horizontal technology integration (HTI), which draws upon the commonality of requirements and processes throughout the Army, thus rendering obsolete the costly and inefficient "stovepipe" development and procurement method of examining each weapon system singly. Applied to second-generation FLIR, the HTI initiative will dramatically improve combat power on the battlefield. Applied to the BFSV, it will double the combat identification range capability of the first-generation FLIR now in use; and it will reduce the likelihood of fratricide by improving our ability to distinguish friend from foe, even at extended ranges.

Extended combat identification range and reduced probability of fratricide are not the only advantages of the BFSV. Other advantages will permit commanders to detect, identify, and engage targets at greater ranges; they will therefore have more time to make decisions and better synchronize fire and maneuver. Phototelesis technology will provide the ability to transmit FLIR imagery, improving command and control, along with the commander's ability to accurately assess the situation to his front.

The FLIR package also includes other improvements such as a digital electronic input-output port for automatic target cueing, target tracking, target recognition, battlefield digitization, combat identification, and other built-in test functions. The BFSV gunner-operator will then be able to electronically zoom the target view to reduce the acquisition and engagement time, select white-hot or black-hot imagery—much as in the images now available in tank thermal sights—and insert annotations and reticles to facilitate target engagement.

The Bradley fire support vehicle's configuration as a Bradley will render it virtually indistinguishable from the Bradleys of the maneuver force it is supporting, will afford observers the mobility to keep pace with the Bradley-Abrams combined arms team, and will ensure that the combined arms team retains its ability to move fast, strike hard, and dominate the modern battlefield. *(This article was prepared by the staff of the Dismounted Battlespace Battle Lab at Fort Benning.)*

The Q-36 Weapons Locating Radar

A Primer for Brigade Commanders and Staffs

LIEUTENANT COLONEL WILLIAM A. SWEET

During the early phases of contingency operations, units can expect to live off the tailgates of C-130 aircraft operating on a forward landing strip. Knowing the effect the enemy's indirect fire can have on this lifeline, these units need a system that will prevent enemy mortars and artillery from interdicting their lines of communication.

Imagine a system that could acquire enemy mortars and artillery firing to an accuracy of 100 meters. This system would report this information to the brigade tactical operations center (TOC) before those rounds hit. If the commander desired, it could transmit fire commands to the brigade's direct support howitzers before the rounds hit. It would shut down the enemy's indirect fires, allowing safer conditions in which to conduct logistical and tactical operations.

Fortunately, this system is already in infantry brigades, and the opposing force (OPFOR) at the Joint Readiness Training Center (JRTC) has already determined it to be a high payoff target.

The AN/TPQ-36 weapons locating radar—fielded during the early 1980s—is organic to the direct support artillery battalions of the Army's light, air assault, and airborne divisions. During early JRTC rotations, however, some combined arms commanders left this radar system at their home stations. As they became more aware of its capabilities, most of them began deploying it into the landing strip within the first ten chalks. To make the most of the Q-36 weapons locating radar, brigade commanders and staff officers need to understand its capabilities and limitations.

Q-36 Radar Capabilities

The Q-36 can acquire mortar, artillery, and rocket fires out to a range of 24 kilometers. The core of the system consists of three components—an antenna, an operations control group (in a common shelter), and a generator.

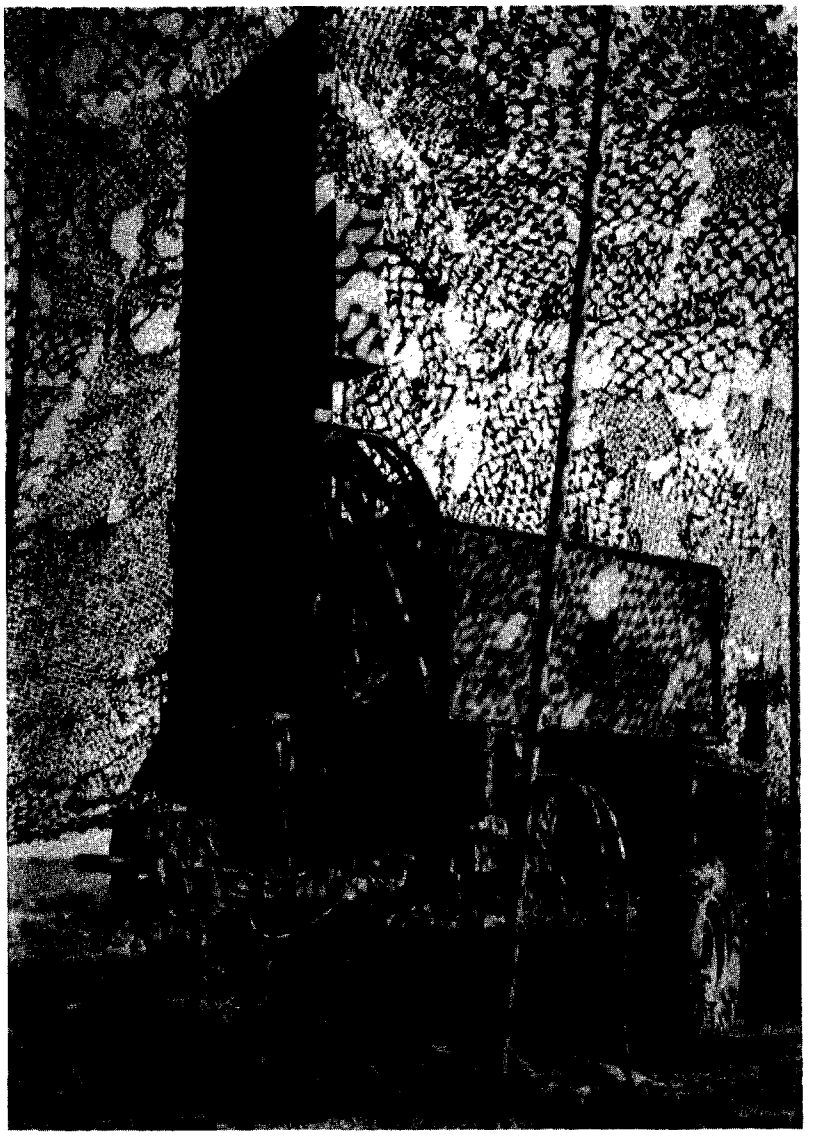
In the original configuration, the Q-36 is mounted on two five-ton trucks with trailers. The radar section also has

a reconnaissance vehicle. The Block II system now being fielded mounts the entire system on high-mobility multipurpose wheeled vehicles (HMMWVs); a working radar section can now be deployed with two HMMWVs and two trailers.

Although the Q-36 is capable of locating indirect fire systems out to a range of 24 kilometers, the probability of acquiring these targets decreases beyond 12 kilometers. Also a function of the range is the accuracy of acquisition. The error is one percent of the range to the target for low-angle (artillery) fires and less for high-angle (mortar) fires. Therefore, the circular error probable, or CEP, at 10 kilometers is 100 meters—accurate enough for a fire-for-effect mission and certainly close enough for establishing enemy dispersion patterns.

The system communicates digitally with the artillery battalion TOC through the LTACFIRE/TACFIRE systems. The radar is capable of tracking nine rounds in the air at the same time. Although this can be a limitation in combat situations, it is probably not a factor in military operations other than war.

A significant idiosyncrasy of the Q-36 software is its inability to acquire hostile fire when the projectile is travelling away from the antenna (Figure 1). This may not be a limitation on the linear battlefield, but it can be important in military operations other than war and warrants serious consideration when positioning the radar.



The AN/TPQ-36 weapons locating radar is organic to the direct support artillery battalions of light, air assault, and airborne division.

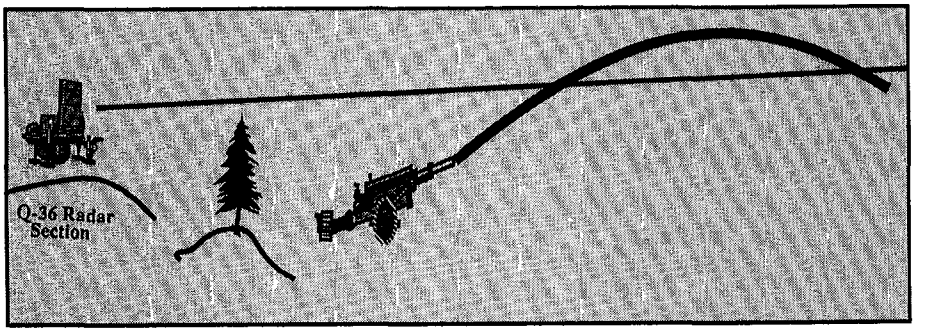


Figure 1. Trajectory of round is away from the radar, and acquisition is not reported.

Staff Considerations

For those of you who are brigade commanders and staff officers, I offer the following as a primer on the factors you should carefully consider in each staff area when employing the Q-36.

Operations Officer: Obviously, the decision on where to place the radar in the airflow must be based on an analysis of METT-T (mission, enemy, terrain, troops, and time). Assuming the enemy has mortars or other indirect fire systems, you might ask where on the brigade high payoff target (HPT) list the combined arms commander has placed indirect fire systems. The answer may determine where the radar is placed in the airflow.

Knowing that a few well-placed enemy mortar rounds on the landing strip could halt the airflow usually makes this decision obvious, but deploying the radar is not cheap. Most divisions in which the Block II program has not yet been fielded have transferred their radars to HMMWVs. In these cases, a working radar section can be deployed in one C-130 aircraft, or the

entire section in two C-130s. But in the divisions that have not converted to HMMWVs, the radar shelter is still on a five-ton truck, and a working system will not fit on a single C-141. The system with the shelter on the back of a truck is not deployable by C-141, so you have to plan for a 463L pallet and tie-down equipment, and be able to load the shelter back on the truck once the plane lands.

It is also advisable to include an artillery survey vehicle in the early airflow. An orientation error of one degree will result in an error of 178 meters when reporting acquisitions at 10 kilometers. Satellite-based survey methods, such as the global positioning system (GPS), simply do not provide data that has the precision or accuracy that artillery acquisition and firing elements require. If you have a Block II system, it may include a self-locating survey device such as the modular azimuth positioning system (MAPS). If you have the older system, you will also need to deploy a survey vehicle with a position and azimuth determining system (PADS) from the artillery battalion.

When planning the initial position for the radar, consider its technical limitations and security. This usually leaves you with four possible positions—in the brigade support area (BSA); with a firing battery; with the artillery battalion TOC; or alone. Because of the risk of losing the radar, most units at the JRTC choose one of the first three options. But the technical requirements of the system (range, communications, screening crest) can drive you to position it outside the perimeters of these other units, thereby aggravating the security problem.

If the commander has determined that the Q-36 radar is essential to his mission, you need to consider security for it. The entire radar section consists of eight soldiers (six in the Block II configuration), led by a warrant officer. The section does not have the resources to conduct its mission and also its own 24-hour security. If the radar is already high on the enemy's HPT list, the eight-man section cannot hope to repel a determined attack.

A principal positioning consideration is the screening crest, or mask angle, from the radar position (the angle from the horizontal to the highest point on the horizon). The radar operator programs the Q-36 to look over the horizon, whether that is a hill or trees to his front. If the screening crest is too high, the entire trajectory of the rounds fired from a weapon will be below the radar's beam and remain undetected (Figure 2). Even if a round is detected, the radar will track it for a shorter portion of its trajectory, which will result in a larger error in locating the origin of the fires. Valleys and heavily forested areas are not suitable for the Q-36. If you force the section into an unsuitable area, your intelligence collection plan will suffer.

Force protection and fratricide are other key planning considerations. If the commander has decided to engage the enemy's indirect fire systems with artillery, you can literally have firing data on the howitzers before the impact of the enemy rounds. But the radar can't distinguish an 82mm round from an 81mm round from a 152mm round. They all look the same. The radar can establish an area (called a censor zone) around a known mortar location and then ignore rounds fired from that location, but it must be given the proper information. It is therefore critical that the battalions track and report the positions of their 60mm mortars. You need to work through the FSO to ensure that friendly mortars are protected from radar acquisition.

Engaging enemy mortars with artillery may not be the best solution. Can you clear the targets for engagement with indirect fires faster than the enemy can displace his mortars? How well is the brigade staff trained in its clearance-of-fire battle drill? If you engage enemy mortars with artillery, is there a possibility of collateral damage and civilian casualties? These are issues you need to discuss during the decision phase of daily targeting meetings. With a few acquisitions, the S-2 can probably give you a templated position for the enemy's mortar cache. If you can capture or destroy his ammunition, you will have shut him down as surely as if you had engaged him with indirect fires.

The radar must be properly oriented to support the main effort. This is both a range and an orientation issue. The radar's ability to acquire targets decreases beyond 12 kilometers. A commander

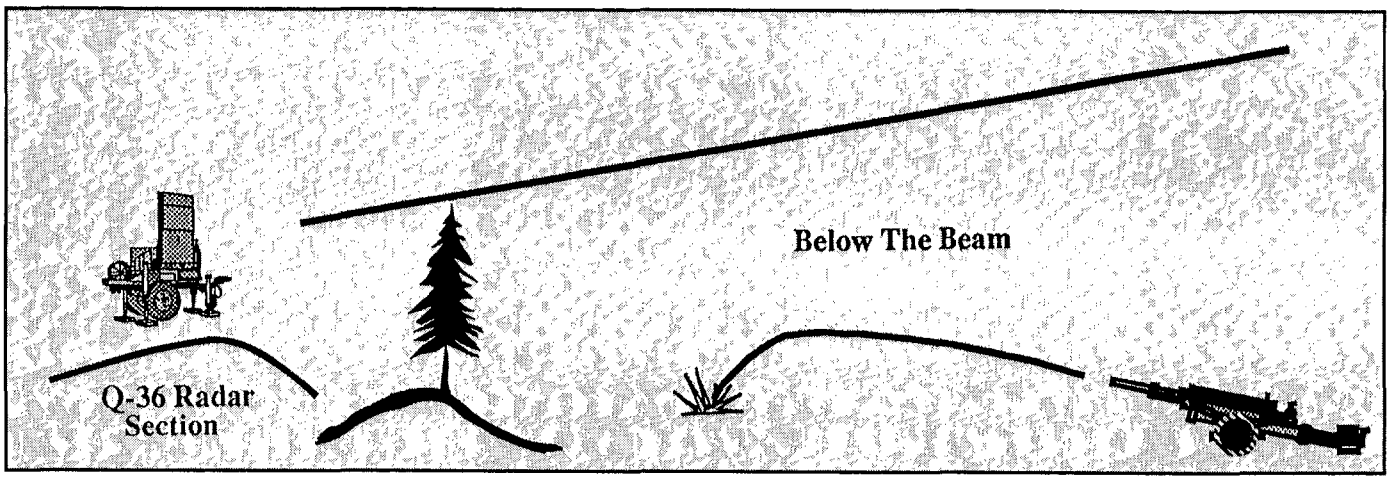


Figure 2. Screening crest is too high, and trajectory is below the radar beam.

may also need to accurately acquire targets that friendly weapons cannot engage. At any one time, the radar can scan only in a 90-degree arc. At the JRTC, we have seen radars oriented on the rear battle during a deliberate attack because planners failed to prioritize all their acquisition assets during a critical battle.

Recognizing that the Q-36 radar is on the top of the OPFOR commander's HPT list, many units try a deception with a wooden replica of the radar. Such deception plans can work, but they're not without cost. Building a replica and planting it somewhere in the brigade sector does not make a deception plan. If you want to play a shell game with the replica and the actual radar, make it a believable deception. Consider all the resources you'll need to replicate the signature of an operational radar—trucks, camouflage nets, soldiers, generators. For example, what are you doing with your loudspeaker teams? Where will the OPFOR expect to find the radar? Wherever you choose to place the replica, remember that it will draw the attention of the OPFOR. If you believe the payoff is worth the resources invested, try it. But the OPFOR soldiers are not easily fooled; they know all the component parts that make up a radar.

Intelligence Officer: Although the Q-36 radar can look at a 360-degree arc, it takes time to rotate the antenna through the four 90-degree sectors, so you need to focus its sector of scan as part of the collection plan. Where does the radar need to look? Is it within range of the area you want it to search? Or do you need to move it? Talk to the FSO and the artillery battalion S-3. If there is more than one area, and the radar cannot cover them all with a 90-degree sector from its position, the commander must specify how long he wants it to look in each area. Address these issues during the detect phase of your daily targeting meetings.

The field artillery battalion S-2 controls the radar cueing, so he must know where the enemy mortars have been templated. Is he using the radar to confirm or deny your templates? Has he received an update since the initial situational template was published? You need to talk to him daily.

When properly programmed, the LTACFIRE will report all acquisitions to the brigade FSO through a TACFIRE format. This format will give you the origin of the fires and the predicted impact point. Have you received and plotted all the radar acquisitions on your map, and what does this data tell you? This is information that the commander needs in developing his vision of his battle space.

Logistics Officers: Because the Q-36 radar is unique in the brigade, returning it to operational status when it breaks is all the more difficult. Of the 300 lines of prescribed load listing (PLL) items the artillery battalion carries, some 93 of them are the essential repair parts supply list (ERPSL) for the radar. Most of these are circuit cards that cost thousands of dollars each. Did the artillery battalion bring the ERPSL as part of its PLL? How many of these lines are at zero balance? Does the forward support battalion (FSB) have any lines on its authorized stockage list (ASL) to support the radar? If not, does the main support battalion (MSB) have them, and did the brigade deploy with them?

Is there a radar repairman (MOS 39CX5) in the FSB? If he is found only in the MSB, did your brigade deploy with him? If the brigade commander is interested in keeping the Q-36 radar operational, these are questions you should be prepared to answer before the radar goes down.

The commander should be briefed twice a day concerning the operational status of crew-served weapons and other key weapon systems in the brigade; the operational status of the radar should be part of this briefing. If the radar is key to his plan, the commander needs to know its status.

Personnel Officer: Only seven radar operators (MOS 13R) are authorized in the brigade, and one of them is a warrant officer (MOS 131A). The section also contains a generator repairman (MOS 52D). Does your brigade have the authorized number of soldiers? Does one of the radar operators have the X5 additional skill identifier that allows him to perform maintenance on the radar? When you have a low-density MOS for such a critical system, you need to know the status of each of these soldiers.

Although the Q-36 is organic to the direct support artillery battalion, it is a brigade asset. Employing it requires staff coordination at brigade level. With the Q-36, the brigade can shut down the enemy's indirect fires. Brigade commanders have discovered the importance of the Q-36 radar to their brigades. Brigade staff officers also need to know the characteristics of the Q-36 radar so they can ensure that it is available when and where the commander needs it.

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