
APPENDIX C

FIREFINDER FRIENDLY FIRE AND FIELD EXERCISE MODES

This appendix addresses the subjects of friendly fire radar gunnery and the Firefinder field exercise mode (FEM). Both are radar gunnery functions. The important difference, however, is that the FEM is used exclusively for training purposes and is not an operational mode. Its primary purpose is to give operators experience in locating and processing targets without the need for live fire.

Section I. FRIENDLY FIRE RADAR GUNNERY

FIREFINDER MISSIONS

The secondary mission of Firefinder radars is to support friendly firing elements. The secondary mission is performed in combat only when the commander deems it absolutely necessary. The reason is that the secondary mission takes the radar away from its primary mission of locating hostile weapons. Also, it exposes the radar to possible location by hostile EW systems for other than its primary mission. In the friendly fire operational mode, Firefinder radars can provide accurate actual burst, datum-plane, or predicted-impact location data. These data allow the firing elements to determine registration corrections for nonstandard conditions. Because the radar 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 depends on the factors of METT-T, with the threat of enemy acquisition capabilities being a primary consideration

FRIENDLY FIRE MODE

When operating in the friendly fire mode, the Firefinder radar sets up a horizontal "window"

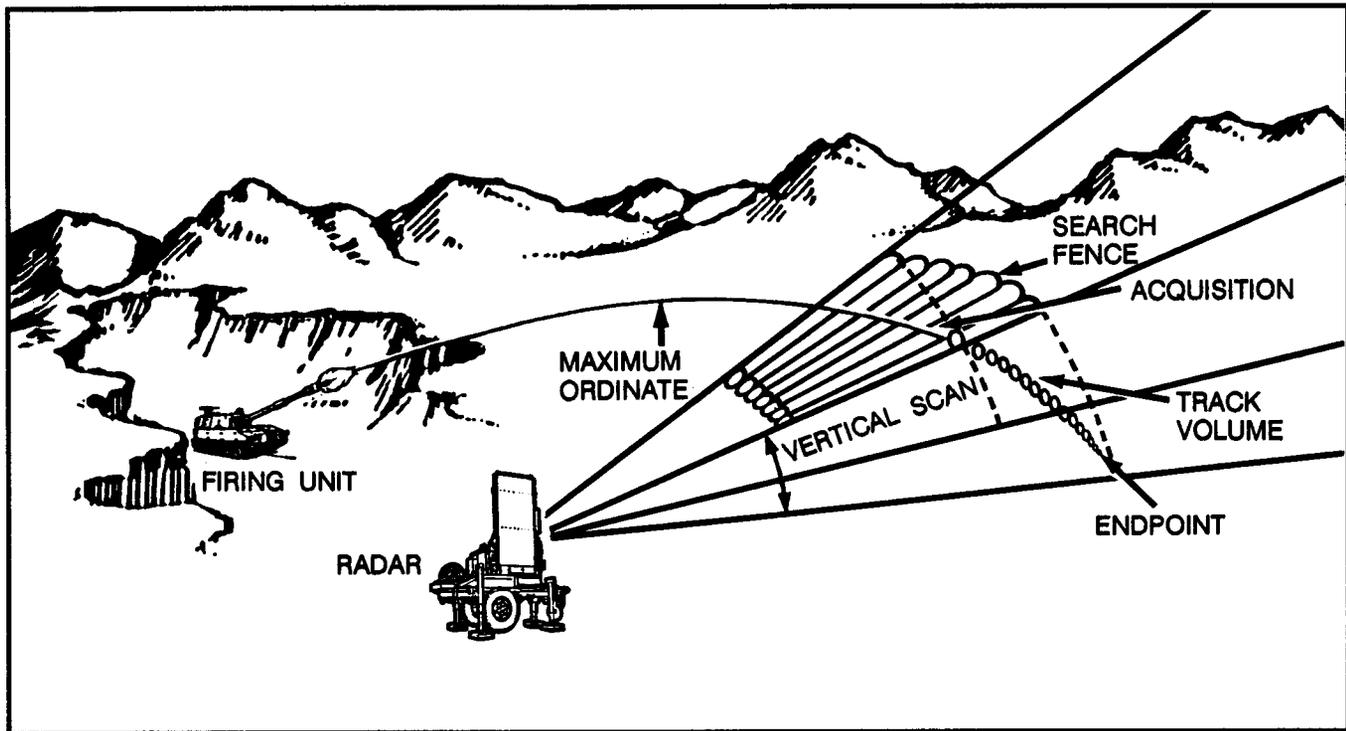
through which the projectile must pass. The window is referred to as the friendly fire search fence as shown on the next page. For operation in friendly fire mode, the normal search fence of 1,600 mils (used in the hostile fire mode) is focused to a width of approximately 440 mils. The narrowed search fence provides the best probability of detecting rounds fired. The radar tracks a projectile until an airburst is detected, the selected datum plane altitude is intersected, or the radar has enough data to predict the point of impact.

In the optimum radar tracking situation for a friendly fire mode mission, 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 1,200 mils.

Before the Firefinder radars can conduct a mission in friendly fire mode, specific information must be stored in the friendly fire buffer of the radar computer. Data required in the friendly fire buffer are as follows:

- Submode type of mission.
- Battery location (casting, northing, and altitude).

PROJECTILE TRACKING-FIREFINDER RADARS



- Registration point location (casting, northing, and altitude).
- Maximum ordinate of the trajectory to the nearest meter from the appropriate tabular firing table (TFT) (maximum ordinate above gun).
- Quadrant elevation or fall angle from the TFT (Table G).
- TACFIRE target number.

Orienting data required for the friendly fire buffer and for the actual conduct of the mission are contained in the TACFIRE FM;INTM and follow-up messages to observer. In nondigital operations, the orienting data are transmitted by voice to the radar on VHF-FM radios. Time of flight is part of the orienting data required to minimize radiation time.

NOTE: See TC 6-40 and TC 64A for more details on orienting data.

Up to three sets of friendly fire buffer data can be stored in computer memory for later use. When the required data listed above are entered, the computer will either accept the search fence or reject it by showing an error message to the operator. The radar operator must then coordinate with the firing unit for adjustments to the firing data or orienting point that will allow the radar to observe the rounds in the friendly fire mode.

In friendly fire mode, the radar can perform three types of missions:

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

- Observe a datum-plane registration (artillery datum-plane mode).

These friendly fire mode missions support the two types of registrations conducted by the FDC. The radar high-burst registration provides “did hit” observations for the FDC high-burst registration. The radar impact-predict and datum-plane registrations provide “did hit” observations for the FDC mean-point-of-impact (MPI) registration. The MPI calculations by the FDC differ for the two types of radar observation, because they correspond to different orienting points. All of these calculations are discussed in detail in TC 6-40.

HIGH-BURST REGISTRATION

For a high-burst registration, the high-burst altitude above the registration point is the actual orienting point for the radar. 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 is to ensure the radar 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. The radar section must then coordinate with the firing unit to select a new high-burst altitude (or orienting point for the radar) that meets the technical tracking criteria of the radar. The grid coordinates and altitude of each observed burst are passed to the firing unit by the radar operator. The firing unit must then determine registration corrections as it would for a regular high-burst registration.

IMPACT-PREDICT REGISTRATION (MEAN POINT OF IMPACT)

In an impact-predict mission, the radar uses the 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 radar must track the round along its trajectory for a sufficient distance (350 meters) above the radar screening crest. If the radar cannot track the round far enough along its trajectory, it will notify the operator that it has limited track coverage. Coordination must then be made with the firing unit to end the mission or to continue it by selecting anew registration point. The predicted burst locations are reported to the FDC, which then averages them as “did hit” data and compares them to the fired “should hit” data of the registration point to obtain MPI registration corrections.

DATUM-PLANE REGISTRATION (MEAN POINT OF IMPACT)

The datum-plane registration is a lesser-used capability of the Firefinder radars. The FDC 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 radar must be able to observe the rounds in flight as they pass through this altitude. In calculating firing data, the FDC uses the altitude of the datum plane as the altitude of the registration point. If the radar 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. The firing unit must then adjust the altitude of the target. When the radar observes the registration rounds, the coordinates reported to FDC 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 FDC corrects the “should hit” data by the altitude difference between the datum plane and the actual registration point. The FDC must then compute registration corrections in the same way it would to obtain “did hit” data for an MPI registration.

FRIENDLY FIRE LOG

The radar operator and radiotelephone operator (RATELO) use DA Form 5310-R (Firefinder Friendly Fire Log) to record all the pertinent data for any type of friendly fire operation. The form is designed to be used with either a digital or a conventional FDC; however, it will not always be necessary to use DA Form 5310-R. When the friendly fire mission is transmitted by digital means, all messages sent and received by the radar are recorded by the electronic line printer (ELP). The DA Form 5310-R should be used anytime a friendly fire mission is sent by voice.

NOTE: A reproducible copy of DA Form 5310-R is at the back of this book.

Message to Observer

When the RATELO receives a warning order, he checks the appropriate box in Block 1 of SECTION I and enters the complete firing unit call sign and date-time group.

He then enters (in Blocks 2, 3, and 4) the orienting data furnished by the FDC. The M (meters) or F (feet) block should be marked to help eliminate errors.

The radar operator can then select a buffer and load the friendly fire data into the computer. If the radar rejects the data, mark the appropriate box in Block 6 and take corrective action.

MESSAGE TO OBSERVER

FIREFINDER FRIENDLY FIRE LOG (TO BE USED WITH AN/TPQ-36/AN/TPQ-37) For use of this form, see FM 6-121. The proponent agency is TRADOC.					
SECTION I. MESSAGE TO OBSERVER					
BLOCK	RADAR MODE (CHECK APPROPRIATE BOX)				
1	<input type="checkbox"/> AA: ARTILLERY, AIRBURST <input checked="" type="checkbox"/> AI: ARTILLERY IMPACT PREDICT <input type="checkbox"/> MI: MORTAR IMPACT PREDICT <input type="checkbox"/> AD: ARTILLERY DATUM PLANE <input type="checkbox"/> MD: MORTAR DATUM PLANE				
	UNIT W3B69		DATE-TIME GROUP 231345Z MAY 90		
2	UNIT LOCATION	EASTING 651322	NORTHING 3884988	ALTITUDE 140	<input checked="" type="checkbox"/> M <input type="checkbox"/> F
3	TARGET LOCATION ENDPOINT	EASTING 658850	NORTHING 3887400	ALTITUDE 100	<input checked="" type="checkbox"/> M <input type="checkbox"/> F
4	MAXIMUM ORDINATE (HEIGHT ABOVE BATTERY ALTITUDE) 870		QUADRANT ELEVATION 480		
	TARGET NUMBER AC1423				
5	BUFFER NUMBER (CIRCLE ONE) ① 2 3				
6	FRIENDLY FIRE SEARCH FENCE (FFSF) ERROR MESSAGES (CHECK APPROPRIATE BOX[ES])				
	<input type="checkbox"/> ENDPOINT BEYOND 30 KM (Q-37)/24 KM (Q-36) <input type="checkbox"/> TRAJECTORY INCORRECT <input type="checkbox"/> ENDPOINT ABOVE MAXIMUM _____ M <input type="checkbox"/> ENDPOINT INSIDE 3 KM (Q-37)/1 KM (Q-36) <input type="checkbox"/> ENDPOINT ABOVE MAXIMUM ORDINATE <input type="checkbox"/> ENDPOINT BELOW MINIMUM _____ M <input type="checkbox"/> LIMITED TRACK COVERAGE				
SECTION II. MESSAGE TO FDC					

Message to FDC

Once the computer accepts the orienting data, the RATELO sends a message to the FDC that the radar is ready to observe. The appropriate boxes in SECTION II for the commands used should be checked to indicate how the mission will be controlled.

MESSAGE TO FDC

LIMITED TRACK COVERAGE

SECTION II. MESSAGE TO FDC		
(CHECK APPROPRIATE BOX(ES))		
<input type="checkbox"/> AT MY COMMAND	<input checked="" type="checkbox"/> REQUEST SPLASH	<input checked="" type="checkbox"/> READY TO OBSERVE
<input checked="" type="checkbox"/> REQUEST SHOT	<input type="checkbox"/> REPORT WHEN READY	<input type="checkbox"/> ONE GUN
RECORD AND REPORT TO FDC		

Record and Report to FDC

As each round is detected the RATELO records it in SECTION III. If digital communications are not being used, the RATELO will transmit these data to the FDC.

RECORD AND REPORT TO FDC

REPORT WHEN READY

SECTION III. RECORD AND REPORT TO FDC							
ROUND NUMBER	EASTING <i>a</i>	NORTHING <i>b</i>	ALTITUDE <i>c</i>	M F	METHOD SENT <i>d</i>	TIME SENT <i>e</i>	ACKNOWLEDGED <i>f</i>
1	658897	3887354	97		VOICE	1359	✓
2	658853	3887354	100		"	1400	✓
3	658875	3887406	96		"	1402	✓
4	658829	3887456	98		"	1403	✓
5	658839	3887518	96		"	1405	✓
6	658773	3887202	107		"	1407	✓
7	658840	3887410	100		"	1411	✓
8							
9							
REMARKS			TIME END OF MISSION RECEIVED 1412		MISSION OBSERVED BY BOWER		

DA FORM 5310-R

Section II. FIREFINDER FIELD EXERCISE MODE

USES

The Firefinder FEM program is a valuable tool for combat training in both peace and war. It can be used to train not only the radar section but also the entire gunnery team. Simulated targets in the FEM program allow the radar to locate (generate) and process targets without the need for live-fire acquisition. The targets generated in the FEM are identical to targets produced in the operational modes. The FEM program for the AN/TPQ-36 contains 100 simulated targets, and the FEM program for the AN/TPQ-37 contains 150 simulated targets.

SECTION AND/OR PLATOON TRAINING

The FEM program allows radar sections to train for both hostile and friendly fire missions in either a field or a garrison location. The radar operator is required to process the FEM-generated targets just as he would targets acquired by the radar in the operational modes. Through the simulation of TACFIRE in the FEM program, a target can be transmitted and an acknowledgment received. This allows the section to train without actual TACFIRE support.

GUNNERY TEAM TRAINING

The entire gunnery team can benefit from the use of the FEM program during rehearsals before the conduct of actual operations or during command post exercises (CPXs), live-fire training, and maneuver exercises. During command post and maneuver exercises, the command element can select targets that reflect the tactical situation of the exercise by using an overlay on which the FEM targets are plotted. Sequential actions taken by each element training are discussed below.

Command or Exercise Control Element

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

- The scenario.
- Factors of METT-T.
- Intelligence estimates.
- Target value analysis (TVA).
- High-payoff target lists.
- Commander's attack guidance.
- Targeting priorities.
- The FEM target overlay.

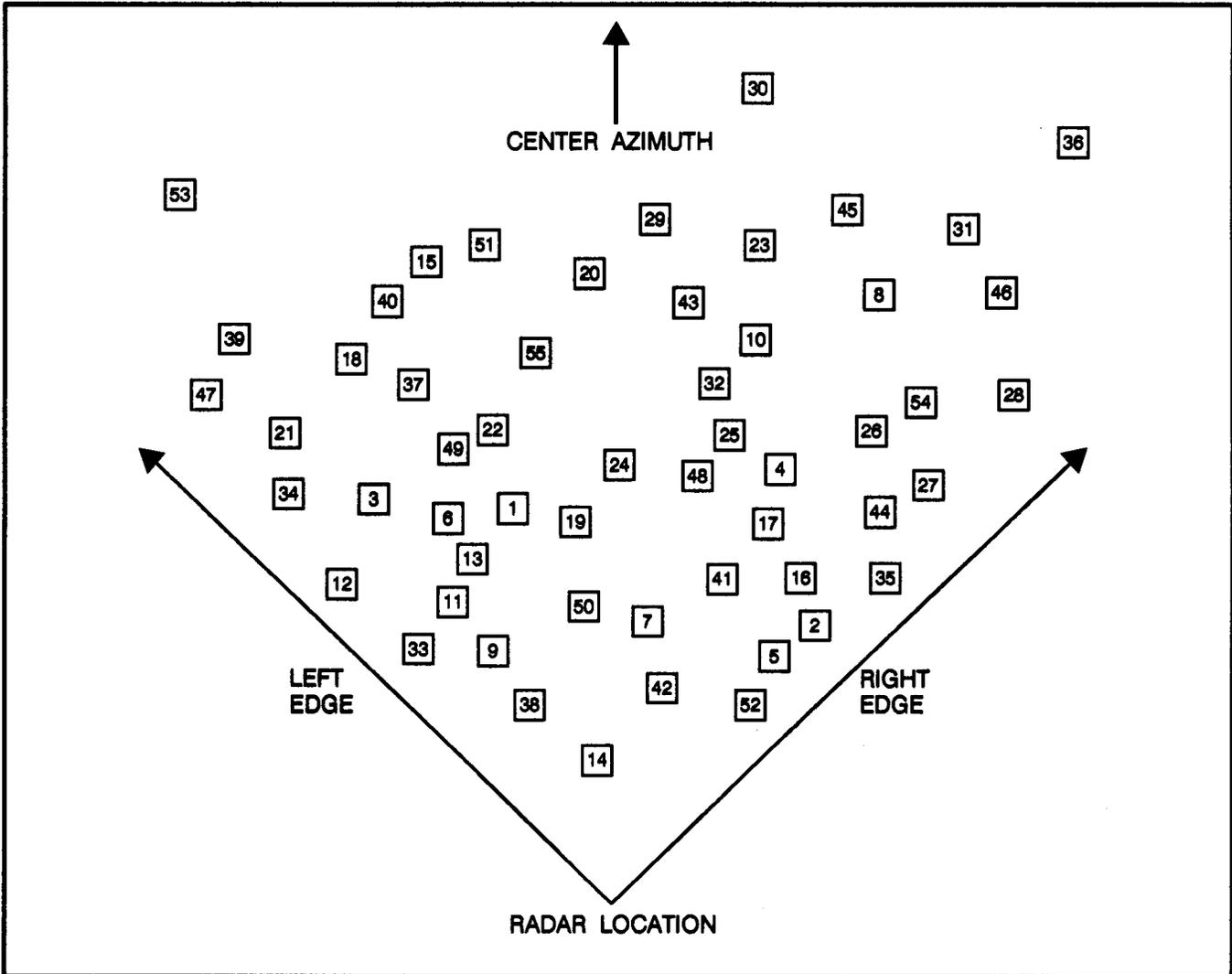
All of these are used as exercise source documents.

The FEM overlay should have all the FEM targets for the particular radar plotted on it. The overlay creates a 1,600-mil fan that the command or control element can rotate to any azimuth required by the situation. Initial search data for the radar are determined from situational information and are transmitted to the radar. (See the sample FEM overlay on page C-7.) As the tactical situation changes and on the basis of operational guidance issued by the command or control element, new search data and priority guidance are determined and sent to the radar. The command or control element also notifies the radar section what FEM targets to enable (generate).

Cueing Agents

Cueing agents designated by the command or control element must be able to identify the cueing criteria required and the method they

SAMPLE FEM OVERLAY



NOTE: This is a sample FEM overlay showing only a few of the targets, which are depicted as boxes. Search data and targets to be selected can be determined by rotating the overlay around the radar position. See appropriate radar operator manual for FEM target location selection and placement.

are to use to cue the radar section. When the cueing criteria are met during the exercise, the cueing agent sends the cue command to the radar.

Radar Section

After receiving the initial search data and commander's priority guidance, the section

prepares the radar to support the mission. When notified by the command or control element, the radar operator turns on the appropriate FEM targets. The section then waits for the cue command from the cueing agent. When the section receives the cue command, the operator turns on the radar transmitter, processes the target, and sends it to TACFIRE.

**Tactical Fire
Direction System**

TACFIRE will process the targets received according to the commander's criteria established in the system. The commander's criteria should conform to the exercise guidance issued by the command or control element. Normally, fire missions will be generated for priority targets. Intelligence targets developed will be sent to the TOC and/or the targeting element where they will be entered in TACFIRE. This information aids in determining the enemy artillery order of battle.

**TOC and/or
Targeting Element**

The TOC and/or targeting element will then process the weapon locations and impact predictions.

Firing Unit

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

NOTE: Use of the FEM program during live-fire exercises can generate fire missions in an impact area if the proper search and zone data are entered into the radar. Other targets will provide useful training for the TOC and targeting elements.

SCENARIO DEVELOPMENT

The steps for developing training by using the FEM program are described below.

Step 1

Determine training goals (mission requirements for the exercise). These should include -

- Mission-essential task list (METL) requirements.
- ARTEP mission training plan (AMTP) requirements.

Step 2

Analyze resources to include-

- Training areas available.
- Support available.
 - TACFIRE (battalion or div arty).
 - Aggressor.
 - Pyrotechnics.
 - FIST elements.
 - Other.

Step 3

Develop an OPORD.

- Determine intelligence sources and estimates.
- Determine commander's targeting criteria.
- Determine commander's priority guidance for radar.
- Use the FEM overlay to determine the following data for the RDO:
 - Radar location.
 - Search data.
 - Zone data.
 - Reporting channels
 - Cueing agents.
- On the basis of the scenario and OPORD, identify, potential FEM targets to be used.

Step 4

Develop a plan for updating and changing the tactical situation and mission. The plan should include-

- Tactical movements.
- Intelligence updates.
- Radar search and zone data.

- Nuclear, biological, chemical (NBC) situation.
- EW threat.
- FEM targets to be used.
- Cueing for radar.

Step 5

Develop a scenario to include –

- Movement times.
- Cueing agents.
- Times when changes will be made in-
 - Search or zone data,
 - Intelligence estimates.
 - Tactical situation.
 - EW threat.

IMPLEMENTING THE SCENARIO

The following are steps for implementing the scenario during the training.

During IPB, the battalion S2 (in conjunction with the div arty S2 and division G2, when available) determines likely enemy artillery and mortar locations. To do this, he uses aerial photos and standard military maps along with other intelligence information.

The command element then initiates the scenario and positions the radar according to the commander's guidance and mission requirements.

NOTE: Position the FEM overlay so that targets will be generated from logical tactical positions. Also, the radar position selected should be correct regarding site and screening crest to ensure that appropriate targets are produced.

Use the FEM overlay to determine targets and search data. These data include the following:

- Center of search sector for the radar.
- Left and right sector edges.
- Minimum and maximum search ranges.
- Zones to be used.
- Commander's priority (for CFFZs).
 - Yes = On (target reports sent as Priority 1 message).
 - No = Off (target reports sent as Priority 2 message).
- Electronic warfare information

The command element transmits the search data to the radar section. The section is told what FEM targets to turn on.

Cueing agents identified in the OPORD cue the radar when cueing guidance is met.

When cued, the radar section turns on the transmitter. The section then processes and transmits the targets to TACFIRE.

TACFIRE processes the information as if it were actual target locations. TACFIRE relays it to either the battalion TOC, the div arty TACFIRE, or other subscribers as directed by the tactical situation. The S3 and S2 take the target data provided and develop the data into the enemy order of battle. Any target sent in by the radar that meets the commander's attack criteria will produce a fire mission. The firing units can process these targets by generating fire commands for either live or dry fire.