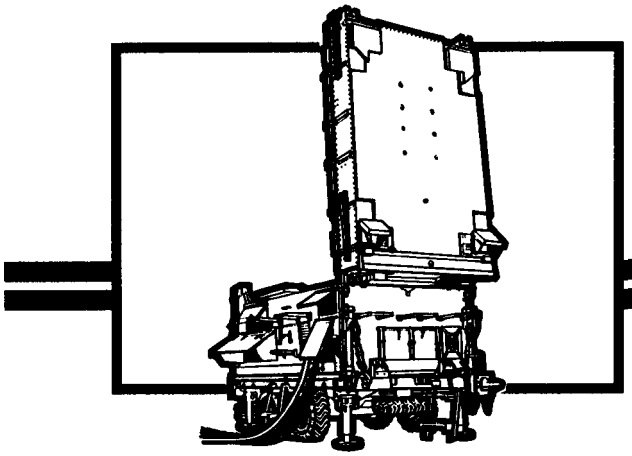


CHAPTER 4

TACTICAL EMPLOYMENT OF FIELD ARTILLERY TARGET ACQUISITION ASSETS

Sound tactical planning is a must to effectively cover the division zone of responsibility with TA assets. Planning must be done at the division and brigade FSEs to use TA assets to best support the maneuver commander's mission and priorities. The FA headquarters that controls the TA assets is responsible for employing them as *planned.*

RADAR EMPLOYMENT

Missions

The primary mission of Q-36 and Q-37 weapons-locating radars is to detect and locate enemy mortars, artillery, and rockets quickly and accurately enough to permit immediate engagement. Their secondary mission is to observe registrations and help the FDC adjust fire for friendly artillery units. The secondary mission should be performed only when absolutely necessary. Radiation should be reserved for the primary mission.

The mission of the AN/TPS-25A and AN/TPS-58B radars is to detect, identify, locate, and track moving ground targets. Through proper positioning and use, the MTLRs give the field artillery the ability to acquire moving targets in enemy territory. MTLRs can also enhance the counterreconnaissance mission by identifying enemy reconnaissance elements.

Operation

The Firefinder radars use a combination of radar technique and computer-controlled signal processing to detect, verify, and track projectiles in flight. They use phased-array antennas and automated signal processing to detect and track multiple projectiles in flight. The computer uses the tracking data to determine the trajectory of each projectile. In the hostile fire mode, the computer extrapolates the trajectory to calculate the firing weapon location and the projected point of impact. The operator then digitally transmits the firing weapon location to the controlling TOC or supported artillery unit. In the friendly fire mode, the radar can be used to observe registrations and area adjust-fire missions. See TC 6-40 for detailed procedures.

Both the AN/TPS-25A and AN/TPS-58B MTLRs are Doppler systems. They locate and track targets by changes in the frequency of the return signal produced by movement of the targets. The specific audio return of a target enables the radar operator to identify it as personnel, a light or heavy wheeled vehicle, or a tracked vehicle. Both MTLRs can be used to vector friendly forces.

Firefinder Detection Probability

The Firefinder radars will support the operational concept and commander's intent

if radar capabilities and limitations are considered in employing the radars. Radar range capabilities must be maximized. Generally, weapons-locating radars find the enemy weapon better if the projectile is large, near, and fired at a high angle. However, accurate detection and location of enemy weapons depend on several factors as described below.

Existing EW Threat. The controlling headquarters, S2, and radar personnel must know the appropriate radar survivability measures. (See the survivability matrix on page 4-17 or the survivability flowchart in Chapter 3.) These measures must be weighed against the maximum detection probability of the radar based on its positioning, radiation time, mask angle, and so forth. The EW threat will dictate how long the radar can remain in position and will therefore affect cueing time. In a low-intensity conflict, there may be no EW threat. If there is no EW threat, the radar could conceivably radiate continuously and detect the maximum targets possible. In low-, high-, or mid-intensity conflict where an EW threat exists, commanders may have to consider the trade-off between survivability and mission. For example, if the threat weapons are defeating our forces and our counterfire is not effective, the commander may decide to extend cueing time to more effectively attack counterfire

Number of Threat Weapons. The number of threat weapons firing will influence radar performance. This is because a number of guns rapidly firing many rounds can quickly fill the radar temporary display queue. Guns firing from new locations will then not be detected unless the operator quickly reduces the backlog in the temporary display queue. Location averaging and automatic censoring can be used to prevent this overloading. With location averaging, each newly detected location is immediately checked for correlation with the average location in permanent storage. If the new location correlates with an earlier detected location in permanent storage, the new location is averaged with the previous location. The averaged location is then put back in permanent storage with the same identification number, and the new location is dropped from the temporary queue. (See TM 11-5840-354-10-1 for detailed discussion.) The automatic censoring mode causes an examination of each round for proximity to previous weapon locations impermanent storage. If a round appears to originate from a previous weapon location and a preselected threshold count of rounds (2-16) from one location is reached, the track is dropped. Automatic censoring and location averaging should be used together for optimum effectiveness. (See TM 11-5840-354-10-1.)

Enemy Weapon Types and Projectile Sizes. High-angle trajectories enhance the probabilities of detection; therefore, high-angle mortars are easier to acquire than low-angle artillery. Also the larger the projectile, the more probable it is to be detected. Rockets are larger than mortars and artillery and therefore are more likely to be detected.

Range to the Enemy Weapon. The closer the radar is to the target, the higher the probability of its detecting and locating the target.

Mask in Front of the Radar. The lower the mask, the higher the probability of detection. (The sooner the radar can detect the projectile coming out of the tube, the more accurate the location will be.)

Positioning. Radars must be positioned to support the commander's intent and to facilitate radar moves that maximize radar operations for the next phase of the battle. Radar must be on time and within range. Questions that should be answered are as follows:

- Can the positioning of the radar be optimized to make maximum use of the radar range capabilities?

- Does the radar position provide for future movement?
- When all radars are in position, do the AN/TPQ-36 and AN/TPQ-37 radars complement each other and are they positioned to cover the maximum effective ranges to detect most of the enemy weapons?

Effective Range Capabilities.

An understanding of the effective range capabilities of the weapons-locating radars is essential to plan for the effective employment of the radars.

AN/TPQ-37 Radar. Actual capabilities of this radar are classified. They are shown in the radar classified technical manual ([C] TM 11-5840-355-10-2). However, the planning ranges used as a baseline to position the AN/TPQ-37 are 30 kilometers for mortars and artillery and 50 kilometers for rockets.

AN/TPQ-36 Radar. The effective range capabilities of the AN/TPQ-36 are based on the accuracy standard of 1 percent of range or 100 meters circular error probable (CEP) (with a 90 percent probability), whichever is larger, The probability of detecting and locating mortars is excellent out to 12 kilometers. The probability of detecting and locating artillery out to 12 kilometers is also excellent. However, at ranges past 12 kilometers, there is a higher probability of detecting mortars than low-angle artillery. Detection of rockets is good out to 24 kilometers because of the large size of the rocket. Generally, increased artillery ranges make the destruction of targets acquired beyond planning ranges a lower probability. For example, the probability of the AN/TPQ-36 acquiring mortar or artillery to the accuracy standard is greatest for distances between 5 and 12 kilometers. Although the AN/TPQ-36 will locate artillery and mortar targets out to 24 kilometers, probabilities of actually detecting those targets to the specified accuracy are lower. The AN/TPQ-36 will locate rockets out to 24 kilometers with a greater probability of detection and accurate location than artillery and mortars because of the size of the projectile.

RESPONSIBILITIES

Fire Support Coordinator

The FSCOORD, along with the division G2 (or brigade S2) and G3 (or S3), develops and recommends–

- High-payoff targets and priorities.
- Target selection standards.
- Target priorities for acquisition.
- Target attack guidance and attack guidance matrix.
- Decision points and time lines for execution.
- FSCOORD measures to expedite attack of targets.
- TDA requirements.

Using input from the div arty S2 and S3, the FSCOORD –

- Recommends radar sectors of search.
- Coordinates positioning for field artillery TA assets.
- Approves the FA support plan, to include the TA tab and radar deployment orders (RDOs). (See Appendix G.)

> **NOTE:** A reproducible copy of DA Form 5957-R (Radar Deployment Order) is at the back of this book. Its use is explained in Appendix G.

The FSCOORD, along with the G2(S2) and G3(S3), monitors execution of the plan through the–

- Div arty S3 for all cannon and rocket systems available to the division.

- Air liaison officer (ALO) for allocated tactical air support.
- Division aviation officer for employment of attack helicopter battalions.
- Division electronic warfare officer (EWO) for EW support.

Division Artillery S3

The div arty S3 has staff responsibility for the control and operation of the div arty CP. He has overall supervisory responsibility for the three main elements of the div arty TOC-operations, fire control, and targeting. Specific duties of the S3 relating to FA target acquisition are as follows:

- Maintain the current status and capabilities of div arty TA assets.
- Prepare the FA support plan to include the TA tab and RDOs provided by the S2.
- Coordinate the implementation of the TA tab.
- Schedule the fires of the firing units.
- Ensure targets are attacked in accordance with the commander's attack guidance.

Division Artillery S2

The div arty S2 has primary staff responsibility for the division FA targeting assets. Aided by the counterfire officer, the div arty S2 develops, maintains, and coordinates plans for employment of these assets. This employment is based on a thorough IPB and evaluation of the factors of METT-T. Employment of the TA assets is coordinated with the G2 and FSE to ensure that it supports the division commander's intent and the corps effort. Factors the S2 must consider include –

- Command and control relationships.
- Sectors of search.
- Zone management.
- Cueing.
- Communications.
- Positioning.
- Survivability.
- Specific offensive and defensive considerations.

Counterfire Officer

The counterfire officer–

- Acts as principal advisor to the S2 for planning, directing, coordinating, and controlling div arty TA assets.
- Recommends coverage and changes in coverage of field artillery TA assets within the division area.
- Monitors the operations of those TA assets.
- Monitors and operates the div arty TA/intel net (frequency-modulated [FM]) (digital); that is, he acts as net control station (NCS).
- Prepares the RDOs for radars controlled by div arty or FA brigade.

Fire Support Officer

The FSO has two critical functions to ensure effective employment of the radars. First, he must coordinate the positioning of the TA assets with the G3 or S3. To do so, the FSO must understand the capabilities and limitations of those assets and the importance of an optimum radar site in terms of accomplishing the mission and enhancing the radar survivability. Second, the FSO must recommend Firefinder zones to the commander during the planning process. These zones focus the radar and supporting artillery on the maneuver commander's TA priorities.

COMMAND AND CONTROL RELATIONSHIPS

The div arty S2 recommends an organization for combat of TA assets to best meet the intent of the division and corps commanders. Command and control of radars can be –

- Centralized at div arty or FA brigade.
- Decentralized by attaching radar sections to a subordinate FA unit.
- A combination of centralized and decentralized control.

Centralized Control

All TA assets may be held under the centralized control of the div arty or its reinforcing FA brigade. Centralized control of assets optimizes coverage to support the division commander's intent. The S2, in concert with the counterfire officer and the FSE, will –

- Designate for each radar a general position area, a sector of search, and Firefinder zones.
- Establish cueing guidance.
- Designate cueing agents.
- Control movement of the radars.
- Designate to whom the radar passes targets.

When the FA brigade has control of TA assets, the div arty should provide its target production section with its associated equipment to the FA brigade. Like the div arty, the FA brigade headquarters does not have an organic target production section and thus does not have target processing capability without augmentation. Regardless of which headquarters exercises control, subordinate battalions may be tasked to provide logistical, survey, and security support because of the dispersal of radars across the division.

Decentralized Control

Radar sections may be attached to DS battalions or reinforcing (R) FA battalions, when available. When the radar sections are attached, the FA battalion S2 controls them executing the same responsibilities as the div arty S2 and counterfire officer. When attached, AN/TPQ-36 sections usually are responsible for covering the supported maneuver brigade zone of responsibility. The brigade FSO coordinates with the S2 mission requirements and priorities based on the maneuver commander's guidance and intent. Normally, control of the AN/TPQ-37 radars and the moving-target-locating radar is retained centrally by div arty. However, these radars also can be attached. Another option is to place a Q-37 radar under the operational control of a multiple launch rocket system (MLRS) unit.

Combination Control

Any combination of centralized and decentralized operational control of radars may be used according to the situation. For example, two Q-36 radars may be attached to the DS battalions supporting the two committed maneuver brigades while the remaining Q-36, two Q-37s, and the MTLR are kept under div arty control.

Regardless of the control options used to employ the radar, logistical support for the radar section is a key factor in its tactical employment. Normally, field artillery TA radar sections are attached to another FA unit for administrative and logistical support. For a discussion of the logistical support entailed by such attachment, see Appendix H.

SECTORS OF SEARCH

Sectors of search are the areas on the battlefield where the WLRs and MTLRs focus their TA capabilities. The sectors of search are determined during the *decide* function of the targeting process, on the basis of a thorough IPB. During the *decide* function, decisions are made concerning what targets should be acquired and attacked, where and when targets are likely to be found, and who can locate

them. Doctrinal employment considerations, in conjunction with templates and intelligence produced in the IPB process, dictate the areas in which the radar searches should be focused.

The location of friendly boundaries and fire support coordinating measures may also affect the assignment of sectors of search. The area given to a specific radar as a sector of search may be affected by the positioning of a common sensor boundary (CSB) as described on page 4-8.

ZONES

Zones are a means of prioritizing radar sectors of search into areas of greater and lesser importance. Zones allow us to orient on the maneuver commander's battlefield priorities. A zone is a geometric figure placed around an area that designates the area as more, or less, important than other areas. Four types of zones can be entered into a Firefinder radar computer. These are critical friendly zones (CFZs), call-for-fire zones (CFFZs), artillery target intelligence zones (ATIZs), and censor zones (CZs). Certain rules must be observed to properly input zones into the Firefinder computer. These rules are outlined in Appendix G. The firing unit locations the radar has developed as targets are displayed for transmission in the order of the priority of the zones in which targets are located. The zone priorities for location identification, from highest to lowest, are:

- Locations of weapons firing into a CFZ.
- Weapons firing from a CFFZ.
- Weapons firing from an ATIZ.

All other weapon firing locations are displayed after locations associated with these zones. All locations other than those associated with a CFZ or CFFZ are formatted by the radar computer as TACFIRE target reports in ATI;CDR format. If the radar has no zones loaded, then all locations are transmitted in the ATI;CDR format. The radar computer will not develop weapon locations that are within a censor zone.

Critical Friendly Zones

A CFZ is an area, usually a friendly unit or location, that the maneuver commander designates as critical. It is used to protect an asset whose loss would seriously jeopardize the mission. When the computer predicts that an enemy round will impact in a CFZ, the location of the weapon that fired the round will be reported by the computer in precedence ahead of all other detections. Any location of a weapon firing into a CFZ will result in an immediate call for fire (FM;RFAF message), unless it is manually overridden by the radar operator. The FM;RFAF message is received by TACFIRE as a Priority 1 message. Thus, a CFZ provides for the most responsive submission of targets to the fire support system.

Call-For-Fire Zones

A CFFZ designates a search area forward of the FLOT that the maneuver commander wants suppressed, neutralized, or destroyed. An area designated as a CFFZ would likely be on a suspected regimental artillery group (RAG) or division artillery group (DAG) position and is closely tied to information developed during the IPB process. A CFFZ provides the second most responsive priority of requests for fire generated by the radar. A target identified in a CFFZ will generate an FM;RFAF Priority 2 message. However, the commander may upgrade this to a Priority 1 message for certain CFFZs. (See Appendix G.)

Artillery Target Intelligence Zones

An ATIZ is an area in enemy territory that the maneuver commander wishes to monitor closely. Any weapons acquired in this zone will be reported to the TACFIRE computer ahead of all target detections except CFZ and CFFZ, but the detections will only result in a target report (ATI;CDR).

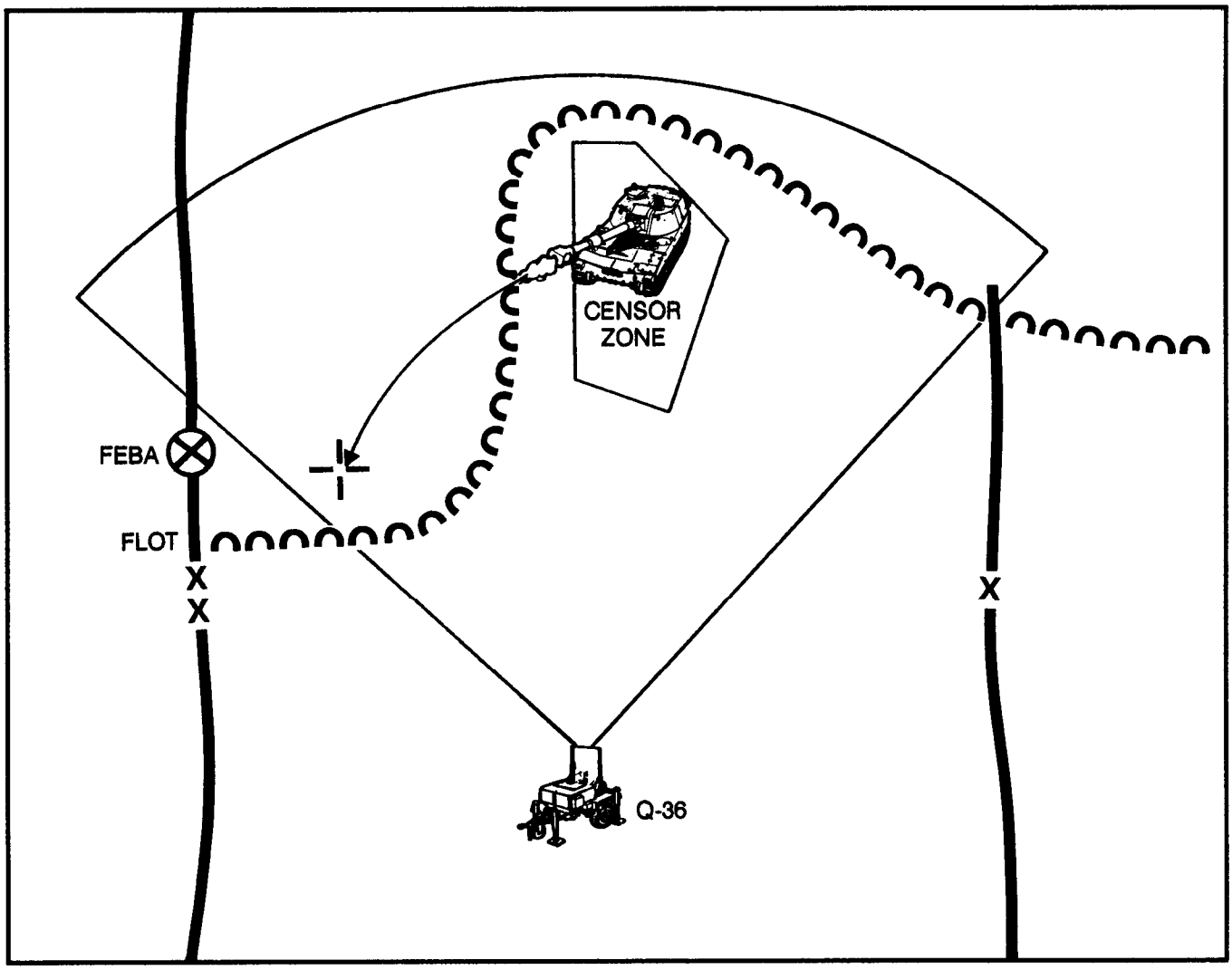
Censor Zones

A CZ is an area from which the commander wishes to ignore all target detections. CZs must be used very judiciously, since the computer does not report to the operator a round originating from a CZ. A CZ may be used to ignore a friendly artillery position that, because of its aspect angle to the radar, could be detected as enemy artillery. This situation could occur when an uneven FLOT exists or when friendly units are in enemy territory. The figure below is a graphic example of the use of a censor zone to ignore an artillery unit providing fires when the FLOT is uneven. A CZ may also be used when artillery fires in support of rear operations.

CAUTION

The use of CZs and CFZs at the same time can cause rounds originating from a CZ and firing Into a CFZ not to be detected. It is essential that the radar technician and S2 monitor the combined use of CZs and CFZs closely to ensure that the radar capability of providing target data to protect critical friendly zones is not inhibited.

USE OF A CENSOR ZONE



COMMON SENSOR BOUNDARY

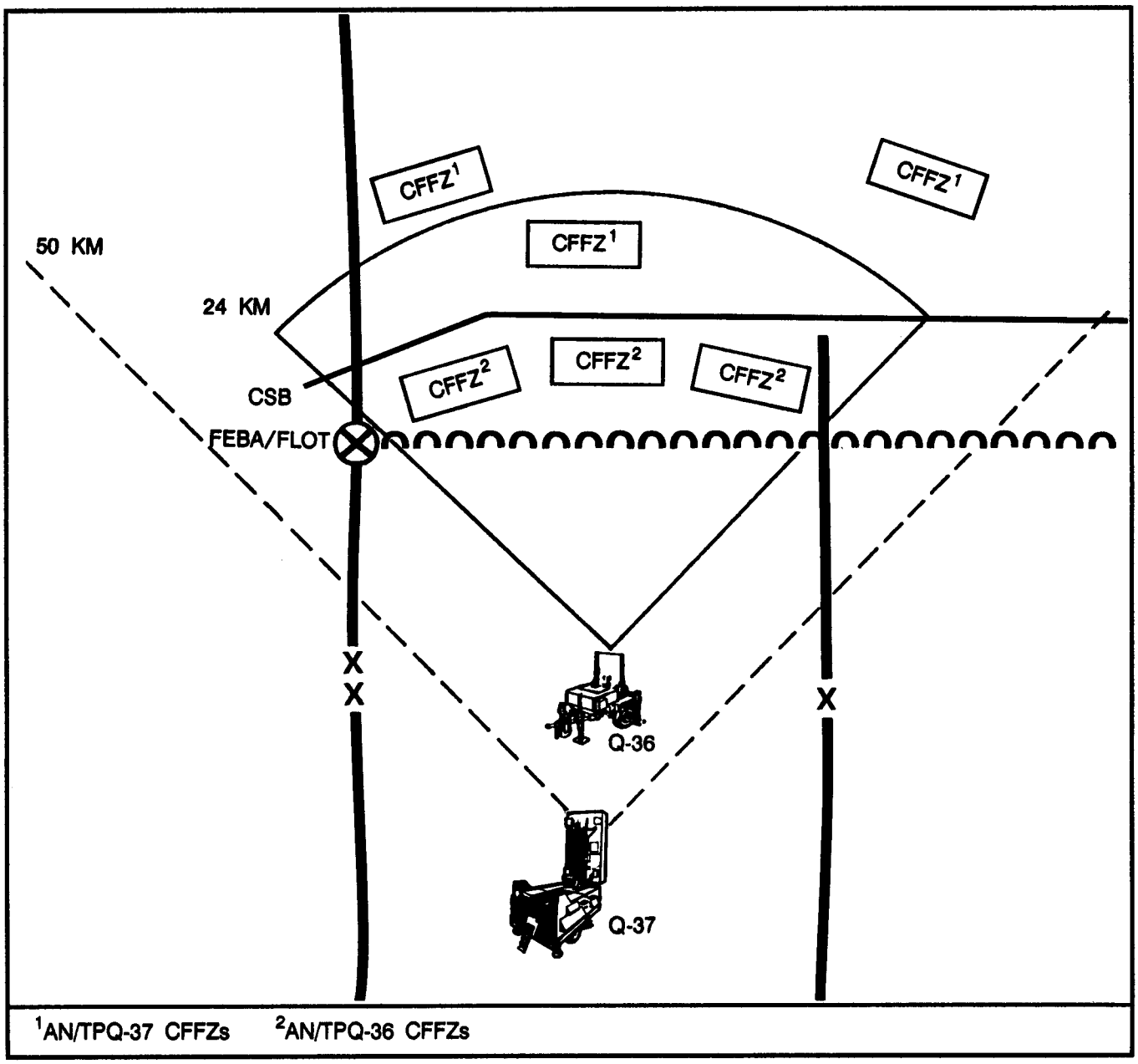
Target duplication between Firefinder radars is likely during combat operations. In addition, the sheer volume of targets being passed from the radars will overwhelm the targeting element, especially if the radars are under centralized control. An effective method of reducing the duplication of these targets for attack is to establish a common sensor boundary for call-for-fire zones. The CSB is a line established by the div arty or FA brigade that divides TA areas of search into close and deep areas for the An/TPQ-36 and AN/TPQ-37, respectively. The CSB is established by designating a line beyond which no CFFZs for the AN/TPQ-36 would be established. The AN/TPQ-37 would not establish any CFFZs short of this line. All radars could process targets generated for attack from their CFFZs through the same or different headquarters, and none would be duplicated. When the radars are used in this way, the maximum range capabilities of the radars are not restricted. The CSB is not a fire support coordinating measure, although the CSB may coincide with a coordinated fire line (CFL). The CSB is only a tool used by FA TA controlling headquarters to maximize effectiveness of radars.

In determining the placement of the CSB, factors considered are:

- Range of the FA attack systems.
- Available attack assets.
- Effective ranges of TA assets.
- Likely enemy indirect fire weapon deployment areas, such as RAG and DAG positions, developed through a thorough IPB.
- Availability of ammunition.

When a radar is required to move for survivability, the CSB may have to be adjusted to ensure optimum radar coverage. For example, if the Q-36 moves, the Q-37 will have to cover the Q-36 area of responsibility until the Q-36 is in position. The figure below shows a typical CSB.

COMMON SENSOR BOUNDARY



CUEING

Cueing is the process designed to prompt or notify, the radar to begin radiating to acquire hostile fire. Determining when and how to best cue the radar is one of the most difficult planning decisions. Although individually scheduled cueings may be random preplanned cueing "schedules" are often ineffective and unnecessarily subject the radars to enemy direction-finding and analysis. Radars can be cued more effectively by designated cueing agents who operate under specific cueing guidance. The cueing guidance is designed to fully exploit the radar potential and still minimize or eliminate unnecessary radiation. The situation will dictate who best can cue the radar and the specific conditions under which it should be cued.

Possible cueing agents may include:

- Combat observation/lasing teams (COLTs).
- Forward observers (FOS).
- Aerial fire support observers (AFSOs).
- Rear area CPs (such as those in brigade or division support areas).
- Brigade- or division-level IEW systems.

Cueing of radars may be centralized, with all requests going through the radar controlling headquarters, or it may be decentralized. For decentralized cueing, the controlling FA headquarters will establish cueing guidance, to include authorized cueing agents, communications links, and conditions under which the radar may be cued. At maneuver brigade and above, where a written operation plan (OPLAN) or OPORD is used, the cueing guidance should be in the TA tab to the FA support plan. At maneuver battalion or task force (TF) level, the radar cueing instructions are given in the radar deployment order. (See Appendix G.)When cueing agents other than FA assets are designated cueing guidance for them should be given in the basic order as coordinating instructions or under specific tasks to subordinates.

Authorized cueing agents should be restricted to those units or installations the commander deems most critical to his operations. The responsiveness of the radar in detecting incoming fires will be further improved by tying the authorization to cue a radar with the establishment of a CFZ, instead of either establishing a CFZ or designating a cueing agent alone.

Communications links used to cue radars should be defined in the cueing guidance. Voice radio nets that are normally monitored by the radar are the most responsive means. Because this link is usually an FA unit command net cueing agents should restrict the time they use the net. Agents should use the net only the time required to initially establish communications and then to cue the radar as necessary.

Special conditions under which the radar should be cued must be passed to the cueing agents. A hostile artillery or mortar attack of very short duration that is observed by the cueing agent but does no serious damage should not constitute cause for cueing the radar. The criterion for cueing a radar should be damaging fires received during critical operations.

Fire support and/or maneuver rehearsals should include practicing the activation of cueing agents by use of appropriate cueing guidance. Clarification of cueing guidance or designation of other cueing agents, if required, should be issued at that time.

Cueing must be based on real-time information so that the radar has a high probability of tracking projectiles when it is turned on. An example for real-time cueing is shown on the following page.

EXAMPLE

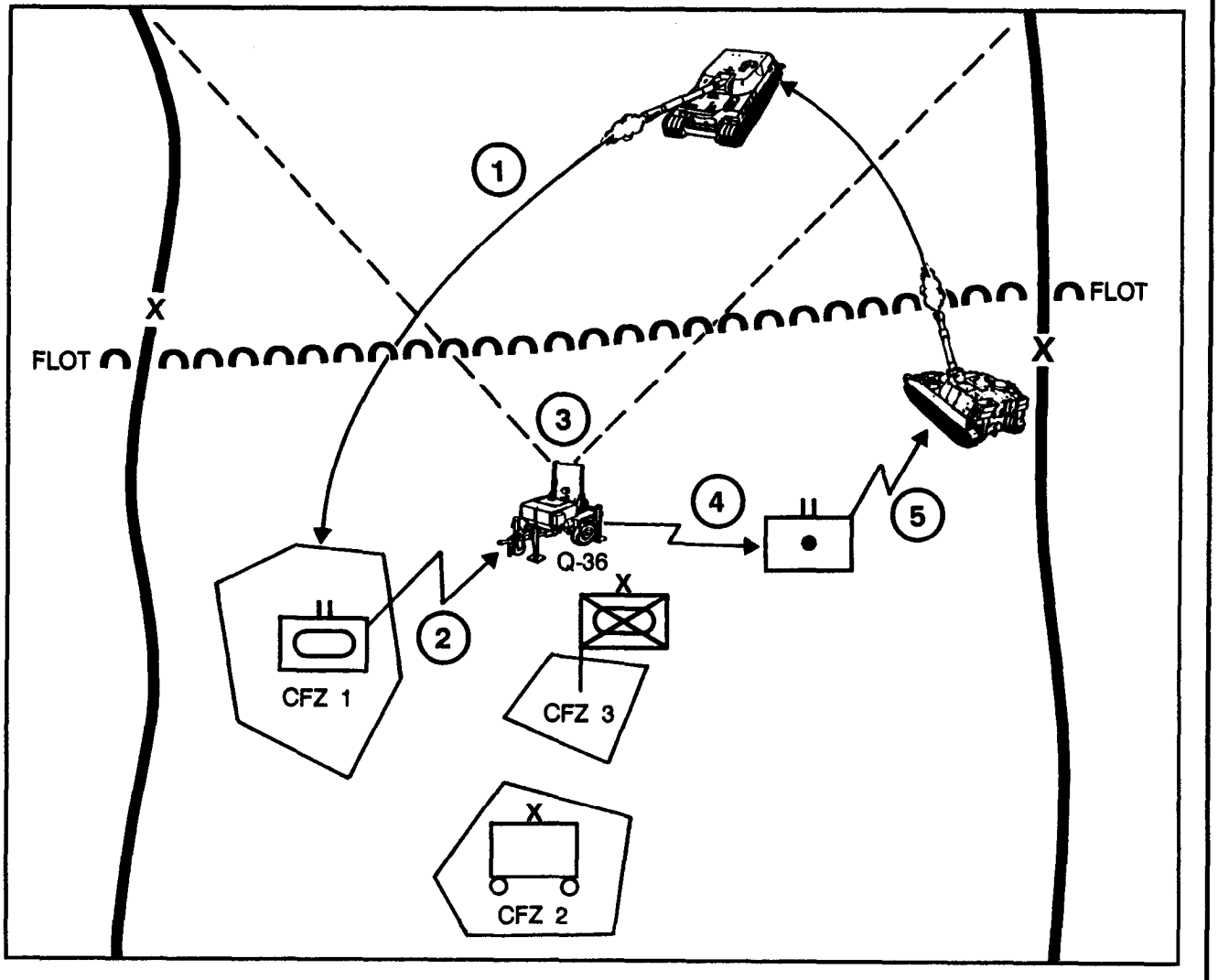
On the basis of the brigade mission and the commander's intent, the brigade FSCOORD recommends to the brigade commander the designation of the brigade TOC, the armored TF assembly area, and the brigade support area as CFZs. The armored task force FSO, the brigade FSO, and the forward support battalion S3 are designated as cueing agents and given specific cueing guidance. Each cueing agent establishes communication with the designated radar section. He also establishes internal alert procedures within his CFZ with the appropriate commanders.

The armored TF assembly area receives hostile artillery fire (1). The task force FSO immediately cues the radar (2).

The radar responds to the cue, locates the position of the hostile artillery firing on the task force (3), and generates a request for fire (4).

The FA battalion FDC executes the attack in accordance with the commander's attack guidance (5).

REAL-TIME CUEING



COMMUNICATIONS

The preferred means of communication between a radar and the supported unit is wire. FM radios require electronic line of sight. Messages from Firefinder can be sent to any unit equipped with TACFIRE, a battery computer system (BCS), a fire direction system (FDS), or a digital message device (DMD). However, messages from an MTLR are normally sent by voice unless the radar is provided with a digital communications capability.

A Firefinder radar in general support should operate in two radio nets. The div arty TA/intel net is the digital radio net for Firefinder. The second Firefinder radio will operate in the div arty command net for voice traffic. A Firefinder that is attached to a battalion should operate digitally in one of the fire direction nets as directed by the S3 and in the battalion command FM voice net. Firefinder radars controlled by the FA brigade will use the TA/intel net to pass targets digitally and the command net for voice transmissions.

An MTLR in general support and within radio range of div arty should operate in and pass targets on the div arty TA/intel net. If the MTLR is attached or is out of radio range with the div arty TOC, it should pass targets as directed. Normally, this is done through the nearest FA unit.

POSITIONING

A thorough analysis of the factors of METT-T will influence the selection of a general position area and the radar sector of search. The FSE and the controlling FA headquarters must both make this analysis. Both must also consider the technical and tactical considerations and the survivability factors involved in employing TA assets.

METT-T Considerations

A thorough analysis of the factors of METT-T will dictate which of these factors are most and least important. Information derived from this analysis is recorded on the RDO and sent to the radar section. (See Appendix G.) The radar technician reconnoiters the general position area and makes the actual site selection.

Mission. TA assets must be emplaced where they can accomplish their mission.

Enemy. The enemy situation and capabilities greatly influence the employment process. A thorough intelligence preparation of the battlefield will help TA planners in orienting TA assets. The IPB process should indicate to the TA assets where to look and what to look for. If the enemy is on the offensive, the radars should be emplaced farther from the FLOT than might be necessary if the enemy is on the defense. If the enemy is using electronic warfare, the radar will need numerous alternate positions to prevent location. The radar section will make its moves on the basis of the Firefinder survivability flowchart shown in Chapter 3.

Terrain (and Weather). Terrain can affect movement, concealment, communications, and positioning. In mountainous terrain, selecting general position areas to take full advantage of the Firefinder radar range and capabilities is difficult. It will also be difficult to find a position with an optimum screening crest. On the other hand, flat open terrain could make concealment difficult. Heavy rains, heavy snows, sandstorms, and dust storms degrade the capabilities of Firefinder by decreasing the probability of location. Such severe weather conditions have less effect on the AN/TPQ-37. Heavy rains or melting snow may make some terrain impassable for Firefinder radars, particularly the heavier AN/TPQ-37.

Troops. The size of the area to be covered and the number of radars available for search affect employment. A DS battalion could have

two radars attached to it rather than one. This would allow more flexibility in selecting position areas. Firefinder radars should be emplaced within effective and practical communications range of the unit they support. Whenever possible, wire communications should be established.

Time Available. Planners must consider how much time is required for reconnaissance, liaison, movement, occupation, and establishment of survey points needed in the position area.

Technical and Tactical Considerations

As the target acquisition planner selects a general position area for a radar, he must be aware of the technical and tactical considerations that influence his selection. Some of these considerations cannot be fully determined by the planner and can be applied only by the radar technician as he makes the actual site selection.

System Capabilities and Limitatlons. The capabilities and limitations of the radars are very important in selecting positions to employ them. The most technically perfect site is worthless if the radar cannot perform its mission. Some of the capabilities that should be considered in the employment of radars are listed in the radar planning table in Chapter 3. Some of the system limitations that should be considered are as follows:

- Radars are active emitters. The Firefinder radars have several electronic counter-countermeasures (ECCMs) designed into the equipment. However, the enemy may still detect, jam, or seek to destroy the radar. Because of its capabilities, the radar could well be a high-priority target for enemy EW operations.
- The radar mobility depends on the serviceability of the prime mover and the terrain it must traverse.
- The radar must be carefully positioned to avoid visual or infrared detection. The sheer size of the radar makes it difficult to camouflage and conceal. The noise of the generator must also be considered in employing the radars.
- Because of the lengths of the radar cables, the control shelter, generator, and radar cannot be dispersed enough to reduce their vulnerability to enemy indirect fire.
- A Firefinder radar cannot indicate to the operator the type of weapon that has been detected. Also, the radar cannot indicate the weapon trajectory, that is, low angle or high angle. The AN/TPQ-36 reports all targets as mortars, regardless of actual weapon type. The AN/TPQ-37 reports all targets as artillery, regardless of actual weapon type.
- An MTLR cannot distinguish between friendly and enemy personnel or equipment.

Electronic Line of Sight. For the MTLRs, electronic line of sight to the target is necessary to detect and locate the target. The primary way of achieving ELOS is by placing the radar on prominent terrain. The AN/TPS-25A can be installed on one, two, or three mast sections. The antenna is 7.6 meters above the ground when the radar is installed on three mast sections. The Firefinder radars do not require electronic line of sight to the weapon. However, ELOS to the projectile in the ascending leg of its trajectory is essential for target location.

Aspect Angle. When Firefinder radars conduct friendly fire missions, the aspect angle (angle T) between the radar and the firing unit should be less than 1,200 mils. The MTLRs can detect and locate moving targets only when a change in the target range is apparent.

Other Radar Sets Operating in the Area. If other radars are operating in the same area, care must be taken to ensure that the antennas do not face each other. This is especially true of radars of the same type that operate on the same frequency.

Cover. Radars are "soft" targets and offer only limited protection for either the personnel or the equipment of the section. Therefore, the radar section should make maximum use of all natural cover available. Firefinder radars should always be placed in defilade to protect the section from enemy direct fire and observation. MTLRs should be used mainly during periods of limited visibility.

Concealment. Because of the size and quantity of the equipment and vehicles organic to the radar section, it is very important to select general position areas so that natural concealment can be used. This is especially true for the AN/TPQ-37 section, because the antenna is more than 22 feet high when fully erected and is very hard to camouflage. The edge of a tree line is the most desirable location for a radar site. Here, the radar antenna trailer with antenna-transceiver group can be placed on the outer edge of the tree line and camouflaged to blend into the background of trees. All other equipment and vehicles can be placed in the woods and hidden from enemy view by camouflage nets, trees, and other types of camouflage. Camouflage should be a continuous and automatic function of the radar section. It should begin as soon as the reconnaissance party first checks the site; it should end when the radar section finally departs the site. The radar technician should choose the exact radar site to make concealment of the radar section easy.

Routes of Approach. The radar site should have more than one route of approach. These routes of approach should be accessible by vehicle, free from enemy observation, and capable of being guarded by a minimum number of personnel. In selecting a radar site, the radar technician must consider road construction, overhead clearances, bridges, fords, tunnels, and obstacles.

Security. Because a radar section is so small, it is almost impossible for the section to provide effective local security for itself in a tactical situation. For this reason, the radar site should be located near the defensive perimeter of another unit, if feasible, or the radar section could be augmented with personnel from the supported unit. Either option eases the local security requirements for the radar section.

Survey. It is critical that TA assets are on common control with delivery assets. The S3, the div arty survey officer, and the FA battalion or TAB reconnaissance and survey officer (RSO) must include TA assets in the overall survey plan.

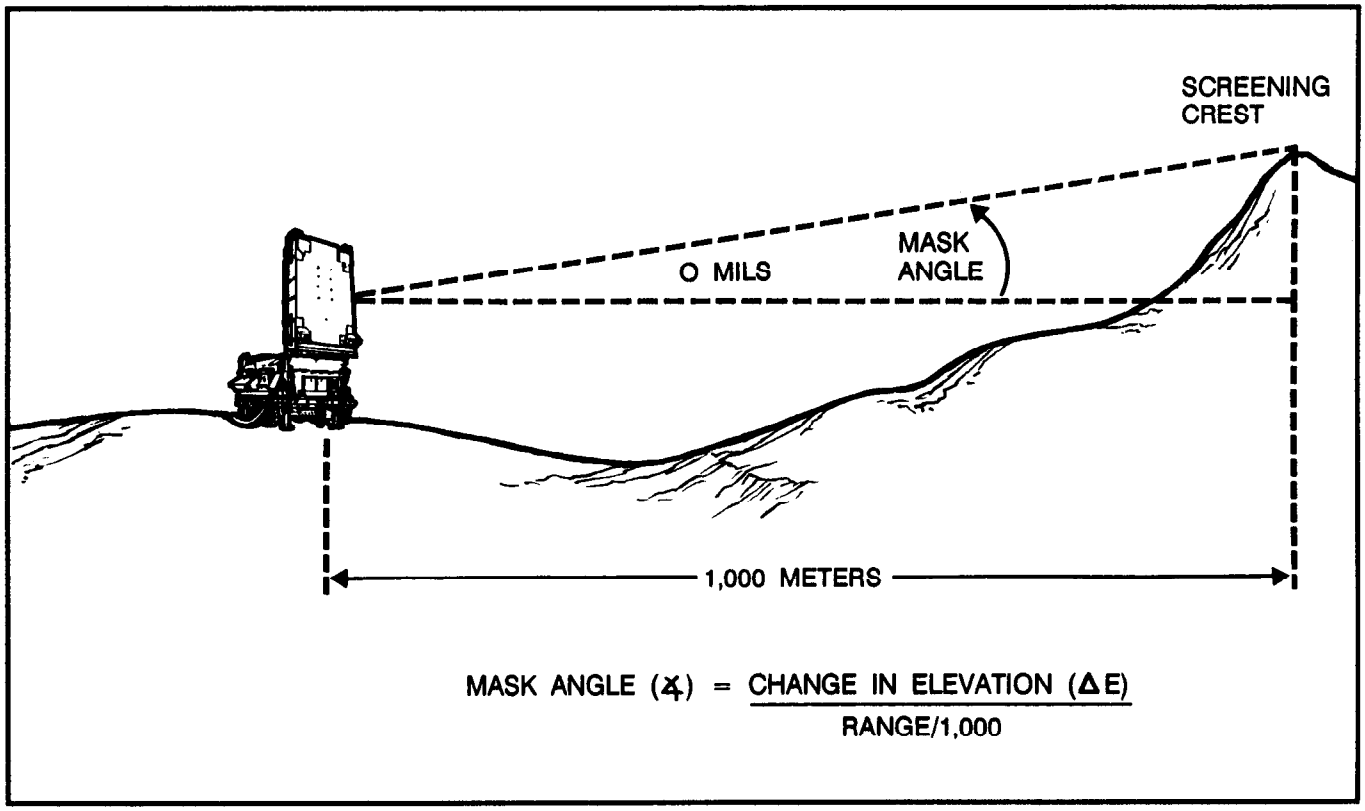
Screening Crest. A screening crest is not essential for locating hostile weapons with Firefinder radars. However, it does increase survivability of the system by serving as a defense against enemy observation, direct fire, and electronic countermeasures (ECM). A radar site must be selected with care to ensure that the screening crest is high enough to protect the radar section from the enemy yet low enough to allow the radar to track an enemy projectile on its ascending trajectory. The maximum recommended vertical angle (mask angle) is shown in the table and figure on page 4-15. The TA technician should try to select his radar site so that the screening crest is within 1,000 meters of the site. He should also ensure that the screening crest is always in friendly territory. By using the formula shown in the figure on the following page, the TA technician can perform a map reconnaissance and estimate his mask angle for the future position.

Slope of the Ground. The slope of the ground is important for two reasons — for drainage and for leveling the trailer and antenna-transceiver group. The slope of the ground must be less than 120 mils (7°) to permit leveling the trailer and antenna-transceiver group, which will not function properly without leveling. Drainage also must be checked to ensure that radar equipment will not become stuck during heavy rain.

SCREENING CREST MASK ANGLES

RADAR	MINIMUM	MAXIMUM	OPTIMUM
AN/TPQ-36	15 mils	30 mils	22 mils
AN/TPQ-37	5 mils	15 mils	10 mils

ILLUSTRATION OF MASK ANGLE



Firefinder Survivability Considerations

The electromagnetic signature of a radar is its greatest vulnerability. The enemy, through signal analysis, can use radio direction-finding (RDF) equipment to identify the radar employed. Knowledge of US doctrine would give the enemy an indication of the artillery organization to which the radar reports. Ground-based direction-finding (DF) of the radar signal can accurately locate the radar if three or more RDF receivers in a base detect the signal. When the enemy combines his radar ECM capabilities, radars become a lucrative source of information for friendly forces order of battle. The electromagnetic signature associated with Firefinder radars is primarily directed energy along the beam. Additionally, side-lobe radiation creates an electromagnetic signature. The unique imagery signature associated with Firefinder and MTLR antennas makes them particularly vulnerable to being acquired visually. Every effort must be made to reduce the vulnerability of FA radars to direction-finding and analysis. The following countermeasures should be considered when Firefinder radars are employed.

Occupy Optimum Sites. The best countermeasure to enemy EW is to occupy optimum sites. An optimum Firefinder site is one in which the radar is emplaced on level terrain having a gentle downward slope for the first 200 meters in front of the radar and then a sharp rise to a screening crest. In an optimum site, tunneling is effective in reducing side-lobe radiation. However, the number of optimum sites for positioning may be limited.

Screening crest. Use of a screening crest is absolutely critical to radar survivability in an environment where the enemy has ECM capability. It should be of primary concern in selecting positions to occupy.

Double screening crests. The use of two screening crests makes the radar more difficult for the enemy to locate. Radiation that is diffracted by the first crest and diffracted again by the second crest cannot be accurately located by direction-finding.

Tunneling. Tunnelings the technique of reducing the side, top, and back lobes of radiation by careful site selection. Positioning the radar so that vegetation is to the sides and the rear is an example of tunneling. Tunneling also may be accomplished by the use of digging-in or by sandbagging the position. Use of tunneling will reduce radar vulnerability to direction-finding of side-lobe radiation.

Background. Background is the area against which a target is detected. Normally, background considerations are associated with moving-target-locating radars. Backgrounds can be open, hard, or soft. An open background just above a screening crest is optimum for a weapons-locating radar.

Reduce Radiating Time. The shorter time the radar transmits, the less apt it is to be acquired. The maximum continuous transmission time for Firefinder radars should never exceed 2 minutes in an EW threat environment. Transmission time should be kept to the absolute minimum when feasible. The Firefinder survivability flowchart (in Chapter 3) should be used in conjunction with the EW threat associated with the IPB as determined at the S2 or G2 level. The flowchart can help to determine a practical way of employing Firefinder on the basis of the tactical situation. The chart allows flexibility in determining how long to radiate (cumulatively) from any position. It can also be used to determine how long a particular position can be occupied on the basis of the tactical situation and mission.

Narrow the Sector of Search. Another countermeasure to reduce Firefinder vulnerability is to narrow the radar sector of search. Although the radar can search a sector

1,600 mils wide, in an EW threat environment the beam should be narrowed to the minimum needed to accomplish the mission.

NOTE: The Firefinder survivability matrix shown below is based on the survivability flowchart in Chapter 3. The matrix is designed as a quick reference for the controlling headquarters and can be used in conjunction with the flowchart.

FIREFINDER SURVIVABILITY MATRIX

RADAR	SCREENING CREST	TUNNELING	EW THREAT (AIRBORNE THREAT NOT COVERED)	RADAR POSITION HAS SCREENING CREST AND TUNNELING	RADAR POSITION HAS SCREENING CREST ONLY	RADAR POSITION HAS NEITHER SCREENING CREST NOR TUNNELING
WEAPONS-LOCATING RADAR AN/TPQ-36	• WITHIN 1,000 METERS OF RADAR POSITION • IN FRIENDLY TERRITORY • FROM 15 TO 30 MILS ENEMY CANNOT ACHIEVE ELECTRONIC LINE OF SIGHT WITH HIS DIRECTION-FINDING SYSTEMS	USE OF FOLIAGE, BERM, OR BUILDINGS TO REDUCE SIDE-LOBE RADIATION	GROUND EW THREAT REVIEW WITH S2 CURRENT EW THREAT TO FIREFINDER	ACCUMULATE 15 OR MORE MINUTES OF RADIATION —but—	ACCUMULATE 8 OR MORE MINUTES OF RADIATION —but—	RADIATE 8 MINUTES MINUS MARCH-ORDER TIME OR 2 MINUTES, WHICHEVER IS GREATER; MAKE SURVIVABILITY MOVE —but—
				DO NOT EXCEED 2 MINUTES OF CONTINUOUS RADIATION		
			NONE	• NO EW TIME LIMIT • RADIATE AS MISSION REQUIRES • MONITOR EW SITUATION		
WEAPONS-LOCATING RADAR AN/TPQ-37	• WITHIN 1,000 METERS OF RADAR POSITION • IN FRIENDLY TERRITORY • FROM 5 TO 15 MILS ENEMY CANNOT ACHIEVE ELECTRONIC LINE OF SIGHT WITH HIS DIRECTION-FINDING SYSTEMS		GROUND EW THREAT REVIEW WITH S2 CURRENT EW THREAT TO FIREFINDER	ACCUMULATE 15 OR MORE MINUTES OF RADIATION —but—	ACCUMULATE 8 OR MORE MINUTES OF RADIATION —but—	RADIATE 8 MINUTES MINUS MARCH-ORDER TIME OR 2 MINUTES, WHICHEVER IS GREATER; MAKE SURVIVABILITY MOVE —but—
				DO NOT EXCEED 2 MINUTES OF CONTINUOUS RADIATION		

MTLR Survivability Considerations

Like the Firefinder radars, MTLRs produce a distinctive electromagnetic signature that makes them particularly vulnerable to enemy ECM. Additionally, the fact that MTLRs require electronic line of sight to the target and are emplaced from 1 to 2 kilometers from the FLOT makes them extremely vulnerable to visual detection. The following countermeasures should be considered in MTLR employment.

Occupy Optimum Sites. A site that facilitates good cover and concealment is critical for an MTLR to survive. Normally, the system should be elevated and employed during periods of reduced visibility. Tunneling and narrowing sector of search, as discussed for the Firefinder radars, also apply to MTLRs.

Reduce Radiating Time. In an ECM threat environment the MTLR should not exceed 2 minutes of continuous operation.

Narrow the Sector of Search. The MTLR should search an area no larger than the mission demands. If the AN/TPS-25A can do the same mission with a 360-mil sector as it can with a 540-mil sector, use the lesser sector.

Orient on Soft Background. If there are no terrain features or vegetation to reflect or absorb the radar beam beyond the target area, the background is open. Unrestricted access to unreflected radar beams is an ideal situation for enemy DF operators. Hard backgrounds such as rock, buildings, bunkers, or structures reflect radar beams. During reflection, the beam is bent and some phase-shifting occurs. A phenomenon known as multipath effect (the receiving of the same signal from different directions and out of phase with each other) makes it difficult to obtain good direction-finding bearings to the radar. However, this does not keep the intercept operator from performing signal analysis. Hard backgrounds are better than open backgrounds but are not as good as soft backgrounds such as foliage, tree lines, or brush. If a radar set is oriented toward soft ground and is sited to take advantage of tunneling, its vulnerability to intercept and direction-finding will be reduced considerably.

OFFENSIVE OPERATIONS

The primary role of target acquisition radars in the offense is to protect the friendly force by locating targets for engagement. In offensive operations, particular attention must be given to planning target acquisition to facilitate future operations. The TA planners need to ensure a smooth transition from one phase of the operation to the next by providing for continuous coverage of the zone of operation. The FSCOORD must specifically concern himself with coordinating the use of the terrain for the radar and recommending Firefinder zones.

Because in the offense our intelligence of enemy locations is developed to a degree that many enemy positions are known in advance and our force is uncovered as it maneuvers, the first Firefinder zone to be considered for use is the call-for-fire zone. Establishing a CFFZ will facilitate immediate counterfire to suppress enemy artillery disrupting our scheme of maneuver. Critical friendly zones may be phased along the maneuver axis of advance and activated when entered by friendly forces. This is particularly important in those areas where friendly forces are most vulnerable (for example, river-crossing sites and areas open to easy visual observation).

Assets may have to be decentralized to facilitate command, control, and movement. Cueing should be more decentralized during offensive operations. The FA controlling headquarters, in close coordination with the FSE, should designate cueing agents that can cue the radar by calling it directly. The controlling headquarters must inform the radar section who these agents are and which ones have priority. This is necessary to streamline our

acquisition and counterfire effort when committed maneuver forces may be particularly vulnerable to enemy indirect fire.

The main emphasis of MTLRs in the offense is on discerning enemy attempts at lateral repositioning or reinforcement.

One additional consideration in the offense is that TA assets may move forward so far or so fast that survey may initially be unavailable in some positions. Therefore, the TA assets may have to use hasty survey techniques for control until survey is available.

DEFENSIVE OPERATIONS

The primary role of TA radars in the defense is to protect those units and installations the commander deems critical to a successful defense. TA planners must also consider how to execute a transition from defensive to offensive operations such as counterattacks. Positioning, task organization, and on-order missions should facilitate the transition.

Firefinder in the Defense

In the defense, the first consideration in the use of the nine zones of a radar is to protect critical units or installations by using CFZs. The maneuver commander should indicate which these zones are. Once the commander has done so, the FSE must give these to the radar controlling artillery headquarters, which passes the zones to the radar.

The second consideration for the use of zones is areas in which to use CFFZs. On the basis of a thorough IPB and other target indicators, CFFZs should be used to monitor those suspect areas from which we anticipate artillery fire that could jeopardize our mission. This facilitates effective counterfire to suppress or neutralize those targets. ATIZs may be used in those areas where we are not sure about enemy artillery. They can also be used in areas that the maneuver commander may wish to monitor closely but are out of range of friendly organic artillery. A use of a censor zone is to place one around friendly artillery that may be firing in such a way that it could be acquired by Firefinder radars as hostile fire. For example, this could easily occur in the case of a nonlinear FLOT.

The MTLR in the Defense

The primary use of the MTLR in defensive operations is to provide combat information on the enemy. This is done by orienting the sector of search on target areas of interest (TAIs), named areas of interest (NAIs), or enemy avenues of approach. The MTLR normally remains in general support under div arty control, but it may be attached to a DS battalion to support a maneuver brigade operation. The MTLR is particularly effective in the counterreconnaissance effort. Because the radar operator can distinguish wheeled vehicles from tracked vehicles and heavy tracks from light tracks, the MTLR section can be of great value in identifying the actual location of the enemy reconnaissance (recon) forces, The MTLR should be positioned so that it can see the enemy coming directly at it. It also requires line of sight to the target and must be positioned on prominent terrain.