



sitions to just record and watch and which to pursue.

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

Target Processing Battle Drill

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

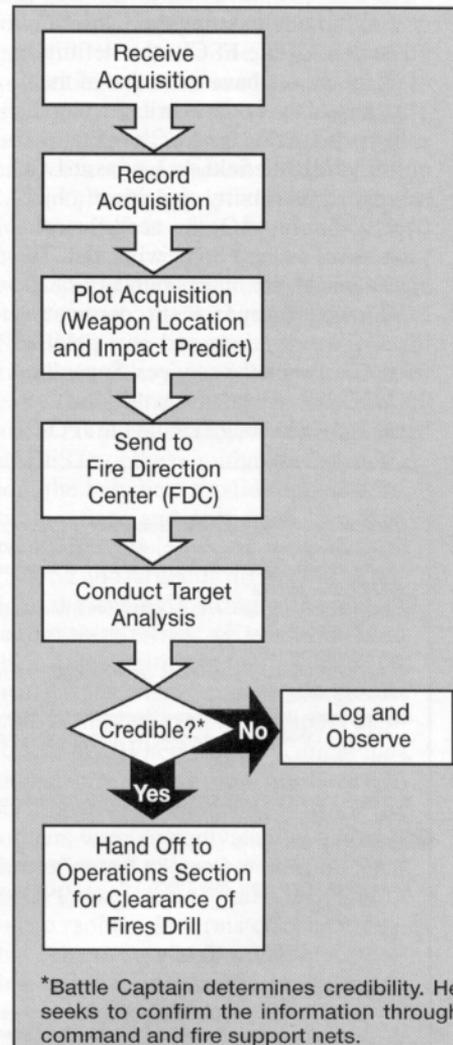


Figure 1: Target Processing Battle Drill (Low Intensity)

Firefinder Radars: Eliminating Unwanted Targets in Low-Intensity Conflict

by Sergeant First Class Scott E. Rogers

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

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

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

The fact is that the Firefinder radar has a propensity to track "unwanted" tar-

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

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

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

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

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

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

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

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

The first thing to look at in analyzing the target is whether or not the acquisition makes sense in terms of the current military and political situation in the AO. Have there been reports of riots, demonstrations, snipers or other tensions in the area from which the acquisition

originated or where the round impacted? Is a US facility or troops in the vicinity of the impact or a disaffected faction in the vicinity of the weapons location? If an acquisition plots as going from a sparsely occupied area to another sparsely or unoccupied area, the credibility is lowered. If, on the other hand, it goes from an area with a disaffected group to an area of high tensions, then credibility is enhanced. The battle captain immediately seeks confirmation over the various radio nets.

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

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

Aircraft Acquisitions. In determining whether an acquisition is an aircraft, the target analyst must know flight operations in the area. During the initial stages of Operation Joint Endeavor in January 1996, the battery tracked a lot of acquisitions over high power lines. We quickly learned that due to the low cloud deck, aircraft were following the

power lines and using them as navigational aids. As the weather improved, these type of acquisitions declined. We also picked up our own jet aircraft as they circled Joint Military Commission meetings as a "show of force."

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

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

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

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

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

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

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

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

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

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

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

Midnight on New Year's Eve of December 1995 in Croatia prompted a huge roar of celebratory gun fire, and

thousands of tracers crossed the sky. Another example was in Brcko along the Sava River where a wedding occurs almost every Saturday night, prompting celebratory small arms fire.

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

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

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

The area from which the acquisition was tracked then remains under observation for confirming data.

Conclusion

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

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



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Notes:

1. For an excellent method of clearing targets in low-intensity conflict, see the article "Put Out the Fire: Countering Mortars in Operations Other than War," by Captain Keith R. Yoder and Chief Warrant Officer Four Luke M. Thompson, *Field Artillery*, February 1995.

2. For a description of this problem, see the articles "False Targets: Mirages in the Desert," by Captain Michael D. Farris and First Lieutenant Peter A. Catanese; "Mirages in the Desert: Opportunity Knocking," by Major John Dornstader, Captain Maurice E. Posmanick and Major David M. Patterson, both in the February 1992 *Field Artillery*; and the letter-to-the-

editor "TA Successes and Challenges in Bosnia," by Second Lieutenant Richard Brunner and Sergeant First Class Scott E. Rogers in the May-June 1996 *Field Artillery*.

3. The article "Red Rain—Counterfire Operations in Bosnia-Herzegovina" by Captains Brian T. Hodges and Jay W. Hallam and Major Brian T. Camperson in the September-October 1996 *Field Artillery* also explains a target processing battle drill and procedures for determining if a Firefinder radar acquisition is valid.