ATP 3-09.12

Field Artillery Counterfire and Weapons Locating Radar Operations

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This publication supersedes ATP 3-09.12, dated 24 July 2015.

Headquarters, Department of the Army

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Contents

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Preface

This publication contains the techniques used to plan and conduct field artillery (FA) counterfire operations, and for the employment and management of weapons locating radar (WLR) systems. It incorporates techniques on equipment such as the AN/TPQ-50 and AN/TPQ-53 WLRs. This publication retains information on the AN/TPQ-36 system that the Army is phasing out. The publication provides techniques on counterfire operations using division artillery (DIVARTY) and the field artillery brigade (FAB) WLRs and attack/delivery systems. The material contained in this Army Techniques Publication (ATP) applies to all FA personnel involved in the conduct of counterfire operations.

To comprehend the doctrine contained in ATP 3-09.12, readers must first understand the fundamentals of Unified Land Operations described in ADP 3-0 and FM 3-0. They must understand the functions and principles of fire support (FS) planning, coordination, execution, and assessment of the FS support system, and how to conduct FA operations during large-scale combat operations (LSCO) described in FM 3-09.

The principal audience for ATP 3-09.12 is FA commanders, staffs, and WLR personnel. Trainers and educators throughout the Army, and the FS community will also use this manual. This manual should be studied by those members of the combined arms team or other services who are responsible for FA counterfire and the delivery of FS during LSCO.

Commanders, staffs, and subordinates ensure their decisions and actions comply with applicable United States, international, and, in some cases, host-nation laws and regulations. Commanders at all levels ensure their Soldiers operate in accordance with the law of war and established rules of engagement (See FM 6-27/MCTP 11-10C).

ATP 3-09.12 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. Terms for which ATP 3-09.12 is the proponent publication (the authority) are marked with an asterisk (*) in the glossary and are boldfaced in the text. For other definitions shown in the text, the term is italicized and the number of the proponent publication follows the definition.

ATP 3-09.12 applies to the Active Army, the Army National Guard, Army National Guard of the United States, and United States Army Reserve unless otherwise stated.

The proponent of ATP 3-09.12 is the Commandant, United States Army Field Artillery School and Chief of the Field Artillery. The preparing agency is the United States Army Fires Center of Excellence, Directorate of Training and Doctrine. Send comments and recommendations on a Department of the Army (DA) Form 2028 (*Recommended Changes to Publications and Blank Forms*) to Directorate of Training and Doctrine, 700 McNair Avenue, Suite 128, ATTN: ATSF-DD, Fort Sill, OK 73503; by e-mail usarmy.sill.fcoe.mbx.dotd-doctrine-inbox@mail.mil; or submit an electronic DA Form 2028.

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Introduction

ATP 3-09.12 contains the fundamental techniques and guidance required for planning, coordinating, conducting FA counterfire, and the employment of FA WLRs. It provides information on how to train and conduct operations and describes the techniques currently being used and known to be effective. The doctrine is consistent with joint, multi-Service, and other Army doctrine.

Counterfire is an operations function that aims to accurately engage enemy indirect fire systems once acquired. The counterfire process is not the sole responsibility of the Fires Warfighting function and should be integrated with the planning process through targeting. FA target acquisition (TA) identifies and provides an accurate target location to the supported maneuver commander to allow for immediate counterfire operations against the target.

This publication describes current and emerging fires TA systems. The main piece of equipment used for counterfire operations and TA is the WLR. ATP 3-09.12 explains the techniques for counterfire operations, employing and managing WLRs, and target processing. This publication describes TA techniques to accomplish the mission as stated in the operations order and to employ, maintain, and operate WLRs to locate the enemy indirect weapon systems.

ATP 3-09.12 is divided into four chapters and eleven appendices:

Chapter 1 Introduction to Field Artillery Counterfire and Targeting.

Chapter 2 Roles and Responsibilities.

Chapter 3 Field Artillery Counterfire/Weapons Locating Radar Sections and Personnel.

Chapter 4 Employment Considerations for Weapons Locating Radars.

Appendix A Automated Target Data Processing.

Appendix B Friendly Fire Log.

Appendix C Embedded Training.

Appendix D Mask Considerations.

Appendix E Support Requirements.

Appendix F Tools and Procedures.

Appendix G Rocket Artillery Mortar (RAM) Warn.

Appendix H AN/TPQ-53 Weapons Locating Radar System Characteristics.

Appendix I AN/TPQ-50 Weapons Locating Radar System Characteristics.

Appendix J AN/TPQ-36 Weapons Locating Radar System Characteristics.

Appendix K Target Acquisition Tab.

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Chapter 1

Introduction to Field Artillery Counterfire and Targeting

This chapter discusses techniques for conducting targeting in support of field artillery (FA) counterfire operations. The chapter begins with an introduction to targeting and its relationship to FA counterfire. It provides a listing of the ten counterfire imperatives and provides a description of counterfire operations. The chapter concludes with counterfire planning and the military decision-making process (MDMP). It provides some staff considerations for counterfire operations in support of large-scale combat operations (LSCO).

INTRODUCTION TO TARGETING

1-1. *Large-scale combat operations* are extensive joint combat operations in terms of scope and size of forces committed, conducted, as a campaign aimed at achieving operational and strategic objectives (ADP 3-0). In LSCO, fire support (FS) could be the principal means of destroying enemy forces. As in all Army operations, counterfire is not conducted in a vacuum, but as part of an overall joint operation.

1-2. The maneuver commander's FS requirements are continually identified, planned, and executed as part of the targeting process. *Targeting* is the process of selecting and prioritizing targets and matching the appropriate response to them, considering operational requirements and capabilities (JP 3-0). Targeting helps integrate and synchronize FS with other Army and joint functions (command and control [C2], intelligence, movement and maneuver, protection, sustainment, and information). The Army targeting process or joint targeting cycle coordinates and synchronizes FS to shape enemy forces in the deep area to set conditions for subordinate units. Units use the Army targeting process or the joint targeting cycle as appropriate according to organizational echelon.

1-3. Army targeting and its steps of decide, detect, deliver, and assess (referred to as D3A) is integrated with the operations process, joint targeting cycle, and the MDMP. Targeting occurs continuously throughout an operation. Its steps mirror planning, preparing, executing, and assessing. Corps and below units normally utilize the Army targeting process. Corps and division commanders and staffs must understand and be able to interface with the joint targeting cycle.

1-4. The targeting methodology organizes the efforts of the commander and staff to accomplish key targeting requirements. See figure 1-1. Targeting is an outgrowth of the commander’s decisions and establishes the requirements for the development of an effective information collection and intelligence analysis effort. It helps the staff and targeting working group decide which targets must be acquired and engaged. Targeting working groups can vary in composition and structure as determined by the commander and standard operating procedures of the unit. Targeting working groups, their-duties and make-up are discussed throughout this publication. Targeting develops options used to engage targets. A *target* is an entity or object that performs a function for the threat considered for possible engagement or other action (JP 3-60).

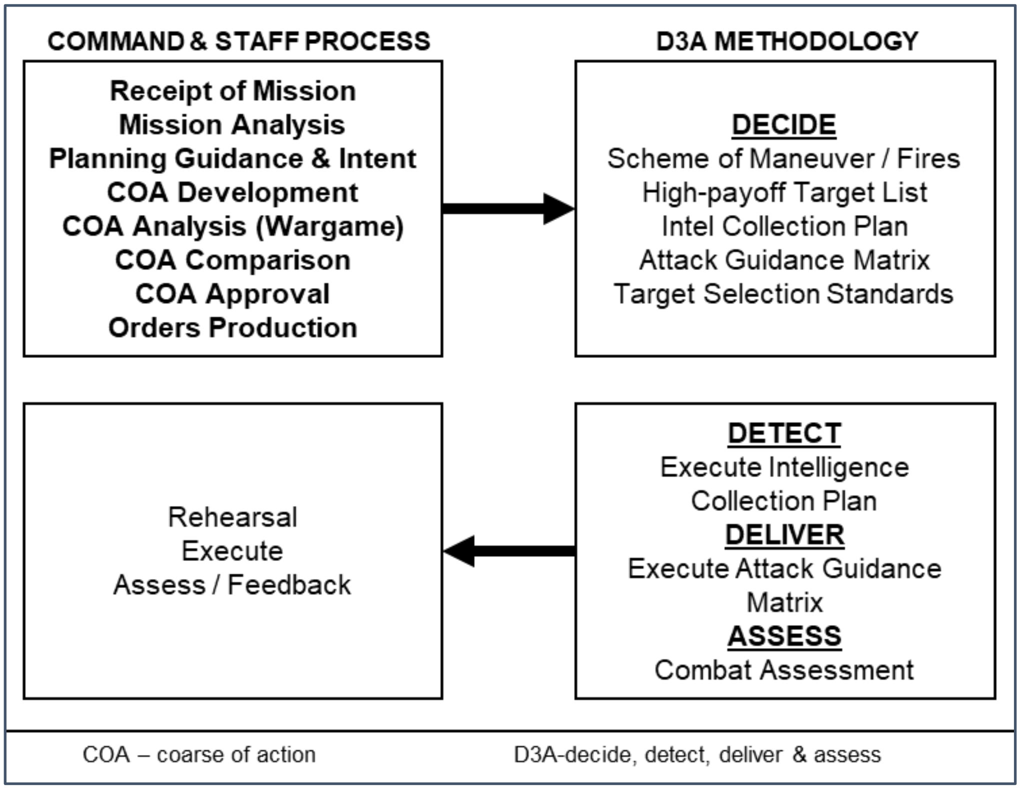


Figure 1-1. Targeting Methodology

DECIDE

1-5. The decide function is the most important and requires close interaction between the commander and the intelligence, plans, operations, fire support element (FSE), and servicing judge advocate. The staff officers must clearly understand the following:

- Unit mission.
- Commander's intent.
- Commander's planning guidance.
- Friendly assets and capabilities.
- Threat capabilities.
- Threat vulnerabilities.
- Rules of engagement.

1-6. With this information, the staff officers can prepare their respective running estimates. From the standpoint of targeting–the FS, intelligence, information related capabilities, and operations estimates are interrelated and closely coordinated among each cell. Key staff products include target value analysis and the intelligence estimate from the targeting and intelligence officers. War gaming allows the fire support coordinator (FSCOORD) or fire support officer (FSO) to develop the decide function products.

DETECT

1-7. The detect function is conducted during the execution of the operation order (OPORD). Target acquisition (TA) assets gather information and report their findings back to their controlling headquarters (HQ), which in turn pass pertinent information to the tasking agency. Some collection assets provide actual targets, while other assets must have their information processed to produce valid targets. Not all of the information reported would benefit the targeting effort, but it may be valuable to the development of the overall situation. The target priorities developed in the decide function are used to expedite the processing of targets. Situations arise when the engagement, upon location and identification, of a target is either impossible (for example out of range) or undesirable (outside of but moving toward an advantageous location for the attack). Critical targets that cannot or are chosen not to be engaged in accordance with attack guidance should be tracked to ensure they are not lost. Tracking suspected targets expedites execution of the attack guidance. Tracking suspected targets keeps them in view while they are validated. Planners and executers must keep in mind that assets used for target tracking may be unavailable for TA.

DELIVER

1-8. The deliver function's main objective is to attack targets in accordance with the attack guidance provided. The tactical solution (the selection of a weapon system or a combination of weapons systems) leads to a technical solution for the selected weapon. The technical solution includes the following:

- Specific attack unit.
- Type of ordnance.
- Time of attack.
- Coordinating instructions.

ASSESS

1-9. Commanders continuously assess the operational environment (OE) and the progress of operations, and compare them to their initial vision and intent. Commanders adjust operations based on their assessment to ensure objectives are met and the military end state is achieved. The commander and his staff assess the results of mission execution. If combat assessment reveals that the commander's guidance or conditions of operational success have not been met, detect and deliver functions of the targeting process must continue to focus on the targets involved.

1-10. The assessment process is continuous and directly tied to the commander's decisions throughout planning, preparation, and execution of operations. Staffs assist the commander by monitoring the numerous aspects that can influence the outcome of operations and provide the commander timely information needed for decisions. The commander's critical information requirements are linked to the assessment process by the commander's need for timely information and recommendations to make decisions. Planning for the assessment identifies key aspects of the operation that the commander is interested in closely monitoring, and where the commander wants to make decisions. For more detailed information on targeting see ATP 3-60.

THE FIRE SUPPORT SYSTEM AND TARGET ACQUISITION

1-11. A *high-payoff target* is a target whose loss to the enemy will significantly contribute to the success of the friendly course of action (JP 3-60). A *high-payoff target list* is a prioritized list of high-payoff targets by phase of the operation (FM 3-09). Targeting is prioritized using the high-payoff target list (HPTL). Success in battle relies heavily on the ability to accurately identify, locate, and attack high-payoff targets (HPTs). This calls for rapid and accurate target development, TA, and post-strike assessment. FS planners and the FSCOORD work closely with intelligence personnel and the field artillery intelligence officer to identify TA requirements and focus on detecting HPTs. As an element of the FS system, *Target acquisition* is the detection, identification, and location of a target in sufficient detail to permit effective employment of capabilities that create the required effects (JP 3-60). Staffs evaluate target information and route it to the appropriate supporting commands. This includes information from all echelons and from adjacent and supporting elements.

1-12. TA is conducted in accordance with the five principles of the law of war/law of armed conflict to permit the effective employment of weapons. TA can occur at numerous points along the execution timeline and at all levels of command, including the attack and deliver system performing the final attack (JP 3-09).

Information Collection And Target Detection

1-13. TA requirements often comprise a large portion of the overall information collection effort especially when conducting deep operations or employing sophisticated cross domain cyberspace operations. In some cases, especially during LSCO, units must be prepared to fight in order to acquire targets. The challenges to TA against a peer threat include integrated air defense systems, long-range fires, counter reconnaissance, cyberspace and electromagnetic warfare (EW) operations, deception operations, and camouflage. *Electromagnetic warfare* is military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy (JP 3-85). Commanders allocate maneuver, fires, and multi-domain intelligence, surveillance, and reconnaissance capabilities to enable TA. For more information on how the staff and intelligence sections overcome collection gaps see FM 2-0.

Named Area Of Interest To Target Area Of Interest

1-14. A *named area of interest* is the geospatial area or systems node or link against which information that will satisfy a specific information requirement can be collected. Named areas of interest are usually selected to capture indications of adversary courses of action, but also may be related to conditions of the operational environment (JP 2-01.3). To effectively target the enemy, the intelligence and FS staffs develop named area of interest (NAI) and target area of interest (TAI) locations.

1-15. A *target area of interest* is the geographical area where high-value targets can be acquired and engaged by friendly forces (JP 2-01.3). Not all TAIs will form part of the friendly course of action (COA); only TAIs associated with high priority targets are of interest to the commander. These TAIs are identified by the targeting staff during wargaming and are recorded on both the targeting synchronization matrix and intelligence synchronization matrix. TAIs differ from engagement areas in degree. Engagement areas plan for the use of all available weapons; TAIs might be engaged by a single weapon and lead to the establishment of geographical targets, to include point, area, and linear.

1-16. The staff also develops a HPT list that can include geographic NAIs and TAIs as well as enemy organizations, networks, and individuals identified as key or critical to the OE and are taken into account in COA, branches and sequels. NAIs should not be tied to a specific terrain; rather, they should be based upon the enemy locations or suspected locations. NAIs are used both to confirm or deny an enemy COA and locate HPTs. TAIs cannot exist outside of an NAI as they are both inextricably linked to the commander's priority information requirements and decision points. The operations officer tasks intelligence, surveillance, and reconnaissance assets to observe NAIs and TAIs.

Target Acquisition Assets

1-17. TA can be accomplished by a wide range of capabilities, from visual identification to sophisticated electronic means. TA is most effective when comprised of complementary and unique collection assets and capabilities across echelons and warfighting functions. The expression of accuracy of TA assets is target location error and is criteria captured by the targeting team on the target selection standards. "Target selection standards are criteria applied to enemy activity (acquisitions and battlefield information) and used in deciding whether the activity is a target. Target selection standards put nominations into two categories: targets and suspected targets. Targets must meet accuracy and timeliness requirements for engagement. Suspected targets must be confirmed before any engagement.

1-18. Some of the many possible target detection assets include satellites and other national assets, joint intelligence, surveillance, and reconnaissance systems to include the United States Air Force distributed common ground system, unmanned aircraft systems (UAS), weapons locating radars (WLRs), forward observers, scouts, and special operations forces. When planning the TA portion of information collection, it is useful to group those assets into the four primary information collection tasks and missions of reconnaissance, surveillance, security operations, and intelligence operations. For a complete listing of intelligence collection capabilities by command echelon, refer to FM 2-0.

TARGET ENGAGEMENT AUTHORITY

1-19. *Engagement authority* is an authority vested with a joint force commander that may be delegated to a subordinate commander that permits an engagement decision (JP 3-01). The authority and responsibility to engage targets rests with the joint force commander (JFC) responsible for the area of operations (AO). The JFC communicates engagement criteria to the force through rules of engagement specific to each AO. In LSCO, especially during the offense, it is critical that Target Engagement Authority be delegated to the absolute lowest echelon that has the proper resources to identify and attack enemy formations, facilities, and other capabilities in-accordance with the Law of War and established rule of engagement. Delegating target engagement authority to the lowest level enables more flexibility by entrusting engagement decisions to leaders at the tactical level.

COUNTERFIRE

1-20. *Counterfire* is fire intended to destroy or neutralize enemy weapons (JP 3-09). Counterfire provides freedom for maneuver by destroying or neutralizing the enemy indirect fire capabilities. Counterfire can be accomplished by using different FS assets to include joint fires. *Joint fires* are fires delivered during the employment of forces from two or more components in coordinated action to produce desired effects in support of a common objective (JP 3-0). Counterfire must be synchronized and integrated with the current and future scheme of maneuver.

1-21. Counterfire contributes by providing fires against the enemy integrated fires complex. Counterfire protects friendly forces, combat functions, and facilities from enemy indirect fires by targeting enemy weapons, TA assets, C2 facilities, communications, and logistics sites. The counterfire battle is not a separate battle, but one aspect of the overall combined arms fight. Counterfire gains freedom of maneuver for all friendly forces. Counterfire is inseparably tied to current and future operations and is part of the overall combined arms fight to achieve fire superiority.

1-22. In LSCO, the corps commander is responsible for counterfire throughout the depth of the corps AO. The commander determines the best way to protect the corps combat forces and to defeat, delay, or disrupt the threat array. This estimate or analysis includes an assessment of the counterfire capabilities of the corps and its subordinate divisions. For more information on corps operations see ATP 3-92. The corps commander's counterfire responsibilities include the following:

- Segmenting the battlefield by delineating maneuver boundaries and assigning an AO for corps and its subordinate divisions. This helps establish the delineation of counterfire responsibilities within the corps zone.
- Assigning missions and responsibilities, to include specific task requirements to intelligence assets through the intelligence officer.
- Allocating resources. Corps assets may be retained at corps or allocated to subordinate divisions. Conversely, in some situations, the corps commander may require the use of division assets to support a corps counterfire responsibility. The corps commander should provide guidance for use of certain critical assets such as corps aviation assets, air interdiction, intelligence, surveillance, and reconnaissance capabilities, special operations forces, and cyberspace electromagnetic activities resources.
- Requesting additional TA and attack/delivery systems from theater or joint task force (JTF) level or from other joint HQ.
- Detecting and attacking. The corps detects and attacks targets within its AO, typically beyond the established fire support coordination line. The corps also may attack targets within a division AO when the division has forwarded such a request to corps based on priority and need. Within its capability, the corps may respond to requests for additional fires from adjacent units.
- Assessing. Finally, the corps commander must assess the protection of his combat units and the effects of counterfire against threat FS systems. As appropriate, the commander adjusts information collection and/or attack priorities for protection of his force and attack of enemy targets. Commander may reallocate assets and modify the missions of subordinate units.

1-23. The corps commander decides how the corps will conduct counterfire operations. The corps commander also provides guidance to coordinate and delineate corps, division, field artillery brigade (FAB), and division artillery (DIVARTY) responsibilities involved with enemy artillery analysis to reduce redundant efforts, and potential gaps and seams in analysis, production, and dissemination of intelligence and information. This guidance influences how subordinate division commanders fight through the allocation of corps assets, the issuance of attack guidance, and the identification of corps HPTs. Corps commander can support a division commander's counterfire efforts by attacking threat FS systems at depth; thus, the corps commander helps to shape the division counterfire battle. In addition to allocating assets to divisions, the corps commander can further support a division counterfire battle by responding to the division requests with air interdiction, strike coordination and reconnaissance, multiple launch rocket systems (MLRS), cyberspace electromagnetic activities, and EW assets. With respect to counterfire in the division AO, the corps commander:

- Assigns missions to division and corps FS assets and delineates their areas of responsibility by establishing boundaries.
- Detects and attacks targets forwarded by the division. As appropriate, the corps, after coordinating with the division FSE, may attack threat FS targets within the division zone by massing fires to achieve required effects. Procedures for attacking threat systems firing from across boundaries also must be coordinated.
- Task-organizes and allocates assets. After assessing mission variable factors: mission, enemy, terrain and weather, troops and support available, time, and civil considerations (METT-TC) and commander’s intent, the corps commander can assign additional assets to the divisions for detection and attack of threat FS systems. Most often, corps provides non-divisional FA delivery assets to augment DIVARTY FS capabilities. This can be done by either of the following actions:
  - Assigning a FAB a support relationship such as reinforcing (referred to as R) or general support-reinforcing (GSR) to a DIVARTY.
  - Attaching the FAB to the division requiring augmentation. The FAB normally is then further attached to the DIVARTY.

1-24. Division Counterfire Responsibility: Typically, most of the reactive counterfire battle takes place within the division AO. Most of the threat active FS systems are located in this area. The responsibilities of the division commander mirror those of the corps commander. Although the division assets are fewer in number and variety, the division commander does have organic WLR, target processing, and delivery assets to conduct counterfire. The FSCOORD for the division is responsible for orchestrating the division counterfire effort. When a FAB from corps is available to the division, the DIVARTY commander may assign it the counterfire role. Responsibility for the execution of the division counterfire effort, however, remains with the DIVARTY commander. The division owns the counterfire fight in LSCO. To facilitate the counterfire fight all brigade WLR assets will be incorporated under the counterfire HQ. The brigade will conduct a limited counterfire fight utilizing the AN/TPQ-50 systems.

PROACTIVE COUNTERFIRE/TARGETING

1-25. Proactive counterfire is the specific targeting of enemy indirect fire systems including their C2, sensors, platforms, and logistics before they engage friendly forces. The proactive measures consist of zone management, site analysis, and position survivability considerations. The proactive counterfire process begins with targeting and continues throughout the operation. The intelligence and targeting officers develop NAIs and TAIs where the enemy indirect fire assets are expected. The objective is to identify, locate, and attack the enemy's strike capability before it can impact friendly operations. MLRS or high mobility artillery rocket system (HIMARS) battalions (BNs) from the FAB and DIVARTY, normally perform the bulk of proactive counterfire in support of division operations, using organic fires as well as allocated, joint, national, or multinational assets to acquire and disable attack components of the enemy's strike capability. Examples of target sets include:

- Cannon, rocket, and missile delivery systems.
- Prepared launch sites.
- Artillery ammunition storage facilities.
- Fire direction centers (FDCs).

- WLRs and forward observers.
- Fixed or rotary wing airfields/strips.
- FS communication infrastructure.

1-26. Intelligence assets must be synchronized and integrated to accurately locate targets. Attack/delivery systems to include artillery, mortars, aviation assets, attack helicopters, naval surface FS, and cyberspace electromagnetic activities must be dedicated against the threat total FS system. Considerations for conducting proactive counterfire/targeting include:

- All available artillery units participate.
- Integrate all available joint FS attack/delivery systems.
- Requires augmentation by Army and joint intelligence assets to locate and accurately target the enemy indirect FS systems
- The intelligence staff officer at echelon manages the intelligence mission command information system, intelligence collections assets, and information dissemination.
- Understanding the enemy order of battle, emplacement, and displacement procedures.
- Establishing digital interface from sensor to shooter.
- Making maximum use of an established permissive fire support coordination measure (FSCM) to facilitate the clearance of fires.
- Managing no-fire areas that protect special operations forces, long-range surveillance detachments, reconnaissance troops, and scouts is critical.
- Use of advanced field artillery tactical data system (AFATDS) to clear fires should be maximized (See Appendix A for additional information).
- Establishing WLR call for fire zones (CFFZs) and artillery target intelligence zones (ATIZs).
- Air Support Operations Center dissemination and execution of airspace coordination order, air tasking order, and airspace coordinating measures (ACMs).

REACTIVE COUNTERFIRE

1-27. Reactive counterfire provides immediate organic or joint fires to neutralize, destroy, neutralize, or suppress enemy indirect fire weapons once acquired. The FS system responds primarily to enemy mortar and artillery fires during or immediately following enemy engagement of friendly forces. Reactive counterfire usually requires quick response capabilities for optimum effectiveness and can benefit from the establishment of quick fire channels.

1-28. FA units employ a variety of counterfire acquisition assets to accurately locate enemy indirect fire assets as they are engaging friendly forces by establishing sensor-to-shooter links to attack the enemy systems. Ensure that the mission fired report and artillery target intelligence is sent to the all source analysis section. Other key considerations for conducting reactive counterfire include airspace clearance, the use of both permissive FSCMs that facilitate quick engagements and restrictive measures such as no-fire areas to protect critical assets, establishing quick-fire channels with sensor-to-shooter links, and designating WLR zone managers.

1-29. The FSCOORD is the primary advisor for counterfire and must emphasize to the maneuver commander that all combat information is reported through operations channels. Counterfire provides joint fires in response to enemy indirect fire weapons as acquired. Counterfire is achieved through joint fires and the information collection effort.

1-30. *Information collection* is an activity that synchronizes and integrates the planning and employment of sensors and assets as well as the processing, exploitation, and dissemination systems in direct support of current and future operations (FM 3-55). These efforts are linked through operations throughout the depth of the battlefield. While a fine line may exist between counterfire and attack at depth, once a target is capable (that is, within range) of affecting the close fight, its attack is considered a target of opportunity. Information collection assets must be prioritized to accurately locate targets. Attack/delivery systems (such as artillery, mortars, close air support, attack helicopters, naval surface fire support and select nonlethal enablers) may be brought to bear on the enemy total FS system.

1-31. Counterfire planning is integral to the targeting process. Counterfire begins with targeting during the MDMP and continues throughout the operation. Counterfire planning consists of zone management, pattern analysis, site analysis, and position survivability considerations. The intelligence officer and the targeting officer develop named areas of interest and target areas of interest where the enemy indirect fire assets are expected. Those areas are synchronized with the collection plan and zone management.

COMMANDER'S TEN COUNTERFIRE IMPERATIVES

1-32. Targeting and counterfire are combat multipliers for the maneuver commander. Counterfire is one of the best methods available to assess a corps, division, or brigade combat teams (BCTs) ability to plan and synchronize operations. When nested with FS planning, coordination, and execution the 10 counterfire imperatives are a good tool to use in assessing and coordinating the overall counterfire fight. The 10 imperatives are as follows:

1. Provide commander's intent and guidance to enable counterfire operations and scheme of fires in support of the commander's objectives. Counterfire planning begins during the MDMP and continues throughout the targeting process feeding the targeting working group, targeting decision board, and information collection plan. Commander's guidance (corps, division, and BCTs) sets the conditions for planning counterfire operations. The commander's guidance must be clear, concise, and easily understood. Whenever commander's guidance for counterfire and targeting is not clearly understood during the planning of an operation, FS planners should solicit that guidance from the commander. Commanders must include an endstate in their planning guidance for counterfire, to promote unity of effort and the integration, and synchronization of available FS and collection assets. Successful counterfire operations may require commanders to accept risk elsewhere while seeking to exploit opportunities.
2. Develop and execute an information collection plan that supports the targeting and counterfire fight. Successful counterfire operations require proactive and continuous collection and analysis of the enemy FS system. Collection managers must utilize the HPTL in accordance with the commander's guidance. WLRs and collection assets must be prioritized, integrated, and synchronized with counterfire operations. The FA intelligence officer and the information collection manager at each echelon ensures that TA assets are properly integrated and synchronized into the overall collection and FS plan. The FSCOORD is responsible for positioning FS assets to respond to counterfire requirements. Position WLRs to support the observation and collection plans considering the enemy FS capabilities and range. Combat assessments, battle damage assessment, munitions effectiveness assessment, and reattack criteria will drive information collection requirements for counterfire operations.
3. Develop a permissive battlefield design using geometries and FSCMs. A *fire support coordination measure* is a measure employed by commanders to facilitate the rapid engagement of targets and simultaneously provide safeguards for friendly forces (JP 3-0). Using battlefield geometries and FSCMs to delineate the AO between corps and divisions is essential to effective counterfire operations and future planning. Permissive FSCMs allow for maximum use of destructive combat power to facilitate the attack of enemy indirect fire systems, while mitigating the risk to friendly forces. The commander adjusts battlefield geometries and FSCMs as required to keep pace with operations.
4. Plan and manage terrain and distribute on common graphics (logistics sites, position area for artillery - primary and alternate). Ensure FA units and WLRs are positioned to support counterfire operations at points of vulnerability such as obstacles, canalizing terrain, bridges, or gap crossings. The counterfire HQ is responsible for logistic support and recommends positioning of sensors and counterfire delivery systems, and ensures position area for artillery and radar position areas (RPA) are distributed using common graphics. Plan for primary, alternate, and tertiary position area for artillery and RPA.
5. Plan airspace that allows for responsive counterfire (ACMs, airspace coordination areas, and counterair). *Airspace coordinating measures* are measures employed to facilitate the efficient use of airspace to accomplish missions and simultaneously provide safeguards for friendly forces (JP 3-52). Close coordination is required to integrate airspace with counterfire operations. Counterfire conducted in LSCO will require high volumes of airspace. Army tactical missile system and

guided MLRS target engagements will require detailed airspace planning, coordination, and de-confliction. Unit airspace plans must be developed during MDMP and throughout the targeting and operational process to account for counterfire operations. When commanders have control of airspace, the joint air ground integration center is the execution node for fires and airspace control. For more information on the joint air ground integration center see ATP 3-91.1.

6. Designate and resource the counterfire HQ (role/manning/location). Define the force field artillery (FFA) HQ role verses the counterfire HQ role in the counterfire fight. The corps or division commander can designate the role of the counterfire HQ to a DIVARTY, FAB, or separate FA BN. The DIVARTY can provide the counterfire HQ for the division if task organized with the necessary firing units, sensors, target processing section (TPS), and target acquisition platoon (TAP) to coordinate the counterfire fight. FABs can serve as the FFA HQ or the counterfire HQ for a division or corps. Army National Guard FABs are routinely assigned to support the divisions and corps as the counterfire HQ.

7. Develop a sustainment and protection plan for all TA and attack/delivery systems. The execution of sustainment operations across all class of supply are critical to counterfire operations. CL V sustainment, ammunition haul capability, triggers, required supply rate (referred to as RSR and controlled supply rate referred to as CSR) are crucial to the counterfire fight. WLR sections do not have the capability to provide force protection for themselves and firing units often need protection augmentation. A protection plan must be developed during the MDMP to include engineer support, local force protection to secure movement along main supply and alternate supply routes, short-range air defense, cueing schedules, frequency management, and deception.

8. Communicate at distance using a primary, alternate, contingency, and emergency plans (referred to as PACE plans), digital architecture, AFATDS database management, and liaison officers. When conducting counterfire in LSCO be prepared to operate in a degraded environment. Establish a primary, alternate, contingency, and emergency plan for the analog and digital architectures from sensor to shooter. AFATDS database must be verified and continuously updated to include: FSCMs, firing unit data, sensor data, targeting data, and communications architecture. Establish liaison officers at echelon and in adjacent units for cross boundary fires. (See Appendix A for additional information)

9. Conduct tactical fire direction: Tactical fire direction and firing unit management is key to ensuring responsive fires. During the MDMP and the targeting process develop target selection standards and attack guidance that enables rapid decision making and responsive fires. Plan for a dedicated all weather counterfire shooter using hot and cold status.

10. Maximize WLR home station training. Develop and rehearse the counterfire battle drill from sensor to shooter covering all elements of the primary, alternate, contingency, and emergency plan and all TA resources possible. Develop a weekly digital training sustainment program that is focused and event driven at all echelons.

COUNTERFIRE OPERATIONS

1-33. As part of the combined arms battle, counterfire must be effectively planned and integrated into the supported maneuver commander's scheme of maneuver. The commander receives input and recommendations from his FSCOORD, FSO, intelligence and operations officers at echelon, and any other staff officers involved in counterfire operations.

INTEGRATING COUNTERFIRE WITH SCHEME OF MANEUVER

1-34. The FSCOORD issues decisions and guidance as necessary to direct counterfire efforts, to ensure effective coordination occurs, and to ensure that counterfire is synchronized with all other aspects of FA supported-unit operations. FA units receive counterfire guidance through the FFA HQ (if designated) or the chain of command. Counterfire responsibilities for the supported maneuver unit staff and FS planners include:

- Supporting the maneuver commander's critical assets.
- Developing, disseminating, and managing intelligence and order of battle information on the enemy indirect fire system.

- Advising the maneuver commander in the establishment of attack guidance for counterfire targets.
- Coordinating counterfire operations with higher echelon counterfire operations.
- Integrating counterfire into the operation plan in a complementary manner to enable maneuver operations. Achieving indirect fire superiority within the supported maneuver commander's AO.

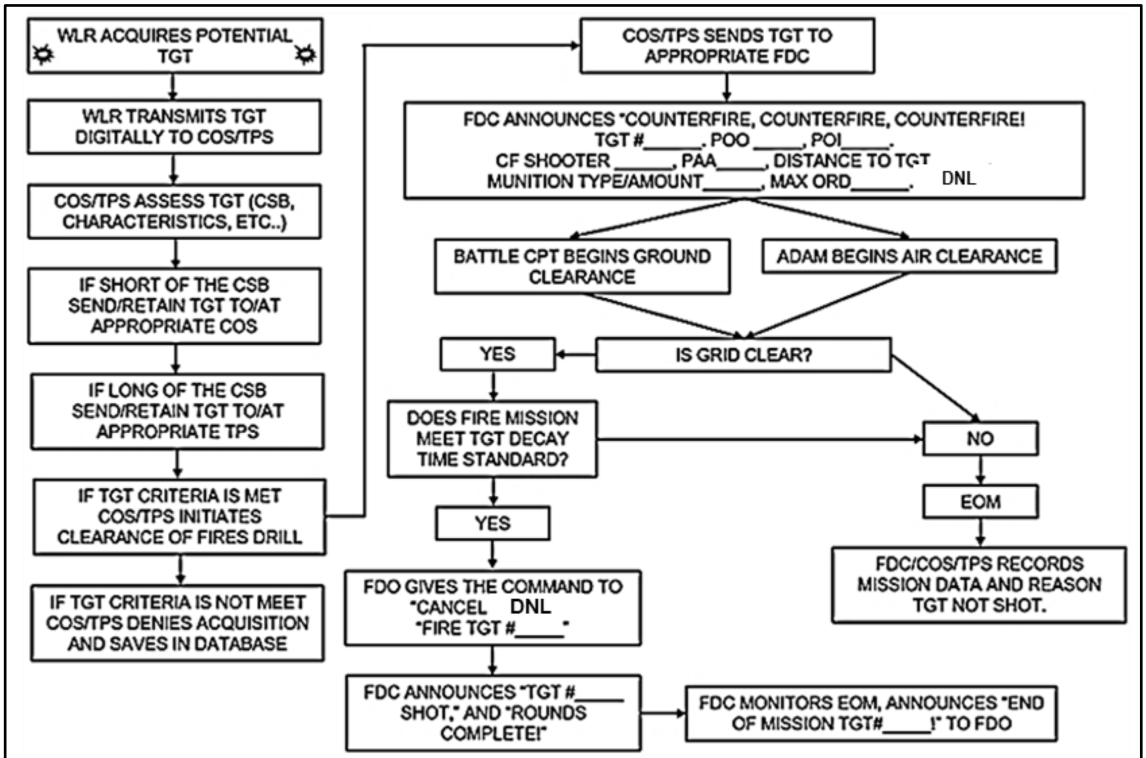
BRIGADE COMBAT TEAM

1-35. The BCT organic FA BN has a counterfire operations section (COS) to coordinate the counterfire fight on behalf of the BCT commander. For an example of a counterfire battle drill see figure 1-2, on page 1-11. The FSCOORD advises the BCT commander on whether to use centralized or decentralized counterfire. The COS may remain at the direct support (DS) FA BN Main command post (CP) or it can co-locate with the FSE at the BCT main CP. The COS receives information from WLR sections and turns that information into targetable data. The COS initiates clearance of fires procedures. The COS then passes that target data to the appropriate delivery system based on the approved attack guidance matrix. For more information on the attack guidance matrix see ATP 3-60.

1-36. The BCT conducts centralized counterfire by keeping control of its WLRs and executing BN-level fire missions. WLR target data can be sent to the FSE or the COS under centralized control. The FSCOORD directs the routing of target data. Centralized control provides for positive clearance of both ground and air before executing a fire mission.

1-37. The BCT conducts decentralized counterfire by assigning a DS relationship between a WLR and a subordinate firing unit. The counterfire section or the BCT FSE monitors, but does not control the WLR. Decentralized control streamlines the process of sensor to shooter response time, however, it is critical that procedures are in place for clearance of fires.

1-38. Possible control methods to deconflict WLR coverage during decentralized operations may include the use of BCT forward boundaries, common sensor boundaries, FSCMs, phase lines, or designating specific target sets or coverage areas.



ADAM-air defense airspace manager
COS-counterfire operations section
CSB-common sensor boundary
DNL-do not load
EOM-end of mission
FDC-fire direction control
FDO-fire direction officer
MAX ORD-maximum ordinate
POO-point of origin
POI-point of impact
TGT-target
TPS-target processing section
TSS-target selection standards
WLR-weapons locating radar

Figure 1-2. Counterfire Battle Drill

Note. This is an example of a counterfire battle drill, and a common TTP for the COS/TPS to be authorized to process fire missions directly to the shooter in lieu of the FDC. Units can adjust as necessary based on the tactical situation, standard operating procedures, and METT-TC.

COUNTERFIRE PLANNING

1-39. Counterfire planning must be integrated into targeting, FS planning, and the MDMP. The targeting officer or FA intelligence officer and the information collection manager at each echelon ensures that TA assets are properly integrated and synchronized into the overall collection and FS plan. The FSCOORD is responsible for positioning FS assets to respond to counterfire requirements.

STAFF PLANNING CONSIDERATIONS

1-40. The development of targetable data (target intelligence) is necessary for the proper deployment of WLR, the timely and effective acquisition of enemy indirect fires, the coordination of cueing and survivability criteria, and the execution of counterfire operations. The *weapons locating radar* is a continuous target acquisition counterbattery system that detects in-flight projectiles, and communicates point of origin and point of impact locations (FM 3-09). FA Intelligence is an integral part of combat intelligence and is vital to the survivability of TA and delivery platforms on the battlefield. It is an indispensable element to the artillery commander in the ability to exercise command.

1-41. The operations officer selects position areas for WLRs based on intelligence preparation of the battlefield (IPB), the range capabilities of WLRs, the units HPTL, and a comprehensive analysis of the OE. *Intelligence preparation of the battlefield* is the systematic process of analyzing the mission variables of enemy, terrain, weather, and civil considerations in an area of interest to determine their effect on operations (ATP 2-01.3). A thorough analysis of the METT-TC can provide which factors are most important to consider. Generally, in a traditional battlespace, WLRs are deliberately positioned to acquire adversary weapons, prevent loss of the WLRs to adversary action, and avoid unnecessary movement. This maximizes WLRs coverage and cueing time. Through analysis of threat characteristics known as the order of battle at the tactical level, staffs can begin to derive additional information such as:

- Types of systems.
- Number of systems.
- Capabilities of each system (munitions, ranges, rates of fire, rate of march).
- Dispositions: deployment distances between firing units in relation to maneuver missions of each echelon; (DS versus counterfire).
- Logistical capability.
- Communication nodes and capabilities.
- Counterfire capability: WLRs assets, ranges, typical battlefield emplacements.
- EW threat and capabilities to friendly WLRs.

1-42. During each phase of planning, the staff focuses on the development of specific counterfire products and details any additional planning considerations that are considered to create an effective counterfire plan. This will be used as a tool to annotate best practices as they relate to planning through the lens of counterfire. The counterfire planning process begins with the commander's guidance, IPB, and selection of tentative high-value targets early during the planning process and continues throughout operations. A *high-value target* is a target the enemy commander requires for the successful completion of the mission (JP 3-60). These high-value targets are converted to HPTs and prioritized based on their importance to the friendly commanders mission. The validation of these HPTs occurs during COA analysis (wargame).

COUNTERFIRE/TARGETING AND THE MILITARY DECISION-MAKING PROCESS

1-43. Counterfire/targeting planning is conducted with all of the MDMP steps: receipt of the mission, mission analysis, COA development, COA analysis, COA comparison, COA approval, and order production.

Receipt of the Mission:

- Counterfire/targeting focus:
  - Develop initial running estimates.
  - Develop initial information requirements.
  - Identify available assets from higher HQ.
- Request the following information from supporting command WLRs to facilitate the supported commands counterfire planning process:
  - Type of system.
  - Active or passive.
  - Range of the system.
  - Frequencies used.
  - Detection capabilities.
  - Manning requirements.

Mission Analysis:

- Counterfire/targeting focus:
  - Update and refine running estimates.

- Assist in incorporating counterfire efforts into the information collection plan.
- Assist intelligence section with IPB as is relates to adversary indirect firing capabilities.
- Identify threat capabilities with the ability to render WLR and other TA capabilities non-mission capable.
- Identify EW threat.
- Adversary indirect firing systems and capabilities.
- Obtain enemy Order of Battle from the intelligence section. This determines how the enemy will support the most likely COA and most dangerous COA. It is also the foundation for the integration of WLRs into the information collection plan.
- Develop initial counterfire plan and support relationships (Task and Purpose) identify possible Position Area for Artillery and record grids location.
- Determine proposed common sensor boundaries.
- Determine cueing guidance based on EW threat.
- Assist the intelligence section with target system analysis. Prioritize high-value targets determined by the calculated value to the adversary by phase.
- Determine priorities and initial zone placement by phase.
- Determine WLR to counterfire section linkage.
- Obtain communications architecture with higher HQ.
- Determine WLRs protection to include security force and engineer support.
- Determine WLRs support responsibilities.
- Determine size of counterfire target(s) to recommend standard fire order to create the commander's desired effects.
- Recommended changes to Task Organization.

Course of Action Development:

- Counterfire/targeting focus:
  - Update and refine running estimates.
  - Ensure the counterfire plan is integrated with the information collection plan and supports scheme of maneuver.
  - Obtain Global Positioning System (GPS) accuracy report for the area of interest.
  - Develop steps to counter the threats capabilities to attack WLRs and TA assets.
  - Refine WLRs positions, responsibilities, and zones.
  - Develop triggers for WLRs movements.
  - Determine threat to WLRs by position.
  - Determine Commanders guidance for cueing, on demand or situational, based on EW detect threat.
  - Identify and validate any sensor to shooter links.
  - Confirm communication and reporting plan.
  - Provide input to FSCM and airspace coordinating measure development necessary for permissive fires.
  - Review and recommend criteria for Target Selection Standards, Attack Guidance Matrix, and HPTL.
  - Review information collection plan.
  - Develop an initial draft Counter Battery appendix to FS Annex D for the OPORD.
  - Task organization (Friendly).

Course of Action Analysis:

- Counterfire/targeting focus:

    - Update and refine running estimates.
    - Cueing schedule based upon enemy FS systems engagement of friendly forces at critical points during the wargame.
    - FSCMs.
    - Airspace coordination measures.
    - Develop initial TAB T (TA) to appendix 4 (FA support plan referred to as the FASP) to Annex D for operations order.
    - Create radar deployment order (RDO) using DA Form 5957 (*Radar Deployment Order*).

Course of Action Comparison:

- Counterfire/targeting focus:
    - Update and refine running estimates.
    - Refinement of the counterfire plan.

Course of Action Approval:

- Counterfire/targeting focus:
    - Update and refine running estimates.
    - Refinement of the counterfire plan.

Orders Production:

- Update and refine running estimates.
- Counterfire/targeting focus: Finalize counterfire inputs to the operations order. Inputs should include, but are not limited to:
    - RDO.
    - Position Area for Artillery.
    - Zone management.
    - Cueing schedule.
    - EW threats.
    - Survivability criteria.
    - Common sensor boundaries.
    - Frequency integration.
    - Required information for tactical control of counterfire.
    - Reporting criteria.

COUNTERFIRE/TARGETING IN SUPPORT OF LARGE-SCALE COMBAT OPERATIONS

1-44. Counterfire in support of LSCO consists of supporting offensive, defensive, and stability tasks. The staff must plan for the specific targeting of enemy FS systems with special attention to how the enemy commander will utilize FS to counter friendly offense, defense, and stability operations. Each of the supporting tasks provide different opportunities for the utilization of triggers, detection platforms, delivery platforms, and the ability to shape the OE.

COUNTERFIRE/TARGETING IN SUPPORT OF OFFENSIVE OPERATIONS

1-45. Friendly force movements during the offensive operation typically provide a basis for triggering movements of WLRs, cueing, and synchronization with delivery platforms. During the offense, triggers for movement of WLRs, cueing, and synchronization with a delivery platform are typically based upon friendly force movements during the offensive operation.

1-46. Counterfire and WLR planners must ensure a smooth transition from one phase to the next by providing continuous WLR coverage across the AO. This is done by synchronizing sufficient detection and delivery assets to effectively reduce the enemy's ability to mass at the decisive point of the operation. Requirements for WLR positioning and movement are identified during the MDMP and tied to specific events. This allows continuous coverage by facilitating mutually supporting coverage between WLRs. The FA commanders monitor this process closely to ensure that the use of terrain, movements, and radar zones are properly coordinated.

1-47. A method for providing continuous WLR coverage is to stagger WLRs and adjust coverage while advancing forward. This is done by moving one or more WLRs forward while another WLR covers the moving radars sector of search. This can be enhanced by the FAB or DIVARTY WLRs assisting the BCT WLRs by providing coverage while they move. Triggers for initiating this movement can be based on phase lines, events, or time determined during the planning process. The movement of WLRs must be synchronized with the scheme of maneuver.

1-48. The first consideration for WLR zones in the offense is the mission and contingency operations. Establishing CFFZs facilitates immediate counterfire to suppress, neutralize, or destroy enemy artillery that may disrupt the scheme of maneuver. A critical friendly zone (CFZ) may be planned along the axis of advance and over critical friendly forces determined by the supported commander. Special consideration should be given to gap crossings, breaching forces, choke points, or other vulnerable areas. In order for CFZs to be effective, they should have a dedicated sensor and shooter synchronized with the critical timeline to provide suppression of enemy FS systems at critical points of the operation.

1-49. Control of WLRs will generally be more decentralized to facilitate command, control, movement, and cueing. The FSCOORD at all levels designates cueing agents. This is necessary to streamline the counterfire effort when committed maneuver forces may be particularly vulnerable to enemy indirect fire.

Weapons Locating Radars in Support of Offensive Operations

1-50. The effective assignment of WLRs enables responsive fires during offensive tasks. Quick-fire nets allow the observers to communicate with specific FA or mortar fire units. These kinds of communication arrangements enhance responsiveness. Communication planning should also include communications networks for the clearance of fires.

1-51. During the execution of offensive tasks, WLRs acquire information on NAIs/TAIs that when analyzed may confirm or deny priority intelligence requirements, and decisively determine enemy FS plans, and attempt to locate enemy indirect fire systems. Particular attention must be given to planning TA that enables future operations. The TA planners provide focus on the identification of enemy indirect fire assets. Detailed planning should provide synchronized detection and delivery against enemy FS systems. The FS planners must identify and coordinate the use of the terrain for the WLR. FS planners recommend to the counterfire/targeting officer and counterfire noncommissioned officer (NCO) at echelon the development of WLR zones for the commander.

1-52. Requirements for WLR positioning and movement are identified early in the operations process and tied to specific events. The designated counterfire HQ monitors this process closely to ensure that the use of terrain, movements, and WLR zones are properly coordinated. Considerations for TA during the offense include:

- Coordinate WLR employment across the supported command's AO to enables effective targeting of enemy FS systems.
- Position WLRs to support the observation and collection plans considering:
  - Enemy FS capabilities and scheme of maneuver.
  - Range.
  - Security.
  - Maximum flexibility.
- Plan for frequent repositioning of WLRs.
- Use CFFZs to provide prioritization within the AFATDS over on call missions to effectively engage HPTs.

  - Coordinate with the air defense airspace management (ADAM) element/ and the (brigade aviation element if at brigade level) on creation of ACMs to allow for timely air clearance to engage targets within CFFZs.
- Plan CFZs (based on the supported commanders guidance) along the axis of advance and areas that include:
  - Essential friendly force positions.
  - Gap crossings.
  - Breaching forces.
  - Choke points or other vulnerable areas. CFZs require a sensor and a shooter synchronized for detection and delivery during the critical event.

COUNTERFIRE/TARGETING IN SUPPORT OF DEFENSIVE OPERATIONS

1-53. The primary role of WLRs in the defense is to provide target location data and information to allow for the targeting of enemy FS systems prior to the decisive point. Counterfire in the defense uses WLR acquisitions to provide friendly assets the ability to destroy, disrupt, or delay the enemy and deny the enemy the ability to mass fires. TA planners must also consider transitions to offensive tasks such as counterattacks. Positioning, task organization, and on-order missions should facilitate transitions.

1-54. The first consideration is to identify the potential position areas for artillery that the enemy will utilize to mass fires in support of breaching forces, gap crossings, choke points or other vulnerable areas in the friendly defensive plan. CFZs are established over critical areas where the enemy will achieve success if fires are massed. The triggers for CFZ activation, cueing, and synchronized shooter are based upon enemy offensive maneuver actions. Also in consideration is the use of the WLR's zone capabilities to provide coverage for critical units or installations using CFZs. The supported commander should indicate the assets that are deemed essential to ensure mission accomplishment. If the commander does not identify these assets, the FSCOORD or FSO must query the commander for the necessary guidance. Once the guidance is obtained, the information is passed to the FSE for implementation.

1-55. CFFZs are planned on suspected or known enemy indirect fire systems in confirmed Position Areas for Artillery. The intent is to suppress, neutralize, or destroy enemy indirect fire systems before they start their preparatory fires. CFFZs are planned based on IPB and target indicators. CFFZs are used to monitor suspect areas from which enemy indirect fires may jeopardize the mission.

1-56. Counterfire personnel conduct analysis of WLR targets acquired from ATIZs, request additional delivery capabilities, and develop understanding of how the enemy utilizes FS with maneuver.

1-57. An ATIZ may be established in areas where friendly forces are not sure about enemy indirect fires and need to develop the situation. They can also be used in areas of suspected enemy indirect fires that the commander wishes to monitor closely but are out of friendly indirect fire range.

Weapons Locating Radars in Support of Defensive Tasks

1-58. The primary role of WLRs in the defense are to provide target intelligence and information to allow for counterfire mission processing. The FSCOORD must also consider transitions to offensive tasks such as counterattacks. Position, task organization, and on-order missions should facilitate transitions. Considerations for WLR during defense include:

- Employ WLRs to provide observation of NAIs, TAIs, and critical assets.
- Integrate WLR placement and acquisition data into fire planning.
- Assist the support command FSE in the development of an observation plan.
- Ensure that responsibility for related FS tasks are identified and coordinated.
- Include priority intelligence requirements.
- Rehearse the observation plan to ensure that all targets are adequately observed, that triggers are effectively coordinated, and that backup plans are adequate.
- Employ WLRs in support of higher echelon shaping operations.
- Link UAS to rapidly respond to acquired enemy indirect fires units.

- Position observers to see both targets and trigger lines.
- Ensure adequate sensor-to-shooter communication.
- Ensure counterfire is integrated into the targeting process to reduce enemy FS capabilities prior to the enemy entering the friendly engagement areas.
- Coordinate surveillance, reconnaissance, and WLR requirements with the supported commands intelligence officer.
- Coordinate WLR employment across the supported command's AO.

COUNTERFIRE IN SUPPORT OF STABILITY OPERATIONS

1-59. Counterfire operations conducted in support of stability tasks are essentially the same as those conducted for offensive and defensive tasks. Counterfire is an essential combat multiplier during stability tasks. Due to the nature of stability tasks it is extremely important to have an accurate location of enemy indirect weapons systems. WLRs are usually positioned in static locations and rarely moved once established. During stability operations the use of WLRs to provide 6400mils coverage becomes an essential factor in the counterfire fight. Due to the nature of stability tasks, it can be assumed that the enemy will have freedom of maneuver and the ability to initiate contact at the time and location of their choosing. TA planners must weigh the advantages and disadvantages of WLRs operating in 360 degree mode. Planners must be able to properly advise the commander and staff on the loss in probability of detection and range while operating in the 360 degree mode versus the advantages of operating in a directional mode and gaining range and probability of detection. TA planners must understand the system and how to properly coordinate, integrate, and synchronize this system with the capabilities of all WLRs. Proper planning for use of WLRs for the counterfire fight begins with targeting during the MDMP and continues throughout the operation.

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Chapter 2
Roles and Responsibilities

This chapter discusses FA organizations and the role they may be assigned to support counterfire. The chapter defines the Counterfire HQ and FFA HQ roles. It also discusses the FA organizations that perform a counterfire role when assigned.

FIELD ARTILLERY ORGANIZATIONS

2-1. FA organizations and their related CPs integrate FA operations, targeting, counterfire, and attack/delivery systems to synchronize the execution of FA missions. CPs must aggressively seek information about the current tactical situation (friendly unit locations, obstacles, cleared lanes, and bypassed units), while disseminating this information to all subordinate and supporting units. Since FA CPs are also primary enemy targets, they should be as small and mobile as possible to allow for rapid and frequent displacement.

COUNTERFIRE HEADQUARTERS

2-2. Counterfire is not separate from the combined arms fight, but an aspect of the overall battle. In LSCO, the corps and division commanders are responsible for counterfire throughout the depth of their AOs. A corps should be allocated two FABs, one to serve as the counterfire HQ and one to serve as the FFA HQ for the corps. The DIVARTY is in the optimal position to be the counterfire HQ for the division. If a FAB/DIVARTY is designated as the counterfire HQ they must be allocated the necessary assets to conduct the counterfire fight. The counterfire HQ will coordinate with the division and corps intelligence officer for sensor tasking authority and additional intelligence capabilities to integrate all available assets into the counterfire fight in a proactive manner. The counterfire HQ duties include:

- Plan and coordinate sensor management.
- Conduct pattern analysis of enemy indirect fire systems. A pattern analysis plot sheet is a common analysis tool for listing information. It can be configured to determine enemy indirect fire activity as it occurs within a specified time. The pattern analysis plot sheet is a circular matrix and calendar. Each concentric circle represents one day and each wedge in the circle is one hour of the day. For more information on pattern analysis see ATP 2-19.4 and ATP 2-33.4.
- Establish counterfire TAI.
- Based on pattern analysis conduct WLR zone management in support of the counterfire fight.
- Recommend positioning of counterfire delivery systems.
- Write the TA Tab to Annex D.
- Recommend counterfire procedures to facilitate permissive fires.
- Participate in the targeting process and provide recommendations for air interdiction, and strike coordination and reconnaissance requests and nominations through the division or corps FSE.
- Establish counterfire mission digital and voice procedures and communications architecture using AFATDS and the joint automated deep operations coordination system (JADOCS).

FORCE FIELD ARTILLERY HEADQUARTERS

2-3. A *force field artillery headquarters* is a battalion size or higher unit designated by the supported commander who specifies its duration, duties, and responsibilities (FM 3-09). A command's organic FA HQ is normally the FFA HQ (DIVARTY). When formations do not have an organic FA HQ (to include a JTF), the respective commander may designate an FFA HQ such as a FAB. Functions of the FFA HQ may include:

- Provides C2 for subordinate units which could include a FABs rocket BNs, or cannon BNs to support the commander's concept of operations.
- Facilitates single point of contact for outside agency coordination for force protection and additional fires.
- Accepts or passes control of fires during passage of lines operations.
- Coordinates sustainment and protection of subordinate FA units.
- Plans fires and positions all FA units with a support relationship of general support (GS) or GSR.
- Recommends command and support relationships of FA units to the operations officer and the commander.
- Establishes meteorological (MET), survey, and WLR plans for the command.
- Produces a FA support plan or OPORD.
- Assists the corps or division FSE in the production of Annex D (Fires) of the OPORD.
- Facilitates targeting for the division and corps deep fight.
- Orchestrates the counterfire battle for the commander.
- Assigns a subordinate or FA unit the duties of the counterfire HQ.
- Serves as alternate corps or division CP for limited durations.
- Participate in the targeting process and provide recommendations for, air interdiction, and strike coordination and reconnaissance requests.

Note: North Atlantic Treaty Organization FA units are given missions and responsibilities in accordance with North Atlantic Treaty Organization Standardization Agreement 2484. Other multinational FA units that are attached or OPCON are given missions and responsibilities in accordance with their national guidance.

FIELD ARTILLERY BRIGADE

2-4. A FAB's primary tasks are conducting corps-level strike operations and augmenting division level shaping operations. *Strike* is an attack to damage or destroy an objective or a capability (JP 3-0). The FAB provides the corps with the capability to mass effects during shaping operations in the conduct of LSCO. The FAB can be task organized with delivery and sensor systems to support mission requirements. A division, corps, JTF, or other force may have a FAB or its units attached or placed under operational control (OPCON). The FAB's BNs are fully capable of providing DS to joint, special operations forces, and other Army units. When operating under the control of the JFC or another Service, the Army Service component command or Army Forces commander exercises administrative control over the FAB. The FAB, when designated by the JFC or corps commander, can serve as a counterfire HQ or be assigned a counterfire mission.

2-5. The FAB uses its CPs to provide C2 of the operations of subordinate FA BNs. The CP integrates FS planning and coordination, execution, target production, and information from all intelligence sources. A FAB can serve as the FFA HQ for a Corps or JTF, or the counterfire HQ for a JTF, corps, or division. Army National Guard FABs have a dual role, serving as both the Army National Guard division commander's FFA HQ and as a FAB when required. For more information on FAB CPs and operations see ATP 3-09.24.

DIVISION ARTILLERY

2-6. DIVARTY controls the divisions' organic and attached FA units and indirect FS operations, coordinating closely with the division FSE for continuous operations to the division main, tactical, and rear or support area CP. To win in LSCO quickly, decisively and with minimum friendly causalities, each division must be supported with the fires of additional FABs equipped with long range precision fires capability. The DIVARTY can provide the counterfire HQ for the division. If allocated the necessary firing units, the TPS of the TAP, in conjunction with the DIVARTY CP can be designated and coordinate the counterfire fight for the division.

2-7. The primary role of the DIVARTY is to facilitate shaping operations within the division AO. The DIVARTY serves as the FFA HQ for the division. Additionally the DIVARTY commander, as the senior artilleryman in the division, is responsible for standardizing training for FA units that are assigned, attached, or placed under the OPCON of the division. The DIVARTY commander will mentor the commanders and leaders of these FA units and typically be assigned other key responsibilities on behalf of the division commander. Those responsibilities could include management of the assigned or attached 13-series career management field Soldiers, training oversight, and certification programs.

2-8. The DIVARTY is not currently allocated organic firing units, but is task organized with additional units based on mission requirements. Task organization may include a combination of MLRS, HIMARS, or cannon BNs as well as other enablers. The DIVARTY, when allocated appropriate rocket and cannon units, brings a long range and precision FS capability to the division. In LSCO, allocating units from a FAB to a DIVARTY in a reinforcing (R) support relationship is appropriate to provide the division with adequate FS.

2-9. As a division's FFA HQ, the DIVARTY plans, directs, coordinates, and controls the fires of all organic, attached, and reinforcing FA units supporting the division. The CP develops FA support plans and ensures that available firepower adequately supports the division concept of operations. The DIVARTY can serve as the counterfire HQs for the division, or can delegate that role to a reinforcing FA unit.

2-10. If the counterfire HQ is delegated to an R FA unit, it is important to remember that the DIVARTY commander remains responsible for the overall division counterfire fight as the division commander's FSCOORD. The DIVARTY CP provides the division with the ability to have an alternate CP if the division CP has to displace or is incapacitated. The DIVARTY CP may perform C2 tasks for the division for a limited period only. For more information on DIVARTY organization and operations see ATP 3-09.90.

Field Artillery Battalion

2-11. The FA BNs destroy, defeat, and disrupt the enemy with integrated fires in support of forces conducting LSCO. The FA BN usually has a close established command relationship, but the commander may further assign a command or support relationship.

2-12. FA BNs consist of MLRS, HIMARS, and FA cannon batteries, both self-propelled and towed that are organic, assigned, or attached to their supported unit. Active Army FABs have either MLRS or HIMARS BNs (Army National Guard FABs have a mixture of MLRS or HIMARS BNs), self-propelled or towed artillery cannon BNs.

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Chapter 3

Field Artillery Counterfire/Weapons Locating Radar Sections and Personnel

This chapter introduces WLR sections and the personnel necessary to perform WLR and FA counterfire operations. Counterfire operations are an integral part of the commander's overall concept of operations.

3-1. FA WLRs are assigned to the TAP of the FAB, DIVARTY, and all FA BNs organic to BCTs. These assets are a crucial element in the commander's counterfire fight. The WLR is the commander's primary means for collecting real time information on the location of the enemy indirect fires systems. The WLR is used to produce point of origin (POO), and point of impact (POI) to support counterfire and provide targeting intelligence. BCTs will have two organic AN/TPQ-53s and four organic AN/TPQ-50s, while DIVARTYs and FABs will each have two organic AN/TPQ-53s and two organic AN/TPQ-50s. Incorporating these WLRs into the information collection plan using reinforcing and GSR echeloned employment, enhances the overall coverage capability of the force. This redundant capability allows for one system to provide coverage while another system moves, conducts maintenance or repair activities. AN/TPQ-53s are not intended to work independently, but as a system of systems providing a tactical capability to the force.

3-2. The TPS of the FAB and DIVARTY, and the COS of the FA BNs, are responsible for managing the commander's counterfire fight through the integration and synchronization of WLRs. These two sections focus on priority intelligence requirements and answer the commander's critical information requirements concerning the enemy indirect weapons systems. The information gathered is to be disseminated timely and accurately to the unit commander, staff, and echelons above and below.

FIELD ARTILLERY BRIGADE AND DIVISION ARTILLERY TARGET ACQUISITION PLATOONS

3-3. The FAB and DIVARTY support the corps and division commander's scheme of maneuver by coordinating, integrating, synchronizing, and employing fires to achieve the commander's objectives. The FAB and DIVARTY TAPs provide continuous WLR support in support of the commander's counterfire operations and gather information on enemy indirect fires systems. In addition, the FAB and DIVARTY WLRs can provide coverage for the BCTs organic WLRs when moving, performing maintenance, or repair. The FAB and DIVARTY TAPs are identical in structure and are comprised of a platoon HQ, WLR sections, and TPS. Duties of the TAP include:

- Provide WLR support to detect, locate, classify, report, and communicate the POO, POI, radar cross section, and velocity of indirect fire systems for the counterfire fight.
  - Provide GS WLR coverage for units operating within the area of search.
  - Provide WLR maintenance support.
  - Confirm the actual burst or impact location of friendly fires.
- Survey support if not provided by other available assets to:
  - Ensure common survey for the supported command.
  - Establish declination stations.
- Target processing support to:
  - Recommend and coordinate sectors of search within the supported HQ AO and adjust coverage of WLRs as the situation develops.
  - Develop and recommend WLR zones.

- Monitor the operation of organic and supporting WLRs.
- Develop targets and suspect targets and refine target locations.
- Pass targets to the FSE or fire control element (FCE) for action.
- Maintain the target production map and the artillery target intelligence file in automated targeting systems.
- Request battle damage assessment on targets produced and passed to the FCE for action.

WEAPONS LOCATING RADAR SECTIONS AND TEAMS

3-4. The FAB and DIVARTY TAP WLR sections are identical in structure. The FAB and DIVARTY TAPs will contain 2ea AN/TPQ-53 sections and 2ea AN/TPQ-50 WLR teams. The assigned radar personnel are trained to conduct radar operations on all WLRs.

SURVEY

3-5. The use of survey provides FA assets with a common grid that will permit the massing of fires. Survey is also used as a secondary method to establish survey control points (near stake and far stake data) for the WLR. The survey capabilities consist of an improved position and azimuth determining system-global positioning system (referred to as IPADS-G) which is located within all TAPs.

TARGET PROCESSING SECTION

3-6. The FAB and DIVARTY TPS consists of six FA personnel. The TPS consists of 1ea assistant counterfire officer, 1ea counterfire NCO, 2ea targeting NCOs, and 2ea target processing specialists. The section is responsible for locating enemy indirect fires systems, sensor management of the WLRs, and maintaining the current maintenance status of the WLRs during operations. The TPS assists with integrating and synchronizing the WLR assets in accordance with the commander's intent and concept of operations.

FIELD ARTILLERY BATTALION TARGET ACQUISITION PLATOON

3-7. The FA BN TAP has a COS instead of a TPS and has 4ea AN/TPQ-50 radars. The TAP organic to the FA BN supports all 3 types of BCTs. The TAP includes a platoon HQ, COS, WLR sections and teams, and survey equipment. ARNG TAPs consists of a mix of AN/TPQ-36, AN/TPQ-53, and AN/TPQ-50 WLRs.

COUNTERFIRE OPERATIONS SECTION

3-8. Each BCT FA BN TAP has an organic COS which conducts similar duties as the TPS at the FAB and DIVARTY. The COS is responsible for providing responsive and accurate counterfire.

3-9. The COS consists of the following personnel: a targeting officer, the counterfire NCO, 2ea targeting NCOs and 2ea target processing specialists. This section works together with the BN intelligence officer and staff to produce targetable data. These personnel have the responsibility to perform counterfire operations and to satisfy information requirements.

TARGET ACQUISITION PERSONNEL

3-10. TA personnel's primary responsibility is operating and managing the WLRs for the commander. This includes synchronizing and integrating WLRs with the concept of operations. TA personnel are also the primary executers of the commander's counterfire fight.

3-11. The TA personnel located in the WLR section provide acquisition (target) data along with POO and POI estimates to the COS or TPS. The COS or TPS generate fire mission data and develop a WLR common operational picture by collaborating, sharing, and refining relevant information. The commander utilizes the operations process, IPB, targeting, detection, verification, and location methodology to help with controlling operations and providing a command presence.

PLATOON HEADQUARTERS

3-12. The TAP HQ consists of the platoon leader and the platoon sergeant. The duties of the platoon leader and platoon sergeant are listed in the following two paragraphs.

Target Acquisition Platoon Leader

3-13. The platoon leader of the TAP is responsible for the training, readiness, and maintenance of the platoon WLR equipment. The platoon leader supervises the movement, positioning, and emplacement of the WLRs. The platoon leader develops the platoon into an effective fighting force capable of performing its combat mission. Other duties include:

- Performs necessary tactical and technical coordination for FA WLRs and data collection systems, including communications, encryption and UAS interrogation keys (multi-mission radars), security, force protection, positioning, logistics, and administration.
- Maintains a status of FA WLRs and informs the commander and counterfire officer when necessary. Advises the commander and staff on the technical considerations affecting the employment of WLRs and recommends the general locations of radar sites and search azimuths.
- Monitors the mission support requirements of all WLRs within the supported area.
- Assists in the selection of radar sites.
- Reviews and consolidates requisitions for tools, repair parts, supplies, and equipment.
- Inspects maintenance of platoon vehicles and equipment.
- Monitors the terrain management plan for the positioning of each WLR section.
- Maintains communications between the section, BN and the counterfire HQ.
- Performs necessary tactical coordination for WLRs in the AO.
- Assists in the development of the RDO using the DA Form 5957.

Target Acquisition Platoon Sergeant

3-14. The platoon sergeant of the TAP is the senior enlisted advisor to the platoon leader and must be prepared to assume the duties and responsibilities of the platoon leader. The platoon sergeant ensures that WLR personnel are trained to perform all procedures used during combat operations. The platoon sergeant is responsible for the maintenance, logistics, and discipline of the platoon. The platoon sergeant works in close coordination with the platoon leader to ensure unity of effort. Other responsibilities consist of the following:

- Mentors and evaluates each WLR section chief.
- Coordinates survey support for the platoon.
- Coordinates and recommends general position areas and search areas in accordance with the commander's guidance and intent.
- Supervises maintenance and training of the WLR sections.
- Participates in the development of RDO.
- Maintains the WLR maintenance status chart.
- Manages all administrative actions for the radar platoon in conjunction with the counterfire NCO and section chief.
- Prepares and maintains accountability charts for all essential repair parts stockage list.
- Coordinates higher level maintenance for unserviceable equipment.

Weapons Locating Radar Section

3-15. The WLR sections for each radar are different. The personnel that make up the different radar sections and their duties are listed as follows.

Section Chief (AN/TPQ-36, AN/TPQ-50, and AN/TPQ-53)

3-16. The radar section chief is responsible for the training, discipline, and tactical employment of the WLR section. The section chief executes the selection and emplacement procedures for the WLR within the general area for positioning during operations. The section chief coordinates for supplies and or maintenance support through the platoon sergeant or the TPS or COS. The section chief is responsible for the maintenance of all assigned equipment. Other responsibilities consist of the following:

- Reconnoiters and selects the site for WLR.
- Perform, coordinates and supervises hasty survey.
- Supervises -10 and -20 level maintenance of WLR equipment.
- Instructs personnel in all aspects of WLR operations and associated techniques.
- Organizes and maintains security and defense of WLR position area.

Team Chief (AN/TPQ-36, AN/TPQ-50, and AN/TPQ-53)

3-17. The team chief performs the duties of the section chief when he is absent and also performs these additional duties:

- Operates and supervises the operation of the WLR system.
- Assists in the emplacement and concealment of the WLR position.
- Assists the section chief in all assigned duties.
- Provides technical guidance to WLR operators.
- Troubleshoots, adjusts, aligns, and repairs WLRs using built-in-test routines, measurement, and diagnostic equipment authorized by the maintenance allocation chart.
- Uses fault-isolation-test, replaces cards, modules, components, and selected parts on the WLRs.

Weapons Locating Radar Specalist (AN/TPQ-36, AN/TPQ-50, and AN/TPQ-53)

3-18. The duties of the radar personnel are essentially the same for all WLRs regardless of organizational structure of the assigned WLR section. Their responsibilities consist of the following:

- Emplaces and displaces the WLR and ancillary equipment.
- Initializes and operates all WLR and ancillary equipment.
- Determines and corrects the altitudes of weapon locations from a contour map, when required.
- Transmits TA data which includes the POO, POI, and other target data to the TPS or COS as directed by the RDO.
- Maintains record of transmitted target data locations.
- Operates and performs maintenance on the WLR's prime movers.
- Performs unit WLR maintenance using built-in-test-equipment, fault detection, and isolation.
- Isolates failures of a line replaceable unit that can be replaced by a crewmember.
- Provides local security.
- Performs other duties assigned by the section chief.

Radar Repairer (AN/TPQ-36, AN/TPQ-50, and AN/TPQ-53)

3-19. The radar repairer performs field-level maintenance and resides in the brigade support BN. He provides the following duties as needed:

- Performs unit maintenance using built-in-test and built-in-test-equipment, fault detection, and isolation.
- Uses fault-isolation-test, replaces cards, modules, components, and selected parts.
- Troubleshoots, adjusts, aligns, and repairs using built-in-test routines, measurement, and diagnostic equipment authorized by the maintenance allocation chart.
- Replaces or forwards unserviceable equipment to higher level maintenance.
- Performs connector repair on certain specified cables.

Power Generation Equipment Repairer (AN/TPQ-36, AN/TPQ-50, and AN/TPQ-53)

3-20. The generator equipment repairer repairs and maintains tactical utility and precise power generation equipment. The mechanic is part of the brigade support BN and is sent to work on the generators as needed. The generator mechanic performs the following duties:

- Troubleshoots generator mechanical and electrical systems and components; diagnosis and isolates malfunctions; tunes engine, and replaces components.
- Maintains repaired equipment.

Counterfire Officer

3-21. The counterfire officer is located in the current operations and TPS at the FAB or DIVARTY, corps, and division main CP. Duties of the counterfire officer include:

- Provides target location error (TLE) information on available WLRs to the FSE or FSCOORD as a basis for their recommendations to the targeting team.
- Acts as the principal advisor on counterfire and the employment WLRs.
- Writes the TA Tab to the operations order.
- Develops and issues the RDOs.
- Coordinates WLR planning and execution with the FAB operations officer, and the platoon leader.
- Recommends search azimuth, WLR zones, common sensor boundary, and cueing schedules.
- Provides input for RPA for WLRs.
- Uses automated systems to ensure that WLRs are properly oriented, cued, and targets are expeditiously attacked.

Assistant Counterfire Officer

3-22. The assistant counterfire officer at the FAB/DIVARTY is in charge of the TPS and is positioned to assist the FAB or DIVARTY counterfire officer. Duties of the assistant counterfire officer include:

- Supervises FAB/DIVARTY TPS.
- Recommends and updates WLR coverage.
- Acts as counterfire officer in the absence of the counterfire officer.
- Ensures enemy indirect fire targets are passed to fire control and operations elements for action.
- Follows the target selection standards when developing enemy targets and suspected targets.
- Acts as the principal advisor to the intelligence officer on the integration of WLR.
- Assists in the development of the TA Tab portion of the operations order.
- Conducts coordination of WLR assets with the intelligence, operations, and targeting personnel.
- Ensures information from shelling reports and mortar bombing reports are integrated into the target development process.
- Recommends position areas for the WLR.
- Provides additional recommendations on the following:
  - WLR coverage and cueing schedule.
  - Additional TA assets.
  - Target development.
  - Targeting information from other sources.

Counterfire Noncommissioned Officer

3-23. The counterfire NCO at the FAB or DIVARTY is assigned to the TPS. The counterfire NCO at the FA BN TAP is assigned to the COS. The counterfire NCO assists the counterfire officer at the TPS or targeting officer at the COS and performs the following duties:

- Supervises the activities of the TPS or COS.
- Counterfire NCO is the senior 13R at echelon.

- Mentors the platoon sergeant on all aspects of WLR operations and personnel management.
- Reviews and consolidates requisitions for tools, repair parts, technical supplies, publications, and equipment.
- Evaluates the targeting NCO.
- Coordinates survey support.
- Coordinates logistics and security requirements and liaises with the supported unit.
- Collects and disseminates information provided by the intelligence section.
- Monitors the operations, status, and current and proposed locations of all WLRs.
- Participates in the MDMP.
- Provides recommendations for WLR positioning and search sectors, as well as, placement of zones and the common sensor boundary.
- Maintains a counterfire database.
- Assists in the development of cueing guidance and maintenance schedules for WLRs.
- Assists in the development of the TA Tab and RDO.

Targeting Officer

3-24. The FA BN targeting officer is located at the COS in the BCT FA BN. The targeting officer supervises the COS personnel and the targeting officer duties include:

- Serves as the FA BN counterfire officer.
- Evaluates the counterfire NCO of the COS within the BCT FA BN.
- Integrating the counterfire plan into the BCTs targeting process.
- Recommends and updates WLR coverage.
- Ensures enemy indirect fire targets are passed to fire control and operations elements for action.
- Follows the target selection standards when developing enemy targets and suspected targets.
- Conducts coordination of TA assets with the BN and brigade operations officers and intelligence officers.

Targeting Noncommissioned Officers

3-25. The two targeting NCOs assigned to the FAB or DIVARTY TPS or the FA BN COS perform the following duties:

- Establishes and maintains communications using the AFATDS.
- Passes enemy indirect fire targets to the FSE or FCE for action.
- Ensures tracking of information from shelling reports and mortar bombing reports are integrated into the target development process.
- Assists with maintaining the counterfire database, maps, charts, and records.

Targeting Specialists

3-26. The targeting specialists are responsible for assisting the targeting NCO, and other duties, which include:

- Sets up and maintains all targeting element or counterfire operations databases, maps, charts, and records.
- Initializes the AFATDS, which is used in conjunction with the targeting information from the target production map and other sources to produce targets.
- Passes targets generated by WLRs to the FSE or FCE for action.
- Assists in the tracking of crater analysis results and ensures assessments are integrated into the target development process.
- Assists with maintaining the counterfire database.

Chapter 4

Employment Considerations for Weapons Locating Radars

This chapter discusses concepts and procedures pertinent to the tactical employment of FA WLRs. The techniques contained in this chapter are applicable to WLRs employed at all echelons.

CENTRALIZED PLANNING AND DECENTRALIZED EXECUTION

4-1. Commanders rely on staffs and personnel to execute their intent. Turning intent into reality takes the combined efforts of teams from both inside and outside the organization. Commanders build effective teams through professional development and training. During combat, they organize forces to accomplish their missions based on their concept of operations. The commander assigns responsibilities, establishes or delegates appropriate command or support relationships, and establishes coordinating instructions. Sound organization provides for unity of effort, centralized planning, and decentralized execution. Unity of effort is necessary for effectiveness and efficiency. Centralized planning is essential for controlling and coordinating the efforts of friendly forces.

4-2. The nature of the operation will determine the level in which control and planning for WLRs should be conducted. Additionally, the capabilities of each WLR must be considered when retaining or delegating control.

4-3. DIVARTY and FA BN AN/TPQ-53s should be considered a division and above asset in regards to control and planning. This is due to the far reaching capabilities of the AN/TPQ-53 which will be able to acquire targets across the battlefield, easily detecting targets in adjacent unit AOs. To coordinate unity of effort with this system of systems, and mitigate the risk of lost targets of opportunity, control and planning for an AN/TPQ-53 should be retained at division level and above unless required by operational needs or based on mission variables.

4-4. Due to the AN/TPQ-36 and AN/TPQ-50 WLRs limited ranges, control and planning is primarily at the parent unit. FA BNs should retain C2 over their organic AN/TPQ-36 and AN/TPQ-50s to support the BCT's counterfire fight. FAB and DIVARTY AN/TPQ-50s should be considered for coverage of friendly soft targets behind the forward line of own troops (FLOT). These include friendly CPs, sustainment locations, and other enemy unconventional force targets.

4-5. The counterfire HQ will determine the appropriate support relationship for all WLRs within its AO based on the following factors:

- Nature of friendly operation.
- WLR capabilities.
- Number and type of WLRs available.
- Enemy threat.
- Communication availability between WLRs and counterfire HQ.

4-6. Figure 4-1 is an example of the flow of control and orders for WLRs across a division AO. The DIVARTY, acting as the counterfire HQ, issues guidance and orders to the FA BN on where to place the FA BNs' organic AN/TPQ-53s. This is represented by the dashed lines. The DIVARTY maintains centralized planning and control over the AN/TPQ-53s and the FA BNs executes these orders (decentralized). The FA BN is also responsible for the coordination of security and logistical support of their organic AN/TPQ-53s. Notice how the DIVARTY also maintains a direct flow with the rear AN/TPQ-50 which is organic to it. The FA BNs maintain a direct link with their organic AN/TPQ-50s, represented by the solid arrows. The FA BNs have complete tasking authority of their organic AN/TPQ-50s, issuing placement and search guidance at their discretion.

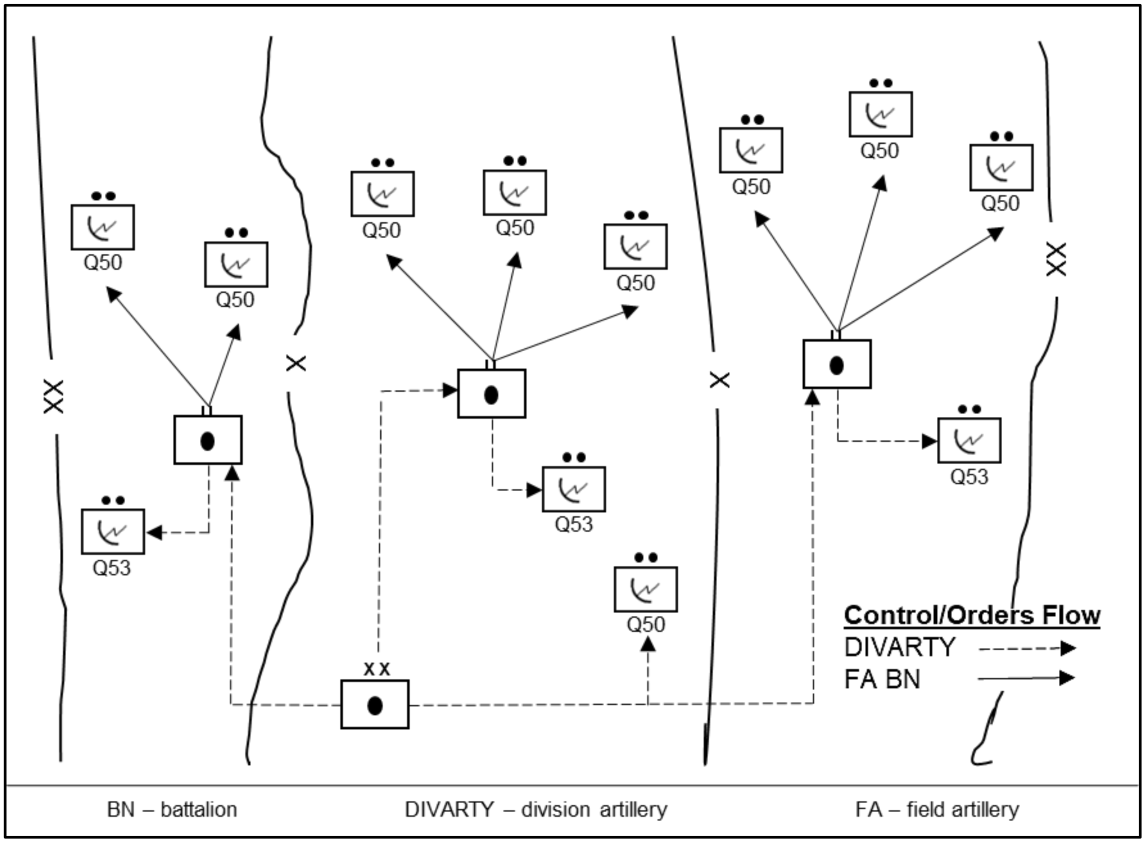

Figure 4-1. Division WLRs command and control.

COMMAND AND SUPPORT RELATIONSHIPS

4-7. There are command and support relationships to consider when it comes to employment of the WLR systems. The command and support relationships are listed in the following paragraphs.

COMMAND

4-8. The WLRs are organic to the TAPs in the FAB, DIVARTY, and BCT's FA BNs. The following paragraphs briefly describe command and support relationships.

4-9. WLRs may be placed under the control of another unit using one of the following command relationships: attached, OPCON, or tactical control (TACON). Command responsibilities are service support and authority, which include the task of organizing and reassigning WLRs to support the remaining force, higher HQ, or parent unit.

SUPPORT

4-10. Support relationships for WLRs consist of the following: DS, reinforcing, GSR, and GS. Support relationships define specific relationships and responsibilities between supporting and supported units. Normally, only DS and GS relationships are established for WLRs. Additional information on command and support relationships can be found in FM 3-09.

WEAPONS LOCATING RADAR EMPLOYMENT

4-11. The primary method of specifying WLR coverage and movement for the WLR section is the RDO. Higher HQ may also develop a radar execution matrix based off localized standard operating procedures as a planning tool for managing multiple WLRs. Both methods provide the required information for conducting WLR operations. However, the primary method for orienting WLRs is digitally using the AFATDS RDOs.

POSITIONING

4-12. The operations and counterfire officers determine the general positioning areas for WLRs. The radar section chief selects the final radar site based on radar position analysis system and visual sighting. During the MDMP, planners need to factor in the proximity of WLRs to adhere to separation requirements. The tactical situation will determine if there is a need for site improvement. LSCO may require frequent repositioning of the WLR and the ability to march-order and displace quickly.

4-13. The radar section chief coordinates site improvement or hardening directly with supporting engineers or contracted support. Site improvement normally includes survivability of the WLR, safety, and line of site. The engineer unit improves the position or constructs berms to enhance the survivability of the WLR and section and egress routes. For an example of how to berm the AN/TPQ-53 see appendix H. The antenna should be bermed to the height of the antenna trailer. This provides protection for antenna transceiver group (ATG) electronics while providing a clear line of sight for the antenna. The engineer unit clears obstructions to provide a clear line of site. Limited resources, and the requirement to march-order and displace quickly may preclude the requirement for long term site improvement.

4-14. Safety for friendly forces in the vicinity of the WLR is a major concern during the planning and implementation process. The heat and radiation generated by the WLR poses a personnel hazard. These hazards are minimized by positioning the WLR a safe distance from friendly forces. Elevating the antenna above the level of personnel and vehicles can mitigate the clutter and radiation hazard.

RADAR TASKING PROCEDURES

4-15. The DA Form 5957 is an enclosure to the TA Tab see figure 4-2 on page 4-4. The RDO provides the information required to deploy the radar section and begin operations, the instructions for completing DA Form 5957 are located in table 4-1 on pages 4-5 and 4-6.

Note: The DA Form 5957 RDO is a classified document once completed with mission data.

RADAR DEPLOYMENT ORDER

For use of this form see ATP 3-09.12; the proponent agency is TRADOC.

SECTION: T96 (Q-53) 52 DIVARTY	CALL SIGN: Thunder 96	RDO NUMBER: ORR17-001-T96-0001
DTG PUBLISHED: 301800JAN2017	DTG EFFECTIVE: 302300JAN2017	
MISSION: Counterfire ISO 52ID offensive operations, and primary observer for Sensor-to-Shooter mission		
TARGET BLOCK: AU0001-AU9999	CUEING POSTURE: GOLD	DISPLACEMENT POSTURE: DOLPHIN

OPERATING FREQUENCIES	PRI	ALT	PRI	ALT	PRI	ALT
	xxx	xxx	xxx	xxx	xxx	xxx

RADAR POSITION AREAS (RPA)

PRIMARY: 14S PJ 770 400 (RPA T01)	ALTERNATE: 14SPJ 775 385 (PA T02)	TERTIARY: 14S PJ 775 455 (RPA T03)

SEARCH SECTORS FOR EACH RPA *(direction entered in mils; range entered in meters)*

RPA	AOS PRI	AOS ALT	SOS PRI	SOS ALT	LEFT EDGE PRI	LEFT EDGE ALT	RIGHT EDGE PRI	RIGHT EDGE ALT	MIN RANGE PRI	MIN RANGE ALT	MAX RANGE PRI	MAX RANGE ALT	SUB-MODE
PRIMARY	1600	1450	1600	1600	800	650	2400	2250	500	500	60000	60000	LRO-Rocket
ALTERNATE	1600	1450	1600	1600	800	650	2400	2250	500	500	60000	60000	LRO-Rocket
TERTIARY	1800	1900	1600	1600	400	650	1000	1100	500	500	60000	60000	LRO-Rocket

THREAT ASSESSMENT

EW THREAT (Y/N)	Y	AFFECTING FRIENDLY ASSETS (Y/N): Y THREAT TYPE: ELINT, HARM (moderate threat)
CBRN (Y/N)	Y	MOPP LEVEL 1 THREAT TYPE: chemical non-presistant low threat
GROUND (Y/N)	Y	THREAT TYPE: Mechanized Infantry sighted withnin 8 km of RPA's
AIR (Y/N)	Y	THREAT TYPE: Rotary wing and armed UASoperating along FLOT

CUEING AGENTS (CALL SIGN AND DESIGNATION) IN PRIORITY

Thunder 35/52 DIVARTY TPS	Thunder 10/DIVARTY FCE	Warriors 10/52nd Div Fires

REPORTING CHANNEL FREQUENCIES

Voice: 992	Digital: 993	Voice: 990	Digital: 991	Voice: 880	Digital: 881

ZONE DATA

TYPE AND NUMBER	DESCRIPTION AND/OR COMMAND PRIORITY	GRID COORDINATES OF ZONE CORNER POINTS					
CFFZSS0001	Rocket, Priority 1	14S PJ 900 420	14S PJ 369 258	14S PJ 268 157	14S PJ 025 850		
CFFZCG0001	Cannon Artillery	14S PJ 159 357	14S PJ 258 147	14S PJ 745 632	14S PJ 970 769		
CFFZCG0002	Cannon Artillery	14S PJ 695 358	14S PJ 147 852	14S PJ 256 400	14S PJ 222 333		
CFFZCG0001	2/52 ID breach location	14S PJ [illegible]	14S PJ [illegible]	14S PJ [illegible]	14S PJ 444 555		

SECURITY/SUPPORTUNIT INFORMATION

SECURITY FORCE		SUPPORT		OTHER	
UNIT: 1/A2-23 IN		UNIT:		UNIT: B/3-13 FA	
FREQ: 663	CALL SIGN: Gunner 11	FREQ:	CALL SIGN:	FREQ: 333	CALL SIGN: Steel 10
REMARKS: Infantry Squad, Mech		REMARKS:		REMARKS: Sensor-to-Shooter Btry (MLRS)	

NOTES:
* Establish communications with security force "Gunner 11" upon receipt of RDO for link-up location..
* Be in position ready to radiate NLT 300000JAN2017
* Begin cueing 300500JAN2017.
* T96 will maintain positive communication with Steel 10 (B/3-13 FA) and Thunder 35 at all times.
* Acquisitions originating from CFFZCG0001 with a weapon type classification of "ROCKET" will be directly transmitted to B/3-13 FA (Located vic 14S PJ 376 437) primary digital net FH CT 333, alternate voice net FH CT 334.
* Operator will report sensor-to-shoot target to Thunder 35-AFTER-transmitting target to B/3-13 FA.
* All other acquisitions will be reported normally to Thunder 35 in accordance with primary, alternate, contigency, emergency (PACE) plan

DA FORM 5957, OCT 2020 PREVIOUS EDITIONS ARE OBSOLETE APD AEM v1.00

ALT-alternate, AOS-azimuth of sensors, CBRN-chemical biological and nuclear DTG-date time group, EW-electromagnetic warfare, FREQ-frequency, MAX-maximum, MIN-minimum, MOPP-mission oriented protective posture, PRI-primary, RDO-radar deployment order, SOS-sector of search

Figure 4-2. DA Form 5957

Table 4-1. The instructions for completing DA Form 5957

Field	***Description***
Section:	List the WLR section name and type. Such as CBR76 (AN/TPQ-53).
Call Sign:	Enter the WLR section's call sign. Such as, "Thunder 76."
RDO Number:	Enter the RDO name/number; for example CG0001.
Date Time Group (DTG) Published:	Enter the DTG in which the RDO was or will be published.
DTG Effective	Enter the DTG in which the RDO is effective.
Mission:	Enter a brief description of the mission, include the command support relationship. For example, GS to 1-82 FA, In support of 1/1CD breaching operation, or DS to 2-15 FA, In support of 1/10MTN artillery raid.
Target Block:	Enter the desired target block range that the WLR will use. Such as, AB0001 – AB3999.
Cueing Posture:	Refers to the amount of time a radar will radiate. Cueing Postures should also be assigned prompt words such as "Neptune" would be 30 minutes on, and "Zeus" would be one (1) hour on. Both Displacement and Cueing Posture prompt word descriptions should be published in the TA Tab to the Annex Delta. Consider the Threat Assessment section of the RDO when determining posture conditions.
Displacement Posture:	Refers to the time a WLR remains in a location before it must conduct a survivability move. A prompt word should be assigned for different lengths of time before displacing; example, "Silver" is six hours, "Gold" is eight hours.
Operating Frequencies:	To maintain frequency management enter in the primary (PRI) and alternate (ALT) frequencies the WLR will use. If filling out for an AN/TPQ-53, complete all three PRI and ALT blocks. If filling out for an AN/TPQ-50, use only the first PRI and ALT blocks and leave the remainder blank.
Radar Position Areas (RPA):	Enter a PRI, ALT, and tertiary general RPA for the WLR. The WLR section chief will report the findings of the ground reconnaissance and select the refined location for the WLR. It is important that the cueing agent trust the judgement of the WLR section chief on the ground, and should defer the final location selection to the WLR section chief.
Search Sectors:	Complete all sections for the primary, alternate, and tertiary RPA.
Azimuth of Search (AOS Block):	Enter the PRI and ALT azimuth of search in mils; this is the center azimuth of the desired search sector.
Sector of Search (SOS Block):	Enter the PRI and ALT sector of search in mils; this is the total width of the search fan. An example would be 1600 if a 90 degree sector is desired. If operating between 91degress and 360 degrees enter the desired width; example "2400" or "6400".
Left and Right Edge:	Enter in the PRI and ALT left and right edges of the search fan in mils; example, if azimuth of search is 900 mils with a sector of search of 1600 mils, then left edge would be 100 and right edge would be 1700. If desiring to blank out a section of the search fan during 360 degree operations (proximity to other radars or obstructions) enter the PRI and ALT left and right edges as well; example. Azimuth of search 900 mils with a sector of search 3400 mils, then the left edge would be 5600 and the right edge would be 2600. This will effectively blank out 2601 to 5599.
Minimum (MIN) and Maximum (MAX) Ranges:	Enter the PRI and ALT MIN and MAX ranges for the WLR in meters.
Sub-Mode:	Enter the desired sub-mode of operations for the WLR such as 90 degree short range optimized, or 90 degree long range optimized.
Threat Assessment:	In this section, indicate and describe possible or known threats for the radar section using (Y) for yes and (N) for no. Consult with S2/G2 for the current and future enemy situation when preparing this section.

Table 4-1. The instructions for completing DA Form 5957 (continued)

Field	Description
Electromagnetic Warfare (EW):	Indicate if there is an EW threat in the box next to EW Threat. Next specify if the threat is affecting friendly assets. Give a brief description of the threat type. If there is an EW threat review the survivability flow chart in conjunction with the commander's risk assessment and METT-TC to determine emission limits.
Chemical, Biological, Radiological, and Nuclear (CBRN Block):	Indicate if there is a chemical, biological, radiological, and nuclear threat. If yes enter the MOPP level, and describe the threat type, such as persistent or non-persistent chemical agent.
Ground:	Indicate if there is a ground threat. If yes describe the threat type, such as: squad sized elements of unconventional forces, or mechanized forces observed within 10 km.
Air:	Indicate if there is an air threat. If yes describe the threat type, such as: attack aviation (type if known) observed within 15 km, or UAS (type if known) observed within 10 km.
Cueing Agents (Call Sign and Designation) In Priority:	List in priority by call sign, agents that can cue the WLR; example, "Thunder 35, DIVARTY CF" or "Thunder 15, DIVARTY FCE."
Reporting Channel Frequencies:	List the communications nets on which the WLR is to operate. Include a description for each. For example Thunder 35, DIVARTY CF Voice: 798 and Digital: 790. These should coincide with the cueing agents above each field.
Zone Data:	List the type of zone and zone number (for example CFZ0001), and grid coordinates of the zones (minimum of three points and maximum of six points). In the description column. List the description of the activity (if any) in the zone. Also, list the command priority for CFFZs if upgraded. If a circular zone is desired, enter "circular" in the description, as well as the radius in meters. Then enter the center grid in the first coordinate box and N/A for the remainder.
Attached Unit Information:	Due to its small size, the radar section cannot provide its own security in a tactical situation. For this reason, the radar section must fall under the security of an adjacent unit or be augmented with personnel and weapon systems to provide security. Enter the unit name (example 1/A/2-22 IN), the frequency (FREQ Block) for communication, the unit call sign, and in the remarks a brief description (example one infantry platoon). Complete the information for all additionally attached units.
ALT - alternate AOS - azimuth of search CBRN - chemical biological radiological nuclear CD - cavalry division CF - command fire CFFZ - call for fire zone DIVARTY - division artillery DS - direct support DS - direct support DTG - date time group EW - electromagnetic warfare FA - field artillery FCE - fire control element FREQ – frequency GS - general support IN- infantry	Km-kilometer MAX-maximum METT-TC-mission enemy terrain troops available time and civilian considerations MIN-minimum MOPP-mission oriented protective posture MTN-mountain PRI- priority RDO -radar deployment order RPA-radar position area SOS-sector of search TA-target acquisition TAB-table UAS-unmanned aircraft system WLR-weapon locating radar

Notes: The preparer can enter additionally details, or instructions, for the mission that were not be covered within other portions of the DA Form 5957.

AZIMUTH SEARCH SECTOR

4-16. Sectors of search are areas within the AO where WLRs focus their capabilities. Sectors of search are determined during IPB and refined in the decide function of targeting. During the Decide function, decisions are made concerning what target systems should be acquired and engaged, where and when targets are likely to be found, and what assets can locate the target. Doctrinal employment considerations, in conjunction with templates and intelligence assessments produced during IPB, dictate the areas in which the WLR search should be focused. The location of friendly boundaries and FSCMs may also affect the assignment of search sectors.

COMMON SENSOR BOUNDARY

4-17. To facilitate timely dissemination of acquisitions to the appropriate unit(s) which will engage potential target, planning and employment of a common sensor boundary (CSB) is critical. A c*ommon sensor boundary* is a line depicted by a series of grid coordinates, grid line, phase line, or major terrain feature that divides target acquisition search areas into radar acquisition management areas (FM 3-09).

4-18. The CSB should be planned and managed by either the FFA or counterfire HQ. The following factors influence the placement of the CSB:

- Availability of attack systems.
- Range of FS systems.
- Range and operational mode of WLRs.
- Known and suspected locations of enemy indirect fire systems.
- Type and availability of munitions.
- Friendly maneuver operations.

4-19. The location of the CSB is adjusted based on the tactical situation. Repositioning of WLRs, changing enemy situations, and the establishment or deletion of FSCMs may dictate adjustment or deletion of the CSB.

4-20. Figure 4-3 on page 4-8, depicts an example of a standard use of the CSB in a linear division operation. The AN/TPQ-50 WLRs would transmit their acquisitions to the appropriate FA BN counterfire operation section, as they are all tracking short of the CSB. The AN/TPQ-53 WLRs' range can acquire targets in adjacent units' AO and beyond the CSB. All acquisitions from the BCTs AN/TPQ-53s should be transmitted to the managing COS. The COS will then assess the target. If the target is located within the BCT boundaries and short of the CSB, then the BCT's FA BN will action the target. If the target is located outside of the BCT boundaries, or beyond the CSB, then the target will be transmitted to the counterfire HQ's TPS.

4-21. In Figure 4-3 the CSB is tied to the FA BNs' C battery (BTRY) planning range. Assuming that C BTRY is equipped with 155 millimeter (mm) cannons, the CSB planners place the CSB is a position that will allow the BTRY to engage any target acquired short of the CSB. This can also be a forcing function for the BCT FSCOORD and FA BN staff to ensure that their counterfire shooters are in a positon to support the BCT's counterfire fight.

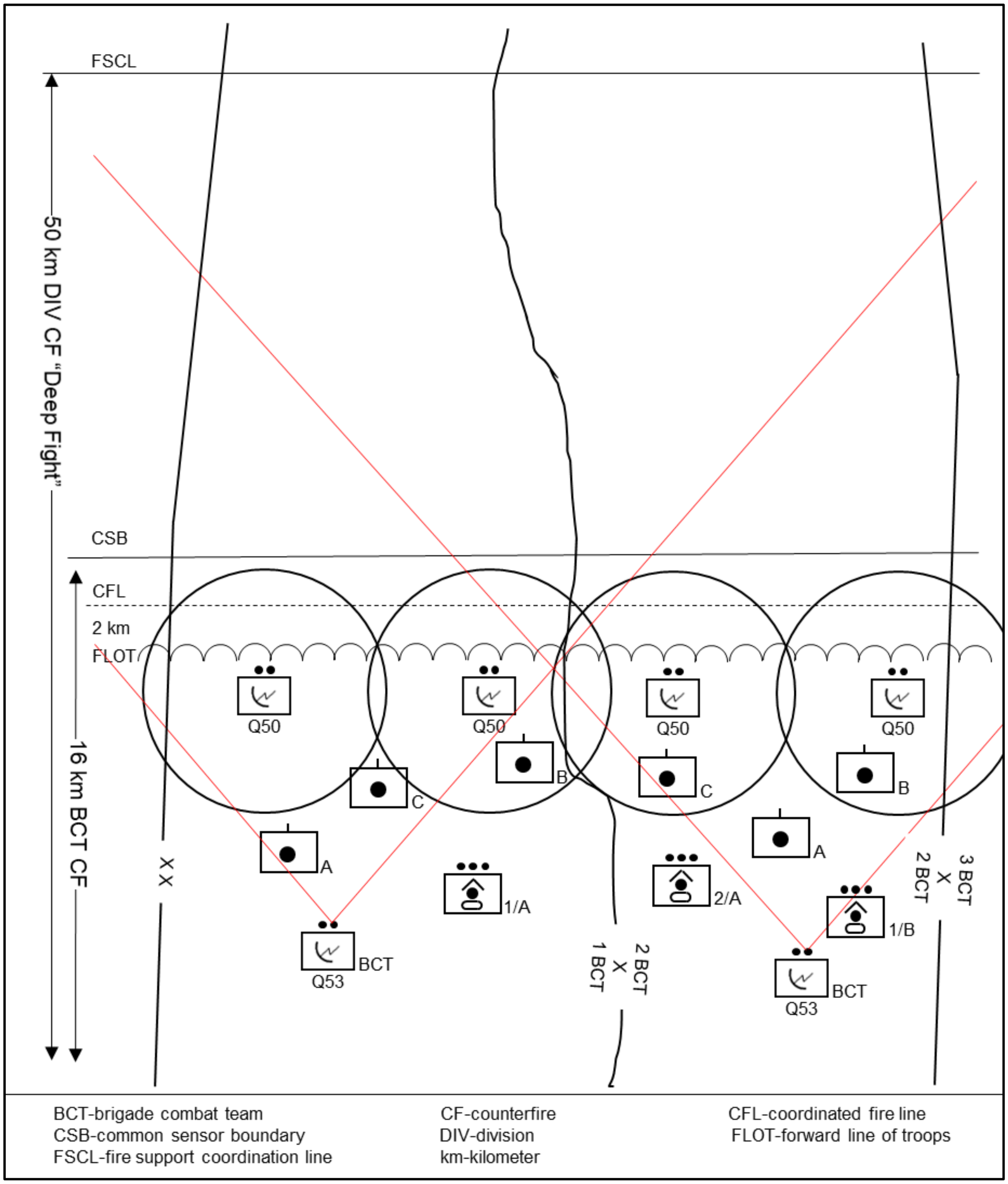

Figure 4-3. Linear common sensor boundary example

4-22. Figure 4-4 on page 4-9, depicts an example of an offensive operation that requires the counterfire HQ to assume a larger counterfire role within a BCT's AO. The flow of acquisitions would be the same as previously covered in the example of Figure 4-3. The CSB has been placed along 2nd BCT's CFL. The breaching BCT's (2nd BCT) FS systems will be supporting the breaching elements with obscuration, call for fire, and pre-planned targets. The DIVARTY/FAB should assume a higher level of control and involvement of the counterfire fight within 2nd BCT's AO. This will relieve pressure on the BCT's FA BN, and mitigate missed opportunities for counterfire.

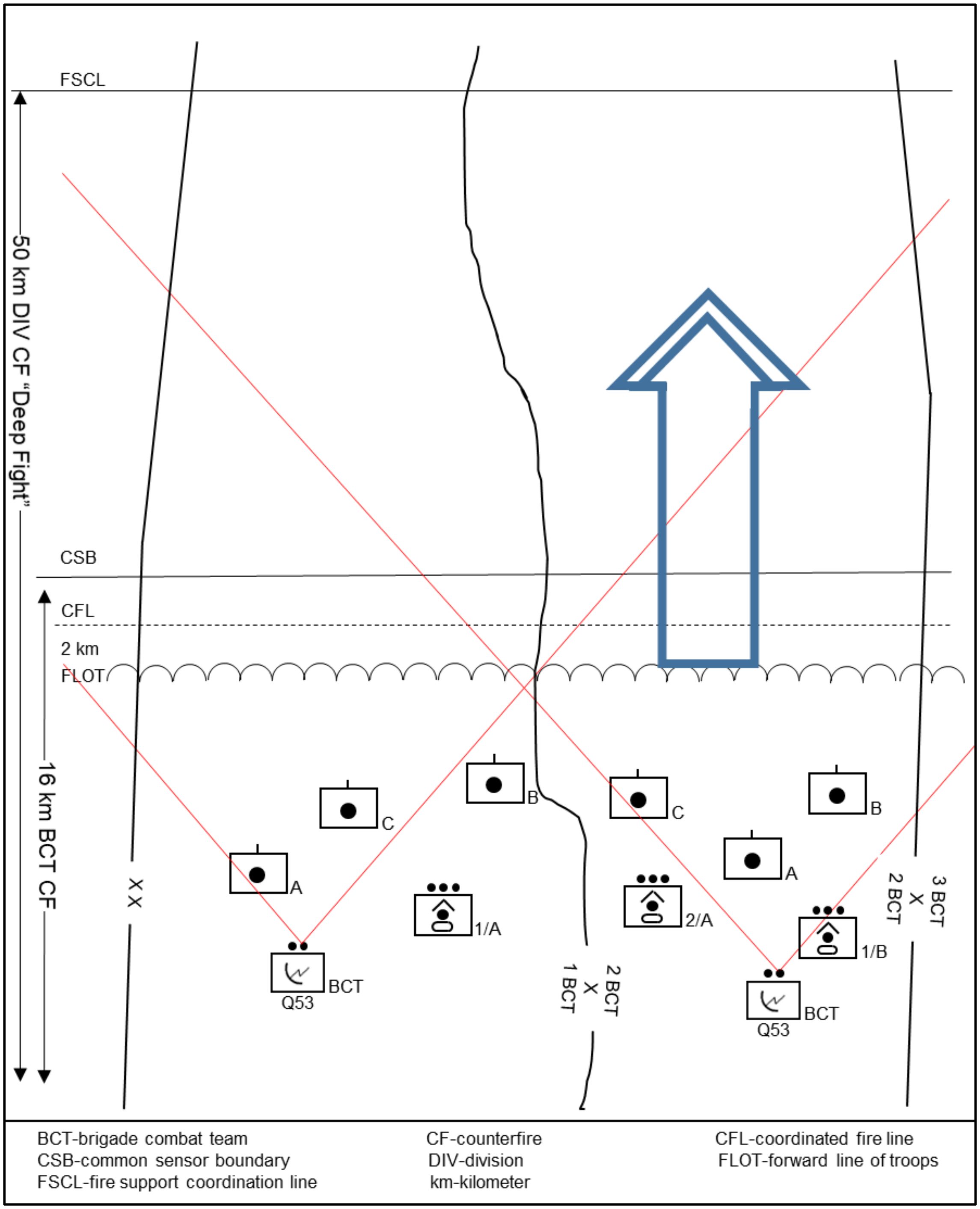

Figure 4-4. Common sensor boundary in support of offensive operations

ZONES

4-23. There are two types of zones (priority and censor). Priority zones are further broken down into three sub-zones: CFZ, call for fire zones (CFFZ), and artillery target intelligence zones (ATIZ). Censor zones (CZs) are further broken down into to two sub-zones (air and ground).

4-24. Zones are a means of prioritizing acquisitions within the radar sectors of search. Zones focus WLR acquisitions on the supported commander's priorities. A zone is a geometric figure placed around an area that designates the area as more, or less, important.

CRITICAL FRIENDLY ZONE

4-25. A *critical friendly zone* is a friendly area of coverage employed by weapons locating radar which the maneuver commander designates as critical to the protection of an asset whose loss would seriously jeopardize the mission (FM 3-09). When the WLR predicts a round will impact in a CFZ, the WLR generates a call for fire message which provides the POO and POI. This happens automatically unless overridden by the radar operator. A call for fire message priority 1 is transmitted to the COS or TPS. The CFZ provides the most responsive submission of targets to the FS system. The CFZ does not have to be located within the WLR's sector of search however, the WLR needs sufficient track volume to calculate the POO and POI.

CALL FOR FIRE ZONE

4-26. A *call for fire zone* is a weapons locating radar search area from which the commander wants to attack hostile firing systems (FM 3-09). A CFFZ is placed around a known or suspected enemy FS position identified as a HPT. A target identified in a CFFZ generates a call for fire priority 2 message. The commander may upgrade the priority, to priority 1. A CFFZ must be in the WLR's sector of search.

ARTILLERY TARGET INTELLIGENCE ZONE

4-27. An *artillery target intelligence zone* is a weapons locating radar search area in enemy territory that the commander monitors closely to detect and report any weapon ahead of all acquisitions other than those from critical friendly zones or call for fire zones (FM 3-09). Any weapon detected in an artillery target intelligence zone will generate an artillery target intelligence message. The ATIZ is developed during the MDMP and contributes to pattern analysis. Acquisitions from an ATIZ may warrant changing the ATIZ to a CFFZ.

CENSOR ZONE

4-28. A *censor zone* is an area from which the weapons locating radar is prohibited from reporting acquisitions (FM 3-09). A CZ is normally placed around friendly weapon systems to prevent them from being acquired by friendly WLRs. The CZ is most often used in noncontiguous situations or during cross FLOT operations, raids, or infiltration. The *forward line of own troops* is a line that indicates the most forward positions of friendly forces in any kind of military operation at a specific time (JP 3-03). Care must be used when employing a CZ since the WLR ignores all acquisitions coming from the CZ. This remains true even if the hostile weapon is firing at a unit inside a CFZ. When using a CZ careful planning and characteristic understanding must be considered.

DEVELOPING ZONE DATA

4-29. Zone data must support the tactical plan and satisfy the WLRs requirements for data input. The counterfire and targeting officers use the MDMP to develop zone data. The data is entered and transmitted from the COS/TPS to the WLR using the automated RDO. The following considerations apply when developing zone data:

- A zone must be defined by a minimum of three and a maximum of six coordinates.
- If using a circular zone include center grid and radius desired.
- Only a CZ and CFZ may overlap while simultaneously active.
- Grid coordinates must be listed and entered sequentially.
- Active zone coordinates cannot fall outside the sector of search (except for CFZ).

ZONE PLANNING

4-30. Radar zones are managed to comply with the commander's priorities. Understanding the commander's plan, and integrating FSOs into the development, refinement, and triggering are key to successful radar zone management. Planning guidance may be found in a number of different documents. These locations include the fires paragraph, tasks to subordinate units, and coordinating instructions of the operations plan or order, and the FS annex. Information from these sources provides the necessary guidance and information to initiate zone planning.

4-31. The following procedure provides a list of activities essential for successful zone planning:

- Prioritize AO and scheme of maneuver events for zone planning based on the commander's guidance.
- Develop zones during COA development and the wargaming (COA analysis) process.
- Approve and allocate zones to subordinate FSEs that support the scheme of maneuver, meet the commander's priorities, and facilitate the engagement of HPTs.
- Develop and assign decision points as triggers for the execution of planned zones.
- Incorporate decision points (triggers) for planned zones and WLR movement into the appropriate decision support template, synchronization and execution matrices, and information collection plan.
- Rehearse planned zones during combined arms, FA technical, and FS rehearsals.
- Refine zones during execution as the situation develops or the scheme of maneuver changes.
- Develop positioning guidance for the WLRs that optimizes the probability of acquisition and supports the coverage of planned zones.
- Incorporate ACM planning.

ZONE MANAGEMENT

4-32. The counterfire or targeting officer is responsible for employing the WLRs and zone management considerations. This involves planning the counterfire operation and fully understanding the WLR support requirements.

4-33. Basic guidelines for zone management include:

- Allocate a certain amount of zone nominations to subordinate units.
- Conduct bottom up refinement that reflects the developed situation template, and scheme of maneuver.
- Develop triggers to activate and deactivate zones.
- Manage zones by resolving duplication.
- Time phasing zones by priority.
- Include zones in the FS execution and synchronization matrices.
- Include zones in the RDO or radar execution matrix.
- Refine and update zones as operations progress.

STAFF RESPONSIBILITIES

4-34. Responsibilities for WLR employment and zone management must be a fixed responsibility to focus the planning process and execution. The supported commander is ultimately responsible for counterfire. Usually the FSCOORD is the executive agent for executing the counterfire operations. Zone management responsibilities include:

- FSCOORD
  - Translates the commander's intent for engagement of enemy indirect fire weapons.
  - Ensures counterfire priorities are articulated in the fires paragraph to the operations order.
- Targeting and counterfire officer:
  - Synchronizes all WLR and zone development to facilitate targeting.
  - Ensures planned zones are synchronized with the applicable elements of the HPTL.
  - Allocates, verifies, and updates zones to ensure the commander's intent for engagement is met.

  - Assigns cueing agents corresponding to named areas of interest, target areas of interest, priority intelligence requirements, and information requests associated with planned zones.
  - Provides guidance to lower echelon targeting and counterfire officers.
  - Ensures priorities and triggers are developed for the activation and inactivation of zones.
  - Integrates planned triggers into the appropriate decision and synchronization matrices.
  - Incorporates planned zones into the combined arms and FS rehearsals.
  - Incorporates decision points, planned zones, and WLR movement into the decision support template and synchronization matrix.
  - Monitors range capabilities of both the WLRs and engagement systems to ensure positioning and movement supports the counterfire plan.
- Operations officer:
  - Ensures the TA Tab portion of the FA BN operations order includes coordination measures for zone development.
  - Recommends attack guidance and firing unit assignment to support the responsive engagement of WLR acquisitions.
- FSO:
  - Recommends priority zones to support the operation plan.
  - Nominates zones to the commander for approval and priority.
  - Develops precise triggers along with identifying and recommending cueing agents for priority zones.
  - Ensures the developed triggers are incorporated into the supported unit decision support template and synchronization matrix.
  - Establishes ownership for the zones.
  - Ensures any changes to the scheme of maneuver are compared against the planned zones.
- Intelligence officer:
  - Recommends CFFZs based on the template of enemy artillery positions and known intelligence data.
  - Recommends zones as the information collection plan develops or the scheme of maneuver changes.
- Assistant counterfire officer and counterfire NCO :
  - Ensures the capabilities and limitations of the WLR system are considered during the planning process.
  - Selects WLR positions that support the coverage of the planned zones and facilitates movement to support the scheme of maneuver.
  - Performs technical zone management of the radar employment plan.

4-35. Figure 4-5, on page 4-13, depicts an example of zone placement and management for a division breaching operation. The numbers next to each zone type in the figure coincide with the BCT AN/TPQ-53 WLR responsible to build and observe that zone. CFFZ 1 means that 1BCT AN/TPQ-53 must build and observe that zone. Due to the nature of the operation, some zones will be built and observed by multiple WLRs. The CFZ over the breach site is one such zone. This zone will be built and observed by all three of the BCTs' AN-TPQ-53 WLRs. Because it is a CFZ, it is not required to be within the search fence of the 1st and 3rd BCTs' AN/TPQ-53 WLRs. Lastly, the artillery battery directly in front of 2nd BCT's WLR has both a CZ and CFZ that are overlapped. This will ensure that while the battery is conducting fires, the WLR will not use processing power acquiring friendly fires from the battery.

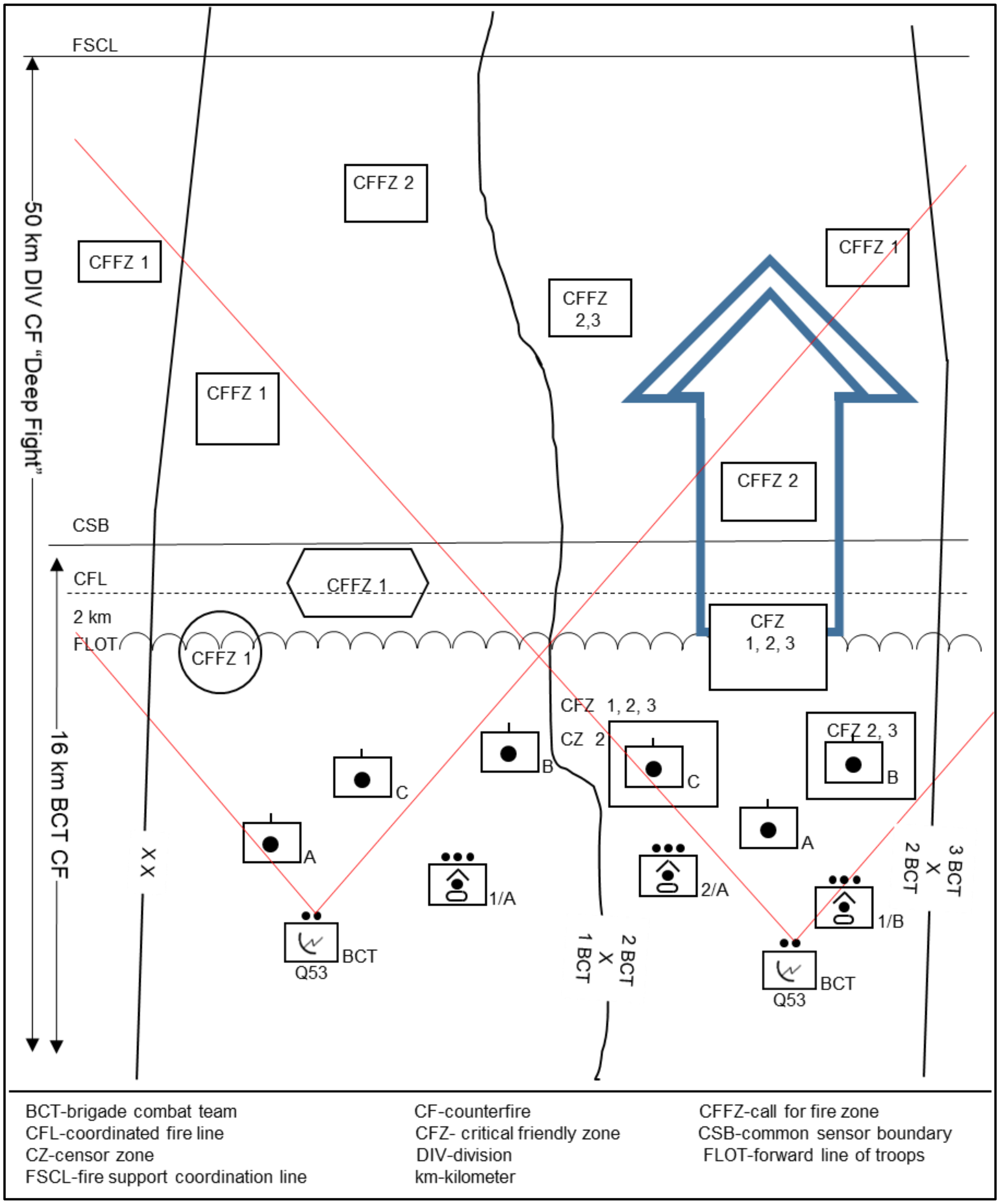

Figure 4-5. Zone management example

AIRSPACE COORDINATING MEASURES CONSIDERATIONS

4-36. When planning zones it is critical to incorporate the creation of ACMs that will facilitate hasty air clearance. There are several ACMs to consider with regards to counterfire, such as coordinating altitude, coordination level, and restricted operations zone (ROZ). See FM 3-09 for more information on the use of ACMs with FS.

4-37. A *restricted operations zone* is airspace reserved for specific activities in which the operations of one or more airspace users is restricted (JP 3-52). The use of a ROZ is particularly useful for CFFZs. Creating a ROZ that is tied to a CFFZ will enable the COS/TPS to clear airspace rapidly once a target has been acquired within a CFFZ. The ADAM element should be nested in the planning of zones in order to request the ROZ creation in accordance with the Air Tasking Order time request standards. It is important when requesting and using a ROZ to do so sparingly. Being a good steward with airspace usage is a large part of the overall friendly air battle.

4-38. A common technique is for a ROZ to be requested and on order for activation. Once a target is acquired within a CFFZ, the COS or TPS will request activation of the corresponding ROZ in preparation for another acquisition. When the WLR acquires a second target from the same CFFZ, the ROZ will be activated and the airspace will now be precleared for counterfire. Using pattern analysis to predict the frequency and placement of enemy firing is critical to this technique. Figure 4-6 depicts the placement of two on order ROZs in association with their respective CFFZs.

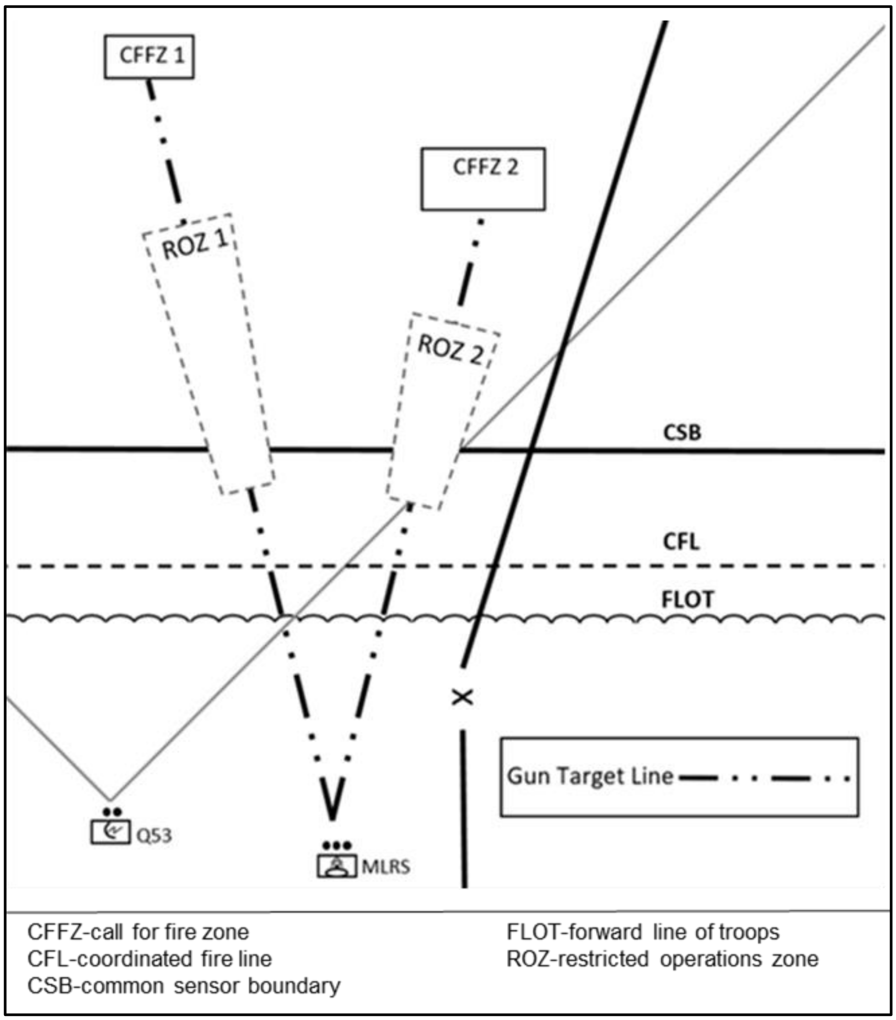

Figure 4-6. Airspace coordinating measures and zones

CUEING

4-39. Cueing is the process designed to prompt or notify the WLR to begin radiating. The Cueing agent is a C2 element that has the authority to direct the WLRs search area and search time. Cueing authority should be limited with a clear chain of succession to eliminate multiple cueing agents trying to direct the WLR which can cause confusion or conflict of mission. Determining when and how to best cue the WLR is one of the most difficult planning decisions. This is due to advancements in the adversary's electronic intelligence and electronic attack systems that are now able to instantaneous/near-instantaneous acquire and engage friendly WLRs from the moment of active cueing. Continuous cueing is not recommended in a high EW threat environment. Additionally, implementing an on-off schedule (such as 30 seconds on /30 seconds off) may not be an effective survivability practice when engaged with a peer/near-peer adversary due to advancements in technology. The targeting, counterfire, and intelligence officers' recommendation of cueing guidance to the commander is based on the enemy's current electronic intelligence capability. Both authority to cue and priority for cueing requirements must be clearly understood and documented.

4-40. Planned random schedules based solely on hours of the day are not recommended and are usually ineffective. Unnecessary cueing subjects the WLR to enemy direction finding. Therefore, cueing should be event driven to provide maximum support during critical phases of the battle.

4-41. The controlling HQ establishes cueing guidance, to include authorized cueing agents, communication links, and conditions under which the WLR may be cued. Radar cueing instructions are listed in the RDO and the TA Tab. When cueing agents, other than FA assets are designated, cueing guidance should be given in the base order as coordinating instructions or tasks to subordinate units.

4-42. The critical factor when planning WLR cueing is responsiveness. Cueing should allow the WLR to locate enemy positions during initial volleys of fire, preferably the first rounds. There are two techniques for cueing; situational (proactive) and demand (reactive). Situational and demand cueing may be used separately or in combination.

Situational Cueing

4-43. Situational cueing is the preferred technique for cueing WLRs and is the most responsive. This method ties cueing to events or triggers that are determined during IPB and the planning process. For example, during the execution of offensive operations an event or trigger may be a breaching or air-assault operation. When executing defensive operations, cueing may be tied to suspected enemy phases of fire depicted on the decision support template. Situational cueing focuses the WLR on the commander's intent and what is critical.

Demand Cueing

4-44. Demand cueing is the activation of WLRs once the enemy is known to have begun firing. For demand cueing to be effective, cueing agents must be designated and a responsive communication system between the cueing agents and WLR established. Specific cueing guidance must also be established to fully exploit the WLRs capabilities and minimize or eliminate unnecessary radiation. The situation will dictate who best can cue the WLR and the specific conditions under which it should be cued. Possible cueing agents may include:

- Forward observers.
- Aerial observers.
- Scouts.
- Intelligence officers.
- FSOs.
- Counterfire officers and targeting officers.

4-45. Cueing must be based on real-time information so that the WLR has a high probability of tracking projectiles. Consider the situation when a task force FSO is designated as a cueing agent. The following events occur:

- The task force assembly area receives hostile artillery fires.
- The task force FSO immediately cues the WLR.
- The WLR responds and locates the hostile artillery firing on the task force.
- The WLR transmits a call for fire to the COS or TPS.
- The FA BN executes the call for fire.

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Appendix A
Automated Target Data Processing

This appendix explains how the AFATDS processes target indicators and suspect targets. It provides the detailed information necessary to effectively use AFATDS to manage the processing of targets and target indicators. This appendix includes AFATDS target generation functions, target indicator processing, suspect target processing, target damage assessment, file maintenance, and target purging. This appendix also provides a brief introduction to JADOCS.

GENERAL

A-1. The amount of processing required to develop a target varies extensively. In its simplest form, target data processing is the passing of a target from a known, accurate, and reliable source to the FSEs for attack within established attack guidance and target selection standards. In its most complex form, it is the collation of target indicators and suspect targets from diverse sources into a target identification and location accurate enough to justify attack.

A-2. Target data is transmitted and processed automatically according to the commander's guidance and target selection standards stored in the AFATDS computer.

A-3. AFATDS uses the target generation function to automate the tasks performed by the targeting and target processing elements. The target generation function consists of a series of processes that compare and combine target information to generate targets and update the suspect target list and target indicator file. Target generation takes suspect targets, artillery target intelligence targets, and target indicators (such as shell reports) as inputs, and through several processes eliminates duplication, determines and refines suspect target locations, and generates targets. The target generation function can be turned on or off based on the targeting needs in a given tactical situation. The outputs of this function are generated targets and an updated suspect target list and target indicator file. Some key definitions related to target generation include:

- Target indicators are directional information that forms a ray (line) from a given point, in a given direction, to a derived maximum distance along which a possible enemy target may be located. Examples of target indicators include shelling, flash, and jam strobe reports. A target indicator will have a target type.
- Target data is grid producing information received at AFATDS via a fire request or information and intelligence. Target data is also produced by AFATDS. For example, AFATDS uses intersecting target indicator rays to determine a grid location, thereby generating target data.
- Target data that has passed target selection standards and meets the commander's criteria for reliability, accuracy and timeliness will be considered worthy of attack consideration. This target data will undergo further mission processing to determine if a fire mission will be initiated based on comparisons to additional targeting and attack guidance, relative value to other targets, and if attack systems are capable of engaging the target.
- A suspect target is data that has failed selection standards and may not be worthy of attacking because it does not meet the commander's criteria for reliability, accuracy, or timeliness. Suspect targets are further refined until they pass target selection standards and the operator initiates a fire mission on the suspect target, or the suspect target decays (based on target decay guidance) and is deleted from the suspect target list.

TARGET INDICATOR PROCESSING

A-4. The FA BN FSE receives a shelling report from one of the unit's observers. The FA BN FSO may direct that the report be forwarded to the FAB or DIVARTY (or the designated counterfire HQ).

ADVANCED FIELD ARTILLERY TACTICAL DATA SYSTEM AUTOMATIC PROCESSING OF TARGET INDICATORS

A-5. AFATDS always performs certain functions when a target indicator is initially received, whether it was received from an observer or created through operator input. When AFATDS receives target indicator data, some of the information required to process the indicator may or may not be present. AFATDS automatically determines missing information based on the reporting observer's unit data and default data files. Missing information is determined as follows:

- Target Indicator Number - If the received target indicator does not have a target indicator number, one is assigned based on the next available target indicator number from the target indicator number block. The target indicator number must always begin with "II". If a target indicator is received with a number that does not begin with "II", the number will automatically be replaced with an "II" number. AFATDS maintains a target indicator numbering block, which the operator cannot edit. This block goes from II0000 to II9999.

Note. When you enter a target indicator into AFATDS do not enter a target number (AFATDS will automatically number the indicator).

- Target Indicator Decay date time group - If the target indicator decay date time group for the target indicator is not provided, AFATDS computes the date time group by adding target decay guidance for the target type to the date time group of acquisition or report. The date time group of the report will default to the current time if not provided.
- Target Type - If the received target indicator does not specify a target type, one is assigned based on the following rules. If the caliber of the mortar is reported, AFATDS will determine the target type as shown in table A-1.

Table A-1. Mortar caliber target type mapping

Caliber	***Target Type***
108 - 150mm	Heavy
61 - 107mm	Medium
Less than 60mm	Light
Not given	Unknown
mm – millimeter	

- Sensor Directional Error - If the target indicator does not include the sensor directional error (mils) then it is determined based on the default value for the reporting sensor's unit data or unit type.
- Sensor Location - If the sensor location at time of report is not provided, then that sensor unit's most current location is used to determine this value. If no location for the reporting unit is available, the target indicator report is discarded.

TARGET SIMILARITY

A-6. AFATDS uses target similarity to determine if targets should be combined, or if target indicators are close enough to generate target data. The matrix number is the individual number for that target type. The matrix is also used for target duplication checks.

DIRECTION AND DISTANCE

A-7. The direction and distance of the target indicator ray is determined by:

- Direction of ray originating from the shell impact location.

- Length of ray is based on the following:
  - Use length provided, if given.
  - If a flash to bang is provided, use distance = 350 x time (seconds). The result is the length of ray in meters.
  - If length or flash to bang time is not provided, the ray length is based on the target type.

Display

Target indicators are displayed as "fans" based on the sensor directional error. Figure A-1 shows a target indicator with a 10km length and a sensor directional error of 10 mils.

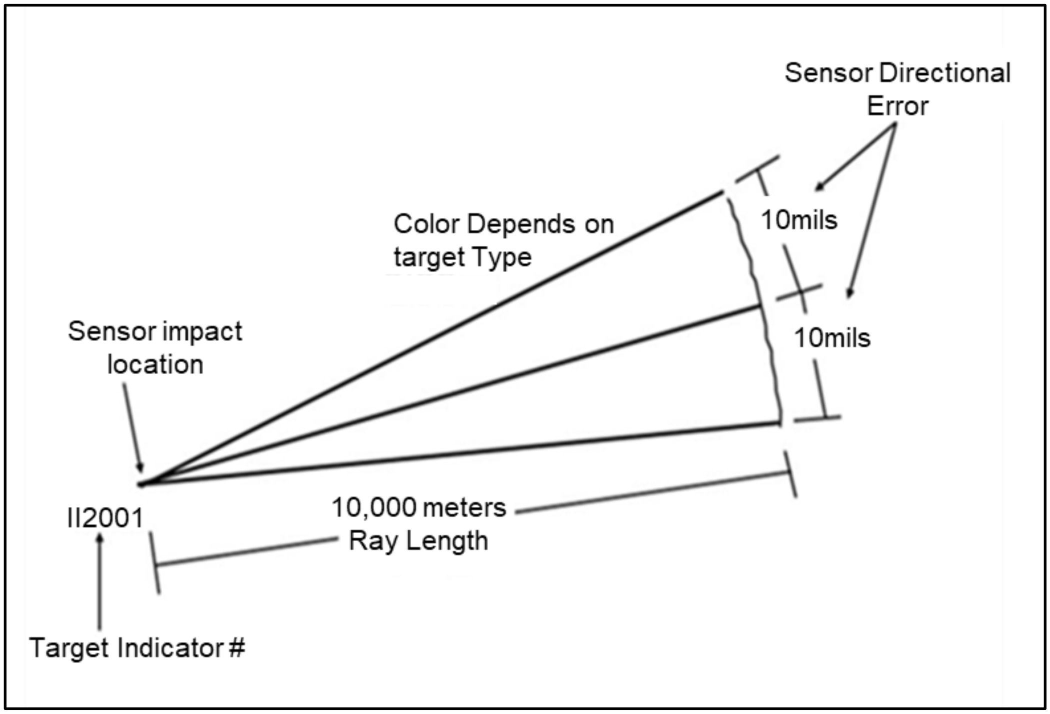


Figure A-1. Target indicator display

Note. Each target indicator ray has an assigned color based on target type.

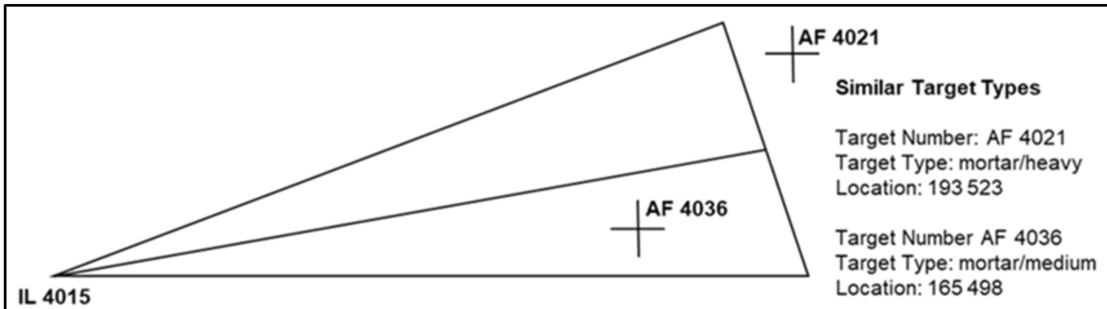
TARGET INDICATOR FUNCTION

A-8. Based on the tactical situation, the AFATDS operator may or may not want the system to run the target indicator function. AFATDS allows the operator to turn target indicator processing on or off. When the target indicator processing is "off", AFATDS adds the target indicator to the target indicator list with no additional processing or comparisons. When target indicator processing is "on", AFATDS performs the following checks (in order):

- Compares the target indicator against the current (but non-active) target files (targets on the "On-call", "Suspect", "Planned", and "Inactive" target lists). If the indicator ray covers a similar target, the FSE with target indicator processing duty is notified of the "Target Indicator Match" via an alert and reviews information on the target indicator and all matched targets. The operator may take various actions from this alert:
  - Selectively initiate fire mission(s) against the target(s) indicated as a match. This will open the initiate fire mission screen already filled out for the selected target.

- Add selected matched target(s) to an existing fire plan. This will place the targets on the selected fire plan.
- Display the target indicator fan-target comparison. This graphically displays the indicator fan and the associated matched target(s) on the map.
- Selectively update matched target(s) with a new "last updated" value based on the target indicator date time group of acquisition report.
- Delete the target indicator. This will discard the received target indicator data and will not add it to the target indicator list.
- Continue processing the target indicator. This will add the target indicator to the target indicator list for possible combination with existing target indicators.

- Compare the target indicator with other target indicators already on file. If the target indicator did not match a target or the operator selected "Process target indicator" from the target match window, AFATDS will add the new target indicator to the target indicator list and determine if it can be combined with existing target indicators. See figure A-2, for an example of target comparison. The following rules are used in this comparison:
  - The new target indicator is compared against existing target indicators in the target indicator file that have a similar target type. Only target indicators that have not passed their decay date time group are considered.
  - When target indicator rays of three or more of the compared target indicators intersect to form a point or common area, and all points are located within 400m, AFATDS automatically combines the rays and generates a new target number and passes the target to the target selection standards check for further processing. Combined target indicators are deleted from the list.
  - If no match is found, the new target indicator is added to the target indicator file. The operator can purge the target indicator list of target indicators when their "decay time" date time group is passed. To do this simply select "automatically purge" option on the target indicator list window.



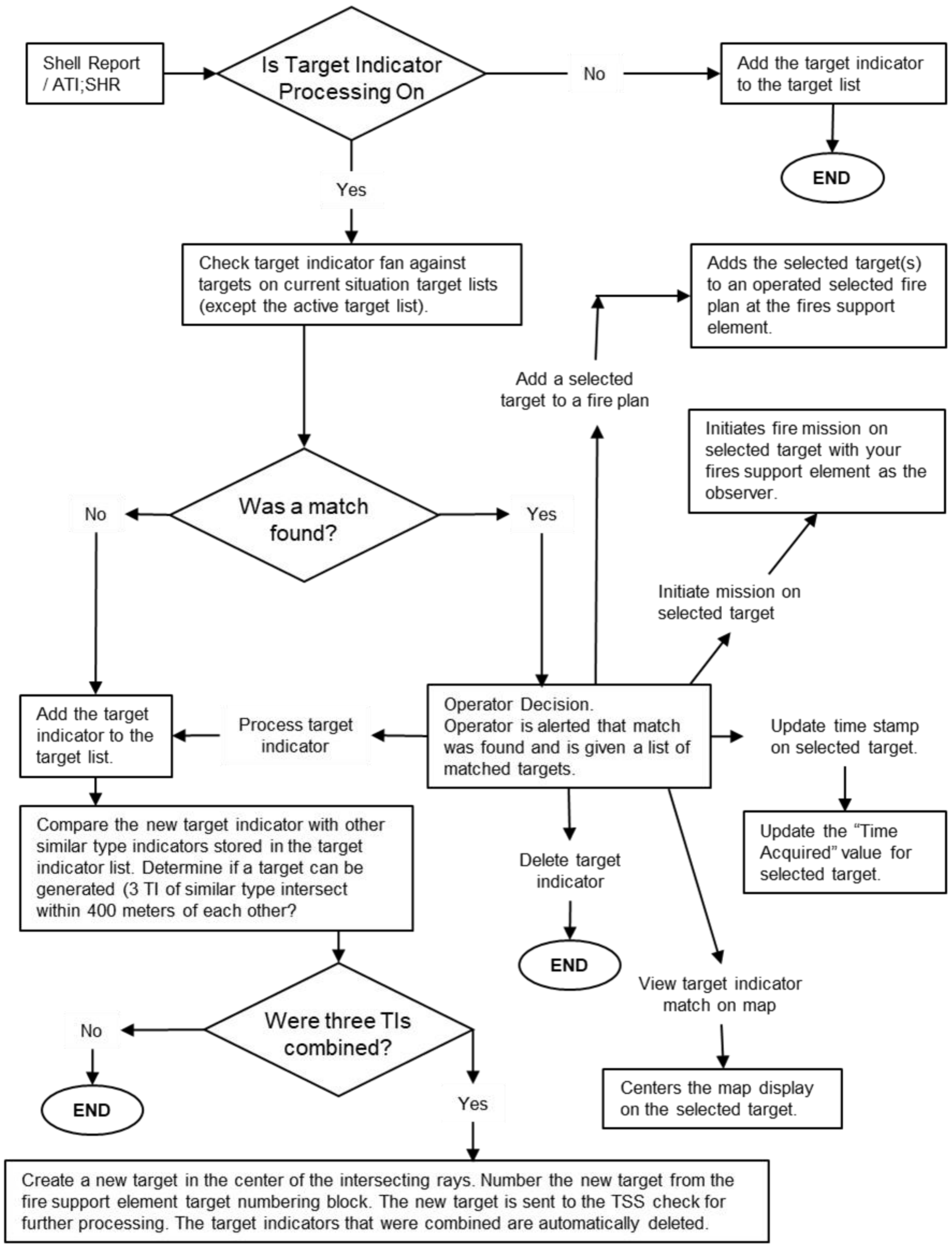
Target Indicator Number: IL 4015
Reporting Sensor ID: A FIST 1-77 IN
Sensor/Impact Location: 123 456
Direction to Target: 0980
DTG of Acquisition/Report: 171500Nov01
Target Description:
Target Type: mortar/heavy
Number of rounds: 20
Weapon/Signal Type: mortar
Duration of Shelling/Emission: 5 minutes
Flash to Bang Time:
Length of Ray: 6000 km
Sensor Directional Error: 10 mils
Target Indicator Decay DTG: 171630Nov01

Target Indicator Description:
Target type: mortar/heavy
Number of rounds: 20
Weapon/Signal Type: Mortar
Duration of Shelling/Emission: 5 minutes
Flash to Bang Time:
Length of Ray: 6000 km
Sensor Directional Error: 10 mils
Target Indicator Decay DTG:
171630NOV01

DTG-date time group	FIST-fire support team	ID-identification
IN-infantry	km-kilometer	NOV-November

Figure A-2. Target comparison

A-9. Figure A-3 provides a summary of the possible results of target indicator processing.



ATI – artillery target intelligence, SHR – shell report, TI – target indicator, TSS – target selection standard

Figure A-3. Target indicator processing.

SUSPECT TARGET PROCESSING

A-10. Suspect targets represent target information that has not passed target selection standards. This section discusses how AFATDS processes suspect targets after target selection standards failure. The operator may turn suspect target processing "on" or "off". When it is turned off, all suspect targets are simply added to the suspect target list with no further processing. When it is turned on, AFATDS evaluates each suspect target against other suspect targets to combine the new suspect target with an existing suspect target and generate a target with a better target location error and more current date time group. AFATDS applies the following considerations when identifying suspect targets for combination and applying the associated target data for the "new" (combined) target:

- Decay Time. Only suspect targets that have not passed their decay date time group are considered for combination.
- Target Type. Only targets with a similar type will be considered for combination. For example, an "Artillery, Unknown" target would not be combined with a "Building, Metal" target.
- Target Size. The target size and TLE, for the new or extracted suspect targets, is used to determine overlap. If an overlap exists between the new target and a single existing target and the overlap area meets or exceeds the operator established percentage of overlap required, then the two targets match. Basically, the overlap percentage tells AFATDS how close two targets must be (considering the area and TLE of each target) in order to combine them. Figure A-4 shows some examples of this comparison.

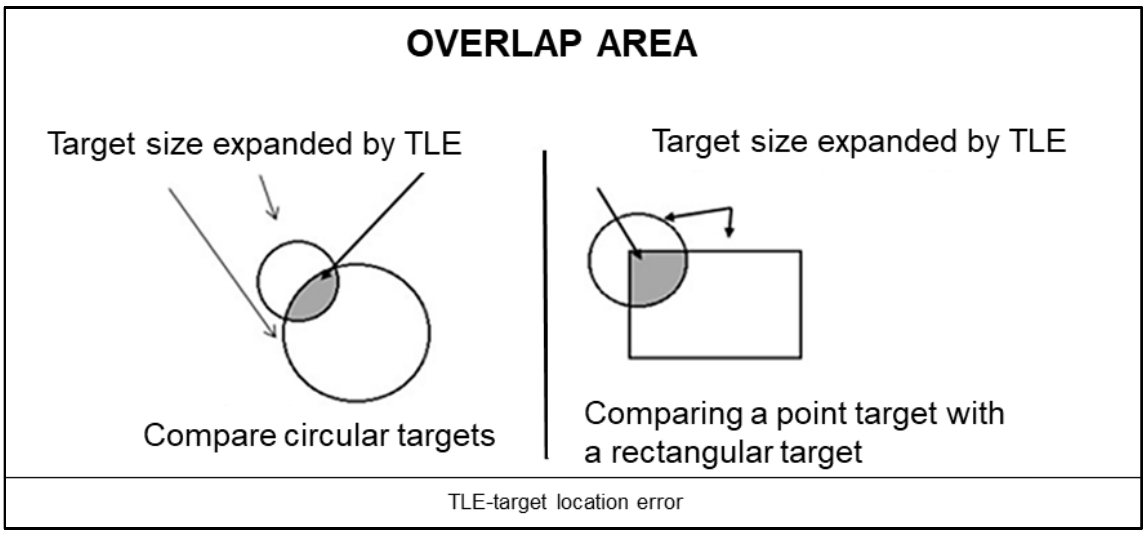


Figure A-4. Suspect target overlap

A-11. If multiple overlaps exists between the new suspect target and two or more existing suspect targets and each overlap area meets or exceeds the operator established percentage of overlap required, then the following rules apply:

- The suspect target with the greater degree of similarity to the new suspect target is combined with the new suspect target.
- If the degree of similarity is the same, the suspect target with the greater degree of overlap with the new suspect target is combined with the new suspect target.

A-12. When two targets are combined, the new target is sent to target selection standards for further processing. Both of the "parent" targets (the two that were combined) are removed from the suspect target list. The operator may specify the "Overlap percent to be used by the AFATDS when considering targets for combination. A larger percentage (for example 75 percent) will result in fewer, but more accurate combinations than a smaller percentage (such as 25 percent). As with the target indicator list, the operator may decide to have the suspect target list purged of targets when their decay time date time group is passed. To do this, simply select the "automatically purge" option on the suspect target list window. Finally, the operator may see the targets on the suspect target list that was generated by AFATDS (these will be the targets that have a "yes" in the "Combined" column of the list). There is an option to "not combine" a combined target if desired. Figure A-5 illustrates multiple target overlap.

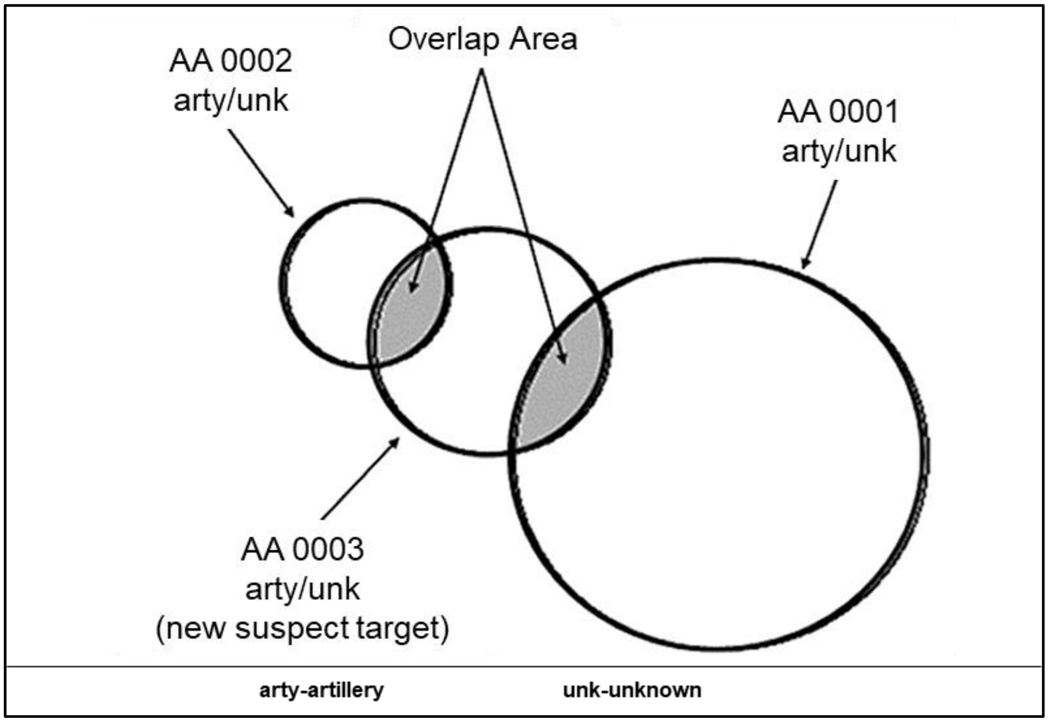


Figure A-5. Multiple targets overlap

TARGET DAMAGE ASSESSMENT

A-13. Target damage assessment is a function of AFATDS that allows target disposition to be entered by the observer on the mission fire request after the attack of a target. Target damage assessment can be flagged in the commander's guidance of AFATDS, causing targets to remain active until disposition is received from the observer for the particular target. Target damage assessment in AFATDS guidance is target type specific. Therefore, it is not very useful in the determination of target damage assessment on a particular target generated from the suspect target processing function. Flagging an individual target type in the target management matrix will cause that target type to remain active until the reporting sensor sends a mission fire request for that target that contains target damage. A target generated by the suspect target or target indicator processing function will have the processing AFATDS station as the observer, which seldom has eyes on the target.

FILE MAINTENANCE AND TARGET PURGING

A-14. File maintenance for suspect target and target indicator processing consists of purging targets that are no longer valid. This can be done manually or automatically. Manually deleting targets from the suspect target or target indicator list involves selecting the target list requiring maintenance and reviewing individual targets, and validating or deleting individual targets from the target list. The most effective method of performing file maintenance is to set target purging to automatic, which automatically purges targets based on the target decay time established in the target selection standards. This task is accomplished by selecting "Automatic Purge" on the suspect target or target indicator list.

JOINT AUTOMATED DEEP OPERATIONS COORDINATION SYSTEM

A-15. The JADOCS is a software application that presents and manipulates command, control, communications, intelligence, information, and communications interfaces to and from various systems to obtain, coordinate, and disseminate information. It maintains a comprehensive fires common operation picture, through the visualization of friendly air and land tracks, including artillery and radar positions via AFATDS, as well as hostile air tracks received from the air defense systems integration server.

A-16. JADOCS maintains comprehensive target entity databases including access to the modernized integrated database as well as enemy and friendly order of battle databases received digitally from the intelligence distributed common ground station - Army. This digital integration of United States and allied fires provides a forum for nominating, vetting, and validating suspect targets, determining methods of engagement, conducting target are risk mitigation in a coordinated and collaborative digital environment for both deliberate and dynamic targeting. JADOCS can be utilized on any classification of network and resides at BCT and above. JADOCS works with AFATDS via a direct server-client interface to execute both deliberate and dynamic targeting.

Appendix B
Friendly Fire Log

This appendix discusses the secondary mission of the WLR which is to support friendly fire elements. It also provides an example of the radar friendly fire log and instructions for filling it out.

FRIENDLY MISSION

B-1. Friendly fire missions are missions that are fired to conduct weapons registration with nonstandard conditions, or to validate firing tables and calculations for existing conditions. This includes actual burst datum plane and predicted impact location data.

B-2. The AN/TPQ-36 performs this mission only when the commander deems it absolutely necessary. The reason is that the secondary mission takes the AN/TPQ-36 away from its primary mission of locating hostile weapons. In addition, it exposes the WLR location to hostile EW systems. Because the AN/TPQ-36 WLRs cannot radiate in friendly fire mode and hostile fire mode at the same time, the commander must issue specific guidance as to when and how friendly fire mode will be used. This determination is made based on METT-TC, availability of observers, and the ability of the supported unit to meet the requirements for accurate fire.

B-3. The AN/TPQ-53 WLR can perform hostile and friendly missions simultaneously. The AN/TPQ-50 does not perform friendly missions. Effective use of zones and prior coordination with the FDC may be used to separate hostile from friendly acquisitions.

FRIENDLY FIRE LOG

B-4. The radar operator uses DA Form 5310 (*Radar Friendly Fire Log*) to record all the pertinent data for any type of friendly fire mission. The form is designed to be completed with input from the fire direction center. DA Form 5310 should be used anytime a friendly fire mission is sent by voice, digital, or when printer is not operational. See figure B-1 for an example DA Form 5310 on page B-2.

RADAR FRIENDLY FIRE LOG
(TO BE USED WITH WEAPON LOCATING RADARS)
For use of this form see ATP 3-09.12; the proponent agency is TRADOC.

SECTION I. MESSAGE TO OBSERVER

BLOCK				
1	RADAR SUBMODE *(CHECK APPROPRIATE BOX(ES))* ☐ ARTILLERY/CANNON IMPACT PREDICT ☑ MORTAR IMPACT PREDICT ☐ ROCKET IMPACT PREDICT ☐ ARTILLERY AIRBURST, HIGH BURST			
	UNIT A/3 FA, 2/52 ID		DATE-TIME GROUP 302300JAN2017	
2	UNIT LOCATION ▶ EASTING 776		NORTHING 452	ALTITUDE (M/F) 126
3	TARGET LOCATION END POINT ▶ EASTING 952		NORTHING 478	ALTITUDE (M/F) 258
4	MAXIMUM ORDINATE *(HEIGHT ABOVE BATTERY ALTITUDE)* (M/F) 59000		QUADRANT ELEVATION 555	
	TARGET NUMBER AA2005		Q-53 MISSION TIME *(0-600 Seconds)*	
5	BUFFER NUMBER *(CHECK ONE)* ✓ 2 3 4 5 6			
6	FRIENDLY FIRE SEARCH FENCE (FFSF) ERROR MESSAGES *(CHECK APPROPRIATE BOX(ES))* ☐ END POINT BEYOND 50 KM (Q-53) / 24 KM (Q-36) / 10 KM ☐ END POINT INSIDE 1 KM (Q-36) / 500 M (Q-53) ☐ TRAJECTORY INCORRECT ☐ END POINT ABOVE MAXIMUM ORDINATE ☐ LIMITED TRACK COVERAGE ☐ END POINT ABOVE MAXIMUM ______ (M/F) ☐ END POINT BELOW MINIMUM ______ (M/F)			

SECTION II. MESSAGES TO FDC

CHECK APPROPRIATE BOX(ES)

☐ AT MY COMMAND ☑ REQUEST SPLASH ☑ READY TO OBSERVE ☐ CHECKFIRE
☑ REQUEST SHOT ☐ REPORT WHEN READY ☐ ONE GUN ☐ NO OBSERVATION

SECTION III. RECORD AND REPORT TO FDC IMPACT POINTS

ROUND NUMBER	EASTING *a*	NORTHING *b*	ALTITUDE *c* (✓ M / F)	METHOD SENT *d*	TIME SENT *e*	ACKNOWLEDGED *f*
1	9545	4410	178	Digital	302305JAN2020	302305JAN2020
2	9536	4420	180	Digital	302306JAN2020	302306JAN2020
3	9530	4421	180	Digital	302306JAN2020	302306JAN2020
4	9522	4415	180	Digital	302308JAN2020	302308JAN2020
5	9515	4411	180	Digital	302309JAN2020	302309JAN2020
6	9516	4410	180	Digital	302309JAN2020	302309JAN2020

TIME END OF MISSION RECEIVED 302309JAN2017	MISSION OBSERVED BY T96, SGT DOE, John
REMARKS	

DA FORM 5310, SEP 2021 PREVIOUS EDITIONS ARE OBSOLETE. APD AEM v1.00

Figure B-1. DA Form 5310

B-5. Before the WLRs can conduct a mission in friendly fire mode, specific information must be stored in the friendly fire buffer of the radar computer. Instructions are listed in table B-1 on page B-3 for completing DA Form 5310.

Table B-1. Instructions for DA Form 5310

Section 1 Message to Observer		
Block 1: Sub-mode type of mission Unit Designation: Date time group (DDHHMMJUN15, DD - is the day, HHMM - is the time, JUN – month, 15 – year).		
Block 2: Battery location (easting, northing, and altitude).		
Block 3: Registration point location (easting, northing, and altitude).		
Block 4: Maximum ordinate (max ord) of the trajectory to the nearest meter from the appropriate tabular firing table (max ord above gun). Quadrant elevation or fall angle from the Tabular Firing Table G. Target number.		
Block 5: Select a buffer.		
Block 6: Check the appropriate boxes for error messages.		
Section 2 Message to Fire Direction Center		
Always check boxes to request shot and splash from fire direction center. (BTRY) fire direction center (FDC) Request shot and splash, out. (BTRY) FDC (BTRY), Shot, over. (RADAR) (BTRY), Shot, out. (BTRY) FDC (BTRY), Splash, over. (RADAR) (BTRY), Splash, out. (RADAR) (BTRY FDC) Did hit grid 321654, over. (BTRY) FDC Did hit grid 321654 , out		
Section 3 Record and Report to Fire Direction Center		
By round report did hit data by location (easting, northing, and altitude). (Battery FDC) this is (Radar), ready to observe, request shot and splash, over.		
Remarks	Record time end of mission	Radar operator rank & name
BTRY-battery FDC - fire direction center		

OPERATOR VOICE REGISTRATION PROCEDURE

B-6. The following is an example of how to perform a radar registration using voice communications-

- Key players are BN, battery (BTRY), fire direction center (FDC), and radar.
- BN FDC (BTRY FDC), this is (BN FDC), Performs (type) (radar) registration at grid _555444_, altitude 123, over.
- (BTRY) FDC Perform (type) (radar) registration at grid _555444___, Altitude __123_, Out.
- (BTRY) FDC (Radar) this is (BTRY FDC), prepare to copy, over.
- (RADAR) (BTRY FDC) This is (radar), prepare to copy, out.
- (BTRY) FDC (Radar) this is (BTRY FDC), observe (type) (Impact Elevation: mean POI, High burst, datum plane) registration, at grid _555444__, altitude __123___, max ord_456_, QE_258___ (specify if m or ft), and HIEGHT OF BURST_50___ (if a high burst or datum plane), firing unit grid _333444__, firing unit altitude _324__, report ready to observe, over.
- (RADAR) Observe (type) registration grid _555444__, altitude _123__, max-ord _456___, QE_258_, and height of burst _50___ (if necessary), firing unit grid_333444___, firing unit altitude 324 _, will report ready to observe, out.
- (RADAR) (BTRY FDC) this is (radar) ready to observe, request shot and splash, over.
- (BTRY) FDC Request shot and splash, out.
- (BTRY) FDC (BTRY), Shot, over.
- (RADAR) (BTRY), Shot, out.
- (BTRY) FDC (BTRY) Splash, over.
- (RADAR) (BTRY) Splash, out.

- (RADAR) (BTRY FDC) Did hit grid _321654_______, over.
- (BRTY) FDC Did hit grid_321654___, out.

B-7. At this point, repeat the last six steps until the necessary number of good rounds have been observed by radar. BN FDC will end mission-

- (BN FDC)(Radar) and (BTRY FDC), this is (BN FDC), End of mission, over.
- (RADAR)End of mission, out.
- (BTRY) FDCEnd of mission, out.

Note. Height of burst for radar registrations is the height of registration point plus height of ground above sea level (The height of the registration point above sea level). Radar will forward did hit information for each to BN and or BTRY FDC via normal mode of communication.

OPERATOR VOICE ADJUST FIRE MISSION

B-8. The following is an example for performing a radar adjust fire mission using voice communications:

- (RADAR) (BN FDC), this is (radar), hostile weapon (number and type of possible) firing, at grid _234567__, Altitude _369___, Time _1455 over.
- BN FDC Hostile weapons firing at grid _234567__, out.
- BN FDC (BTRY FDC), this is (BN FDC), conduct adjust fire mission with (radar), at grid _234567__, altitude _369___, over.
- (BTRY) FDC Conduct (radar) fire mission, at grid _234567__, altitude __369____, out.
- (BTRY) FDC (radar), this is (BTRY FDC), authenticate __WH_____, over.
- (RADAR) I Authenticate__NC_______, out.
- (BTRY) FDC (radar), this is (BTRY FDC), max ord _562__, QE_521_, altitude _369___. Request ready to observe, over.

Note. (BTRY) will also have to provide grid and altitude of firing BTRY (center gun) if radar does not have this information already.

- (RADAR) MAX ORD _562__, QE _521___, ALTITUDE _369____ out. (At this point, wait while Radar loads their computer with information.)
- (RADAR) (BTRY FDC) this is (radar). Ready to observe request shot and splash, 1 round, over.
- (BTRY) FDC Request shot and splash, 1 round, out (wait for guns to fire).
- (BTRY) FDC (BTRY), shot, over.
- (RADAR) (BTRY), shout out.
- (BTRY) FDC (BTRY), splash, over.
- (RADAR) (BTRY), splash out.
- (RADAR) (BTRY FDC, did hit grid is _42259632__, over.
- (BTRY) FDC Did hit grid _42259632_, out (At this point, BTRY makes corrections.)

Note. Subsequent adjust rounds may be required.

- (RADAR)(BTRY FDC), this is (radar), fire for effect, request shot and splash, over.
- (BTRY) FDCFire for effect, request shot and splash, out.

B-9. Radar will follow the mission, like a friendly fire mission, to compile did-hit information at this point:

- (BTRY) FDC (BTRY FDC), shot, over.
- (RADAR) (BTRY FDC), shot, out.
- (BTRY) FDC (BTRY FDC), splash, over.
- (RADAR) (BTRY FDC), splash, out.

B-10. Repeat the previous 4 steps until (BTRY) completes rounds and radar logs did-hit information:

- (BTRY) FDC (Radar), this is (BTRY FDC), rounds complete, over.
- (RADAR) (BTRY FDC), rounds complete, out.
- (RADAR) (BTRY FDC), this is (radar). End of mission, over.
- (BTRY) FDC (Radar), end of mission, out.
- Radar will then forward did-hit information to BN and or BTRY FDC via normal mode of communications.

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Appendix C
Embedded Training

This appendix provides a brief overview of embedded training procedures. It also provides instructions on how to develop and implement scenarios.

APPLICATION OVERVIEW

C-1. Embedded training are off-line, separate computer programs that function with the WLR's existing operational programs to allow the system to be used in a training mode. These off-line training programs provide the operator with realistic operating scenarios for the purpose of evaluating and improving proficiency. The scenarios include real-time simulation of hostile and friendly weapons fire.

C-2. Embedded training increases the radar operator's ability to process targets and communicate with other net subscribers. It allows radar operators to perform all normal mission processing functions. However, when the simulation is running, the WLR will not radiate when the radiate switch lamp is pressed. Embedded training allows the section chief to develop scenarios that present radar operators with a high density of hostile and friendly targets and conduct real or simulated communications with other net subscribers.

SECTION AND PLATOON TRAINING

C-3. Embedded training provides a vehicle for training a WLR section or an entire platoon in either a garrison or a field environment. The system's ability to simulate digital communications or communicate with actual tactical systems makes this possible. An individual section can train by itself and the scenario will replicate all digital communications. The section can send their acquisitions to a FSE, which provides the opportunity to train the TPS and targeting team members while providing realistic training for all WLR operators.

GUNNERY TEAM TRAINING

C-4. The entire gunnery team can benefit from the use of embedded training during rehearsals, before the conduct of actual operations, or during CP exercises, live-fire training, and maneuver exercises. These programs allow the development of scenarios that reflect the actual tactical situation or exercise event list. This facilitates training of the entire gunnery team and provides the capability to conduct FS and technical rehearsals for actual situations.

SCENARIO DEVELOPMENT

C-5. The common steps for developing training using embedded training are:

- Step 1. Determine training goals (mission requirements for the exercise). These should include:
  - Mission-essential task list requirements.
  - Mission training plan requirements.
- Step 2. Analyze resources.
- Step 3. Establish RDO data from the commander's targeting criteria in the operations order.
- Step 4.Identify simulation targets to be used on the basis of the scenario and targeting criteria.
- Step 5. Develop a plan for updating and changing the tactical situation and mission.
- Step 6. Develop the scenario target tables using the detailed procedures for selecting and loading target data into the embedded training.

Embedded Training

C-6. Planning and developing the embedded training scenario and simulation data should be a team effort with the intelligence section and FSE. The team should follow these steps:

- Step 1. Review each phase of the tactical operation to determine and record probable enemy mortar, artillery, and rocket firing locations.
- Step 2. Sequence the phased firing locations into a simulation target table for the WLR.
- Step 3. Load the target table using the scenario generation screen.
- Step 4. The operator selects "ADD" on this screen and enters each target separately with the following elements of data- weapon type, weapon velocity, quadrant elevation (QE), weapon location, impact location, firing interval, time on and time off, and volley.
- Step 5. After entering each individual target, the operator must wait for a response to determine acceptability of the data entered. If the program accepts the target with no response, the data becomes a part of the scenario target file.
- Step 6. These targets are entered, numbered, and time sequenced.
- Step 7. After all targets from the target table have been entered and accepted, the scenario is saved for use in the training exercise.

Note. This is a lengthy and time consuming process, and it must have the support and cooperation of the command elements to achieve success.

Implementing the Scenario

C-7. The command or exercise control element determines the commander's priority guidance for WLR, search data, cueing agents, and cueing guidance. These determinations are based on:

- Scenario.
- METT-TC.
- Intelligence estimates.
- Target value analysis.
- HPTL.
- Commander's targeting guidance.
- Targeting priorities.
- Embedded training target overlay.
- Embedded training target table.

Cueing Agent

C-8. Cueing agents are designated and provided a copy of the scenario target tables by the command or control element. They must be able to identify the cueing criteria required and the method they are to use to cue the WLR section. When the cueing criteria are met during the exercise, the cueing agent sends the cue command to the WLR.

Weapons Locating Radar Section

C-9. After receiving the initial search data and commander's priority guidance, the radar section chief prepares the WLR to support the mission. When notified by the FSE, the radar operator turns on the appropriate simulation targets. The radar operator waits for the cue command from the cueing agent. When the radar operator receives the cue command, the operator turns on the radar transmitter, processes the targets, and transmits them digitally to the FSE.

Counterfire Operations and Target Processing Sections

C-10. The COS and TPS processes targets received from the WLR according to the commander's criteria established in their tactical fire direction system. The commander's criteria should conform to the exercise guidance issued by the FSE. Normally, fire missions are generated for priority targets. Artillery target intelligence reports are sent to the CPs or the targeting element where they will be entered in the tactical fire direction system.

Firing Element

C-11. Upon receipt of fire missions, the firing unit generates firing commands (live or dry fire).

Note. Use of embedded training during live-fire exercises can generate fire missions in an impact area if the proper search and zone data is entered into the WLR computer. The AFATDS must be set up to accept simulated targets or any acquisition sent from embedded training. Other targets will provide useful training for the FSE.

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Appendix D

Mask Considerations

Appendix D explains how to calculate the track volume for the WLRs. It is intended for use by the radar section leader to enable him to determine whether a WLR site will provide enough track volume to locate hostile firing positions. It also provides procedures for correcting insufficient track volume.

DEFINITIONS

D-1. The following explanations are associated with mask and see figure D-1:

- Flat mask is a single mask angle or a default value in the WLR when no mask angle is entered into the radar computer which is called the remote control display unit. Mask angle is the vertical angle from the WLR to the top of the mask or screening crest at a given azimuth. The lowest mask angle and the highest mask angle are calculated and entered in the radar's computer during initialization.
- Mask variation is the difference between the lowest and highest mask angles.
- Vertical scan is the maximum vertical scanning capability of a specific type of radar. Vertical scan for the AN/TPQ-53 is unlimited, the AN/TPQ-50 is 425 mils, and the AN/TPQ-36 WLR is approximately 80 mils with all scanning frequencies enabled. Each frequency that is disabled results in a loss of approximately 2.5 mils of vertical scan.

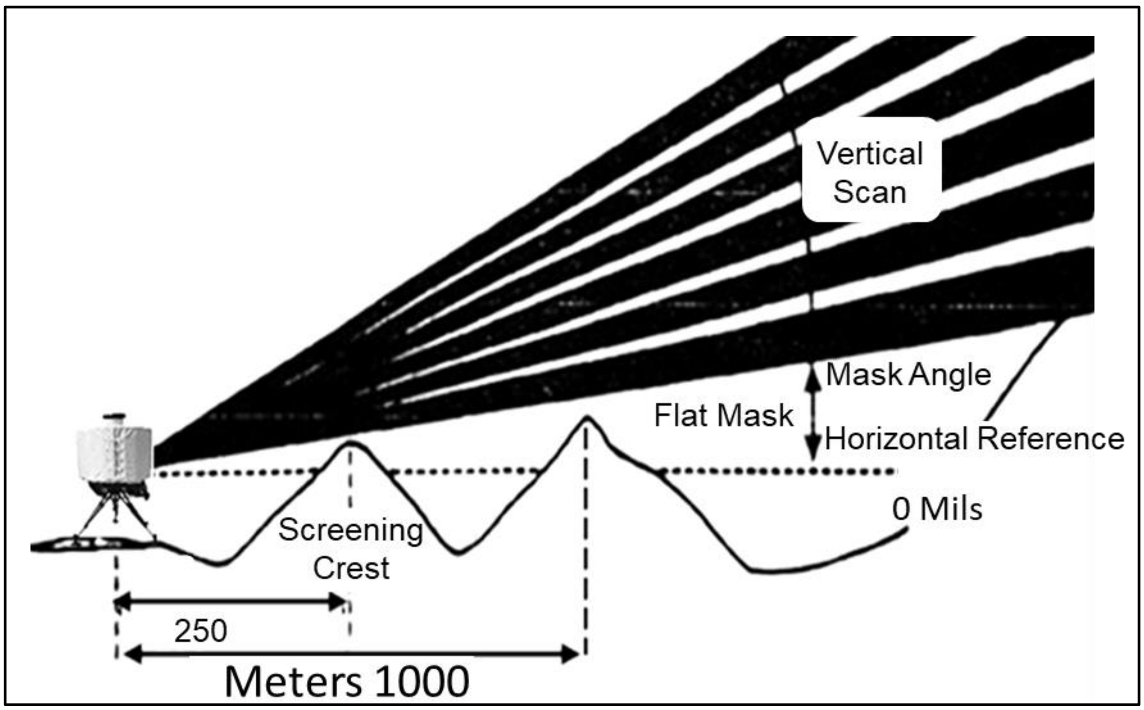


Figure D-1. Masking characteristics

TRACK VOLUME

D-2. The amount of track volume is determined by the vertical scan of the WLR and the amount of vertical scan that is lost because of the terrain contour, or screening crest in front of the WLR. From any WLR position, the altitude of the screening crest along the terrain contour in front of the position will vary across the WLR's sector of search. This varying screening crest altitude results in varying mask angles along the terrain contour. The variance between the smallest mask angle and the largest mask angle reduces the WLR's vertical scan.

D-3. Sometimes this reduction is enough that the available scan coverage is less than the 50 mils track volume required by the WLR to extrapolate weapon locations. When the track volume is reduced below 50 mils, the radar section leader must compensate by artificially adjusting the low mask angle, narrowing the search sector, or by moving the WLR to a new position that provides adequate track volume.

D-4. Whenever possible, an aiming circle or other accurate measuring device should be used to determine mask angles along the terrain contour. These measured mask angles are entered in the computer to depict the terrain contour. Otherwise, the WLR will radiate into hill masses that are higher than the flat mask default in the radar computer. Automatic terrain following can be used when digital terrain is available for the WLR site. Radar terrain following is used when the radar does not have digital terrain. Radar terrain following is a process of the WLR radiating in each sector to determine the mask angle. This capability allows the radar section leader to compute mask angles before occupying a radar site.

TRACK VOLUME CALCULATION AND SUBSEQUENT ACTIONS

D-5. The WLR search fence starts at the lowest mask angle entered in the radar computer (or at the flat mask default value if no lowest mask angle is entered) and goes to the highest point of the vertical scan. The first step in calculating track volume for the WLR site and search sector is to subtract the low mask angle from the high mask angle. This difference must then be subtracted from the vertical scan of the WLR. The result is the track volume for the WLR site. Figure D-2, on page D-3, shows the procedure for calculating track volume.

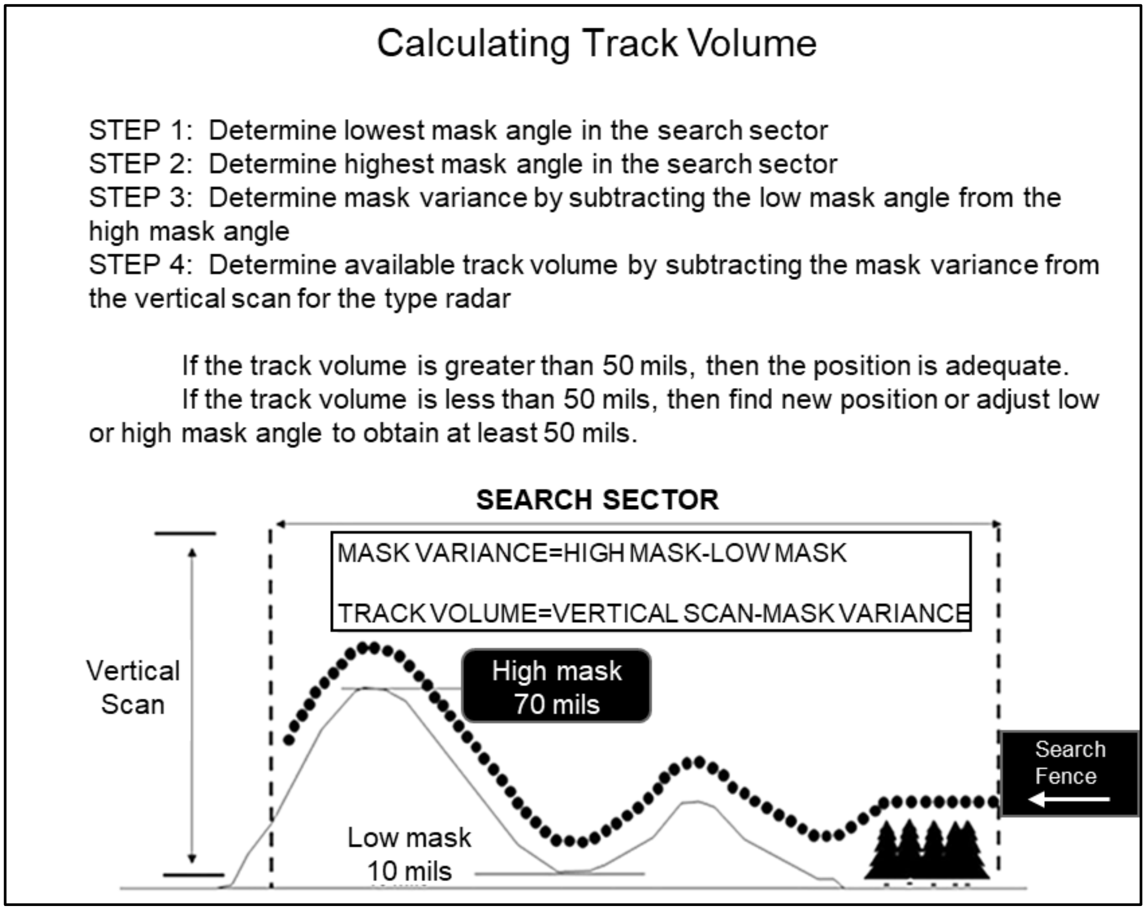


Figure D-2. Track volume

D-6. Although the ideal mask variation may be met, the maximum allowable mask variation for a WLR can be calculated by subtracting the 50 mils of track volume required for firing weapon location from the vertical scan of the WLR. The maximum allowable mask variations are:

- AN/TPQ-36 - 30 mils.
- AN/TPQ-50 - 395 mils.
- AN/TPQ-53 - No limitations on mask variations, however large variations very close to each other are undesirable.

D-7. Thus, any mask variation exceeding the allowable maximum variation would not allow enough track volume for the WLR to determine firing weapon locations. In that event, some action must be taken to regain enough track volume to perform the WLR mission. Possible actions include doing nothing, raising the low mask angle, narrowing the search sector, or moving the WLR. If nothing is done, a dead space is created where projectiles cannot be detected. Figure D-3 on page D-4 depicts a dead space area.

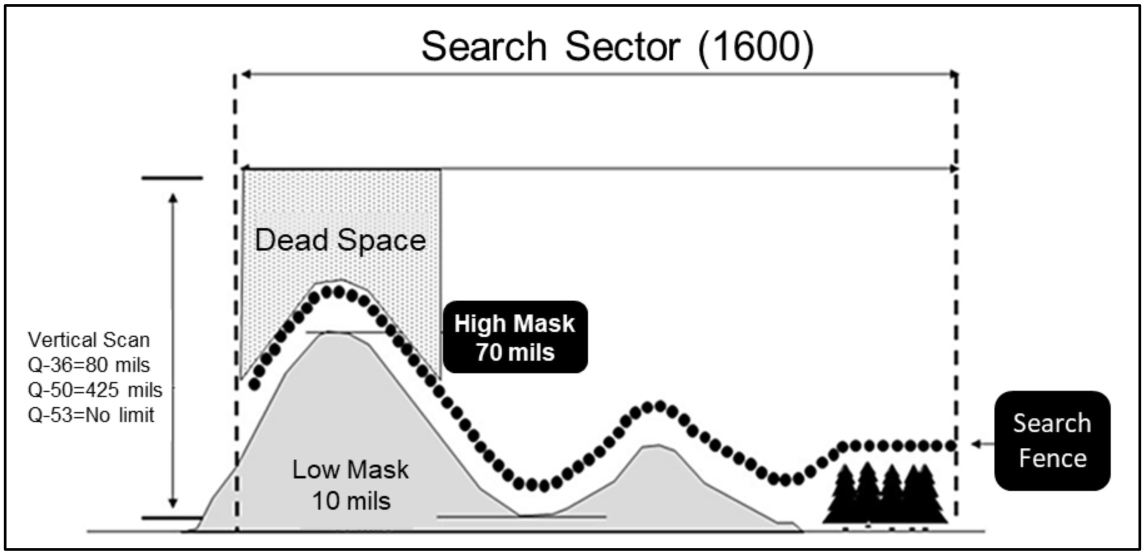


Figure D-3. Dead space area

D-8. Figure D-3 gives an example of no action taken with a mask variation of 60 mils. This allows 20 mils of track volume over portions of the search sector. This creates a dead space area. The result is an area where enemy indirect fire cannot be detected. Figure D-4 shows the possible adverse effects of a dead space.

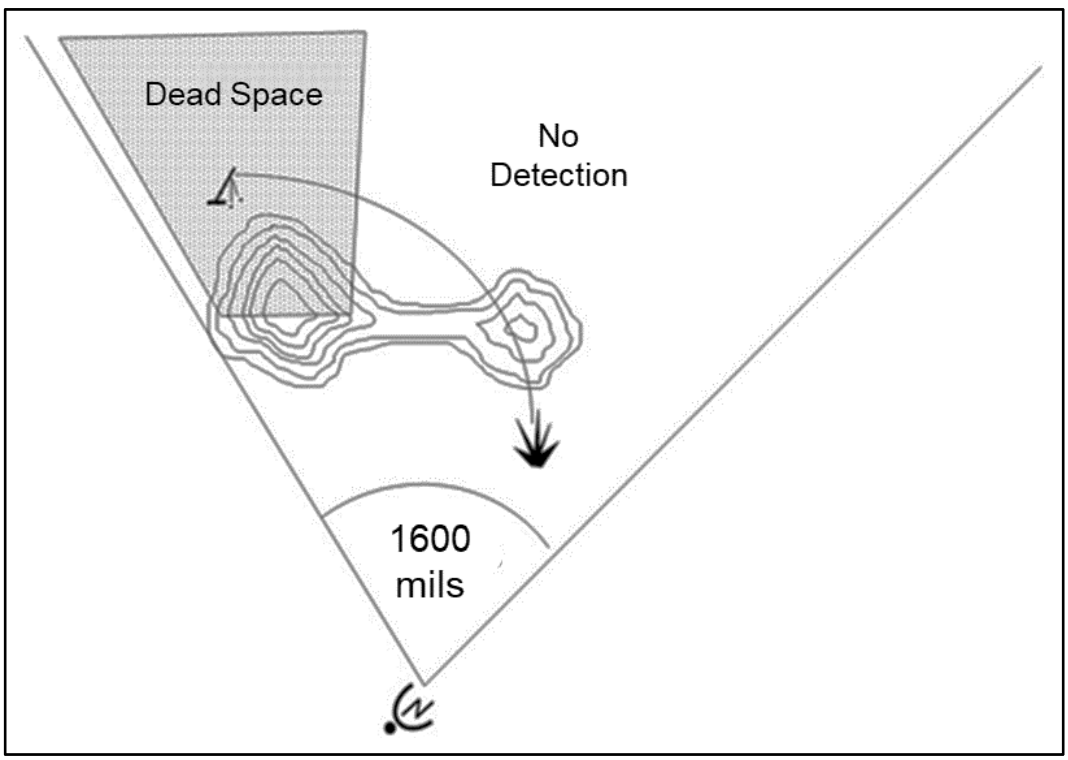


Figure D-4. Effects of dead space area

D-9. The first solution is to raise the low mask angle. This will provide enough track volume to eliminate the large dead space area. Nonetheless, this solution will produce a small dead space area under the low mask area. This may or may not be acceptable. Figure D-5, on page D-5, shows the result of raising the low mask angle.

Note. If WLR must occupy this position, you must adjust the mask variance in order to obtain 50 mils of track volume.

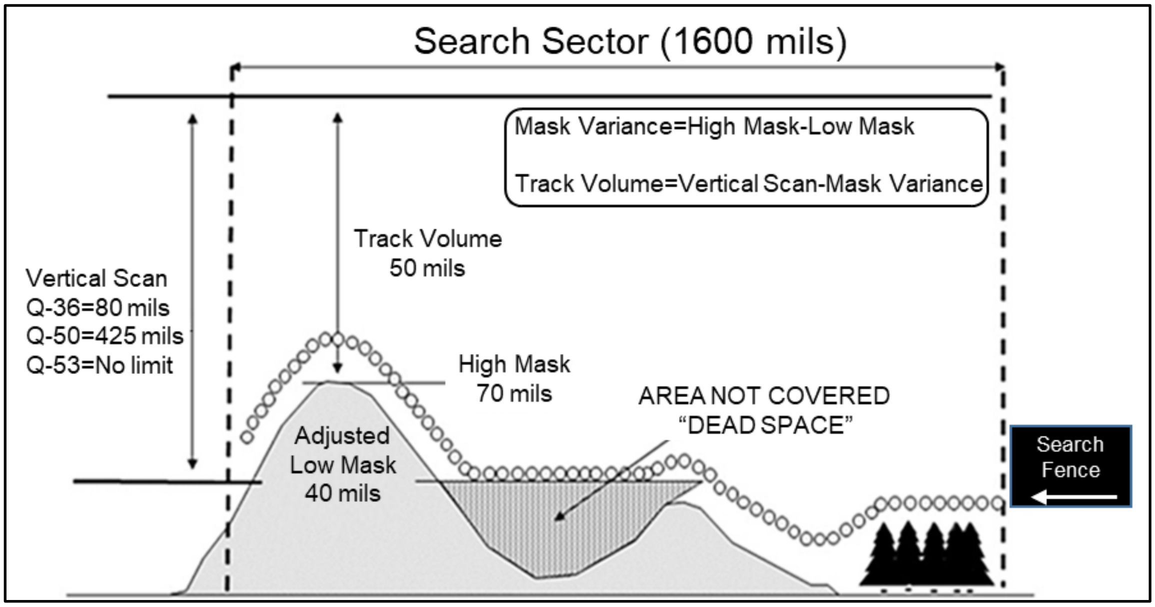


Figure D-5. Raising the low mask angle

D-10. The next solution might be to narrow the search sector or move the search sector. This will lower the mask variation and eliminate the dead space in the search sector. This still leaves an area with no WLR coverage. Narrowing the search may not be acceptable based on the tactical situation. Figure D-6 depicts narrowing the search sector.

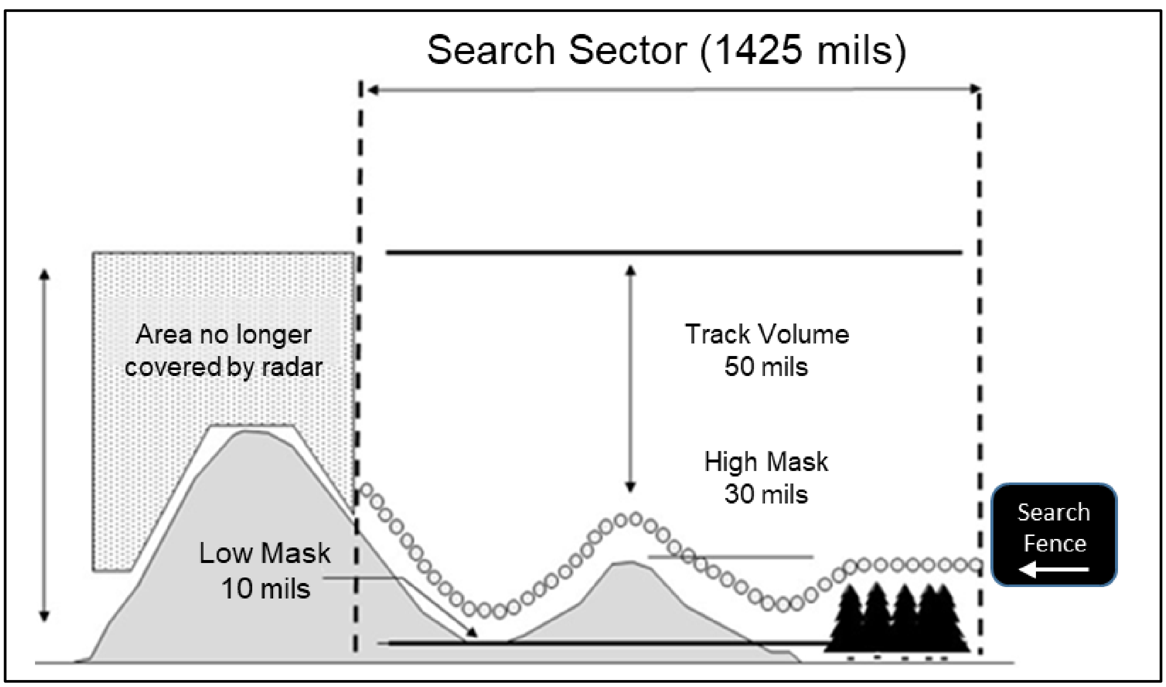


Figure D-6. Modifying the search sector

D-11. If none of these solutions are acceptable, the WLR must be moved to another site to provide the required coverage. The radar section chief computes mask angles and track volume again at the new location. It is the radar section chiefs' responsibility to ensure the WLR provides enough track volume.

Appendix E
Support Requirements

WLRs are widely dispersed across the AO and require support from units that may not be familiar with the support requirements for the WLR. Appendix E outlines the support requirements.

SURVEY

E-1. Common datum and common survey is critical for successful employment of WLR systems. The specific survey data required for each WLR system is described below:

- Survey data
  - Grid zone.
  - Site location (universal transverse mercator coordinates within 10 meters circular error probable).
  - Distance from near stake (WLR location) to far stake (orienting point). This distance between near and far stakes should be at least 250 meters. The minimum distance is 100 meters. However, the further the distance the better the accuracy that the system will report.
  - Azimuth from near stake to far stake (0.4 mils probable error).
  - Vertical angle from near stake to far stake (0.5 mils probable error).
  - Altitude of the near stake (10m probable error).

E-2. The AN/TPQ-36 radar is equipped with the modular azimuth positioning system-hybrid (MAPS-H). The MAPS-H provides required survey for the radar systems. MAPS-H will be initialized using input from a common survey point or the Defense Advanced Global Positioning System Receiver (referred to as the DAGR). Once initialized, the MAPS-H will be continually updated by input from the DAGR, if installed. For initialization, operation, and update information refer to TM 11-6605-308-12&P.

SUSTAINMENT SUPPORT

E-3. When the WLR section is attached to a unit, the unit of attachment is responsible for providing routine personnel, administrative, and sustainment support. The WLR section's parent unit forwards mail, pay, and routine distribution to the unit of attachment's HQ for delivery to the WLR personnel.

FIELD MAINTENANCE

E-4. Field maintenance is on-system maintenance, repair and return to the user, including maintenance actions performed by operators. It is most often performed by the owning or support unit using tools and test equipment found in the unit. Field maintenance is not limited to simply remove and replace actions. Field maintenance allows for repair of components or end items on or near the system if the maintainers possess the requisite skills, proper tools, proper repair parts, references, and adequate time.

E-5. Within the FAB, field maintenance for items other than WLR systems is performed by the assigned forward support company. TAP and maintenance personnel of the assigned corps support BN share WLR field maintenance responsibilities. The radar section chief supervises operator maintenance within the TAP. WLR section and forward support company personnel perform operator and field maintenance at the BCT FA BN level.

E-6. Within the DIVARTY field maintenance is conducted by the WLR sections (operator maintenance) and by the maintenance platoon. Within the FA BN of the BCT, field maintenance is conducted by the WLR sections (operator maintenance) and by the forward support company.

SUSTAINMENT MAINTENANCE

E-7. Sustainment maintenance is off-system component repair and/or end item repair and return to the supply system or by exception to the owning unit, performed by national level maintenance providers. National level maintenance providers include the Army Materiel Command and installation directorate of logistics maintenance activities. The sustainment function can be employed at any point in the integrated logistics chain. The intent of this level is to perform commodity-oriented repairs to return items to a national standard, providing a consistent and measureable level of reliability and to execute maintenance actions not able to be performed at the field level of maintenance.

REPAIR PARTS

E-8. The logistics concept for WLR systems does not place any unusual demands on the supply system. The mandatory parts list governs the supply of WLR peculiar items. Each section deploys with its mandatory parts list. The supported unit provides common expendables and the parent unit forwards system-peculiar expendables to the section on an as required basis.

SECURITY

E-9. Because of its small size, the WLR section cannot provide for its own security in a tactical situation. For this reason, the WLR section must fall under the security of an adjacent unit or be augmented with personnel and weapon systems to provide security. The deployed WLR section falls under the responsibility of the supported unit for these functions. The TA platoon leader must work closely with the security force to integrate and employ inner or outer cordons as appropriate. The WLR section should include the designated security force in training events to identify integration requirements and communication plan. Units should develop their own security standard operating procedures based on METT-TC and their specific AO. The WLR should not be located with other friendly high-value targets.

METEOROLOGICAL DATA

E-10. MET data is crucial to hostile projectile acquisition and accuracy of friendly fire data. The MET parameters entered during WLR initialization affect radar performance by correcting for atmospheric refraction. MET parameters are also important in estimating the effect of wind direction and strength on the projectile's trajectory. However, the greatest effect on the accuracy of hostile and friendly weapon impact prediction is caused by wind.

E-11. The line used from the computer MET must correspond to the same altitude as the line used from the TA MET. It is also necessary to determine the MET station altitude. This can be determined from the header line of either the TA MET or the computer MET. Station height in the header of both MET messages is entered in tens of meters and is equal to altitude.

Appendix F
Tools and Procedures

There are numerous factors that must be considered when employing WLRs within the AO. The purpose of this appendix is to provide a collection of formats, procedures, and ideas that have been collected from combat training centers. Most of the formats and procedures can be modified to meet WLR section changing requirements.

WEAPONS LOCATING RADAR TROOP LEADING PROCEDURES

F-1. Employment of WLRs are integrated into the commander's intent and guidance and synchronized with the scheme of maneuver. The radar section chief's involvement in the planning process and troop leading procedures are essential for successful WLR employment and responsive counterfire. The radar section chief requires usable tools to facilitate mission preparation and execution. The ability to issue clear warning orders, achieve time lines, conduct pre-combat checks and inspections, and initiate priorities of work are essential to any successful mission.

F-2. Troop leading procedures provide the required guidance to focus the WLR section's preparation for and execution of the radar employment plan. Using standard troop leading procedures helps clarify mission requirements, fix responsibilities, and make the best use of available time. Troop leading procedures provide a vehicle for preparing the section for operations.

F-3. The troop leading procedure is the process by which the WLR section chief receives a written or verbal RDO. The troop leading procedures listed below are suggestions for effective time management:

- Receive the mission RDO (situation map, operations graphics, and execution matrix):
  - Perform mission analysis; assess the threat (intelligence cell and WLR section).
  - Review critical tasks, positioning guidance, planned zones (intelligence cell and WLR section).
  - Prioritize pre-combat checks first, then inspections (WLR section chief).
  - Prepare a timeline (WLR section chief).
  - Conduct risk assessment and management.
- Issue a concise warning order to your section, (WLR section chief):
  - Section mission.
  - Positioning guidance.
  - Threat and counter measures.
  - Pre-combat inspections.
  - Timeline.
- Make a tentative plan, (WLR section chief):
  - METT-TC. Logistics resupply.
  - Survivability measures.
  - Section rehearsals, (site occupations or displacements, defense).
- Initiate movement, (WLR section):
  - Conduct pre-combat checks.
  - Perform rehearsals.
  - Issue movement order and risk assessment.

- Conduct reconnaissance, (WLR section):
  - Select sites to support mission requirements.
  - Perform or coordinate for survey requirements.
  - Make site assessments for survivability and site defense.
- Complete the plan, (WLR section chief):
  - Report site assessments to intelligence cell.
  - Prepare a verbal order for section.
  - Develop route strip maps, preliminary site defense plan.
  - Develop battle-tracking overlays for reconnaissance vehicle and shelter.
- Issue the order (WLR section chief):
  - Focus on movement, positioning, site defense, and survivability measures.
  - Be clear and concise.
  - Require a back brief from the section chief and senior radar operators. This should be a section huddle and each member must understand their role.
- Supervise (WLR section chief):
  - Final pre-combat inspections.
  - Crew drill rehearsals for occupations, site, defense, shelter, and chemical, biological, radiological, and nuclear operations.
  - Execution.

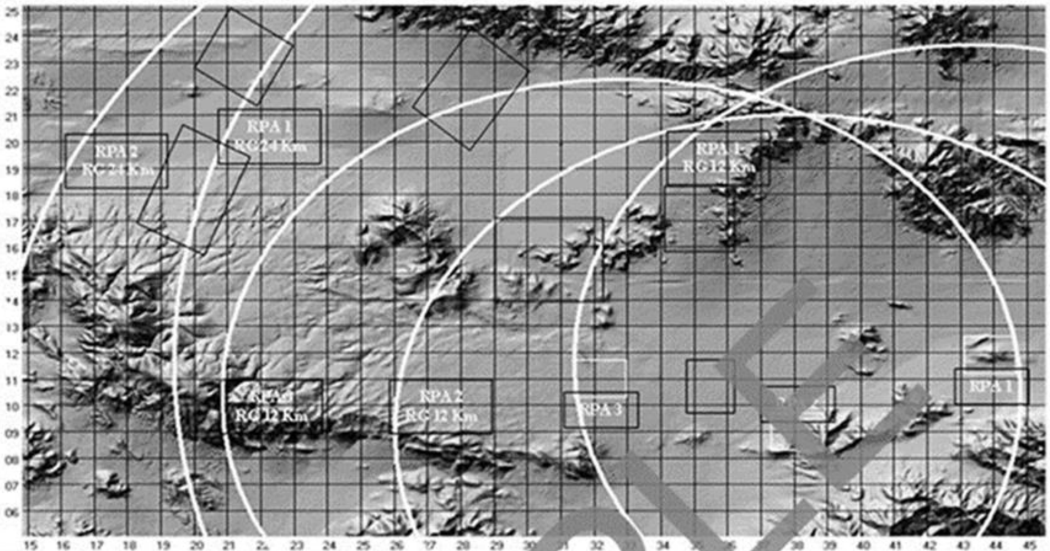
F-4. Troop leading procedures can and should be modified to facilitate planning and execution of each mission. The steps do not have to happen sequentially and may happen simultaneously as METT-TC dictates.

Note. Planning time for a given section should not exceed one third of the total time available. This one third lasts from receipt of the order from higher HQ through back briefs from unit immediately following issuance of the operations order.

WEAPONS LOCATING RADAR EXECUTION MATRIX

F-5. The RDO and execution matrix can be used as is, or modified to reflect the phases or events of an operation. Figure F-1, on page F-3, shows another example of a modified RDO and execution matrix (example includes a terrain graphic).

Note. The WLR execution matrix is a classified document once completed with mission data.



Enemy: Remnants of the 173d MRR(-) opposite 3 BCT to est. an MRB(-) sized security zone to delay & attrit the BCT and gain time & space for follow on forces from the 71st MRR(-) to build a main defensive area.

Mission 3BCT, 52ID, attacks in zone to destroy 25th MIBR & to seize key terrain vic NV 2224 & NV 2319 to protect the flank of the 52ID Main Effort (1BCT).

EFST: Disrupt effective RAG fires against TF 1-12 in its SBF position, TF 2-34 during breaching operations, and TF 1-14 during their assault on OBJ MEADE.

EFAT: Destroy 18 of 36 RAG cannon systems.

Security Assets Inf Sec / A 1-12 TF Survivability Assets: None

Q37 Coverage: Fires Bde provides coverage once TF 1-12 LDs

Q36 Mvmt Plan: O/O Follows TF 1-12

PCC/PCI: CASEVAC, React to CBRN attacks **Risk Management** Accidental/Tactical Risk Conducted at section level.

	Phase I 181800L	Phase II TF 1-12 crosses LD	Phase III Obj Meade secured		
RDR Loc.	21601952	17082055	15902233		
AOS	5200	5200	4800		
CUE Schd	IVY	IVY	IVY		
Ready to Cue	181800L	190800L	O/O		
Alt Loc.	500 mtrs	N/C	N/C		
L Sector	-800	N/C	N/C		
R Sector	800	N/C	N/C		
Digital Freq.	FH 109	N/C	N/C		
Voice Freq.	FH 107	N/C	N/C		

Name	Type	Purpose	Trigger	Grids					
Raider 2	CFZ	Protection of TF 1-12 in SBF, Breach & Obj Patton	TF 1-12 Crosses PL PIG	5123,5523, 5519, 5119	OFF	ON	ON		
Dragon 1	CFZ	Protection of TF 1-14 in Obj Meade	TF 1-14 Crosses PL Rat	5816, 6216, 6221, 5721	OFF	ON	ON		
Thunder 1	CFFZ	Facilitate the Destruction of enemy FA systems in the RAG.	181800L	5318, 6215, 6210, 5310	ON	ON	ON		

Alt – alternate, AOS – azimuth of search, BCT – brigade combat team, BDE – brigade, CASEVAC – casualty evacuation, CBRN – chemical biological radiological nuclear, CFFZ - call for fire zone, CFZ – critical friendly zone, EFAT – essential field artillery task, EFST – essential fire support task, FA – field artillery, FH – frequency hopping, FREQ – frequency, ID – infantry division, Inf – infantry, LD – line of departure, Loc – location, MIBR – mechanized infantry brigade, MRB – motorized rifle brigade, MRR – motorized rifle regiment, mtrs – meters, Mvmt – movement, N/C – no change, OBJ – objective, O/O – on order, PCC – pre combat checks, PCI – pre combat inspection, PL – phase line, RAG – regimental artillery group, RDR – radar, RG – range, RPA – radar position area, SBF – sensor boundary fan, Sec – section, TF – task force

Figure F-1. Combined radar deployment order and execution matrix

RADAR POSITION ANALYSIS SYSTEM

F-6. Radar Position Analysis System (RPAS) is a computer program that enables the user to analyze the performance of the WLRs based on their location, orientation, and setup with respect to specified hostile or friendly weapon systems. Variations of the AN/TPQ-50, AN/TPQ-36, and AN/TPQ-53 WLRs are modeled in RPAS. Multiple versions of each WLR is supported to assist in Joint Operations planning. RPAS has multiple weapons systems available that include four main categories: recoilless rifles, mortars, artillery, and rockets. The user may construct a scenario in which up to seven WLRs are positioned. The WLRs can be analyzed individually or as a group.

F-7. The RPAS Software is ideally suited for mission planning. The software allows the input of known and suspected weapon locations, possible enemy objectives, enemy weapon types, and areas of search for the WLR. This data is used to create a visual display that will determine the probability of detection, facilitating effective use of WLRs. RPAS accomplishes this based on line of sight requirements.

REQUIREMENTS

F-8. RPAS requires the Digital Terrain Elevation Data (DTED), manmade structures that are in the line of sight of the WLRs, and types of projectile that are anticipated or known. RPAS also supports the input of other files to provide a visual reference and to align with ground based observations.

F-9. Performance assessments are generated for the hostile weapon point-to-point trajectory analyses whenever the probability of location is less than the maximum possible value of 99 percent. The purpose of the assessment is to indicate the cause(s) for less than full detection and, to possibly suggest ways in which the performance can be improved. The software will generate an advisory message to indicate factors that can affect WLR probability of detection. For example, a message may appear such as “WARNING: Search fence is very near top of elevation coverage.” Indicating a limited number of beams are available over the screening crest.

F-10. With assessments, RPAS also provides a variety of outputs to evaluate WLR positioning. These outputs are referred to as plots and are displayed with color coding and provided in text format:

- Terrain Plot – displays terrain heights in the radar area.
- Screen Angle Plot – displays terrain screening angles and weapon trajectory.
- Elevation Plot – displays antenna elevation coverage.
- Clutter Plot – displays terrain clutter returns.
- Visibility Plot – displays target visibility with respect to the terrain.
- Trajectory Target-to-Interference Plot - displays the projectile target-to-interference ratio along weapon trajectory.

F-11. The Trajectory Target-to-Interference Plot displays the most data in relation to the probability of detection. It will contain a color coded chart displaying if the WLR was able to acquire the target. On the margin of the plot diagram will be a text box that contains the probability of detection and the circular error of probability.

RISK MANAGEMENT

F-12. *Risk management* is the process to identify, assess, and control risks and make decisions that balance risk cost with mission benefits (JP 3-0). The risk management worksheet provides a starting point to logically track the process of assessing hazards and risks. It is used to document risk management steps taken during the planning, preparation, and execution of training and combat missions and tasks. See ATP 5-19 for additional information on risk management and worksheet.

Appendix G

Rocket Artillery and Mortar Warn

This appendix describes rocket artillery mortar (RAM) warning (Warn) techniques. RAM Warn provides the commander and the supported unit with an early warning capability of imminent rocket artillery or mortar attack to enable the affected personnel the ability to protect themselves from the effects of the attack.

OVERVIEW

G-1. RAM Warn provides Soldiers, staff personnel, and operators with automated warnings and enhanced alerting capabilities. RAM Warn integrates the BCT organic sensors, commercial off-the-shelf warning systems and communication devices, and the forward area air defense (FAAD) workstation in the ADAM element. The RAM Warn capability is integrated into the ADAM element architectures to provide warning to forces and assets as determined by the commander. Without detection capabilities and C2, RAM Warn is inoperable. RAM Warn integrates and operates with Army Battle Command System for battlefield situational understanding. The RAM Warn system is generally designed to be used in fixed and semi fixed sites, however there may be situations in a fluid, maneuver, decisive action event where the RAM Warn system may be employed.

G-2. RAM Warn is a dynamic, modular, and readily-transportable system that provides incoming RAM attack warnings. RAM Warn supports the BCT's force protection mission by performing the following:

- Issuing guidance and orders.
- Delivering audible and visual alerts.
- Maintaining situational understanding.
- Supporting dynamic, joint-forces integration operations.

G-3. RAM Warn sensor links consist of line-of-sight radio transmitters at sensor locations connected through a retransmission site, if necessary, to the ADAM element operating a FAAD computer with counter rocket artillery and mortar Warn services software. RAM Warn communication devices can cover up to 15km distance between the sensors and the ADAM element; or 30km with the use of relay equipment. The transmitter and associated equipment is assigned to each sensor and a retrans section, and each section is responsible for the employment and maintenance of their equipment. Figure G-1 on page G-2 shows RAM Warn architecture.

G-4. Each section that has the RAM Warn system will have a mesh network consisting of radios that serves as the backbone of the Warn system. RAM Warn architecture offers two primary capabilities readily to adapt to components that are modularized, standardized, and reconfigurable. The two capabilities provide the following functions:

- Links the RAM Warn Alert Cell Nodes, the FAAD, and sensors (radars) through a uniquely modular, dynamic system.
- Computes the incoming POI information and selects the appropriate alert cell node towers within the impact zone to notify.

Figure G-1. RAM Warn architecture

> **WARNING**
>
> **Never deploy the system close to overhead wires or lower line. Failure to comply with these warnings could result in death or serious injury.**

> **CAUTION**
>
> Antennas emit high frequency electromagnetic radiation. Always maintain safe distance from and never stand in front or in the direct path of an operationally configured antenna. Failure to observe this caution can result in minor to moderate injury.

COMMAND AND CONTROL

G-5. The C2 system consists of the FAAD which is located with the ADAM element in the FSE. The FAAD provides overall C2 for the RAM Warn system by integrating software, sensors, and the warning systems. The FAAD interfaces with the Army C2 network by interfacing with the air and missile defense workstation. (AMDWS)

G-6. The FSE and ADAM personnel share responsibility for the planning, coordinating and synchronizing of RAM Warn operations for the BCT. The FA BN has responsibility for the emplacement of sensors and relays.

G-7. The FSE plans, coordinates, and synchronizes sensor coverage with the ADAM element and FA BN. The FSE must advise the commander and ensure the primary mission of the WLRs is to the counterfire fight.

G-8. The ADAM element plans and coordinates the emplacement of the warning systems and develops and executes the RAM Warn architecture. The ADAM element coordinates with the FSE for WLR cover to support the RAM Warn task. The ADAM element emplaces the indoor and outdoor RAM Warn antenna masts and radios at the area which the commander wishes to have warning capability for enemy indirect fire.

G-9. The FA BN coordinates its WLR coverage with the brigade FSE, and executes the BCT sensor coverage plan. The FA BN also plans, coordinates, and employs retrans teams and emplaces sensor and retransmission RAM Warn masts and radios as required. The retrans teams belong to the FA BN and the primary purpose is to retransmit FM communications from the firing batteries to the BN FSE, coordination must be made and the commander advised if RAM Warn retransmission will interfere or affect retransmission of the BN's fires communication.

G-10. To initiate an automatic warn it takes two or more sensors acquiring the same round. Due to the unique limitations of each radar and location requirements for each radar system listed previously, careful planning must be done to place radars in a position for redundant coverage of the proposed defended area. In certain instances it may not be possible to have all radars in a position to perform counter fire and RAM Warn simultaneously. Counterfire, Targeting, and Intelligence Officers in concert with S3's and key planners must perform detailed analysis of the enemy weapons systems, high pay off targets and tactics to ensure that sensor coverage for the counterfire mission is not degraded or inform the commander of the coverage issues if a RAM Warn mission is directed.

SITE SELECTION

G-11. Site selection is a general site survey to determine the location of the outdoor antenna and a site path profile to determine the RF signal path profile.

G-12. The RF signal path profile must be performed before installing the equipment and determines the best location of the antenna, based off the height and obstacles in front of the antenna. Once conducted, provide a copy of the data to the installation team.

G-13. When conducting a general site survey in an urban environment, consider placing the antenna(s) on top of area buildings and structures for better line of sight to the receiving wireless systems.

G-14. In a non-urban environment, identify terrain features that provide a clear line of sight between the antennas, such as hilltops or areas with few or short trees. To maximize performance, personnel should always try to mount the antenna in a location where a direct line of sight exists. If the obstruction is not exceptionally high, aim both antennas near the top of the obstruction.

G-15. The wireless system also supports installation in non-line of sight conditions. Position the antenna as high as possible and obtain a satisfactory multipath RF signal by directing each antenna towards a structure in sight of both communicating wireless systems.

G-16. The placement of antennas is important to minimize interference during transmission. If using a mast, select a location with level ground. Once the mast is erected, ensure the mast is level.

WARNING

Maintain a minimum distance equal to twice the height of the antenna between power lines and antennas

G-17. RAM Warn tower positions are critical and should allow for overlapping audio and wireless network transmission. Place outdoor alarms no greater than 1000m apart to ensure proper coverage. The maximum audio radius for the outdoor alarms is 500 meters. The maximum distance recommended between for the audio warning towers is 3-5 km. When doing an outdoor site survey for the RAM Warn outdoor alert cell nodes, allow at least 30 feet from the center mast to any pedestrian pathway and roadways to allow for the guy line installation. Personnel should always choose a location free of overhead obstructions and ensure the site is free of items causing electrical or RF interference. The area should be as flat as possible and free from debris. If there are rocks and gravel present, attempt to clear the area so the stakes are embedded in solid soil. Figure G-2 shows the different parts of the outdoor mast assembly for the alert cell node.

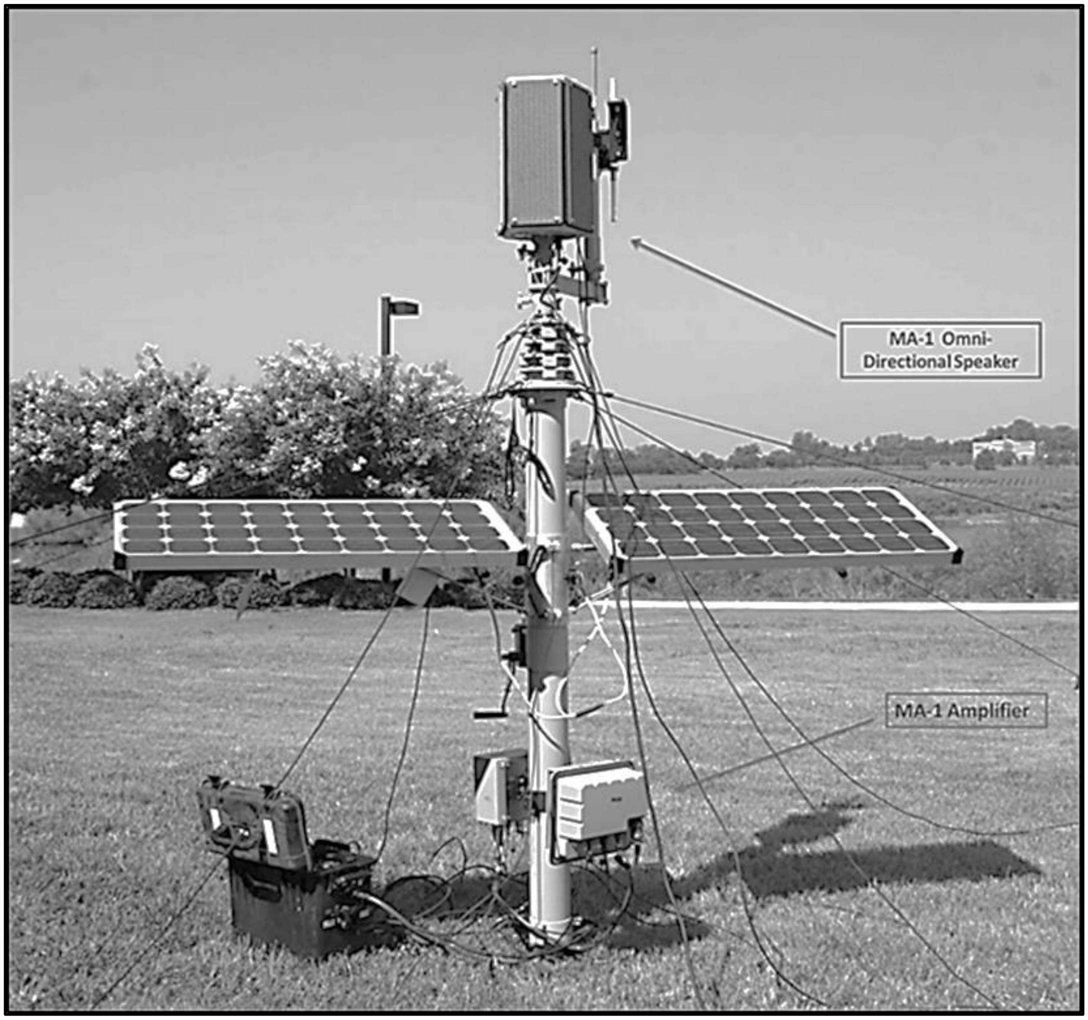


Figure G-2. Outdoor mast assembly

Appendix H

AN/TPQ-53 Weapons Locating Radar System Characteristics and Employment

This chapter discusses characteristics and employment techniques for the AN/TPQ-53 WLRs. The AN/TPQ-53 is a highly mobile WLR system. The AN/TPQ-53 is capable of locating hostile mortar, artillery, and rocket fire in a cluttered environment, and provides friendly artillery registration and adjustment. The system was designed to provide 90 degree coverage against all indirect fire threats, and 360 degree azimuth at degraded ranges. The principal functions of the system are to detect, track, classify, and accurately determine the POO and POI of enemy indirect fires. The AN/TPQ-53 provides continuous and responsive counter-battery TA for any military operation. The AN/TPQ-53 is designed to meet ongoing mission requirements and provide a solution that can meet full operational capability in a single C-17 aircraft.

SECTION I - CHARACTERISTICS AND EMPLOYMENT

H-1. The AN/TPQ-53 can be operated in either mission essential group (MEG) configuration or sustained operations group (SOG) configuration. Figure H-1 on page H-2 depicts the AN/TPQ-53 in its MEG; consisting of the AN/TPY-3 TA subsystem, which contains the following sub-systems:

- Prime mover.
- ATG.
- Prime power group.
- Communications group (digital and voice).
- Remote control and display unit.

H-2. The SOG of the AN/TPQ-53 consists of the prime mover and the operations control shelter (OCS) to conduct operations. The OCS may be powered from an external source or from an on-board 10kW generator, which eliminates external power connections. Using the onboard generator frees the crew from heavy power cable deployment and allows separation from the ATG at distances up to 1km, enhancing Soldier survivability. The AN/TPQ-53 can also use commercial power and can automatically or manually switch between tactical and commercial power or between primary and backup tactical power without system interruption.

Figure H-1. Mission essential group configuration

H-3. In its SOG configuration, the system combines an AN/TPY-3 with the additional capabilities of the AN/VPC-95 Communication Subsystem (see figure H-2).

Figure H-2. Sustained operations group configuration

REMOTE OPERATIONS

H-4. Operators can remotely operate the AN/TPQ-53 using fiber optic cables to a distance of 1000m. Operations can either be conducted in the SOG, a hardened structure, or the CP.

SITE REQUIREMENTS

H-5. The choice of a site for the radar set is dictated primarily by the tactical situation, the area to be observed, and the terrain restrictions. There are no restrictions on the location of the OCS except that it must be within 1000m of the MEG due to the length of the fiber optic cable. The OCS can be entrenched, sandbagged, or located among trees. The OCS should be located in a protected area and never in the line-of-sight of the antenna.

H-6. Generally, the following should be considered when selecting a site for the MEG:

- The slope of the ground (must be equal to or less than 5 degrees) with the prime mover positioned facing down slope.
- The ground should be of adequate strength and consistency.
- The terrain mask angle.
- The height and density of foliage or trees relative to the antenna.
- Other radar sets operating in the area.
- The site selected should have adequate drainage.

H-7. The slope of the ground should be such that the prime mover and the antenna transceiver group can be leveled. The bubble level located on the prime mover dashboard must indicate that the vehicle is on ground that falls within the capabilities of the leveling system. The area in front of the antenna should be clear of nearby clutter that will weaken (attenuate) the radar beam. Solid objects and heavy foliage within 300m should not extend above the bottom of the antenna. The slope of the ground should be such to minimize possible multipath errors. Multipath errors are caused mainly by ground reflections. To minimize multipath errors, the terrain should not exceed 2-3m in height from the terrain height at the antenna for a distance of 200-250m.

H-8. The system should be emplaced on man-made or natural ground which provides adequate strength for stability. Such man-made surfaces include, but are not limited to: concrete, asphalt, dirt roads, and gravel pads. Acceptable natural ground conditions should be of consistency and moisture content that does not allow the soil to noticeably flow under the sand pads during emplacement. The ground should be as free of organic content for example logs, branches, peat as possible, as this can lead to settling. Care should also be taken to prevent washout conditions from eroding soil from beneath emplaced sand pads.

H-9. The angle from the antenna to the top of the nearest obstruction, above which the radar set provides search coverage is the terrain mask angle. Two conflicting requirements influence mask angle: enemy radar jamming and direction finders; and detection of enemy projectiles. To be effective, radar jamming and direction finders generally require a line-of-sight to the antenna of the WLR.

H-10. A high mask angle is useful against ground-based jamming and direction finders because the jamming must be located at a point above the mask angle. As the jammer or direction finder is forced up in height, the number of suitable sites is generally reduced. Also, because the radar set detects projectiles to determine the weapon location, the radar set does not require a line-of-sight to the weapon emplacements. Therefore, a mask angle that masks off the line-of-sight to the weapons location reduces the effectiveness of enemy jamming and direction finding located in the vicinity of the weapons.

H-11. Enemy weapon locations generally tend to require lower radar mask angles. Maximum allowable mask angles decrease with increasing weapon location range, lower weapon location elevations, and lower weapon velocity. However, the radar set does not require a line-of-sight to the weapon location. The radar set must track the enemy projectile for a sufficient elevation arc before the projectile reaches the highest points of its trajectory (apogee). Considering the requirements for effectiveness against jamming, while maintaining adequate detection capability of projectiles, a lower mask angle (dependent upon the QE and velocity of the rounds fired) will provide the specified performance when the WLR and the weapons are at the same altitude.

H-12. Another factor which influences site selection is the height and density of foliage or trees relative to the WLR antenna and the AO. Radar signals may be weakened (attenuated) by more than 1 decibel per meter of heavy foliage. Therefore, foliage more than a few meters deep can severely reduce or inhibit the WLR effectiveness. The WLR effectiveness is evident when the operator looks at the AO with the clutter map function enabled and raw video displayed. If the remote control display unit shows a lot of white area, then the radar beams are being blocked by the foliage (screening crest) in front of the WLR. For this reason, it is important to place the trailer well back from trees in the direction of WLR search, if operation in a forest environment is required. The angle to the top of the nearest tree is the mask angle, ideally about 10 mils.

H-13. The site can be camouflaged, but the camouflage must provide clearance for 360-degree antenna rotation. The camouflage for the ATG must be of a radar transparent type, while the camouflage for the OCS can be radar scattering.

H-14. If other radar sets are operating in the area, consideration for WLR site location should be taken into account in order to minimize the common illumination volume between radar sets.

H-15. When a site location has been selected, the site grid coordinates and a boresight reference have to be established and marked to properly orient the WLR during occupation. A fifth-order survey is required to determine the site grid coordinates. This survey is performed by a survey team prior to the arrival of the WLR set and will not be done by the installation team. When the position has been determined, it is marked by the primary stake (near stake). A near stake is not required if utilizing Inertial Navigation System or a Global Positioning System.

H-16. For the boresight reference, a second stake (far stake) is preferably located more than 250m away in any convenient direction from the primary stake. A far stake is not required if utilizing Inertial Navigation System or a Global Positioning System.

H-17. The minimum acceptable distance is 100m. The azimuth angle (AZ Ø) formed by the intersection of the line between the two stakes and grid north is then measured by the survey team. The measured azimuth, along with the site grid coordinates, is recorded for subsequent use during initialization of the weapons location program.

PLANNING CONSIDERATIONS

H-18. During planning the tactical position areas are selected based on IPB, the range capabilities of the WLR, and METT-TC. A complete analysis of METT-TC will dictate which factors are most important. Generally, WLRs are positioned far enough from the FLOT to acquire enemy weapons and to prevent loss of personnel and equipment to enemy action. While avoiding unnecessary moves supports maximizing coverage and cueing time this might not be possible in LSCO.

H-19. The AN/TPQ-53 is usually located 8-12km behind the FLOT. The system was designed to detect acquisitions from 500m-60km. The AN/TPQ-53 has the flexibility to optimize coverage with a variety of operational modes and sub-modes.

H-20. The AN/TPQ-53's are not intended to work independently, but as a system of systems providing a tactical capability to the force. This redundant capability allows for one system to provide coverage while the other system move, conduct maintenance or repair activities. Positioning may change based on the tactical situation.

PROXIMITY OF OTHER WEAPONS LOCATING RADARS

H-21. Other WLR systems or active emitters can interfere with WLR coverage by attenuating or jamming the WLR beam. WLRs and emitters in close proximity on a similar azimuth of search may cause jamming or false locations. Inadvertent jamming and false locations can be avoided by careful planning of WLR positions.

H-22. The following positioning guidelines are provided to ensure non-degraded performance of the AN/TPQ-53 WLR systems when operating in close proximity:

- Two AN/TPQ-53 arrays operating in one of the 90 degree modes must be separated by 5km and facing in the same general direction with a maximum angle of 889 mils (50 degrees) formed by the intersection of the boresight axes of the 2 arrays. Each will electronically scan up to 800 mils (45 degrees) from their respective mechanical azimuth of search. Figure H-3, on page H-5, shows the geometric orientation of the two systems in close proximity. The systems should be operating on separate frequencies [25 megahertz (MHz) separation] and the transmitting and receiving systems will be.

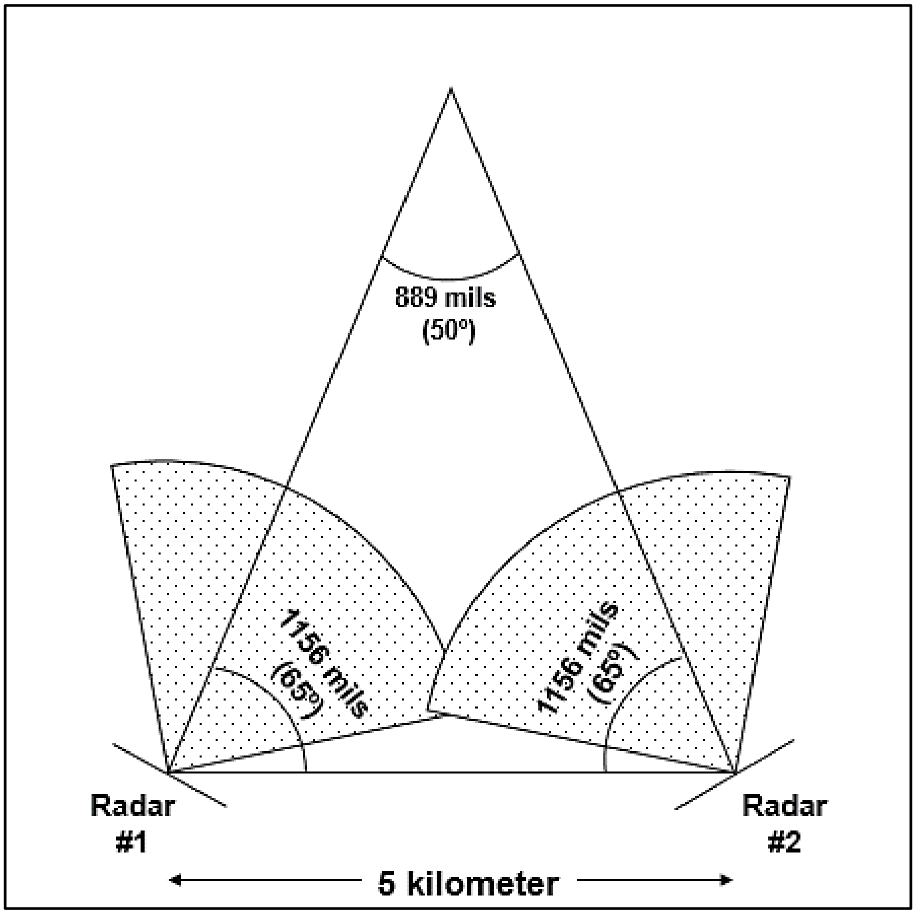


Figure H-3. Close proximity operating systems 90 degree mode

- Two AN/TPQ-53 arrays operating in one of the 360 degree modes must be separated by 20km. Both systems will be rotating at 30 revolutions per minute asynchronously and will eventually electronically scan towards each simultaneously. The systems should be operating on different frequencies (25 MHz separation) and both systems have an active sector of 6222 mils (350 degrees) with at least a 178 mil (10 degrees) inactive region being centered on the azimuth angle towards the other AN/TPQ-53 system. This coordinated azimuth sector control assures that neither system forms transmit or receive beams within ±89 mils (5°) in azimuth of the other system. Figure H-4 shows the geometric orientation of the two close proximity systems in 360 degree mode.

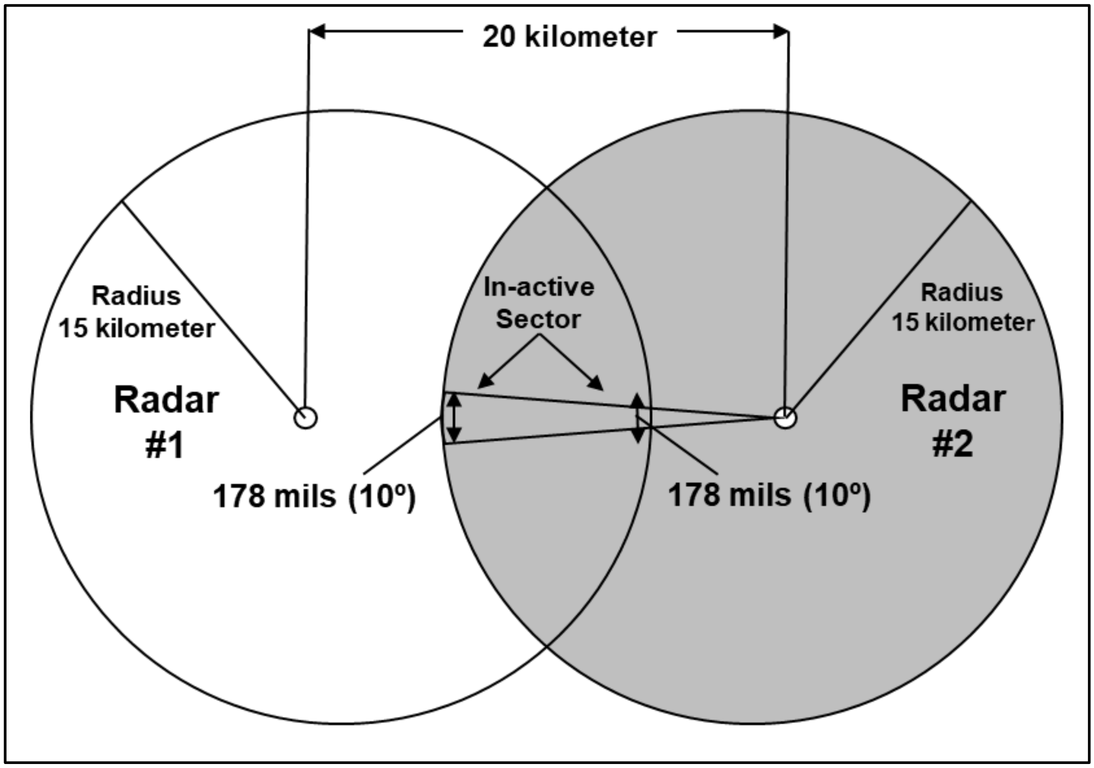


Figure H-4. Close proximity systems operation 360 degree mode

- When one AN/TPQ-53 WLR is operating in a 360 degree mode and a second AN/TPQ-53 WLR is operating in a 90 degree mode, the systems must be separated by 20km. The systems should be operating on different frequencies (at least 25 MHz separation, more is better). The system in 360 degree mode should have an active sector of at most 6222 mils (350 degrees) with at least a 178 mils (10 degrees) inactive region being centered on the azimuth angle towards the other AN/TPQ-53 system. The system in 90 degree mode should be oriented such that the other AN/TPQ-53 WLR in 360 degree mode is at least 5 degrees outside of the operating sector. This coordinated azimuth sector control ensures that neither system forms transmit or receive beams within ±89 mils (5 degrees) in azimuth of the other system. Co-located Systems - 360 degree mode, above, shows the geometric orientation of the two co-located systems in 360 degree mode.

AN/TPQ-53 Radar Position Area Cluster Method

H-23. During LSCO, it may be beneficial for the counterfire HQ to issue placement direction with relatively broad guidance. The sheer number of AN/TPQ-53s on the battlefield may make cueing both WLRs within a BCT's AO at the same time unnecessary. To facilitate bounding, survivability moves, and other tactical needs, using the RPA cluster method can be beneficial. It will allow the counterfire HQ to centrally plan the BCTs' AN/TPQ-53s placement and search guidance, while still giving the BCTs leeway to execute decentralized operations.

H-24. As stated previously, the AN/TPQ-53 is designed to be a system of systems. To enable the counterfire HQ to rapidly issues RDOs, and manage the WLRs within its AO, using the BCTs' two AN/TPQ-53s as a team that shares RPA clusters may be helpful. The counterfire HQ creates one RDO per BCT that gives the general location and search requirements for the BCT's AN/TPQ-53s. Then the BCT COS must ensure that one WLR is always in position and cueing. The COS will then conduct decentralized execution of cueing and moving its AN/TPQ-53s as directed in the RDO, while ensuring one WLR is always in position and cueing as directed. This is a method not a standard.

H-25. Figures H-5 and H-6 provide an example of the RPA cluster method. The RPA names are only a sample naming convention. RPA shapes are not standardized, the counterfire HQ should determine what works best for each operation.

H-26. In Figure H-5 the counterfire HQ gave both 2nd and 3rd BCT their general location, cueing schedule, and search azimuths for their respective AN/TPQ-53s with RDOs. Each BCT COS will select which WLR section will be in a specific RPA. In 2nd BCT's AO, the first AN/TPQ-53 is emplaced and cueing in RPA CD01; the second AN/TPQ-53 is in RPA CD02 is on standby to cue. In 3rd BCT's AO, its cueing WLR is in RPA EF03 while its second WLR is on standby in RPA EF01. Note on both figures the RPA clusters have three sites that are at least 5km apart; this enables the BCT's AN/TPQ-53s to support each other and the mission if required.

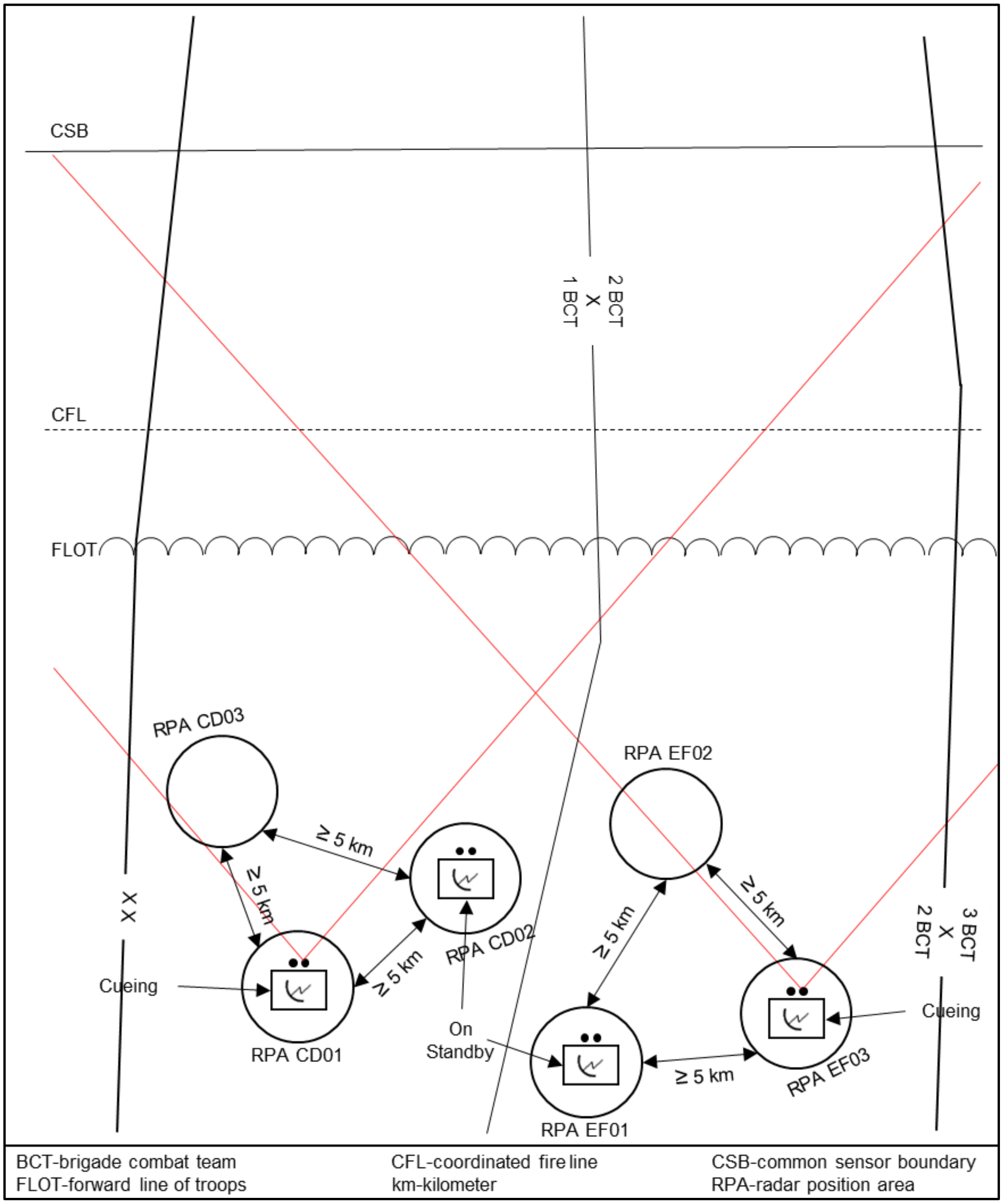


Figure H-5. Example of the radar position area cluster method

H-27. Figure H-6, on page H-9, depicts the movement of AN/TPQ-53s using RPA clusters. Due to numerous possible triggers outlined in the RDO (for example bounding with maneuver forces, or conducting a survivability move), 2nd BCT's COS activates the WLR in RPA CD02. Once confirmation has been received that the WLR in RPA CD02 is cueing, the COS directs the WLR in RPA CD01 to cease cueing and conduct its move to RPA CD03. Using RPA, 3rd BCT's COS has the same options for its WLRs to support the maneuver and the operating tempo.

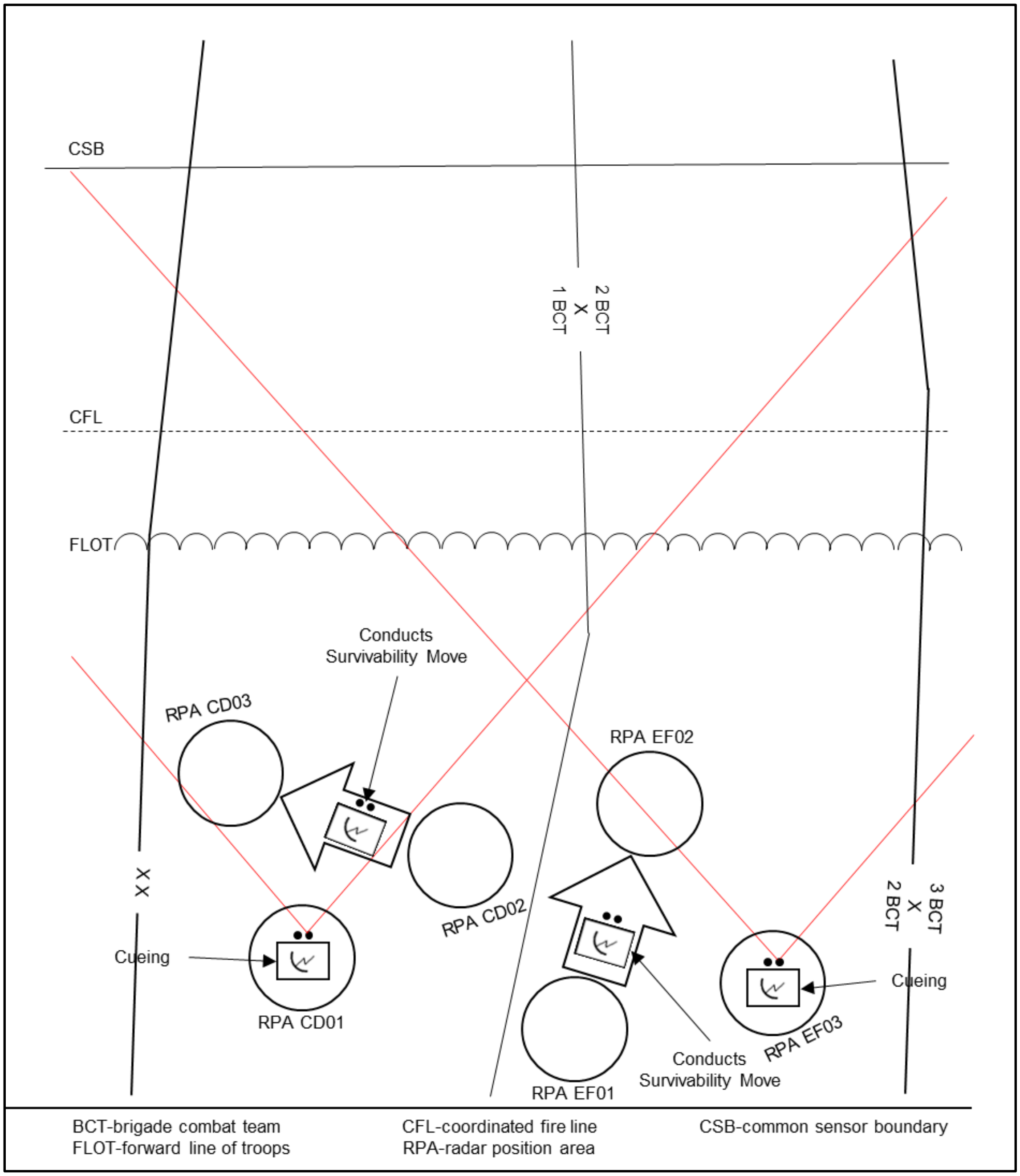


Figure H-6. Example of radar movement using the radar position area cluster method

SITE ACCESS

H-28. The WLR site should have more than one route of approach. Routes of approach should be accessible by section vehicles, free from enemy observation, and capable of being guarded by a minimum number of personnel. The quality of access must also be considered. Some essential considerations include:

- Accessibility during poor weather conditions. Can the position be accessed during periods of rain and snow? Positions that may deteriorate during inclement weather should be avoided to prevent stranding the WLR.

- Overhead clearance. Avoid locations where trees, power or telephone lines may damage WLR components when entering and exiting the position. Check the clearance requirements for tunnels and overpasses to ensure section equipment does not exceed requirements.
- Bridges. Check the bridge classifications on routes to WLR positions. Ensure that the bridge classification of section equipment does not exceed the load bearing capabilities of the bridge.
- Fords. Check fords to ensure they are passable to the WLR section equipment. If heavy rains are expected some positions may become untenable because of fording restrictions.
- Obstacles. Check routes for current and planned obstacles. These obstacles may include road craters, tank ditches, abates, or wire obstacles. Also, check for natural obstacles such as fallen trees and rockslides. Ensure that the access is sufficient to allow egress after combat has occurred. Rubble from buildings, utilities, and fallen trees should not prevent the WLR section from displacing from a position.

H-29. Safety is an important consideration when operating and working around the WLR. Possible safety concerns include radiation, wind, noise, and electrical hazards.

WIND

H-30. Because of the large surface area of the AN/TPQ-53 antenna, high wind velocity can cause serious safety hazards. Camouflage nets should be lowered or removed to prevent damage to equipment or injury to personnel.

H-31. For standard (un-armored) cab AN/TPQ-53 Systems: Whenever wind velocity reaches a constant 55 miles per hour (mph) (48 knots) or gusts up to 78 mph (68 knots) during operations, the antenna must be placed in the stowed position. When non-operational, the WLR must be stowed when winds reach 60 mph (52 knots) with gusts to 85 mph (74 knots).

H-32. For armored Cab AN/TPQ-53 Systems: Whenever wind velocity reaches a constant 76 mph (66 knots) or gusts up to 90 mph (78 knots) during operations, the antenna must be placed in the stowed position. When non-operational, the WLR must be stowed when winds reach 85 mph (74 knots) with gusts to 100 mph (87 knots).

SECTION II – DETECTION, VERIFICATION, AND LOCATION METHODOLOGY

H-33. The AN/TPQ-53 WLR is a mobile, radar set that automatically locates single or multiple hostile mortar, artillery, and rocket launched weapons. The AN/TPQ-53 can detect, classify, track, and determine the location of enemy indirect fire. It provides a net ready system with increased range and accuracy throughout a 1600 mil search sector as well as 6400 mils coverage for locating firing positions. The AN/TPQ-53 systems use a track-while scan approach. Track-while scan uses a fixed timeline of search beams, which revisits every point within the WLR coverage rapidly enough to establish and maintain a track on any target that enters the radar coverage without the need for any dedicated verify beams. A variation of track-while scan, called enhanced track-while scan foregoes the use of verify beams in the same manner as pure track-while scan, but allows the use of dedicated track beams on established targets while enabling a reduction in the overall track-while scan search volume (elevation). Enhanced track- while scan is the most efficient in terms of radar timeline used per number of targets, especially in a typical mission that sees weapons fired upward from the ground through a search fence. The AN/TPQ-53 uses either enhanced track-while scan or track-while scan for its search strategy, depending on mode. This extremely efficient use of WLR resources increases the overall range coverage of the radar.

H-34. AN/TPQ-53 must collect information in its search fence before it begins to track. There are no verification beams for this WLR in the 90 degree modes. A track is formed through revisits in the search fence. When a track appears to be a target of interest, the AN/TPQ-53 dynamically schedules periodic beams dedicated to tracking that specific target. In the 360 degree mode the AN/TPQ-53 is a "track while scan" radar, there are no dedicated track beams, but the extensive elevation coverage of the 360 degree search fence facilitates the location of mortars to 15km and artillery and rockets to 20km. A track can start at any height in the coverage.

H-35. Figure H-7 depicts how the AN/TPQ-53 6400 mil azimuth coverage is achieved. Beams are steered electronically forward and backward of the center beam by 30 degrees as shown, while the array is mechanically rotating at 30 revolutions per minute. This method illuminates the targets three times per scan. The system operates in a track-while-scan mode with a fixed radar timeline which allows for the volume search every scan.

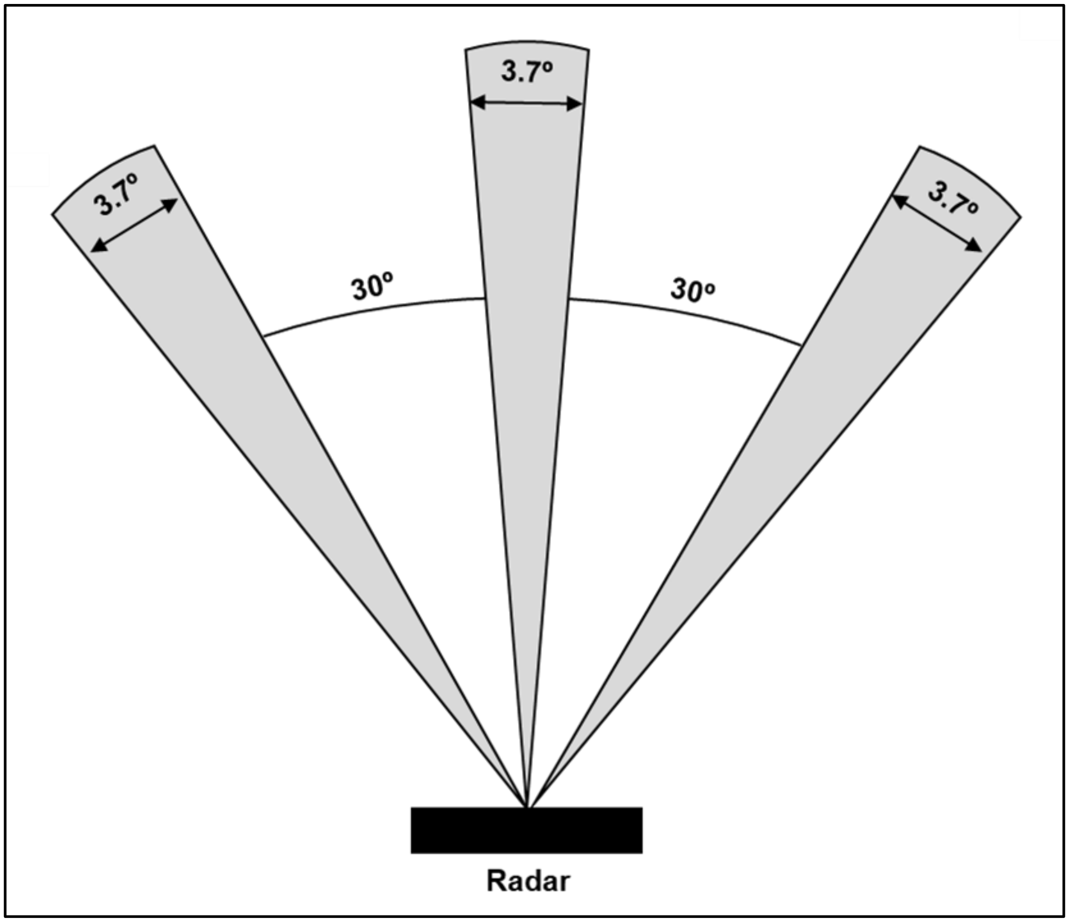


Figure H-7. Azimuth coverage of the AN/TPQ-53 in 6400 mil mode

AN/TPQ-53 DETECTIONS AREA

H-36. The possible detection area is a three dimensional space defined by the minimum and maximum range, search sector, and the vertical scan of the WLR. Planning ranges are used for the purpose of this discussion; however, the maximum planning range for the WLR is not an absolute. It is the range at which the probability of detection becomes low enough to be unsuitable for planning purposes. Nonetheless, objects may be detected beyond the maximum planning range. Conversely, objects within the planning ranges may not be detected. Listed below are the planning ranges for the various operational modes of the AN/TPQ-53:

- 90 Degree Normal - 0.5 to 20km for mortars, 0.5 to 34km for artillery, and 0.5 to 50km for rockets.
- 90 degree short range optimized mode - 0.5 to 20km for mortars, 0.5 to 25km for artillery, and 0.5 to 25km for rockets.
- 90 Degree Long Range Optimized Mode - 0.5 to 20km for mortars, 0.5 to 34km for artillery, and 0.5 to 60km for rockets.
- 90 Degree 107mm Rocket - 25 to 34km for artillery, and 25 to 50km for rockets.
- 360 Degree Normal - 3 to 15km for mortars, 5 to 25km for artillery, and 5 to 20km for rockets.
- 360 Degree Weather - 3 to 15km for mortars, 5 to 25km for artillery, and 5 to 20km for rockets.

Q-53 Search Sector And Ranges

H-37. The search sector for the AN/TPQ-53 is the azimuth coverage of the WLR's search sector or sectors and the frequencies used. Each defined sector specifies the azimuth center, azimuth left and right boundaries, and the minimum and maximum range of the search area. It is possible to define up to 27 sectors in a full circle with a minimum value of 237 mils (13 degrees) each, to total no more than 6400 mils.

H-38. The following table H-1 describes the intended AN/TPQ-53 search sectors and associated range limits for each mode:

Table H-1. AN/TPQ-53 search sector limits

Operating Mode	*Right/Left Sector Edges*	*Min/Max Range*
90 degree – normal	+/- 800 mils (+/- 45 degrees)	500m to 50km
90 degree – short range optimized mode	+/- 800 mils (+/- 45 degrees)	500m to 25km
90 degree - Long Range Optimized Mode	+/- 800 mils (+/- 45 degrees)	500m to 60km
90 Degree – 107mm Rocket	+/- 533 mils (+/- 30 degrees)	25km to 50km
360 Degree – Normal	0 to 6400 mils	3km to 20km
360 Degree – Weather	0 to 6400 mils	3km to 20km
km – kilometer max – maximum	mm – millimeter	min – minimum

Mode Section Considerations

H-39. The AN/TPQ-53 is a versatile system that gives the commander multiple subsets within the 90 degree or 360 degree operating modes. TA planners use the mission variables of METT-TC, commander's guidance, and future operations to determine which mode to employ. The following is a list of possible considerations:

- The range of enemy indirect systems. If > 20km use direct azimuth mode.
- To reduce the number of moves in the offense use direct azimuth mode to maximize range.
- When there is not enough separation between two AN/TPQ-53 WLRs use direct azimuth mode.
- When IPB identifies templated location of enemy indirect fire systems use direct azimuth mode.
- When a more accurate TLE for the POO is required use direct azimuth mode.
- When the enemy electronic intelligence threat is high use direct azimuth mode.
- When IPB does not identify likely enemy indirect fire locations use 360 degree mode.
- When the enemy indirect fire systems range is <20km consider using 360 degree mode.
- To provide WLR coverage over a large static location use 360 degree mode.
- Depending on the shape and size of the AO 360 degree mode may be the optimal mode to maximize the coverage area.

AN/TPQ-53 Vertical Scan

H-40. The maximum steerable elevation angle of the AN/TPQ-53 using 90 degree mode is 587 mils (33 degrees). In 360 degree normal mode, the AN/TPQ-53 has a fixed 373 mils (21 degrees) of elevation coverage. Figure H-8, on page H-13, depicts how the AN/TPQ-53 elevation coverage is achieved in 6400 mil mode. One single three degree beam and three additional six degree beams cover from 1.5 degrees to 22.5 degrees above the horizon. A projectile could enter anywhere within the volume area and the WLR system will identify and classify it.

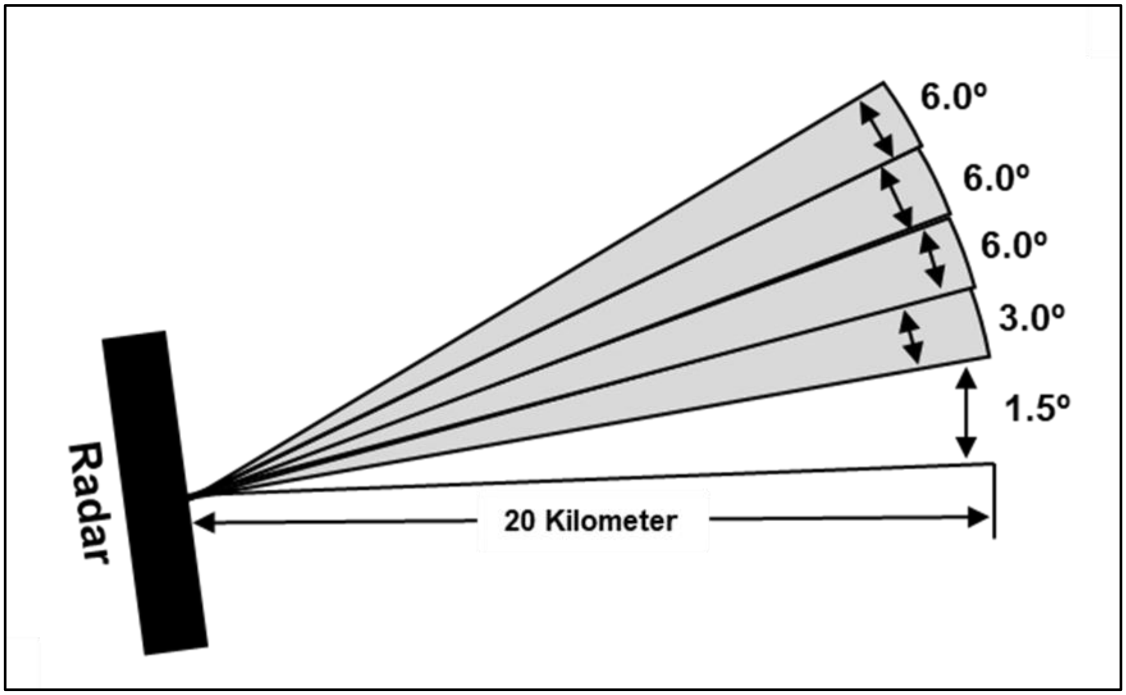


Figure H-8. Elevation coverage of the AN/TPQ-53 in 6400 mil mode

RANGE AND ACCURACY COVERAGE HOSTILE MODE

H-41. The AN/TPQ-53 was designed to provide weapon locations at the ranges and accuracies specified in table H-2 throughout a 1600 mil search sector.

Table H-2. AN/TPQ-53 1600 mils coverage range and location accuracies

Weapon Type	*Range*	*Accuracy (Circular Error Probable 50)*
Mortar light (60mm)	0.5 to 15km	30m or .3% of range
Mortar medium (81mm)	0.5 to 18km	30m or .3% of range
Mortar heavy (120mm)	0.5 to 20km	30m or .3% of range
Cannon light (105mm)	3 to 30km	30m or .3% of range
Cannon medium (155mm)	3 to 32km	30m or .3% of range
Cannon heavy (8 in)	3 to 34km	30m or .3% of range
Rocket light (80mm)	5 to 15km	30m or .3% of range
Rocket light (107mm)	8 to 50km	30m or .3% of range
Rocket medium (122mm)	8 to 50km	30m or .3% of range
Rocket heavy (240mm)	15 to 60km	30m or .3% of range
km – kilometer	mm – millimeter	

H-42. The AN/TPQ-53 was designed to provide weapon locations at the ranges and accuracies specified in table H-3 throughout a 6400 mil search sector.

Table H-3. AN/TPQ-53 6400 mils coverage range and location accuracies

Weapon Type	*Range*	*Accuracy (Circular Error Probable 50)*
Mortar light (60mm)	3 to 10km	50m or .5% of range
Mortar medium (81mm)	3 to 12km	50m or .5% of range
Mortar heavy (120mm)	3 to 15km	50m or .5% of range
Cannon light (105mm)	5 to 18km	75m or 1% of range
Cannon medium (155mm)	5 to 20km	75m or 1% of range
Cannon heavy (8 in)	5 to 20km	75m or 1% of range
Rocket light (107mm)	5 to 20km	75m or 1% of range
Rocket medium (122mm)	8 to 20km	75m or 1% of range
km – kilometers	mm – millimeter	

H-43. The operator can tailor the search sectors to enable coverage between 230 and 6400 mils in azimuth. The operator can select a maximum of 27 sectors, while in 360 degree mode, with a minimum of 1 sector. An individual sector can be no smaller than 230 mils (13 degrees). The WLR can detect and acquire six or more projectiles within the search area at any given time.

H-44. The AN/TPQ-53 can acquire and track hostile and friendly mortar, cannon, and rocket projectiles throughout a 6400 mils search sector. The search sector can be moved and steered throughout the 6400 mil coverage without repositioning the vehicle or trailer on which the antenna is mounted.

H-45. The AN/TPQ-53 is a multifaceted system which in 1600 mil modes has the ability to track mortars with a range of 500m to 25km, and artillery or rockets out to a range of 60km. The TPQ-53 provides flexibility for optimizing the operational mode to the tactical situation by offering additional search modes tailored specifically for short range or long range capabilities. For example, short range optimized mode allows for optimized tracking of short range, high angle rate targets. The operational mode should be determined during the MDMP and issued to the WLR section trough the RDO.

H-46. The AN/TPQ-53 also has the ability to operate using a 6400 mil azimuth search sector with a designed to minimum range of 3km and maximum range of 20km. It is imperative for mode use to be determined during the MDMP and issued to the WLR section through the RDO.

H-47. The AN/TPQ-53 software allows it to perform in 6 operating modes to include:

- 90 degree normal mode.
- 90 degree short range optimized mode.
- 90 degree long range optimized mode.
- 90 degree 107mm rocket mode.
- 360 degree normal mode.
- 360 degree weather mode.

H-48. The 90 degree normal search mode utilizes 4 distinct waveforms which allow it to provide coverage from 500 meters to 50km. These waveforms overlap to provide very high revisit rates at close range and lower revisit rates at long range, ensuring the system will accurately locate targets from 500 meters-50km.

H-49. The 90 degree short range optimized mode differs from the normal 90 degree mode, max ranges decreases to 25km. This mode provides additional elevation coverage at short ranges (500 meters-12km) and even higher revisit rates to improve probability of location and resulting accuracy. The 90 degree short range optimized mode is used to optimize locating high angle targets in close range and provide an 85% or greater probability of locating targets within 500 meters of POO.

H-50. The 90 Degree long range optimized mode is derived from the 90 degree normal mode. This mode has been modified in order to locate 240mm rockets at 60km. This mode provides improved performance over 90° mode from 12-60km while retaining some very short range capability in to 500 meters.

H-51. The 90 Degree 107mm rocket mode was designed to enable performance against long range 107mm rockets out to 50km. It is derived from the 90 degree normal mode with all but the long range search fences removed, and all detections inside of 25km suppressed. This mode is intended to be operated over a 1067 mil (60 degree) sector when the threat is specifically very long range 107mm (light) rockets.

H-52. The 360 degree search mode allows coverage of 360 degrees or 6400 mils by rotating the antenna array at a rate of 30 RPMs. Through beam steering, a beam stack at both 30 degrees to the left and right of the main beam stack enables electronic scanning of the entire search sector covering 21 degrees of elevation three times in each mechanical rotation.

H-53. The 360 degree weather mode was designed to provide 360 degrees performance from 3-20km while operating in heavy rain clutter. This mode improves Doppler resolution to reduce the effects of clutter, but to offset this improvement; it reduces the search elevation coverage of the 360 degree normal mode. To counteract the reduction in search elevation coverage, this mode adds the ability to dynamically place beams on tracks of interest, maintaining performance while in rain clutter in a 6400 mil (360 degree) mode.

Target Classification

H-54. The AN/TPQ-53 classifies acquisitions as three distinct target types: mortar, artillery, or rocket. The AN/TPQ-53 does not differentiate subtypes for these target types and defaults to unknown. The target classifications generated by the AN/TPQ-53 for transmission to AFATDS are mortar, artillery, and rocket unknowns. Of significant importance in target type classification for the AN/TPQ-53 system is the low datum plane. Estimates of target dynamics at launch are the primary discriminators used in the system software to determine the target type classification. This launch state is based on extrapolation of the target track to the low datum plane. As such, the low datum plane must match the true low point of the sector of operations as closely as possible. Significant mismatch in the low datum plane and the true gun height may cause the AN/TPQ-53 to misclassify the target, inducing accuracy errors, or possibly even failure to locate as the track may no longer appear to be a target of interest.

Probability Of Location

H-55. The AN/TPQ-53 was designed to achieve at least 85% probability of location for all targets at the ranges listed in tables H-2 and H-3. Optimal operational mode selection based on priority threat intelligence ensures targets are located with the highest probability.

AN/TPQ-53 Friendly Fire

H-56. The AN/TPQ-53 does not have a dedicated friendly fire mode. Friendly fire missions can be executed while the system simultaneously performs its hostile weapon locating mission. The AN/TPQ-53 has the ability to perform friendly fire missions in both 90 degree modes and 360 degree modes.

H-57. In the 90 degree mode, unlike the AN/TPQ-36 system, the AN/TPQ-53 can track weapons for friendly fire registration while simultaneously tracking hostile targets. The AN/TPQ-53 can register at all impact ranges between 3km and 40km. The AN/TPQ-53 can perform friendly fire registration in both 90 and 360 degree modes.

H-58. When executing a friendly fire mission in 90 degree mode, the WLR sets up a horizontal "window" through which the projectile must pass. The window is referred to as the friendly fire search fence as shown in figure H-9. The narrowed search fence provides the best probability of detecting and tracking friendly rounds fired. The WLR tracks projectiles until it has enough data to predict the POI.

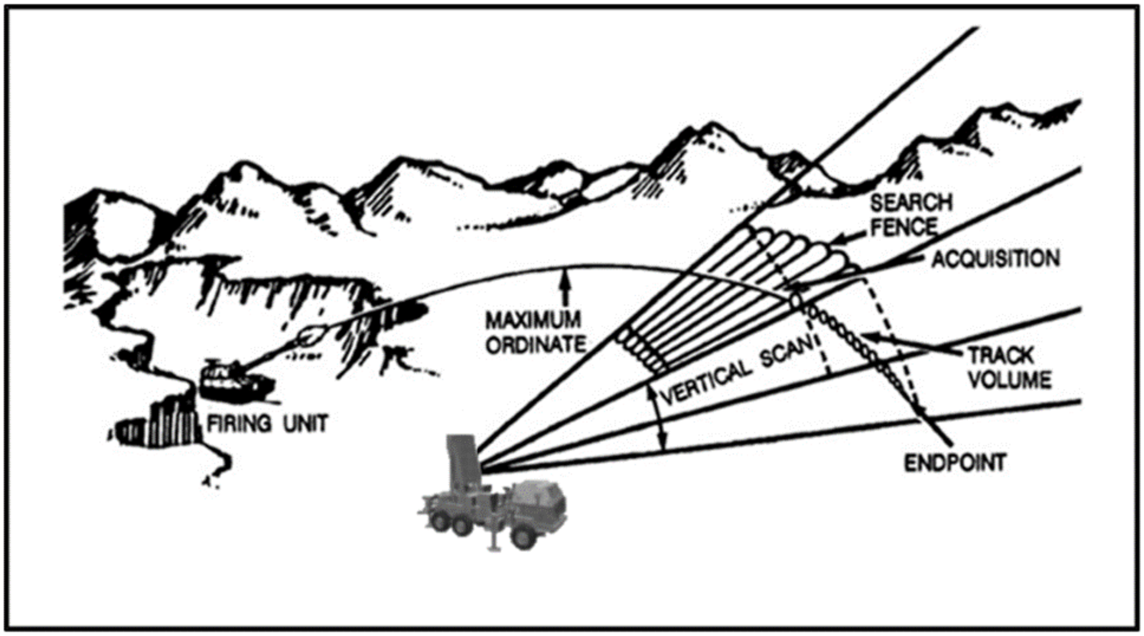


Figure H-9. Friendly projectile tracking

H-59. When executing a friendly fire mission in 360 degree mode, the WLR utilizes the hostile search fence to perform friendly fire registration, identifying the friendly round based on the expected target trajectory.

H-60. When operating in the friendly fire mode the WLR provides friendly units with accurate predicted impact location data. The AN/TPQ-53 supports 3 missions that are used to provide this data. The missions are listed below:

- Mortar impact prediction.
- Artillery impact prediction.
- Rocket impact predication.

H-61. See the AN/TPQ-53 operator manuals for the correct friendly fire mission procedures.

OPERATING THROUGH ELECTRONIC COUNTERMEASURES

H-62. Operating through electronic countermeasures consists of detecting the presence of jamming or interference and performing actions to minimize or eliminate the effects of jamming.

AN/TPQ-53

H-63. The WLR can indicate jamming by any or all of the following: displaying a line at the jamming azimuth on the operational display, jam strobe message (azimuth, frequency, time) in the jammer database, the jammer indicator displaying the number of active jammers, or the electromagnetic attack indicator indicating an Active status in the operations screen. To avoid degradation of WLR performance the following tactics may be used:

- Keep the WLR's electromagnetic attack countermeasures features enabled.
- Avoid operation within line of sight or in the same sector as the jammer.
- Operate on a different frequency than the jammer.
- Use deception.

H-64. Keeping the WLR's electromagnetic attack countermeasure functions enabled allows for activation of the jam strobe and electromagnetic protection functions. The jam strobe identifies the azimuth of the jamming while the electromagnetic protection functions serve to remove the effects of interference from the jammer.

Line of sight issues can be avoided by selecting optimal WLR sights. Relocating the WLR to avoid jamming may or may not be possible based on the tactical situation. Changing WLR frequencies will sometimes help avoid the jammer's operating frequency. If these steps do not work, it may be possible to fool the jammer by ceasing to radiate for a few minutes, change frequencies, and then resume operations. This may help prevent the jammer from staying on the WLR's frequency.

H-65. The following bullets provide A concise summary of the AN/TPQ-53 capabilities:

- Transportability: The AN/TPQ-53 can be shipped worldwide by ground, rail, water, and air. The AN/TPQ-53 can be air transported by large cargo airplanes. The AN/TPQ53, in its MEG configuration, can be air transportable in a single C-130 sortie, and the MEG/SOG configuration can be air transported in a single C-17 sortie without disassembly and with drive-on and drive-off capability. It can be placed in a travel configuration prepared to convoy within 2 minutes of off-load.
- Emplacement and Displacement: Four operators can emplace and bring the system in to full operation in 10 minutes. Four operators can displace the system into a travel configuration and be ready for movement within 5 minutes. Add an additional 15 minutes for inclement weather or nighttime operations.
- Self-surveying and Orientation: The AN/TPQ-53 can perform self-location functions. Operators can also manually bore sight the WLR and input location and orientating data in the event of automated systems failure.
- Search Sector Tailorability: The AN/TPQ-53 operator can tailor the search sectors to enable coverage between 230 and 6400 mils. The AN/TPQ-53 operator can select a maximum of 27 sectors with a minimum of 1 sector. Tailoring a search sector enables the sensor to scan that particular sector more often than it would if scanning the entire 6400 mil detection span. An option exists for search sectors to be automatically defined by the system based on the current operating mode or for the operator to override the automatically generated sectors and manually define them.
- DTED: The Q-53 can upload DTED from external media the operator downloaded separately and use DTED Level 1, DTED Level 2, and SRTM data.
- Radar Terrain Following Data: AN/TPQ-53 can implement and store electronic radar terrain following data. The operators can also manually input terrain data. The system defaults to the most accurate data. In 90 degree modes, search beams automatically follow the terrain mask in use.
- Did-Hit-Data Capability: The AN/TPQ-53 provides did-hit-data (projectile impact location) of friendly indirect fires in the 1600 mil mode to an accuracy of 30m or .3% of range. In the 6400 mils mode, the AN/TPQ-53 will achieve an impact location accuracy of 50 meters or 0.5% of range for mortars and an accuracy of 75 meters or 1% of range for cannons and rockets.
- Impact Point Prediction: For hostile fire, the projectile impact point accuracy is typically within 250 meters or 2% of range.
- Locating non-standard munitions: The system can track and locate projectiles launched with nonstandard quadrant elevations and high muzzle velocities.
- False Location Rate: The AN/TPQ-53 has a false location rate of no more than one every 6 hours in both modes. Combat experience and testing has demonstrated that similar WLRs and RF emitters of the same band, rotary and fixed wing aircraft can cause an increase in false locations.
- Height Correction Automated or Manual: The WLR automatically height corrects all targets or provides the operator with the option to manually input corrections in order to achieve the actual firing location with the use of Digital Terrain and Elevation Data Level 1, Digital Terrain and Elevation Data Level 2, and SRTM data.
- Transmit Targets on the Move: The system can recall from system storage, process and digitally transmit targets previously acquired in position while on the move.
- Sense and Warn: Radar can provide an acquisition message set while in 1600 mils or 6400 mils mode to facilitate sense and warn mission.
- Voice and Digital Communications: The AN/TPQ-53 can communicate and pass data with multiple subscribers on multiple nets operating on one digital and one voice communication nets.
- State Vector Capability: When an AN/TPQ-53 is working within an area protected by RAMWarn activities, these WLRs send state vector data for indirect fire munitions to the FAAD control node.

The FAAD uses this data along with other sensor data to correlate the position of the incoming indirect fire munitions and forwards the data to warn Soldiers in the affected area quickly of the pending hazard.

- Tactical Display: The system can electronically display tactical maps and graphic overlays of friendly and enemy locations and boundaries and all fire support coordinating measures upon request. The operator must have the ability to display the operational area in sufficient detail and scale to make tactical decisions to support ongoing operations.
- Prime Power: The AN/TPQ-53 has an organic primary and a backup tactical power sources common to the United States military. The AN/TPQ-53 can automatically or manually switch between tactical and commercial power or between primary and backup tactical power without system interruption.
- Computer Backup: All computer systems can retain their data via backup or auto-save capability for 60 minutes in the event of a power failure.
- Survivability: The AN/TPQ-53 has enhanced survivability against artillery primarily by a combination of deployment capabilities, rapid displacement, emission control, side lobe signature reduction, and reduced signatures.
- Jam Strobe Reporting: The AN/TPQ-53 provides jammer azimuth and frequency in the intercept report format.
- Audible Alarm: An operator adjustable alarm (audio and visual) will alert the operator and differentiate between the following events:
  - A new location identified.
  - A received message.
  - A system fault.
  - An over temperature.
- Target Track Capacity: The AN/TPQ-53 can detect, verify, and locate 50 projectiles simultaneously in flight within the search area.
- Tracking through Clutter: The system detects and tracks targets while minimizing the effects of clutter on system performance over the entire surveillance volume. The system can process targets in an urban, high relief, and low relief terrain clutter environment along with sea clutter.
- Saturation Alleviation: The AN/TPQ-53 automatically performs saturation alleviation of targets in a manner which is dependent on the primary mission the AN/TPQ-53 is conducting. The operator also has a limited manual control of system sensitivity.
- Passive Interference Display: The AN/TPQ-53 provides a display that informs the operator of interference levels over the entire range of AN/TPQ-53 operating frequencies, across the entire 6400 mil sector.
- Data Recording: The AN/TPQ-53 provides built-in or integral data recording of all key operational, system readiness, and technical data without system degradation or operator distraction, as well as playback and analysis at non-mission essential workstations. The AN/TPQ-53 will record data during electronic operations and synchronize it with the display data. The AN/TPQ-53 has the following data recording capabilities:
  - Data recording capacity for up to 72 hours.
  - Record equipment status, failure indication, diagnostic, fault isolation, and other typical sample data histories for a 200 hour operation period, onto removable storage devices.
  - Copying the recorded data media and archiving selected portions in a master database.
  - On-demand, off-line post-mission playback of recorded data enabling interaction with the recorded playback, that includes selective zooming, event focus, and editing of training data.
  - Provides a data port for accessing WLR data for inner-platform networking growth.

Appendix I

AN/TPQ-50 Weapons Locating Radar System Characteristics and Employment

This chapter discusses characteristics and employment techniques for the AN/TPQ50 WLR. The AN/TPQ-50 is designed to detect short range mortars firing from all angles. The AN/TPQ-50 provides automated 6400 mil coverage.

SECTION I – CHARACTERISTICS AND EMPLOYMENT

I-1. The AN/TPQ-50 has two different operating configurations: stand alone or on vehicle configurations (see figure I-1). They each provide the capability to detect enemy indirect fire through 6400 mil azimuth coverage. At a minimum, the AN/TPQ-50 is designed to detect, track, and locate mortars, rockets, and artillery. It has a location range from 0.5-10km. The AN/TPQ-50 will classify each weapon located as a mortar, artillery, or rocket. The system further classifies mortars by light, medium, and heavy projectiles.

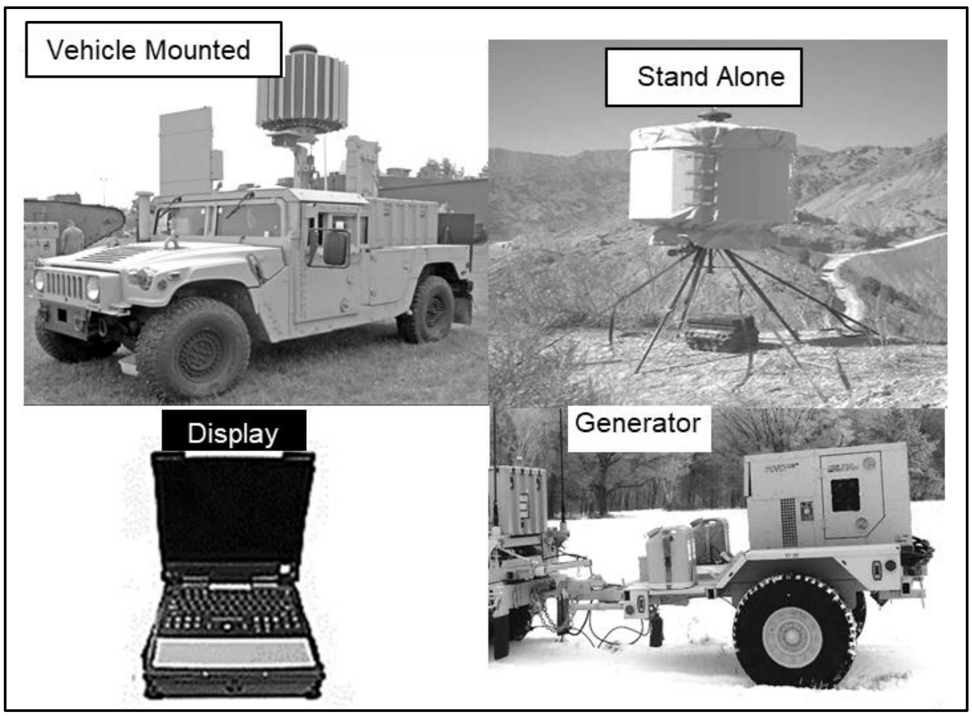


Figure I-1. AN/TPQ-50 configurations

I-2. In nominal weather conditions the AN/TPQ-50 standalone system assembly, alignment, and initialization can be accomplished by two trained operators in less than 20 minutes. For the on-vehicle configuration this can be accomplished in 10 minutes. Disassembly can be accomplished by two trained operators in approximately 10 minutes. Care must be taken during assembly and disassembly to prevent damage to the equipment, especially the antenna columns.

SITE REQUIREMENTS

I-3. Emplacement and planning considerations for all versions of the AN/TPQ-50. The following factors should be taken into consideration when determining site selection and emplacement:

- In the event that there are no physical obstructions in the local area, there is no advantage to emplacing the AN/TPQ-50 above ground level. The emplacement height above local terrain should be less than 15m.
- Place the AN/TPQ-50 in an area with the clearest field of view possible because nearby buildings, trees, and other obstructions could seriously degrade system performance. The ideal location for the AN/TPQ-50 system is on a hill above the surrounding terrain with a clear field of view and a slope of 10 degrees or less.
- Raising the emplacement height of the AN/TPQ-50 will result in better performance. The WLR should be emplaced to minimize any obstructions, and should mask no more than 4 degrees of elevation in the AO.

I-4. When properly sited, the AN/TPQ-50 can provide continuous 6400 mil (360 degree) surveillance. However, the operator may choose to limit the azimuth coverage to less than 6400 mils, but no less than 267 mils (15 degrees), if obstructions such as buildings, vehicles, or trees are located near the AN/TPQ-50. Modifications to the search sector may also be adjusted if a 6400 mil search sector is not required.

I-5. Ensure the AN/TPQ-50 is positioned at least 20m from obstructions to prevent reflection damage. Failure to position the AN/TPQ-50 20 meters from an obstruction will likely damage the radar and degrade its performance.

CAUTION

If obstructions are located within 20 meters of the AN/TPQ-50, the signal return strength may damage the system

I-6. The AN/TPQ-50 performance can be degraded or the false location rate may increase due to radio frequency interference from other WLRs or communications equipment. Therefore, the AN/TPQ-50 emplacement and planning considerations should take into consideration any possible interference sources. Interference sources may include high power emitters, such as air surveillance radars since they operate in the same frequency band as the AN/TPQ-50. There are also many jamming devices on the battlefield, both friendly and enemy. This must be taken into consideration during all steps of the MDMP for decisive action, especially during stability operations. If the AN/TPQ-50 is located within a tactical assembly area, "ON" and "OFF" procedures for these jamming devices must be taken into consideration as well as the area of effect for these systems.

I-7. Emplacement times are critical in all operations, especially early entry scenarios, when the initial force on the ground is extremely susceptible to enemy indirect fire. To minimize this risk, two operators can emplace the AN/TPQ-50 and bring it to full operational capability in twenty minutes. This is a very important consideration to keep in mind when considering phase lines and triggers during the MDMP.

I-8. Analysis of combat operations has identified that a significant number of AN/TPQ-50 acquisitions occur at ranges between 2-10km and these fires may originate from all sectors of the defensive perimeter. The AN/TPQ-50 fills these short range, close support, and 6400 mil coverage capability gaps. The AN/TPQ-50 provides uniform continuous indirect coverage.

I-9. The AN/TPQ-50, can simultaneously locate weapons fired both in-bound and out-bound, in respects to the WLR location. This capability is a definite combat multiplier and must be taken into consideration during the counterfire or targeting process.

I-10. The AN/TPQ-50 predicts the impact point for all projectiles accurately enough to provide localized warning in sufficient time for personnel to properly react. This early warning provides enhanced force protection for friendly personnel.

PLANNING CONSIDERATIONS

I-11. During planning the tactical position areas are selected based on MDMP, the range capabilities of the WLR, and METT-TC. A complete analysis of METT-TC will dictate which factors are most important. Generally, WLRs are positioned far enough from the FLOT to acquire enemy weapons and to prevent loss of personnel and equipment to enemy action. Avoiding unnecessary moves supports maximizing coverage and cueing time.

I-12. The AN/TPQ-50 is usually positioned 1 to 2km behind the FLOT to support brigade counterfire. Positioning may change based on the tactical situation.

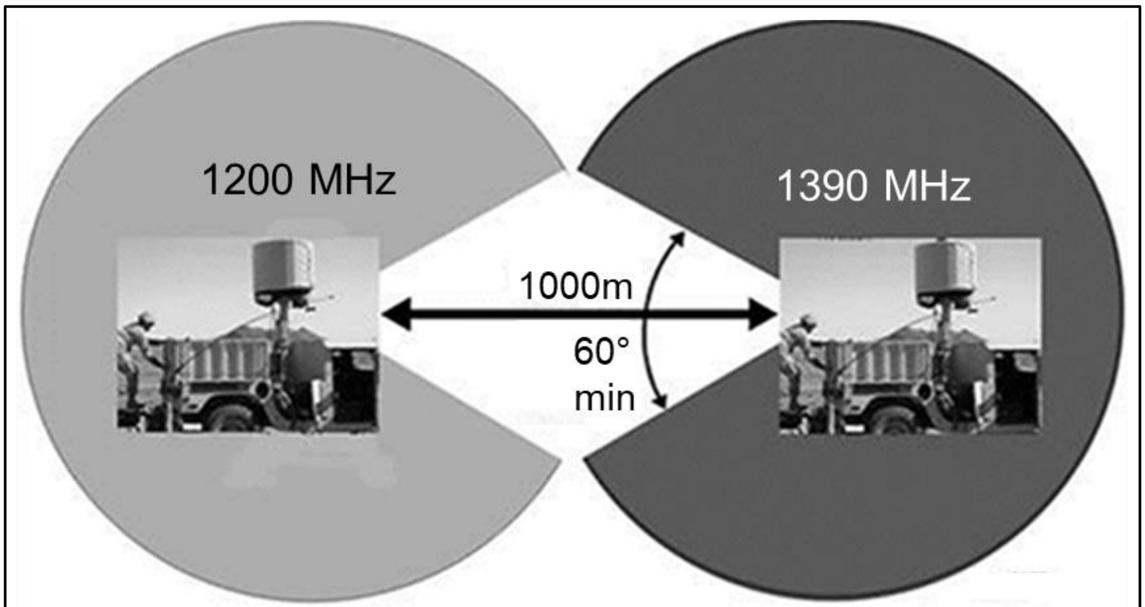
PROXIMITY OF OTHER WEAPONS LOCATING RADARS

I-13. Other WLR systems or active emitters can interfere with WLR coverage by attenuating or jamming the WLR beam. WLRs and emitters in close proximity, operating on the same frequency or azimuth of search may cause jamming or increase the false location rate. Inadvertent jamming can be avoided by careful planning of WLR positions.

I-14. The AN/TPQ-50 performance can be degraded due to radio frequency interference from other WLRs or communications equipment; therefore, site selection should take interfering sources into consideration. High power emitters, such as air surveillance radars, can be a source of substantial interference. The AN/TPQ-50 should be placed as far away as possible from this type of interference. All sources of information should be used to determine all possible emitters in the AO to avoid interference.

Note. Several air surveillance radars and Counter Radio Controlled Improvised Explosive Device EW Systems operate in the same frequency band as the AN/TPQ-50.

I-15. If multiple AN/TPQ-50 systems are operating in the same area, each AN/TPQ-50 system is positioned a minimum of 1000m apart and on a different frequency from the other systems. Minimum frequency separation of 30 MHz for three or less AN/TPQ-50s and minimum frequency separation of 20 MHz with more than three AN/TPQ-50s. See figures I-2, I-3 and figure I-4 for examples of operating two or more AN/TPQ-50s from the same AO.



m-meter MHz-megahertz min-minimum

Figure I-2. AN/TPQ-50 position considerations for two weapons locating radars

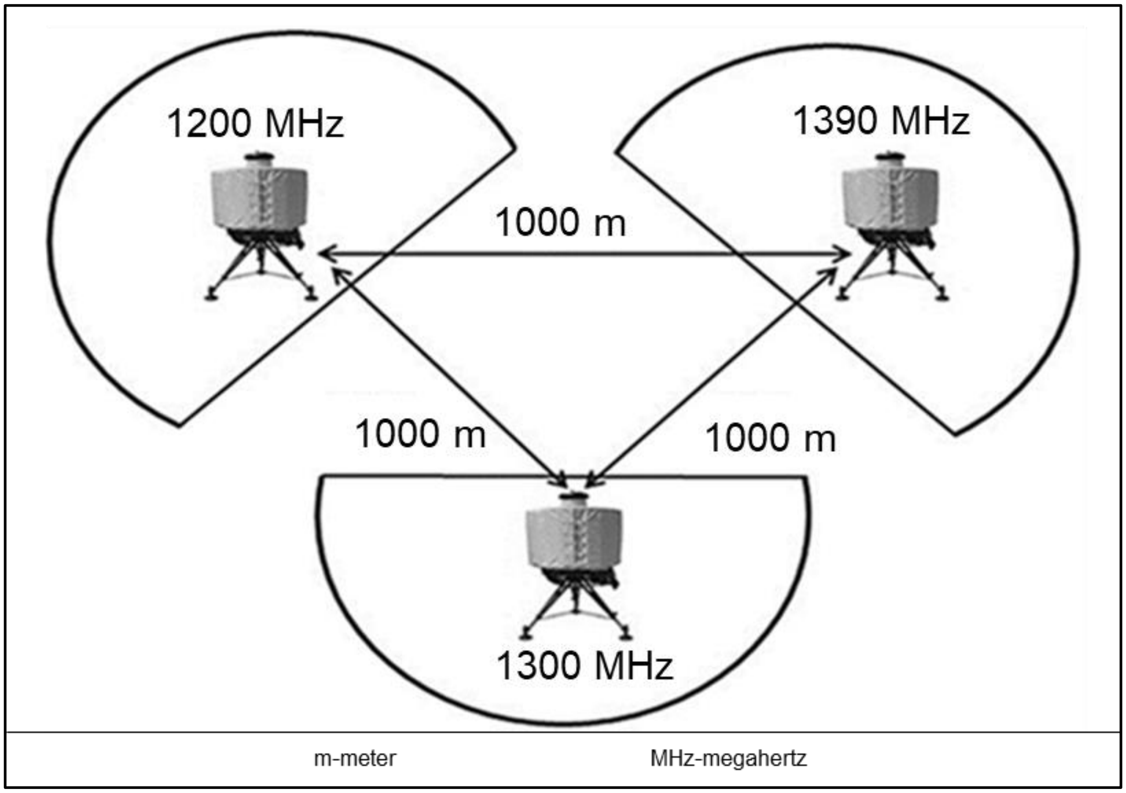


Figure I-3. AN/TPQ-50 position considerations for three weapons locating radars

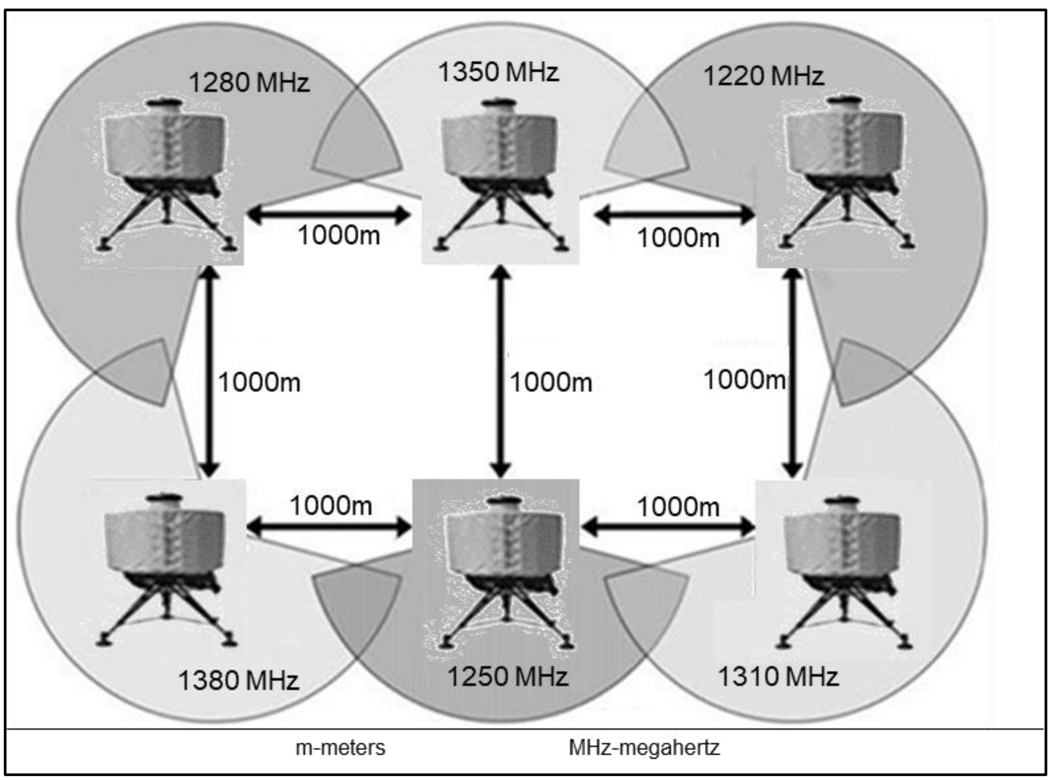


Figure I-4. AN/TPQ-50 position considerations for more than three weapons locating radars

Note. All sectors facing the other AN/TPQ-50 systems are blanked, or turned off and the frequencies are separated as described above.

SITE ACCESS

I-16. The WLR site should have more than one route of approach. Routes of approach should be accessible by section vehicles, free from enemy observation, and capable of being guarded by a minimum number of personnel. The quality of access must also be considered. Some essential considerations include:

- Accessibility during poor weather conditions. Can the position be accessed during periods of rain and snow? Positions that may deteriorate during inclement weather should be avoided to prevent stranding the WLR.
- Overhead clearance. Avoid locations where trees, power or telephone lines may damage WLR components when entering and exiting the position. Check the clearance requirements for tunnels and overpasses to ensure section equipment does not exceed requirements.
- Bridges. Check the bridge classifications on routes to WLR positions. Ensure that the bridge classification of section equipment does not exceed the load bearing capabilities of the bridge.
- Fords. Check fords to ensure they are passable to the WLR section equipment. If heavy rains are expected some positions may become untenable because of fording restrictions.
- Obstacles. Check routes for current and planned obstacles. These obstacles may include road craters, tank ditches, abates, or wire obstacles. Also, check for natural obstacles such as fallen trees and rockslides. Ensure that the access is sufficient to allow egress after combat has occurred. Rubble from buildings, utilities, and fallen trees should not prevent the WLR section from displacing from a position.

SAFETY CONSIDERATIONS

I-17. Safety is an important consideration when operating and working around the AN/TPQ-50. Possible safety concerns include radiation, wind, noise, and electrical hazards.

ELECTROMAGNETIC RADIATION HAZARDS

I-18. The hazard ranges for the AN/TPQ-50 extends full 6400 mils scanning: 2.0m within 1600 mils of the stare sector, non-scanning: 6.4m, and more than 1600 mils outside of stare sector: 0.8m.

WIND

I-19. The AN/TPQ-50 system includes a weather cover that is placed over the WLR assembly for protection from wind, rain, snow, or sand. The mesh at the bottom of the cover allows hot air to flow out when used in hot, dry temperatures. The weather cover's drawstrings and Velcro straps further protect the AN/TPQ-50 from conditions. The AN/TPQ-50 can operate in a 35 mph (30 knot) wind. However if the prevailing wind is 57 mph (50 knots) or more the system must be disassembled to avoid damage.

SECTION II – DETECTION, VERIFICATION, AND LOCATION METHODOLOGY

I-20. The AN/TPQ-50 is extremely proficient at detecting airborne objects, and aircraft are no exception. Even though an aircraft can provide a stable detection pattern for a track, it does not meet the expected velocity and trajectory profile of artillery, rockets, or mortars. Therefore, the aircraft may be displayed as a non-discrimination track or as a non-projectile track.

AN/TPQ-50 DETECTION AREA

I-21. The possible detection area is a three dimensional space defined by the minimum and maximum range, search sector, and the vertical scan of the WLR. Planning ranges are used for the purposes of this discussion. However, the maximum planning range for the WLR is not an absolute. It is the range at which the probability of detection becomes low enough to be unsuitable for planning purposes. Nonetheless, objects may be detected beyond the maximum planning range. Conversely, objects within the planning ranges may not be detected. Planning ranges for the AN/TPQ-50 are 0.5 to 10km for mortars, artillery, and rockets (see figure I-5).

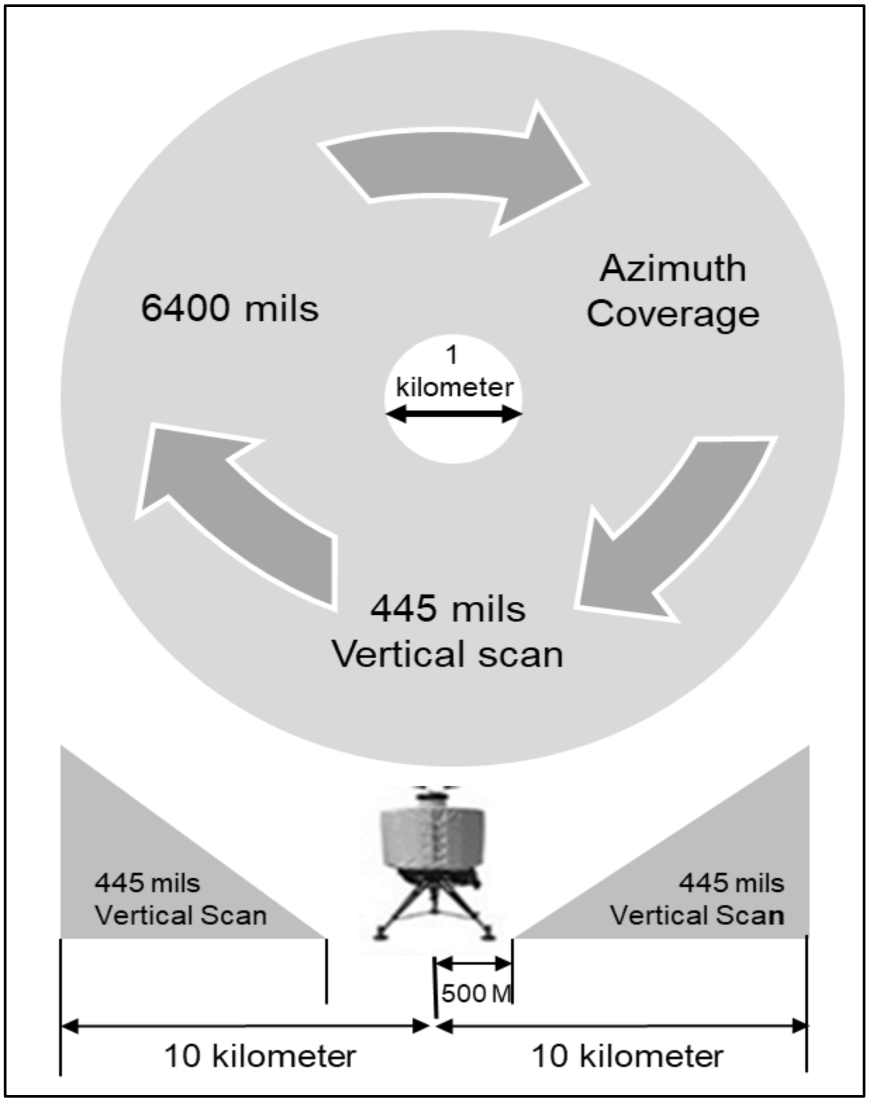


Figure I-5. AN/TPQ-50 search sector and range

Note. AN/TPQ-50 classifies each weapon as mortar, cannon, or rocket to include as light, medium, and heavy.

AN/TPQ-50 VERTICAL SCAN

I-22. The elevation coverage of the AN/TPQ-50 is 445 mils. This elevation coverage provides the required target tracking time to enable accurate weapon locations for projectiles between .5km and 10km.

TARGET CLASSIFICATION HOSTILE MODE

I-23. The AN/TPQ-50 has the capability of providing friendly fire "did-hit data" with a TLE50 CEP of 50m for mortars (see table I-1 for other weapon TLEs). It has the capability of maintaining track on 20 simultaneous in-flight projectiles originating from separate sites uniformly distributed in the coverage area of the AN/TPQ-50.

Table I-1. AN/TPQ-50 target location error

Weapon	*Range (Km)*	*TLE(m)**
Mortar 60mm	0.5km	50m
Mortar 81mm	0.5-8km	50m
Mortar 120mm	1-10km	50m
Cannon 155mm	1-6km	50m or 2% of range
Rocket 122mm	1-10km	100m or 3.5% of range
Rocket 240mm	1-10km	200m or 3.5% of range
m – meter mm – millimeter	km – kilometer	TLE – target location error

OPERATING THROUGH ELECTRONIC COUNTERMEASURES

I-24. Operating through electronic countermeasures consists of detecting the presence of jamming or interference and performing actions to minimize or eliminate the effects of jamming.

AN/TPQ-50

I-25. It is recommended to select a frequency that is not jammed. The cueing agent along with the frequency manager should conduct frequency deconfliction.

I-26. The following bullets provide a concise summary of the AN/TPQ-50 capabilities:

- The AN/TPQ-50 can perform self-location functions given survey data. Operators can also manually bore sight the WLR and input location and orientating data in the event of automated systems failure.
- The AN/TPQ-50 operator can tailor the search sectors to enable coverage between 267 and 6400 mils. The AN/TPQ-50 operator can select a maximum of 18 sectors with a minimum of 1 sector. Establishing a priority enables the sensor to scan a particular sector more often than it would if scanning the entire 6400 mil detection span.
- The AN/TPQ-50 can upload DTED from external media the operator downloaded separately and use DTED Level 1, DTED Level 2, and SRTM data.
- The AN/TPQ-50 has a target track capacity that can detect and acquire a maximum of twenty projectiles within the search area at any given time.
- The system can recall from system storage, process and digitally transmit targets previously acquired in position while on the move.
- The AN/TPQ-50 can provide an acquisition message set to facilitate sense and warn mission.
- The AN/TPQ-50 can communicate and pass data with multiple subscribers on multiple nets simultaneously and interface through the AFATDS and battery computer system, operating on two digital and two voice communication nets.
- When an AN/TPQ-50 is working within an area protected by RAM-Warn activities, the AN/TPQ-50 sends state vector data for indirect fire munitions to the FAAD control node. The FAAD uses this data, along with other sensor data, to correlate the position of the incoming indirect fire munitions and forwards the data to warn Soldiers in the affected area of the pending hazard.
- The system can electronically display tactical maps and graphic overlays of friendly and template enemy locations and boundaries and all FSCMs upon request.
- The AN/TPQ-50 provides jammer azimuth which facilitates jam strobe reporting.
- The AN/TPQ-50 provides built-in or integral data recording of all key operational, system readiness, and technical data without system degradation or operator distraction, as well as

playback and analysis at non-mission essential workstations. The AN/TPQ-50 will record data during electronic operations and synchronize it with the display data.

Appendix J

AN/TPQ-36 Weapons Locating Radar Systems Characteristics and Employment

This chapter discusses characteristics and employment techniques for the AN/TPQ36 WLRs. The AN/TPQ-36 is optimized to locate shorter range, high-angle and lower velocity weapons, mortars, and shorter range artillery. It also can locate longer range cannons and rockets within its maximum range. While detecting mortars and artillery, the AN/TPQ-36's higher probability of detection extends to approximately 14,500 meters for artillery and 18,000 meters for mortars. Rockets can be detected with reasonable probability out to 24,000 meters. The AN/TPQ-36 can search up to 6400 mils (not simultaneously) by using the extended azimuth search function in which the computer automatically traverses the antenna from two to four positions and performs target location.

SECTION I – CHARACTERISTICS AND EMPLOYMENT

OPERATIONS CONTROL GROUP

J-1. The operations control group (OCG) is the focal point for operating the AN/TPQ-36. The OCG consists of the shelter mounted on a vehicle with the shelter cable set. The shelter cable set consists of two 50-foot cables. These cables connect the shelter to the ATG. One cable is a power cable that provides power from the ATG to the shelter. The second cable is a data cable that allows data exchange between the antenna and the shelter. The cables are stored on cable spools attached to the back of the shelter during movement. An alternate method of storing the cables is to place them in the utility vehicle bed under the shelter. This allows the cables to remain connected to the shelter during movement. This technique is often used since it shortens the emplacement time.

ANTENNA TRANSCEIVER GROUP

J-2. The ATG consists of the antenna, MAPS-H, a modified antenna trailer, radiating elements and associated feed, receiver preamplifiers, receiver protectors, azimuth and elevation positioning circuits, beam steering circuits, tilt sensor, and boresight telescope. The antenna is erected to the vertical position during operations and lowered to the horizontal position for transport. The OCG prime mover tows the ATG during movement. The modified trailer is equipped with the medium track suspension system. MAPS-H is a GPS aided, inertial surveying system, designed for use in the ground mobile environment. It provides the AN/TPQ-36 with an on-board position location and survey capability. MAPS-H uses a vehicle motion system to determine the location of the AN/TPQ-36 antenna.

POWER DISTRIBUTION GROUP

J-3. The power distribution group (PDG) consists of generator mounted on a prime mover, and the prime power cable. The generator is a 400 hertz, 60 kilowatt, precise power tactical quite generator mounted on a special pallet. The prime power cable is contained on a spool that is mounted on the left rear of the generator pallet. The prime power cable is a 32m cable that connects the PDG generator to the ATG via a power distribution box with an eight meter cable. This allows the PDG to be positioned up to 30 meters from the ATG, given the requirement for 10m of slack in the cable.

Trailer Power Distribution Unit

J-4. The trailer power distribution unit is a 400 hertz, 60 kilowatt generator, mounted on a M200A1 trailer. The prime mover tows the trailer. Based on the cable lengths the OCG can be placed 40 meters from the ATG. The PDG can be placed up to 30 meters from the ATG given the combined lengths of the prime power and ATG power cable.

SITE REQUIREMENTS

J-5. The technical aspects and characteristics of the AN/TPQ-36 determine the requirements for site selection. The section chief selects the actual WLR site from the general area for positioning established by the FAB, DIVARTY, or BN operations officer. These positions are recommended by the counterfire officer during the MDMP. The technical considerations for site selection and emplacement include:

- Slope.
- Area in front of the antenna.
- Screening crest.
- Masking.
- Aspect angle.
- Electronic line of sight.
- Track volume.
- Proximity of other WLRs.
- Cable lengths.

Slope

J-6. Slope is an important consideration for the proper positioning of the AN/TPQ-36. Safety is a consideration when positioning the ATG. The slope of the terrain cannot exceed 7 degrees (120 mils) to ensure proper leveling of the ATG. The ATG will not operate properly without leveling. Some slope is advantageous and enhances AN/TPQ-36 functioning. Slope also provides drainage to the site that can help prevent components from becoming stuck during periods of heavy or continuous rainfall.

Area In Front Of The Weapons Locating Radar

J-7. The area in front of the ATG should be clear of foliage that extends above the bottom of the antenna. AN/TPQ-36 signals can be attenuated by more than 1 decibel per meter if operating within heavy foliage. A few meters of foliage can severely reduce the detection effectiveness. A clear area in front of the ATG minimizes attenuation of the radar beam. This area should extend 200-300 meters in front of the ATG. The ideal site will have a clear area in front of the ATG that has a gentle downward slope for approximately 200-300 meters and then gradually rises up to the screening crest. The downward slope reduces multipath errors. Multipath errors are created when the computer controlled signal processor transmits or receive signals traveling by more than one path during detection.

Screening Crest

J-8. A screening crest increases the survivability of the AN/TPQ-36 by serving as a defense against enemy observation (visual and infrared), direct fire, and electronic countermeasures. The screening crest also helps attenuate sound. Ideally, the screening crest should be in friendly territory and located approximately 1000 meters in front of the ATG, perpendicular to the AN/TPQ-36 azimuth to center sector. When possible utilize a dual screening crest. The first screening crest should be approximately 250 meters and the second screening crest at 1000 meters from the AN/TPQ-36 site.

J-9. The vertical angle to the screening crest should be between 15-30 mils for the AN/TPQ-36. The optimum vertical angle is 10 mils. The difference between the highest and lowest points on the screening crest should not exceed 30 mils for the AN/TPQ-36. A difference of more than 30 mils reduces the ability of the AN/TPQ-36 to produce enough track volume to compute a POO or POI. The vertical angle between the ATG and the top of the screening crest is called a mask angle.

MASKING

J-10. The radar section chief must consider visibility and masking (for example, varied elevations, dense trees or foliage, and high buildings). This becomes of greater importance when covering a 6400 mil sector. Radar position analysis system is used to conduct site analysis and determine the optimum initialization data. Blind spots in the coverage can be determined and reported to the counterfire section for appropriate action. See appendix F for more information on the radar position analysis system.

ELECTRONIC LINE OF SIGHT

J-11. The overriding consideration in the selection for an AN/TPQ-36 site is electronic line of site. All WLR systems must have an electronic line of sight to the projectile being detected to acquire the weapon. However, electronic line of site to the weapon is not required. The section chief verifies electronic line of sight before occupying the site. This can be done manually or with radar position analysis system. Verifying the electronic line of sight before occupying the site can save valuable time by eliminating untenable sites.

TRACK VOLUME

J-12. Track volume is determined by the vertical scan of the WLR. The vertical scan can be reduced because of the terrain contour or screening crest in front of the WLR. WLRs require 50 mils of track volume to detect a projectile. The difference between the high and low mask angles should not exceed 30 mils for the AN/TPQ-36.

PLANNING FOR TACTICAL CONSIDERATIONS

J-13. The tactical position areas are selected based on IPB, the range capabilities of the AN/TPQ-36, and METT-TC. A complete analysis of METT-TC will dictate which factors are most important. WLRs are positioned far enough from the FLOT to acquire enemy weapons and to prevent loss of personnel and equipment to enemy action. Avoiding unnecessary moves supports maximizing coverage and cueing time. The tactical considerations for positioning the AN/TPQ-36 is generally positioned 3-6km behind the FLOT.

J-14. Positioning will change based on the tactical situation. These considerations include the layout of the battlefield contiguous or non-contiguous, or linear and non-linear.

PROXIMITY OF OTHER WEAPONS LOCATING RADARS

J-15. Other WLR systems or active emitters can interfere with WLR coverage by attenuating or jamming the WLR beam. WLRs and emitters close in proximity or azimuth of search may cause jamming. Inadvertent jamming can be avoided by careful planning of WLR positions.

J-16. When two or more AN/TPQ-36s are operating in the same area they must be separated by at least 250 meters.

CABLE LENGTHS

J-17. Cable lengths must be considered when selecting a WLR site. The cables determine the maximum extent to which the components of the WLR can be dispersed. The location of system components is determined by terrain contour, foliage, site access, and threat. Ideally, the WLR components should be positioned to take advantage of naturally available cover and concealment. Nonetheless, cable lengths may dictate the actual positions.

J-18. Based on these lengths, the AN/TPQ-36's OCG can be placed up to 40m from the ATG and 30 meters from the PDG. The remote control display terminal can be located up to 90m from the shelter when using both control display terminal cables. Emplacement of system components must allow for 10m of slack in the cables to prevent damage to cable heads and connectors.

Site Access

J-19. The WLR site should have more than one route of approach. Routes of approach should be accessible by section vehicles, free from enemy observation, and capable of being guarded by a minimum number of personnel. The quality of access must also be considered. Some essential considerations include:

- Accessibility during poor weather conditions. Can the position be accessed during periods of rain and snow? Positions that may deteriorate during inclement weather should be avoided to prevent stranding the WLR.
- Overhead clearance. Avoid locations where trees, power lines, or telephone lines may damage WLR components when entering and exiting the position. Check the clearance requirements for tunnels and overpasses to ensure section equipment does not exceed requirements.
- Bridges. Check the bridge classifications on routes to WLR positions. Ensure the military load classification of section equipment does not exceed the capacity of any bridge encountered along the route.
- Fords. Check fords to ensure they are passable to the WLR section equipment. The ATG for the AN/TPQ-36 can only ford 30 inches of water. If heavy rains are expected, some positions may become untenable because of fording restrictions.
- Obstacles. Check routes for current and planned obstacles. These obstacles may include road craters, tank ditches, abates, or wire obstacles. Also, check for natural obstacles such as fallen trees and rockslides. Ensure the access is sufficient to allow egress after combat has occurred. Rubble from buildings, utilities, and fallen trees should not prevent the WLR section from displacing.

SAFETY CONSIDERATIONS

J-20. Safety is an important consideration when operating and working around the WLR. Possible safety concerns include radiation, wind, noise, and electrical hazards.

Hazards Of Electromagnetic Radiation To Personnel

J-21. The hazard ranges for the AN/TPQ-36 WLR extends 5m in front of the antenna within a 1600 mils fan about the boresight for all transmitting operations. For narrow-sector azimuth scan angles less than 400 mils, an additional sector must be controlled to a distance of 30m from the antenna.

J-22. For fixed beam mode, the hazard area extends to a distance of 75m in front of the WLR. The narrow-scan hazard sector usually applies to friendly fire mode operations and fixed-beam to certain maintenance operations.

Wind

J-23. Because of the large surface area of the AN/TPQ-36 antenna, high wind velocity can cause serious safety hazards. When wind velocity reaches a constant 52 mph (45 knots) or gusts up to 75 mph (65 knots) during operations, the antenna must be placed in the stowed position.

J-24. When nonoperational, the WLR must be stowed when winds reach 65 mph (56 knots) with gusts to 100 mph (88 knots). Camouflage nets should be lowered or removed to prevent damage to equipment or injury to personnel.

SECTION II – CHARACTERISTICS AND EMPLOYMENT

J-25. The AN/TPQ-36 uses a search, verify, track approach to achieve an acquisition on all suspected targets. Search, verify, track requires that the WLR respond very quickly to every detection reported during search, by inserting a verify beam into the search frame.

J-26. Establishing the search fence is the first step performed by the WLR for detecting an object. The WLR accomplishes this by transmitting a series of beams that conform to the terrain. Once an object penetrates the search fence, the software determines the object's speed, elevation, range, and azimuth. The software uses this information to predict the object's next location and to send out verification beams to determine if the object has a ballistic trajectory.

J-27. If a ballistic trajectory is verified, the software sends out a series of tracking beams. See figure J-1. These beams provide the WLR with the information required to mathematically extrapolate a predicted launch and impact point. The WLR stops sending out tracking beams when the following conditions exist:

- A solution is computed for the acquisition.
- Three sequential misses happen.
- The predicted azimuth for the next track update is outside the left or right limit of the WLR's search sector.
- The predicted elevation of the next track is above or below the WLR's minimum or maximum search elevation.

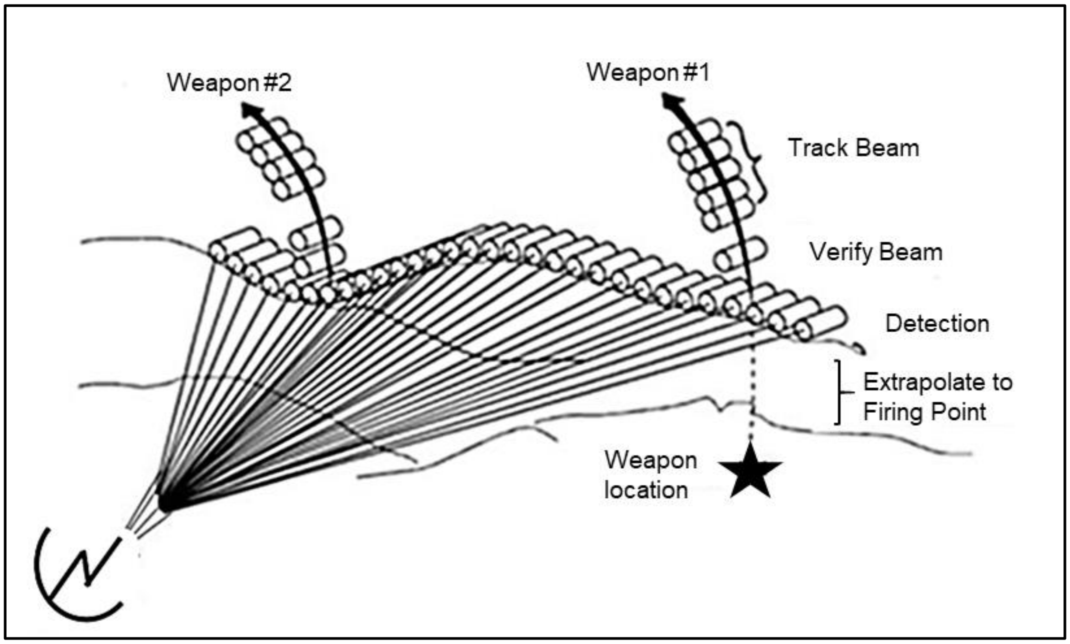


Figure J-1. AN/TPQ-36 detection, verification, and location methodology

Note. Search beam on the screening crest verifies penetration of projectiles. Verification and tracking beams transmit automatically. Computer determines POO and POI.

AN/TPQ-36 DETECTION AREA

J-28. The possible detection area is a three dimensional space defined by the minimum and maximum range, search sector, and the vertical scan of the WLR. Planning ranges are used for the purposes of this discussion; however, the maximum planning range for the WLR is not an absolute.

J-29. A system's actual maximum effective range is the range at which the probability of detection becomes low enough to be unsuitable for planning purposes. Nonetheless, objects may be detected beyond the maximum planning range. Conversely, objects within the planning ranges may not be detected. The planning ranges for the AN/TPQ-36 is 14.5km for artillery, 18km for mortars, and 24km for rockets.

AN/TPQ-36 SEARCH SECTOR AND RANGES

J-30. The search sector is the area left and right of the WLR's azimuth of search where the WLR can locate targets. The maximum search sector for the AN/TPQ-36 is plus or minus 800 mils from the azimuth of search for a total of 1600 mils. The search sector can be narrowed based on the tactical situation.

J-31. Figure J-2 illustrates possible AN/TPQ-36 search sector and associated range limits.

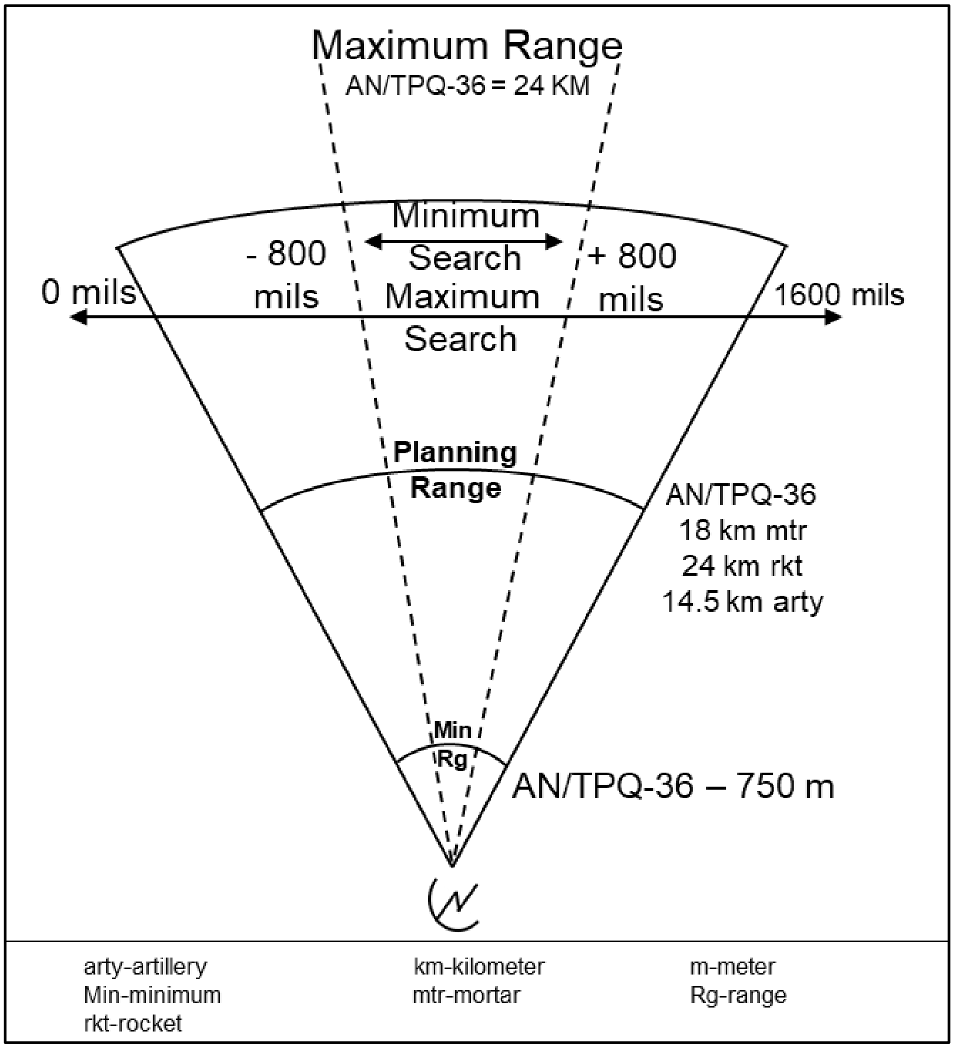


Figure J-2. Q-36 search sector and range

Note. The AN/TPQ-36 must have a minimum of 900 meters difference between minimum and maximum ranges.

AN/TPQ-36 VERTICAL SCAN

J-32. The vertical component of the detection area is vertical scan. This area extends vertically from the search fence to the maximum scan elevation of the WLR. The vertical scan for the AN/TPQ-36 is approximately 80 mils with all 32 scanning frequencies enabled. (Each frequency disabled results in a loss of approximately 2.5 mils of vertical scan.) A minimum of 20 frequencies are needed to track a round.

J-33. Figure J-3, on page J-7, shows the vertical scan capabilities of the AN/TPQ-36. The three dimensional area shown in the diagram is the area where an object can be detected and tracked. There must be a sufficient amount of vertical scan at the points where an object passes through the detection area for the WLR to track the object and compute a solution. The amount of available vertical scan is called track volume.

Note. The AN/TPQ-36 requires a minimum of 50 mils of track volume to track a round for long enough to achieve a solution.

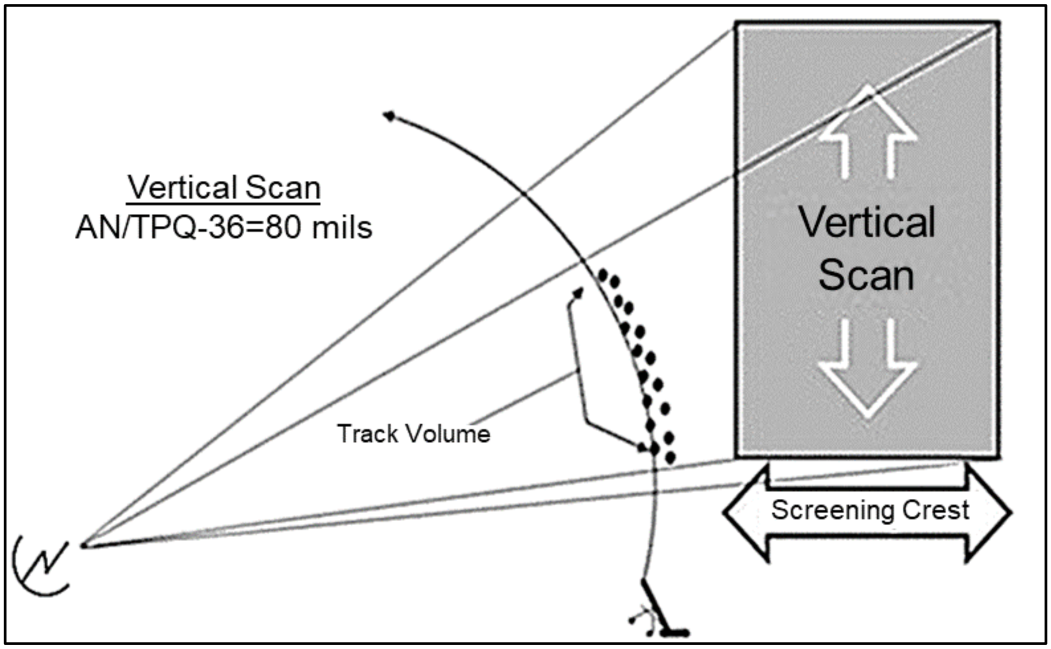


Figure J-3. Vertical scan

Note: Track volume is determined by the difference between vertical scan and the height of screening crest in mils.

J-34. There are two other major factors that affect the AN/TPQ-36s ability to detect, verify, and locate. These factors are aspect angle and speed of the object. The aspect angle is the angle measured from antenna to the target path of the object. The aspect angle must be greater than 1600 mils. This means the object must be traveling toward the antenna. Objects approaching at 1600 mils may not be detected by the WLR.

J-35. The velocity of the object is a critical element. The velocity must be within the minimum and maximum velocity thresholds for all WLR systems.

AN/TPQ-36 VELOCITY REQUIREMENTS

J-36. Most mortar, artillery, and rockets have a velocity greater than 80m per second. The velocity requirements for the AN/TPQ-36 are that it tracks objects moving toward the WLR at ground surface speeds of at least 50m per second and no greater than 1500m per second. Tracks objects moving away from the radar at ground surface speeds no greater than 80m per second.

AN/TPQ-36 RADAR BEAMS

J-37. A radar beam is actually composed of four individual beams that comprise a track cluster. The track cluster is simply identified as a radar beam.

J-38. Figure J-4 shows a cross section of a radar track beam used to track an object traveling through the detection area.

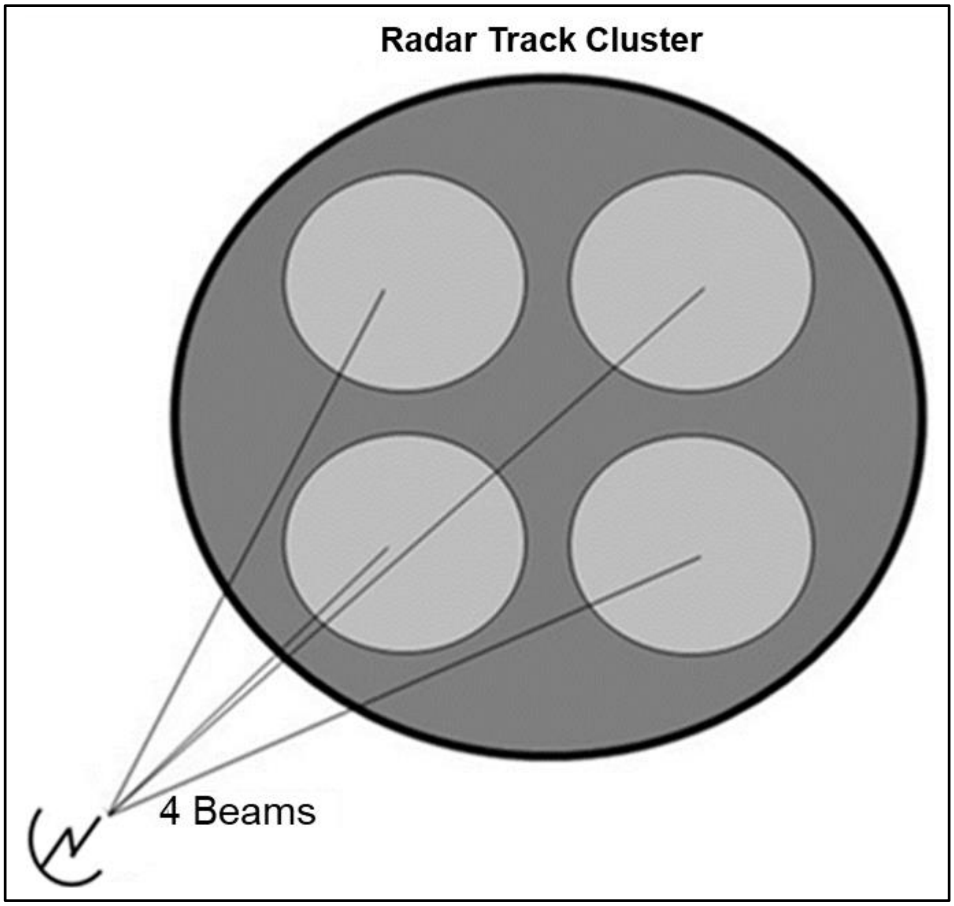


Figure J-4. Radar track beam cross section

Note: The software uses the radar beams as a pathway for monitoring projectiles passing through the detection area.

J-39. There are three possible outcomes when an object passes through the search fence and the radar transmits the verification or tracking beam. The outcomes are miss, hit, or plot. A miss occurs when the projectile strikes none of the individual beams in the track cluster. A hit is indicated when at least one beam in the track cluster is struck, but not all. A plot occurs when the following conditions happen:

- All four beams of the track cluster detect the object.
- The detected range of the object is within 75 meters of the predicted range.
- The detected azimuth is within 20 mils of the predicted azimuth.
- The detected elevation is with 15 mils of the predicted elevation.

J-40. When the software achieves an adequate number of plots it computes a solution for the POO and POI. The number of plots required to achieve a solution varies based on WLR type, which include the initial detection range and the tracking time. In general, the AN/TPQ-36 needs between 3-15 plots depending on the reasons for track termination.

J-41. Figure J-5, on page J-9, summarizes the tracking process:

- Step 1. Object breaks the radar's search fence.
- Step 2. Radar verifies that object has ballistic characteristics.
- Step 3. Radar tracks object along its predicted trajectory.

- Step 4. Computer extrapolates the POO and POI.

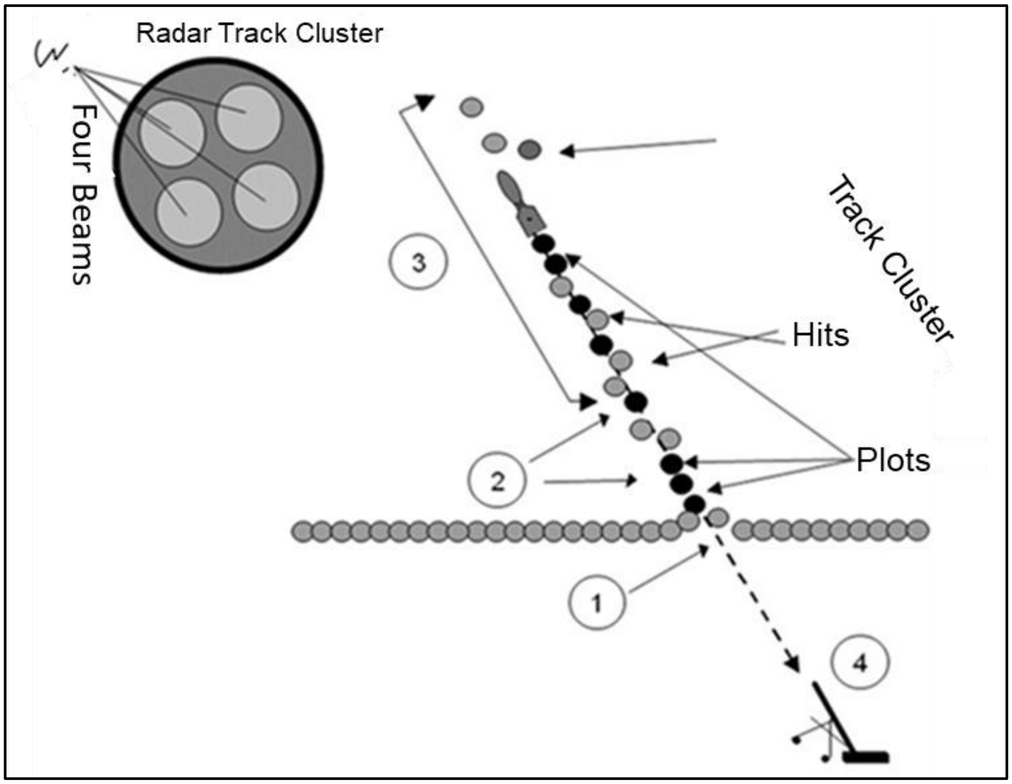


Figure J-5. Hostile mode process example

Note: The Graphic illustrates the hostile mode of detection, verification, and location methodology.

AN/TPQ-36 VIDEO INTEGRATION

J-42. Video integration improves the radar's probability of detecting objects beyond 3km, but reduces the probability of detection short of 3km (see figure J-6, figure J-7, and also turn to page J-12 to see figure J-8 and figure J-9). A radar beam looks at a spot for a given amount of time, and can consist of 1, 2, or 4 dwells. A dwell consists of 16 radar pulses, resulting in a target being illuminated up to 16 times in a single dwell. The AN/TPQ-36, with video integration on, uses the 2 or 4 dwell mode, rather than 1 dwell. The number of times a target can be illuminated increase to 32 or 64 with video integration off.

Note. Whether or not to use video integration needs to be described during planning targeting threat assessment and in accordance with the priority intelligence requirements.

J-43. In noncontiguous or static position operations, if the WLR is located in the middle of the static position and it is more than 3km to the edge of the static position perimeter, it could be beneficial to turn video integration "ON", depending on the nature of the threat.

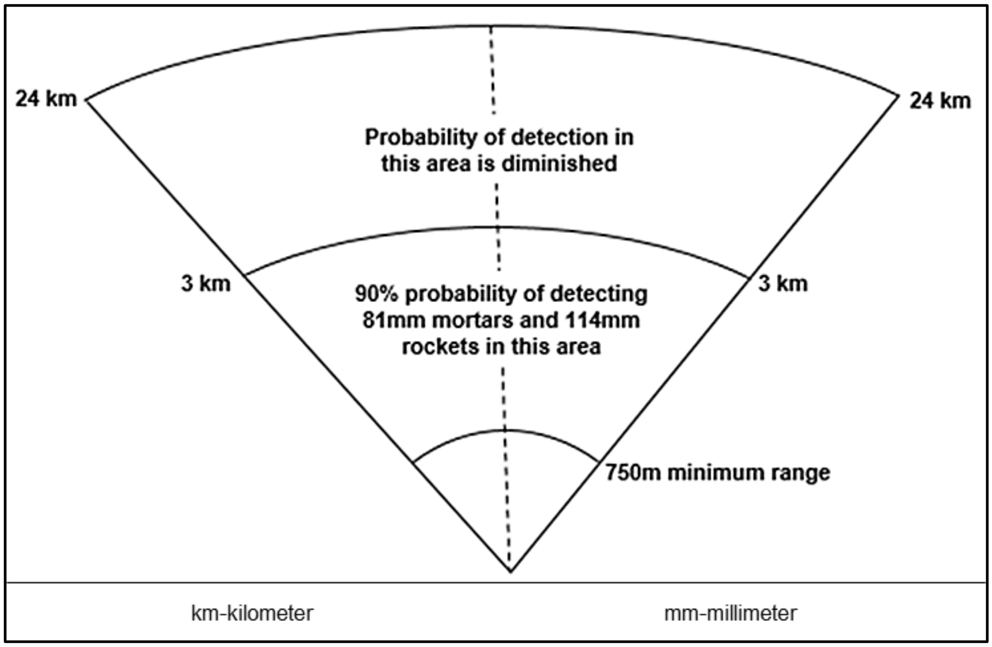


Figure J-6. AN/TPQ-36 probability of detection, video integration "OFF"

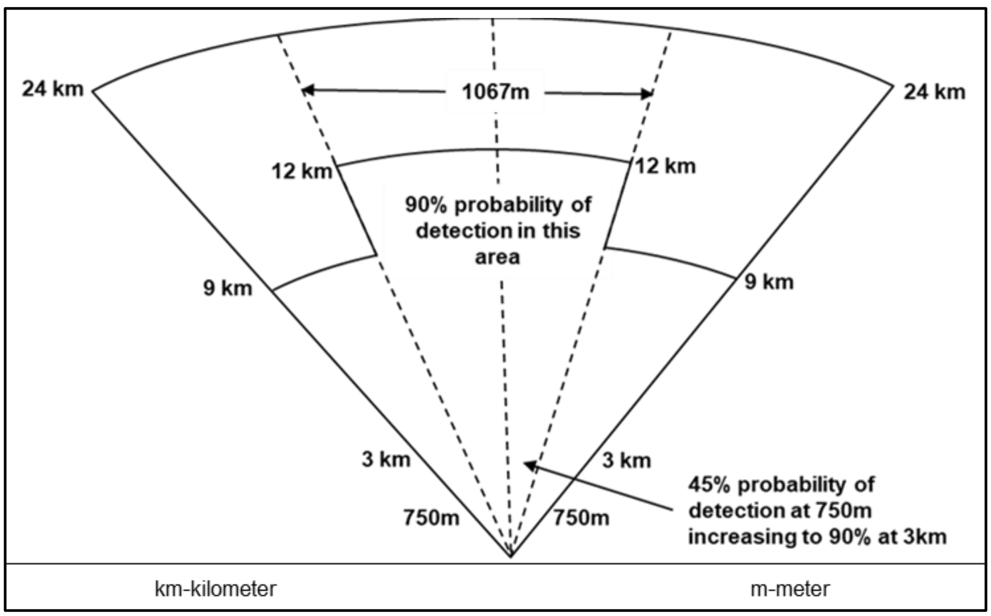


Figure J-7. AN/TPQ-36 probability of detection, video integration "ON"

J-44. It is important to understand how these systems acquire and track projectiles in flight and extrapolate weapons location from this information. The AN/TPQ-36 WLRs performs these basic steps to determine a POO:

- Establishes the search fence.
- Verifies penetration of the search fence.
- Validates the trajectory.
- Tracks the projectile.
- Extrapolates the firing location and determines the POO.

J-45. Several conditions must exist for the WLR to achieve a solution and provide a POO. First, the range to the projectile must be such that the radar beam strikes the object on the ascending branch of the trajectory. In hostile mode, the WLR will only detect objects on the ascending branch of their trajectory. The size and speed are critical when identifying an object in the hostile mode. Once the software identifies the object, it determines the trajectory of the object. The object must display a ballistic trajectory or the software rejects it. There must be sufficient time for the software to achieve a solution on a ballistic trajectory. The tracking time for the AN/TPQ-36 is 3-5 seconds.

J-46. The WLR can only determine locations from objects presenting characteristics within the technical capabilities of the software. The object must pass through the detection area of the search sector. It is important to understand the detection area in which the WLR can detect an object.

TARGET CLASSIFICATION

J-47. The AN/TPQ-36 classifies acquisitions as three distinct target types: artillery, mortar, rocket, or missile. The target classifications generated by WLR for transmission to AFATDS are mortar, artillery, and rocket unknowns. The acquisition ranges for mortars are the same as the ranges for artillery.

PROBABILITY OF LOCATION

J-48. In general, the AN/TPQ-36 can locate up to ten simultaneously firing weapons with QEs greater than 300 mils without degradation in probability of location. This is true when no more than two projectiles are being tracked or new firings do not occur at ranges less than 6km, or greater than three-quarters of the specified range for a specific projectile type. When both of these conditions occur, the probability of location may decrease to a probability of detection no lower than 50%. Wind and rain do not degrade the performance of the WLR when the following conditions exist:

- Winds do not exceed 40 mph with gusts to 75 mph.
- Rain does not exceed 5 inches per hour with horizontal wind gusts of 40 mph.

J-49. The probability of locating a cannon projectile is 85% or greater at ranges from 4 -30km when weapon QEs are greater than 200 mils at ranges less than 10km and 300 mils at ranges greater than 10km. The ranges vary depending on the size of the projectile. The range fan for detecting light cannon is from 4-20km over the entire search sector. For medium cannon, the range fan is from 4-25km over the center 1067 mils of the search sector and 4-20km over the outside sector of the search sectors. The range fan for heavy cannon is from 4-30km over the center 1067 mils of the search sector and 4-22km over the outside search sectors. Table J-2 shows the higher probability coverage areas for cannons.

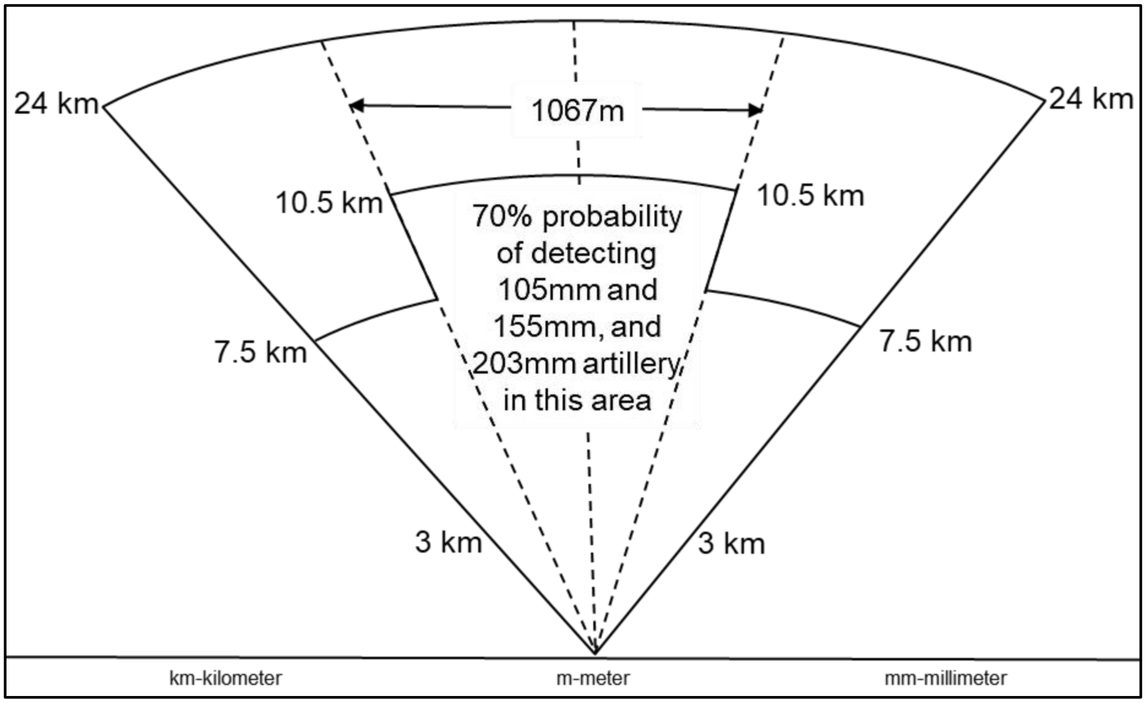


Figure J-8. AN/TPQ-36 probability of detecting artillery, video integration "ON"

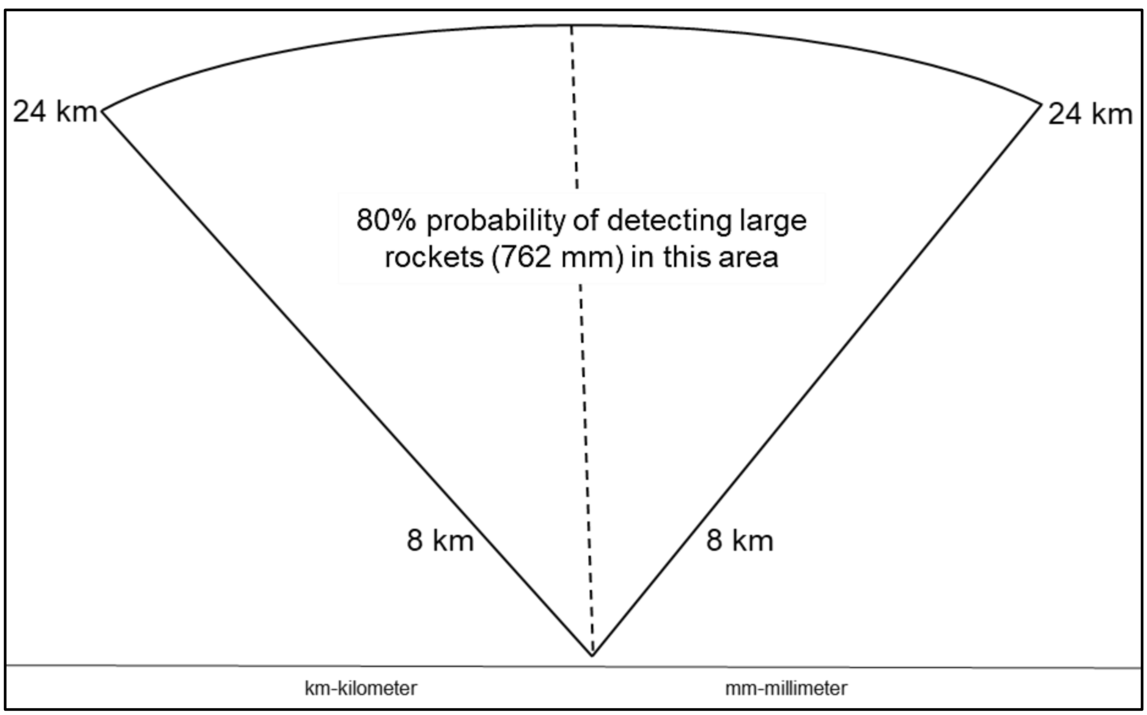


Figure J-9. AN/TPQ-36 probability of detecting rockets, video integration "ON"

ACCURACY

J-50. The maximum 50% target location errors by projectile type are:

- All cannon - 35m or .35% of range, whichever is greater.

- Long-range rocket - 70 meters or .4% of range, whichever is greater.

The maximum 90% target location errors by projectile type are:

- All cannon - 90 meters or .9% of range, whichever is greater.
- Long-range rocket - 175 meters or 1% of range, whichever is greater.

J-51. Table J-1 (50%) and table J-2 (90%) target location error data.

Table J-1. AN/TPQ-36 maximum 50% target location error

Target Category	*4km*	*10km*	*20km*	*Ranges 22km*	*25km*	*30km*	*37km*	*50km*
Mortar	N/A	N/A	N/A	N/A	N/A	N/A		
Cannon	35m	35m	70m	77m	88m	105m		
Rocket	70m	70m	80m	88m	100m	120m	148m	200m
km – kilometer				m – meter				

Table J-2. AN/TPQ-36 maximum 90% target location error

Target Category	*4km*	*10km*	*20km*	*Ranges 22km*	*25km*	*30km*	*37km*	*50km*
Mortar	N/A	N/A	N/A	N/A	N/A	N/A		
Cannon	90m	90m	180m	198m	225m	270m		
Rocket	175m	175m	200m	220m	250m	300m	370m	500m
km – kilometer				m – meter				

AN/TPQ-36 FRIENDLY MODE

J-52. The AN/TPQ-36 requires separate modes to conduct friendly fire. Hostile and friendly fire cannot be performed simultaneously with this system.

J-53. The methodology used by the AN/TPQ-36 to search, verify, and track an impact or burst location in the friendly mode is the same as that for the hostile mode. The major differences are the size of the search fence, angle-T, and orientation of the detection area. In friendly fire mode, the WLR tracks projectiles as they travel away from the WLR. Therefore, the WLR detects and tracks the projectile on the descending leg of its trajectory. The detection area in the friendly mode is significantly smaller since the search sector must be narrowed to approximately 440 mils.

J-54. When operating in friendly fire mode, the WLR sets up a horizontal "window" through which the projectile must pass. The window is referred to as the friendly fire search fence. The narrowed search fence provides the best probability of detecting and tracking friendly rounds fired. The WLR tracks projectiles until an airburst is detected, the selected datum plane altitude is intersected, or the radar has enough data to predict the POI.

J-55. In the optimum friendly fire radar-tracking situation for the AN/TPQ-36, the angle (angle-T) made by the radar-orienting point (radar-target) line and the gun-orienting point (gun-target) line is from 800 to 1200 mils. See figure J-10.

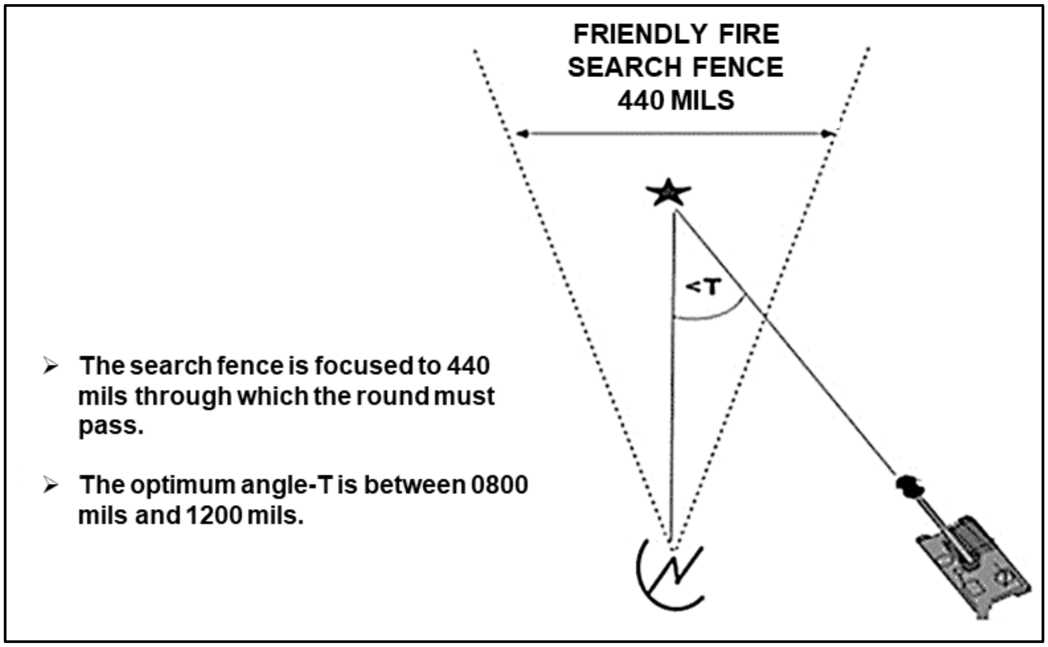


Figure J-10. Angle "T"

J-56. Orienting data required for the friendly fire buffer and the actual fire mission can be sent by the FDC by voice or digital transmission. The data entered into the computer will either accept the search fence or reject it by displaying an error message. The radar operator must then coordinate with the FDC for adjustments to the firing data or orienting point that will allow the WLR to observe the rounds in the friendly fire mode. In friendly fire mode, the AN/TPQ-36performs three types of missions:

- Observe a high-burst registration (artillery airburst mode).
- Predict impact locations (artillery impact-predict mode).
- Observe a datum-plane registration (artillery datum-plane mode).

J-57. These friendly fire mode missions support the two types of registrations conducted by the fire direction center. The radar high-burst registration provides "did hit" observations for the fire direction center high-burst registration. The radar impact-predict and datum-plane registrations provide "did hit" observations for the fire direction center mean-point-of-impact registration. The mean-point-of-impact calculations by the fire direction center differ for the two types of radar observation, because they correspond to different orienting points.

J-58. When operating in friendly fire mode the radar provides friendly units with accurate actual burst, datum-plane, or predicted-impact location data. It has five mission sub-modes that are used to provide this data. The mission sub-modes are listed below:

- Mortar datum plane.
- Mortar impact prediction.
- Artillery airburst.
- Artillery datum plane.
- Artillery impact prediction.

J-59. The AN/TPQ-36 can also observe adjust fire missions. The observation functions performed by the AN/TPQ-36 to observe an adjust fire mission are the same as an impact predict registration.

HIGH-BURST REGISTRATION

J-60. For a high-burst registration, the high-burst altitude above the registration point is the actual orienting point for the AN/TPQ-36. The high-burst altitude is located two probable errors in height above the registration point expressed up to the next 10 meters. The radar must be able to observe this point and begin tracking the trajectory of the round at least 350 meters before the burst. This ensures the AN/TPQ-36 can track the round to the burst point. If the radar cannot observe the orienting point, the radar operator will be notified by an error message.

J-61. The radar section chief must then coordinate with the firing unit to select a new high-burst altitude (or orienting point for the WLR) that meets the technical tracking criteria of the radar. The radar operator passes the grid coordinates and altitude of each observed burst to the firing unit. The firing unit must then determine registration corrections as it would for a regular high-burst registration.

IMPACT-PREDICT REGISTRATION

J-62. In an impact-predict mission, the WLR uses friendly fire mode to track the round on its descending trajectory toward the registration point and to predict where the round will impact without actually observing the ground burst. To provide data, the WLR must track the round along its trajectory for a sufficient distance above the radar's screening crest. If the WLR cannot track the round far enough along its trajectory, it will notify the operator that it has limited track coverage.

J-63. Coordination must then be made with the firing unit to end the mission or to continue it by selecting a new registration point. The predicted burst locations are reported to the fire direction center, which then averages them as "did hit" data and compares them to the fired "should hit" data of the registration point to obtain the mean POI registration corrections.

DATUM-PLANE REGISTRATION

J-64. The datum-plane registration is a lesser-used capability of WLRs. A *datum (geodetic)* is a reference surface consisting of five quantities: the latitude and longitude of an initial point, the azimuth of a line from that point, and the parameters of the reference ellipsoid (JP 2-03). During a datum-plane registration, the fire direction center selects a registration point, for example, a grid intersection. The altitude for the datum-plane registration is the altitude of a selected horizontal datum plane above the registration point through which all rounds will pass. The WLR must be able to observe the rounds in flight as they pass through this altitude. In calculating firing data, the fire direction center uses the altitude of the datum plane as the altitude of the registration point. If the WLR cannot track along the trajectory for a sufficient distance to its datum-plane orienting point, the same error messages will be displayed to the operator as for a high-burst registration.

J-65. The firing unit must then adjust the altitude of the target. When the WLR observes the registration rounds, the coordinates reported to fire direction center are those of each penetration or intersection point of the datum plane at the datum plane altitude rather than the predicted location of impact. The fire direction center corrects the "should hit" data by the altitude difference between the datum plane and the actual registration point. The fire direction center must then compute registration corrections in the same way it would to obtain "did hit" data for a mean POI registration. Procedures for manually recording fire mission data are provided and outlined under the friendly fire log.

J-66. The computer either accepts or rejects all parameters entered as search fence data. See figure J-11, friendly fire search fence parameters.

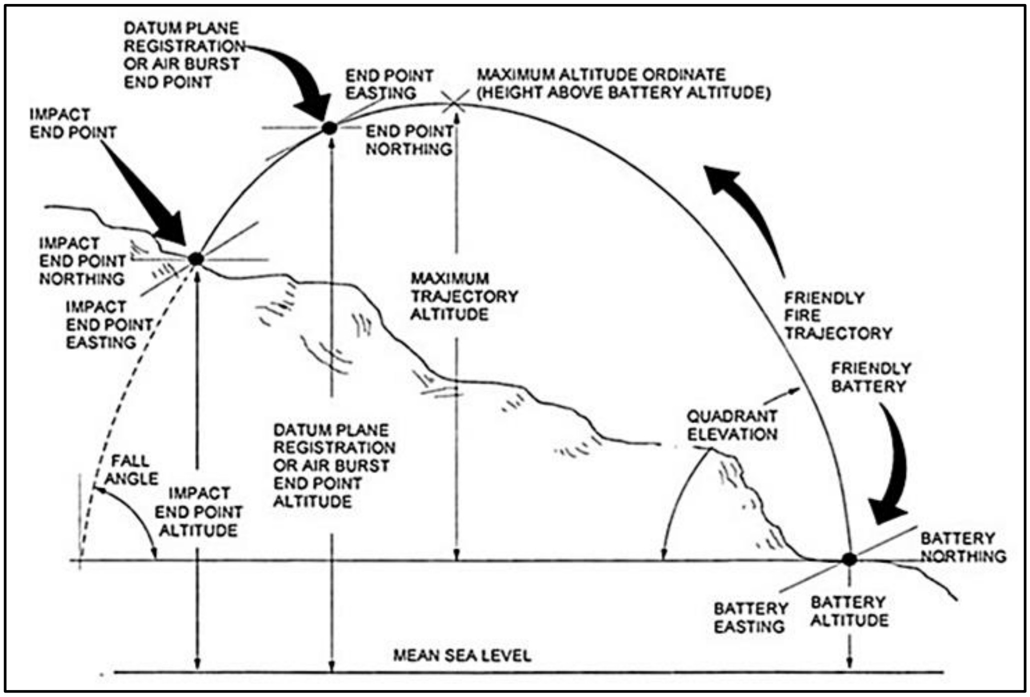


Figure J-11. Friendly fire search fence

J-67. The AN/TPQ-36 friendly fire mode logging procedures are described in Appendix B.

OPERATING THROUGH ELECTRONIC COUNTERMEASURES

J-68. Operating through electronic countermeasures consists of detecting the presence of jamming or interference and performing actions to minimize or eliminate the effects of jamming.

AN/TPQ-36

J-69. The AN/TPQ-36 indicates jamming by displaying a vertical line at the jamming azimuth on the operational display, printing a jam strobe message, the interference or jamming indicator being lit on the operations screen, or for some types of jamming, displaying many short duration tracks on the monitor. To avoid degradation of AN/TPQ-36 performance the following tactics may be used:

- Turn on the WLR's electronic counter countermeasures feature.
- Avoid operation within line of sight or in the same sector as the jammer.
- Operate on a different frequency than the jammer.

J-70. Turning on the AN/TPQ-36 electronic counter countermeasures function allows the operator to activate the jam strobe and pulsed interference rejection functions. The jam strobe identifies jamming and identifies the azimuth of the jamming while pulsed interference rejection helps filter out interference from the jammer. If pulsed interference rejection does not work, the other tactics can be implemented. Line of sight issues can be avoided by selecting optimal WLR sights. Relocating the AN/TPQ-36 to avoid jamming may or may not be possible based on the tactical situation. Changing frequencies will sometimes help avoid the jammer's operating frequency. Increment frequencies one at a time and determine from the jam strobe indicator if the jammer is still present. Increase the frequency, starting at the lowest frequency, the least amount necessary to avoid degrading the radars performance. If these steps do not work, it may be possible to fool the jammer by ceasing to radiate for a few minutes.

Appendix K
Target Acquisition TAB

This appendix explains the planning, development, and distribution of the TA Tab to the Fire Support Plan in Annex D (Fires) of an OPORD. It provides detailed information on the individual responsibilities of certain staff members as they relate to the TA Tab's creation and distribution. The TA Tab is a managerial tool used primarily by the FAB, DIVARTY, and FA BN staffs. It is used to ensure that all WLRs are employed to support the maneuver forces and meet the commander's intent. Although no specific format for the tab is prescribed, the five-paragraph OPORD format is used when the TA Tab is issued separately.

PREPARATION

K-1. At echelon, the Counterfire/Targeting officer is responsible for creating, deciphering, and distributing the TA Tab as it pertains to their unit's responsibility in the counterfire fight. The intelligence officer at echelon, assistant counterfire officer, and counterfire NCO provide additional input during the development process. The TA Tab is written in the five paragraph OPORD format and includes any relevant enclosures.

TARGET ACQUISITION TAB HEADING

K-2. The tab heading includes the security classification, the title line, references, and the time zone used throughout the operation. The classification is shown at the top and bottom of each page of the document. Refer to figure K-1.

TAB A (TARGET ACQUISITION) TO APPENDIX H (FIRE SUPPORT PLAN) TO ANNEX D (FIRES) TO OPORD 22-444.

REFERENCES: Map, Series V783S, Sheet Number 458, Edition 6-SRP, Scale 1/50000.

Time Zone Used Throughout: SIERRA.

Figure K-1. Target Acquisition Tab heading

MAJOR PARAGRAPHS

K-3. Major paragraphs include the situation, mission, execution, service support, and the command and signal paragraphs.

SITUATION PARAGRAPH 1

K-4. This paragraph includes the friendly situation, supported units, and other TA assets in sector. Include specific enemy and friendly information that form a basis for threat assessments required for the RDO.

MISSION PARAGRAPH 2

K-5. This paragraph should be a clear, concise statement of the counterfire mission as it pertains to WLRs. It contains who, what, when, where and why.

EXECUTION PARAGRAPH 3

K-6. The execution paragraph explains how the mission will be accomplished. It contains the following subparagraphs:

- Concept of the Operation: This subparagraph (3a) gives the commander's concept for WLR and counterfire operations. This should include identification of designated cueing agents and general cueing guidance. Specific cueing guidance is listed in the coordination subparagraph (3d).Target Processing: This subparagraph (3b) is used to denote target processing flow. This information flow describes the relationship between the WLRs and the HQ controlling them. This paragraph does not represent the actual communications nets used but shows the destination flow of targeting information. The following are examples of the types of information that may be included in the processing subparagraph:
  - All FA BN AN/TPQ-53 WLRs will report targets to their organic COS.
  - FA BN COSs will assess each AN/TPQ-53 target. Retain if within the BCT AO or short of the CSB. Send targets to the DIVARTY TPS if outside the BCT AO or past the CSB.
  - All AN/TPQ-50 WLRs will report targets directly to their organic COS or TPS.
- The target processing flow is based on the tactical situation and command relationships. Mission Command: This subparagraph (3c) deals with the command relationships assigned to WLRs. WLRs may be assigned a command relationship of attached/OPCON/TACON/DS/GS to FA BNs or higher HQ. Additionally, assign target blocks for each WLR.
  - Coordination: The coordination subparagraph (3d) covers information that is not addressed in the unit tactical standing operating procedure (referred to as a TACSOP). At a minimum, the paragraph should contain the following: The requirement for the FA BNs to report AN/TPQ-53 WLRs' refined locations and sectors of search to the DIVARTY TPS.
  - Cueing and displacement guidance established by the DIVARTY counterfire officer, to include prowords and descriptions.
  - Displacement guidance established by the DIVARTY counterfire officer, to include prowords and descriptions.
  - CSB. Consideration must then be given to the establishment of a CSB. The CSB is indicated by a series of grid coordinates to define its location.
  - Coordination for communications nets and relays, if required.
  - Additional coordination for survey and security, if required.
  - Instructions on requesting GS WLR coverage.

SERVICE SUPPORT PARAGRAPH 4

K-7. This paragraph lists service support requirements as required. It may refer to the service support annex.

COMMAND AND SIGNAL PARAGRAPH 5

K-8. The fifth paragraph lists required information as necessary. It may refer to the fire support annex. Any additional pertinent information will be include as enclosures.

ENCLOSURES

K-9. Enclosures to the TA Tab can include the following:

- Capabilities overlay, normally containing the following:
  - Major unit boundaries, CFL, fire support coordination line, and FLOT.

  - Major search sectors to include primary and alternate sectors, zones with type and number, and radar type and section description. Primary zones are depicted by solid lines, alternate zones, by dotted lines. Section standard operating procedures should specify color coding for individual radar data.
  - Common sensor boundary, drawn as a solid line labeled with CSB and the effective DTG.
  - Major unit locations, especially those covered by a CFZ.
  - Overlay title, classification, and register marks.
- Any RDOs. It may not be possible to include all RDOs as enclosures. This is especially true for radars attached to subordinate FA BNs.

K-10. The following sample TA Tab provides an example of how a TA Tab might be constructed. See figures K-2, K-3, K-4, and K-5, on pages K-4 through K-7, accordingly.

(UNCLASSIFIED)

TAB A (TARGET ACQUISITION) TO APPENDIX 2 (FIRE SUPPORT PLAN) TO ANNEX D (FIRES) TO OPERATION ORDER 21-001 (REGAL RETRIBUTION), 52nd AD. TRAINING PURPOSES ONLY

(U) References: ANNEX D (FIRES) TO OPERATION ORDER 21-001 (OPERATION REGAL RETRIBUTION) – 52nd ARMOI DIVISION, FORT MURPHY, TEXAS

(U) Time Zone Used Throughout: LOCAL

1. (U) SITUATION.

a. (U) On 01NOV2020 Donovian forces began massing along the Carian River between the Gulf of Caria and eastwards toward the Belkan Flats. On 21NOV2020 Donovian forces of the Operational Strategic Command – West (OSC-W) with elements of the 11th Mechanized Infantry Division (MEID) as the main effort with the 98th Tank Division (TD) and the 81st MEID in support, invaded the country of Atropia IOT seize the port city of Maldo and surrounding area. Atropian forces, along with the elements of the US Army VI Corps, halted the advance of the 11th MEID at the Frey River (east shore) in Saint Regisburg, south to Junesville and to the west edge of Saint Bella.

2. (U) MISSION.

a. (U) On 310500JAN2021 2-52AD will conduct breaching operations on key terrain K2 (vic. 83Z PJ 585 525) IOT obtai a sizeable foothold on the east shore of the Frey River for further offensive operations. 1/52AD will establish guard on the Fre River and key terrain K1 (vic. 83Z PJ 600 680). 3/52AD will maintain guard on key terrain K3, K4, K5, and K6 with support fror the 4/2ID Atropian. O/O 52AD continue to attack to destroy OSC-W forces and reestablish the international boarder.

3. (U) EXECUTION

a. (U) <u>Concept of Operation</u>: 52AD WLRs will deploy to locate high-payoff targets, enemy fire support systems, and protect friendly forces using maximum range capabilities to support the offensive operation against the Donvian 11th MEID. Priority of effort in order is 2/52AD, 1/52AD, and then 3/52AD.

b. (U) <u>Target Processing</u>: General support WLRs will send their targeting information directly to the DIVARTY Target Processing Section (TPS). AN/TPQ-50 and AN/TPQ-53 WLRs direct support to FA BNs will report information to their respective ABCT Counterfire Operations Sections (COS). The COS will then access targets, retain and action any that fall within ABCT AO and short of the CSB. If target is outside of ABCT AO or long of the CSB the target will be forwarded to the DIVARTY TPS for action. Targeting information developed at ABCT level will be sent to the 52nd DIVARTY.

c. (U) <u>Mission Command</u>: The 52nd DIVARTY is the Counterfire HQs for the 52AD AO, and retains the authority to alter command support relationships for all WLRs within the command of 52AD. All ABCT AN/TPQ-53 WLRs will receive centralized placement, search, and cueing guidance from the 52nd DIVARTY TPS. The ABCTs' COS will execute this guidance decentralized. All ABCTs will retain full tasking authority over their organic AN/TPQ-50 WLRs unless directed otherwise by the TPS.

(1) (U) AN/TPQ-50, R91, 3-81 FA
Mission: DS 3-81 FA, TGT Block AA0001-AA9999

(2) (U) AN/TPQ-50, R92, 3-81 FA
Mission: DS 3-81 FA, TGT Block AB0001-AB9999

(3) (U) AN/TPQ-50, R93, 3-81 FA
Mission: DS 3-81 FA, TGT Block AC0001-AC9999

(4) (U) AN/TPQ-50, R94, 3-81 FA
Mission: DS 3-81 FA, TGT Block AD0001-AD9999

(5) (U) AN/TPQ-53, R95, 3-81 FA
Mission: DS 3-81 FA, TGT Block AE0001-AE9999

D-2-A-1

(UNCLASSIFIED)

ABCT-Armored Brigade Combat Team, AD-Armor Division, AO-Area of Operation, COS-Counterfire Operations Section, CSB-Common Sensor Boundary, DIVARTY- Division Artillery, DS-Direct Support, FA-Field Artillery, GS-General Support , ID-Infantry Division, MEID-Mechanized Infantry Division, OSC-W- Operational Strategic Command – West, TD-Tank Division, TGT-Target, TPS-Target Processing Section, WLR-Weapons Locating Radar

Figure K-2. Tab A, page D-2-A-1

(UNCLASSIFIED)
TAB A (TARGET ACQUISITION) TO APPENDIX 2 (FIRE SUPPORT PLAN) TO ANNEX D (FIRES) TO OPERATION ORDER 21-001 (REGAL RETRIBUTION), 52nd AD. TRAINING PURPOSES ONLY

(6) (U) AN/TPQ-53, R96, 3-81 FA
Mission: DS 3-81 FA, TGT Block AF0001-AF9999

(7) (U) AN/TPQ-50, S91, 4-81 FA
Mission: DS 4-81 FA, TGT Block AG0001-AG9999

(8) (U) AN/TPQ-50, S92, 4-81 FA
Mission: DS 4-81 FA, TGT Block AH0001-AH9999

(9) (U) AN/TPQ-50, S93, 4-81 FA
Mission: DS 4-81 FA, TGT Block AI0001-AI9999

(10) (U) AN/TPQ-50, S94, 4-81 FA
Mission: DS 4-81 FA, TGT Block AJ0001-AJ9999

(11) (U) AN/TPQ-53, S95, 4-81 FA
Mission: DS 4-81 FA, TGT Block AP0001-AP9999

(12) (U) AN/TPQ-53, S96, 4-81 FA
Mission: DS 4-81 FA, TGT Block AK0001-AK9999

(13) (U) AN/TPQ-50, U91, 5-81 FA
Mission: DS 5-81 FA, TGT Block AL0001-AM9999

(14) (U) AN/TPQ-50, U92, 5-81 FA
Mission: DS 5-81 FA, TGT Block AN0001-AL9999

(15) (U) AN/TPQ-50, U93, 5-81 FA
Mission: DS 5-81 FA, TGT Block AO0001-AO9999

(16) (U) AN/TPQ-50, U94, 5-81 FA
Mission: DS 5-81 FA, TGT Block AP0001-AP9999

(17) (U) AN/TPQ-53, U95, 5-81 FA
Mission: DS 5-81 FA, TGT Block AQ0001-AQ9999

(18) (U) AN/TPQ-53, U96, 5-81 FA
Mission: DS 5-81 FA, TGT Block AR0001-AR9999

(19) (U) AN/TPQ-50, T91, 52nd DIVARTY
Mission: DS 52nd DIVARTY, TGT Block AS0001-AS9999

(20) (U) AN/TPQ-50, T92, 52nd DIVARTY
Mission: DS 52nd DIVARTY, TGT Block AT0001-AT9999

(21) (U) AN/TPQ-53, T95, 52nd DIVARTY
Mission: GS, TGT Block AU0001-AU9999

(22) (U) AN/TPQ-53, T96, 52nd DIVARTY
Mission: GS, TGT Block AV0001-AV9999

D-2-A-2
(UNCLASSIFIED)

AD-Armor Division, DIVARTY- Division Artillery, DS-Direct Support, FA-Field Artillery, GS-General Support, TGT-Target, TPS-Target Processing Section

Figure K-3. Tab A, page D-2-A-2

(UNCLASSIFIED)

TAB A (TARGET ACQUISITION) TO APPENDIX 2 (FIRE SUPPORT PLAN) TO ANNEX D (FIRES) TO OPERATION ORDER 21-001 (REGAL RETRIBUTION), 52nd AD. TRAINING PURPOSES ONLY

d. Coordination:

(1) (U) Reports. ABCTs' COS will report WLR locations, search sectors, and planned zones to the DIVARTY TPS for all DS WLRs.

(2) (U) Cueing. Cueing is a deliberate act only initiated on the direction of appropriate cueing agents. Maximum radiation time is based on the current Electronic Warfare (EW) threat assessment. The DIVARTY S2/CFO will update the EW threat throughout the mission on the DIVARTY CF net. Each ABCT COS may divide cueing time between like assets unless specified otherwise. Cueing postures when directed to cue are as followed:

(a) (U) BRONZE: 30 minutes
(b) (U) SILVER: 1 hour
(c) (U) GOLD: 2 hours
(d) (U) PLATNIUM: 4 hours
(d) (U) DIAMOND: unlimited cueing

(3) (U) Displacement. Maximum time in position is based on the current EW and enemy force threat assessments. The WLR section will immediately displace if in direct contact or receiving accurate indirect fires (within 300 meters). The DIVARTY S2/CFO will update the EW/enemy threats throughout the mission on the DIVARTY CF net. Displacement postures are as followed:

(a) (U) SHARK: 4 hours in location.
(b) (U) DOLPHIN: 6 hours in location.
(c) (U) WHALE: 8 hours in location.
(d) (U) TURTLE: 12 hours in location.

(4) (U) Maintenance. Each ABCT WLR will conduct daily PMCS for no less than one (1) hour each day. Each ABCT COS will execute an internal maintenance plan while ensuring there is no dead space at all times. At least one (1) ABCT AN/TPQ-53 will be in position ready to radiate at all times. If it is not possible to ensure zero dead space, each COS will request permission to execute PMCS. The request will be routed to the TPS for DIVARTY approval. If required, request GS WLR support IAW GS WLR request guidance.

(5) (U) Common Sensor Boundary. Effective 300430JAN2021 CSB DOG: 83Z PJ 800 840, 83Z PJ 750 770, 83Z PJ 750 620, 83Z PJ 630 620, 690 580, 83Z PJ 700 500, 83Z PJ 660 420, 83Z PJ 778 420, 83Z PJ 880 250, 83Z PJ 925 480, 83Z PJ 925 460, 83Z PJ 945 460, 83Z QJ 045 120.

(6) (U) Zones. Commander's guidance states all maneuver objectives when occupied will be covered by CFZs. AN/TPQ-53s will observe all CFZs within 52AD's AO. S2s at echelon will ensure that suspected artillery positions are covered by CFFZs. CFFZs within 2/52AD's AO will be upgraded from priority 2 to priority 1.

(a) (U) Call for Fire Zones
1. (U) CFFZSS0001: 83Z QJ 030 420, 83Z QJ 030 440, 83Z QJ 060 440, 83Z QJ 060 420.
2. (U) CFFZCG0001: 83Z PJ 925 480, 83Z PJ 925 460, 83Z PJ 945 460, 83Z PJ 945 480.
3. (U) CFFZCG0002: 83Z PJ 910 350, 83Z PJ 910 370, 83Z PJ 880 370, 83Z PJ 880 350.

(b) (U) Critical Friendly Zones
1. (U) CFZCG0001 (52AD HQ): 83Z PJ 413 325 (circular) 500m radius
2. (U) CFZCG0002 (52nd DIVARTY HQ): 83Z PJ 470 370 (circular) 500m radius
3. (U) CFZCG0003 (Breach Site): 83Z PJ580 530, 83Z PJ 610 550, 83Z PJ 620 510, 83Z PJ 580 510

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(UNCLASSIFIED)

ABCT-Armored Brigade Combat Team, AD-Armor Division, AO-Area of Operation, COS-Counterfire Operations Section, CSB-Common Sensor Boundary, CF-Counterfire, CFFZ-Call For Fire Zone, CFZ-Critical Friendly Zone, DIVARTY- Division Artillery, DS-Direct Support, EW-Electromagnetic Warfare, FA-Field Artillery, HQ-Headquarters, TPS-Target Processing Section

Figure K-4. Tab A, page D-2-A-3

(UNCLASSIFIED)

TAB A (TARGET ACQUISITION) TO APPENDIX 2 (FIRE SUPPORT PLAN) TO ANNEX D (FIRES) TO OPERATION ORDER 21-001 (REGAL RETRIBUTION), 52nd AD. TRAINING PURPOSES ONLY

(7) (U) Security. Due to small size and operational requirements WLR sections cannot provide their own security. Each WLR will be augmented with a security element at all times. The ABCTs are responsible to coordinate security for DS WLRs within their AO. DIVARTY staff and TAP leadership is responsible to coordinate security for DIVARTY DS/GS WLRs. Ensure coordination is made between ABCTs when DIVARTY WLRs cross ABCT boundaries. If ABCT WLRs are re-tasked by DIVARTY, it is the responsibility of the DIVARTY staff to coordinate security if/when the DS WLR is crossing into another ABCT's AO.

(8) (U) GS WLR Requests. The ABCTs' COS will request GS WLR coverage NLT 48 hours prior to planned operations. The request will be routed to the TPS for DIVARTY approval. Requests requiring immediate action will be processed on a case-by-case basis.

4. (U) SERVICE SUPPORT

All ABCT are responsible for the logistical support of their DS WLRs. DIVARTY WLRs DS/GS will be provided logistics from the BSB that is responsible for that AO. The DIVARTY staff and TAP leadership will ensure coordination is made between WLR sections and the respective BSB(s). If ABCT WLRs are re-tasked by DIVARTY, it is the responsibility of the DIVARTY staff to coordinate logistics if/when the DS WLR is crossing into another ABCT's AO.

5. (U) COMMAND AND SIGNAL

a. (U) Command.

(1) (U) Location of the Commander and Key Leaders.

(a.) Phase II. 52AD Commander and FSCOORD are located 83Z PJ 413 325.

(2) (U) Command Posts.

(a.) Phase II. 52AD HQ is located 83Z PJ 413 325.

(b.) Phase II. 52ND DIVARTY is located 83Z PJ 470 370.

b. (U) Reports

(1) (U) Combat Power.

(a.) (U) WLR Sensor Plan. Brigades will report their WLR sensor plan to 52AD FSE.

(b) (U) WLR Movement and Status Report. Brigades will report when WLRs move and when they go in action and out of action to 52nd DIVARTY TPS.

(c) (U) Counterfire Reports. Brigade COS will submit Counterfire reports to 52nd DIVARTY TPS every 24 hours NLT 1000.

c. (U) Signal. TBD.

ENCLOSURES:

Encl 2: RDO ORR21-001-R95-0001. 3-81 FA (R95), AN/TPQ-53

Encl 5: RDO ORR21-001-S96-0001. 4-81 FA (S96), AN/TPQ-53

D-2-A-4

(UNCLASSIFIED)

ABCT-Armored Brigade Combat Team, AD-Armor Division, AO-Area of Operation, BSB-Brigade Support Battalion, COS-Counterfire Operations Section, DIVARTY- Division Artillery, DS-Direct Support, FSCOORD-Fire Support Coordinator, FSE-Fire Support Element, FA-Field Artillery, HQ-Headquarters, RDO-Radar Deployment Order, TPS-Target Processing Section

Figure K-5. Tab A, page D-2-A-4

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Glossary

SECTION I – ACRONYMS AND ABBREVIATIONS

ACM	airspace coordinating measure
ADAM	air defense airspace management
AFATDS	advanced field artillery tactical data system
ALT	alternate
AO	area of operations
ATG	antenna transceiver group
ATIZ	artillery target intelligence zone
BCT	brigade combat team
BN	battalion
BTRY	battery
C2	command and control
CFFZ	call for fire zone
CFZ	critical friendly zone
COA	course of action
COS	conterfire operations section
CP	command post
CSB	common sensor boundary
CZ	censor zone
DIVARTY	division artillery
DOD	Department of Defense
DS	direct support
DTED	digital terrain elevation data
DTG	date time group
EW	electromagnetic warfare
FA	field artillery
FAAD	forward area air defense
FAB	field artillery brigade
FCE	fire control element
FDC	fire direction center
FFA	force field artillery
FLOT	forward line of own troops
FS	fire support
FSCM	fire support coordination measure
FSCOORD	fire support coordinator
FSE	fire support element

FSO	fire support officer
GS	general support
GSR	general support-reinforcing
HIMARS	high mobility artillery rocket system
HPT	high-payoff target
HPTL	high-payoff target list
HQ	headquarters
IPB	intelligence preparation of the battlefield
JADOCS	joint automated deep operations cooordination system
JFC	joint force commander
JTF	joint task force
km	kilometer
LSCO	large-scale combat operations
MAPS-H	modular azimuth positioning sytem - hybrid
MDMP	military decision-making process
MEG	mission essential group
MET	meteorological
METT-TC	mission, enemy, terrain and weather, troops and support available, time available, civil considerations
MHz	megahertz
MLRS	multiple launch rocket system
mm	millimeter
mph	miles per hour
NAI	named area of interest
NCO	noncommissioned officer
OCG	operations control group
OCS	operations control shelter
OE	operational environment
OPCON	operational control
OPORD	operation order
PDG	power distribution group
POI	point of impact
POO	point of origin
PRI	primary
QE	quadrant elevation
RAM	rocket artillery mortar
RDO	radar deployment order
ROZ	restricted operations zone
RPA	radar position areas
RPAS	radar position analysis sytem
TA	target acquisition

TAI	target area of interest
TAP	target acquisition platoon
TLE	target location error
TPS	target processing section
UAS	unmanned aircraft systems
WLR	weapons locating radar

SECTION II – TERMS

airspace coordinating measures

(DOD) Measures employed to facilitate the efficient use of airspace to accomplish missions and simultaneously provide safeguards for friendly forces. (JP 3-52)

artillery target intelligence zone

(Army) A weapons locating radar search area in enemy territory that the commander monitor closely to detect and report any weapon ahead of all acquisitions other than those from critical friendly zones or call for fire zones. Also called ATIZ. (FM 3-09)

call for fire zone

(Army) A weapons locating radar search area from which the commander wants to attack hostile firing systems. (FM 3-09)

censor zone

(Army) An area from which the weapons locating radar is prohibited from reporting acquisitions. (FM 3-09)

common sensor boundary

(Army) A line depicted by a series of grid coordinates, grid line, phase line or major terrain feature that devides target acquisition search areas into radar acquisition areas. Also called CSB. (FM 3-09)

counterfire

(DOD) Fire intended to destroy or neutralize enemy weapons. (JP 3-09

critical friendly zone

(Army) A friendly area of coverage employed by weapons locating radar which the maneuver commander designates as critical to the protection of an asset whose loss would seriously jeopardize the mission. (FM 3-09)

datum (geodetic)

(DOD) 1. A reference surface consisting of five quantities: the latitude and longitude of an initial point, the azimuth of a line from that point, and the parameters of the reference ellipsoid. 2. The mathematical model of the Earth used to calculate the coordinates on any map. Different nations use different datum for printing coordinates on their maps. (JP 2-03)

electromagnetic warfare

(DOD) Military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. Also called EW. (JP 3-85)

engagement authority

(DOD) An authority vested with a joint force commander that may be delegated to a subordinate commander that permits an engagement decision. (JP 3-01)

fire support coordination measure

(DOD) A measure employed by commanders to facilitate the rapid engagement of targets and simultaneously provide safeguards for friendly forces. Also called FSCM. (JP 3-0)

force field artillery headquarters

(Army) A battalion size or higher unit designated by the supported commander who specifies its duration, duties, and responsibilities. (FM 3-09)

forward line of own troops

(DOD) A line that indicates the most forward positions of friendly forces in any kind of military operation at a specific time. Also called FLOT. (JP 3-03)

high-payoff target

(DOD) A target whose loss to the enemy will significantly contribute to the success of the friendly course of action. (JP 3-60)

high-payoff target list

(Army) A prioritized list of high-payoff targets by phase of the operation. (FM 3-09)

high-value target

(DOD) A target the enemy commander requires for the successful completion of the mission. Also called HVT. (JP 3-60)

information collection

(Army) An activity that synchronizes and integrates the planning and employment of sensors and assets as well as the processing, exploitation, and dissemination systems in direct support of current and future operations. (FM 3-55)

intelligence preparation of the battlefield

(Army) The systematic process of analyzing the mission variables of enemy, terrain, weather, and civil considerations in an area of interest to determine their effect on operations. Also called IPB. (ATP 2-01.3)

joint fires

(DOD) Fires delivered during the employment of forces from two or more components in coordinated action to produce desired effects in support of a common objective. (JP 3-0)

large-scale combat operations

(Army) Extensive joint combat operations in terms of scope and size of forces commtted, conducted as a campaign aimed at achieving operational and strategic objectives. (ADP 3-0)

named area of interest

(DOD) The geospatial area or systems node or link against which information that will satisfy a specific information requirement can be collected. Named areas of interest are usually selected to capture indications of adversary courses of action, but may be related to conditions of the operational environment. (JP 2-01.3)

restricted operations zone

(DOD) Airspace reserved for specific activities in which the operations of one or more airspace users is restricted. (JP 3-52)

risk management

(DOD) The process to identify, assess, and control risks and make decisions that balance risk cost with mission benefits. Also called RM. (JP 3-0)

strike

(DOD) An attack to damage or destroy an objective or a capability. (JP 3-0)

target

(DOD) An entity or object that performs a function for the threat considered for possible engagement or other action. (JP 3-60)

target acquisition

(DOD) The detection, identification, and location of a target in sufficient detail to permit the effective employment of capabilities that create the required effects. Also called TA. See also target anlysis. (JP 3-60)

target area of interest

(DOD) The geographical area where high-value targets can be acquired and engaged by friendly forces. Also called TAI. (JP 2-01.3)

targeting

(DOD) The process of selecting and prioritizing targets and matching the appropriate response to them, considering operational requirements and capabilities. (JP 3-0)

weapons locating radar

(Army) A continuous target acquistion counterbattery system that detects in-flight projectiles, and communicates point of origin and point of impact locations. (FM 3-09)

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26 October 2021

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