its zone to protect CAS. Furthermore, this FSE has a habitual relationship with the artillery operating in the area in support of the ground BCT.

The aviation brigade and attack helicopter battalion FSEs help the ground BCT FSE by providing aviation maneuver planning factors that allow proper timing of SEAD along the route to and from the engagement area (EA). The FSEs work together to plan and execute SEAD along the ingress route, in the EAs and then along the egress route. In addition, the FSEs synchronize aviation and indirect fires with the direct fires in the EAs to contribute to the commander's desired effects.

Supporting Artillery Assets. The second area of concern is in relation to supporting artillery assets. The questions are which artillery assets will support the aviation attack, under what relationship will these artillery assets operate and what will the fire mission request chain be?

Generally, there are three options for the artillery-aviation relationship. (See Figure 2 on Page 24.) First is a quick-fire channel established with the ground BCT's direct support (DS) or reinforcing (R) artillery battalion. The second option is a quick-fire channel established with a general support (GS) artillery battalion (such as 2d Battalion, 20th FA Regiment, the 4th Division's GS MLRS battalion) or with supporting corps artillery battalions. Last is the artillery DS to the aviation company or battalion.

The most common option is creating a quick-fire channel from the aviation unit to the ground BCT's DS or R artillery battalion. This method gives the ground maneuver commander the most flexibility while still providing the aviation unit responsive fires. Typically, the attack aviation unit receives priority of fires (POF) within the BCT's and division's zone while committed.

When using this option, the BCT fire support officer (FSO) decides what the fire mission request chain must be. The aviation unit can either call-for-fire directly to the artillery battalion fire direction center (FDC) or the aviation unit can call the brigade FSE that then forwards the request to the supporting artillery FDC. The latter method allows the ground brigade FSE to approve and prioritize the request and, if desired, forward it to other assets, such as CAS or GS artillery. This option has the most centralized control; however, it does so at the expense of responsiveness.

A second option is to establish a quick-fire channel from the aviation unit to a GS artillery battalion positioned where its zone of fire is in the zone of action of the aviation unit. This requires coordination between the division artillery and the supported ground BCT to ensure the GS battalion is positioned properly to support the attack.

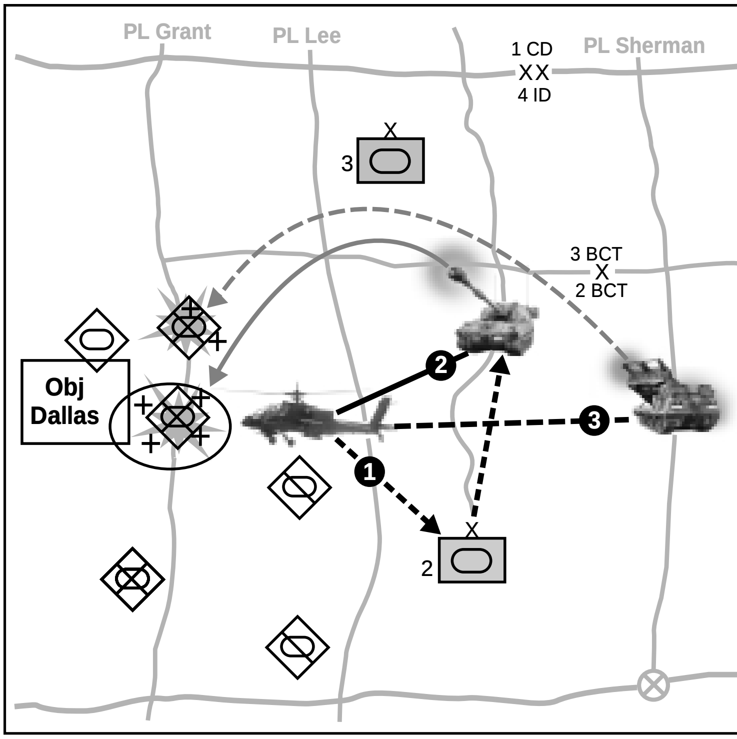
The primary advantage to this option is it does not take DS or R fires away from the BCT's committed ground forces. When using this method, the call-for-fire typically goes from the aviation unit directly to the GS artillery battalion FDC.

The last option is to place an artillery battery or battalion DS to the aviation unit for the duration of the mission. This provides the aviation unit the most responsive fires. However, this option limits the flexibility of the ground maneuver commander by aligning the DS battalion to the aviation unit exclusively, although typically for a short time. Additionally, this option requires the aviation commander to coordinate the positioning of the DS artillery where it can range his aviation's zone of action.

When determining which option to use, planners consider the advantages and disadvantages of cannon versus rocket artillery units. Cannons typically provide the most responsive and sustained fires. They also can be fired closer to friendly units than rocket systems and provide a variety of munitions types, including smoke and mines, that rocket systems can't. However, rocket artillery has longer range and greater lethality and can engage more targets simultaneously.

• What are the targets aviation should attack?
• What are the target objectives? Disrupt, Delay, Limit, Isolate...
• What are the target effects? Suppress, Neutralize, Destroy...
• What are the fire support means to use? Direct Support, Reinforcing, General Support (Quick-Fire Channel?) or General Support-Reinforcing (Quick-Fire Channel?)
• What are the priorities for engaging targets?
• Where is the aviation company within the brigade combat team (BCT) priority of fires?
• Is aviation incorporated into the BCT observation plan?
• Who clears fires? Which commo net is for clearing fires?
• What are the call-for-fire (CFF) procedures? Which commo net is for CFFs?
• Who approves CFFs?
• Who plans and executes suppression of enemy air defenses (SEAD) in the BCT zone?

Figure 1: Considerations for Fire Support for Army Aviation Close Attack Operations



Command and Control
- AH-64 Company is OPCON to 2 BCT.

Fire Planning
- 2 BCT FSE takes the lead for:
  - SEAD in BCT zone.
  - CFF to assist target destruction.
- Is assisted by 1-4 Avn FSE/4 BCT Avn FSE.

CFF Options
1. Send to 2 BCT FSE.
2. Send through a quick-fire channel established with the DS/R FA battalion.
3. Send through a quick-fire channel established with the GS MLRS positioned in the 2 BCT zone.

Target Clearance
- Commander, 2 BCT, clears the targets.
- 2 BCT FSE is the clearing agency.
- Targets are cleared on 2 BCT fire support net.

Legend:
Avn = Aviation
1 CD = 1st Cavalry Division
CFF = Call-for-Fire
DS = Direct Support
FSE = Fire Support Element
GS = General Support
4th ID = 4th Infantry Division
MLRS = Multiple-Launch Rocket System
PL = Phase Line
R = Reinforcing
SEAD = Suppression of Enemy Air Defenses

Figure 2: Artillery in Support of the Aviation Attack. In this scenario, an AH-64D company and Kiowa Warrior troop are under the operational control of (OPCON) a BCT. The scenario illustrates artillery assets in support of and their relationship with aviation and fire mission processing options.

Clearance of Fires. The third major area of concern is clearance of fires. Experience in the 4th Infantry Division shows that if clearance of fires responsibilities and procedures are not clearly defined during planning and rehearsals, then fire support execution will be unresponsive and can cause fratricide.

Per *FM 6-20-40 Tactics, Techniques and Procedures for Fire Support for Brigade Operations*, the BCT commander clears fires requests short of the coordinated fire line (CFL) within his zone. Before executing the mission, the aviation brigade and ground brigade FSOs determine which voice or digital radio nets to use to clear fires. Typically, the ground BCT FSE is the clearing agency for the brigade commander using the brigade fire support voice net.

When deciding clearance procedures, the FSOs consider minimizing the number of nets the aviation unit must talk on because helicopters have a limited number of FM radios. The FSOs may consider using the same net to both request and clear fires. Once the FSOs decide which procedures to use, they disseminate the call signs, frequencies and digital addresses to the aviation unit and ground BCT FSE.

Experience in the 4th Infantry Division shows that addressing these three areas during the planning process is most effective when the procedures are specified in the division operations order (OPORD) directing the use of attack aviation assets in the close fight. The division's planners determine which FA unit will provide fire support for the attack aviation and clearly state so in the OPORD. For example, "2 BCT: NLT 022000DEC, position DS or R battalion where it can support A Co, 1-4 Aviation's close attack. Establish quick-fire channel between A Co, 1-4 Avn and 2 BCT FSE." Another option would be to state "NLT 022000DEC, establish quick-fire channel between A Co, 1-4 Avn and 3-16 FA during close attack mission."

If the division planners decide to use GS artillery assets to support close attack operations, then the fragmentary order (FRAGO) specifies position areas for artillery (PAAs). For example, "2 BCT: NLT 022000DEC, secure 2 km radius PAA 13 to protect 2-20 FAR during close attack operations." And, "Div Arty: NLT 022000DEC, position one battery from 2-20 FAR in PAA 13 to support close attack operations in 2 BCT zone."

The 4th Division turned a weakness identified during Phase I of the Division Capstone Exercise into a strength by developing these TTPs and standardizing them in the division SOP. The TTPs cue staff officers to requirements when planning and executing fires in support of attack aviation. The division and brigade staffs validated the effectiveness of these TTPs during Phase II of the Division Capstone Exercise.

The next step is to continue to refine these procedures and, ultimately, see them included in FA doctrine.

Lieutenant Colonel Richard S. Richardson is the 4th Infantry Division (Mechanized) Deputy Fire Support Coordinator (DFSCOORD) at Fort Hood, Texas. In his previous assignments, he was the 4th Aviation Brigade Fire Support Officer (FSO) and S3 Operations Officer for the 2d Battalion, 20th Field Artillery Regiment, both in the 4th Division; and G3 Plans Officer for the IIId Armored Corps, all at Fort Hood. At the National Training Center (NTC), Fort Irwin, California, he was a Field Artillery and Aviation Team Observer/Controller in the Operations Group. Other assignments in the 4th Division at Fort Carson, Colorado, include commanding C Battery, 10th Field Artillery Regiment and serving as the FSO for the 4th Aviation Brigade. Lieutenant Colonel Richardson is a graduate of the Command and General Staff Officers Course and School of Advanced Military Studies both at Fort Leavenworth, Kansas, and the USAF Joint Firepower Control Course at Hulburt Field, Florida.

Fires TTP to Defeat the COE OPFOR

T-90 Tank

By Major W. Wayne Ingalls, MI

In a short time, the term "contemporary operational environment" (COE) has become a buzzword that many misunderstand. The COE is the environment in which the new opposing force (OPFOR) operates. Fortunately, the FM 7-100 series of manuals that explains the COE and the OPFOR fighting in that environment have been signed and should be distributed to the field sometime during the 2d Quarter of FY03. (See the figure.)

So what is the COE? Instead of referring to the book definition in FM 7-100, one can look out the window or turn on the news. The world we live in is the COE, and we hear and read about real-world threats daily. The mission of the OPFORs at the Combat Training Centers (CTCs) is to emulate these real-world threats: be a plausible, flexible force using a composite of actual worldwide forces. The concept of the COE extends into the year 2020.

COE OPFOR. The COE OPFOR is nonlinear and doesn't adhere to a template. He no longer focuses on destroying friendly maneuver forces by overwhelming them with a mass of echeloned formations or attacking from the march with a rigid timeline.

This OPFOR is more dispersed—does not need to mass his artillery to produce mass effects. Commanders and their staffs cannot afford to be fixated on old ideas, such as OPFOR "phases of fire" and the "advanced guard" formation.

As far as equipment is concerned, the COE OPFOR can use any piece of equipment that is either fielded in at least one country *or* available for export. The COE OPFOR can use equipment that is not yet fielded if it is available on the world export market.

However, there is a caveat. The OPFOR's force structure and equipment must reflect the type of enemy the training unit would face to accomplish its assigned mission. The CTCs maintain the philosophy "Train as you will fight."

Because the training unit's mission drives the CTC scenario and the OPFOR's equipment, units must identify training objectives for each exercise or rotation early. The OPFOR will alter its force package, as required, to present a sparring partner for the friendly force's tough, realistic training.

The COE OPFOR's equipment is likely to be better than any single potential threat nation in the world because the OPFOR can use equipment that is not yet fielded. And given that the COE projects out to 2020, it compels units to train for the next war.

The COE OPFOR's perspective is new on the CTC battlefields and motivates much of what he does. The OPFOR studies history and sees the US as a very strong opponent but one who can't take casualties. This is based on American experiences in Somalia and Vietnam.

According to the OPFOR perspective, America wants a casualty-free fix for long-term problems followed by a rapid redeployment of forces. The OPFOR is in his home region and will fight for the long term. Therefore, the OPFOR wants to inflict casualties then flee to fight another day. As US casualties build, America will lose interest in the region.

- *FM 7-100 OPFOR Doctrinal Framework and Strategy*
- *FM 7-100.1 OPFOR Operations*
- *FM 7-100.2 OPFOR Tactics*
- *FM 7-100.3 OPFOR Paramilitary and Nonmilitary Organizations and Tactics*

The field manual series 7-100 (final drafts) discuss the contemporary operational environment (COE) and the opposing force (OPFOR) fighting in that environment. Readers can request access of the manuals online at the Reimer Digital Library at http://www.leavenworth.army.mil/threats/index/.

This leads to another essential tenet of the COE OPFOR: information warfare. Because America is seen as casualty-averse, one major reason for inflicting casualties on US forces is to publicize the event and cause a change in policy (withdrawal from the region). Casualties for US troops in Afghanistan have been exceptionally light, but it may have been a far different media story were it not for the Northern Alliance's fighting the Taliban and al Qaeda and absorbing most of the casualties.

In a similar fashion, reports of civilian casualties may influence US policy and, therefore, are the premise of some OPFOR tactics, techniques and procedures (TTPs)—such as positioning combat systems and forces in urban and protected areas. Some media estimates claim that US and anti-Taliban fighters caused as many as 3,600 civilian casualties to date in Afghanistan.[1]

The new FM 7-100-based OPFOR was in effect at one CTC before the final edition of the doctrinal manuals was signed. In Battle Command Training Program (BCTP) Warfighter exercises, the COE OPFOR has fought nearly a dozen divisions and corps. The Combat Maneuver Training Center (CMTC) in Hohenfels, Germany, formally adopted COE-based scenarios in April 2002, and the National Training Center (NTC) at Fort Irwin, California, did so in May 2002. Both these "dirt" CTCs had conducted several COE-transition rotations before formal implementation.

The Joint Readiness Training Center (JRTC) at Fort Polk, Louisiana, long has been the most COE-like of the CTCs. In fact, the JRTC assessed that its battlefield already represented 80 percent of the variables described in the COE.[2]

Essentially, the COE at the JRTC will increase the emphasis on information operations, criminal elements on the battlefield and an improved OPFOR force structure that has more anti-tank and air defense systems and more modern equipment. The JRTC is conducting COE-transition rotations with the new doctrine implemented for the Stryker Brigade Combat Team rotation in March.

The OPFOR's equipment and tactics at the CTCs have changed to reflect the COE.

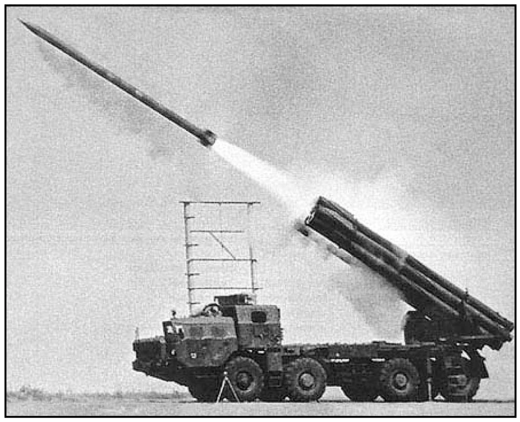
OPFOR Equipment. In many ways, the availability of technologically advanced equipment is just a part of the environment. This equipment is listed in the OPFOR Worldwide Equipment Guide (WEG) online at the Training and Doctrine Command (TRADOC) Threat Support Directorate's website: http://leav-www.army.mil/threats/products/Products.htm. Essentially, the guide is a catalog from which the OPFOR can "buy" the equipment it needs for the specific training mission.

The following are sample pieces of equipment from the catalog available to the BCTP OPFOR and, if noted, available to the dirt CTC OPFORs.

9A52-2 Smerch. This is a 300-mm multiple rocket launcher (MRL) with a 90-kilometer range. Fragmentary high-explosive (HE) munitions, dual-purpose improved conventional munitions (DPICM) and sensor-fuzed warheads fit on an inertially course-corrected rocket with time-fuze adjustment. These provide greatly improved accuracy with an error of 0.019 percent of the range (171 meters at 90 kilometers). In addition to the BCTP, the OPFORs at the NTC and CMTC use these long shooters.

T-90 Tank. This main battle tank has the *TShU-1-7 Shtora-1* optronic countermeasures system designed to disrupt the laser target designation and rangefinders of incoming anti-tank guided missiles (ATGMs). The T-90 also has a laser-warning package that tells the tank crew when it is being lased. Shtora-1 is an electro-optical jammer that jams the enemy's semiautomatic command to line-of-sight (SACLOS) ATGMs, laser rangefinders and target designators. At this point, only the BCTP OPFOR has used the T-90s, but there have been discussions about upgrading the dirt CTCs OPFOR tank fleets to T-90s.

IL-220U Artillery-Locating Radar. This Ukrainian-made phased-array radar can detect Army tactical missile system (ATACMS) launches at 55 kilometers, multiple-launch rocket system (MLRS) launches at up to 40 kilometers, tube artillery firing at up to 20 kilometers and mortars at up to 30 kilometers. In addition to BCTP, the capabilities of this system will be replicated at the CMTC and the NTC, giving the OPFORs target acquisition capabilities comparable to our Q-37 Firefinder.



9A52-2 Smerch

BL-904 Artillery-Locating Radar. This Chinese-made radar has not completed fielding, even in the Peoples Republic of China, but it is available for export. Therefore, the OPFOR can use it. The radar essentially is the Chinese equivalent of our Q-36 Firefinder that can detect MLRS firing at approximately 30 kilometers.

G-6 Rhino Howitzer. This is a South African self-propelled (wheeled) 155-mm howitzer with a range of up to 39 kilometers (base bleed). Only the BCTP OPFOR has used this system; however, the dirt CTCs are using other long-range tube systems.

Unmanned Aerial Vehicles (UAVs). A variety of UAVs are available, either with a pre-programmed flight path allowing approximately 150 kilometers of reconnaissance depth or a true remotely piloted vehicle (RPV) with an approximate reconnaissance depth of 50 kilometers. In the near future, the OPFOR at the dirt CTCs will have access to simulated UAVs.

According to *FM 100-12 Army Theater Missile Defense Operations* published in March 2000, "Threat experts project more than 50 UAV developer countries and 75 UAV user countries by 2005." Some of these countries include Russia, China, France, South Africa, Iraq and Iran.

SA-18 Grouse. This is a Russian-made man-portable air defense system (MANPADS) that intelligence analysts at the TRADOC Deputy Chief of Staff for Intelligence (DCSINT) have assessed to be about 90 percent as effective as a Stinger.[3] Overall, there is an increased number of MANPADS that are more lethal. All the CTCs use this system.

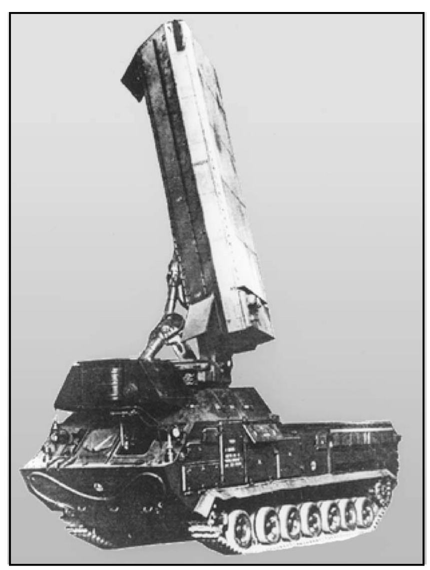
OPFOR Surrogate Vehicle (OSV). A product upgrade for the BMPs used at the NTC and CMTC, the OSV has a Bradley turret on a VISMOD M113 chassis. It has a 30-mm cannon and fires the AT-5 ATGM. OSVs can carry five AT-5 missiles and engage armored targets at a range of 4,000 meters.

Expendable Battery-Powered Global Positioning System (GPS) Jammers. These deny forces the use of GPS. The GPS jammers' range is approximately 400 to 1,000 square meters, depending on battery life. The CMTC probably will use this system.

Expendable Battery-Powered Radio-Frequency Jammers. These deny forces the use of a particular frequency range. The radio frequency jammers' range is approximately 400 to 1,000 square meters, depending on battery life. The CMTC probably will use this system.

Another significant change to OPFOR equipment is the doubling or tripling of the quantity of anti-tank systems in the force with an emphasis on infantry as the primary tank killers. Also, the OPFOR reconnaissance units will have hand-held thermal viewers with a range of 2.5 kilometers.

COE OPFOR Tactics. One of the innovations the FM 7-100 series discusses is an offensive mission called a



IL-220U Artillery-Locating Radar

OPFOR Surrogate Vehicle (OSV)

"Strike." This mission is "an attack designed to destroy a key enemy organization through a synergistic combination of precision fires and ground maneuver in a small span of time."

The effects of a successful Strike are more than just the loss of a number of combat systems. Rather, defeat comes through the paralysis that occurs when a key organization is completely devastated in a small span of time.

The OPFOR has brigade tactical groups (BTGs) and division tactical groups (DTGs). The DTG is essentially a task-organized division-level unit. The OPFOR's operational-strategic command (OSC) is a corps- or army-level organization. Both the DTG and OSC can execute Strikes. (Strikes are beyond the capability of a BTG without augmentation.)

Command and control for a Strike is provided by an integrated fires command (IFC). The IFC commander is roughly equivalent to the old chief of rocket troops and artillery. Interestingly, one of the command and control options available to the DTG or OSC commander is to place the IFC commander in charge of both fires and *maneuver* elements involved in a Strike.

As in all OPFOR offensive missions, there is a fixing force, an assault force and an exploitation force for the Strike.

Fixing Force. In a Strike, this force focuses primarily on fixing enemy forces that might come to the aid of the target formation. Maneuver forces, precision fires, situational obstacles, chemical weapons and electronic warfare (EW) are well-suited to fix forces.

Assault Force. The assault force in a Strike creates the conditions that allow the exploitation force to complete the destruction of the target formation. One way the OPFOR does this is by using reconnaissance fires. This is the integration of reconnaissance, intelligence, surveillance and target acquisition (RISTA) assets with fire control and weapon systems into a closed-loop, automated fires system that detects, identifies and destroys critical targets in minutes. The assets designated for reconnaissance fires are under the centralized control of the IFC commander.

Reconnaissance fires enable the OPFOR to deliver rotary-wing air, surface-to-surface missiles (SSM), cruise missiles and artillery fires (including precision munitions) on enemy targets very rapidly. The likely targets for reconnaissance fires are RISTA assets or anything that can detect or prevent a successful Strike. In addition, reconnaissance fires may target assets that speed recovery after a Strike, such as logistical and casualty evacuation assets.

Exploitation Force. The exploitation force in a Strike completes the destruction of the target formation and most often will consist of highly lethal ground maneuver formations and precision long-range fires systems. Armored or attack aviation units are ideally suited to be the core of the exploitation force, but a Strike may be successfully executed without maneuver forces. The exploitation force may be comprised entirely of long-range fire systems.

OPFOR TTPs. Here are six TTPs the OPFOR uses.

Long Shooters Employed at Near-Maximum Range. The Smerch with its 90-kilometer range and other OPFOR systems have a significant range advantage over our MLRS, even when MLRS is using extended-range rockets (ER-MLRS). For most of the fight, the bulk of the OPFOR artillery assets fire from well outside of standoff range, thus limiting their risk to counterfire. The shorter-range systems join the fray only when engaging important targets, such as those in an OPFOR Strike mission.

Displacement Time versus ATACMS Approval Time. While the OPFOR long shooters may be outside of ER-MLRS range, they are not out of ATACMS range. However, most OPFOR systems can displace in under three minutes, far shorter than the time it takes to get approval to launch an expensive ATACMS.

Dispersion. While the concept of dispersion is certainly not new to the OPFOR, he now has an improved capability to mass fires without massing systems. Training units should not expect to see large artillery concentrations in the form of army group rocket artillery (AGRA), army artillery groups (AAGs), division artillery groups (DAGs) or regimental artillery groups (RAGs)—they are artillery formations of past OPFORs. At all the CTCs, the COE OPFOR often fights with only one to three systems at any location on the battlefield.

Position Systems in Urban/Protected Sites. This is nothing more than a variant of the famous Iraqi "human shield" tactic. The OPFOR can fire at friendly forces and then take advantage of the time it takes for friendlies to get approval to fire into an urban or protected area. If the OPFOR has moved, friendly counterfire could cause collateral damage, perhaps casualties, and result in negative media coverage—which may be the OPFOR's originally intended results. Even if friendly forces destroy the OPFOR weapon, the damage done in terms of international public relations could outweigh the tactical advantage of taking out the system.

Streamline Sensor-to-Shooter Links. To get more responsive fires, the OPFOR has cut out layers of bureaucracy in its shooting system. The OPFOR usually does not have the same concern for preserving human life that US forces do, so he won't care about collateral damage or whether or not the soldier calling in the mission has "eyes on" the target.

In many cases, the OPFOR sensor will talk directly to the shooter. This is particularly true when the sensor has a laser target designator and the OPFOR is employing a lone Krasnopol-capable system. (For information about the Soviet-made Krasnopol, see the article "Krasnopol: A Laser-Guided Projectile" by Walter L. Williams and Michael D. Holthus in the September-October 2002 edition.)

Friendly Force TTPs. Here is a summary of some of the TTPs that friendly forces have used successfully against the COE OPFOR.

Countering the OPFOR Range Advantage. This is not an entirely new problem as the OPFOR has used such systems as the Chinese WM-80 with an 80-kilometer range for years. The COE OPFOR's emphasis on extreme dispersion, however, does add to the complexity of the problem. Here are some TTPs units can use to counter the OPFOR's ability to fire beyond the range of MLRS rockets.

• First units detect the long-shooters. This, in itself, is problematic. The most common method in Warfighter exercises is to detect long-range systems, such as the WM-80 and the Smerch, using a Q-37 radar with a long-range tape that gives a probability of detection beyond the standard range of 50 kilometers. But this Version 10 radar software is not fully tested and, as such, has not been fielded.

Then units determine if the system is on the high-payoff target list (HPTL) by checking the attack guidance matrix (AGM) and, if it is, use the target selection standards (TSS) to engage the target. The AGM pre-approves engaging the target with ATACMS; thereby, units avoid the time-consuming approval process.

• A second method for engaging HPTs beyond ER-MLRS is by using the Q-37 long-range tape to detect the target and then cueing intelligence assets to track the target. Joint surveillance and target attack radar system (JSTARS) tracks the movement of the asset, and then a UAV (dynamically re-tasked from a nearby location) stays on the target until ATACMS, fixed-wing aircraft or attack helicopters can engage it.

• A third technique for engaging these types of targets is to destroy them via a raid. Systems such as the WM-80 and the Smerch have a long minimum range and cannot engage targets inside that range. Artillery and (or) infantry can be transported to inside the minimum range of the OPFOR targeted system to destroy it in an artillery raid, a combination of indirect and direct fires or by direct fires alone.

Targets in Restrictive-Fire Areas (RFAs). This is not a new problem either as various threats, such as North Vietnam and Kosovo, have hidden behind their populace. There are essentially two basic TTPs to use in these situations.

• Units make the judge advocate general (JAG) officer part of the targeting team. As an example, the targeting team in a maneuver brigade typically consists of the brigade executive officer, brigade S3 (or battle captain), brigade S2 and brigade fire support officer (FSO). To minimize collateral damage, the JAG officer attends all targeting meetings as the expert on the rules of engagement (ROE). When a target is located inside an RFA, he advises the commander as to whether or not the commander should engage it with indirect fires. Timely and appropriate legal analyses as to whether or not targets in urban or protected areas can be engaged under the ROE are critical for military operations in the COE.

• This TTP is based on mission, enemy, terrain, troops, time and civil considerations (METT-TC). To minimize collateral damage against targets located in RFAs, units engage these targets with direct fires vice indirect fires. Units send highly mobile infantry and human intelligence (HUMINT) teams into the RFAs to engage and destroy the targets. This requires the infantry and HUMINT to be ready with little notice to increase the probability of finding and destroying such targets.

UAVs can be helpful but only if the OPFOR target is easily distinguishable from the population. For example, a Smerch can't easily blend into the population in contrast to a dismounted mortar squad.

The Reconnaissance/Counterreconnaissance Fight. Again, this is not a new problem, but it is more difficult now with the fielding of the OPFOR OSV and hand-held thermal sights. Studies have shown for years that units that win the reconnaissance/counterreconnaissance fight at the CTCs tend to win battles. Despite the advent of OPFOR UAVs, ground reconnaissance remains the OPFOR's primary means of gathering intelligence.

Here is what the Center For Army Lessons Learned (CALL) says: "Ground reconnaissance is the key to the OPFOR situational awareness. They will invest up to a battalion for aggressive reconnaissance. Ensure you have an equally aggressive counter-reconnaissance plan….Deny the enemy his eyes and you are on your way to victory."[4]

The only way to deny the OPFOR his ground reconnaissance eyes is to kill his scouts and keep killing them—the OPFOR always will replace dead scouts. Units must plan to win this fight by resourcing the victory. This means using lots of artillery—our scouts can't kill an OPFOR scout in a BMP or even a BRDM with direct fire. This also means that "first string" personnel must be alert and fight this fight continually, even during the "fuzz factor" time from about 0100 to 0300.

Conclusion. Fort Sill is incorporating COE OPFOR instruction into several courses. The Pre-Command Course, Captain's Career Course, Officer Basic Course and Warrant Officer Advanced and Basic Courses all have instruction on the COE OPFOR doctrine, tactics and equipment. However, the instruction is only an overview, so graduates will need additional training in units.

The National Simulation Center at Fort Leavenworth, Kansas, will field a Caspian Sea scenario that incorporates the COE, probably in the summer of 2003. Once installation simulation centers have this scenario, the COE OPFOR will become a reality in Janus training.

With the incorporation of the COE OPFORs at the CTCs and into other training methods, US Army training becomes more realistic and relevant. As FA units fight this OPFOR during training and continue to face COE threats around the world, they will refine fire support TTPs and devise new ones to defeat the COE enemy.

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Endnotes:

1. "After the Taliban: Facts and Figures" by *The Guardian*, United Kingdom, 1 November 2002. This document is online at http://www.guardian.co.uk/afghanistan/story/0,1284,805570,00.html.
2. Tony Pietrantonio, Intelligence Planner in the Plans and Exercise Maneuver Control Group at the Joint Readiness Training Center (JRTC), Fort Polk, Louisiana, presented "The Contemporary Operational Environment: Assessment and Implementation Time Line" PowerPoint briefing at the JRTC in June of 2002.
3. Author's note taken during the "COE Replication Requirements (COE OPFOR)" by Lieutenant Colonel Jon Cleaves of the Training and Doctrine Command (TRADOC) Deputy Chief of Staff for Intelligence (DCSINT) during the 7th Annual Worldwide OPFOR Conference at Aberdeen Proving Ground, Maryland, in April 2002.
4. "How to Fight at the Combat Training Centers (CTCs): The Contemporary Operational Environment (COE) Handbook," Handbook 02-xx, Version 1 (Fort Leavenworth, Kansas: Center for Army Lessons Learned). This CALL handbook is online at http://call.army.mil/products/ctc/coe-handbook/coe-toc.htm.

Legal Issues with Fires in COE Populated Areas

By General Burwell B. Bell III, Major General Guy M. Bourn, Colonel Patrick Lisowski, JA, and Lieutenant Colonel Gary A. Agron

On the morning of 28 January 2002, the 3d Armored Cavalry Regiment (ACR) executed a combat mission as assigned by III Corps during its Battle Command Training Program (BCTP) Warfighter exercise. As the regiment approached the city of "Tongduchon," it received a high volume of fires resulting in personnel and equipment casualties from enemy artillery located at multiple points inside the city.

The corps G5/civil affairs officer had listed the city on the protected target list (PTL). The corps fire support element (FSE) had established a corps restricted fire area (RFA) around the city before hostilities began; therefore, any fires into the city required coordination with the corps FSE.

In self-defense, the 3d ACR and its reinforcing FA brigade fired counterfire missions into the city. Enemy news media reported civilian casualties and property damage and alleged Law of War violations.

In response, the III Corps Commanding General appointed an *AR 15-6, Procedures for Investigating Officers and Board of Officers* investigation into the matter. Findings from the investigation concluded that the regimental commander properly conducted a review of the fires and did not violate the Law of Land Warfare. The regimental commander articulated a legitimate military purpose for every target. He directed the use of observed fires and selected discriminating munitions to minimize collateral damage. Finally, the commander made a proportionality assessment by weighing the distinct military advantage to be gained against likely collateral damage to ensure he would not cause unnecessary suffering or appear to have conducted indiscriminate attacks. The commander, supported by his FSE and staff judge advocate (SJA), was not in violation of the Law of War.

III Corps has established tactics, techniques and procedures (TTPs) to address the challenges in targeting enemy forces using cities and towns as sanctuary. This article describes the legal issues and a method to conduct proper targeting analysis before firing missions into populated areas.

The New Enemy. The corps faced a new paradigm in its Warfighter with the enemy in the contemporary operational environment (COE). The fire support target set was the same: mortar, cannon, rocket and missile systems, command and control (C^2) nodes, radars and logistical support sites. However, the destruction or defeat of this enemy was much more challenging.

The new enemy operated on a lethal, nonlinear battlefield. He used an integrated fires command (IFC), much like the corp's deep operations coordination cell (DOCC), to command and control all lethal fires. His artillery systems had longer ranges. This opposing force (OPFOR) used smaller formations than in the past dispersed on the battlefield, usually batteries rather than battalions. He was difficult to defeat employing conventional counterfire as he used shoot-and-scoot tactics; thus, engaging these fleeting targets was challenging.

The enemy was keyed to the fact that the United States is averse to unrestricted collateral damage; therefore, he used the populated urban and complex environments for protection and as sanctuaries. The OPFOR exploited civilians as a protective shield by "hugging" their lethal, long-range artillery systems next to churches, schools and homes. He knew that by arguing Law of War allegations, coupled with detrimental media coverage, US commanders would be more hesitant to authorize the use of indirect or aerial fires in populated areas.

A Solution. III Corps Artillery, the corps FSE and the corps SJA, along with their divisional counterparts, conducted a Fire Support Seminar in November 2001 to prepare for the 2002 III Corps Warfighter exercise. The FSE and SJA addressed the legal issue of the friendly force's targeting a COE OPFOR in populated areas while ensuring friendly fires are prompt, responsive, effective and don't violate the rules of engagement (ROE). Areas addressed included ROE, target identification, the authority to approve shooting and the process to authorize firing units to shoot. The seminar resulted in two products: TTP for applying the Law of Land Warfare to targeting and a populated area targeting record.

The goal was for commanders to be able to justify fires against targets shielded by populated areas. The III Corps Artillery Commanding General wanted to ensure that decisions to fire into populated areas were the result of a deliberate decision-making process. The populated area targeting record documented the decision-making for each fire mission and came in handy when commanders were questioned about not only decisions to fire, but also decisions not to fire a particular mission.

Additionally, the SJA placed a judge advocate in all the crucial tactical operations centers (TOCs) within the firecycle. The availability of judge advocates helped communicate to commanders that they have the ability to fire missions previously thought to be "illegal."

TTP for Applying the Law of Land Warfare to Targeting. In attacking the COE OPFOR in populated areas, commanders conducted a quick assessment before delivering indirect or aerial fires. The four areas assessed were the articulation of the military objectives, minimization of collateral damage, analysis of proportionality and judging the "reasonableness" of the commander's actions. See Figure 1.

Articulating Military Objectives. Commanders must first articulate a legitimate military purpose for every target in a populated or protected area. According to the Law of War, Article 52(2) of Protocol I, "Attacks shall be limited strictly to military objectives. In so far as objects are concerned, military objectives are limited to those objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization in the circumstances ruling at the time, offers a definite military advantage."

Examples of "by their nature" military objectives are combatants, artillery weapon systems, ammunition and fuel depots. Examples of "location" include bridges, key road intersections and airfields. Examples of "purpose" are civilian buses or trucks used to move enemy troops or equipment and factories producing materials to support the war (ball bearings, electronics, etc.). Finally, examples of qualifying military "use" include a school used as artillery headquarters, a hotel billeting troops or a residence used to hide military supplies.

During the Warfighter, the COE OPFOR used the town of Tongduchon for sanctuary and fired against the approaching 3d ACR. The combatants, artillery weapon systems and ammunition placed among civilian buildings were legal military objectives. Any artillery located next to a church, a soccer field or among houses was an appropriate military target. Finally, the use of civilian buildings to house and headquarter the artillery units was sufficient cause to target and attack those buildings.

Minimizing Collateral Damage, Unnecessary Suffering, Incidental Damage or Indiscriminate Attacks. Collateral damage is defined as "unavoidable and unplanned damage to civilian persons and property incurred while legitimately attacking a military objective." (Quote is from the *Operational Law Handbook*, Page 9, published by the International and Operational Law Department of The Judge Advocate School, 2003, Department of the Army.)

The OPFOR exploited civilians as a protective shield by "hugging" their lethal, long-range artillery systems next to churches, schools and homes.

Incurring collateral damage is not a violation of international law. No Law of War treaty defines this concept. The Hague Convention states, "It is especially forbidden to employ arms, projectiles or material calculated to cause unnecessary suffering." Indiscriminate attacks that cause incidental injury to civilian life or incidental damage to civilian property "excessive in relation to the concrete and direct military advantage anticipated" are prohibited by the Geneva Conventions.

The 3d ACR engaged artillery targets in the city based on the fires it was receiving. The Q-37 Firefinder radar detected the fires originating from many locations within the city. Counterfire was directed against the Q-37 acquisitions only. Artillery was not fired in other locations of the city, thus limiting collateral damage and unnecessary deaths.

Proportionality Assessment. The anticipated loss of civilian life and damage to property incidental to attacks must not be excessive in relation to the concrete and direct military advantage expected to be gained. Commanders must weigh the military objective against the collateral damage potential before attacking targets in built-up areas. To assess proportionality, the commander considers the type of delivery system and the type and number of munitions to be employed.

At first, the 3d ACR unnecessarily restricted its response to the enemy fires by not returning fire. The staff did not want to incur any collateral damage. As the regiment approached the town, maneuver units received artillery fires that did not affect its advance.

Later that night, the regiment received fatal artillery fires that slowed the unit's tempo. Self-defense justified a response to the attacks. The standard fire order for counterfire against artillery targets is 36 multiple-launch rocket system (MLRS) rockets. However, the acquisitions came from inside the city of Tongduchon. The commander, with advice from his fire support officer (FSO) and SJA, reduced the number of rockets to 24 to limit the collateral damage. Close air support (CAS) from available F-16 aircraft was considered; however, the FSO determined the munitions on-board the aircraft would have caused greater collateral damage than the MLRS rockets.

Another example of a commander conducting a proportionality assessment during the III Corps Warfighter occurred when the 1st Brigade, 1st Cavalry Division, received anti-tank (AT) fires from an enemy section barricaded in a school in the town of "Chongchung." The brigade commander had MLRS, cannon, mortar and CAS fires available to destroy the AT section. With help from his FSO and SJA, he assessed that CAS and MLRS fires against one AT section in a heavily populated area was disproportionate and had the potential for excessive collateral damage and civilian suffering. He directed the use of smoke to obscure the targeting vision of the AT section and suppress its attacks and, later, destroyed it by direct fires.

Also during the Warfighter, the 49th Armored Division received artillery

I. Military Necessity—What are we shooting at and why?

1. DTG of Mission: ______________________

2. Location—Grid Coordinates: ______________________

3. Enemy Target (WMD, Chem, IFC, Scud, Arty, Armor, C^2, Log)
   a. Type and Unit: ______________________
   b. Importance to Mission: ______________________

4. Target Intel:
   a. How Observed: UAV, FIST, SOF, Other: ______________
   b. Unobserved: Q-36, Q-37, ELINT, Other: ______________
   c. Last Known DTG of Observation or Detection: ______________

5. Other Concerns as Applicable:
   a. US Casualties—Number: __________ Location: __________
   b. Receiving Enemy Fire—Unit: __________ Location: __________

II. Collateral Damage—Who or what is there now?

6. City: __________ Original Population: __________

7. Estimated Population Now in Target Area (if Known): __________

8. Cultural, Economic or Other Significance and Effects: __________
____

III. Munitions Selection—Mitigate Civilian Casualties

9. Available Delivery Systems within Range: 155, MLRS, ATACMS, AH-64, CAS, Other: ______________________

10. Munitions: DPICM, PGM, Other: ______________________

IV. Commander's Authorization to Fire—Proportionality Analysis

11. Legal Advisor's Rank and Name: ______________________

12. Civil Affairs/G5 Advisor: ______________________

13. *Is the anticipated loss of life and damage to civilian property acceptable in relation to the military advantage expected to be gained? Yes/No*

14. Commander or Representative's Rank, Name and Position:
____

15. Optional Comments: ______________________

16. DTG of Decision: ______________________

17. *Target Number:* ______________________

Note: Commanders are responsible for assessing proportionality before authorizing indirect fire into a populated area or protected place (NFA, RFA or PTL). Refer to ROE; seek legal advice and copy SJA, G5 and FSE.

Copies provided to Commander, FSE, SJA, G5 and PAO.

Legend:

ATACMS =	Army Tactical Missile System	**MLRS =**	Multiple-Launch Rocket System
CAS =	Close Air Support	**NFA =**	No-Fire Area
C^2 =	Command and Control	**PAO =**	Public Affairs Officer
DPICM =	Dual-Purpose Improved Conventional Munitions	**PGM =**	Precision-Guided Munitions
		PTL =	Protected Target List
DTG =	Date Time Group	**ROE =**	Rules of Engagement
ELINT =	Electronic Intelligence	**RFA =**	Restricted-Fire Area
FIST =	Fire Support Team	**SJA =**	Staff Judge Advocate
FSE =	Fire Support Element	**SOF =**	Special Operations Forces
G5 =	Civil Affairs	**UAV =**	Unmanned Aerial Vehicle
IFC =	Integrated Fires Command	**WMD =**	Weapons of Mass Destruction

Figure 1: Populated Area Targeting Record—Military Necessity, Collateral Damage, Mitigation of Civilian Casualties and Proportionality Assessment

fires. Q-37 acquisitions classified the fires as long-range artillery originating from the city of "Suwon." The division could not use MLRS to fire against the artillery because it was out of range. The target was also inside a corps RFA. After analysis using the automated deep operations coordination system (ADOCS) software, the corps deputy fire support coordinator (DFSCOORD) and the corps air liaison officer (ALO) assessed the targets were inside a large park in an RFA.

The DFSCOORD, ALO, SJA and G5 then approached the deputy commanding general (DCG) in the III Corps tactical operations center (CTAC) and requested authorization to attack the artillery in the city using CAS. The attack was of military necessity (self-defense in response to lethal fires), minimized collateral damage (the park and surrounding area was not heavily populated) and was proportional by employing CAS with joint direct attack munitions (JDAM).

The DCG approved the mission. To further reduce collateral damage, he directed the CAS sortie use two JDAMs per pass versus an entire load of six bombs per pass. The SJA and G5 recorded the mission on the populated area targeting record.

This battle drill took less than two minutes and was in time to direct and destroy the artillery battery in the city of Suwon.

Judging the "Reasonableness" of a Commander's Action. Commanders have many factors to consider when applying the Law of Land Warfare to targeting. (See Figure 2.)

From these criteria, the FSE and SJA developed the populated area targeting record. Commanders do not literally answer each question before engaging the enemy; rather, each quickly assesses the situation using the record as a foundation. As each target is attacked, the FSE, along with an SJA representative, fills out the worksheet. These records then are filed so they can be used to respond to allegations or investigations initiated due to the event.

Commanders are solely responsible for decisions to fire into populated areas. General officers or their designated representatives approve indirect fires into populated areas. In III Corps the general officers delegated authority to brigade and regimental commanders with access to judge advocates, but no lower.

1. Identification of the Target
2. Location of the Target
3. Potential for Allies or US to Suffer Casualties as a Result of the Target
4. Military Objective Gained
5. Prior Knowledge of Potential Collateral Damage—Protected Persons or Protected Places Near the Target
6. Whether the Enemy is Misusing a Protected Place (School, Hospital, Church, etc.)
7. Accuracy of the Information (Human Intelligence Verifies a Sensor)
8. Delivery Systems Available
9. Munitions Employed
10. An Objective Assessment of the Commander's Actions—Whether or Not They Were "Reasonable"
11. Results of the Engagement

Figure 2: Law of Land Warfare Factors to Consider in Targeting

The COE OPFOR knows that media coverage resulting from firing into populated areas can destroy public support for US efforts and alienate our allies. During the Gulf War, intelligence analysts submitted the Al Firdus Bunker as a target. The bunker was camouflaged, surrounded by wire and guarded by sentries. Unknown to targeting planners, Iraqi civilians used the bunker to sleep in at night. The bunker was bombed at night and 300 innocent civilians died. Based on the information known at the time, the commander's decision to attack the bunker was not a Law of War violation, but it was an adverse media event and the US deeply regretted the incident.

The Iraqi government tried to use the media to erode public and coalition support, presenting the US as inhumane and willfully killing women and children in the bunker. But ensuing investigations justified the targeting process—based on what the commander knew at the time, the bunker target met the requirements for military necessity and the attack minimized collateral damage and was proportional.

When the enemy improperly uses protected places (hospitals, schools, churches, etc.) to hide or shelter their forces and fire against friendly forces, the enemy is violating the Law of War; those places lose their protected status. Consequently, more collateral damage should be expected when enemy ground forces and weapons systems are intermingled in populated areas, particularly when US ground units return fire in self-defense.

Unfortunately, due to the fog of war that surrounds the contemporary battlefield, even with current technological advances, it is impossible to prevent all collateral damage or noncombatant casualties. Commanders who conduct proper targeting analysis before firing missions into populated areas can reduce the risk of collateral damage and civilian casualties and be prepared to respond to adverse media reports as well as Law of War allegations.

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Major General Guy M. Bourn commanded the IIId Armored Corps Artillery, Fort Sill, Oklahoma, until August 2002. He currently serves as Chief of the Office of Military Cooperation at the American Embassy in Cairo, Egypt. Previously, he was a Special Assistant to the Chairman of the Joint Chiefs of Staff at the Pentagon. He commanded the 17th Field Artillery Brigade, IIId Armored Corps Artillery, and served at Chief of Staff of Fort Sill.

Colonel Patrick Lisowski, Judge Advocate General's Corps (JA), is the Staff Judge Advocate (SJA) for the IIId Armored Corps at Fort Hood. Prior to that he was the SJA for the 1st Cavalry Division, also at Fort Hood. His other assignments include serving as SJA for the Air and Missile Defense Center at Fort Bliss, Texas. He also has served as an operational law attorney, trial counsel, defense counsel and litigation attorney for the Army. He is a graduate of the University of Pennsylvania Law School.

Lieutenant Colonel Gary A. Agron was the III Corps Deputy Fire Support Coordinator at Fort Hood until August 2002. Currently, he is an Army War College Senior Fellow at the University of Texas in Austin. Previously, he commanded 1st Battalion, 12th Field Artillery; C Battery, 1st Battalion, 36th Field Artillery; and Headquarters and Headquarters Battery, all in the 17th Field Artillery Brigade at Fort Sill.

Why Can't Joe Get the Lead Out?

By Colonel Gary H. Cheek

> "If there is one thing a Dogface loves, it is artillery—his own."
>
> Audie Murphy, *To Hell and Back* (New York: MJF Books, 1949)

After 20 years of automation, at least six different fire direction computers and countless versions of software, are we better today? Are our fires faster or slower? More or less precise? Can we do more things at once or are we driven to sequential operations? Are our operations simpler or more complex?

Certainly in some ways we are better. We are more precise, and our computer systems are far more capable than they were even a few years ago.

It is troubling, however, that while we are more accurate than ever before, our fires are slower, impersonal and sequestered in a fire support stovepipe isolated from maneuver. Indeed, in today's information age, we have lost the human dimension of fire support and are operating with an overly centralized, complex and marginally responsive fire direction system.

The time has come for a visit to our past to reassess our doctrinal close support fire direction procedures and find a new way ahead that leverages the virtues of the information age yet allows the most powerful computer of all—the human mind—to orchestrate the complex business of fire support. This will allow Joe to "Get the lead out."

Looking Ahead Through the Past. Who, you might ask, is "Joe?" On 26 January 1945, Second Lieutenant Audie Murphy won the Medal of Honor directing artillery fire and firing a machine gun off the top of a burning tank destroyer. While recreating this action in the movie *To Hell and Back*, Murphy, playing himself, calls-for-fire, imploring the fire direction center (FDC) to "Tell them Joes to get the lead out."

In the banter that takes place between Murphy and the FDC, a bond develops between Murphy and the firing battery. Murphy says, "You're right on the nose, keep it coming." "Good shootin', Mac; the tanks are heading for cover." The FDC responds, "Send us a correction; let's stay on those tanks." Murphy replies, "Just keep after that infantry!" The FDC asks, "How close are they?" Murphy responds, "Hold the phone, I'll let you talk to them!"

In fact, Murphy made seven 50-yard corrections on his fire mission to keep fires on the lead German elements. On his final correction, the FDC responded "50 over? That's your own position." Murphy responded, "I don't give a damn. *50 over*."[1]

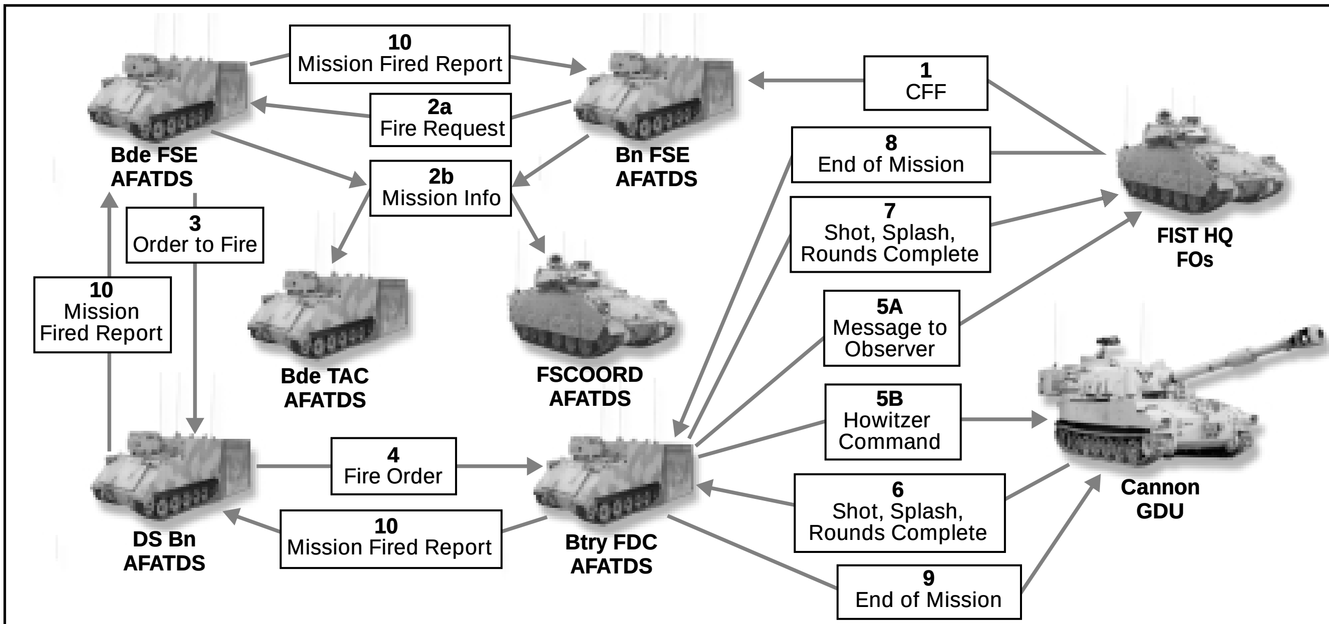
Wounded, Murphy retreated from his position, recalling, "As if under the influence of some drug, I slide off the tank destroyer and, without once looking back, walk down the road through the forest. If the Germans want to shoot me, let them. I am too weak from fear and exhaustion to care."[2]

This scenario strikes at the heart of what is wrong with the direction of our information-age Army, and, more specifically, "Joe" of the Field Artillery and fire support. We have lost the human dimension of fire support, the intimate bond between observers and firing batteries and all that comes with it. We have lost the ability to transcend quantitative data with intuitive judgment and exercise that complex translation of emotions and instincts into action, feeling the sense of urgency that comes from human need and the great sense of satisfaction that comes from serving your fellow soldier.

Imagine if Lieutenant Audie Murphy were in combat today. He would make a voice call for artillery fire to his company fire support officer (FSO) who would input the call-for-fire into his handheld terminal unit. Or perhaps Murphy would input the call-for-fire into his Force XXI battle command brigade and below ($FBCB^2$) terminal and send it forward. See Figure 1.

In the perfect world, this call-for-fire would zip through the intervention points (IPs) of the task force fire support element (FSE), brigade FSE, battalion FDC, battery FDC and, ultimately, to the guns that would fire, all with a digital processing time of perhaps two minutes. More likely, however, broken communications would lose Murphy's mission. Or it would not meet the attack criteria and would receive a review or two, significantly delaying it or running the risk of a higher command post's rejecting it. Then the mission that started 550 yards from the observer's position would require automated clearance of fires.[3]

This decision-making process would not appreciate Murphy's plight as no emotion would connect the fact that Murphy is alone against six tanks and two reinforced rifle companies. How could he convey his plight to the firing battery? How would the battery know it was "on the money"? How would it know how close the enemy was or whether the tanks were heading for cover? The answer is that the battery never would know because Murphy's



1. FIST sends *CFF* to the battalion FSE with FFE "When Ready" method of control.
2. The battalion FSE analyzes the target against mortars and FA, selects the FA option and sends the FA *fire request* to the brigade FSE and *mission info* to the brigade TAC and FSCOORD. (The fire request may be sent to the brigade TAC and info to the brigade FSE.)
3. The brigade FSE analyzes the target to determine the *order to fire* to the DS FA CP.
4. The FA battalion CP analyzes the target to determine the battery to fire and sends the *fire order* to the battery FDC.
5. The battery FDC performs technical fire direction, sends *howitzer commands* to the GDUs and *MTO* through the battalion FSE to the FIST.
6. The cannon GDUs fire When Ready and send *"Shot," "Splash" and "Rounds Complete"* to the battery FDC.
7. The battery FDC relays *"Shot," "Splash" and "Rounds Complete"* through the battalion FSE to the FIST.
8. The FIST observes the fire and sends *"End of Mission"* through the battalion FSE to the battery FDC.
9. The battery FDC sends *"End of Mission"* to the cannon GDUs and generates an *MFR* to place the target in an inactive state.
10. The battery FDC sends the *MFR* to the DS battalion CP to be forwarded to all AFATDS in the mission chain.

Legend:

AFATDS = Advanced Field Artillery Tactical Data System
Bde = Brigade
Bn = Battalion
Btry = Battery
CFF = Call-for-Fire
CP = Command Post
DS = Direct Support
FDC = Fire Direction Center
FFE = Fire for Effect
FSCOORD = Fire Support Coordinator
FSE = Fire Support Element
FOs = Forward Observers
GDUs = Gun Display Units
MFR = Mission Fired Report
MTO = Message to Observer
TAC = Tactical Command Post

Figure 1: Current Doctrine—Execute Fire Support Team (FIST) Fire Missions with FA Cannons

mission, after all, would be just another email message.

The truth is that we would not use digital for such a fire mission in combat, just as most of our observers don't use digital devices for fire missions at our Combat Training Centers (CTCs) and in most training. That begs the question: Why do we persist in developing technologies that don't work well for our core task of providing close supporting fires to our maneuver formations?

Imagine a late-night scenario where a Marine long-range reconnaissance patrol (LRRP) is under attack and the only unit within supporting range is a US Army FA battery. A quiet voice whispers over the fire direction net, "Is this a uniform sierra alpha [US Army] Redleg?" The battery FDC acknowledges and processes a mission for high-explosive munitions (HE) and variable-time fuzes (VT) on the exact grid of the LRRP.

"Just shoot it out here and give us, 'Shot.' We'll get down," a tense voice states, trying to keep as quiet as possible.

The battle rages for several hours, and the battery provides illumination and coordinates reinforcing artillery fires to help the besieged Marines. The FDC listens as the Marines cross talk on the fire direction net, hearing gunfire and shells exploding as the LRRP clings to survival. By 0230, the action is over. The last message from the LRRP sums up what happened, "Man, we were out here all alone and in deep shit until we called you. We love our uniform sierra alpha brothers. Dragon 6, out."

Far fetched? This action took place in Vietnam on 28 June 1968, and the FDC captured the action on a tape recorder. In fact, the FDC replayed it for the soldiers on the gun line so they could understand the urgency of a contact fire mission.

That same LRRP called the battery every week for weeks after, just to wish the Redlegs well and thank them again for the fire support that saved the LRRP that dark night of 28 June.[4]

In the joint world, do we really expect to have this type of compatibility digitally? Do our gun sections and FDCs have this kind of bond with their observers?

Leadership is the most important element of combat power; it is what allows commanders to combine firepower, maneuver, information and protection into a synergistic whole. It is a human endeavor that the information age can only assist, not replace. In the business of fire support, leadership is no less important as it is the human interaction of leaders and soldiers that allow us to make intuitive assessments and bring the decisive effects of fires to bear.

Our doctrine and equipment put us in a digital world where faces, emotions and instincts are lost. Fire missions have become anonymous and the routines to process them unaccountable as no one knows the status of the mission once it's transmitted to the next IP.

One such case occurred on 16 April 1953 in the struggle for Arsenal Hill during the Korean War. In this action, Second Lieutenant William DeWitt, fresh out of the Officer's Basic Course at Fort Sill, was visiting the front to receive coaching from the experienced First Lieutenant Edward Haley. Unfortunately, Chinese artillery struck the artillery observation post, severely wounding the entire observation team, leaving a blinded DeWitt in charge.

As the Chinese infantry attacked the position, the company continued to fight with small arms and planned "flash fires" with devastating effects on the enemy. However, the determined enemy fought on, breaching the wire and closing in on the bunker complex.

Despite his wounds and inexperience, DeWitt took action. "[DeWitt] had never given an order in war. He had not been authorized to take over from Haley. But one thing prompted him to act. He said to Drake [in the bunker complex], 'I hear grenades outside.' Drake listened and replied, 'You're right.' 'They're coming closer,' said DeWitt, 'and there are more of them.' Filled with self-doubt, he reached for the PRC-10. The radio worked; he was talking to Kimmitt, his battalion commander. Uncertainty filled him as he said it, 'Give us VT fire—lots of it—right on the position.'

"What followed is proof of which lies in the right words spoken at a crucial moment; they have the power to change the course of a life. Back came Kimmitt's voice, 'Very good, very good, very good, Son.' It was like a light suddenly shining on DeWitt….In a matter of seconds—43 of them—the killing shell was breaking over Arsenal Hill directly over DeWitt's head."[5]

In our digital world with requirements for 16 hours of sustainment training per week, do we really expect a new second lieutenant to be able to make the automated system work for him—in contact, wounded and blinded? Will an Effects Management Tool allow a battalion commander to expedite fires while providing reassurance to an untried observer bringing fires in on his own position?

Today's Digital System. A visit to our past shows what we have lost in our 20-year struggle with digital operations and the implications for fire support.

No Soldier-to-Soldier Bonding. First, and most obvious, fire support has lost its soldier-to-soldier bond. Our doctrine and equipment put us in a digital world where faces, emotions and instincts are lost. Fire missions have become anonymous and the routines to process them unaccountable as no one knows the status of the mission once it's transmitted to the next IP.

Our automated system replaces leadership with control, mandating a fire mission run through programmed IPs for approval rather than the commander's intent driving junior leader initiative. How can our digital system accommodate the emotions of Audie Murphy or our Marine LRRP? How can senior leaders sense the urgency of battle and apply seasoned, calm leadership when no emotion comes with the call-for-fire?

Contradicts Leadership and Initiative. Our doctrinal system contradicts our leadership doctrine and the initiative that is the hallmark of the US Army. By its very nature, our automated system is very centralized with a series of headquarters screening missions. Today's FSOs believe it is their job to screen missions—not just to clear missions, but to question whether the missions meet the attack criteria derived during the military decision-making process.

This belies our combat history where decentralized execution with subordinates afforded maximum latitude yielded the best results. Who in today's Army would trust a maneuver shooter or a Field Artillery lieutenant to execute a fire mission without supervision? We did so routinely in 1968—what has changed so much today?

Complexity of Our Automated System. Our automated system is very complex and fraught with hazards to derail calls-for-fire. By the time our fire missions have survived the gauntlet of broken communications, IPs, leader decisions and voice relays, we have lost so much time that the mission may no longer be relevant or, worse, that friendly forces may now be in the target area.

With all the intervening headquarters, our FDCs usually have no idea who the observer is. As a result, observers never hear "Shot," never adjust missions and certainly would not get enough warning to "get down." Our rhetoric espouses the virtues of connecting sensors-to shooters, but in reality we do just the opposite.

Getting the Lead Out. So how do we fix the system? First, let's recognize some of the virtues of our current system. It has proven its responsiveness and capability far beyond any analog voice system in many areas, of which counterfire and shaping operations beyond the coordinated firing line (CFL) are examples. It is terrific for transmitting large volumes of data with great precision, such as fire support coordinating measures (FSCM), meteorological messages, target lists and howitzer firing commands. It also has proven itself in the simulation world, as the advanced FA tactical data system (AFATDS) is highly regarded as a champion of the Corps Battle Simulation system and would seem well-suited to support division- and corps-level operations. But each of these successes are not connected to the "point of the spear," the soldier under fire. It is at the point—the execution of fires inside the CFL—that we must change. See Figure 2.

Learn from Burger King. We can draw interesting parallels between our fast-food industry and our call-for-fire procedures. If we look at the customers as our forward observers (FOs), the cash-

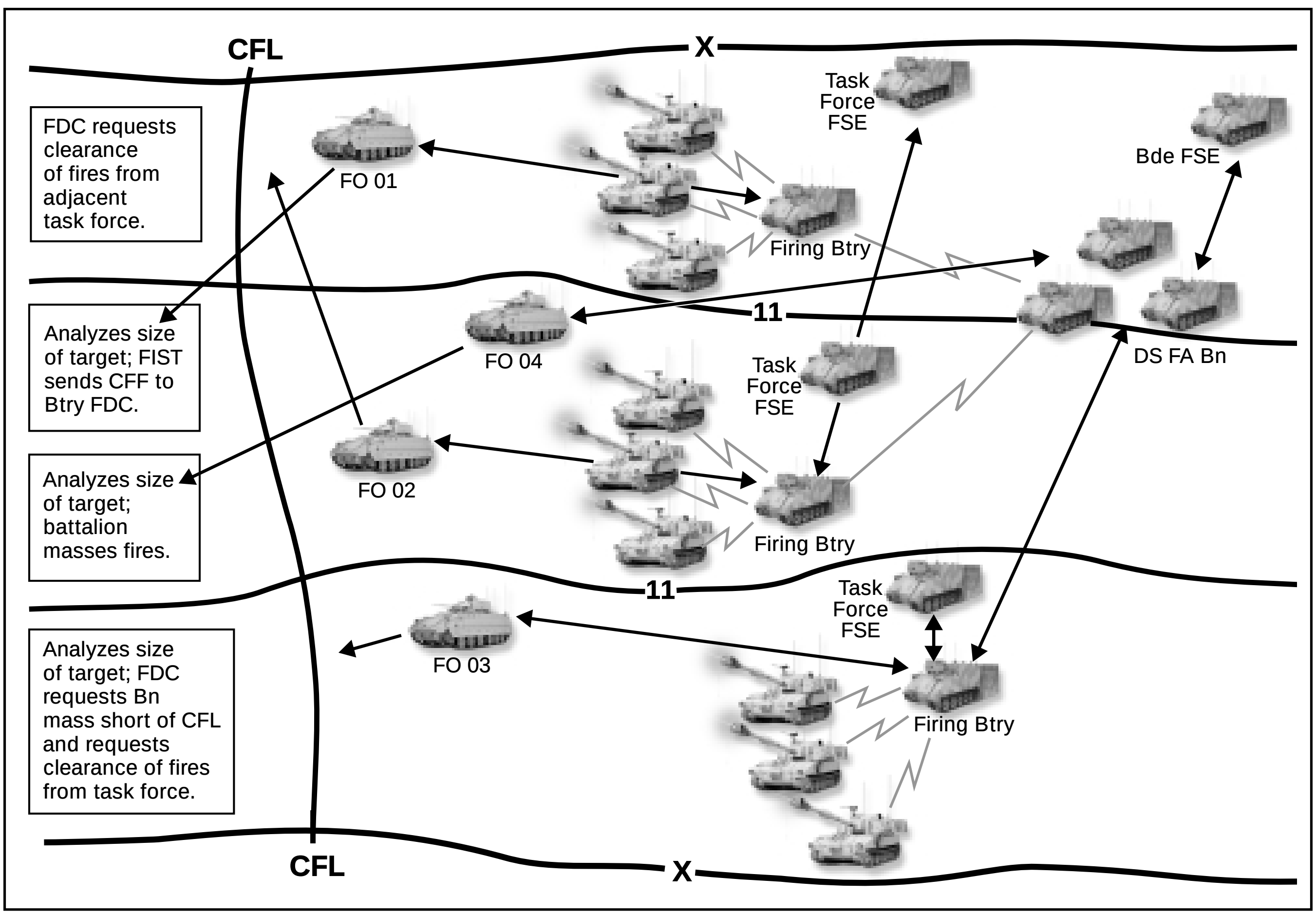


Figure 2: Proposed Doctrine—Execute Fire Missions Inside the Coordinated Fire Line (CFL) with FA Cannons

iers as our FDCs and the cooks as the gun line, we can learn some lessons in efficiency to improve our system.

Note that in the typical fast-food setup, there are multiple cashiers to process orders simultaneously. With the push of a button, the order is input into the system with allowance for various combinations and options. Burger King kept the cashier-to-customer connection rather than allow the customer to punch in his order. Burger King obviously values the human interaction and is wary of the problems and poor service that might result from "untrained" customers' input into its system. Burger King, in fact, can accept an order from almost any "untrained observer" and does so routinely with tourists from foreign lands.

Note that as the order is completed, a digital burst goes to the cooks to prepare the meal and that within minutes, the server provides the food as ordered. There is no loop that seeks parental approval of the order or matches the order against corporate policy in order to tell the customer what he wants.

The Burger King system maintains the human dimension, leverages digital communications for precision, allows for simultaneous actions, requires little technical training and is incredibly simple.

Simplify the System. Where do we go from here? First, we need to eliminate FO digital devices from our modified tables of organization and equipment (MTOEs). With few exceptions, the FO's equipment does not make him more effective; it merely automates an analog process. In fact, you could argue that the technical training required for him to operate his devices actually make him *less* effective as time needed for tactical training is diverted to develop technical skills.

What our observers need is a single target location device that, with the touch of a button, provides an accurate 10-digit grid at 10 kilometers, day or night. Currently our observers have to contend with multiple cables, batteries and devices, none of which can produce an accurate grid without combining the features of all.

Second, we need a Burger King-type computer designed to allow FDCs to rapidly process voice fire missions into digital bursts to firing batteries or guns. With this computer, we need a new command and control architecture that allows for decentralized execution and direct sensor-to-shooter communications. The architecture needs multiple voice fire direction nets to accept calls-for-fire with a simple system in the FDC to translate voice calls-for-fire into a digital fire orders. With this architecture, the FDC's job is to coordinate clearance of fires while preparing the guns for the fire mission.

If we truly trust our Field Artillery lieutenants, we will place battery FDCs in charge of those nets and monitor the calls-for-fire at the battalion and task force levels as we did 30 years ago. And we can keep AFATDS at the battery, battalion and task force levels to manage the combat information that is not time-sensitive or critical to the human dimension of our business.

Imagine if we matched a Field Artillery battery with Crusader-like capabilities on four fire direction nets in support of a Stryker Brigade. The system would have extraordinary power to mass fires simultaneously on a distributed battlefield.

No doubt there are digital warriors reading this article who would tell me the Genesis device is on the horizon—that the latest Palm Pilot forward observation device coupled with the new digital radio and the Effects Management Tool will make it all good. Perhaps I am an analog dinosaur who clings to past glories and cannot see the great potential of emerging technology. But I suspect I am one of many who believe that digitized systems simply won't work for close supporting fires and that new equipment cannot fix what is fundamentally wrong.

At best we espouse to "plan digital and execute voice," which has doomed us to fight with an inefficient single voice fires net. This approach has become defacto doctrine despite two decades of official digital doctrine that states otherwise.

The question is, "Do we have the courage to backtrack on digital operations and the information age?" American companies will make what we ask them to make—that's how we got today's system. They can make a system like Burger King's as well.

US Army Field Artillery FOs have long been heralded as the greatest killers on the battlefield, yet today they must use an unreliable, complex and overly centralized system. They have too many radios, devices, cables and batteries to be successful.

We need to simplify their task and increase the flexibility of our fires, leveraging the smartest computer of all, the human mind. We must become more customer-oriented, be able to take any call-for-fire from any friendly force, coordinate clearance and execute down to the last meter.

We must help "Joe" get the lead out. He must have a simple, reliable and fast fire direction system with multiple points of access to fire support and direct sensor-to-shooter links. Finally, Joe must have voice interaction that allows him to sustain the bond with maneuver that is the human dimension of fire support.

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Endnotes:

1. Audie Murphy, *To Hell and Back,* Universal Pictures, Inc., 1955.
2. Murphy, *To Hell and Back*, 241-243. Note that correcting fire in World War II required the observer to make corrections off the gun target line. Murphy's command of "50, over" directed the FDC to repeat the mission after reducing the gun target range by 50 meters. This roughly corresponds to today's "drop 50" corrections along the observer target line.
3. Ibid., 239. Murphy's initial correction is 200 right, 200 over. Combined with his 350 yards of 50-yard corrections, the initial rounds impacted approximately 550 yards from his position.
4. Jim Gleckler, *Redleg: An American Artilleryman's Personal Account of the Vietnam War* (Miami: Northeastern Oklahoma A&M College, 1985), 112-117.
5. S.L.A. Marshall, *Pork Chop Hill* (Nashville: The Battery Press, 1956), 29.

AFGHANISTAN
Firing Artillery Accurately with Air Force Met Support

By First Lieutenant Joshua D. Mitchell

In the summer of 2002, Task Force Panther, 82d Airborne Division, Fort Bragg, North Carolina, received the mission to replace the 101st Airborne (Air Assault) Division in Afghanistan in support of Operation Enduring Freedom. Due to limited airspace and the limited amount of indirect fire assets tasked—a 105-mm battery and two 120-mm mortar platoons for the one FA battalion deploying—the division artillery meteorological (Met) team remained at Fort Bragg. Left without one of the five requirements for accurate, predicted fire, Charlie Battery, 1st Battalion, 319th Airborne Field Artillery Regiment (C/1-319 AFAR) developed techniques to accurately account for the extreme climate of the combat theater.

Before the battery arrived, A/1-319 AFAR, already in Afghanistan, was reporting range and fuze setting errors during live fire missions while using 120-mm mortars. These errors largely were due to the high temperatures and reduced air density of the Southwest Asian country. C Battery began to see similar firing errors when it calibrated in the desert south of Kandahar. The battalion's Q-36 radar at Kandahar repeatedly reported rounds impacting over the target while the radar was set in the friendly mode.

Due solely to weather conditions, the fire direction center (FDC) faced nearly 500 meters in range errors. With initial assistance from the Air Force's Bagram weather team, we developed procedures to negate these errors by using the Air Force's Interactive Gridded Analysis and Display System (IGRADS).

IGRADS is web-based software that generates 24-hour forecasts of weather conditions up to 50,000 feet above the surface for any given latitude or longitude and is accessed through secure internet protocol relay (SIPR) accounts. IGRADS outputs the data in the format of altitude in feet above ground level (AGL), pressure in millibars, temperature in Celsius, density in grams per cubic centimeter, absolute humidity in grams per cubic meter, wind speed in meters per second and wind direction in degrees. The information can be interpolated and converted into a computer Met message; then with the weighting factors found in *FM 6-16, Tables for Artillery Meteorology (Electronic) Ballistic Type 3 and Computer Messages*, it can be converted to a ballistic Met message for mortars.

Quantifying the Problem. Although accounting for Met may make little difference at installations where the weather parallels standard conditions much of the year (such as Fort Bragg), the lack of Met was a serious deficiency in the summer heat and high altitudes of Afghanistan. Low air density, a function of high temperatures and low pressures, reduces the drag of a projectile and, therefore, causes positive range errors.

Heightened temperatures also affect the drag of a round because of their effects on the compression waves that form in front of and behind the projectile. This drag effect is not linear; but for most M119A2 firing data, an increase in temperature corresponds to an increase in achieved range. High desert temperatures combined with high altitudes, therefore, can cause significant deviations from standard.

The Army already has had this problem in Southwest Asia where extreme temperatures and low density caused range corrections of up to 4,700 meters *(FM 6-15 Tactics, Techniques, and Procedures for Field Artillery Meteorology, Page 3-13).*

Standard Met (Sea Level)					Bagram (1456 Meters MSL)		
Zone No.	Midpoint Height	Pressure (mb)	Temperature (°K)	Density (gm/m³)	Pressure (mb)	Temperature (°K)	Density (gm/m³)
00	0	1013	288.2	1225.0	848	299.2	986.1
01	100	1001	287.5	1213.3	839	298.5	985.8
02	350	0972	285.9	1184.4	815	296.9	977.6
03	750	0926	283.3	1139.2	778	293.8	922.1
04	1250	0872	280.0	1084.6	734	289.8	882.5
05	1750	0820	276.8	1032.0	692	284.9	844.6
06	2250	0771	273.5		651	281.0	
07	2750	0724	270.3		613	276.1	

Legend:
gm/m³ = Grams per Cubic Meter **K =** Kelvin **mb =** Millibars **MSL =** Mean Sea Level

Figure 1: Standard Met Compared to Bagram Met. The Met was taken at 1200 Zulu on 10 September 2002.

The first Met data the Air Force provided using its IGRADS simulation software showed the disparity between the air density and temperature in our area of operations and those of standard conditions (represented in the battery computer system's standard Met file). See Figure 1. On 10 September, the surface temperature at Bagram that is 1,456 meters above mean sea level (MSL) was 299 degrees Kelvin at 1630 local time. The corresponding temperature in standard Met was 279 degrees Kelvin. This seven percent increase would lead to a 195-meter range error when firing at a distance of 11,000 meters, according to Tabular Firing Table (TFT) 105-AS-4. Additionally, the air density at the surface of the Bagram Met was seven percent lower than the equivalent altitude of standard Met, leading to a 281-meter range error. These errors are even more significant when coupled with the fact that 1-319 AFAR's main mission is to provide close supporting fires to Task Force Panther.

Despite the large differences in temperature and density, pressures only diverged slightly between the Bagram and standard Mets. This similarity is largely due to the fact that Bagram and the location on which standard conditions is based both are about 30 degrees latitude, one of the semi-permanent pressure regions created through the earth's patterns of air circulation.

Accounting for Temperature Changes. Before C/1-319th departed Bagram, the Air Force weather station simulated Met data for Firebase Cobra Strike at Khowst that is at an elevation of 1,140 meters. (See the map in Figure 2.) This Met data gave a good representation of pressures for the firebase, but it was still imperative to account for the changes in temperature that happen within a 24-hour period. The difference between the Khowst Met (taken when the surface temperature was approximately 68 degrees Fahrenheit) and the temperature in the middle of that same day (100 degrees Farenheit) caused a plus-250 meter range error because of temperature's dual effect on drag. It was not possible to track these temperature changes through bi-hourly Met messages, as is the normal procedure. Instead, we had to formulate a new technique.

To isolate temperature changes, pressure was set as being independent of temperature, a decision supported by later analysis of temperature and pressure changes through different 24-hour periods. Due to the complexity of meteorological conditions, no direct relationship between temperature and pressure existed in any of the periods studied.

Analyzing temperature gradients over different periods, we found that surface temperature changes in a given day did not affect temperatures at altitudes beyond 4,000 feet (approximately 1,250 meters) above the surface. Irrelevant of the surface temperature, all temperatures from Line 04 of the computer Met message and above were the same in any 24-hour period. This trend is displayed by the data in Figure 3 on Page 40 from 17 November 2002.

Using this information, we created Met messages for five-degree surface temperature intervals from 55 to 100 degrees Farenheit. We calculated these Met messages by taking the given surface temperature and proportionately reducing it to the temperature at 4,000 feet, based on the temperature gradient of the Air Force Met data. This procedure created 10 Met messages with various surface temperatures but with identical temperatures at 4,000 feet and above (See Figure 4 on Page 40.) The same pressures were used for all 10 Met messages.

Once the Met messages were created, the FDC selected them based on propellant temperature. Because propellant temperatures usually lag behind air tem-

Figure 2: C/1-319 AFAR computed Met data for Bagram, Khowst and Shkin using the Air Force's Interactive Gridded Analysis and Display System (IGRADS).

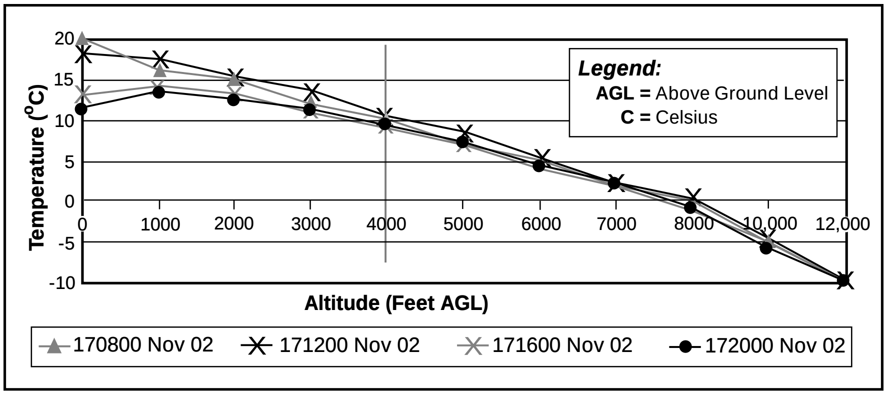

Figure 3: Temperature vs Altitude During a 24-Hour Period

Step 1: Access Data From IGRADS Website.

a. Go to http://weather.offut.af.smil.army.mil/igrads.html using a secure internet protocol relay (SIPR) account.

b. Select Afghanistan—5-kilometer map.

c. Select alphanumeric output.

d. Input latitude and longitude in degrees and minutes.

e. Select the date and time for the Met data —available in one-hour intervals for a 24-hour period.

Step 2: Convert Raw Data into Computer Met.

a. Multiply altitude in feet by 0.3048 to obtain altitude in meters.

b. Add 273.15 to degrees in Celsius to obtain degrees in Kelvin.

c. Based on the age of the Met data, either set wind data to zero or convert direction to mils and speed to knots. If the time of the IGRADS Met data matches within a couple of hours of the time the Met message will be applied, then wind data can be considered fairly reliable. Otherwise, it should be set to zero.

d. Interpolate the data to obtain the weather information at computer Met message midpoint altitudes.

IGRADS Generated Met for 34°57'69°17', 101200 Sep 02			Converted Altitude and Temperature		Final Bagram Met Interpolated at Midpoint Altitudes, Lines 00-04		
Altitude (ft AGL)	Temp (°C)	Pressure (mb)	Altitude (m AGL)	Temp (°K)	Altitude (m AGL)	Temp (°K)	Pressure (mb)
Surface	26	848.28	0	299.2	0	299.2	848
1000	24	819.34	305	297.2	100	298.5	839
2000	22	791.07	610	295.2	350	296.9	815
3000	19	763.56	914	292.2	750	293.8	778
4000	17	736.81	1219	290.2	1250	289.8	734
5000	14	710.70	1524	287.2			

Step 3: Generate Met Messages for Different Surface Temperatures.

a. Using the existing temperature gradient, proportionately converge temperatures at 1,250 meters (or use standard temperature change of –6.5°C per 1,000,-meter increase).

b. Use the same pressures for all Met messages generated.

Bagram Met—Surface Temperature of 79°F			Met for Surface Temperature of 90°F			Met for Surface Temperature of 100°F		
Altitude (m AGL)	Temp (°K)	Pressure (mb)	Altitude (m AGL)	Temp (°K)	Pressure (mb)	Altitude (m AGL)	Temp (°K)	Pressure (mb)
0	299.2	848	0	305.4	848	0	310.9	848
100	298.5	839	100	304.3	839	100	309.4	839
350	296.9	815	350	301.6	815	350	305.7	815
750	293.8	778	750	296.4	778	750	298.7	778
1250	289.8	734	1250	289.8	734	1250	289.8	734

Figure 4: Example of Computation of Computer Met Messages Using IGRADS Data

perature, whether the air is getting warmer or cooler, the FDC would select a Met file offset from the average propellant temperature. For example, the 80-degree Met would be used if propellant temperatures were increasing and averaged around 75 degrees Fahrenheit. In this manner, we accounted for temperature and its effect on the projectile drag.

While the temperature gradient of current Met data is the best representation of the temperatures of the area for a given period, the entire temperature gradient can shift over time. Alternatively, we found that the standard temperature decrease of 6.5 degrees Celsius per 1,000-meter increase in altitude mirrors actual graphs of temperatures for Khowst. (See Figure 5.) Therefore, one should consider using the standard temperature change when no recent Met data is available.

A high-burst registration validated Charlie Battery's procedures a few days after we arrived in Khowst. The registration was conducted 7,005 meters to the northeast with two observers using precision lightweight global positioning system receiver (PLGR) grids. After applying Met and the muzzle velocities for the registered lot, the range correction was only two meters with a fuze setting correction of 0.1. There was still a significant deviation correction, but wind data was not known or applied for the registration.

Further support came during a rocket-assisted projectile (RAP) shoot to the northwest using AH-64 Apache attack helicopters for a laser-adjust mission. At a range of more than 13,300 meters and without a registration, the range correction was merely 33 meters.

Army doctrine warns against using meteorological information more than four hours old or more than 10 kilometers from the midpoint of the trajectory in mountainous terrain. By using IGRADS and accounting for surface temperature changes, Charlie Battery fired accurately with weather information that was up to 30 days old.

Some difficulty arose when the battery conducted missions at altitudes significantly different than the Met station. When the battery flew to Shkin, for example, the firing point altitude of approximately 2,200 meters was nearly double that of Firebase Cobra Strike and Cobra's Met station. Using propellant temperatures as a basis for selecting the Met file to use would not work

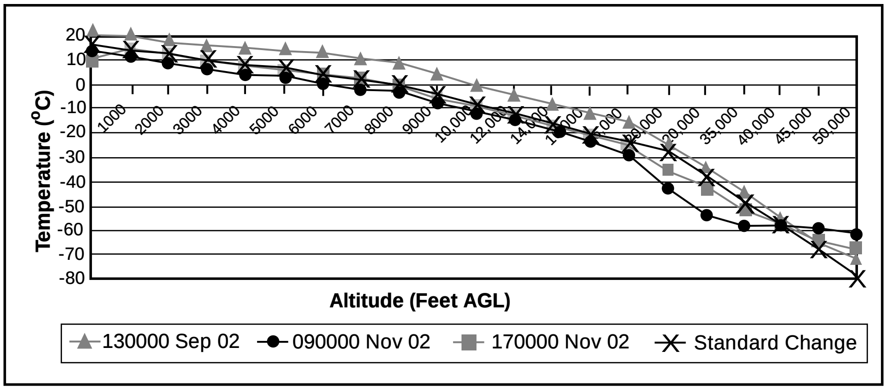

Figure 5: Temperature vs Altitude for Three Different Days

there. Therefore, we had to estimate the temperature at Cobra's Met station as compared to Shkin's surface temperature. To avoid simply guessing the temperature difference between the Met station and the firing point, we used Table D of the tabular firing table to help calculate it.

The drawback to Table D is that it only works for changes in altitudes less than 390 meters. So we extended the data mathematically and applied human logic for altitude changes greater than 390 meters.

Easy Access to IGRADS. Once the Army emplaced a SIPR line into the artillery tactical command post (TAC) at Forward Operating Base (FOB) Salerno, which was a few hundred meters from Firebase Cobra Strike, we could get Met data directly from IGRADS. Not only could we compute current Met messages for the firebase, but we also could produce Met messages for any Met station the mission dictated.

Before departing on a weeklong ground assault convoy that covered more than 400 kilometers southwest of Gardez during Phase III of Operation Alamo Sweep, we generated Met messages at two- to four-hour intervals over a 24-hour period for all three of the future firing points. (See Figure 4.) In this manner, the battery no longer had to estimate the temperature difference between a current firing point and the previous Met station or rely on a Met message that was calculated for a Met station much farther away than the advised distance of 10 kilometers.

We prepared the Met messages for the three new position areas by computing a day's average pressure at each zone for each firing point and then using that data for each of the 10 Met messages. We again created Met messages for five-degree temperature changes, this time ranging from 30 to 75 degrees Fahrenheit.

For Firebase Cobra Strike, Met data now could be forecast with IGRADS that fell within the distance and time requirements of FM 6-15. Based on a daily access to the SIPR net, we could account for winds after we converted the wind speeds to knots and wind directions to mils. When it was not feasible to obtain the Met data for the day, we did not account for wind and used the average pressure profile to generate Mets, as explained in Figure 4. Wind changes are often enough to prevent an FDC from using wind data that is even a few hours old.

Ballistic Mets. IGRADS output also can be converted to ballistic Met messages for mortars, a capability that has become more important to the artillery due to recent deployments of artillery batteries armed with 120-mm mortars.

However, a ballistic Met message is not as straightforward as a computer Met message. The air density and temperature values at each line of the Met message represent a weighted average of the conditions from the surface through that line of Met and back to the surface again and are listed as percentages of standard. The ballistic air density for Line 2 is, therefore, a weighted average of the air densities of Line 1 and Line 2.

To convert the Air Force Met data to a ballistic Met message, one must use the weighting factors and standard conditions found in FM 6-16. Figure 6 shows an example computation for ballistic air density for Line 2 of the Bagram Met. Ballistic temperatures are computed in a similar manner (consult FM 6-16, Pages 2-83, 2-104, 2-133).

Future Use of IGRADS. The Air Force's IGRADS has proven a powerful tool to support an artillery or mortar battery left without a supporting Met section. IGRADS allowed C/1-319 AFAR to fire accurately in a rugged climate despite the lack of normal artillery Met support. Range errors were small or nonexistent. We could also have decreased our deviation errors with more consistently available wind data.

The Field Artillery and Army should consider tapping into this system or implementing a similar system. To fully use the software's capability and free an FDC from relying on a spreadsheet or a calculator, we would have to alter the output of the software to match the format of computer and ballistic Met messages. When that happens, the Army will be better poised to rapidly react to small-scale warfare across the globe.

It is likely that another battery will find itself without artillery Met support somewhere in the world during future phases of the War on Terrorism, and it is in America's best interest to set it up for success.

	Line 1	Line 2	
Standard Air Density (gm/m^3)	1213.3	1184.4	1. 1213.3 x 0.43 + 1184.4 x 0.57 = 1,196.8 gm/m^3 (Standard Ballistic Air Density for Line 2)
Bagram Air Density (gm/m^3)	985.8	977.6	2. 985.8 x 0.43 + 977.6 x 0.57 = 981.1 gm/m^3 (Bagram Ballistic Air Density for Line 2)
Weighting Factors for Line 2	0.43	0.57	3. 981.1/1,196.8 = 82.0% (Bagram Air Density for Line 2 Expressed as Percent of Standard)

Figure 6: Procedures for Computing Ballistic Air Density

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ARNG AFATDS Sustainment Training on RCAS

By Sergeant First Class (Retired) Dennis D. Pannell, ARNG

The Army National Guard (ARNG) now can conduct sustainment training on the advanced FA tactical data system (AFATDS) via an automated network and save travel and training set-up/tear down time plus costs. ARNG units can use the Reserve Component automated system (RCAS) and wide-area network (WAN) and current unit-level scenario devices to conduct the training. The devices are simulate and stimulate (SISTIM) and the digital systems test and training simulator (DSTATS). The combination of the RCAS and the devices maximize training time by providing realistic multi-echelon digital training.

Using RCAS, units can have an AFATDS lab so soldiers can fall in on their workstations immediately after the first formation. Minutes later, after communications checks are completed, AFATDS sustainment training can be in full swing, all during the average two-day guard drill.

Units in multiple states can participate in the training. Without leaving their home stations, Redlegs from the 45th Field Artillery Brigade can connect via RCAS for AFATDS training: the 2d Battalion, 222d Field Artillery (2-222 FA) from Cedar City, Utah; and units in Oklahoma, including 1-158 FA, Lawton; 1-171 FA, Altus; and Headquarters and Headquarters Battery (HHB), 45th Field Artillery Brigade, Enid.

Setting Up the Network. Network connectivity is the crucial piece of this program and can be a challenge to set up. See the steps in the figure.

First, we at headquarters connected inside our duty station facility using RCAS. We positioned two AFATDS workstations in separate parts of the facility and connected them without a problem.

Next, we reached out to one of our in-state battalions about 140 miles away; the connection immediately failed. As it turns out, Internet protocol addresses are specific to the domain. The tactical Internet protocols from our AFATDS standing operating procedures (SOP) were not compatible. The connection only can be achieved with the support of the domain system administrator.

We needed the administrator to issue some static Internet protocols for each AFATDS. Most domains use a protocol called DHCP. Simply put, the primary domain controller (PDC) server automatically establishes an Internet protocol address for network hardware. The problem was we asked the administrator to manually do what is normally automated.

We also had to find out from the AFATDS community what security accreditation the AFATDS operating system carries so our system administrator could ensure the security of his network while incorporating AFATDS.

Next we needed to communicate via the local area network (LAN) that has a router that serves as the gateway in and out of each facility. AFATDS uses a router; you get the router Internet protocol from your network administrator. With the help of the network administrator, we were up and running in Oklahoma.

But we still had one more battalion to connect with in Utah. We got the battalion's Internet protocols and began to try to transmit.

Firewalls are a critical piece of network security, and they worked so well that we couldn't connect with the Redlegs in Utah. More phone calls later, we convinced the firewall managers to open a doorway for our specific Internet protocols to pass through.

SISTM and DSTATS. Two invaluable devices are the SISTIM and DSTATS scenario drivers. These two systems complement each other—what one can't do, the other can.

Both systems have more options than I can discuss in this article, so I will limit my discussion to the most important.

DSTATS simulates Version 10 devices and PK11 FA tactical data systems (FATDS) devices, whereas SISTIM simulates only PK11. SISTIM communicates on a LAN or 188220A protocols, whereas DSTATS only accepts tactical fire direction two-wire or FM radio networks. (The Army is working on a DSTATS 188220A modem, but it hasn't been fielded yet.)

SISTIM can communicate across the WAN while DSTATS communicates with a local workstation. DSTATS can communicate on a two-wire net using a standard telephone line—that is if commercial long distance fees are not a problem. Your unit SISTIM or DSTATS operator should know the proper settings to operate them.

The scenario-building process requires a well-developed mission events list (MEL). For fire mission processing, SISTIM has a target generator that saves many hours of inputting fire missions and target intelligence messages to simulate radar acquisitions.

DSTATS offers the flexibility of running up to 20 scenarios simultaneously. This is critical when training events are triggered by an action rather than by time. An example would be when the scenario calls for enemy counterfire after a multiple-launch rocket system (MLRS) raid. The MLRS raid often has operational hurtles that can cause the timeline to be modified. If limited by a time-driven scenario, the enemy counterfire could be out of sync with the training. DSTATS scenarios can be suspended and then activated by the operator when the trigger event occurs.

DSTATS also allows the active scenario to pause, waiting for the appropriate response from the AFATDS operator.

SISTIM's target generator allows the operator to build a list of 100 targets in less than 30 seconds. However, it has some drawbacks. The targets will appear in equal times between each message unless the operator manually edits each line of the scenario.

DSTATS allows the operator to globally adjust scenario times, either shorter or longer, with only a few keystrokes. To be able to adjust the operational tempo (OPTEMPO), DSTATS is the preferred tool.

To get the best of both devices, AFATDS allows units to use the target list from SISTIM in DSTATS.

AFATDS has a function called intervention points (IP). By turning the AFATDS IPs off, you can receive a call-for-fire from SISTIM and automatically transmit it to DSTATS. DSTATS then allows the operator to save the message. With some simple edits, you can have a ready-made fire mission in DSTATS.

Both devices have an option to set up auto processing for fire missions. In other words, when subordinate fire direction centers (FDCs) or the weapon is being simulated, the simulator processes message-to-observer (MTOs) or mission fired reports (MFRs) and transmits them back to the device of the original message.

DSTATS will process fire missions from AFATDS A98 software but only from a simulated battery-sized element. SISTIM will process messages from the simulated weapon for AFATDS A99 software. Units with A99 will want to use SISTIM, and units still waiting for A99 will want to use DSTATS.

Training Versatility. We used DSTATS and SISTIM to drive training during a two-day drill in late 2001. The 45th Brigade tactical operating center (TOC) manned its AFATDS in the Enid Battle Lab. The 2-222 FA manned its AFATDS in Cedar City. The 2-222 FA used graphics for its local training area, and the 45th TOC used graphics for Fort Sill and the Utah training area.

The 2-222 FA used LAN communication to talk to the brigade TOC, wire networks to talk to subordinate FDCs and single-channel ground and airborne radio system (SINCGARS) FM digital networks to talk to their firing elements (Ml09A6 howitzers).

In addition, we used RCAS workstations with NetMetting to replicate our voice nets. At the same time, SISTIM simulated a Q-37 radar and DSTATS simulated the higher headquarters providing additional calls-for-fire and operational input.

In the future, RC units can use this process for larger home station training, such as participating in "ramp-up" training for Warfighter exercises at Fort Leavenworth, Kansas. In most cases, ARNG units aren't budgeted to attend both the ramp-up and actual Warfighter.

We are just beginning to explore using RCAS to provide AFATDS sustainment training. If units have questions about using RCAS for AFATDS training, they can call the 45th FA Brigade Headquarters, Enid, at (580) 213-3000.

1. The domain system administrator assigns the static Internet protocols. The Internet protocol addresses must be compatible with your domain.

2. The AFATDS communication set up uses a HOP count of "2" in the "Edit Routes" window for all operational facilities outside of the local domain. The HOP count affects the number of router/gateways the communications configuration will cross. All other network settings come from your AFATDS standing operating procedures (SOP), except for Internet protocol addresses.

3. Establish local router addresses.

a. The first method is go to the "Common Operating Environment" (COE) desktop in the external LAN and use the "2" button to select "Set Router Address." At the prompt, enter your local router address. You will need to repeat this step each time you boot AFATDS in your facility. After you enter the initial router Internet protocol, the LAN will prompt you to either enter a new Internet protocol or enter "P" for the previous Internet protocol.

b. The second method to establish a local router address is to select "Set Default' in the network window. You enter the router Internet protocol in the appropriate field and select "OK" in the window.

4. When communicating outside of state boundaries, you must coordinate with all firewall managers. A rule enabling the assigned Internet protocols to pass freely between states will be required for the firewall. Firewall managers need a list of Internet protocols and which port they will use. AFATDS uses a web page type of port. The firewall manager will understand the technical digits you tell him.

Steps in Connecting the Reserve Component Automated System (RCAS) with Multi-State Local Area Networks (LANs) for Advanced FA Tactical Data System (AFATDS) Sustainment Training. The steps assume network hardware is in place (i.e., the network drops are installed) and require a fundamental understanding of AFATDS. Coordination between agencies is the most crucial part of communicating successfully on RCAS.

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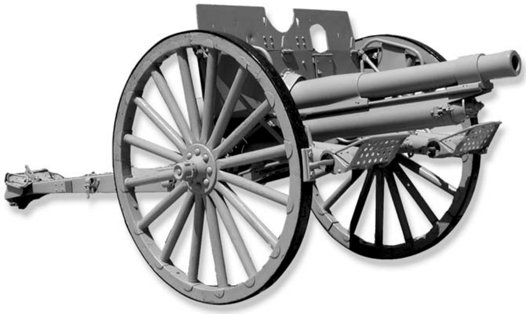

2002 Redleg Reference

The following is a list of articles, interviews, "The Update Point" (UP), "From the Gunline (FGL), "Incoming" (INC) and "Redleg Review" (RR) that appeared in *Field Artillery* during calendar year 2002. The entries are categorized by subject and listed chronologically by title and edition.

Unit Reports

"1-156 FA in World Trade Center Operations" (NYARNG), Jan-Feb

"82d Airborne Division Maneuver and Fires Integration Program," Jan-Feb

"FATC Unique Training for Next-Generation Artillerymen," Jan-Feb

"ARNG Battalion Annual Training Rotation at Fort Sill" (2-110 FA, 29th IN Div (Light), MDARNG), Jan-Feb

"4th ID DCX II: The Digitized Division Fights the COE OPFOR," Mar-Apr

"Silhouettes of Steel" (Reports by Total Army Corps and Division Artilleries and Marine Field Artillery Regiments), Nov-Dec

Doctrine and TTP

"Faster Fires: TTP for Sensor-to-Shooter and Clearance of Fires Operations," Jan-Feb

"The Role of the Reinforcing Battalion," Jan-Feb

"Triggers-A Lost Art," Jan-Feb

"The Company FSO/FSNCO-To Brief, But Not *Too* Brief," Jan-Feb

"Accurate Target Location and the Maneuver Shooter: Are We Ready to Shoot?" Jan-Feb

"Revised Staff Duty Log-Managing Info for Battle Tracking," Jan-Feb

"The Battalion Fire Control NCO," May-Aug

"So, FSO, Did We Integrate Our Mortars Effectively?" May-Aug

"Counterfire in Afghanistan," Sep-Oct

"How to Develop the Best-Ever Fire Support System," Sep-Oct

"Improving the Responsiveness and Lethality of Fires at the BCT Level," Sep-Oct

"The Close Support Battery in Task Force Operations on the 21st Century Battlefield," Sep-Oct

"Improving Close Contact Fires: Dedicated Batteries Linked to Parallel Clearance of Fires," Sep-Oct

"AVP: Increasing Laser Target Location Accuracy at Max Ranges," Sep-Oct

"Maneuver Commander's Guidance for Fire Support-What We Really Need," Sep-Oct

"2002 State of the Field Artillery," Nov-Dec

Personnel/Force Structure

"Davis Bay Named After MOH Recipient," Jan-Feb

"Fort Sill Now Has a National Cemetery," Jan-Feb

"Fort Sill Telephone Directory," Mar-Apr

"NCOs, Stay in Your Lane-the Army Needs You There," (Interview with SMA Jack L. Tilley), May-Aug

"So, You Want to be a Master Gunner?" May-Aug

"Enlisted Redlegs: Take Charge of Your Career," May-Aug

"Desert Fire: The Diary of a Gulf War Gunner" (RR), May-Aug

"The FA and the Objective Force-An Uncertain But Critical Future," Sep-Oct

"2002 State of the Field Artillery," Nov-Dec

"Best Battery Awards: Knox Award Reinstated and Hamilton Award Created in 2002," Nov-Dec

"B/1-319 AFAR Wins 2002 Knox Best AC Battery Award," Nov-Dec

"B/1-147 FA Wins 2002 Hamilton Best ARNG Battery Award," Nov-Dec

"The Knox Trophy and Medal, 1924-1940," Nov-Dec

"Alexander Hamilton-An American Statesman and Artilleryman," Nov-Dec

"US FA Units Worldwide" (Maps of Army and Marine Active and Reserve Component Units, Separate Battery and Above), Nov-Dec

"The First-Ever Gruber Award for the Outstanding FA Professional," Nov-Dec

Leadership

"The Platoon Sergeant and His Lieutenant-Who Does What?" May-Aug

"NCO Leadership Booklets Online," May-Aug

"The First Sergeant," May-Aug

"Welcome Aboard, Sergeant Major," May-Aug

"NCOs and Values-Based Decision Making," May-Aug

"CSIP: AC Battalion Command From an RC Perspective," Nov-Dec

History

"Looking Back 200 Years and Forward to Continue the Legacy" (UP), Mar-Apr

"FA School Library Named After Master Sergeant Morris Swett," May-Aug

"2003 History Writing Contest Rules," May-Aug

"Bombarding the Marianas: Joint Fires at the Strategic, Operational and Tactical Levels," May-Aug

"A Contest of Contrasts: The Principle of Dislocation and the Artillery Fight at the Battle of Chancellorsville," May-Aug

"How Artillery Beat Rommel After Kasserine," May-Aug

"Desert Fire: The Diary of a Gulf War Gunner" (RR), May-Aug

"The Knox Trophy and Medal, 1924-1940," Nov-Dec

"Alexander Hamilton-An American Statesman and Artilleryman," Nov-Dec

Equipment and Technology

"ARNG Fielding AFATDS," Jan-Feb

"Looking Back 200 Years and Forward to Continue the Legacy" (UP), Mar-Apr

"Digitizing the Army for the Objective Force" (Interview with LTG Benjamin S. Griffin, DCS, G8, Pentagon), Mar-Apr

"NetFires-Precision Effects for the Objective Force," Mar-Apr

"JWES: JMEM Weaponeering on CD," Mar-Apr

"The FCS-Based Force in Future Battle," Mar-Apr

"The Multi-Role Armament and Ammunition System (MRAAS) for the Multi-Mission FCS: Direct and Indirect Fire," Mar-Apr

"4th ID DCX II: The Digitized Division Fights the COE OPFOR," Mar-Apr

"HIMARS for Rapidly Deployable Rocket and Missile Fires," Mar-Apr

"What the Commander Needs to Know About Guidance in AFATDS," Mar-Apr

"AFATDS Gunnery: Technical Fire Direction," Mar-Apr

"M270A1: An MLRS Launcher with Leap-Ahead Lethality," Mar-Apr

"Crusader: Hammer for Today, Forge for the Future," Mar-Apr

"FA Essential to Current and Future Force Success" (UP), May-Aug

"Reversing a Negative Trend: The M981 FIST-V on Deadline," May-Aug

"Report Out: Senior Field Artillery Leaders Conference," May-Aug

"The FA and the Objective Force-An Uncertain But Critical Future," Sep-Oct

"Counterfire in Afghanistan," Sep-Oct

"Krasnopol: A Laser-Guided Projectile," Sep-Oct

"2002 State of the Field Artillery," Nov-Dec

"GELON: The Towed Howitzer Night-Sight Mount," Nov-Dec

"Who Says Dumb Artillery Rounds Can't Kill Armor?" Nov-Dec

Training

"Transforming the Field Artillery School" (UP), Jan-Feb

"Post-September 11th: New Emphasis on Transforming Training" (Interview with BG William G. Webster, Jr., Dir. of Training, Office of DCSOPS, Pentagon), Jan-Feb

"New Safety Course Mandatory for Commanders-Battery Through Brigade," Jan-Feb

"Fires Training XXI: A Training Strategy for the 21st Century," Jan-Feb

"Training to Reverse CTC Negative Trends-Getting Fires Back into the Close Fight," Jan-Feb

"82d Airborne Division Maneuver and Fires Integration Program," Jan-Feb

"FATC Unique Training for Next-Generation Artillerymen," Jan-Feb

"CMF 13 Field Artillery School Course Update," Jan-Feb

"Distance Learning-Keeping Soldiers in Units," Jan-Feb

"ARNG Battalion Annual Training Rotation at Fort Sill," Jan-Feb

"Field Artillery Institutional Transformation," Mar-Apr

"The Maneuver Shooter Program: Multiplying the Efficiency of Indirect Fires," May-Aug

"Report Out: Senior Field Artillery Leaders Conference," May-Aug

Joint/Combined Arms

"Afghanistan: Fire Support for Operation Anaconda" (Interview with MG Franklin L. Hagenbeck, Commanding General, 10th Mountain Division), Sep-Oct

"Afghanistan: Joint and Coalition Fire Support in Operation Anaconda," Sep-Oct

"Counterfire in Afghanistan," Sep-Oct

REDLEG REVIEW

BOOK REVIEW

On the German Art of War: Truppenführung

Editors Bruce Condell and David T. Zabecki, Foreword by James S. Corum, Boulder, Colorado: Lynne Rienner Publishers, 2001. 303 pages. ISBN 1-55587-996-9. $57.00

There are a handful of books every student of the military art should read. *On the German Art of War: Truppenführung* is one of them. Published in 1933-1934, *Heeresdienstvorschrift 300, Truppenführung* (unit command), as James Corum writes in his foreword to this English translation, is "one of the most important expressions of doctrine in military history." *Truppenführung* is perhaps the first and most influential coherent expression of modern combined arms warfare in much the same way as Carl von Clausewitz's *On War* is recognized as a founding document of contemporary strategic thought.

The origins of *Truppenführung* can be found in the waning days of World War I. Advances in indirect fire presented defenses with an unprecedented advantage. Attackers crossing no man's land had scant means to counter the withering rain of shell and shrapnel that saturated their path.

In contrast, artillery proved a clumsy instrument for the offense. Massing fires, coordinating infantry and artillery and conducting effective counterbattery fire were all in their infancy. Germany experimented with innovative tactical concepts to break the stalemate of trench warfare but collapsed from strategic exhaustion before it could employ its tactical initiatives with decisive effect.

During the interwar period, General Hans von Seeckt, the head of the *Reichswehr* (the German Army), undertook a comprehensive review of the war's lessons and initiated a series of exhaustive war games and exercises to develop new warfighting concepts. Seeckt codified the insights gained in a series of doctrinal manuals. *Truppenführung* was a revision of this work, updated to account for emerging developments in motorized warfare, aviation and electronic communications. The visionary expanse of the doctrine was reflected in the fact it was written before the Germans created their *Panzer* Divisions and officially established the *Luftwaffe*, yet the manual's prescriptions proved readily adaptable to large-scale armored warfare and air-ground operations.

Ironically, one area in which the doctrine proved less than insightful was its treatment of artillery. During World War II, it was the Americans with their flexible artillery organization, air observers and fire direction centers (FDCs) that pioneered the great artillery innovations of modern combined arms warfare.

While *Truppenführung* may have under-appreciated the future role of fire support, it deserves a close reading by today's artillerymen. First, it is a seminal document for understanding the origins and evolution of combined arms fighting. Combined arms warfare may well be an enduring feature of 21st century conflict as well. Information systems, advanced sensors and precision weaponry could make fusing different arms an even more powerful and decisive capability. Creative thinking about combined arms warfare could well be an important task for future artillerymen. *Truppenführung* is a good place to start such an intellectual odyssey.

Truppenführung also offers a valuable case study in the dynamics of "transformation," the effort to develop unprecedented new military capabilities. It is an outstanding example of the kind of mental engine that is needed to drive profound change and innovative thinking.

The editors have provided a valuable addition to the list of vital military readings. They also include a brief, useful selected bibliography as a guide for further study. Particularly recommended are the works of Shimon Nivah, Richard Simpkin, Williamson Murray and Zabecki.

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