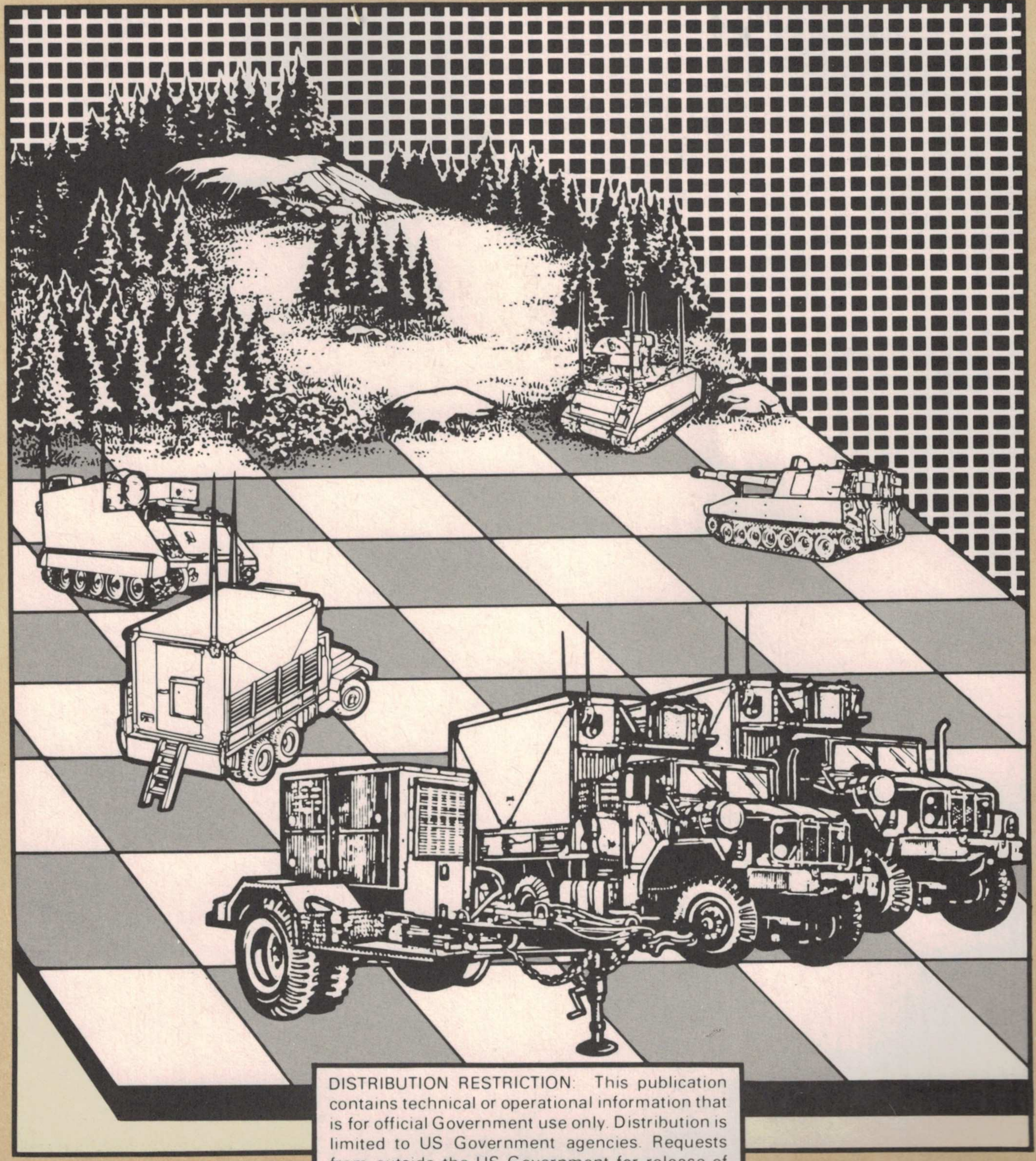
FM 6-1

TACFIRE OPERATIONS

HEADQUARTERS DEPARTMENT OF THE ARMY



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FM 6-1
13 MAY 1986

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FM 6-1

TACFIRE OPERATIONS

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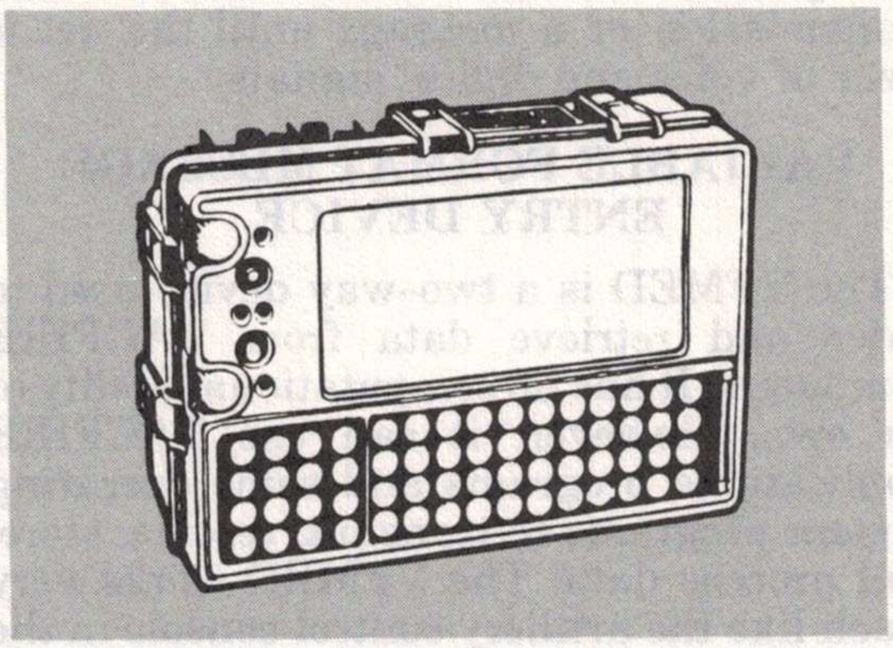
DIGITAL MESSAGE DEVICE



Hardware. The DMD comes with a carrying case with shoulder strap and a series of cables for connecting the DMD to communications equipment, the G/VLLD, and external power supplies. Units using field artillery aerial observers (FAAOs) must procure a cable that interfaces the DMD with a helicopter radio (AN/ARC-54) separately.

Communications. The DMD communicates over all standard Army radios and wire, to include AN/PRC-77, AN/VRC-12, AN/ARC-54, AN/GRC-106, and AN/TRC-145. The DMD does not use a COMSEC device or a net-sensing device. Operators must train to transmit only when the net is silent. With the improved version (AN/PSG-2A), operators can program up to 100 authentication codes that enable the DMD to automatically authenticate outgoing messages.

FIRE SUPPORT TEAM DIGITAL MESSAGE DEVICE

The FIST DMD is an 18-pound, man-portable tactical digital message communications terminal with limited computational functions. It can transmit, receive, and relay messages to any digital communications device on up to four digital nets by use of standard Army radios or field wire.

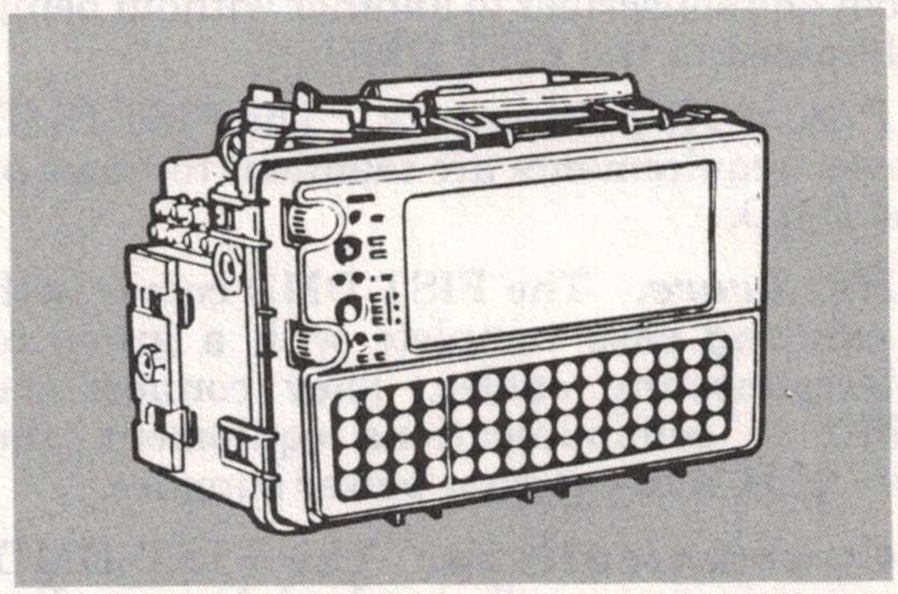
Capabilities. The FIST DMD has all the capabilities of the DMD (AN/PSG-2) and can be used in that capacity. In addition, it enables the company FSO to coordinate the fire support requirements of his forward observers, to relay messages throughout four digital nets, to calculate his own position, and to run Copperhead and Hellfire missions using the G/VLLD. The battalion FSO uses a FIST DMD to coordinate fire support with the FISTs and battalion mortar platoons, which have mortar fire ballistic calculators (MBC-23).

The FIST DMD accommodates up to 20 subscribers throughout the four nets. It maintains mission data and the location of each FO subscriber. The FSO can use the FIST DMD in one of three modes for each subscriber.

NOTE: *The following discussion addresses FIST headquarters operations, but it can apply to FSO operations as well.*

Review. When a subscriber of the FIST DMD is placed in the review mode, all message traffic from the FO is addressed to the FIST DMD. Upon receipt of a message, the FIST DMD holds the message until the company FSO calls the message up, modifies it if he desires, and transmits the message to a fire support asset he (the company FSO) selects. If the fire support asset is in the review mode, a message returning from the selected fire support asset proceeds in a similar manner. It is addressed to the FIST, is stopped at the FIST DMD, and is sent on by actions taken by the FIST DMD operator. The receive message queue stores up to 16 messages.

FIRE SUPPORT TEAM DIGITAL MESSAGE DEVICE



Automatic. When a subscriber of the FIST DMD is placed in the automatic mode, a link is established in the subscriber table between an FO and one of the company FSO's fire support assets. When an FO addresses a call for fire to the FIST DMD, the FIST DMD automatically readdresses the message to the assigned fire support asset and forwards it to that asset on the appropriate net. If the fire support asset is also in the automatic mode, responses from the fire support asset return in a similar manner.

Fire request approval. When a subscriber of the FIST DMD is placed in the fire request approval (FRA) mode, a link is established between the FO and the fire support asset. This link is terminated at the end of the mission (EOM) by transmission of an EOM message. For example, an FO addresses a call for fire to the FIST DMD. The FIST DMD stops the message and holds it until the operator calls up the message, reviews it, and sends it on to the appropriate destination. Upon transmission of the message to the selected fire support asset, a link is established so that all subsequent transmissions continue to flow as in an automatic mode until one of the parties sends an EOM message.

Direct Access Mode. This function is similar to that of a radio retransmission station. When an FO using the relay mode addresses a station on one of the three other nets servicing the FIST DMD, the FIST DMD picks up the transmission. By identifying the subscriber, the FIST DMD selects the proper net and retransmits the message on to the intended destination. The FIST DMD routes returning calls similarly.

Monitor Mode. This function allows the FIST DMD to monitor messages sent directly from one subscriber to another without being addressed to the FIST DMD.

Power Requirements. The FIST DMD power requirements are identical to those of the DMD.

Hardware. The FIST DMD comes with a carrying case complete with a group of interconnecting cables. They connect the DMD to communications equipment, the G/VLLD, and external power supplies.

Communications. The FIST DMD communicates on all standard Army radios and wire, to include AN/PRC-77, AN/VRC-12, AN/GRC-106, and AN/TRC-145. It does not use a COMSEC device. It incorporates a net monitor that inhibits transmission of a message until the net is clear of voice and digital signals.

VARIABLE FORMAT MESSAGE ENTRY DEVICE

The VFMED is a two-way device used to enter and retrieve data from TACFIRE computers. It has no computational ability of its own. However, it can use TACFIRE applications programs and some operating system programs to transmit, receive, store, and process data. The VFMED works very much like the artillery control console in the computer center. The fire support, O/I, targeting, and liaison elements use the VFMED as a remote extension of the computer to perform their command and control functions.

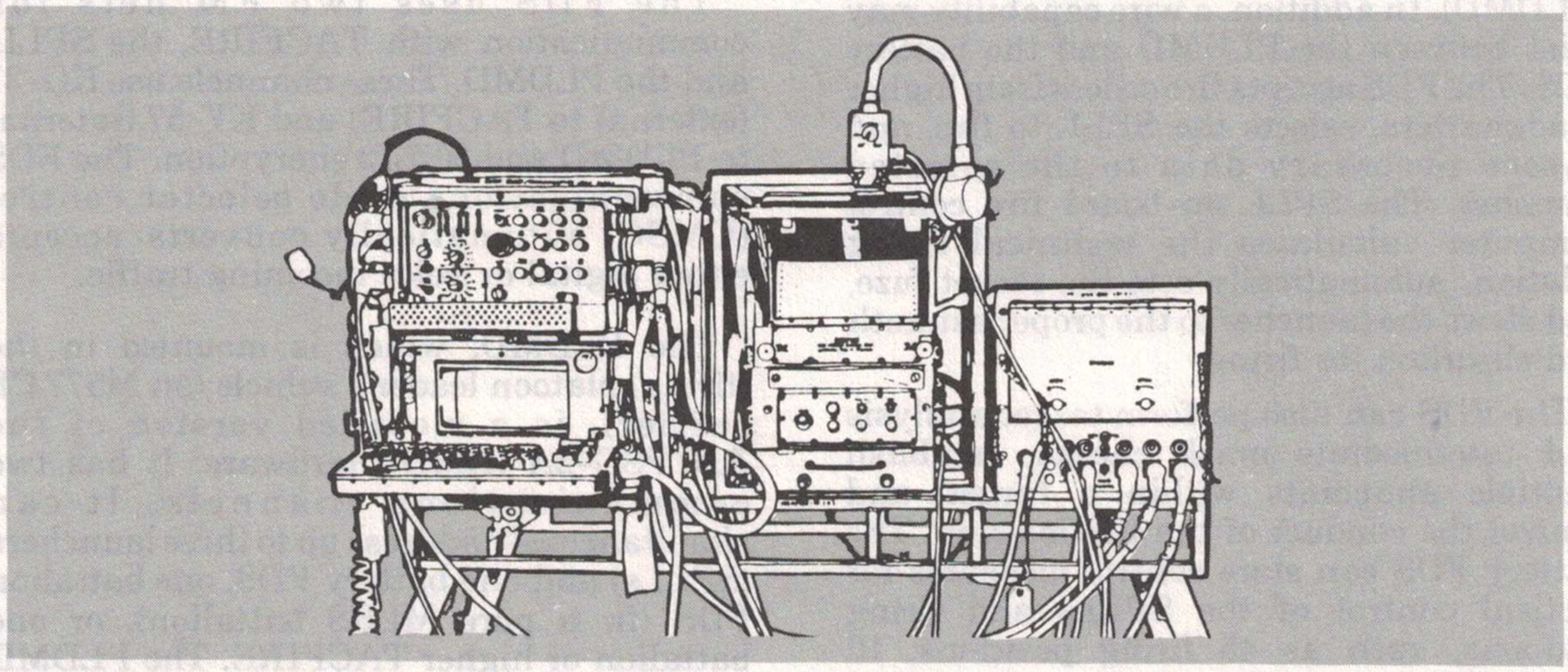
Power Requirements. The VFMED uses 28VDC power. Vehicles must have 100-ampere alternators to provide enough power. Standard tactical generators (1.5-kw, 3-kw, and 4.2-kw DC) are also suitable. The PDU distributes power to each device and has a circuit breaker for each circuit. The universal mount provides ground jumpers for each component. Once the grounding rod is properly positioned and secured, a crew member attaches the grounding strap to the ground point at the rear of the power distribution box.

Hardware. The VFMED consists of a power distribution unit, a KG-31 COMSEC device, a remote data terminal (RDT), an ELP that prints all incoming and outgoing message traffic, and a keyboard and DE for composing and receiving messages. The DE, keyboard, ELP, and KG-31 are interchangeable with their counterparts in the computer centers.

Communications. The RDT can service only one digital net. It will interface with standard tactical radios and will use wire lines that connect in the system through the power distribution box.

Position Considerations. The VFMED can be transported by or mounted in 3/4-ton or larger vehicles. The VFMED uses a universal mount for tactical vehicles and a table mount in other situations. In all cases,

VARIABLE FORMAT MESSAGE ENTRY DEVICE



the VFMED shelter should protect the VFMED from dirt/sand, rain, direct sunlight, and high wind as well as provide for blackout operations. The VFMED works best on dry, clear, and level ground. Position considerations that normally apply to power supplies and radio communications also can directly affect VFMED operations. Crew members should bury cables and wires that vehicle and foot traffic can damage. A set of duckboards or other dunnage/support will help support and protect the VFMED when mounted on soggy or loose soil.

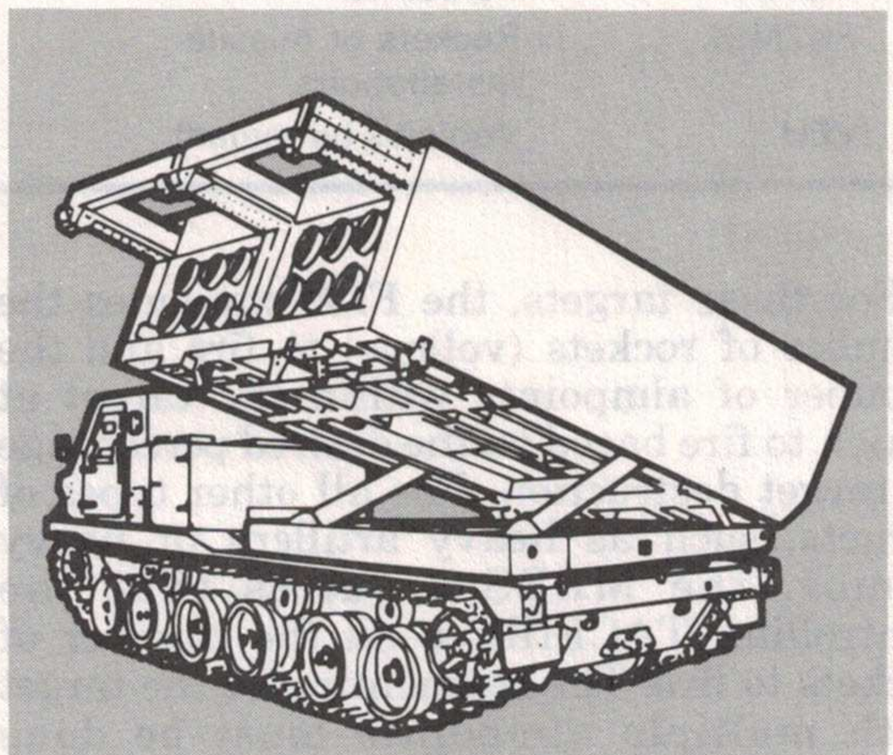
RELATED SYSTEMS

The Field Artillery leads the way in terms of proliferating ADP systems throughout the battlefield. TACFIRE is the first major automated tactical command and control system fielded. TACFIRE and its group of remote devices form a nucleus for FA command and control. A group of new systems with on-board ADP computers can also function with TACFIRE, but these systems are not considered TACFIRE devices.

MULTIPLE LAUNCH ROCKET SYSTEM

The MLRS uses a battery computer unit (called a fire direction system [FDS] for MLRS application) for fire direction at battery and battalion levels. The FDS consists of a BCU with specialized MLRS software, COMSEC equipment, radio communications devices, and a UGC-74A printer mounted in an M577 command post (CP) carrier.

MULTIPLE LAUNCH ROCKET SYSTEM



The FDS provides tactical fire control. It is linked to the self-propelled launcher-loader (SPLL) on-board fire control computer, TACFIRE, and the platoon leader's DMD (PLDMD). In addition, a wire capability may exist between the PLDMD and the battery FDS. The FDS accepts fire orders from higher headquarters, selects the SPLL to fire, and passes necessary data to the selected launcher. The SPLL on-board fire control computer calculates the technical firing solution, automatically sets the rocket fuze, and slews the launcher to the proper azimuth and elevation for firing.

The FDS can also perform target analysis and intermediate mask checks, establish multiple aimpoints within a target, and control the conduct of the fire mission. The battery FDS can store control measures for tactical control of the SPLLs and firing platoons, such as 45 firing positions, 10 ammunition resupply points, and tactical geometry data. The FDS computes target effects data for certain types of targets only.

TARGET EFFECTS DATA

ADA	Air defense artillery
ARMOR, LT	Light armor
ARTY, LT or MDM	Light or medium artillery
ASSY	Assembly area
EQUIP	Equipment (for example, radars)
PERS	Personnel
RKTMSL	Rockets or missile installations
VEH	Vehicles (wheeled)

For these targets, the FDS computes the number of rockets (volleys) to fire and the number of aimpoints within the target at which to fire based on the desired percentage of target destruction. For all other types of targets, such as heavy artillery or heavy armor, the MLRS requires that the controlling TACFIRE send the number of rockets to fire. The segmenting of the target with multiple aimpoints must be done manually to cover a large or irregularly shaped target. The largest target the MLRS fire direction system will consider is one with a 500-meter radius or a 2,000- by 1,000-meter rectangle.

The FDS uses two FM nets for communication with TACFIRE, the SPLL, and the PLDMD. These channels use KG-31 (external to TACFIRE) and KY-57 (internal to PLDMD and SPLL) encryption. The FDS communications mode selector control (CMSC) automatically converts/accepts either digital or voice incoming traffic.

The PLDMD, which is mounted in the (firing) platoon leader's vehicle (an M577 CP carrier), is a modified version of the AN/PSG-2A (DMD) hardware. It has two communications channels. It can simultaneously address up to three launchers (SPLLs) and one battery FDS, one battalion FDS (in a pure MLRS battalion), or one battalion or higher TACFIRE. The PLDMD can compose, transmit, and store messages; store and update the status and location of SPLLS and associated tactical data; and act as a relay between the FDC and the launchers. The PLDMD will link with a TACFIRE only on a limited and nonsecure basis using the following messages only:

- Receive from TACFIRE: FM;RFAF, COMD;CC, COMD;CF, MET;CM, and SYS;PTM
- Send to TACFIRE: /SYS;PTM.

The PLDMD weighs less than 10 pounds and measures 11 by 8 by 4 inches. Because it uses only the vehicle 28VDC power system as a power source, it cannot be used without the platoon leader's vehicles or a substitute.

The FDS incorporates two external communications channels, which provide digital (primary), voice (secondary), and wire communications with TACFIRE and the PLDMD. The FDS can receive messages on both channels at the same time. The FDS at both battalion and battery can receive fire missions directly from a target acquisition device, such as a Firefinder radar. However, since the FDS can operate on only two channels, the FDS and the target acquisition device usually conduct the mission on another predesignated channel. Because of these restrictions, this mode is anticipated only for specific operations in a limited time frame.

In case of a battalion FDS failure or combat loss, one of the battery FDSs of the MLRS battalion assumes the role of the battalion system. The data base transfer must be done manually between the two systems. However, the battery FDS can reinitialize as a battalion system using the same tape transport unit that contains its battery programing. The SPLLs and the PLDMDs of the new battalion FDS are controlled by the remaining battery systems, since each MLRS battery FDS can control up to five platoons with three launchers each. Unit SOP establishes which battery FDS is the battalion alternate, which platoons are controlled by which battery FDS, and how the battalion data base is transferred to the alternate. If the MLRS battery FDS in the 203-mm/MLRS composite battalion becomes inoperative—

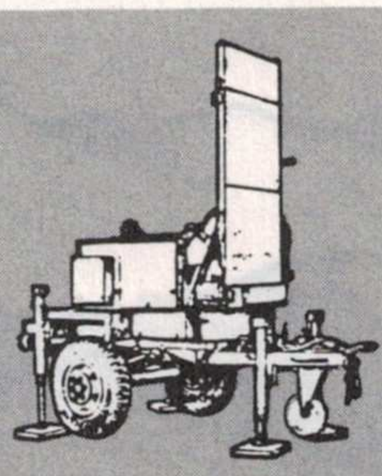
- The MLRS tape transport unit can be used to restore the MLRS program into the cannon BCS (the hardware is the same) or
- One of the PLDMDs in the MLRS battery can accommodate limited digital radio communications with the TACFIRE at battalion or div arty.

Use of the PLDMD to replace the FDS must be considered an emergency measure only because of the considerable degradation in capability. The PLDMD uses only the TSEC/KY-57 device and TACFIRE uses only the KG-31. Therefore, all traffic between the two will be unencrypted. Classified data can be sent only by use of an off-line encryption system. Capabilities are limited, and the automatic tactical fire direction of the MLRS FDS is lost. However, the PLDMD allows TACFIRE to continue to use the SPLLs as fire support assets and allows for continued tactical operations until the FDS can be repaired or replaced. The MLRS battery FDS is the only element of the MLRS command and control system which automatically converts TACFIRE-category messages into MLRS-category messages that the SPLLs onboard fire control computer can accept. Neither the PLDMD nor the TACFIRE, with current software programming, can do automatic tactical fire direction/selection of launcher to fire, target effects processing, or multiple aimpoint generation. Therefore, when PLDMD is used directly with TACFIRE, the number of rockets to engage the target must always be transmitted to the PLDMD in the FM;RFAF format. If the target meets the criteria to be subdivided for multiple aimpoints, this must be determined and manually entered by the operator at the PLDMD.

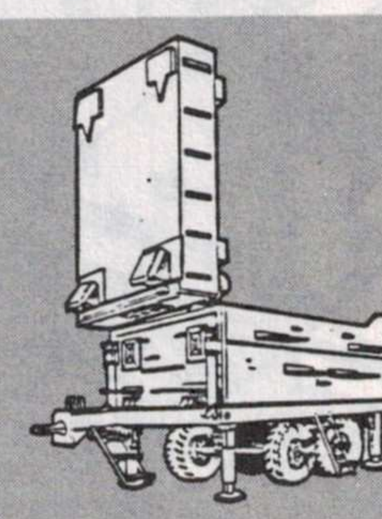
FIREFINDER RADARS (AN/TPQ-36 AND AN/TPQ-37)

In terms of interfacing with TACFIRE, these radars are functionally identical. Both report target information and requests for fire using a DMD emulator. The emulator works in conjunction with a net-sensing device that monitors digital or voice traffic and transmits messages only when the net is clear. Each radar section uses three AN/VRC-12 series radios, one of which operates on the digital net. Each Firefinder has a KY-57 for secure voice but currently does not have a secure digital communications capability. Classified information must be manually encoded and transmitted by voice, since Firefinder has no plain-text capability.

FIREFINDER RADARS



AN/TPQ-36 RADAR



AN/TPQ-37 RADAR

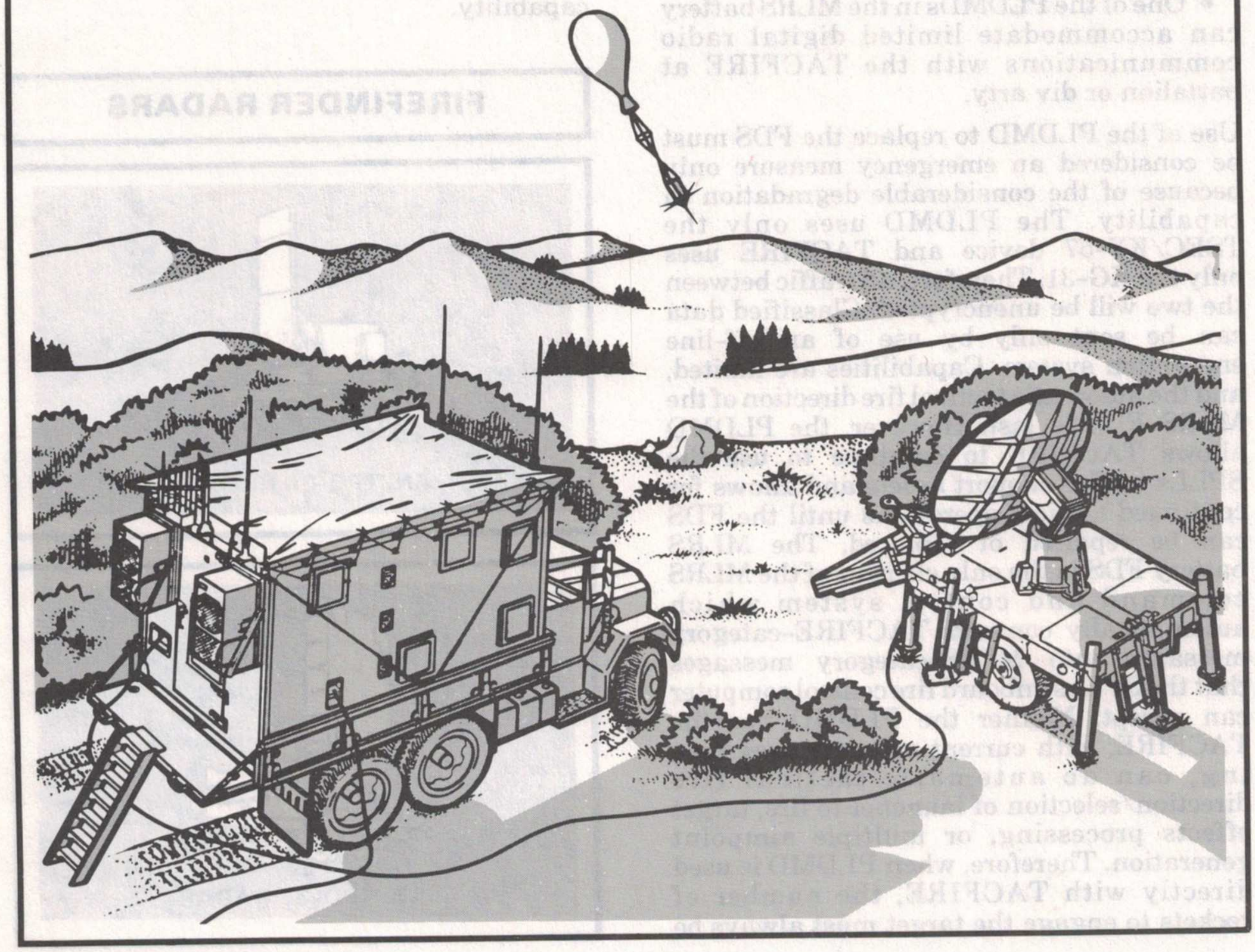
MET DATA SYSTEM

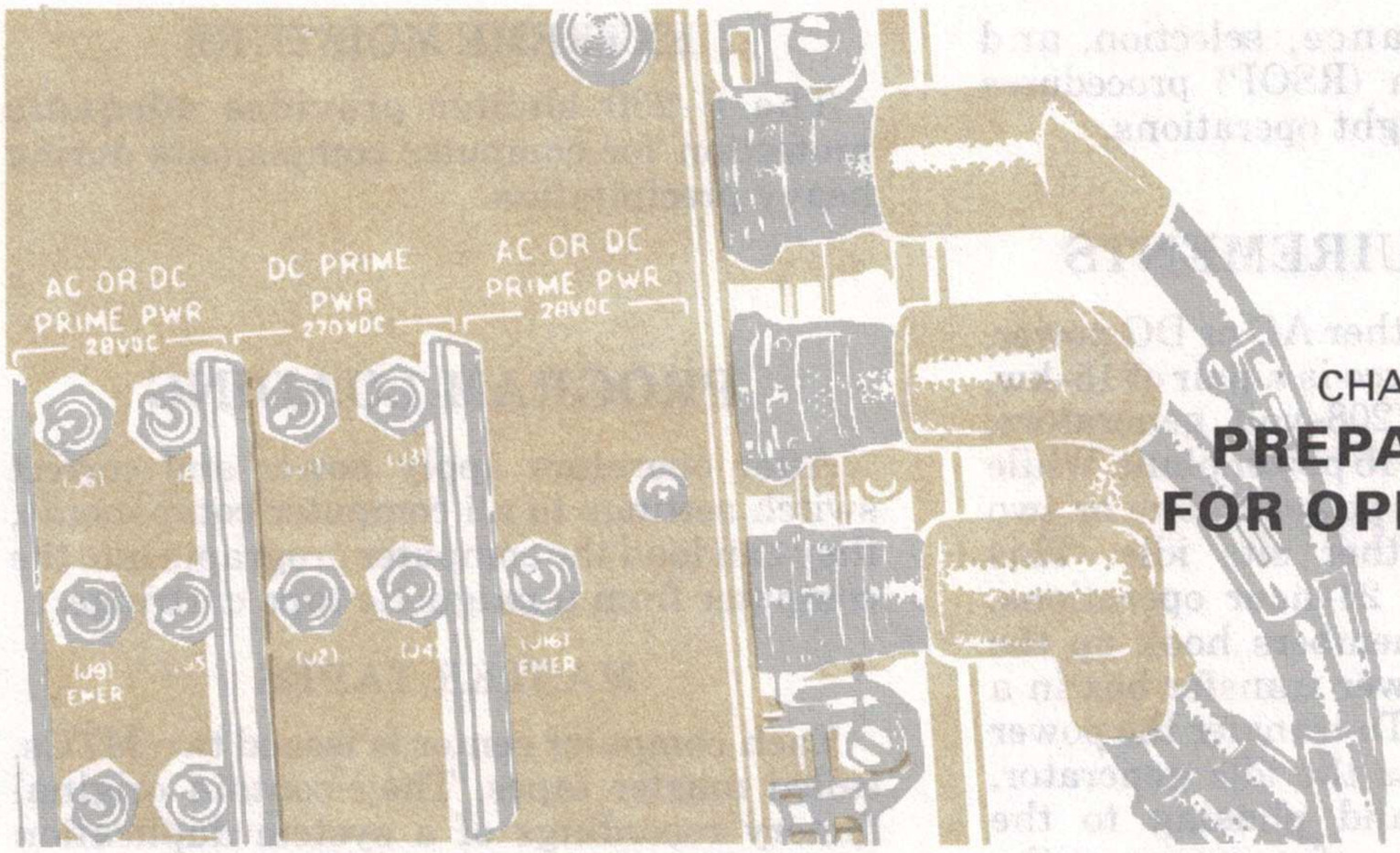
The MDS (Appendix A), soon to be fielded, provides computer ballistic and fallout met messages to the computer system with which it operates. The computer, in turn, sends these met messages to all other users.

The MDS has an RDT identical to that of the VFMED to translate the on-board computer language to digital messages (and vice versa). Operator keyboard actions are basically identical to those used with a VFMED. Operators manually synchronize and authenticate all messages transmitted to TACFIRE. A KG-31 COMSEC device encrypts/decrypts digital messages. The MDS has two AN/VRC-46 radios and can accept one digital wire line.

The MDS digitally transmits formatted computer ballistic and fallout met messages as well as plain-text messages. The sound ranging met message contains 27 characters, and the DMDs at sound ranging platoons accept only 26 characters. Therefore, the MDS must transmit the sound ranging met message as a plain-text message in two segments.

MET DATA SYSTEM





CHAPTER 2

PREPARATION FOR OPERATIONS

The TACFIRE computer is the hub of a command, control, and communications system at battalion, div arty, FA brigade, and corps artillery echelons. Before it will operate effectively, operators must meet the computer power, hardware, and software requirements. Starting from scratch, a well-trained crew may require as much as 3 hours to put TACFIRE into full operation. However, with a good SOP and program data already on a magnetic tape cartridge, a crew can set up a powered-down computer for full operation within 30 minutes. When emplacing from a move mode, crews can put TACFIRE into full operation within 5 to 15 minutes.

POSITION REQUIREMENTS

The guidance and procedures for positioning are established in FM 6-20-1 and FM 6-20-1J. The responsibility for positioning artillery rests with the artillery commander. However, the operations officer (S3) selects the position area for the TACFIRE computer shelters. His selection is based on guidance from the commander, tactical SOP, operations order, or FA support plan.

The S3 should consider these requirements for emplacing TACFIRE:

- The area should be as level as possible and should never exceed a 15° slant.
- The soil consistency must allow for good grounding for the power plant(s).
- The area must allow the two 5-ton trucks associated with each S-280 shelter to be within 20 feet of one another for DC power hookups.
- At BCD computer centers, the cabling between the computer shelter and the display shelter limits the separation distance to 50 meters.
- The cabling between the AN/MJQ-15 power plants and the S-280 shelters limits the separation distance to 100 meters. The generators are designed to be collocated around the power junction box. The S3 should position the power plant(s) as far from working areas as is practical because of noise and exhaust fumes.

The VFMED emplacement requirements were discussed in Chapter 1. TACFIRE interfaces with the operations element VFMED by wire or radio. Therefore, the distance from the TACFIRE computer shelter(s) to the operations complex is not a major operational factor in terms of TACFIRE capabilities.

Normal communications, camouflage, concealment, and dispersion considerations apply.

Occupation of position must be well planned, well organized, and executed as quickly as possible to place TACFIRE "on the air." The TACFIRE annex of a unit SOP should outline operator/crew drill exercises for occupation of position. Units should

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exercise reconnaissance, selection, and occupation of position (RSOP) procedures regularly, to include night operations.

POWER REQUIREMENTS

TACFIRE can use either AC or DC power. The primary power source is a pair of 15-kw, 400-Hz, 3-phase, 120/208-volt generators, known as an AN/MJQ-15 power plant. While one generator provides power to one or two S-280 shelters, the other sits idle. This configuration provides 24-hour operations. The TACFIRE crew members hook up the two generators to a power transfer box in a parallel configuration. To transfer the power load, an operator starts the idle generator, matches its voltage and phasing to the operating generator, transfers power at the power transfer box, and shuts off the generator needing shutdown. Grounding requirements are specified in the power plant technical manual.

An alternate source of power comes from 100-amp alternator systems on the two 5-ton trucks associated with each S-280 shelter. When TACFIRE operates on truck-supplied power, termed A-Bus and B-Bus power, the air conditioner and collective protective equipment do not function.

Refer to Chapter 1 for a description of the power supply group and to Chapter 5 for a discussion of continuity of operations during a power failure.

EXTREME CLIMATIC CONDITIONS

Volume 4 of the TACFIRE operator's manual specifies TACFIRE climatic operating parameters in more detail.

EXTREME HEAT

The air conditioner provides satisfactory cooling for the computer components to a maximum ambient outside temperature of 125° F.

EXTREME COLD

The air conditioner provides satisfactory heating for the computer components to a minimum ambient outside temperature of -40° F.

EXTREME MOISTURE

The S-280 shelter provides adequate protection for computer components during heavy precipitation.

PROGRAM LOADING

After operators apply power and correct switch settings to all computer components, they can load the computer programs into the computer from a magnetic tape cartridge.

MASTER TAPES

Each computer center is issued two MTCs, called master tapes. They contain original factory recordings of a system duplication (SYSDUPE) program and a field system program. The SYSDUPE program is the only executable program on the master tape. It records the field system program onto a blank or obsolete field system tape. Only in an extreme emergency should a previously recorded tape be used for this purpose. The master tape does not load the computer system for regular operations. Tape duplication procedures are defined in TM 11-7440-240-10-3 and TM 11-7440-241-10-3.

TACFIRE FIELD SYSTEM TAPES

Each computer center generates two TACFIRE field system tapes by copying the field system program from the master tape onto blank MTCs or obsolete field system tapes. The field system program contains the operating system instructions, maintenance and diagnostic programs, and applications programs. It also contains a host of standard values, to include Joint Munitions Effectiveness Manual (JMEM) data, weapon description data, standard met, tabular firing tables, and standard muzzle velocities.

BLANK TAPES

Each computer center is initially issued four blank tape cartridges. The field system program is recorded on two of these. On the other two, called scratch tapes, dynamic data are recorded periodically during operations and/or immediately before shutdown. Operators can then use these recordings, called salvage point recordings (SPR), to put the computer back into operation where it left off.

LOAD OPTIONS

To load the computer, the operator mounts the field system tape into the magnetic tape unit and then selects one of eight load options. The computer first reads the data on the tape and then runs the selected load option tests. Each load option provides a unique combination of maintenance and diagnostic tests during program load. These tests can be run only during program load. While they take a few minutes to run, they provide valuable indicators of the computer operational status. The SOP should dictate which load options operators should use under various conditions.

PROGRAM LOAD VERIFICATION

Regardless of which program load option he uses, the operator monitors its progress. When the load is successful, he checks for device faults and then begins software initialization.

INITIALIZATION

The time required and the procedures for initialization depend on whether previously recorded data are used. See Appendixes B and C for standardized computer entries.

WITHOUT PREVIOUSLY RECORDED DATA

After he loads the field system tape, the operator must enter dynamic data into the computer before the computer can process information. These data include subscriber tables, legal message types for subscribers, map orienting data, battlefield geometry, fire support coordinating measures, fire unit locations, ammunition status, and target numbering blocks. This usually is a time-consuming task. After he has established digital communications with his subscribers, they can send him some of the initialization information.

WITH PREVIOUSLY RECORDED DATA

Data can also be input by restoring a salvage point recording. This causes previously recorded data to be placed into the computer memory for current use. An SPR allows an operator to quickly restore the computer to the same point in operations at which the restored SPR was made. There are two types of restorations: delayed and immediate. A delayed restoration allows all jobs currently being processed to be completed before the restoration. An immediate restoration interrupts all processing and initiates the restoration.

After the restoration, the operator, the mutual support unit, and other subscribers can then change the outdated dynamic data, as needed, without having to begin from scratch. The TACFIRE operators can create SPRs for future training and contingency plans. Then TACFIRE can be on the air very quickly upon emplacement.

COMMUNICATIONS ESTABLISHMENT

As soon as power is applied to the radios, TACFIRE computer operators can accept voice transmissions. The best means to establish digital communications calls for establishing voice communications first. While the operator sets up the communications software during initialization, he can keep track of those with whom he has voice communications. An alternate method calls for the operations element to answer voice transmissions on behalf of the computer center. Then when the computer is completely initialized, the operations element can report which subscribers have established voice communications.

When the computer operator has initialized the computer, the computer automatically transmits a plain-text message to all subscribers announcing that the system is on the air. At this point, the computer can communicate digitally. The operator then contacts all subscribers, starting with the operations VFMED, according to SOP to verify good digital communications with each subscriber.

TACTICAL DATA BASE ESTABLISHMENT

Before TACFIRE can process data, all battlefield geometry, fire support coordinating measures, map orientation data, ammunition and fire unit data, and met data should be entered into the computer. If

the computer was initialized from a system tape without an SPR, each subscriber sends all pertinent data it generates or is responsible for providing. For example, firing batteries send ammunition and fire unit data. If the computer was initialized from an SPR, the mutual support unit (MSU) or other subscribers send updated dynamic data only. Once the operator confirms that the tactical data base is current and complete, the computer can process data for all subscribers.

DATA RECORDING

TACFIRE can record data at predesignated intervals as well as upon operator request. Storing data on tape precludes data loss due to system failure or system purge. There are two types of salvage point recordings: nucleus and delta.

A *nucleus salvage point recording* records all dynamic data from the computer on tape. An operator can program the computer to initate a nucleus SPR in time intervals of 0 to 300 minutes. If the operator does not program an interval, the computer automatically makes a nucleus SPR every 2 hours. An operator also can initiate a nucleus SPR at any time.

A *delta salvage point recording* records only changes or increments in the dynamic data and not the entire data nucleus. With the delta SPR, an operator has only two options: leave it on or turn it off. When the delta SPR is on, the computer automatically records changes to the dynamic data base every 20 minutes from the time of the last recording or when four pages of memory fill up, whichever occurs first. The delta recording function can be initiated only by recording a nucleus salvage point recording.

CHAPTER 3

COMMUNICATIONS-ELECTRONICS AND DIGITAL TRANSMISSIONS

TACFIRE is a centralized tactical data processing system. This means that a central processor does most of the computer processing and maintains the centralized data base. Remote and peripheral devices or other computers must be connected to the central processor before data can be exchanged. In the tactical environment, this data link is provided by the Army tactical very high frequency (VHF) or high frequency (HF) radios or wire. While the computer can process at the speed of light, the physical properties of tactical wire and radio limit data link transmission speeds to 1,200 bits per second (BPS). At this speed, a call for fire can be transmitted and authenticated in 6 seconds.

DIGITAL COMMUNICATIONS

Before any TACFIRE message can be transmitted over tactical radio or wire, it must be converted to a signal that can be recognized and processed by the communications equipment. Frequency shift keying (FSK) is the technique by which TACFIRE converts computer data to a voice frequency signal. The FSK reproduction of the computer message can be transmitted over tactical radio or wire. This technique of transmitting TACFIRE data is commonly referred to as digital communications. Although slower than the computer, FSK has many advantages over voice.

EFFICIENCY

A lot of data can be transmitted in a short time.

SURVIVABILITY

Although FSK provides a unique signal signature, the short, or "burst," transmission reduces the time for the enemy to direction-find (DF) the signal. Since FSK requires that the radio be properly aligned, the DF station also must be listening on the exact frequency. The voice transmission time is lengthy; therefore, voice transmissions are more susceptible to direction-finding.

MESSAGE ADDRESSING

Each TACFIRE data message can be addressed manually or automatically to specific users. As in the voice world, station calls can be made and only the addressee needs to respond.

DECREASED ERROR RATE

The communications devices transmit formatted messages that computer operators normally do not have to alter. A correctly formatted call for fire, for instance, requires no operator intervention during the complete computing and disseminating process. During unfavorable circumstances, a computer often can reconstruct formatted messages that are garbled or alert an operator to a format error.

MULTIPLE SUBSCRIBERS

Each computer center can group subscribers together for the purpose of disseminating messages by one action. Thus,

an operator does not have to repeatedly address the same message.

SECURE TRANSMISSIONS

Except for elements using the DMD, FIST DMD, or DMD emulator, all TACFIRE-equipped elements are issued COMSEC devices with their digital communications equipment. Thus, each station can encrypt/decrypt digital communications.

HARDWARE

TACFIRE works well with most standard Army communications equipment. TACFIRE equipment issue does not include radios; therefore, TACFIRE-equipped units use existing communications equipment.

FM RADIO

TACFIRE works well with standard Army tactical FM radio equipment, most commonly the AN/PRC-77, AN/GRC-160, and AN/VRC-46 radios. This generation of tactical radios was designed for voice traffic. There are four considerations when FM radio is used for digital communications.

Frequency Alignment. Direct support maintenance must tune all radios in accordance with the technical manuals to ensure that the frequencies are aligned. Radios cannot pass digital traffic unless each radio is properly aligned. Since voice transmissions tend to bleed around the frequency, it may be possible to communicate by voice, but not digitally, when radios are not properly aligned.

Key Time. A radio requires a very short warm-up time after it is keyed before a digital message can be transmitted. This warm-up period, called a key time, allows the radio to generate enough power to transmit the message. All digital devices have key time settings of various increments of fractions of seconds. Too much key time lengthens transmission time; too little key time hinders transmissions. To permit acknowledgements by all subscribers, the computer center must use the same key time as the subscriber with the highest time.

Volume Control. The volume control on a radio controls only the output level of a received message. If it is set too low, the digital device will not sense an incoming digital message. Users should set radios at one half to two thirds of maximum volume to ensure that the digital device receives an adequate signal. In most locations, this will produce an unacceptably loud signal from the radio speaker. As an alternative, users can configure the RCMU or VFMED headset to monitor the net. Then the headset volume control can be used and the radio speaker turned off.

Planning Ranges. FM radio planning ranges are roughly the same for voice and digital communications. Normally, if voice communications are clear and if the radio is properly aligned, digital communications should be clear.

AM/SSB RADIO

Digital communications using the AN/GRC-106 AM radio are normally stable at ranges up to 60 miles as long as line-of-sight transmissions are possible. At greater ranges when line-of-sight transmissions are not possible, atmospheric distortions seriously degrade digital communications. Also, using an omni-directional antenna and a 400-watt station, an AM transmitter is easy to direction-find. Because AM digital communications require a combination of either block mode 1 and 600 BPS or block mode 2 and 1,200 BPS, communications take twice as long.

FIELD WIRE

While WD-1/TT wire was designed for voice communications, it works well for digital if it is in good condition. Splices and other irregularities have greater effect on digital communications than on voice traffic. TACFIRE also accepts 2-wire, 4-wire, and 26-pair cables. With WD-1/TT wire, the TM-184 terminal board is used in lieu of the SB-16 switchboard.

MULTICHANNEL

TACFIRE transmissions are compatible with Army multichannel (MCHAN) (12 and 24) pulse code modulation (PCM). TACFIRE currently requires a sole-user circuit, and there are limited multichannel assets in the divisional signal battalion and the corps signal brigade. Therefore, planners must

coordinate extensively with these units to ensure that TACFIRE-equipped units receive an acceptable allocation of multichannel resources. Since multichannel equipment is less mobile than FA units, planners must carefully coordinate unit displacements to minimize communications disruptions. The PCM/MCHAN communications are highly directional and not as susceptible to enemy electronic warfare (EW) techniques. Using PCM/MCHAN reduces reliance on AM/SSB and FM radio. These radio assets can provide a backup capability.

SOFTWARE

OPERATING SYSTEM

The operating system controls digital communications in TACFIRE. An operator tailors the operating system data base on the basis of guidance from the SOP, the operations order (OPORD), the FA support plan (Appendix D), or the S3. He uses up to seven input message formats described below.

SYS;SBT. The SYS;SBT message sets up the communications network, to include net structure, encryption status, automatic relay, and subscriber addresses.

SYS;LGSB. The SYS;LGSB message defines the messages that are legal for input and relay by each subscriber.

SYS;MISC. The SYS;MISC message defines operating parameters:

Key time. The key time function of the operating system software defines the amount of time the computer waits for an acknowledgement from a subscriber before transmitting a message. Therefore, to facilitate timely acknowledgements, an operator must match the net mode time to the longest key time of any of his subscribers.

Message delay. The message delay function reduces interference caused by two or more subscribers transmitting digital messages at the same time. A delay time is established for each computer and subscriber with a net-sensing device. This implements a transmission protocol for the net in that each net-sensing device will wait a certain time on a clear net before transmitting digital traffic. Thus, the most important element can transmit first. The FO DMDs do not have net-sensing devices. The computer operator programs the computer message delay time for each net. Subscribers with remote data terminals set the message delay time by using the NET ACCESS switch.

SYS;AUTH. The SYS;AUTH message sets up the authentication matrix for communications security.

SYS;COMSEC. The SYS;COMSEC message tests the matrix and specifies whether the computer will automatically encrypt unclassified messages.

SYS;FSO. The SYS;FSO message establishes MOI files for subscribers.

SYS;INIT. The SYS;INIT message enables the computer to communicate digitally with subscribers.

COMMUNICATION CONTROL UNIT

The CCU integrates wire, FM radio, AM/SSB radio, and MCHAN users into any of up to eight nets. Using the CCU, an operator can quickly reconfigure net structures or establish communications links between two or more subscribers so that anyone operating a digital device can communicate with anyone else in the system. The CCU has a default net structure program. After purging the CCU, an operator may have to modify the CCU default net structure to create a current net structure.

NETTING

TACFIRE communications networks are essentially identical to existing artillery voice communications networks. The TACFIRE computers can integrate FM, SSB, wire, and MCHAN communications systems into eight nets. Operators program the computer to associate one DDT with each digital net. Because of the number of DDTs on the systems, battalion computers can have up to six digital nets and BCD computers can have up to seven digital nets. The nets not used for digital communications can be used for voice communications.

A sound digital net structure is based on mission, tactical situation, and mutual

support requirements. The communications-electronics staff officer (CESO) at each FA headquarters can use the following questions to help him design such a structure:

- Which TACFIRE subscribers will support the operation?
- What digital device will each subscriber use?
- What communications means are available to each subscriber?
- What will be the relative location of each subscriber?
- With whom must each subscriber communicate?
- What types of messages will each subscriber transmit and receive?
- How much digital traffic will each subscriber generate?

NOTE. *Sample net structures are provided in Chapters 7, 8, and 9 for the various FA echelons.*

Normally, each TACFIRE-equipped unit has one internal command (FM) voice net and operates in one external command (FM) voice net. Also, each div arty has an internal administration/logistics (FM) voice net, which any subordinate unit can use. All other nets are digital. Therefore, the command net should handle only traffic that cannot be transmitted digitally. Since voice traffic will overlay digital messages, SOP should limit voice traffic on digital nets to a few coordination and emergency situations. The computer center normally is the net control station (NCS) for all internal digital nets.

ENCRYPTION/DECRYPTION

All digital communications between TACFIRE computers, VFMEDs, PLDMDs, FDSs, MDSs, and BCSs are encrypted by use of the KG-31 COMSEC device. This device does not encrypt voice communications. The FO DMD, FIST DMD, DMD emulator (with the Firefinder system), and GDU do not use COMSEC devices.

Computer operators can program the computer to work in either of two encryption modes. In one mode, only classified messages are encrypted; in the other mode, all messages are encrypted. The computer never encrypts messages to a subscriber with a DMD-type device. Also, the computer operator can instruct the computer to not encrypt messages to a subscriber whose KG-31 is not functioning.

AUTOMATIC RELAY

A computer operator can instruct the computer to automatically relay messages from one subscriber to another. This gives the battalion and brigade fire support sections uninterrupted access to the div arty computer. For example, an FSO with a maneuver battalion may extract from the div arty computer targets that have been reported in his zone of responsibility. To do this, he prepares a request on his VFMED and sends it to his battalion computer, which automatically relays it to div arty. The results coming back from div arty are automatically relayed through the battalion computer to the requesting FSO. All this is done in about 60 seconds.

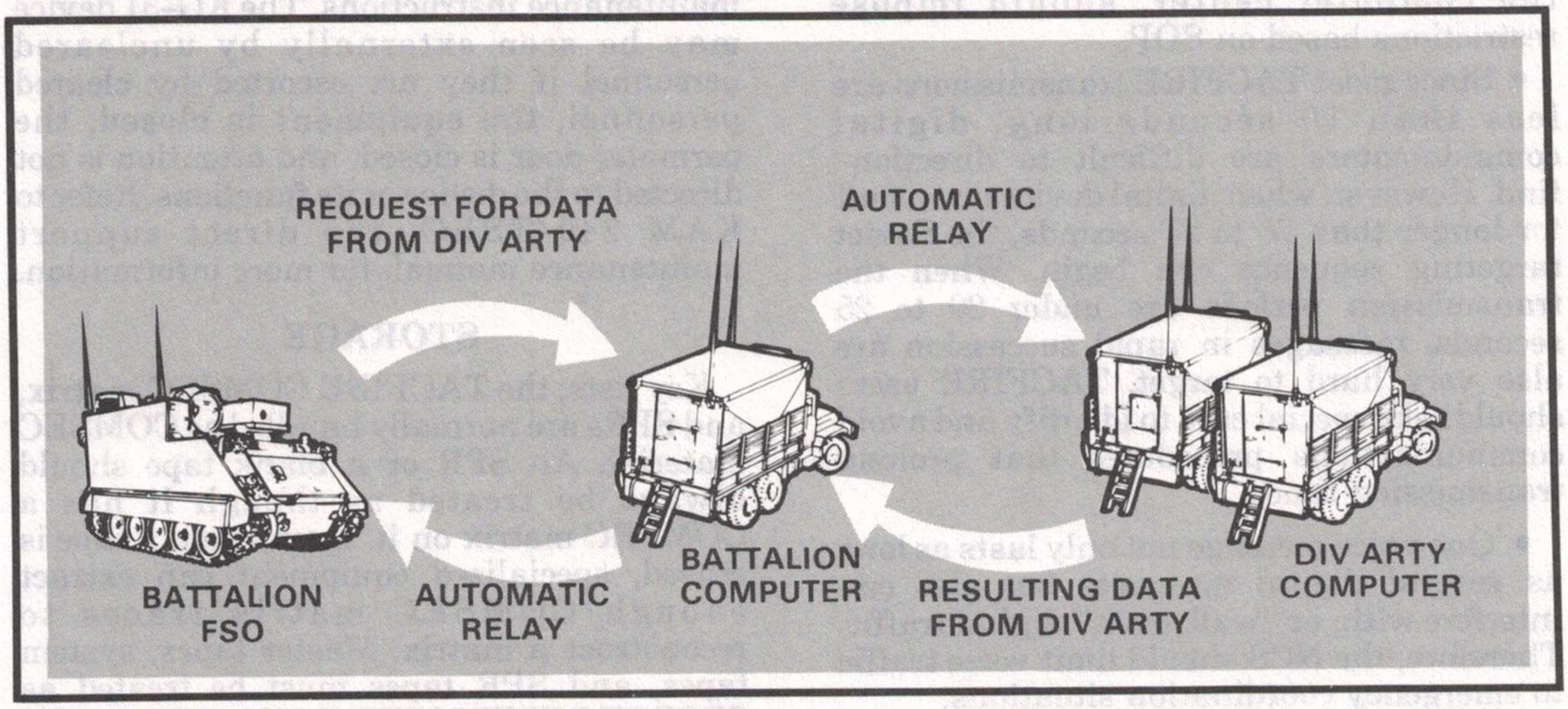
There are three restrictions in using the automatic relay function:

- Both the originator and the final recipient of the relayed message must be subscribers of the same relaying computer.
- The function relays through only one computer. If a message must be relayed through more than one computer, operators at subsequent computers will have to relay the message by manually readdressing it.
- The computer will relay only messages listed in the SYS;LGSB message, which "legalizes" messages for subscribers.

Computer operators can set up subscribers for relay in either of two modes:

- In the *manual default mode,* the computer places the messages in queue as they are received. When the operator reviews the message, he can retransmit it.
- In the *automatic relay mode,* as the computer receives the message, it automatically retransmits it without operator action.

The DMD relay function is similar to the automatic relay function, but it applies only to messages originated by a DMD.



COMMUNICATIONS SECURITY

Communications security for digital communications is as important as COMSEC for voice communications. It is fairly simple to program a cheap computer to interpret the digital transmissions of TACFIRE if they are not properly encrypted. Therefore, many of the same procedures and protective requirements pertain to digital as well as voice communications. For additional information, see AR 380-5, (C) AR 380-40, and (O) TC 380-41. Any element with a KG-31 COMSEC device can encrypt/decrypt digital messages.

AUTHENTICATION

The TACFIRE computer authenticates all messages received and transmitted by subscribers by one of two forms of authentication. The operator may override and process a misauthenticated message.

Sequence Index Number. During normal operations, the computer keeps a sequential log of all encrypted messages transmitted for each subscriber except those with DMDs. The computer maintains synchronization by comparing the sequence number of the incoming message to the sequence number the computer expected to receive. If the incoming message number is correct, the computer transmits an acknowledgement. If the number is incorrect, the computer generates an error message for the operator and transmits an error message to the subscriber.

Authentication Matrix. During initialization, an operator enters an authentication matrix that generates crypto variables corresponding to the codebooks issued to elements using DMDs, FIST DMDs, and DMD emulators. The DMD operators use the authenticators in the codebooks instead of message serial numbers when sending unencrypted messages. If an unencrypted message from a DMD contains the authenticators the computer expected, the computer transmits an acknowledgement. If the authenticators are incorrect, the computer generates an error message for the operator and transmits a nonacknowledgement to the subscriber. Neither the BCS nor the FDS can automatically authenticate a message. If serialization is not used, all messages must be manually authenticated.

RADIO DISCIPLINE

Traditional radio discipline applies to digital communications:

- Since digital traffic has a unique signature, commanders at all levels should impose radio silence when possible.

• When a digital net gets too busy with superfluous traffic, the NCS, which is usually the computer center, should impose restrictions based on SOP.

• Since most TACFIRE transmissions are less than 10 seconds long, digital communicators are difficult to direction-find. However, when digital devices transmit for longer than 20 to 25 seconds, the Soviet targeting sequence can begin. When the transmission periods are under 20 to 25 seconds, messages in rapid succession are also very hard to target. TACFIRE users should take special care to identify and avoid communications procedures that prolong transmission times.

• One voice message not only lasts as long as several digital messages but also can interfere with, or "walk over," digital traffic. Therefore, the NCS should limit voice traffic to emergency coordination situations.

TRANSACTION JOURNAL

The transaction journal provides a record of all messages received and transmitted by the computer. It is in the form of a modified communications line containing items required for reviewing COMSEC. A CESO can use the transaction journal to monitor COMSEC procedures and track down violations throughout the computer digital communications network.

PHYSICAL SECURITY

Commanders of TACFIRE-equipped units have the responsibility to adopt SOPs in accordance with current directives regarding computer operation and storage of classified material. The following references give guidance on physical security requirements: AR 380-5, (C) AR 380-40, AR 380-380, (O) TC 380-41, and (C) KAO 137E KG-31.

COMPUTER

The computer center equipment, except for the KG-31 device, is unclassified when in a purged, nonoperational status. The computer contains SECRET COMSEC data when loaded with a field system program and a TACFIRE COMSEC matrix.

KG-31 COMSEC DEVICE

The KG-31 is classified CONFIDENTIAL. A CONFIDENTIAL clearance is required for internal viewing, external viewing with the permuter door open, and access to the maintenance instructions. The KG-31 device may be seen externally by uncleared personnel if they are escorted by cleared personnel, the equipment is closed, the permuter door is closed, and attention is not directed to the device or its functions. Refer to KAM 240/TSEC, the direct support maintenance manual, for more information.

STORAGE

Key lists, the TACFIRE COMSEC matrix, and SPRs are normally handled as COMSEC material. An SPR or a blank tape should always be treated as though it has a COMSEC matrix on it. Even when a tape is erased, specialized equipment can extract enough COMSEC matrix traces to reconstruct a matrix. Master tapes, system tapes, and SPR tapes must be treated as SECRET RESTRICTED DATA. AR 380-380, 8 March 1985, and DA Pamphlet 5-25, Volume II, March 1984, outline the storage and security requirements.

OUTPUT REPORTS

All input message formats and output reports are subject to the default classification scheme programed into the data base. This scheme is tailored to the most common tactical classification normally applied to the type of information during combat operations. Commanders preparing contingency plans must prepare classification guidance for all information, particularly when classification parameters deviate from those of the TACFIRE default classification values. Users are responsible for the proper disposition of TACFIRE-generated printouts.

TROUBLESHOOTING

Failures in the TACFIRE digital communications system can result in confusion, frustration, and excessive downtime unless operators know how to systematically troubleshoot the digital communications link. Every unit SOP should standardize troubleshooting procedures so that all operators on the failed communications link can work together to discover and correct the fault. The following guidance applies in general terms to all digital communications devices.

Communications failures can be classified as hardware faults or software faults. The first principle in troubleshooting the digital communications link is to search for hardware faults first. Only when voice communications are loud and clear should operators search for software faults.

HARDWARE FAULTS

When an operator realizes that digital communications with a subscriber have failed, he should first make a quick visual inspection of his equipment to see if there are any obvious faults. His inspection should include cabling, power supply, and switch settings. Next, he should try to contact the subscriber by voice. If voice communications are good, he should start software troubleshooting procedures. If voice communications are unsatisfactory, the failure is probably in the communications system itself. The operator should try to isolate the fault to a wire line, connector, switchboard, radio, or remoting device. When he corrects the hardware fault, he should try to reestablish voice communications. If unsuccessful, he should continue troubleshooting for another hardware failure or use an alternate means of communication.

SOFTWARE FAULTS

Having confirmed good voice communications with his subscriber, an operator should verify his software settings according to SOP or other guidance. If all settings and values are correct, he contacts the subscriber by voice to verify that he has the same software settings and values. These settings and values include destination and source codes, block mode, bit rate, key time (or preamble), net access time, encryption status, permuter card settings, codebooks, and authentication matrix.

Sometimes when voice communications are good and digital communications are not, changing the bit rate and/or block mode may correct the problem. The NCS should use this only as a last resort, because all subscribers on a given net must use the same bit rate and block mode. Change the bit rate from 1,200 to 600 BPS and try to communicate. If unsuccessful, change the block mode to X2 using 600 BPS and try to communicate. If unsuccessful, revert back to 1,200 BPS and block X1. Continue to troubleshoot or provide another means of communications.

ELECTROMAGNETIC PULSE

A nuclear detonation produces blast, thermal, and radiation effects. It also produces a phenomenon known as electromagnetic pulse (EMP). EMP is similar to a high-power radiowave, transmitting up to 50,000 watts of power. This radiation has a very broad spectrum of frequencies but primarily affects high frequency bands. As EMP travels from the burst point at the speed of light, conductors collect the waves just as antennas pick up radio waves. These conductors, which include antennas, power cables, and wire, can convert EMP radiation into high-voltage electric currents, which can damage electronic equipment.

EFFECTS

EMP disrupts communications in two ways: blackout and damage.

Blackout. EMP disturbs the atmospheric conditions enough to interfere with radio transmissions for a limited time after the nuclear detonation. Tactical FM, ultrahigh frequency (UHF), and very high frequency (to include MCHAN) radios experience blackout conditions lasting from a few seconds to 10 minutes. When transmitting 60 miles or more, AM radios can be completely blacked out for over an hour with degraded operations continued for several hours.

Damage. EMP can induce high electrical voltages and magnetic forces that can damage electronic equipment. The equipment includes radios, computers, laser range finders, solid-state controls for engines, electroexplosive devices, and missile systems. The amount of damage depends on the yield of the burst, the distance from it, and the circuitry. EMP most easily damages systems and circuitry using small operating voltages, as in solid-state circuitry. Large electric motors and tube-type electrical circuits are less vulnerable to EMP destruction. The EMP magnetic forces also affect components with magnetic memories, to include memory units of computers and magnetic tape, by erasing or disturbing data.

The damage produced by an EMP depends on weapon yield, height of burst, and

distance from ground zero. For ground bursts, the effective range of an EMP is about a 15-mile radius. A high-altitude detonation can extend the range up to a 1,500-mile radius.

DEFENSE

Any material that can conduct electricity can collect EMP radiation and convert it to high-voltage electric currents. Metal masts, antennas, large metal objects, and all forms of cabling and wire make excellent EMP conductors. Cabling can collect and convey the EMP to an electronic device, causing either temporary or permanent damage to the internal circuitry. The amount of EMP conveyed to the equipment is directly related to the amount of internal and external cabling attached to the device.

Most circuit breakers, fuses, and spark arrestors built into TACFIRE-related equipment do not operate fast enough to arrest EMP energy. However, there are measures that units can take to reduce vulnerability to EMP effects. Commanders should consider the following measures in developing SOP defensive postures based on the imminence of nuclear detonations:

- Properly ground all electronic equipment. Merely grounding equipment to large metal objects above ground may not work; a metal object may absorb more energy than it can dissipate in the ground and send excess EMP energy back to the electronic components. If possible, install redundant ground circuits and multiple grounding points.
- Shield all components and cabling as much as possible with metallic shielding. Metallic shielding will absorb some EMP energy before it reaches cables and electronic equipment. Shielding must be watertight to provide the best protection.
- Ensure all gaskets around doors, windows, and vents are in good condition and seal properly.
- Store magnetic tapes, TI-59 calculators, and other small electronic devices in grounded metal containers, such as ammunition boxes.
- Plan to use alternate means of communications.
- Use as little wire as possible when remoting communications equipment.
- Do not cross or lay wire or cables on top of one another.
- Do not run parallel wire and cables closer than 3 inches.
- Do not store cables in a looped configuration when they are attached to electronic equipment.
- Bury wire and cables whenever possible.
- Run individual WD-1 lines into a J-1077 distribution box instead of the communications terminal box at each computer center. The J-1077 box connects to the CTB using a 26-pair cable, which an operator can quickly disconnect.
- Use C-161 repeating coils on WD-1 lines. Since the coils partially ground the line, they can help bleed off much of the EMP energy.
- Keep unused electronic equipment uncabled and shielded.
- Use the smallest antenna required.
- When a nuclear detonation is imminent, EMP defensive posture can be further increased as follows:
  - — Keep doors, windows, and vents closed at all times to increase the metallic shielding of vehicles and shelters.
  - — Disconnect all power, communications, and antenna cables. Leave grounding cables connected to all components.
  - — Turn off all equipment.

ELECTRONIC COUNTER-COUNTERMEASURES

Electronic counter-countermeasures (ECCM) are taken to protect friendly electronic emitters from enemy detection, location, identification, and jamming. With some exceptions, ECCM techniques are the same for digital and voice communications. However, because digital nets have such a distinct signature, the enemy has a greater motivation to use electronic countermeasures against those nets. Some ECCM are discussed below. For additional information, refer to FM 32-30.

USE LOW POWER

Low power should be used, when possible, to reduce the enemy's chances of intercepting the signal.

REMOTE RADIOS

Remoting radios at least 1 kilometer from a command or observation post can deceive the enemy as to its true location.

ENCRYPT

When using a COMSEC device, encrypt all messages when possible. When transmitting a unit or observer location with a DMD, manually encrypt the location in the plain-text message. Always assume that enemy forces can intercept unencrypted digital messages, convert them into machine language, and decipher the information.

USE DIRECTIONAL ANTENNAS

When possible, use a directional, horizontally polarized antenna for lateral communications.

USE TERRAIN MASKING

Locate radio antennas so that a major terrain feature, like a hill or ridge, is between the emitter and enemy radio direction-finding (RDF) systems.

USE WIRE AND MULTICHANNEL

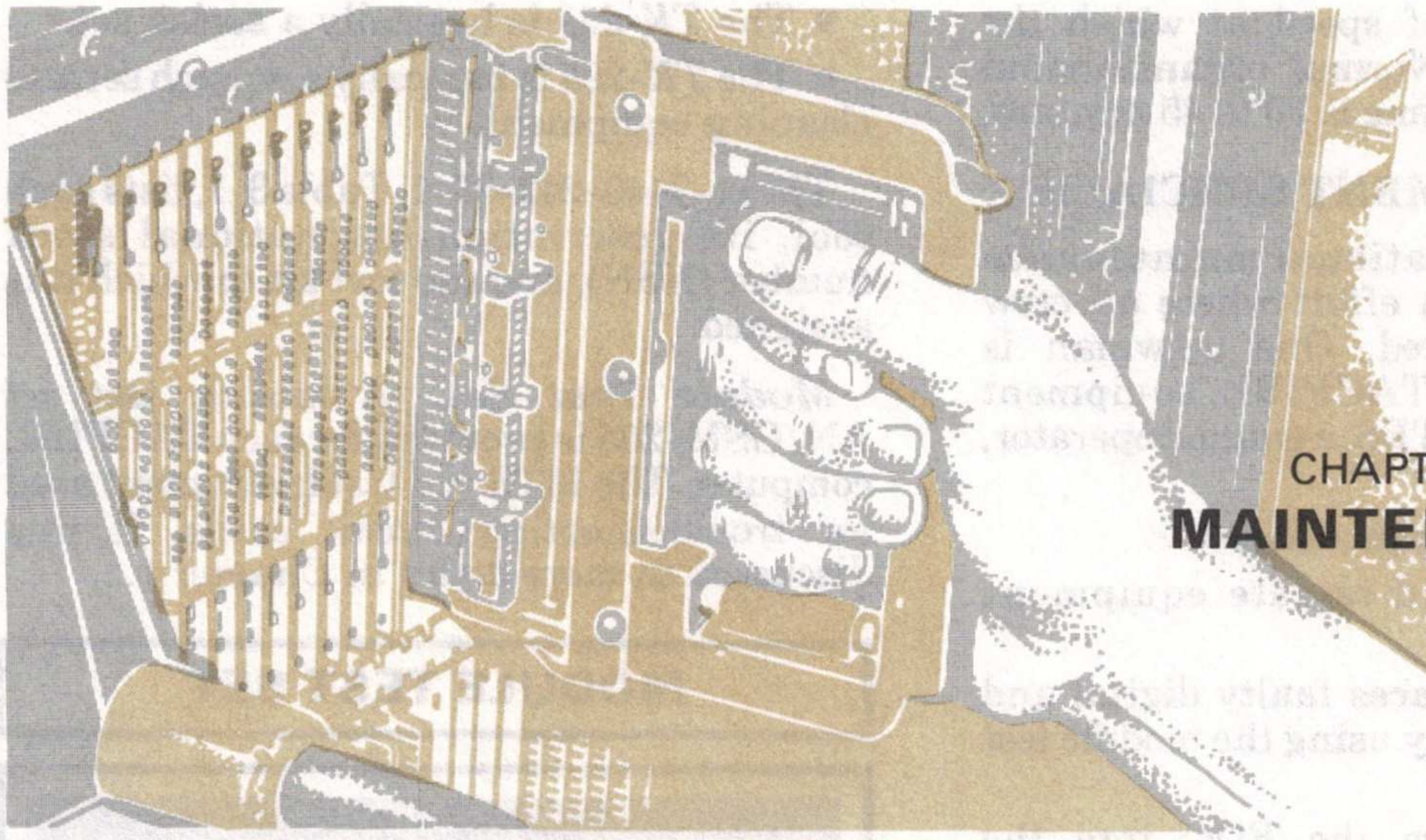
Multichannel is highly directional, very efficient, and difficult to jam.

MINIMIZE LENGTHY TRANSMISSIONS

About 25 seconds after communications begin, the Soviet targeting sequence can continue even if the transmission is terminated. This is the danger point. Because of this capability, any voice or digital transmission longer than 20 to 25 seconds is in danger of being targeted. Additional information concerning the radioelectronic combat threat can be found in FM 100-2-1, DST-1730S-009-81, and DST 1740S-385-81.

WORK THROUGH JAMMING

Change the bit rate and/or block mode to try to work through jamming. If unsuccessful, change to a prearranged frequency; if possible, keep transmitting dummy messages on the primary frequency at the same time. Never transmit in plain text statements indicating that a net is being jammed.



CHAPTER 4

MAINTENANCE

The computer, many of its peripheral components, and the VFMED use electronic components that have few or no moving parts. These components are relatively reliable. Some are electromechanical devices, which operate at high rates of speed. These devices have a higher failure rate. All devices, electronic or electromechanical, are subject to failure after prolonged use. Electronic failures are normally due to electrical overloads or heat. Mechanical failures are normally due to breakage, wear, or misadjustments.

There are two categories of TACFIRE equipment failures:

- *System failure* is when a component fails and the computer cannot perform ADP functions.

- *Device failure* is when a device fails, but the computer can continue to function as operators reconfigure the system to operate without the failed device. This is operation in what is called a degraded mode.

TACFIRE features a variety of maintenance and diagnostic (M&D) programs. They monitor equipment and help isolate failures throughout the computer and peripheral devices. These programs are discussed in some detail in Chapter 6, Section II. In addition to these programs, maintenance personnel use M&D routines, called self-tests, that are built into most peripheral devices.

The modular concept of the components used in TACFIRE simplifies the maintainability of the system in the field. The circuitry of each component of electronic equipment uses integrated circuit cards. Once the maintenance personnel isolate the fault, they can replace the circuit card(s), or the whole component, as required.

Operator maintenance is basically limited to changing light bulbs and keeping the components clean. All school-trained primary operators of TACFIRE are qualified as organizational maintenance personnel and are trained to repair 90 percent of component failures within 30 to 45 minutes. Direct support (DS) maintenance normally provides contact teams who can troubleshoot and replace components in field locations.

ORGANIZATIONAL MAINTENANCE

TACFIRE organizational maintenance personnel are authorized to repair the major components of the computer by replacing lamps, power supplies (DC/DC converters), and circuit cards. Troubleshooting the computer group is unlike troubleshooting other electronic equipment. This is because of the vast amount of circuitry involved, the number of signals generated at a given time,

and the high rate of speed at which the computer operates. Normal organizational maintenance repair time is 30 to 45 minutes.

TACFIRE EQUIPMENT SPECIALIST

Operator/organizational maintenance requires a total team effort where all crew members are involved. One crewman is referred to as the TACFIRE equipment specialist (TES). The TES, a trained operator, also—

- Monitors system operation.
- Helps detect and isolate equipment faults.
- Isolates and replaces faulty digital and analog circuit cards by using the module test set.
- Helps reconfigure the FDC into the degraded mode as required.
- Performs required preventive maintenance (PM) on TACFIRE components.
- Keeps records and reports on status of TACFIRE components.
- Maintains the mission-essential parts (MEP).
- Operates and maintains the communication control unit.

The above-mentioned duties are not specifically assigned to the TES. All school-trained crew members are qualified to perform all TACFIRE operator duty positions and operator/organizational maintenance tasks and functions.

REFERENCE

TM 11-7440-242-23-1 lists the maintenance operations covered in the equipment manuals for TACFIRE. It authorizes categories of maintenance for specific functions on repairable items and components and the tools and equipment required to perform each function.

TOOLS, EQUIPMENT, AND SUPPLIES

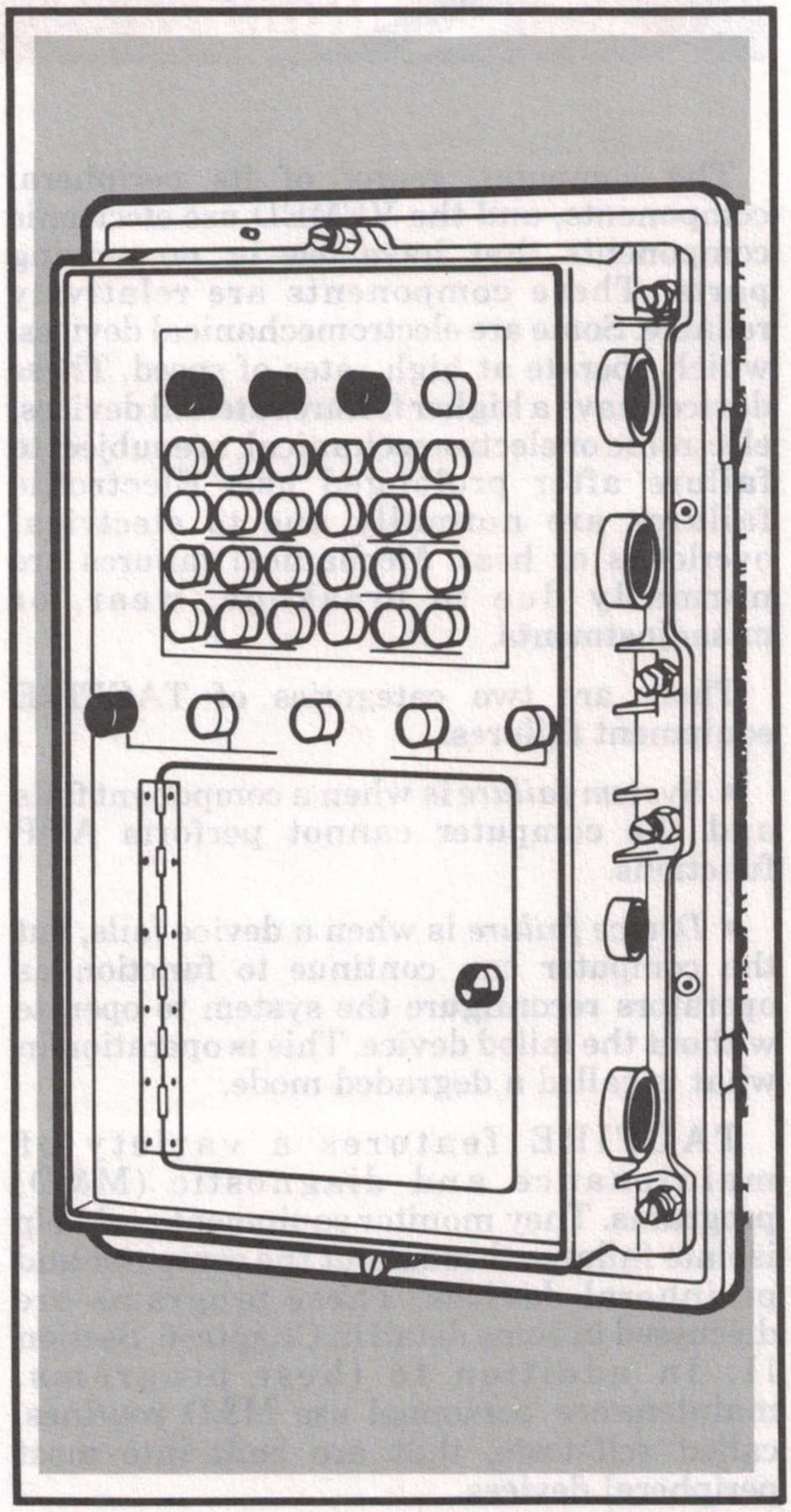
Tool Kits. The TACFIRE organizational maintenance personnel are authorized three tool kits:

- The *TK-101/G* contains basically screwdrivers, pliers, wrenches, and a soldering iron.
- The *TK-223* is basically a socket set.
- The *TK-225* is basically a wrench set and cleaning equipment.

TM 11-7440-242-23-1, Table 3-1, lists each tool, its description, its national stock number (NSN), and the tool kit to which it is assigned.

Module Test Set. A module test set AN/GSM-208 is provided for each TACFIRE computer. The MTS is a test instrument used for troubleshooting circuit cards. It was discussed in more detail in Chapter 1.

MODULE TEST SET



Maintenance Supplies. TM 11-7440-242-23-1, Table 3-2, lists materials used for general maintenance functions by the operator and organizational maintenance personnel. These materials are an addition to tool kit TK-225.

MISSION-ESSENTIAL PARTS

Storage. Mission-essential parts (repair parts) and expendable parts are stored in various storage containers inside the shelters. TM 11-7440-242-23-1, Figures 3-6, 3-7, and 3-8, show the storage locations of these containers. Maintenance personnel should check the contents of these containers often to prevent possible shortages.

Usage. The operator/mechanic is authorized to use only certain MEP items. Refer to the maintenance allocation chart in TM 11-7440-242-23-1, Appendix B, for specific authorizations.

Parts Listing. TM 11-7440-242-23-1, Table 3-3, lists each mission-essential part, part number, type, quantity, and the container in which it is stored.

Lamp Listing. TM 11-7440-242-23-1, Tables 3-12 and 3-13, list the part number and quantity of each indicator lamp used in battalion and div arty type computers.

Part Numbers. TM 11-7440-242-23P, Section IV, gives a national part number and part number index that maintenance personnel use for identifying and ordering parts.

CORRECTIVE MAINTENANCE

TM 11-7440-240(241)-10-10, Chapter 13, Section III, explains how maintenance personnel detect and localize faults.

The M&D test programs are immediately available, when called for by the operator, for testing peripheral equipment. When a fault is detected, the operator isolates the failure to a device, power supply, cable, group of circuit cards, or specific circuit card. He does this by using the system reference number in a fault catalog for the failed component.

After preparing the failed component, the repairer connects the MTS to the failed device and tests those cards designated in the fault catalog for that device.

When he determines that a card is faulty, the operator removes the faulty card, draws a replacement card from the MEP, tests the replacement card with the MTS, and inserts the card into the applicable card slot. The operator again tests the replacement card "in system." When all faulty circuit cards have been replaced in the failed device, the system should be ready to resume normal operation.

The operator records all failures on the appropriate maintenance form.

PREVENTIVE MAINTENANCE

TM 11-7440-240(241)-10-10, Chapter 13, Section II, describes the PM procedures for TACFIRE. Tables 13-4 and 13-6 describe the PM checks and the intervals at which the checks are made.

POWER PLANT MAINTENANCE

Light wheeled vehicle/power generator mechanics (MOSC 63B10) perform organizational-level maintenance on the AN/MJQ-15 power plant.

VFMED MAINTENANCE

When a component fails on a VFMED, personnel must take it to the nearest computer center for diagnostic testing on the MTS and subsequent repair or replacement.

FIST DMD MAINTENANCE

Division support command (DISCOM) and/or corps support command (COSCOM) maintenance units support the FIST DMD for DS maintenance. The DS units may be required to perform organizational maintenance on the FIST DMD if it is beyond the capability of the maneuver unit to which the FIST is attached. Maintenance at the DS level consists of:

- Replacing knobs, connector dust covers, switch boots, interconnecting cables, ventilating screens, and valve assemblies.
- Isolating faults to a replaceable assembly level (board).
- Testing and repairing interconnecting cables.
- Repairing the FIST DMD carrying case and associated hardware.

Testing equipment/tools consist of the AN/USM-223 multimeter, the TK-105/G and TK-101/G tool kits, and the special purpose socket needed to open the case.

DIRECT SUPPORT MAINTENANCE

The DS maintenance concept is slightly different in the DISCOM and the COSCOM in terms of organization, but the functions are the same. The repair personnel (MOS 34Y and 34L) repair the TACFIRE computer and peripheral devices, battery computer systems, VFMEDs, DMDs, and various other systems. They use a mobile maintenance facility, an AN/TSM-141 van equipped with a battalion TACFIRE computer center and diagnostic equipment. Typically, three 34Y and two 34L repair personnel, called a maintenance support team (MST), work in the mobile maintenance facility. Two-man (one 34Y and one 34L) contact teams with 5/4-ton trucks augment each MST. These contact teams do not carry diagnostic equipment with them. Normally, when a computer center requests DS maintenance support in the field, the contact team picks up float components from the MST, exchanges and installs the failed components, and takes the failed components back to the MST for repair. The MST repairs TACFIRE equipment in accordance with the priorities set by the senior maintenance officer or TACFIRE maintenance warrant officer of the artillery unit.

DIVISION SUPPORT COMMAND

Divisional TACFIRE DS maintenance is composed of two elements: the light maintenance company and three forward support companies of the direct support maintenance (DSM) battalion. Each forward support company has one contact team, called a forward support team (FST). Each FST normally locates near a DS battalion center. Each light maintenance company has an MST equipped with one mobile maintenance facility. The MST normally locates near the div arty computer center. To provide centralized control of service, some DSM battalions consolidate their FSTs with the MST.

CORPS SUPPORT COMMAND

TACFIRE DS maintenance at COSCOM operates under a less defined concept than at DISCOM. The contact teams and MSTs are consolidated in the light maintenance company of the DSM battalion in the COSCOM. The light maintenance company has a single MST with a mobile maintenance facility, regardless of the number of FA brigades assigned to corps. The MST normally locates near the corps artillery computer center. The number of contact teams depends on the total number of computer centers assigned to corps artillery. When an FA brigade reinforces a division or is general support to corps, the COSCOM provides DS maintenance support. When an FA brigade is attached to a division, the DISCOM provides DS maintenance support to the FA brigade as well as the div arty.

GENERAL SUPPORT MAINTENANCE

Repair of printed circuit cards and modules is performed at the light equipment maintenance company (GS) by use of the AN/MSM-105(V)1.

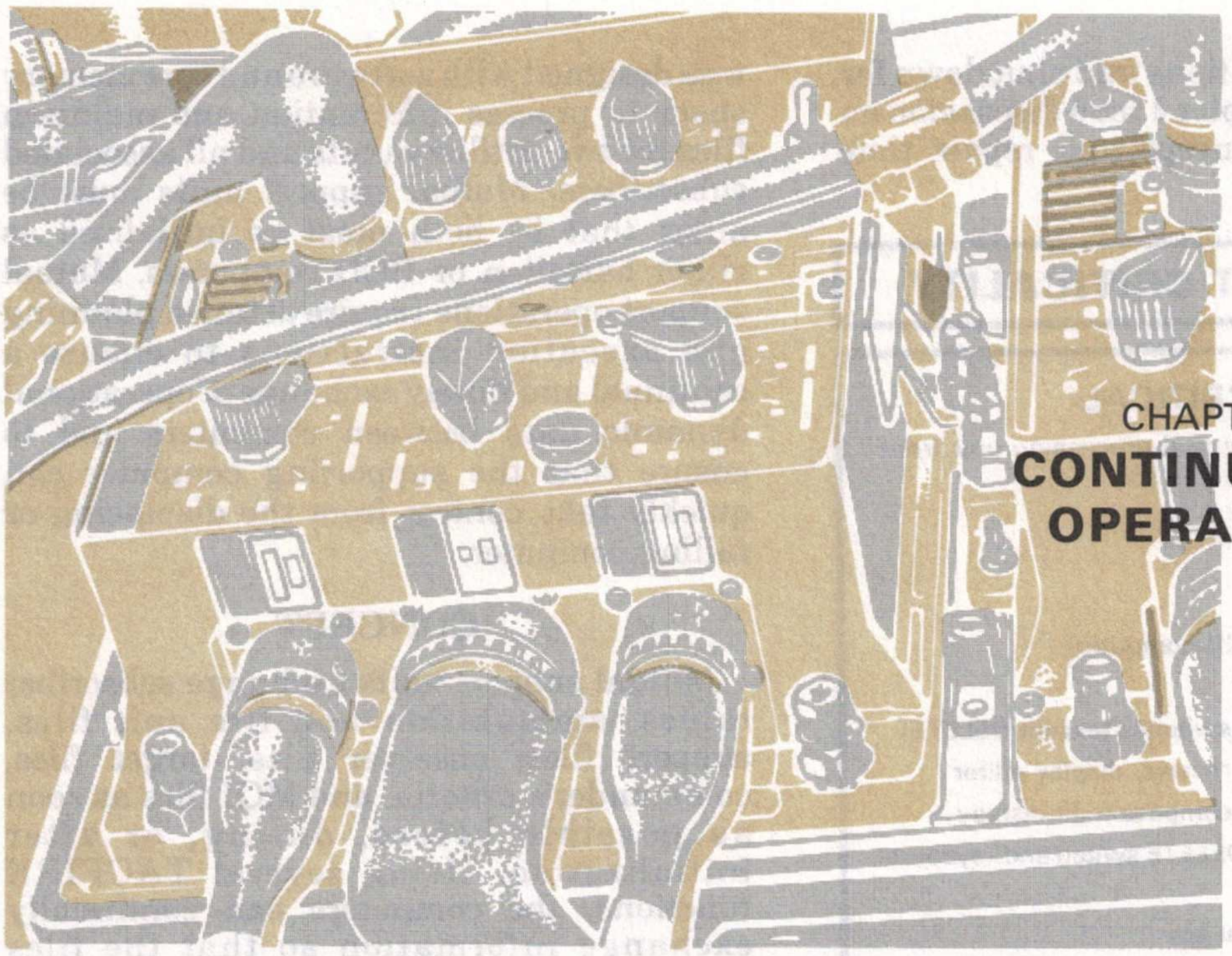
DEPOT MAINTENANCE

Tobyhanna Army Depot (TOAD) is the repair and overhaul depot for TACFIRE. This includes repair to major components, circuit cards, modules, and cables.

> **NOTE.** *All MCMUs being returned to depot must be returned via armed forces courier service.*

TECHNICAL ASSISTANCE

Technical assistance to divisional/ nondivisional units is provided by an electronic equipment representative through the logistic assistance office located in the theater or CONUS regional offices in accordance with AR 700-4.



CHAPTER 5

CONTINUITY OF OPERATIONS

When a component in the TACFIRE computer fails, there is a series of backup means that enables TACFIRE to continue operations. When a noncritical component fails, operators can reconfigure the system and continue operations in a degraded mode. If a critical component fails, resulting in a total system failure, or if a computer shuts down to displace to a new position, a mutual support computer can provide ADP support to the failed/displaced computer subscribers. This mutual support capability ensures continuous command and control and operational continuity for the fire support system.

If a computer fails or displaces and mutual support operations are not possible, all subscribers must revert to manual or organic ADP command and control methods until the computer again resumes control. A battalion computer may fail or displace when there is no mutual support available. Then the commander/S3 can either direct the digital subscribers to conduct operations by voice or direct them to communicate directly with the firing units until the computer is operational. The backups to the BCS include the backup computer system (BUCS), standard Army calculators, and manual methods.

ALTERNATE MODE CONFIGURATIONS

TACFIRE can operate indefinitely when certain components are not operational. Depending on the nature of the nonoperational device, operators can reconfigure cabling and programing so that TACFIRE continues to operate without it in an alternate (or degraded) mode. In the following table, those components listed as noncritical can fail without system failure resulting. If any of the critical components fails, total system failure is nearly always the result.

If a device fails and causes a total system failure, computer personnel must immediately initiate mutual support by notifying the MSU, and, if necessary, all subscribers. A combination of noncritical components may fail to the extent that the computer barely meets, or cannot meet, mission requirements. Then the operations officer or FDO must decide whether to continue in a degraded mode or to start

mutual support operations and shut down for repairs. Refer to Chapter 4 for a discussion on the maintenance concept and repair time parameters.

COMPONENT CRITICALITY

NONCRITICAL

Input/output unit and central processing unit front panel indicators
Data exchange channel
Magnetic tape cartridge
Magnetic tape unit 1
Magnetic tape unit 2 (BCD computer)
Digital plotter map
Artillery control console switches (except DELETE)
Artillery control console receive/display editor
Artillery control console compose/edit display
Artillery control console DELETE switch and keyboard
COMSEC interface
Communications terminal box
Communications junction box (BCD computer)
System power
Digital data terminal
Communication control unit
Electronic line printer 1 (BCD computer)
Electronic line printer 2
Mass core memory unit (battalion computer)
Electronic tactical display (BCD computer)

CRITICAL

Mass core memory unit (if more than one on battalion type computer)
Mass core memory unit (one or more on BCD computer)
Central processing unit (complete failure)
Input/output unit power supplies
Input/output unit (complete failure)
Power converter group (complete failure)
Artillery control console (common logic)
Artillery control console (complete failure)
Artillery control console (computer action and DELETE)
Cables (those that affect computer or artillery control console operability)

MUTUAL SUPPORT

Mutual support is the term used to describe the method employed to continue operations during normal computer displacement or a total TACFIRE computer failure. TACFIRE was designed with software and core memory space to process information and maintain files for two artillery units and all associated subscribers. Mutual support units must be alike; that is, both must be initialized as either battalion or BCD computers. Mutual support operations require detailed planning and execution instructions to ensure a continual and timely exchange of operational dynamic data between computers and to ensure that the supporting computer can quickly take control from the displacing or failing computer.

CONCEPT

Mutual support units exchange subscriber tables, ammunition and fire unit files, support files, observer files, target files, commander's criteria, and MOI files as soon as possible before, during, or after initialization. Using several TACFIRE functions, the computers can continually exchange information so that the files remain basically identical. To initiate mutual support, the displacing/failing computer operator sends last-minute file information and synchronization data to the MSU, lets the MSU assume control, and shuts down. If the failing computer fails with no warning, the failing computer operator contacts the MSU by voice. The MSU then establishes digital communications with the failed computer subscribers and takes control. To return to normal operations, the displaced/failed computer operator requests the MSU to send all updated file data, to include new met data. After receiving all new data, the displaced/failed battalion resumes control of its subscribers. See Appendix E for standardized mutual support procedures.

COMMAND RELATIONS

Normal command relationships and those tactical relationships inherent in the tactical missions should be preserved as much as possible. Initiation of mutual support diminishes the degree of control that the losing commander has over his organic fire support resources, and the impact of MSU must be considered when organizing for combat. Accordingly, a reinforcing unit, for example, would be a natural choice as MSU for a DS unit. Also, the DS unit would provide the same support for the reinforcing unit.

The corps artillery, division artillery, and FA brigade commanders establish the mutual support relationships in either an SOP or the FA support plan. For discussions of mutual support plan alternatives, refer to Chapters 7, 8, and 9.

MUTUAL SUPPORT PLAN

Because mutual support is a complicated process and can be initiated in many different ways, the S3 at each echelon must plan mutual support activities as part of the FA support plan.

Every tactical SOP should include, as an annex, a mutual support/continuity of operations scheme for assigned/attached TACFIRE-equipped FA units. This SOP should contain a sound and definite plan for implementing the mutual support plan.

While specific considerations are different at corps artillery, FA brigade, div arty, and battalion levels, basic planning parameters are the same. Planners should plan for all four aspects of mutual support operations:

- Initialization.
- Transfer of dynamic data after initialization.
- Passing control to the MSU.
- Regaining control from the MSU.

Initialization. There are several planning considerations that apply to initialization. Planners should—

- Match MSUs on the basis of tactical missions. Direct support to reinforcing units is the best match. Direct support to direct support has severe limitations because of requirements for communications to the host of subscribers each DS unit has and limited memory space.
- Develop a digital communications net structure based on nets and equipment available. The best solution has the MSUs set up identically but in such a manner that each unit communicates only with its own units until the units initiate mutual support.
- Ensure that the authentication system, to include physical addresses and COMSEC identification codes, does not result in duplication.
- Determine whether communications between MSUs will require directional antennas and/or radio relay.
- Determine how the two mutual support computers will exchange subscriber tables, legal message types, and messages of interest before or during initialization.

Transfer of Dynamic Data. Planners should—

- Determine how the computers will exchange the ammunition and fire unit files, target files, observer files, support files, and commander's criteria.
- Determine how the computers will update changes to stored information, commander's criteria, and communications net assignments.

Passing Control. Planners must consider how mutual support will take place in terms of both scheduled displacements and unscheduled system failures. Planners should—

- Determine how computer operators will notify the MSU to take control.
- Determine how the MSU will confirm notification and establish voice and digital communications with the displacing/failing unit subscribers.

Regaining Control. Planners should—

- Determine how the displaced/failed computer center will reestablish communications with its own operations element VFMED and, subsequently, the MSU.
- Determine how the displaced/failed computer will update its files from those of either the higher headquarters or the MSU computer.
- Determine how the displaced/failed computer will establish communications with all its subscribers and resume full operations.

DISPLACEMENT

There are two ways to power down the TACFIRE computer to prepare for displacement: purge and power down and power down to a move mode.

PURGE AND POWER DOWN

Initiating Mutual Support. In preparing for movement, the computer

operator passes control of the subscriber's ADP support to the designated MSU in accordance with established policies and procedures. If no mutual support exists at battalion level, the commander should decentralize technical fire direction and mission processing control to battery level.

Salvage Point Recording. Before shutdown, operators can make the computer record all current dynamic data onto a blank magnetic tape cartridge. This is called salvage point recording. It is like taking snapshots of the data stored in the computer memories and filing them. The MTC can then be stored for future use. When time permits, operators should make two SPRs to ensure that the computer will reload correctly. When the operator successfully reloads the computer with the SPR, the computer resumes operations with the same data base it had before shutdown.

Purging. Having recorded a nucleus SPR, the operator can purge the computer of classified information in one of two ways. A *selective* purge clears data from one or more components. A *system* purge clears all data from all components. Operators normally start a system purge before displacement. An operator can start purges from either the ACC or the IOU. A system purge initiated at the ACC produces the following sequence of events:

- The system records a nucleus SPR.
- The transaction journal prints out on the ELP.
- The system forwards plain-text messages to all subscribers: "Bn (or div arty) is shutting down" followed by "Bn (or div arty) is off the air."
- The purge continues and results are displayed on the ELP.

Securing Equipment. After the purge, computer center personnel can power down the system and secure all equipment. If personnel are to be inside the shelter during displacement, the shelter door should not be locked and the prime mover tailgate should not be closed to permit exit from the shelter. Personnel should ensure that the shelter door vent is open and the air-conditioner makeup air control is set to maximum to prevent asphyxiation.

POWER DOWN TO A MOVE MODE

Move modes enable computer centers to store messages, general information, and intelligence messages while displacing. Upon reinitializing the system, operators can immediately process the messages in queue into the computer banks. The two move modes at battalion are the message receive/print mode and the message receiver mode. At BCD computers, only the message receiver mode is available. Power during displacement is supplied by the batteries of the S-280 shelter prime mover, supplemented by the 100-amp alternator. The move mode requires up to two radios and two digital data terminals, the ELP, and the CCU. All other components are off.

Receive/Print Mode. This mode allows the battalion computer system to receive and store messages in queue and print messages for operator review. Of the two move modes available at battalion, the receive/print mode is preferred. It enables the battalion computer system to print and store digital messages received so that, upon recovery, the fire direction element is abreast of the current tactical situation.

Message Receiver Mode. This mode allows the battalion and BCD computer systems to receive and store messages in queue. Operators cannot review incoming digital messages while in this mode.

Move Mode Limitations. When the system message segment table reaches 80 percent of its capacity (200 segments), the computer ignores and does not acknowledge messages transmitted from an external subscriber.

At battalion, when no mutual support capability exists, the commander should direct subscribers to operate by voice until the computer is ready to resume normal operations or direct the subscribers to a specific fire unit net and address for fire mission processing.

Setting up for a move mode requires some reconfiguring of cables. Operators must then change back to the original configuration to resume normal operations.

POWER FAILURE

Power failures can be related to different external sources of power and different types of PCG failures. AC power is supplied to each S-280 shelter by two AC generators, or DC power is provided by two prime movers. In general, the power for each shelter is supplied by one AC generator with the second AC generator on standby. The following paragraphs summarize operator actions for conversion to alternate sources of power.

AC GENERATOR FAILURE

When the AC generator that is supplying power fails, the PCG automatically changes to DC power. When the operator knows in advance of AC generator shutdown and another AC generator is available, he should power up the second generator, synchronize it, and place it in parallel with the first generator. He can then shut down and service the first generator.

DC GENERATOR OPERATION

The two battery-supported 100-amp DC alternators, one on each 5-ton truck, provide an alternate power source. The truck engines must run for 30 minutes every 4 hours to recharge the batteries, because the PCG idle current drain (5 amperes) will discharge the batteries. If the truck engines are not running when the AC generator fails, the system will shut down in 5 minutes or less. This is because the current drain quickly lowers the supply voltage to the level at which the system power supplies automatically turn off. If a transition from AC to DC generators is known of in advance, the truck engines should run at 1,150 rpm before transfer to the DC power souce. This engine speed provides even power to the system and keeps the diesel engine from fouling. If the AC power source fails, an operator should turn off the radios and the IOU before starting the vehicle engines.

EMERGENCY POWER

If neither AC nor B-Bus power is available, the computer will not work. The emergency batteries supply power for lighting and internal radios only.

TEMPERATURE RESTRICTIONS

The air conditioner in the S-280 shelter operates only on AC power. Therefore, when AC power is not available or the air conditioner is not operable for other reasons, the temperature inside the shelter can rise to a point that the computer will lock up and not operate until the system is cooled. Lockup can occur at ambient temperatures as low as 75° F. When temperatures inside the shelter reach 110° F, equipment can suffer permanent damage. Therefore, the computer should use DC power only as absolutely necessary.

COMPUTER REACTION TO POWER LOSS

The computer preserves all processing information during a power failure. When the IOU senses a power loss, it instructs the CPU to store all processing data into memories. This process takes place in a fraction of a second before power is completely lost. When the computer regains power, the CPU begins processing where it left off.

STANDARD TACTICAL MISSIONS

Field artillery is controlled not only through command relationships but also through the assignment of standard or nonstandard tactical missions. Tactical missions describe in detail the fire support responsibilities for an FA unit. Tactical missions for TACFIRE-equipped units must be amplified. Two functions are added to the field artillery established mission statements. These functions must always be specified and planned for, since they directly impact on all FA operations for TACFIRE-equipped units. Incorporating them into the inherent responsibilities helps to streamline the FA support plan. These two responsibilities are peculiar to TACFIRE-equipped units and do not apply to STANAG 2887/ Quadripartite Standardization Agreement (QSTAG) 217. They define the most common relationships and situations in terms of mutual support and commander's criteria (COMCRIT). Like the original seven inherent responsibilities, they can be altered by assigning nonstandard tactical missions.

INHERENT RESPONSIBILITIES OF FIELD ARTILLERY MISSIONS

AN FA UNIT WITH A MISSION OF—	DIRECT SUPPORT (DS)	REINFORCING (R)	GENERAL SUPPORT REINFORCING (GSR)	GENERAL SUPPORT (GS)
ANSWERS CALLS FOR FIRE IN PRIORITY FROM—	1. Supported unit 2. Own observers[1] 3. Force FA HQ	1. Reinforced FA 2. Own observers[1] 3. Force FA HQ	1. Force FA HQ 2. Reinforced unit 3. Own observers[1]	1. Force FA HQ 2. Own observers[1]
HAS AS ITS ZONE OF FIRE—	Zone of action of supported unit	Zone of fire of reinforced FA unit	Zone of action of supported unit, to include zone of fire of reinforced FA unit	Zone of action of supported unit
FURNISHES FIRE SUPPORT TEAM (FIST/FSO)[2]—	Provides temporary replacements for casualty losses as required	No requirement	No requirement	No requirement
FURNISHES LIAISON OFFICER—	No requirement	To reinforced FA unit HQ	To reinforced FA unit HQ	No requirement
ESTABLISHES COMMUNICATIONS WITH—	FSOs and supported maneuver HQ	Reinforced FA unit HQ	Reinforced FA unit HQ	No requirement
IS POSITIONED BY—	DS FA unit commander or as ordered by force FA HQ	Reinforced FA unit or as ordered by force FA HQ	Force FA HQ or reinforced FA unit if approved by force FA HQ	Force FA HQ
HAS ITS FIRES PLANNED BY—	Develops own fire plans	Reinforced FA unit HQ	Force FA HQ	Force FA HQ
ESTABLISHES MUTUAL SUPPORT WITH—	Reinforcing (or GSR) unit or as specified by force FA HQ	Reinforced unit or as specified by force FA HQ	Reinforced unit or as specified by force FA HQ	FA unit specified by force FA HQ
HAS ITS COMMANDER'S CRITERIA ESTABLISHED BY—	Develops own COMCRIT to support maneuver commander	Reinforced FA unit	Force FA HQ[3]	Force FA HQ[3]

[1]Includes all target acquisition means not deployed with supported unit (such as radar, aerial observers, and survey parties).

[2]An FSS for each maneuver brigade/battalion/cavalry squadron and one FIST with each maneuver company/ground cavalry troop are trained and deployed by the FA unit authorized these assets by TOE. After deployment, FIST and FSS remain with the supported maneuver unit throughout the conflict.

[3]A GSR or GS unit assuming control of DS unit subscribers during mutual support operations incorporates the DS unit tactical fire control or technical and tactical fire control COMCRIT until the DS unit regains control of its subscribers.

MUTUAL SUPPORT

The communications requirements for mutual support for DS units are the most demanding because of the high density of subscribers in the digital net structure. A DS-to-DS mutual support relationship normally degrades communications responsiveness. A reinforcing (R), general support reinforcing (GSR), or attached unit is the natural choice for mutual support, since the fire or quick-fire channel can also carry the mutual support communications traffic. Also, the command relationships of R and GSR missions complement mutual support operations. When no R or GSR unit is available, the DS unit MSU must be specified in the operation plan (OPLAN) or FA support plan. Selection of the MSU for each general support (GS) unit must be based on the tactical situation and projected future operations.

MUTUAL SUPPORT ALTERNATIVES

An odd number of TACFIRE-equipped units may be attached/organic to a force artillery headquarters. Then one unit (preferably with a GS mission) must be designated as not having a standard mutual support requirement. When this unit fails or displaces, it can pass control of its subordinate units to another unit (as specified by force artillery headquarters). There are several options for passing control. With each option, planners need to specify communications requirements in terms of who will talk to whom on what net.

Option 1. The odd unit establishes a digital link with another computer, sets up a one-way mutual support function by using MOI processing, and keeps the other computer constantly updated on subordinate unit status. When the odd unit computer fails or displaces, the specified unit takes control of the subordinate units until the displacing/failing unit can regain control.

Option 2. The odd unit does not use MOI processing. Immediately before displacement, the odd unit transmits all pertinent data to the specified unit, directs subordinate elements to contact and operate with the specified unit on designated nets, and shuts down.

Option 3. The odd unit does not use the MOI processing and does not transmit data to the specified unit. The odd unit directs the subordinate elements to contact and operate with the specified unit on designated nets. The subordinate elements send all pertinent data to the specified unit immediately after establishing digital communications.

Special Considerations. These three options do not normally interfere with the MSU operations of the specified unit. If the specified unit has control of its MSU elements, a hand-off by the odd unit could make things difficult for all units involved. Therefore, as possible, the force artillery headquarters should carefully orchestrate the hand-off with current mutual support operations.

COMMANDER'S CRITERIA

The fire support coordinator (FSCOORD) at each echelon develops and recommends COMCRIT to support the maneuver commander's requirements. The COMCRIT requirements for fire support by a DS battalion to a maneuver brigade can diverge from the COMCRIT requirements of the div arty to the division. Likewise, COMCRIT requirements can differ even among adjacent maneuver brigades. Therefore, each DS battalion, div arty, and corps artillery develops and recommends its own COMCRIT. A GS or GSR unit uses the COMCRIT specified by force FA HQ. When a GS or GSR unit assumes control of the subscribers of a DS unit, the GS or GSR unit must incorporate the tactical fire control (TFC) or technical and tactical fire control (TTFC) COMCRIT of the DS unit until the DS unit regains control. Reinforcing units use the COMCRIT of the reinforced unit. When a force artillery HQ or DS battalion specifies the COMCRIT for another unit, the computer operator can either program MOI processing to automatically inform the other unit or use the message relay function to pass COMCRIT updates.

SECTION I

OPERATING SYSTEM PROGRAMS

The operating system (OS) manages computer and communications operations. This section describes the operating system in general terms. Specific applications of the programing requirements pertaining to communications software are presented in Chapter 3.

CAPABILITIES

The operating system—

- Controls input, processing, and output of all data, to include error detection and COMSEC functions.
- Allocates memory space for stored data.
- Schedules processing on the basis of a programable priority scheme.
- Maintains system timers.
- Executes digital communications subscriber scheme.
- Automatically initiates some maintenance and diagnostic programs.
- Keeps statistics on the operations of the system.

FUNCTIONS

Operators can influence the parameters of the operating system.

SUBSCRIBER TABLE

The operator uses the subscriber table to—

- Establish the logical subscriber name for each device with which the computer digitally communicates.
- Establish automatic encryption/decryption with subscribers with keying generators.
- Configure subscribers on digital nets.
- Establish automatic relay.
- Identify those subscribers with a target acquisition capability.
- Identify which subscribers are to have full access to the FSE and ATI programs.

LEGAL MESSAGE TYPES

The computer uses the legal message types for input function to define the processing to which subscribers may have access. There is no default value on the master tape.

PRIORITY, CLASSIFICATION, LOGGING, AND DISPLAY

The operator can alter the priority, classification, logging, and display functions of each input format and output report if the default values programed on the field system tape are not suitable to the mission or function performed.

TACFIRE has seven message *priority levels* and maintains a processing queue for each level. Within a level, the computer processes messages on a first-in, first-out basis. An operator, therefore, can tailor computer processing according to the situation and mission by changing message priorities. However, operators and supervisors must use extreme care, since changes can have significant effects on message processing and handling of classified data.

Every input format and output report has one of the following seven *security classifications*: UNCLASSIFIED (UN), ENCRYPT FOR TRANSMISSION ONLY (ETO), CONFIDENTIAL (C), SECRET (S), CONFIDENTIAL-CRYPTO (C&C), SECRET-CRYPTO (S&C), and SECRET RESTRICTED DATA (SRD). An operator can upgrade/downgrade all classifications but C&C and S&C for each message type. Software does not allow CONFIDENTIAL-CRYPTO or SECRET-CRYPTO to be downgraded. Under certain testing or training situations, a commander can choose to downgrade or unclassify most TACFIRE messages.

The *logging function* determines whether the computer will print messages from external subscribers and messages processed by the ACC operator on the ELP.

The *display function* determines whether the computer will display messages from external subscribers on the RDE, the top scope on the ACC. Display YES messages are displayed for operator action. Display NO messages are automatically processed if they are legal for input by the originating agency.

MESSAGE OF INTEREST

The MOI function gives designated subscribers copies of selected messages that are received or processed by the computer. Though the message used to establish the MOI file is called a SYS;FSO message, MOI processing is not limited to fire support officers. Operators can establish MOI processing for any subscriber with a VFMED, TACFIRE computer, or BCS, to include liaison elements, operations elements, targeting elements, fire support sections, and mutual support computers. Each computer can handle up to 12 MOI files. Each MOI file can reference up to 2 zones, 10 observers, and 28 message types.

MASTER PLAN LIST

The master plan list (MPLIST) feature allows the commander and staff to review the number and names of all plans in the system.

PURGE

An operator can purge the total computer system or selected components of classified data. Maintenance personnel should be sure that the operator has selectively purged any equipment that is taken out of the S-280 shelter. Purging operations do not alter the security status of the MCMUs.

TIME SYNCHRONIZATION

An operator can initiate time synchronization with all computers, including BCS, in terms of day/month/year and hour/minute/second. The computer prints the system processing time on each printout.

DATA CHECK

Supervisors can check all operating system data by obtaining a SYS;1201 report.

SECTION II

MAINTENANCE AND DIAGNOSTIC PROGRAMS

The maintenance and diagnostic programs are a comprehensive set of test programs that can recognize an equipment fault and diagnose the cause. These programs detect system faults, isolate the fault, and display the results of numerous tests for human interpretation.

All but two of the M&D programs operate under control of the OS software. They are initiated/controlled by operator/maintenance personnel by options available at the IOU and/or ACC. The two exceptions are programs that are executed at the beginning of a program load (channel 11 load) only.

There are three types of M&D programs included in the software of TACFIRE: loop tests, fault detection tests, and fault isolation tests.

LOOP TEST

A loop test is essentially a continuity (or communications) test that checks to see whether a device that is supposed to be on-line to the computer is actually on-line. There are two types: local loop test and remote loop test. The local loop test checks all peripheral devices that interface with the computer via the input/output channels. The remote loop test checks the communications links to the remote devices, such as VFMEDs, DMDs, and BCSs, as well as to other computers. Neither type of loop test interferes with operations occurring in the system.

FAULT DETECTION TEST

A fault detection test is more comprehensive than a loop test. It determines whether or not a peripheral or computer device has a fault. This test causes minimum interference with operations occurring in the system.

FAULT ISOLATION TEST

A fault isolation test is a very comprehensive test that an operator can run

on a device that has failed a fault detection test or is known to be failing. This test localizes a failure to a small group of field-replaceable components. It is the most thorough of all the tests and completely inhibits a device from any other operation during the test.

DISPLAY OF TEST RESULTS

TACFIRE displays the results of M&D program tests in one to three places: always on the front panel of the CPU and, depending on the circumstances under which the tests are being run and the results of those tests, on the receive/display scope of the artillery control console and/or on the electronic line printer.

SECTION III

APPLICATIONS PROGRAMS

The applications programs are a set of seven major groups of software functions that store, retrieve, and process tactical and technical data. The programs are based on doctrinal FA processing techniques and use logic flows very similar to manual methods. Many of the programs enable the maneuver or artillery commander to tailor the computer solution to satisfy his individual desires based on the tactical situation, the state of training and morale, and other intangibles on the modern battlefield. These provisions are called commander's criteria. They are discussed in relation to each program in this section as well as in Chapter 1.

Applications programs automate many manual command and control functions. Some of the programs are common to both battalion and BCD computers; some are not.

When working on-line with a BCD computer, the battalion computer centers can use the BCD computer expanded target file and portions of the artillery target intelligence (ATI) file to increase their fire planning capabilities.

TACTICAL DATA BASE

The first three programs, support (SPRT), ammunition and fire unit (AFU), and meteorological (MET), comprise the tactical data base (TDB). The TDB stores base information that feeds dynamic tactical information to the other programs as they calculate data. Sources for the tactical data base include OPORDs, OPLANs, FA support plans, executive officer (XO) reports, met stations, SOPs, operations elements, and fire support elements.

SUPPORT PROGRAM

The support function stores, maintains, retrieves, and/or transmits data for use by other programs. This includes DPM orientation data, zones of responsibility, battlefield geometry, fire support coordinating measures, and (at BCD computers only) the weapons descriptor file. This program warns operators of fire support coordination violations, plots data on the DPM and the ETD, and enables subscribers and operators to use short grid coordinates when operating within a defined area of interest. Users may add, change, or delete data as needed.

MAP MODIFICATION

An operator defines a map modification (MAP MOD) for the computer software. The

MAP MOD specifies a geographic area, called an area of interest/operations, in which the computer and its subscribers operate. The operator specifies the MAP MOD spheroid, grid zone(s), and coordinates. The MAP MOD at corps encompasses an area of 299,999 by 299,999 meters. At the other echelons, this area is 99,999 by 99,999 meters. The boundaries of this area must parallel the military grid system (MGS) grid lines. When referring to locations within the 99,999-meter-square MAP MOD, subscribers and operators can drop the higher order digits in grid locations.

EXAMPLE:
An FO reporting a target within the MAP MOD can drop the sixth significant digit (5 in 543644) for easting and the sixth and seventh significant digits (38 in 3870063) for northing. Thus, he would transmit only grid 4364470063.

If a subscriber or operator enters a grid outside the MAP MOD, he must enter the higher order grid digits. At corps, with the 299,999- by 299,999-meter MAP MOD, full universal transverse mercator (UTM) grid coordinates, to include grid zones, are required.

APPLICATIONS PROGRAMS

BATTALION COMPUTER

Support (battlefield geometry data)	(SPRT)
Ammunition and fire unit	(AFU)
Meteorological	(MET)
Technical and tactical fire control	(TTFC or FM)
Nonnuclear fire planning	(NNFP)

BCD COMPUTER

Support	(SPRT)
Ammunition and fire unit	(AFU)
Meteorological	(MET)
Tactical fire control	(TFC or FM)
Nonnuclear fire planning	(NNFP)
Artillery target intelligence	(ATI)
Fire support element	(FSE)

DIGITAL PLOTTER MAP ORIENTATION

To align and orient the DPM, an operator defines the four corners of the map as mounted on the DPM. He starts in the lower left-hand corner and works in a clockwise direction. The ETD automatically orients on the same data. The orientation procedure defines the scale of the map; the DPM will accept any scale of map.

ZONES OF RESPONSIBILITY

Operators specify zones of responsibilities (ZNE) as closed areas defined by up to 30 points. They assign a name to each zone. Fire support sections transmit to a computer the ZNEs established by the commander for subordinate units.

AIRSPACE COORDINATION AREAS

TACFIRE regards an airspace coordination area (ACA) as a three-dimensional area suspended in space. The ACA impacts only on battalion-level technical fire control processing. If a technical fire control solution violates an ACA, the computer tries other charges and recalculates the mission. The computer does not try high angle in this situation. If the battalion cannot avoid violating an ACA, the computer generates a warning message with the fire commands. BCD computers store ACAs but do not consider them during tactical fire control, since div arty does not generate a ballistic trajectory. ACAs are identified by using the two letters of the establishing agency target block and the numerical designation (1-9) of the ACA.

EXAMPLE:

NAME: ACA#BB

ACA = Airspace coordination area
# = Numerical designation of the ACA (1-9)
BB = Target block designation of establishing agency

BATTLEFIELD GEOMETRY

The support program stores fire support coordinating measures to facilitate rapid coordination and to safeguard friendly troops and installations. When other applications programs access battlefield geometry measures and determine that there is a violation, the computer produces warning

messages to alert the operator to initiate coordination.

Forward Line of Own Troops. The FLOT is specified by at least two points, designated from left to right, facing the enemy. Normally, forward observers send their FLOTs to the FISTs. The FISTs consolidate them and send them to the battalion FSOs. The FSOs consolidate them and use their VFMEDs to transmit them to the battalion computer. Violations of the FLOT will not inhibit processing or cause the output of error/warning messages.

Coordinated Fire Line. The CFL is specified by 2 to 30 points, designated from left to right, facing the enemy. A battalion computer can store one CFL, while a BCD computer can store five. The commander of a brigade or comparable size maneuver unit selects or approves the CFL for his zone. The brigade FSS uses its VFMED to transmit the CFL to the battalion computer.

Restrictive Fire Line. The RFL is specified by at least two points. The fire support section of the commander common to the converging forces uses its VFMED to transmit the RFL to the computer.

Restrictive Fire Area. Restrictive fire areas (RFAs) relate to four coordination areas: free-fire area (FFA), no-fire area (NFA), restrictive fire area, and family of scatterable mines (FASCAM) safety zone (SFZ). An RFA is specified as a closed area by 1 point with a radius forming a circle or by 3 to 12 points defining an irregular area. A VFMED can transmit an RFA to a computer. The name of the measure must be specified in accordance with Appendix B to differentiate among the various areas.

Dead Space Area. A dead space area (DSA) is specified by a minimum of three points. Battery fire direction officers use a BCS to transmit their DSAs to TACFIRE. The TACFIRE computer associates each DSA by name and fire unit and considers each DSA during tactical fire control processing and nuclear and chemical target analyses.

Damage Avoidance Area. A damage avoidance area (DAA) is specified as a closed area by 1 point with a radius forming a circle or by 3 to 30 points defining an irregular area. Division FSEs use the VFMED to transmit the DAAs to the div arty computer. With each DAA, the FSE associates one or more of six standard damage categories and a commander's level of assurance for damage avoidance.

Chemical Hazard Area. A chemical hazard area (CHA) is specified as a closed area described by either one point with a radius forming a circle or five points forming a standard downwind hazard area. Division FSEs use the VFMED to transmit the CHAs to the div arty computer.

Fire Support Coordination Line. The fire support coordination line (FSCL) is specified as a series of points from left to right, facing the enemy. The div arty operations element or the division FSE uses its VFMED to transmit the FSCL to the div arty computer.

TRANSFER OF GEOMETRY DATA

When planning for future operations or creating a fire plan, operators may transfer current geometry data or geometry data already established in another plan to a new plan.

WEAPONS DESCRIPTOR FILE

The support program provides BCD computers with a weapons descriptor file. It contains data on all types of US Army, Navy, Marine, and Air Force fire support delivery means. The weapons descriptor file is on the BCD field system tape, stored in the support files, and used by the TFC and FSE applications programs.

SURVEY

The support program provides the battalion and FDC computers the capability to store, retrieve, and transmit survey control points (SCPs), which are stored in the survey control file. Survey control points may be retrieved by using the SCP name, an area search, or a file search. Survey control points extracted are automatically printed on the ELP.

USER COMMANDS

The support program provides commands that allow users to direct the computer to print data on the ELP, show data on the DPM, display data on the ETD, or transmit data to remote subscribers. Users can verify new or revised data by reviewing the results produced by these commands.

DIGITAL PLOTTER MAP

The DPM can produce copies of battlefield geometry, fire unit locations and range fans, and target locations on tactical overlays for use by other elements. This capability is particularly useful at BCD computers. Since the DPM at battalion automatically plots each fire mission target as the computer receives it, most battalions do not tie up the DPM to make tactical situation overlays unless the battlefield is quiet.

AMMUNITION AND FIRE UNIT PROGRAM

The AFU program stores, maintains, retrieves, and transmits fire unit information. Fire units (FUs) include tactical air (TACAIR), naval, rocket, cannon, and missile units. TACFIRE software contains only generic "air" AFU processing capabilities in which output will be sorties available instead of specific air units, munitions, and so forth. The nonnuclear fire planning (NNFP) program, TTFC programs, and FSE program use AFU data during processing. The AFU program also provides situation reports (SITREP).

DATA BASE

Users have two types of AFU files available: current and planning. All files can contain the same types of information and descriptive data for each fire unit. These data include FU name, location, strength, average muzzle velocity, mission, ammunition inventory, and ammunition restrictions. Also, the program monitors ammunition levels for the purpose of alerting the user when the fire unit has exceeded the controlled supply rate (CSR) and critical ammunition levels. Current files reflect current operational status. Planning files enable the user to establish a data base for planning for future operations. They are particularly useful in advanced fire planning.

SOFTWARE DIFFERENCES

Battalion and BCD computers differ slightly in the types of FU data stored.

The *battalion computer* stores technical data for each fire unit, to include:

- Weapon model.
- Tactical mission.
- Zone of responsibility.
- Unit reinforcing or supporting.
- Weapon strength.
- Azimuth of fire.
- Referred deflection.
- Minimum and maximum ranges.
- Maximum elevation.
- Traverse limits.
- Maximum and sustained rates of fire.
- Powder temperature.
- Reaction time.
- Radiation status.

The *BCD computer* stores only data that apply to tactical fire control functions. Also, BCD software refers to the weapons descriptor file (SPRT program) for data pertinent to weapon systems related to tactical fire control that are not contained in its AFU file, such as range.

AMMUNITION

The AFU program in battalion keeps account of receipt, expenditure, and inventory of all ammunition of each fire unit, to include fuzes, powder, and projectiles by standard odd lots and quantity. At BCD computers, the AFU program maintains for each fire unit an inventory of projectiles and fuzes only.

MISSILE AND ROCKET UNITS

The AFU program can keep track of tactical data of missile and rocket units down to launcher level. This function is at BCD computers only.

CRITICAL AMMUNITION LEVEL

The AFU program can monitor ammunition levels. It produces a warning message when the quantity of a specified shell falls below a specified level.

AVAILABLE SUPPLY RATE

The TACFIRE available supply rate (ASR) function is similar to the controlled supply rate. The ASR refers to the number of projectiles, expressed in rounds per day per *fire unit,* that can be fired during a specified period. When the fire unit exceeds its ASR, the computer generates a warning message. A user can establish an ASR by fire unit or by weapon caliber. Since the CSR expresses the number of rounds to fire per *tube* per day,

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users must convert the CSR to an ASR, expressing the number of rounds to fire *per unit* per day. ASR may not be entered by type of rounds, only by total number of rounds per fire unit per day.

MASK DATA

Fire unit mask data impact on technical fire control solutions only. BCD computer tactical fire control solutions do not consider mask data, since they do not generate ballistic trajectories. If a technical fire control solution violates the FU mask data, the computer will recalculate using a lower charge. The result is a higher quadrant elevation. If all low-angle solutions are unsafe, the computer will recalculate using a high-angle solution. A user can associate up to eight masks for each fire unit. The computer does not display mask data on the DPM or ETD.

MUZZLE VELOCITY

TACFIRE can store one battery average muzzle velocity for each shell family, powder lot, and charge number. When it is not stored, the computer uses standard muzzle velocity. Since the BCS does not compute average battery muzzle velocity data, the battery FDO must compute the data manually and forward it through the BCS to TACFIRE.

NONNUCLEAR MISSION FIRED REPORT

The computer automatically generates a nonnuclear mission fired report (AFU;MFR) message following a completed nonnuclear fire mission. It reports and records ammunition expenditures and ATI data. The operator can change the AFU;MFR data before processing it if the actual number or type of rounds fired differs from what the computer expected. When the operator processes the AFU;MFR, the computer updates its ammunition files and checks to see if any critical ammunition levels or the ASR (CSR) was exceeded. Also, the computer transmits the AFU;MFR data to div arty (or FA brigade) and the mutual support unit to update their ammunition data bases and target files.

NUCLEAR MISSION FIRED REPORT

The nuclear mission fired report (AFU;MFN) is functionally identical to the AFU;MFR. However, since it reports the use of a nuclear weapon, the AFU;MFN is classified as SECRET RESTRICTED DATA.

REGISTRATION DATA

Battalion computers calculate and maintain 27 sets of registration data for each fire unit, up to a maximum of 120 registrations. When parameters are appropriate, these registration corrections can be transferred between FUs by the transmission of one message per registration.

FIRE PLANNING

When planning for future operations or creating a fire plan, users can transfer current ammunition and/or fire unit data, or data established in another plan, to a new plan. Alternatively, a user can plan fires from scratch.

USER COMMANDS

Through the AFU program, user commands can direct the computer to retrieve data on the ELP, draw data on the DPM, display data on the ETD, transmit data to subscribers, or edit AFU data in file.

OUTPUT REPORTS

The AFU program provides a series of output reports that users can use to verify data or to update and maintain charts, maps, and so forth. These output reports include FU data, ammunition data, muzzle velocity data, mask data, and registration data pertaining to a specific fire unit.

METEOROLOGICAL PROGRAM

The MET program stores, maintains, retrieves, and transmits computer, fallout, and forecast mets. The MET program is used by the TTFC programs in fire mission processing and by the FSE programs in nuclear and chemical target analyses.

STANDARD MET

When a user does not use a current computer met, the computer uses standard computer met data based on the standard International Civil Aviation Organization (ICAO) atmosphere. Even with a current met stored, a user can opt to use standard met.

COMPUTER MET

Battalion computer TTFC programs use computer met to compute the ballistic

solution. This is the only met stored at battalion level. The BCD computer stores the computer met for dissemination purposes, but it does not use it for processing any div arty type programs. The message format follows the STANAG 4082 27-line met format.

FALLOUT MET

The FSE programs use a fallout met to compute chemical hazard areas and fallout predictions. Battalion computers can receive, compose, and transmit fallout mets but cannot store them.

FORECAST MET

If a current fallout met is not available or current, the FSE programs can use a forecast met to produce fallout prediction or chemical hazard areas. The BCD computer can store up to six forecast mets. If users store both current fallout and forecast mets in the computer, the FSE program will draw on the fallout met to produce fallout prediction. If there is not a current fallout or forecast met stored in the computer, the FSE program will not produce a fallout prediction. Instead, it will generate a warning message specifying the problem. Battalion computers can receive, compose, and transmit forecast mets but not store them. The forecast met is obtained from the US Air Force.

USER COMMANDS

The MET program provides commands that enable users to direct the computer to print met data on the ELP or transmit data to subscribers. Users can update or delete met data at any time.

FIRE MISSION PROCESSING

TACFIRE fire mission (FM) processing programs draw on commander's criteria, AFU data, met data, and battlefield geometry (SPRT) data when generating tactical and technical fire control recommendations and solutions. The computer generates these solutions in the form of fire orders or fire commands, which the operator can transmit to subordinate elements.

TACTICAL FIRE CONTROL

The TFC programs automate manual tactical fire control procedures. The computer analyzes the target in accordance with commander's criteria and/or JMEM values to determine the volume of fire and type of munitions necessary to defeat the target. It then examines FU capabilities to select the unit(s) to fire. Selection is based on minimum and maximum ranges, traverse limits, ammunition status, weapon capabilities, recency of fire mission assignment, zone of responsibility, tactical mission, and so forth. The TFC program also evaluates the target in respect to most fire support coordinating measures and warns the computer operator when the target location violates one or more measures. BCD computers use TFC programs to select one or more battalions to fire and to generate fire orders for the operator to transmit to them. BCD computers generate fire-for-effect (FFE) mission solutions only. Battalion computers use slightly different TFC programs in conjunction with technical fire control programs to compute fire orders for firing batteries and to process the full spectrum of FM requirements.

TECHNICAL FIRE CONTROL

Technical fire control programs are used in conjunction with tactical fire control programs at battalion level only. These programs are best described as a single group, called technical and tactical fire control. The battalion technical fire control functions automate computation of the fire mission ballistic solution for each unit firing the mission. The battalion TTFC solution contains elements of both a fire order and fire commands. The TTFC program considers violations of fire unit mask and airspace coordination areas during technical fire control processing. TACFIRE processing is limited to battery center to target center using average muzzle velocity for the battery.

BATTALION FIRE MISSION PROCESSING

A DS battalion normally receives calls for fire from FISTs, battalion and brigade FSSs, attached or operational control (OPCON) radars, attached or OPCON FAAOs, and div arty HQ. Other FA battalions receive calls for fire in accordance with their command relationship and tactical missions. Nondivisional battalions receive calls for fire from force artillery HQ, reinforced DS battalions, attached or OPCON radars and FAAOs, and other assets as available. The

following outlines a DS battalion computer FM processing sequence.

Fire Request Receipt. When the computer receives a subscriber's request for fire, it begins processing without operator action (FM;RFAF, display NO). The computer first checks the legality of the message. Then it checks the message for syntax errors, proper authentication, and format. If the fire mission request fails these checks, the computer stops processing the mission and displays it with an error message for the operator.

Target Plot. When the fire request successfully passes the syntax and subscriber checks, the DPM dot plots the target.

Message of Interest. Almost simultaneously, the computer transmits all messages of interest to other subscribers, particularly the battalion fire support sections, informing them that the mission is in progress.

Mission Processing. After the computer processes the mission, it displays its recommended solution on the RDE for the artillery control console operator (ACCO) and on the ELP for the FDO. The recommendation includes the original request for fire, the FM;5205 error and warning report (listing AFU warnings, fire support coordinating measure violations, and other ballistic computation problems), fire commands, the message to observer, and computer-generated requests for additional fire for FFE missions to a reinforcing battalion and/or force artillery HQ. After reviewing the results, the FDO can direct the ACCO to either recompute the mission using different parameters or transmit the fire orders, message to observer, and/or request for additional fire to the respective subscribers.

Delivery of Fires. Each battery FDC uses the BCS to receive the fire orders, to recompute the fire mission to obtain individual piece fire commands, and to command the guns to fire. The BCS sends SHOT and SPLASH messages directly to the DMD.

Subsequent Corrections. The battalion computer has two modes for processing subsequent corrections. The *automatic* mode automatically processes subsequent corrections and transmits them to the batteries without operator action if no error and warning messages are generated. When entering the FFE phase, the computer inhibits the automatic mode and displays the fire commands for the ACCO and FDO to review and transmit. The *display* mode requires the ACCO to review and transmit the fire commands for each subsequent correction.

Fire for Effect. When entering the FFE phase after adjustments, the computer transmits requests for additional fire to the reinforcing battalion and/or force artillery HQ if the assets of the battalion cannot defeat the target.

End of Mission. When the originating agency or FDO ends the mission, the computer transmits an end of mission to all subscribers involved in the mission. It also generates a mission fired report (MFR). After the ACCO reviews the report for accuracy, he processes it. The computer updates its own AFU files and target files as required. Then it transmits an MFR to force artillery HQ, the reinforcing battalion, and/or the MSU to update their files.

BCD COMPUTER FIRE MISSION PROCESSING

A div arty normally receives calls for fire from division FSEs, subordinate battalions, FAAOs, and radars. An FA brigade receives calls for fire from force FA headquarters, FAAOs, subordinate battalions, and other assets as available. Fire mission processing at div arty level is relatively simple and differs from battalion processing in several important ways:

- BCD computers process FFE missions only.
- They do not generate messages to observers.
- They generate tactical fire control solutions to determine the battalion(s) to fire. They do not generate technical fire control solutions. These tactical solutions are then transmitted to the battalions as fire orders.
- The ACCO normally ends the mission by processing the MFR received from the battalion(s) firing the mission. The computer uses the MFR to update its AFU and target files.

BATTALION TECHNICAL AND TACTICAL FIRE CONTROL PROGRAM

A TACFIRE computer loaded with a battalion field system tape can generate tactical and technical fire control (TTFC) solutions for fire requests received from any legal subscriber. The following paragraphs summarize the capabilities and limitations of the TTFC program.

TACTICAL FIRE CONTROL CONSIDERATIONS

The tactical fire control function determines the best shell, fuze, fire unit(s), and volume of fire to attack the target. The program draws the attack criteria from commander's criteria and JMEM data.

Target Location. Observers can specify target location by the grid, shift from a known point, or polar plot method. The computer converts all entries to 10-place grid coordinates. The TFC program compares the target to all fire support coordinating measures stored in the SPRT programs except ACAs and FU masks. If the target violates a fire support coordinating measure, the computer generates a warning message. The operator reviews the message and, if necessary, initiates coordination. The computer does not select a fire unit to attack a target if the target lies in the dead space area of that unit.

Target Size. If the target to be attacked is larger than 250 meters in radius, TACFIRE considers the target to be 250 meters in radius. The computer generates a warning message recommending that the operator divide the target into smaller segments for more effective coverage.

Target Analysis. The computer determines a method to attack a target. The method is based on target size, description, and degree of protection (for personnel targets only). The computer expresses attack method by a percentage of effects for "soft" targets and a standard volleys factor (SVF) for "hard" targets. Unless other attack method values are expressed in the TTFC commander's modifications, the computer uses an attack methods table derived from JMEM data.

Munitions Selection. Unless a specific shell and fuze are specified on the initial request for fire, the computer selects the best available shell/fuze combinations based on JMEM data. However, the computer considers only high-explosive and ICM families of ammunition. The computer selects other munitions only when specified in the initial request for fire and only if they are available.

Volume of Fire. The computer recommends an appropriate volume of fire based on the target attack criteria specified in the TTFC commander's modification file. If volume is not specified in the modification file, the computer uses the default attack methods file derived from JMEM data. Volume of fire for effects-type targets is computed directly from JMEM data. The computer derives volume of fire for volleys-type targets by multiplying an SVF by another factor corresponding to the target size, called the volley size factor (VSF). The product is the number of volleys required to defeat the target.

Fire Unit Selection. TACFIRE selects fire units with the best available munitions for attacking the target. More units may have these munitions than are required to fire the mission. Then the computer selects fire units on the basis of the following criteria, in the order listed:

- The ordering sequence assigned each fire unit in the commander's criteria.
- The busy status of each fire unit.
- The recency of the previous mission of each fire unit.
- The order in which each fire unit was entered into the AFU file.

The computer can select up to 15 fire units to engage a target. The computer does not consider selecting fire units that are—

- Missing any required AFU data in the AFU file.
- Out or displacing.
- Out of range of the target.
- Excluded from TTFC processing.
- Excluded because the target is in the dead space area of the fire unit.

MLRS Selection. The computer selects MLRS before cannon units if the size of the target exceeds the target size established by the commmander's criteria, the target

type/subtype is valid, and the range is in excess of 10,000 meters for MLRS engagement. Otherwise, MLRS is selected only after all cannon fire units cannot collectively defeat the target.

Lance Operations. Normally, Lance battalions are retained as a corps asset and are responsive to the corps. However, corps may attach these units, or parts of them, to a div arty or an FA brigade. For a description of Lance operations, see page 8-14.

TECHNICAL FIRE CONTROL CONSIDERATIONS

When the computer selects the fire units and munitions to engage the target, the technical fire control program computes the ballistic solution for each fire unit. During this phase, the computer checks for ACA violations and FU mask data restrictions. TACFIRE generates fire commands based on battery center locations only. When the computer sends the fire order/fire commands to the BCS, the BCS recomputes the mission to generate individual piece commands for each firing section.

Met. TACFIRE always uses current met, if available, unless the ACCO/FDO directs the computer to use standard met.

Adjusting Fire Unit. When the mission calls for adjusting fires, the computer directs the first fire unit selected to be the adjusting unit unless the adjusting unit is specified in the initial request for fire. TACFIRE always includes the adjusting unit in the FFE phase.

Charge and Angle of Fire. Unless otherwise specified or required, the computer solution uses the highest charge that will generate a quadrant elevation between 240 and 480 mils. If this charge violates an ACA or an FU mask, the computer recomputes using lower charges until either the violation is cleared or the charge cannot range the target. If necessary, the computer will choose to fire high angle to clear a mask. The computer will not choose to fire high angle to clear an ACA. Instead, it will generate a warning message so that the ACCO or FDO can coordinate with the appropriate airspace management element. When computing a high-angle mission, the computer selects the lowest charge that can range the target with a quadrant elevation greater than 950 mils. If a charge is specified in the initial fire request, the computer uses that charge initially but does not necessarily use it for subsequent rounds.

Shell Lot. For an adjust fire mission, TACFIRE selects the standard odd lot (smallest unregistered lot). If the standard odd lot is not available, the computer uses the smallest lot on file. For an FFE mission, TACFIRE uses the smallest lot with current registration data for the charge being fired. If no corrections exist, the computer uses the smallest lot available other than the standard odd lot. For FFE missions, the standard odd lot is used only as a last resort.

Powder Lot. For adjusting fire units, TACFIRE uses the standard odd powder lot. If the standard odd lot is not available, the computer uses the smallest powder lot. For all nonadjusting fire units and FFE missions, the computer selects powder lots in this order:

- First powder lot for which registration corrections exist for the charge and angle of fire selected.
- First powder lot of the same propellant model for which registration corrections exist for the charge and angle of fire selected.
- Smallest powder lot other than the standard odd lot.
- Standard odd lot.

NOTE: *The operator may override the shell and powder lots selected by the computer. He does this by specifying the desired shell and powder lots in the request for fire.*

TYPES OF MISSIONS

The battalion TTFC program processes all types of conventional, chemical, and nuclear fire missions for cannon artillery weapon systems. The following subparagraphs outline the types of missions TACFIRE processes and some procedural guidelines.

Area Missions. When TACFIRE processes a fire mission for targets over 250 meters in radius, the computer prompts the operator to divide the target into smaller segments. The computer can select up to 15 fire units to attack each target or target segment. Observers can establish targets and known points. TACFIRE accepts grid, polar plot, and shift methods of attacking targets of opportunity. Using ADP and digital

communications, computer operators and FDOs can quickly coordinate and execute mass and time-on-target (TOT) missions. The initiator of a fire mission needs only to specify a method of target location to generate fire commands from the computer. He may specify any element associated with fire mission processing (target type, size, strength, and so forth), or he may let the computer select the elements.

Quick fire. Quick fire requests using known points result in the fastest processing.

Sweep and zone fires. To initiate a zone fire mission, the mil change and the number of quadrants to fire must be specified in the initial fire request. The computer determines firing data to the center of the target. The battery FDC or chief of section determines the quadrants to fire.

Registrations. TACFIRE processes precision, HB/MPI, and radar registrations. TACFIRE computes registration data that are stored in the AFU files and graphical firing table (GFT) settings that are transmitted to the fire units. TACFIRE also can update registration corrections and GFT settings on the basis of updated survey data and receipt of concurrent and subsequent met messages.

Precision. TACFIRE will process both quick and time phases of a precision registration as well as a second-lot registration. After the registration, FM;GFT and AFU;REG messages are generated.

High burst/mean point of impact. The current location of both observers involved in the registration must be in the observer file. After the registration, TACFIRE displays the status of each round fired and recommends the rejection of any round that appears to be erratic.

Radar. Radar registration is conducted in the same manner as an HB/MPI registration, except that spottings by the observer are reported as grid locations. Only one observer (radar) is required in radar registration.

Nuclear Missions. The division and corps FSEs analyze and process nuclear targeting information and initiate nuclear missions. The battalion computer calculates the ballistic solution and forwards the fire orders/fire commands to a firing battery. A commander must consider two procedural guidelines for nuclear mission processing:

- The location of the unit firing the nuclear mission as specified in the FM;NUKE message must be the location of the piece that is to fire the mission and *not* the battery center. The only exception would be if the howitzer specified to fire the mission is, in fact, located over battery center. Upon receipt of an FM;NUKE message, fire direction personnel should immediately verify the unit to fire for effect (UFFE) and location (LOC) mnemonic entries to preclude incorrect ballistic calculations.
- To preclude nuclear mission processing without operator knowledge (fire missions are automatically computed upon receipt), the priority, classification, logging, and display (PCLD) message should reflect a display option of YES for the FM;NUKE message.

Toxic Chemical Missions. TACFIRE can process both persistent and nonpersistent chemical munitions against personnel targets. Division/corps FSE performs a chemical target analysis before transmitting a toxic chemical fire mission to the battalions for processing.

Illumination Missions. TACFIRE can process illumination, continuous illumination, and coordinated illumination missions using one gun, two guns (range or lateral spread), or four guns. TACFIRE computes illumination spreads of 400 meters for the M314 shell and 500 meters for the M485 shell. The computer computes height of burst at 750 meters above the target altitude for 105-mm weapons and 600 meters for 155-mm weapons. TACFIRE generates two target numbers for coordinated and continuous illumination missions, one for the illumination and another for the HE. As in manual methods, either the FDC or the observer can control coordinated or continuous illumination missions.

Smoke Missions. Observers can initiate hexachloroethane (HC) or white phosphorus (WP) smoke missions by specifying the shell type in the request for fire.

Check Fire and Cancel Check Fire Commands. An ACCO can check fire or cancel check fire for selected batteries or a

whole battalion. He presses the appropriate message address switches on the switch panel assembly of the artillery control console. The computer sends a CHECK FIRING message to each BCS addressed. The FO can also initiate a check fire from his DMD.

Assault Fire. Assault fire is a special technique of indirect fire in which one weapon in defilade fires on a target at a short range with the maximum charge that will clear the crest. This type of fire is particularly effective against targets with a large vertical dimension, such as bunkers on a hillside. TACFIRE and BCS do not accept observer corrections of less than 1 meter and compute firing data only to the nearest mil. Therefore, FDC personnel may need to use manual methods for precision firing.

Final Protective Fires. Each fire unit stored in the AFU file may be assigned one final protective fire (FPF) in both BCS and TACFIRE. Only one observer can be associated with each FPF.

Quick Fires. An observer can initiate a fire request by using either a previously fired target or a known point target. Using a quick-fire format, the observer enters the target number into the DMD and transmits the message. Upon receiving and acknowledging the message, the computer draws the target location and other data from the target files and processes the mission. The method of control is always WHEN READY/FIRE FOR EFFECT.

Copperhead Missions. There are two types of Copperhead missions processed by TACFIRE. A *priority* Copperhead mission is conducted very much like an FPF, while a *target of opportunity* Copperhead mission is basically handled as an area fire mission. An observer may have one FPF and one priority Copperhead mission or two priority Copperhead missions. The computer uses unique observer data, G/VLLD codes, and cloud height in processing a Copperhead mission. A Copperhead mission is valid for 155-mm weapon systems only, and the angle T must be less than 800 mils.

TARGET REPLOT

Target replot improves the stored target locations. The FDC personnel can, using a military map, extract the FFE target altitude and instruct the computer to replot the target in reference to the fire unit.

COMMANDER'S MODIFICATIONS

The artillery battalion commander can influence the computer's tactical fire control solutions. He can establish criteria to guide the computer selection of fire units, munitions, and volume of fire for each mission. The commander can change the modifications at any time. As circumstances and SOP dictate, the FDO can override the commander's modifications on a mission-to-mission basis. Observer input also overrides the commander's criteria. Following are the parameters involved in establishing the commander's criteria.

Ignore Ammunition. The ignore ammunition (IGAMMO) modification directs the computer to select units to fire regardless of the ammunition on hand. This keeps a fire unit from being excluded solely on the basis of not having the required ammunition. When IGAMMO is in effect, the computer will not generate warnings if critical ammunition levels and ammunition supply rates are violated, since IGAMMO causes the computer to ignore all ammunition constraints. Often, IGAMMO is used for developing fire plans for future operations to determine ammunition requirements. Normally, IGAMMO is not used for current TTFC operations.

Maximum Volleys. The commander can limit the number of volleys a fire unit may fire against a single target. The lower the maximum volleys (MAXVOL), the more fire units the computer must select to achieve the required volleys or desired effects on a target. MAXVOL is specified for each weapon type and applies to each fire unit with that weapon type. If not specified by the commander, the computer uses six volleys as the default value for MAXVOL.

Fire Unit Selection. The commander can assign an ordering priority to each fire unit. He must be careful when ordering fire units, because the one ordered first will *always* be chosen before others. Therefore, it is recommended that all units be ordered equally. Thus, fire units can be selected on the basis of busy status, recency of assignment, and the order entered into the AFU file.

Exclusions. A commander can exclude a fire unit, weapon type, shell, or fuze from consideration during tactical fire control processing.

Attack Methods. The attack methods table in the computer data base defaults to a desired effects value of 10 percent for all effects-type targets and an SVF of 1 for all volleys-type targets. The commander can modify the attack criteria for each target type/subtype. He can also specify an SVF for an effects target. However, he cannot specify desired effects for a volleys (hard) target. The SVF works with another factor (the VSF, which is built into the software program) to generate the computer recommendation for the total number of volleys to fire on the target. The FDO or ACCO can override attack criteria by assigning the number of volleys to fire on the target on a mission-to-mission basis for either effects or volleys targets.

Effects Cutoff Factor. The effects cutoff factor (ECOF) is a value that limits the ammunition expenditure on effects targets. The ECOF specifies the minimum percentage of effects that the commander considers acceptable on any volley during volume-of-fire calculations for effects targets. If the percentage of effects for any volley does not equal or exceed the ECOF value, the computer will not recommend that the fire unit fire that next volley and will use another fire unit. The ECOF is always entered into the computer in tenths of a percent. For example, an entry of 20 specifies an ECOF of 2.0 percent. The computer default value for ECOF is 1 percent.

MLRS Size. If the AFU file contains MLRS fire units, the computer considers those units first to engage a target when the target radius exceeds the size entered in the MLRS size (MLRSIZ) modification.

NOWARN. The NOWARN function suppresses noncritical warning messages that the system often generates with fire commands. While classified as a commander's modification, this function only helps the ACCO process messages faster. It does not directly affect technical and tactical fire control.

P-Zone, P-Type, P-Shell. A commander can specify a zone, target type, and/or projectile as high-priority missions. These priority mission designations affect normal (category C) fire requests only. The computer displays urgent (category A) fire requests ahead of all others. When a normal fire request originates from the priority zone, attacks the priority target type, or specifies the priority shell, the computer processes the mission, changes it to priority (category B), and places it in queue ahead of all normal fire requests.

Urgent Fire Missions. Every TACFIRE target acquisition agency can submit fire requests as normal (category C) or urgent (category A). The computer places normal requests for fire in queue in the order received, except for P-zone, P-type, and P-shell missions as explained above. The computer processes urgent requests differently. When processed, the computer displays the urgent fire mission, with a large banner saying URGENT, to the ACCO ahead of all other messages. The computer will not let the ACCO process anything else until he reviews the urgent fire mission. While not technically a commander's modification to TTFC, urgent fire missions affect processing. To preclude abuse, commanders should specify in a clearly defined SOP how and when observers should use urgent fire requests.

Reinforcing Fires. When operating without a reinforcing battalion, the battalion computer sends requests for additional fire to div arty. When operating with a reinforcing battalion, the reinforced battalion ACCO or FDO can direct the computer to send requests for additional fire to the reinforcing battalion computer. The reinforced battalion computer sends requests for additional fire to div arty only when the combined fires of both battalions do not defeat the target.

Zone of Responsibility. When a fire unit is associated with a zone specified in the geometry files, the computer generates a warning message every time it processes a fire mission for that unit for a target that is not in the zone.

BATTALION FILES

Compared to BCD computers, which can hold 1,364 targets in the ATI files, battalion

fire mission related files are much smaller. However, they are adequate for the battalion mission if the ACCO and FDO supervise an aggressive file maintenance program.

Fire Mission File. The FM file holds up to 30 fire missions. Up to 17 of them can be inactive. This file serves as a buffer for fire missions that are not recorded as targets. The ACCO can retrieve any mission in the file to refire it, check it, record it as a target, and so forth.

Battalion Target File. The battalion target file (TGTFIL) can hold up to 300 targets.

Registration File. In the registration file (REGFIL), the computer can store up to 120 TGTFIL targets as registration points along with all associated registration data.

Known Point File. In the known point file (KNPTF), the computer can designate up to 99 TGTFIL targets as known points.

Observer File. The computer can store data for up to 99 observers, to include G/VLLD codes and cloud heights. Also, this file stores each observer's FPF and Copperhead missions.

MESSAGE TO OBSERVER

The computer generates a message to observer (MTO) whenever the computer processes a fire mission. The MTO provides target number, fire units, volume of fire, angle T when greater than 500 mils, time of flight, probable error in range when greater than 25 meters, munitions, and method of engagement and control.

BCD COMPUTER TACTICAL FIRE CONTROL PROGRAM

A TACFIRE computer loaded with a BCD field system tape can generate tactical fire control recommendations for fire requests received from any legal subscriber.

COMPARISON WITH BATTALION FUNCTIONS

The BCD computer TFC program is similar to the battalion TFC function but differs in some significant ways.

Similarities. The BCD computer TFC function analyzes each target to determine the best way to attack it. The program checks for most fire support coordinating measure violations. The commander can influence TFC processing by establishing commander's modifications. The ACCO can review the fire mission recommendations and change them as required. If the div arty cannon and missile assets cannot defeat the target, the computer generates a request for additional fire to send to the FSE to initiate coordination for nonartillery fire support assets.

Peculiarities. Only FFE missions are processed by BCD computer systems. The TFC programs do not compute technical fire control solutions nor generate messages to observer. They consider only cannon and tactical missile weapon systems using HE and ICM. (The FSE programs enable the division and corps FSEs to analyze targets for attack by chemical and nuclear munitions and naval and TACAIR assets). The TFC function checks fire support coordinating measures, to include chemical hazard areas and the FSCL. However, it does not check for FU mask or ACA violations because no ballistic trajectory is computed. The last major distinction of the BCD computer TFC programs is that they process only missions using the grid method of target location. This is because they do not store observer files and known point files.

TACTICAL FIRE CONTROL

The TFC function determines the battalion(s), munitions, and volume of fire to attack the target. The programs draw the attack criteria from commander's modifications and JMEM data.

Target Location. The BCD computer can process only missions using the grid method of target location. The computer compares the target to all fire support coordinating measures stored in the SPRT files except ACAs and FU masks. If the target violates a fire support coordinating measure, the computer generates a warning message with the attack recommendation. The fire control element (FCE) ACCO can coordinate the target with an FSE. If a DS battalion is to service a target that is within the battalion ZNE, the FCE may elect to transmit the mission and let the DS battalion coordinate the target. Upon receipt of a mission, the

target is shown on the ETD. The DPM does not automatically mark the target.

Target Size. If the radius of a target is larger than 250 meters, the computer generates a warning recommending that the operator split the target into two or more smaller targets for more effective coverage. Otherwise, the computer processes the target as having a 250-meter radius.

Target Analysis. The TFC programs determine a method of attacking a target. The method is based on target size, type/subtype, and degree of protection (for personnel targets only). The computer expresses the attack method by designating a percentage of effects required for each type of soft target and an SVF for each type of hard target. Unless other attack method values are expressed in the TFC commander's modifications, the computer uses standard JMEM values. During target analysis, the computer also draws from the ATI file to fill in any missing data on the target being attacked.

Munitions Selection. Unless a specific shell or fuze is requested in the fire request, TACFIRE selects the best shell and fuze from the JMEM data. The computer then considers a fire unit and determines whether the target can be defeated with the preferred shell and fuze. If not, the next best munition is considered and so on until the target can be defeated or the choice of munition is exhausted. If the target is not defeated, a second fire unit is considered, and the same procedures are followed until all fire units have been considered or the target is defeated. If a specific shell and/or fuze is requested, the computer considers only those munitions.

Volume of Fire. The computer recommends a volume of fire based on the attack criteria specified in the TFC commander's modification file. If volume is not specified in the modification file, the computer uses the default attack method file derived from JMEM data. Volume of fire for effects-type targets is computed directly from JMEM data. The computer derives the volume of fire for volleys-type targets by multiplying an SVF by a VSF. The product is the number of volleys required to defeat the target. If the div arty or FA brigade cannot defeat the target because of ammunition constraints or commander's modification limitations, the computer automatically transmits a request for additional fire to the FSE.

Fire Unit Selection. The computer examines fire units only to determine which battalions can attack a target. The computer does not select a fire unit that lacks any required AFU file data, is out or displacing, is excluded by commander's criteria, lacks the ammunition specified, or is out of range of the target according to the weapons descriptor file. When the computer selects a fire unit for which the target is out of traverse limits, the fire mission recommendation warns the operator of that fact.

MLRS Selection. The computer considers MLRS fire units before cannon units if the target size is greater than the size specified in the commander's criteria for MLRS engagement. Otherwise, MLRS units are selected only after all artillery units cannot collectively defeat the target.

Lance Operations. See pages 6-12 and 8-14.

Battalion Selection. Two or more battalions may have fire units that can attack a target with the best munition. Then the computer orders the battalions based on each battalion ZNE, tactical mission, and assigned order number (ASGORD). If the ZNE and tactical missions are the same, the battalion with the smallest ASGORD will be considered first. Normally, commanders do not order the fire units within each battalion at div arty level.

Tactical Fire Control Recommendation. After computing the TFC solution, the computer prints the recommendation on the ELP in the form of an FM;5201 report entitled "FM Recommendation." The FM;5201 report gives:

- All available information about the target.
- Error and warning messages.
- Units and munitions to fire.
- Effects or volleys required to defeat the target.
- Total effects or volleys achieved.
- The number of other ATI targets within 1 kilometer.

• The effects or volleys that each fire unit and each battalion can achieve if firing alone.

COMMANDER'S MODIFICATIONS

The div arty commander can influence the computer TFC solutions. He can establish criteria to guide the computer selection of battalions to fire, munitions, and volume of fire for each mission. The commander can change the modifications at any time. As circumstances and SOP dictate, FCE personnel can override the commander's modifications on a mission-to-mission basis. A specific request on a request for fire also overrides commander's modifications.

Ignore Ammunition. The IGAMMO modification directs the computer to select units to fire regardless of the ammunition on hand. This keeps a fire unit from being excluded solely on the basis of not having the required ammunition. When IGAMMO is in effect, the computer will not generate warnings if critical ammunition levels and CSRs are violated, since IGAMMO causes the computer to ignore all ammunition constraints. Fire planners use IGAMMO in the nonnuclear fire planning modifications when planning future fires to determine ammunition requirements. Normally, IGAMMO is not used for current TFC operations.

Maximum Volleys. The commander can limit the number of volleys that a fire unit or weapon type may fire against a single target. MAXVOL is specified for each weapon type and applies to each fire unit with that weapon. The lower the MAXVOL, the more fire units the computer must select to achieve the required volleys or desired effects on a target. If not specified for a particular weapon type, MAXVOL defaults to six volleys.

Fire Unit Selection. The commander can assign an ordering number for each battalion and each fire unit within a battalion.

Exclusions. A commander can exclude fire units, weapon types, shells, or fuzes from consideration during tactical fire control.

Attack Methods. The attack methods table in the computer data base defaults to a desired effects value of 10 percent for all effects-type targets and an SVF of 1 for all volleys-type targets. The commander can override the attack criteria for each target type/subtype. He can specify an SVF for an effects target. However, he cannot specify desired effects for a volleys target. For volleys targets, the SVF works with the VSF to generate the computer recommendation for the total number of volleys to fire on the target. The FDO or ACCO can override attack criteria by assigning the number of volleys to fire on the target on a mission-to-mission basis for either effects or volleys targets.

Effects Cutoff Factor. The ECOF is a value that limits the ammunition expenditures on effects targets. The ECOF specifies the minimum percentage of effects that the commander considers acceptable on any volley during volume-of-fire calculations for effects targets. If the percentage of effects for any volley does not equal or exceed the ECOF value, the computer will not recommend that fire unit to fire the next volley and will use another fire unit. The ECOF is always entered into the computer in tenths of 1 percent. For example, an entry of 20 specifies an ECOF of 2.0 percent. The computer default value for ECOF is 1 percent.

MLRS Size. If the AFU file contains MLRS fire units, the computer considers MLRS units first when the target radius exceeds the size entered in the MLRSIZ modification.

Urgent Fire Missions. Every TACFIRE target acquisition agency can submit fire requests as normal (category C) or urgent (category A). The computer places normal requests for fire in queue in the order received. The computer processes urgent requests differently. When processed, the computer displays the urgent fire mission, with a large banner saying URGENT, to the ACCO ahead of all other messages. The computer will not let the ACCO process anything else until he reviews the urgent fire mission. While not technically a

commander's modification to TTFC, urgent fire missions affect processing. To preclude abuse, commanders should specify in a clearly defined SOP how and when agencies should use urgent fire requests.

CAPABILITIES ANALYSIS

The ACCO can activate TFC processing to determine the capability of fire units to defeat a target without initiating a fire mission. The computer prints the solution on the ELP in the FM;5202 report entitled "TGT/FU capability report." The report lists the same information as the FM;5201 FM recommendation report, except it lists only the effects or volleys that can be achieved by each fire unit firing alone. It does not include the effects or volleys by battalions.

FIRE MISSION FILE

The FM file contains all active fire missions. There is no limit to the number of active fire missions in the BCD computer TFC program FM file. The computer ends a mission and deletes the mission from the FM file only when it receives a mission fired report from each battalion firing that mission or when directed by the ACCO to end the mission.

MODIFICATION FILE

The modification file contains all current commander's criteria.

USER COMMANDS

The TFC function provides commands that enable users to transmit output reports; plot targets on the digital plotter map; view targets on the ETD; print output reports on the ELP; and print, transmit, edit, or delete fire mission data.

NONNUCLEAR FIRE PLANNING PROGRAM

The NNFP program automates the manual systems to develop, coordinate, and disseminate fire plans with a schedule of fires. The program draws information and processing functions from other applications programs. The AFU programs provide fire unit data and ammunition inventories. The ATI programs at div arty and the target files at battalion provide target data. The SPRT programs provide fire support coordinating measures checks and other orientation data. The TFC programs recommend ways to attack targets, while the technical fire control programs compute and disseminate fire commands for each target.

Fire planners can use the NNFP program with minimal input to produce hasty fire plans or efficient and comprehensive fire plans. Fire planners can quickly update a schedule of fires or fire commands on the basis of changes in target data, met, FU data, and so forth. When used in conjunction with the FSE program, the NNFP program can integrate nuclear fires into the nonnuclear schedule. Generally speaking, a well-trained fire planner can develop, process, and disseminate a 40-target fire plan in around 30 minutes. Each fire plan can be a maximum of 120 minutes long and consist of up to four phases.

Both BCD and battalion computers use the NNFP program, although capabilities differ in some ways. The BCD NNFP processing capability is somewhat broader, but the battalion computer computes fire commands. Normally, users develop fire plans by using a remote VFMED rather than the ACC in the computer shelter.

FIRE PLANNING PROCESS

Automated fire planning with TACFIRE follows the same basic development techniques as with the manual system. The fire planner begins the process by establishing an NNFP data base, which includes commander's criteria, AFU data, and SPRT data. Next, he develops a preliminary target list from which he selects targets for the fire plan target list. If necessary, he can coordinate the preliminary target list with other agencies. After coordinating the fire plan target list, he can assign specific instructions for each target and compute the fire plan. After reviewing the series of computer-generated output reports, he can continue to modify and

recompute the fire plan until he is satisfied with the schedule of fires. He can then transmit the schedule of fires to the battalion(s) to fire. The battalion computes fire commands, checks them against the targets in the schedule of fires, and transmits them to the firing batteries to await firing.

BATTALION NNFP CAPABILITIES

The battalion computer can plan fires autonomously or in conjunction with a BCD computer as follows:

- Working *with a BCD computer on-line* gives the battalion fire planning efforts a significant boost. Fire planners can use the BCD computer ATI files to develop a preliminary target list much more easily and quickly.
- When working *autonomously,* without a BCD computer on-line, fire planners develop a preliminary target list from the targets in the battalion target files. This takes longer than to develop a list using a BCD computer.

The battalion NNFP programs have some operational limitations. When a fire planner tries to exceed these limitations, the computer generates an error message.

The battalion computer does not schedule groups and series of fires in the same way as a BCD computer. However, a fire planner can apply instructions to targets that manually "schedule" targets in groups and series. Also, the battalion NNFP function does not integrate nuclear fires.

BATTALION NNFP PROGRAM LIMITATIONS

- 32 fire plans (One fire plan is reserved for the current data base; fire planners can develop a unique data base for each of the remaining 31 fire plans.)
- 4 battalions per plan
- 15 fire units per plan
- 150 targets per plan
- 10 weapon types per plan
- 5 fire units per target
- 30 reservations per plan

BCD COMPUTER NNFP CAPABILITIES

BCD computers have a broader range of NNFP capabilities than do battalion computers. They can quickly generate a preliminary target list from their own ATI files, schedule groups and series of targets, and use more battalions and fire units. Division and corps FSEs can use the FSE programs in conjunction with the NNFP programs to integrate nuclear and nonnuclear fires into a single fire plan.

COMMANDER'S MODIFICATIONS

The artillery commander at each level can influence the computer NNFP solutions. He can establish a series of control parameters to guide the computer fire plan processing. Some of the modifications influence tactical and technical fire control solutions that are unique to each fire plan. That is, a commander can specify TFC or TTFC modifications for each fire plan that are different from the modifications for current TFC and TTFC operations and other fire plans. The commander can change the modifications for any or all fire plans at any time. If a fire planner does not build a unique modification file for a fire plan, the computer uses the modification file in the TFC or TTFC programs. A fire planner can override commander's criteria, as needed, on a case-by-case basis. Except where noted, the following criteria apply to both battalion and BCD computer NNFP programs.

BCD COMPUTER NNFP PROGRAM LIMITATIONS

- 32 fire plans (One fire plan is reserved for the current data base; fire planners can develop a unique data base for each of the remaining 31 fire plans.)
- 20 battalions per plan
- 30 fire units per plan
- 150 targets per plan
- 20 weapon types per plan
- 30 fire units per target
- 30 reservations per plan
- 15 groups of targets per plan
- 15 series of targets per plan

transfers all associated AFU data of each fire unit into the fire plan files. The computer uses fire plan AFU data in generating the schedule of fires and in producing firing data. A fire planner can verify AFU data by requesting the AFU;2203 report for the fire plan by the plan name.

Support Data. Fire planners can designate what battlefield geometry and fire support coordinating measures the fire plan will use. The computer does not schedule a fire unit to fire on a target if the target lies in its dead space area. All other geometry violations, except ACAs, generate warnings on the NNFP;4219 report. From that report a fire planner can initiate coordination. A fire planner can verify support data by requesting the SPRT;7202 report for the fire plan by the plan name.

Met Data. A fire planner can use either current or standard met for a fire plan. When developing a fire plan for which current met will not apply, fire planners normally use standard met. It is neither difficult nor time consuming to update a fire plan with current met just before firing the plan. A fire planner can verify which met is specified to be used in a fire plan by requesting the NNFP;4221 report for the fire plan by the plan name.

TARGET LIST DEVELOPMENT

A fire planner uses up to four types of target lists in developing a fire plan. The targets are drawn from the ATI files at div arty level or from the target files at battalion or are submitted directly into the fire plan. Fire planners can incorporate target data from other computers, VFMEDs, and DMDs directly into the fire plan. As a fire planner develops each target list, the computer stores the list in memory.

In the manual system, fire planners first collect a pool of targets on a target list work sheet and then transcribe selected targets to a scheduling work sheet. Using TACFIRE, a fire planner develops a pool of targets in a preliminary target list (FPLST) from which to select targets for the fire plan target list (FPTGT). The fire planner can disseminate both lists to other TACFIRE subscribers for review. When the FPTGT is finalized, the fire planner can compute the fire plan to generate the targets in a schedule of fires (TISF).

SCHEDULE OF FIRES DEVELOPMENT

While TACFIRE automates the target scheduling process, the fire planner makes the scheduling decisions. He specifies H-hour, number of phases, length of each phase, targets to be fired in each phase, and special instructions for each target (if any). Special instructions can include priority, phase in which to fire, time to fire relative to H-hour, fire unit to fire, desired effects or volleys, munitions, and angle of fire. The fire planner can also reserve fire units for specified intervals. In developing a hasty fire plan, instead of applying special instructions, he can compute the fire plan using default and COMCRIT values. When the fire planner computes the fire plan, the computer generates a series of output reports he can review. If the schedule of fires or other fire plan parameters need refinement, the fire planner can change data or instructions to the computer and recompute the fire plan. This process can continue until the fire plan is acceptable.

The output reports detail the targeting data, ammo expenditures, schedule of fires, groups and series of targets (div arty only), and other fire plan summary data. The fire planner uses the NNFP;4219 fire plan summary report to identify AFU, fire support coordinating measure, and zone violations as well as scheduling exceptions.

FIRE PLAN EXECUTION

The term "execution" refers to the generation of firing data for each target by the battalion computer. It does not imply that the weapons actually fire. The fire planner can execute a fire plan as a whole or by phases. The battalion computer computes fire commands for each fire unit and generates warnings if solutions violate airspace coordination areas. When the FDO approves the solution, the ACCO can transmit the fire command summary to the fire units.

USER COMMANDS

The NNFP programs provide a number of commands that enable users to direct the computer to print data on the ELP, draw fire plan overlays on the DPM, display fire planning data on the ETD, and transmit data to subscribers.

NONNUCLEAR FIRE PLANNING OUTPUT REPORTS

The NNFP programs generate a series of fire planning related reports. These reports are periodically printed on completion of a processing step or on demand by fire planning personnel. The following reports are immediately available to TACFIRE-equipped artillery units and fire support sections:

- The *preliminary target list* (NNFP;4211) is the initial target list acquired from the ATI files. For each target listed, the list provides target location, target type/subtype, degree of protection, target size, and target number. It also contains any other information available from the ATI files.

- The *fire plan target list* (NNFP;4212) is a selection of targets from the preliminary target list that are to be part of the fire plan solution. In addition to the data from the preliminary target list, the fire plan target list contains all scheduling instructions that have been applied to each target.

- The *on-call target list* (NNFP;4213) is a list of targets that have been designated as on call. The on-call list contains the same information for each target as in the fire plan target list.

- The *schedule of fires report* (NNFP;4214) provides scheduling results for each target in the fire plan. It also gives the status of each unit in the fire plan for the duration of the plan. A legend defining the entries used in the report is printed at the start of each report. The legend includes the following information: fire unit is idle, unit is firing, fire unit reaction time, nuclear target, unit is in a reserved status, and number of volleys to be fired. The report contains data by phase, by H-time, and by fire unit.

- The *groups of fires report* (NNFP;4215) (BCD only) lists each group of fires in a fire plan. It contains the plan name, group names, H-hour (if specified), target number, firing unit for each target, number of rounds for each target, scheduled time to repeat targets (if applicable), and on-call designator.

- The *series of fires report* (NNFP;4216) (BCD only) lists all series contained in a fire plan. It contains plan and series names, time relative to H-hour, phase and priority, on-call status, target number and its order in the series, group name and its order in the series, fire unit, and number of rounds to fire.

- The *ammunition report* (NNFP;4217) summarizes the fire plan ammunition expenditures. At BCD computers, the report lists the total, by type, for each battalion. At battalion, the report lists the total, by type, for each fire unit.

- The *targets in the schedule of fires report* (NNFP;4218) summarizes associated data for all targets in the fire plan. The scheduled fire plan targets are listed first, followed by on-call targets. The data provided for each target include the location and description, zone in which the target is located, mission fired data (if previously engaged), any geometry, CSR (ASR) or critical ammunition level warnings, H-time, target priorities, phase data, group or series data (if specified), desired and achieved effects or volleys, firing unit(s) assigned to the target, and shell and fuze to be used by each fire unit.

- The *fire plan summary report* (NNFP;4219) identifies the warnings and exceptions generated during the processing of a fire plan. It also summarizes the total number of targets in the fire plan, the number of scheduled and unscheduled targets, and the total number of targets with warnings. Each target is listed along with any warnings and exceptions that apply.

- The *MOD list* (NNFP;4421) lists the contents of the modification file associated with a specific plan name. It includes data specified for ignoring ammunition, the effects cutoff factor, the maximum battalions to engage a target, the zone specified for use with the plan, FU selection criteria, maximum volleys by weapon type, exclusions, and any modifications to the standard attack table.

- The *fire command summary* (NNFP;4223) lists the fire unit, H-time, shell, lot, charge, fuze, volleys, deflection, time, and quadrant for each scheduled target.

- The *nuclear TISF* (NNFP;4224) lists the following data for each nuclear target scheduled to be fired: target number, location, and description; phase and time (relative to

H-hour) target is to be fired; zone(s) of target location; fire unit to engage target (launcher, when applicable); weapon, shell, mark/mod/yield of munition; and the number of rounds to be expended.

- The *mark mod summary* (NNFP;4225) lists all fire units, by weapon type and mark/mod/rounds, that are scheduled to fire nuclear munitions during the fire plan period.
- The *nuclear schedule of fires report* (NNFP;4226) lists all nuclear targets to be engaged during the fire plan. This list specifies H-time (time relative to H-hour), firing unit, and target number.
- The *fire unit reservation report* (NNFP;4227) lists FU reservations by fire unit, weapon, reservation type (nuclear or nonnuclear), and start and end times of reservation.

ARTILLERY TARGET INTELLIGENCE PROGRAMS

The ATI programs automate a significant portion of the targeting element function. These programs, in BCD computers only, store up to 1,364 targets and shell reports, analyze targets, recommend fire missions on incoming targets meeting specified criteria, generate target lists, alert tactical operations center (TOC) personnel to target buildup areas, combine targets, update targeting data or existing targets, and more. The BCD computer collects and stores target information from sources throughout the FA network. As the computer receives each new target, it automatically correlates the new target with each target already on file and resolves duplications. There is no ATI program at battalion. This function is included in the battalion NNFP program. It is limited to assigning target numbers from the battalion targeting block.

COUNTERFIRE VFMED

The counterfire VFMED (CFVFMED) shared by the targeting and operations elements has a unique identifier in the BCD computer subscriber table. The identifier enables the VFMED to access the ATI program processing capabilities and output reports. Other VFMED and computer identifiers in the subscriber table limit the devices to submitting targeting information and extracting target data.

TARGET REPORTS

TACFIRE features several message formats that all FA agencies can use to report targets and shell reports, to update target information, and to forward nonformatted combat intelligence.

Coordinate Report (ATI;CDR). A target-reporting agency uses an ATI;CDR when reporting target location by grid coordinates. The computer stores this report until it is deleted.

Azimuth-Distance Report (ATI;AZR). A target-reporting agency uses an ATI;AZR when reporting target location by the polar plot method. The computer stores this report until it is deleted.

Surveillance Report (ATI;SVL). A target-reporting agency uses the ATI;SVL to report information relating to an established target. The information is reported in plain-text language. Battalions forward these reports with a target number to div arty. The targeting element reviews the report to update intelligence. The report is not stored in the computer.

Combat Intelligence Report (ATI;CBTI). The ATI;CBTI is strictly a plain-text message report of combat intelligence not associated with a target number. Agencies use this report instead of a plain-text message (SYS;PTM) to prompt battalions to forward the message to div arty so that the targeting element can evaluate it. The report is not stored in the computer.

Shell Report (ATI;SHR). An agency uses an ATI;SHR when reporting the results of enemy shelling activity. The computer stores this report.

Mission Fired Report (ATI;MFR). The ATI;MFR is used to update ATI files whenever necessary. Normally, ATI data are provided by the AFU;MFR for nonnuclear missions and by the AFU;MFN for nuclear missions immediately upon completion of a fire mission. The ATI;MFR describes the target, the disposition of the target, and an estimate of the casualties inflicted.

intersections using map spottings, current guidance, and trial solutions to generate acceptable targets from the 8205 and 8206 reports. The computer does not store intersections as targets in the ATI files. Targeting element personnel must choose to enter the intersection as a target using the ATI;CDR message or initiate a fire mission.

ATI Data Retrieval. Any subscriber equipped with either a computer or a VFMED, to include relay subscribers, can retrieve target information from the BCD computer 1,364-target file. There are several ways to retrieve the information.

Query. A query is a one-time request for target information on one of three description levels. The computer generates responses to queries using an ATI;8209 report. A level 1 report specifies a count of targets meeting search criteria. A level 2 report gives a one-line summary of each target. A level 3 report provides complete information on each target. A level 2 report provides most essential target information and takes much less transmission time than a level 3 report. Subscribers can initiate a query on the basis of target numbers, zones, specified areas, target type/subtype, target size, target strength, time of sighting, and report value levels.

Search. The BCD computer ACCO extracts target information using a search method, which differs little from the query method.

Preliminary Target List. The ATI programs have a unique aid to fire planners that is not available in battalion computers. With the ATI programs, a preliminary target list can be developed and stored by use of targets from the ATI files much more quickly than with the NNFP programs only. Battalion computer centers and their subscribers can access the BCD computer capability when available.

COMMANDER'S CRITERIA

The artillery commander can influence the computer ATI processing by establishing a series of controls and changing the ATI data base. These criteria affect four areas: target buildup, fire mission generation, target comparison and communication, and output report generation. The COMCRIT of the ATI programs generally depend more on the tactical situation and the amount of enemy activity than any other programs. Therefore, the counterfire officer must continually tailor the COMCRIT of the ATI programs to match the pace of the battle. There are four questions that can guide personnel when establishing COMCRIT parameters:

- What output reports are needed for analysis?
- How many targets in an area constitute a buildup?
- What targets should automatically generate fire missions?
- How similar should two targets be in terms of type, location, and time to prompt the computer to automatically combine them?

Data Print Criteria. The CFO can regulate the output of the 8202, 8203, 8204, 8205, and 8207 ATI reports. These reports can be too much to handle during surge operations and are considered to be high-volume reports.

Target Buildup Criteria. Target buildup criteria can range from 0 to 99. The incoming target counts as 1. For example, with target buildup criteria of 10, the computer must find 9 other targets within 0.5, 1, or 1.5 km of the incoming target to generate the ATI;8208 target buildup report.

Fire Mission Criteria. TACFIRE uses four FM criteria to selectively generate fire missions on incoming targets. The target must meet or exceed all four criteria to generate a mission.

Report value. The computer uses report accuracy tables for each of the 18 different target acquisition agencies to determine probable error in target location on incoming reports. The report accuracy table reflects the ability of a particular agency to estimate the location of 15 target types in terms of a radial error in meters for coordinate reports. The report accuracy, range error, and location error tables combine to provide a radial error value in meters for azimuth-distance reports. The CFO can specify a maximum report value (RV) for generating fire missions from incoming ATI reports.

WTYP, WDOP, WSIZE. These three qualifiers are a series of combining weights

for each target in terms of the ability of the targeting agency to accurately describe the target type, degree of protection, and size. These values are listed in tables in the ATI programs. Values range from 0 to 99. The higher the weight entered in the modification, the more restrictive the measure. If 99 is entered, no targets can qualify; if 0 is entered, all targets can qualify.

Automatic Combination Criteria. The CFO can control the number of automatic combinations by designating several parameters that each incoming target must meet. The major parameters include target proximity, target similarity, and difference in time of reports.

TIMEX specifies the maximum acceptable time difference between the present time on the TACFIRE computer time clock and the time of sighting of each target report.

TIMEY specifies the maximum acceptable difference in time between two reports considered for combination.

QMOD specifies target comparison limits. QMOD is an arbitrary value that the targeting element can adjust up or down to affect the number of combinations. Q is the tactical factor that is a combination of the relative proximity factor, report accuracy, tactical similarity of the targets, and distance between the targets. As a target enters the computer, the computer generates a Q value for each target combination as it compares the incoming target to every target on file. If Q is greater than or equal to the QMOD, the computer generates a combination report, a recommendation for combination report, or a recommendation for inspection report. If Q is less than QMOD, a combination does not occur. This value is entered in tenths. A value of 4.0 specifies that only two targets with perfect similarity should be combined. As the value for QMOD lowers, the computer can combine targets that are more dissimilar. Normally, QMOD ranges from 1.5 to 3.5.

Relative proximity factor (RPF) specifies combination limitations based on the distance between targets. The RPF is not a distance itself but a factor of an equation in the ATI programs. The higher the factor, the farther the targets can be apart and still combine.

Range Error Table. The range error table contains the probable range errors for each of the four human observer target acquisition agencies used during the processing of azimuth-distance reports. This table may be modified to reflect the current state of training.

Location Error Table. The location error table contains the probable self-location errors for each of the four human target acquisition agencies used during processing of azimuth-distance reports. This table may be modified to reflect the current state of training.

Report Accuracy Table. The report accuracy table reflects each target location agency's ability to estimate the location of 15 target types in terms of a radial error in meters for targets and an azimuth error in mils for shell and azimuth reports. This table may be modified to reflect the current state of training.

USER COMMANDS

The ATI programs provide a number of commands that enable users to direct the computer to print data on the ELP, draw targets on the DPM, display targets on the ETD, and transmit target information to subscribers.

OUTPUT REPORTS

The ATI programs generate a series of output reports that gives the targeting element the most complete targeting information available within the zone of interest. Targeting personnel can select and control the volume and detail of data based on the tactical situation, SOP, and S3 guidance. Some reports are also available to FSEs and FA battalions.

Combination Report (ATI;8201). The ATI;8201 reports computer-generated target combinations. It lists the two original (constituent) targets along with the new solution target. This is a high-volume report.

Recommended for Combination Report (ATI;8202). The ATI;8202 reports two targets that passed the statistical test for combination but did not combine because another set of targets had a better overall agreement. This is a high-volume report. This message contains the incoming target

report, the report recommended for combination with the incoming report, and the comparison test values. The target production personnel should look at this report as a recommendation to try to combine three or more similar targets in the same area by using the ATI;TRY message. If the results are satisfactory, these targets can be combined by means of the ATI;COMB message.

Recommended for Inspection Report (ATI;8203). The ATI;8203 reports two targets that passed the statistical test for combination but did not combine because one or both targets had DNC limitations or both targets had DNA limitations.

Incompatibilities Report (ATI;8204). The ATI;8204 reports all targets located within 1 km of an incoming target report that fail to combine. This is a high-volume report.

In-Fan Report (ATI;8205). The ATI;8205 reports that an incoming artillery or mortar target is in the fan of an existing SHELREP for a compatible weapon system.

Intersecting Rays Report (ATI;8206). The ATI;8206 reports that the ray of an incoming SHELREP intersects the ray of an existing SHELREP for a compatible weapon system.

Constituents Report (ATI;8207). This report is basically a duplication of the ATI;8201 report, which, when printed, immediately follows the ATI;8201 report. Since it is a high-volume duplication, targeting elements generally suppress it so that the computer does not generate it.

Target Buildup Report (ATI;8208). The ATI;8208 lists the radius of the target buildup, the center of the buildup, the test criteria, and the number of targets in the buildup area. The computer generates the ATI;8208 when an incoming target has enough targets close to it that meet the test criteria.

Query Report (ATI;8209). The ATI;8209 summarizes all targets meeting search criteria. Users can request this report in one of three report levels. A level 1 report specifies the number of targets meeting search criteria. A level 2 report gives a one-line data summary of each target. A level 3 report provides complete information on each target. The ATI;8209 report is available to all elements with a TACFIRE computer or a VFMED.

Standing Request for Information Report (ATI;8210). The ATI;8210 report is identical in format to the ATI;8209 report. The computer transmits it to subscribers on the basis of standing requests for information.

Situation Report (ATI;8211). The ATI;8211 report is identical in format to the ATI;8209 report. The SITREP lists the targets submitted into the ATI files since the time of the last SITREP request from the CFVFMED.

Retrieval Report (ATI;8212). The ATI;8212 report is identical in format to the ATI;8209 report but is generated by an ATI;SRCH message format.

ATI Mod List (ATI;8213). The ATI;8213 lists all modifications, ATI criteria files, and standing requests for information (SRI).

DIVISION FIRE SUPPORT ELEMENT PROGRAM

DIVISION FIRE SUPPORT ELEMENTS

The division FSEs, tactical and main, manage the allocation and planning of fire support for the division. The tactical FSE is responsible for the fire support coordination for the immediate battle. It coordinates and implements the fire support efforts planned by the main FSE, responds to requests for additional fire support from subordinate brigade FSEs, and identifies fire support requirements for the immediate and near-immediate tactical situations. The tactical FSE normally does not plan any activity more than 24 hours in advance. It is staffed with representatives from all fire support resources responsive to the fire support needs of the division and is collocated with the division tactical command post. The main FSE is responsible for the production of the fire support portion of the division operations plans and orders. It helps coordinate fire support activities associated with current combat operations but beyond the capabilities of the tactical FSE. The main

required, and the urgency of the attack. Within TACFIRE, the TFC and TTFC programs sufficiently analyze most targets to be attacked by conventional FA fires. If enough conventional FA fires are not available to defeat a target, the div arty FCE submits a request to division FSE for additional assets to attack the target. The division FSE uses the FSE program to analyze the effects of additional conventional FA fires, close air support (CAS), naval gunfire (NGF), chemical attack, or nuclear attack. The target analysis functions of the FSE program are preliminary, chemical, and nuclear target analyses.

PRELIMINARY TARGET ANALYSIS

The PTA gives the FSE a hasty and rough analysis of the best fire support means available to defeat a target. To do this, PTA considers all available HE, chemical, and nuclear munitions along with all delivery methods, to include cannon, NGF, rockets/missiles, and aircraft. The PTA involves the following data processing functions:

- Target segmentation.
- Munition analysis.
- Fire unit selection.
- Range exceptions.
- Ammunition exceptions.
- Fire unit sorting.

Target Segmentation. The computer may divide a target into segments if it is over 2,000 meters long. Operators should further analyze the target segments to determine any safety violations, because the computer checks for geometry, safety, or limitation violations only against the original target center.

Munition Analysis. After segmentation, the computer analyzes all available munitions to determine the optimum means to attack each target segment. The analysis considers conventional, chemical, and nuclear munitions unless the COMCRIT file directs otherwise. The program will analyze target segments for chemical munitions only if the target is a personnel-type target, wind data are on file, and at least one round of chemical munition is on file for the firing unit.

HE munition PTA. The HE munition PTA considers all available artillery (cannon, rockets, and missile), naval guns, and aircraft delivery systems. First, the number of volleys of HE munitions to be fired by artillery cannon to achieve the effects is determined. If cannon artillery cannot achieve the specified effects, available naval guns, artillery rockets and missiles, and aircraft (in that order) are analyzed to determine if any of these units can achieve the required effects. If a unit is found that can produce the desired effects, the computer stores the name and the results achieved for subsequent output. This solution is a recommendation only. Air Force and Navy liaison officers (LOs) make the final determination on using particular aircraft and munitions. Usage depends on sorties and ammunition immediately available.

Chemical munition PTA. Chemical munition PTA considers artillery cannon and aircraft. The program analyzes effects calculations independently for each delivery system but cumulatively for multiple units of one delivery system. Operators can analyze personnel-type targets only. They should always further analyze the target by use of the CTA function before attacking the target.

Nuclear munition PTA. Nuclear munition analysis determines whether a target can be defeated by nuclear attack after all available FU types and weapon yields are considered. The analysis determines if troop safety is violated or if the effects of any fire unit and yield combination extend into a restrictive fire coordination area.

Fire Unit Selection. The computer examines these six fire unit qualifiers during PTA:

- The AFU file is complete for the fire unit.
- The fire unit is the type requested (to include aircraft and naval guns).
- The fire unit weapon type is not excluded.
- The fire unit is authorized to fire the optimum munition.
- The target is not in the fire unit dead space area.
- For a naval unit, the target is in its zone of responsibility.

Range Exceptions. During PTA, the computer considers artillery cannons out of range if the range from the fire unit to the target is greater than seven eighths of the maximum range of the fire unit weapon. For chemical or nuclear ordnance, the computer considers the unit short of minimum range if the range from the unit to the target is less than the minimum range for that ordnance. For HE ordnance, the computer considers the unit short of minimum range if the range from the unit to the target is less than operator-entered minimum range. Missiles are considered out of range if the range from the launch site to the target is less than the weapon minimum range or greater than seven eighths of the weapon system maximum range. The computer never considers aircraft as having range exceptions. It considers naval guns in range only if the target lies in the ship's zone of responsibility.

Ammunition Exceptions. The computer will not recommend a fire unit for a mission if any one of three conditions exists:

- The fire unit does not have enough ammunition on hand to achieve the desired effects.
- The desired effects require more volleys than the fire unit is authorized to expend.
- The fire unit has in its possession the type of ordnance needed to defeat the target, but the ordnance is not authorized and the unit is excluded from firing that ordnance.

These three conditions constitute ammunition exceptions. They explain to fire planners and target analysts why the computer does not select certain fire units because of established ammunition constraints.

Fire Unit Sorting. Fire units are sorted by desirability of attack method according to this scheme:

- Artillery cannon and naval guns using HE munitions.
- Naval guns using HE munitions (if analyzed separately).
- Artillery missiles/rockets using HE munitions.
- Air strikes using HE munitions.
- Nuclear munitions.
- Artillery cannon and missiles using chemical munitions.
- Air-delivered chemical munitions.

Recommendations. The PTA program produces output reports that list the options for attacking a target effectively. They also explain why other options are not effective against a target.

CHEMICAL TARGET ANALYSIS

The CTA function of the FSE program enables the FSE to determine:

- The best available delivery system to attack a given personnel target with a chemical agent.
- The specific agent to be employed (GB-nonpersistent or VX-persistent).
- The best available delivery units.
- The quantity of agent to be delivered on the target to produce the required effects.
- The ability to preclude damage to friendly troops.
- A chemical hazard area.

Fire Unit Selection. A fire unit is selected for analysis if the target is within its range and if it has the chemical ammunition on hand. Even if IGAMMO is specified, the fire unit must have *at least one round of chemical ammunition* on hand to be considered for CTA. Fire units are considered in the following sequence:

- 105-mm howitzer.
- 155-mm howitzer.
- 203-mm howitzer.
- M91 rocket launcher.
- Air delivery: Naval air, Air Force.

Target Segmentation. The target to be analyzed is segmented according to the selected weapon. The size of the segments also depends on the agent used. Coverage refers to the maximum target radius that a specified weapon caliber/agent can attack. When targets are segmented, each segment should also be analyzed to determine any safety violations. Safety checks are conducted only against the original target center. Targets are segmented in the following manner:

- For circular targets, if the radius is less than twice the coverage, the target is

automatically divided into four segments. The center of each segment is at a distance equal to coverage from the original target center and separated by 1,600 mils in azimuth from the original target center. On the other hand, if the radius is greater than twice the coverage, a warning is output stating that the target is too large for automatic segmentation and that it should be manually segmented.

- For noncircular targets, if the length is greater than twice the coverage and the width is equal to or less than twice the coverage, the target is divided into two segments. The center of each segment is at a distance equal to the coverage from the original target center along the major axis (attitude). If length exceeds four times coverage, a notification to manually subdivide is printed.
- For noncircular targets, if the length and width are greater than twice the coverage, the target is divided into four segments. The center of each segment is at a distance equal to coverage from the target center along each axis.

Fractional Casualties Determination. Fractional casualties are effects achieved at various time intervals after the attack. They are determined by use of target radius, target range, wind speed and direction, degree of protection, masking time, and volume of fire. Fractional casualties for GB agents are determined at 2-, 5-, and 10-minute intervals. For VX agents, fractional casualties depend on the degree of protection, mission-oriented protection posture (MOPP), and exposure time.

Fire unit evaluation. The selected fire units are considered by use of the minimum number of volleys established in the static data base. If the achieved effects are greater than or equal to the minimum required effects, processing of that solution stops. If they are not achieved, a greater number of volleys is considered until the minimum required effects are achieved. If the same fractional coverage is achieved with a greater number of volleys, processing stops and the lesser number of volleys is recommended. The maximum number of volleys considered is determined by the MAXVOL specified in the COMCRIT file.

Target segment evaluation. Each segment of a target must be assigned fire units of the same weapon type, caliber, and size and must be attacked with the same chemical agent.

Chemical Hazard Area Determination. Hazard areas in the form of grid coordinates are automatically determined from the weapon used, the wind data entered, and the effects to be achieved.

Results. The chemical target analysis output report (FSE;9211) contains recommendations of up to 12 solutions based on the following criteria:

- Those that produce optimum casualties.
- Those that produce more than optimum casualties but fewer than the upper limit.
- Those that produce fewer than optimum casualties but more than the lower limit.
- Those that produce more casualties than the upper limit.
- Those that produce fewer casualties than the lower limit.

Solutions that are printed are the four best overall, up to four additional GB, and up to four additional VX. Tube recommendations that are included in the four best overall will not be printed within the four additional GB or four additional VX. If there are less than four best overall solutions, the additional GB or VX solutions will not be printed. Also, the CHA will be printed along with any geometry measures that are violated.

NUCLEAR TARGET ANALYSIS

The NTA function of the FSE program at div arty provides selection of the most appropriate nuclear weapon for attack of a specific target. Either the target-oriented or the preclusion-oriented method of analysis is used. The results of NTA are used to—

- Determine methods of attacking a target to obtain desired nuclear effects.
- Analyze multiple targets for attack with a single yield.
- List nuclear yields that will destroy a set of targets.
- Analyze nuclear targets of opportunity.
- Analyze vulnerability of friendly units.
- Provide input data for nuclear fire planning.

With TACFIRE, nuclear target analysis is accomplished in three phases: preanalysis, analysis, and postanalysis.

Preanalysis. The preanalysis phase establishes the criteria to be used in the analysis phase. These criteria are the FSE files, to include the COMCRIT file and appropriate SPRT, AFU, and MET files.

Analysis. TACFIRE can perform both the preclusion-oriented and the target-oriented methods of analysis. In the preclusion-oriented method, a specific aimpoint is analyzed to determine the best weapon to use for maximum area coverage while not violating limiting requirements. There are four distinct types of target-oriented analysis with TACFIRE. They are single target nuclear analysis (STNA), nuclear target of opportunity (NTOP) analysis, remote nuclear analysis (RNA), and nuclear fire planning analysis. TACFIRE can help refine and schedule a nuclear package. TACFIRE will perform nuclear target analysis and list target attack recommendations for employment against a target.

Single target nuclear analysis. The STNA obtains recommendations for nuclear attack against a scheduled or an on-call nuclear target. Targets for current operations or single targets in a nuclear fire plan are analyzed. Criteria such as IGAMMO, ignore nuclear allocations (IGALLO), and number of alternatives (ALTERN), entered with the request for analysis, will override the COMCRIT file data. For criteria not entered, the COMCRIT file provides the missing data. One through nine solutions may be requested; however, if fire unit (or FU and launch site) and one yield are entered, only one solution will be output.

Nuclear target of opportunity analysis. The NTOP analysis obtains a recommendation for nuclear attack against a target of opportunity. To expedite the attack on a target of opportunity, the solution contains one recommendation that reflects the largest yield/best effects that may be used to defeat the target. Aircraft are not considered for NTOP analysis.

Remote nuclear analysis. The RNA option is always for analysis by an FSO; however, it may be used by the division FSEs. The results of RNA are not stored, and an RNA target cannot be included in a nuclear fire plan. Only one recommendation is output if input by an FSO. Division FSE can request up to nine alternatives. If the request was not initiated by division FSE or div arty, exceptions are not calculated and output.

Nuclear fire planning analysis. All targets in the fire plan are analyzed (except those previously analyzed in STNA). The output reports contain the analysis for each fire plan target.

NUCLEAR TARGET ANALYSIS OUTPUTS

OUTPUT MESSAGE (NUMBER)	TYPE ANALYSIS				
	PRECL	FPLAN	STNA	NTOP	RNA
Nuclear weapon summary (FSE;9216)		X	X		
Nuclear target exception list (FSE;9215)		X	X	X	X[1]
Nuclear target alternative list (FSE;9214)		X	X	X	X
Safety and contingency distance (FSE;9213)		X	X	X	X
Desired ground zero proximity (FSE;9217)		X			
Preclusion oriented (FSE;9218)	X				

X = output

[1]Computer will not generate the FSE;9215 report if an FSO initiated the remote nuclear analysis.

Multiple Target Analysis. Multiple target analysis is used to link up to nine targets together for attack by a single weapon, to obtain a nuclear analysis of the individual target elements, and to cause the assignment of the multitargets to a fire unit. The procedures used for multitarget analysis are as follows:

- Determine the targets to be attacked as a multitarget.
- Enter each of the targets in the NUCD file (if not previously entered).
- Analyze the targets.
- Determine the maximum distance that ground zero can be displaced from each target.

Maximum Displacement. TACFIRE determines the maximum distance desired ground zero (DGZ) can be displaced from a target location and still have a 90-percent assurance of attaining the desired effects. The maximum displacement report (FSE;9221) determines the distance that DGZ can be displaced from each of the targets under analysis. The following are procedures for such determinations:

- For each yield, graphically plot each target with a radius equal to the maximum displacement distance (MAXD) derived from the FSE;9221 report.
- Select a DGZ in an area common to the intersecting radius. Input the DGZ, target numbers, fire unit, fuze option, and yield into TACFIRE. When these are not manually selected, the computer automatically selects the primary solution for attack of a nuclear target.

NUCLEAR FIRE PLAN

The primary purpose of the nuclear fire plan is to create a nuclear schedule of fires, to include specific and relative time restrictions, target priorities, and preinitiation data. When the schedule has been generated by TACFIRE and approved, the fire plan can be transmitted to the affected fire units. A maximum of 64 targets per plan can be scheduled.

Targets are scheduled to provide a nuclear schedule of fires either for a nuclear fire plan or for integration of a nuclear schedule with a nonnuclear fire plan. TACFIRE will schedule the fires in the minimum time necessary to attack the targets. Because of the increased lethality of nuclear weapons, various factors are considered when scheduling is conducted.

Before the scheduling portion of the NFP analysis, targets are sorted and ordered based on operator input considerations. Considerations are as follows:

- Targets designated with specific time restrictions are ordered first.
- Targets designated with relative time restrictions are ordered next by the computer.
- Other targets are ordered by priority first and then by sensitivity to preinitiation.

EXAMPLE OF TARGET ORDERING

NUCD FILE TARGETS	SPECIFIC TIME RESTRICTION	NUMBER OF RELATIVE TIME RESTRICTIONS	PRIORITY	SENSITIVITY TO PREINITIATION	ORDER OF CONSIDERATION FOR SCHEDULING
1			3	1	8
2			1	3	7
3	NTIME = 5				2
4		2	3	3	5
5	NTIME = 5				1
6		3	1	1	3
7		2	3	2	6
8		2	1	3	4

NTIME = Nuclear firing time

Other targets are scheduled so as not to violate delay times. The computer will consider all restrictions and schedule the plan using the minimum time.

POSTANALYSIS

In the postanalysis phase, fallout and the effects of nuclear blast on friendly troops are examined. During this phase, analysis results are also evaluated and any scheduling problems resolved, files are updated, and any reanalysis is performed on single targets.

FALLOUT PREDICTION

The FSE fallout prediction function provides information regarding the radiological effects of nuclear fallout. This function generates fallout predictions for planned friendly or received enemy nuclear bursts. Once a target is analyzed for attack by friendly forces or when a nuclear surface burst sighting report is received and confirmed, the FSE, using TACFIRE, prepares and transmits fallout prediction for the friendly units and locations in the area of the predicted fallout. The results of fallout prediction can be disseminated by TACFIRE to FA units and FSOs in the affected areas. The FSE program retrieves met data for use in fallout prediction. The fallout prediction that is produced determines the downwind distance for zone I, zone II, and any friendly units that are in the contaminated area.

REPORTING NUCLEAR STRIKES

The nuclear burst sighting report (NBC1NU) is used to report the sighting of a nuclear burst. If the minimum azimuth (AZMIN) and azimuth separation (AZSEP) criteria in the COMCRIT file are satisfied, three polar reports, one polar report and one coordinate report, or two coordinate reports (within ±3 minutes) serve to confirm the burst sighting. As soon as the sighting is confirmed, a fallout prediction (NBC3) report is generated and reflects any friendly units in the contaminated area.

VULNERABILITY ANALYSIS

The FSE vulnerability analysis function is used to determine the vulnerability of friendly troops to a nuclear strike. A vulnerability analysis may be performed for the following:

- A single friendly unit or units.
- Friendly units for all targets in a plan.
- All units of a particular type/subtype or nuclear type.

The program determines the radius of vulnerability based on the input yield, target type and subtype, or vulnerability category. The distance from the actual ground zero to the friendly unit is determined. If there is any overlap distance, that distance will be identified.

PTA OUTPUT REPORTS

HE Cannon (FSE;9201). This report provides HE cannon attack by div arty and/or supporting conventional naval gunfire recommendations.

HE Missile/Rocket (FSE;9202). This report provides HE missile and rocket attack recommendations.

HE Air (FSE;9203). This report provides HE air strike recommendations. Effects specified are only those associated with the air strike.

Chemical Cannon (FSE;9204). This report provides chemical cannon attack recommendations.

Chemical Air (FSE;9206). This report provides chemical air attack recommendations.

PTA Effective Units and Exceptions (FSE;9207). This report provides PTA exceptions and effective units for preliminary HE and chemical analysis.

Recommendation for Nuclear Attack (FSE;9208). This report provides nuclear attack recommendations.

Nuclear Ammunition Assigned (NUCAM) or Nuclear Ammunition Allocation (NUCAL) (FSE;9209). This report provides a summary of yields and weapons that are assigned or allocated to a plan.

Nuclear Exceptions (FSE;9210). This report lists fire units considered for nuclear PTA but not recommended. The reason for nonrecommendation of the fire unit is also listed.

CTA OUTPUT REPORT (FSE;9211)

This report provides chemical attack recommendations. Up to 12 recommendations may be output.

NTA OUTPUT REPORTS

Safety and Contingency Distances (FSE;9213). This report provides safety and contingency distances for NTA targets. The report is printed by specifying PRNTCE in the FSE;NANAL or FSE;CRITER message.

Nuclear Target Alternative List (FSE;9214). This report lists the fire unit, yield, and height-of-burst (HOB) combinations that can defeat each target. The number of alternatives is limited by the ALTERN field of the FSE;NANAL or FSE;CRITER message. The combinations are listed in the order of largest yield and best effects criteria. The first alternative will be used for scheduling by NFP unless the operator manually assigns another recommendation.

Nuclear Target Exceptions List (FSE;9215). This report lists fire units that are exceptions following NTA. The exceptions printed are determined by the EXCEPT field in the FSE;NANAL or FSE;CRITER input message.

Nuclear Weapon Summary (FSE;9216). This report contains a summary of the number of rounds for the primary assignments, and allocations, of nuclear ammunition by mark and yield required to execute the nuclear fire plan. The LISTYD field must be specified in the FSE;CRITER message to request this report. It is also printed as a result of the NTA request using the FSE;NANAL input message.

DGZ Proximity (FSE;9217). This report lists target pairs whose actual or adjusted distance is less than that specified in the distance (DIST) field of the FSE;CRITER message. It is printed when FPLN is specified in the FSE;NANAL message and targets violate the distance criteria.

Nuclear Vulnerability (FSE;9220). This report lists the vulnerability of friendly units in the target area of a nuclear strike.

Maximum Displacement (FSE;9221). This report provides the maximum displacement distance from each target for the target/fire unit/yield combination specified in the FSE;MAXD input message or for all units, if not specified on the MAXD message.

NUCLEAR FIRE PLAN OUTPUT REPORTS

Nuclear Fire Plan (FSE;9222). This report provides a nuclear schedule of fires for a nuclear fire plan. It is output when an FSE;NSCD message is processed.

Nuclear Schedule of Fires (FSE;9223). This report reflects the nuclear schedule of fires relative to H-time for each target.

FALLOUT OUTPUT REPORTS

Wind (Effective Downwind Message) (FSE;9224). This report lists the wind parameters that are effective in predicting fallout with the M5A2 radiological fallout area predictor.

Fallout Prediction for Friendly and Enemy Nuclear Bursts or NBC3NU (FSE;9225). This report provides data that define zones I and II areas of fallout prediction.

CRITERIA OUTPUT REPORTS

Commander's Criteria File, PTA Criteria (FSE;9226). This report lists the criteria to be used during PTA processing as entered with the FSE;PTA input message.

Commander's Criteria File, PTA Exclusions (FSE;9227). This report lists the exclusions to be used during PTA processing as a result of the FSE;PTAXCL input message.

Commander's Criteria File (NTA, CTA, FP, NFP Criteria) (FSE;9228). This report lists the criteria to be used during NTA, CTA, FP, and NFP as a result of entry of the FSE;CRITER message.

Commander's Criteria File (NTA and CTA Exclusions) (FSE;9229). This report lists NTA and CTA exclusions entered with the FSE;XCLUDE input message.

Nuclear Target Segmentation (FSE;9231). This report lists the segments

of an input nuclear target. It is received only if the FSE;NTGT message data meet segmentation criteria.

ATI DATA OUTPUT REPORT (FSE; 9230)

This report reflects, for comparison, the target information contained in the ATI file and the information specified for the input fire mission. It also provides the distance between the FM and ATI data and the number of targets within 1 km of the input data.

FILE DATA REPORTS

Nuclear Development File (FSE;9232). This file lists the contents of the NUCD file for a specified plan.

Nuclear Allocation File (FSE;9233). This file lists the allocation of nuclear weapons for the specified plan.

Friendly Unit File (FSE;9234). This file lists the contents of the friendly unit file for the specified plan.

WARNING OUTPUT REPORTS

Chemical Warning (FSE;9235). This report provides a warning at div arty that a chemical fire mission has been transmitted.

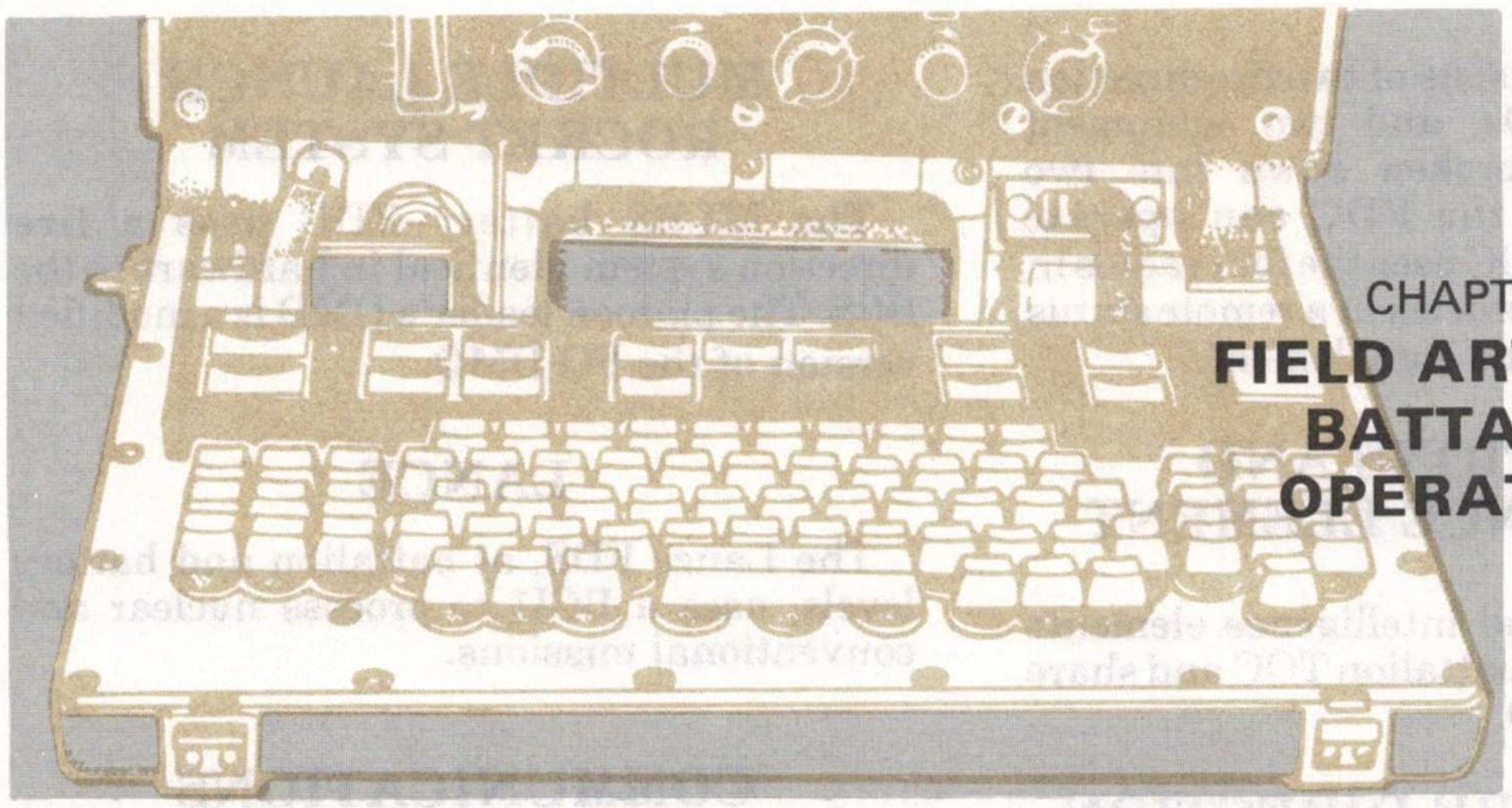
Nuclear Warning (FSE;9236). This report provides a warning at div arty that a nuclear fire mission has been transmitted.

Nuclear Warning (With Fallout Prediction) (FSE;9237). This report provides a warning at div arty that a nuclear fire mission has been transmitted and includes fallout prediction for the mission.

Nuclear Schedule Warning (FSE; 9238). This report is output at div arty when the FSE directs transmission of a nuclear schedule of fires.

ERROR AND WARNINGS

All error and warning messages associated with the division FSE are identified as FSE;9239.



CHAPTER 7

FIELD ARTILLERY BATTALION OPERATIONS

The battalion TACFIRE computer can work independently of or in conjunction with a BCD computer. It provides a comprehensive and responsive command and control system for the battalion commander, his staff, and the fire support sections. This chapter presents operational guidance to help personnel of each functional element in an FA battalion understand how TACFIRE enhances mission accomplishment.

SECTION I
ORGANIZATION AND EQUIPMENT

The TACFIRE computer not only calculates tactical and technical fire control solutions; it also provides automated data processing of other functions for subscribers using remote terminals. The computer stores many forms of command information and can prompt operators to initiate fire support coordination. The DS battalion computer typically processes information from the O/I element, the fire support sections, the force artillery headquarters, the fire support teams, the attached/OPCON radar sections, the attached/OPCON FAAOs, the battery FDCs, and the mutual support computer. A GS battalion may also process command and control functions for organic MLRS units.

NOTE: *The following paragraphs highlight TACFIRE-related equipment only.*

BATTALION FIRE DIRECTION CENTER

The battalion (bn) FDC operates the computer OA-8389/GSG-10(V). The computer and associated peripheral devices are inside an S-280 shelter mounted on a 5-ton truck. A second 5-ton truck carries cargo. A single AN/MJQ-15 power plant, consisting of two trailer-mounted generators, powers the shelter components.

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The FDC section consists of two fire direction officers, two ACCOs, and two equipment specialists. When broken down into two three-man shifts, the FDC can operate continuously. The FDC uses the four radios in the command post vehicles in a remote status as its communications complement.

OPERATIONS AND INTELLIGENCE ELEMENT

The operations and intelligence elements are collocated in the battalion TOC and share the use of a VFMED.

BATTERY FIRE DIRECTION CENTER

The battery (btry) FDC uses a battery computer system.

FIRE SUPPORT SECTIONS

Each fire support section at maneuver battalion and brigade uses a VFMED. Also, each battalion FSS has a FIST DMD with which to communicate with each FIST and battalion mortar FDC.

FIRE SUPPORT TEAM HEADQUARTERS

The FIST HQ uses both a FIST DMD and an FO DMD. The FIST HQ uses the FIST DMD to communicate with its normal subscribers. Whenever he needs to leave the FIST HQ, the company FSO can use the FO DMD to communicate with the FIST DMD.

FORWARD OBSERVERS

Each FO party uses an FO DMD.

FIELD ARTILLERY AERIAL OBSERVERS

Each FAAO uses an FO DMD.

RADAR

Each radar section uses either an FO DMD or a DMD emulator.

MULTIPLE LAUNCH ROCKET SYSTEM

The MLRS battery FDC uses a fire direction system identical in hardware to the BCS. The platoon leader's DMD is a modified version of the FO DMD.

LANCE

The Lance FDS, at battalion and battery levels, uses a BCU to process nuclear and conventional missions.

COMMUNICATIONS

DIRECT SUPPORT BATTALIONS

Radio. The DS battalion with TACFIRE requires four digital internal FM radio nets: the operations/fire (OPS/F) net and three fire direction (FD) nets. There is also an assigned retransmission frequency that should be compatible with these internal frequencies. The battalion operates on two digital external FM nets: one of the three div arty operations (OPS) nets and the battalion OPS/F net of the battalion acting as the mutual support unit. The DS battalion uses this net only when controlling its MSU subscribers.

The fire direction nets (FD1, FD2, FD3) are used for fire mission processing. The battalion OPS/F net is used for fire support planning and coordination between the brigade FSE, battalion FSEs, and DS FA battalion TOC.

The battalion retransmission stations provide the same retransmission capability as in a non-TACFIRE DS battalion. Also, all fire support vehicles have retransmission capability and the FIST DMD at FIST HQ and at battalion and brigade (bde) FSSs can relay digital messages.

The battalion also operates in the div arty command/fire direction (CF1 and CF2) (SSB radioteletypewriter [RATT]) nets. Often, units use the CF1 net as an additional means to transmit TACFIRE data instead of using the teletype.

Wire. The battalion installs a wire system similar to that of the non-TACFIRE

battalion. The battalion should use the wire system, when available, rather than the radio to transmit digital communications. Priorities for wire lines are:

- From the DS battalion computer to the brigade FSS VFMED and firing batteries.
- From the DS battalion computer to the multichannel terminal at the maneuver brigade to the div arty TOC and MSU TACFIRE computer.
- From the DS battalion switchboard to the brigade switchboard for common-user telephone service throughout the division communications system.

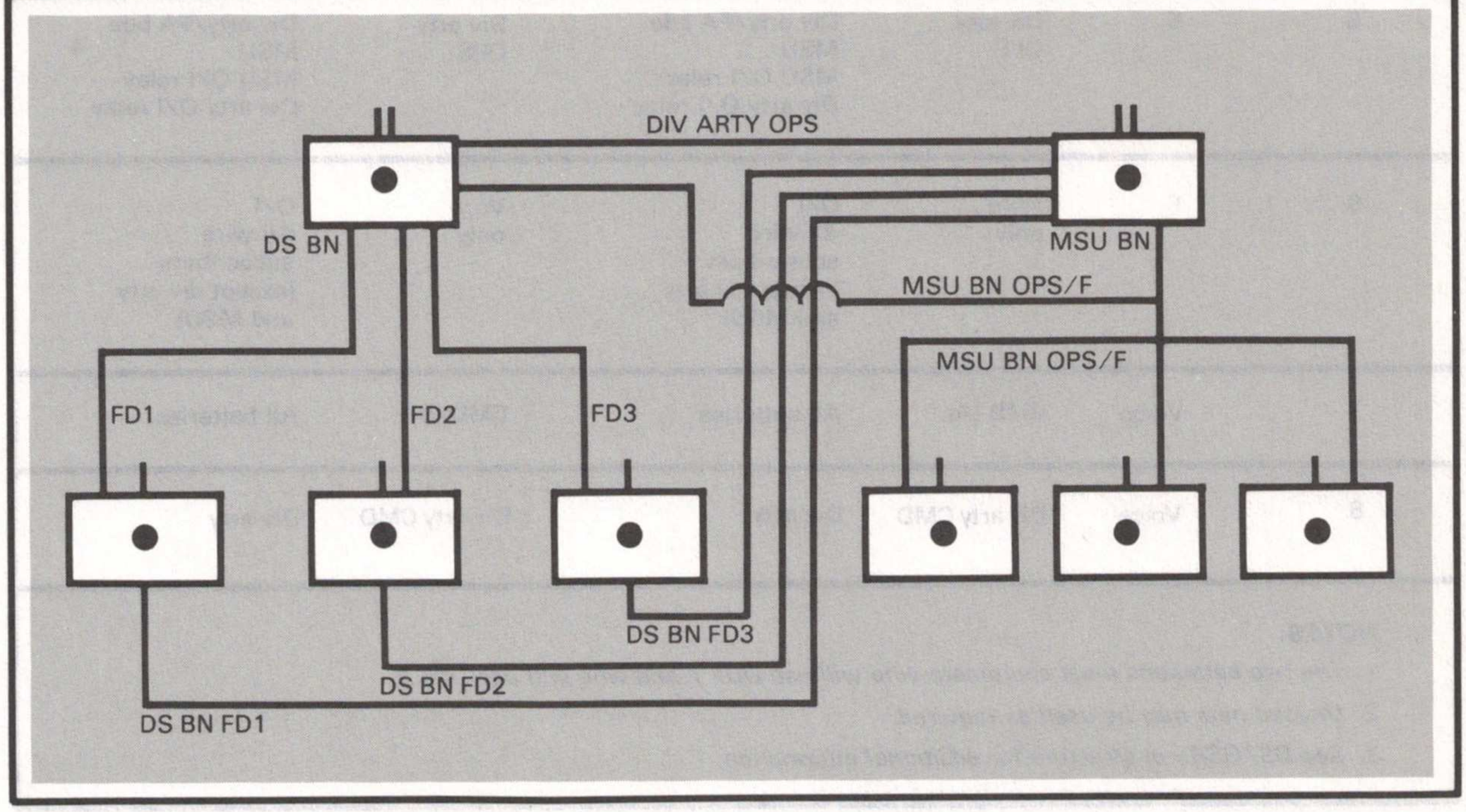
GENERAL SUPPORT BATTALIONS

Radio. The GS battalion with TACFIRE normally uses one internal OPS/F (FM digital) net to control organic batteries. The battalion habitually operates in one of the external div arty OPS nets. Operations in other external nets depend on MSU operations. The battalion operates in the div arty CF2 (SSB RATT) net and will operate in the CF1 (SSB RATT) net to monitor met data. The div arty CF1 net may be used for TACFIRE communications instead of teletype.

All GS battalions with TACFIRE are equipped to provide mutual support to another battalion and to assume the role of a DS battalion. When a GS battalion is the MSU for a DS battalion, it can use one of the div arty OPS (FM digital) nets for the computer-to-computer link. However, for ease in transferring MSU control, it is recommended that the GS battalion use its external div arty OPS frequency for the computer-to-computer continuity link. When it assumes the role of a DS battalion, the GS battalion will use the DS battalion FD1, 2, and 3 frequencies. When the GS battalion performs as MSU and assumes the role of another GS battalion, it will use the OPS/F net of that battalion.

Wire. The wire requirements of the GS TACFIRE battalion are similar to those of the non-TACFIRE battalion in that the prime consideration is to obtain entrance into the division multichannel system. A sole-user line, if available, should be used for digital traffic.

MUTUAL SUPPORT COMMUNICATIONS STRUCTURE



Mutual Support Configurations. The following tables illustrate typical net configurations for three mutual support arrangements. These are guides only and have been designed primarily to simplify the MSU mission. Battalions should reconfigure their net structures based on the tactical situation to optimize their communications capabilities.

BATTALION NET STRUCTURE FOR GS-GS MUTUAL SUPPORT UNIT

CCU NET	DDT	GS BATTALION (A)		GS BATTALION (B)	
		NET	SUBSCRIBERS	NET	SUBSCRIBERS
1	A	OPS/F	Batteries A, B, C	MSU OPS/F	Same
2	B	MSU OPS/F	Same	OPS/F	Batteries A, B, C
3	C				
4	D				
5	E	Div arty OPS	Div arty/FA bde MSU MSU O/I relay Div arty O/I relay	Div arty OPS	Div arty/FA bde MSU MSU O/I relay Div arty O/I relay
6	F	Wire only	O/I All wire subscribers (except div arty and MSU)	Wire only	O/I All wire subscribers (except div arty and MSU)
7	Voice	CMD (A)	All batteries	CMD (B)	All batteries
8	Voice	Div arty CMD	Div arty	Div arty CMD	Div arty

NOTES:

1. *The two battalions must coordinate who will use DDT 1 and who will use DDT 2.*
2. *Unused nets may be used as required.*
3. *See DS/GSR net structure for additional information.*

BATTALION NET STRUCTURE FOR DS–GSR MUTUAL SUPPORT UNIT

CCU NET	DDT	DS BATTALION		GSR BATTALION	
		NET	SUBSCRIBERS	NET	SUBSCRIBERS
1	A	FD1	Btry A Bn FSO (FIST DMD) Observers	DS bn FD1	DS bn subscribers
2	B	FD2	Btry B Bn FSO (FIST DMD) Observers	DS bn FD2	DS bn subscribers
3	C	FD3	Btry C Bn FSO (FIST DMD) Observers	DS bn FD3	DS bn subscribers
4	D	GSR bn OPS/F	GS bn subscribers Bn FSOs (VFMED) Bde FSO Radar	Bn OPS/F	Batteries A, B, C Observers LOs
5	E	Div arty OPS	Div arty/FA bde MSU MSU O/I relay Div arty O/I	Div arty OPS	Div arty/FA bde MSU relay Div arty O/I
6	F	Wire only	O/I All wire subscribers (except div arty and MSU)	Wire only	O/I All wire subscribers (except div arty and MSU)
7	Voice	Bn CMD	All batteries O/I	Bn CMD	All batteries LOs O/I
8	Voice	Div arty CMD	Div arty	Div arty CMD	Div arty

NOTES:

1. Units assigned as MSU must make careful and thorough coordination. This includes:

- *Screening sequence identification numbers (SID) and physical address assignment for compatibility (changing as needed).*
- *Providing CEOI call signs and frequencies for all subscribers and nets.*
- *Ensuring that this information is disseminated to all subscribers. Without it, fire units cannot give SHOT to observers.*

2. The brigade FSO can be on—

- *Wire only net.*
- *Least busy FD net.*
- *Div arty/MSU OPS net.*

BATTALION NET STRUCTURE FOR DS-DS MUTUAL SUPPORT UNIT

CCU NET	DDT	DS BATTALION (A)		DS BATTALION (B)	
		NET	SUBSCRIBERS	NET	SUBSCRIBERS
1	A	FD1 (A)	Btry A Bn FSO Observers Bde FSO	FD1 (A)	DS bn (A) subscribers
2	B	FD2 (A)	Batteries B and C Bn FSOs Observers	FD1 (A)	DS bn (A) subscribers
3	C	FD1 (B)	DS bn (B) subscribers	FD1 (B)	Btry A Bn FSO Observers Bde FSO
4	D	FD2 (B)	DS bn (B)	FD2 (B)	Batteries B and C Bn FSOs Observers
5	E	Div arty OPS	Div arty/FA bde MSU MSU O/I relay Div arty O/I relay	Div arty OPS	Div arty/FA bde MSU MSU O/I relay Div arty O/I relay
6	F	Wire only	O/I All wire subscribers (except div arty and MSU)	Wire only	O/I All wire subscribers (except div arty and MSU)
7	Voice	Bn CMD (A)	All batteries and O/I	Bn CMD (B)	All batteries and O/I
8	Voice	Div arty CMD	Div arty	Div arty CMD	Div arty O/I

NOTES:

1. MSU between two DS units is the most demanding on TACFIRE because of possible communications overload (up to 90 subscribers are conceivable). To prevent communications overload, implement surge operations IAW unit SOP.

2. The two battalions must coordinate who will use DDTs 1 and 2 and DDTs 3 and 4. (Allocation of FD1 through 4 as shown is only for illustration. Any nets may be used as long as they are coordinated with the MSU.)

3. Observers should be divided evenly between the FD nets. Ensure that all batteries know to which net each observer is assigned.

4. See DS/GSR net structure for additional information.

MUTUAL SUPPORT CONSIDERATIONS

The following discussion highlights mutual support considerations that are unique to a battalion. For a general discussion of mutual support, refer to Chapter 5. The div arty or FA brigade commander specifies the mutual support relationships of each organic and/or attached battalion in the TACFIRE tab to the

FA support plan. Positioning and tactical missions impact heavily on mutual support capabilities. Therefore, the force artillery headquarters should establish mutual support relationships on a case-by-case basis. They should be based on tactical mission tailoring, positioning requirements, and other considerations as they apply.

DIRECT SUPPORT BATTALION

The preferred mutual support unit for a DS battalion is an R or a GSR battalion. This preference is due to the nature of the command relationships and digital communications requirements. The least preferred MSU for a DS battalion is another DS battalion. Since a battalion is limited to four digital fire nets, a DS battalion must double up two battalion task forces on two or more fire nets during MSU operations. Supporting two maneuver brigades puts a heavy load on a limited communications capability. The divisional GS battalion can support the subscribers of a DS battalion as well as a corps artillery battalion.

DIVISIONAL GENERAL SUPPORT BATTALION

The preferred MSU for a divisional GS battalion is a corps artillery GS battalion under div arty control. Other alternatives include (in order of preference) GSR, R, and DS battalions. The latest BCD-level software requires four core memories to function. Therefore, the GS battalion cannot load and operate as a div arty system for mutual support to div arty as it could with early software versions.

NONDIVISIONAL GENERAL SUPPORT BATTALION

The nondivisional GS battalions may provide mutual support for one another or for divisional battalions, depending on the tactical mission (or attachment) of the FA brigade to which they are attached.

LIAISON OFFICERS

When a mutual support computer takes control of the subscribers of a displacing battalion, the displacing battalion commander in effect delegates operational control of his unit to the MSU. For better continuity, the displacing commander can elect to send the S3 or one of his assistants to the MSU TOC to monitor and assist in the MSU operations until the displacing computer once again takes control of its own subscribers.

TACTICAL CONFIGURATIONS

There are several ways that an FA battalion S3 can configure a TACFIRE-equipped tactical operations center. The options presented here apply specifically to a DS battalion. Other units can apply these principles to their own situations. The discussion here is based on the position requirements listed in Chapter 2.

OPTION 1

The S3 collocates the TACFIRE computer with the O/I element in DS battalion headquarters. This option features face-to-face coordination and communication among all staff personnel and the most responsive emplacement and displacement of TACFIRE equipment. The primary drawback is greater vulnerability to enemy counterfire, particularly if radios are not remoted out of the TOC.

OPTION 2

The S3 places the TACFIRE computer as far from the O/I element as is practical. The O/I VFMED should communicate with the computer by wire, if possible. If the wire line fails or is not available, the VFMED operator should use a radio on a designated digital net. This arrangement enhances the survivability of a battalion against counterfire. However, face-to-face coordination between the O/I element and the FDC is degraded.

OPTION 3

The S3 leaves the TACFIRE computer in the DS battalion HQ area and collocates the O/I track with the VFMED with the brigade command post (CP). This option enhances responsiveness of information gathering and fire support integration. The brigade FSO can follow the brigade commander with the brigade FSS VFMED.

OPTION 4

The S3 collocates the TACFIRE computer and O/I VFMED with the maneuver brigade

CP. This option combines the advantages of options 1 and 3. However, it does increase the vulnerability of the TOC to enemy counterfire.

FIRE SUPPORT CONSIDERATIONS

REINFORCING FIRES

The capabilities of the TACFIRE computer give a DS battalion two options for using the fires of a reinforcing battalion. The option used depends on the need for centralized control by the DS battalion based on the tactical situation. Option 1 applies only to a DS-R relationship. Option 2 can apply to DS-R and DS-GSR relationships.

Option 1. The DS battalion tactically controls all six firing batteries. The FDC includes the reinforcing unit batteries in its AFU files and transmits missions directly to them. The reinforcing battalion TOC monitors the battle through MOI processing and remains prepared to assume mutual support operations. When the reinforcing battalion is equipped with TACFIRE, this option strips the TOC of control of its firing batteries. When the reinforcing battalion does not have TACFIRE but has BCS-equipped batteries, this option provides the centralized and responsive control afforded by TACFIRE.

Option 2. The R or GSR battalion tactically controls its own firing batteries. The reinforced unit transmits requests for additional fire to the reinforcing battalion computer to fire the mission. The reinforcing battalion generates its own tactical fire control solutions and coordinates its own fires.

DEDICATED BATTERY

TACFIRE facilitates operations with a dedicated FA battery in support of a maneuver company in a movement to contact. The ACCO excludes the dedicated battery from tactical fire control processing, while the FDO directs the firing battery FDC to initate autonomous operations with the company FIST. Excluding the dedicated battery from TFC processing does not preclude processing of other functions. However, TACFIRE does not monitor ammunition expenditures when a battery operates autonomously. Therefore, the battery FDO should transmit all current AFU data to update TACFIRE files when the battalion FDC resumes control of the firing battery.

SECTION II

OPERATIONS

The guidance in this section only touches the surface in terms of TACFIRE capabilities. However, for personnel with little or no TACFIRE experience, it presents a basic framework of how each element uses TACFIRE for data processing for its functions.

BATTALION FIRE DIRECTION CENTER

The FA battalion FDC initializes, operates, and maintains the battalion computer. It supports each of the battalion subscriber ADP requirements, computes the tactical and technical fire control solutions, and directs and controls the fires of organic and supporting FA units in support of current operations. It is the NCS for each of the battalion internal digital nets. The FDC regularly exchanges data with the MSU and the force artillery headquarters. The FDC personnel advise the battalion S3 of TACFIRE-related situations that warrant his attention.

OPERATING SYSTEM

The FDC personnel program the operating system to establish the digital communications network, processing capabilities for each subscriber, COMSEC parameters, MOI processing, relay functions, and technical system operating parameters. The FDO or ACCO receives guidance for programing the operating system from the S3, OPORD, OPLAN, FA support plan, or SOP.

TACTICAL DATA

The computer must have basic elements of tactical data stored in memory to effectively process combat information. This tactical data base includes the functions of the SPRT, AFU, and MET programs. The programs include the geographical area of interest, zones and boundaries of the supported force, fire unit operations and technical data, ammunition status, controlled supply rates, fire support coordinating measures, friendly unit vulnerability postures, MAP MOD, and computer met data. The FDC does not normally generate any of this; tactical data are submitted to the computer through the joint efforts of the force artillery headquarters, battalion O/I element, fire support elements, mutual support unit, and firing batteries. The FDC can check battlefield geometry data and some graphical firing unit data by making a graphical display on the digital plotter map. The data displayed include the zones and boundaries of the brigade and maneuver battalions, fire unit locations and range fans, and fire support coordinating measures. The FDC can prepare overlays of the tactical situation for use by the operations element. When all tactical data have been submitted and stored in the computer, the ACCO can direct the computer to print a hard copy of all tactical data and pass it to the operations element to review and resolve discrepancies.

FIRE MISSIONS

The FDC receives fire mission requests from FISTs, FSEs, radars, FAAOs, force artillery headquarters, the reinforced battalion, and the O/I element. The computer displays warnings of violations of fire support coordinating measures with the fire control solution for each mission. Using the warnings along with the target plot on the digital plotter map, the FDO can quickly start coordination by contacting the FSE or battalion S3. After reviewing the fire control solution, the FDO or ACCO can either recompute, delete, or transmit the fire commands, request for additional fire, and message to observer.

FIRE PLANNING

The FDC provides the ADP support for all of the battalion fire planning efforts, to include the fire planning inputs of the respective FSSs. When the fire plan is executed (computed), the FDO reviews the summary of fire commands, checking for ACA violations, FU mask violations, and other scheduling problems associated with technical fire control. After resolving all discrepancies, the FDO can again execute and transmit the fire commands to the firing batteries.

ARTILLERY TARGET INTELLIGENCE

When the battalion ACCO processes incoming ATI messages, the computer automatically forwards the target information to the BCD computer at force artillery headquarters. Also, the computer forwards information copies to all subscribers set up for MOI processing for that format.

OPERATIONS/ INTELLIGENCE ELEMENT

The operations/intelligence element uses a VFMED to coordinate the battalion fire support requirements. The VFMED not only can access the battalion TACFIRE computer but, using the relay function, can also access the div arty (or FA brigade) computer.

MESSAGES OF INTEREST

The O/I element can receive up to 28 types of messages of interest from the battalion computer. The MOI helps the section keep up with intelligence, fire support, and planning information. The VFMED receives and prints information copies of reports submitted to the TACFIRE computer by fire support agencies throughout the network, to include up-to-date reports on fire units.

TACTICAL DATA

The O/I element normally enters OPORD ammunition and fire unit data, such as CSR and critical ammunition levels, into the computer. The O/I element can check, troubleshoot, and correct AFU files. It can check all battlefield geometry measures, to include zones, for accuracy and completeness. When time permits, the S3 can ask the

FDC to produce tactical overlays. When a firing battery BCS is not operational, the battery normally sends its XO report to the O/I element by voice. The VFMED operator can then enter the XO report data into the computer.

FIRE MISSIONS

The O/I element can use its VFMED to initiate artillery fire missions.

NONNUCLEAR FIRE PLANNING

After coordinating with the brigade FSO, the O/I element specifies all tactical data and COMCRIT to apply to a fire plan supporting a maneuver operation. It prepares a preliminary target lsit and transmits it to the battalion fire support sections. The maneuver battalion FSOs add targets based on target lists submitted by fire support teams. The operations element resolves duplications and prepares the fire plan target list, including target phasing, attack, and scheduling instructions. The operations element prepares the schedule of fires and transmits it to the brigade FSO for review and approval. After approval of the schedule of fires, the battalion S3 directs the FDC to execute the fire plan. The FDC then computes fire commands and disseminates them to the fire units. By computing a fire plan for a future opeation, the S3 can closely estimate the required supply rate (RSR) for that operation.

FASCAM FIRE PLANNING

FASCAM fire planning procedures place the burden of identifying minefield locations and determining appropriate densities completely on the minefield planners (FSO/S3/combat engineer). Safety zones must also be identified so that the minefield location data can be properly disseminated through maneuver channels when the FASCAM is fired.

ARTILLERY TARGET INTELLIGENCE

The intelligence officer can extract targets from the div arty computer files by area, type/subtype, time, or other specified parameters. When he establishes a standing request for information, the div arty (or FA brigade) computer will automatically inform him every time a target meeting the specified criteria is reported from anywhere throughout the system.

FIRE SUPPORT ELEMENT PROGRAMS

The O/I element should report changes to the battalion CP location and vulnerability status to the div arty or FA brigade computer on the FSE;FRIEND message.

COMMANDER'S CRITERIA

The brigade assistant FSCOORD, in conjunction with the DS battalion S3, normally develops and recommends to the DS battalion commander a COMCRIT scheme to support each operation. When approved by the maneuver commander, the operations section enters new COMCRIT into the computer by use of the VFMED.

BATTERY FIRE DIRECTION SYSTEM

The cannon battery FDC is equipped with a battery computer system and can operate independently of, or in conjunction with, the battalion TACFIRE computer.

BATTERY COMPUTER SYSTEM

The BCS computes technical firing data and transmits the data directly to each howitzer section. The BCS optimizes effects in the target area by computing fire commands for each individual weapon. The ability to compute individual aiming points and firing data also means that the firing battery can occupy a larger area. This results in reduced vulnerability to counterbattery fires. The tape transport unit stores a weapon-independent program and a weapon-dependent program for 16 models of 105-mm, 155-mm, 203-mm, and 14.5-mm weapons. Further information on BCS capabilities is on pages 1-17 and 1-18.

AUTONOMOUS OPERATIONS

Autonomous operations (AUTOPS) refer to planned or emergency conditions in which a firing battery FDC does not operate in conjunction with a battalion TOC. In this

mode, the battery FDC receives calls for fire directly from its habitually associated FISTs and battalion FSO or, in the case of a GS unit, from force artillery headquarters. The battery FDO establishes manual tactical fire control parameters, since the BCS does not calculate tactical fire control solutions.

Direct Support AUTOPS. The BCS accepts digital messages from any digital device. However, the BCS does not work smoothly with a VFMED; the BCS operator must manually transmit each message format to the VFMED. The battalion FSO can use his FIST DMD much more efficiently than his VFMED to coordinate operations with the battery. The BCS operator transmits all messages to observer, SHOT messages, and SPLASH messages directly to the observers.

General Support AUTOPS. A BCD computer can interact with a BCS only if operators at both computers establish a set of procedures to enable the BCS to process missions. A BCS does not process requests for fire received from BCD computers.

Dedicated Battery. See the previous discussion of dedicated battery fire support considerations (page 7-8.)

OPERATIONS WITH TACFIRE

With TACFIRE, all calls for fire come to battalion. The battalion FDC controls the activities and procedures on digital nets. The battalion FDC keeps each battery FDC updated on all fire support coordinating measures, observer locations, known points, met data, and registration data. A BCS operator can store some of this information in the BCS. He passes other information to the battery FDO to update charts, maps, and other records. The BCS operator transmits all or parts of AFU data to battalion anytime that significant data change, the battery moves to a new position, or battalion requests file data. SHOT and SPLASH messages are sent by the BCS operator to the agency conducting the mission. TACFIRE transmits the message to observer, so the BCS operator will delete his. If the observer is operating in a fire net other than the BCS primary fire net, the BCS operator must change the frequency on his second radio to the fire net of the observer. The BCS operator will then send the SHOT and SPLASH messages directly to the observer over the second radio. Since the fire orders received from TACFIRE contain the tactical fire control solution, the BCS operator has only to execute the FM;FC to compute firing data. The BCS recomputes the mission to generate firing commands for each howitzer section.

EXECUTIVE OFFICER'S REPORT

Both the BCS and the TACFIRE store complete and detailed ammunition and fire unit data. Battery XOs must provide complete XO reports, to include projectile, propellant, and fuze *models* in addition to quantities. The battery FDO must ensure that his BCS operator enters the correct model data for each projectile, powder, and fuze. The operator can transmit many of the BCS formats to the battalion TACFIRE computer. The battery FDO determines the location of each battery dead space area and forwards it to TACFIRE.

BATTALION FIRE SUPPORT SECTION

The battalion FSS uses both a VFMED and a FIST DMD to coordinate and plan the maneuver battalion fire support requirements. The FSS uses the FIST DMD to coordinate and monitor the activities of the FISTs and uses the VFMED to submit information to and extract it from the DS battalion computer. Using the relay function, a battalion FSS can communicate digitally with the brigade FSS and extract information from the div arty computer files. The VFMED can encrypt all transmissions. The FIST DMD does not use a COMSEC device.

MESSAGES OF INTEREST

Using the VFMED, the battalion FSS can receive messages of interest from the DS battalion computer. Each FSS can establish up to 28 messages of interest to help section personnel keep up with intelligence, fire

support, and planning information. The VFMED receives and prints information copies of fire mission requests and reports submitted by fire support agencies (including FISTs) within its zone. The FSS can also use MOI processing to get up-to-date status reports on fire units.

TACTICAL DATA

The FSS uses the VFMED to send all fire support coordination data that apply to the supported maneuver force to the TACFIRE computer for update. According to unit SOP, the battalion FSS consolidates the FLOT data received from FISTs and transmits the maneuver battalion FLOT data to the TACFIRE computer. The FSS can extract the DS battalion ammunition and fire unit data, as needed.

FIRE MISSION DATA

The battalion FSS receives fire mission data through MOI processing from the battalion computer. This information is printed at the VFMED immediately after receipt of the mission at the battalion FDC. The FSS plots the target location to determine if additional coordination is required. If the mission violates friendly troop safety, the FSS initiates a check fire by voice for that mission. If a target is more suitable for engagement by mortars, the FSS cancels the mission and directs the FIST or FO to use battalion mortars. When the battalion FSO leaves the FSS, he uses the FIST DMD to communicate with TACFIRE and his section. He can direct his FISTs to give him copies of their fire requests so he can monitor their activities while away from the VFMED. Or he can direct the FSS to relay that information to him. He can request information from the battalion computer or his FSS whenever necessary, and he can also initiate fire missions from his FIST DMD.

NONNUCLEAR FIRE PLANNING

Using the VFMED, an FSS can develop a fire plan target list, disseminate and coordinate it throughout the maneuver brigade fire support agencies, refine it, and submit it to the DS battalion to execute. The FSS can compile target lists submitted by subordinate FISTs and store the target lists in the TACFIRE computer. The FSS can also participate in the preparation of the DS battalion fire plans. The company FSOs submit target lists to the battalion fire support officer. He consolidates these target lists and resolves duplications. He then prepares a target list containing battalion-level targets in coordination with the maneuver battalion S3. If div arty ATI files are available, the battalion FSO advises the DS battalion S3 of maneuver battalion target search requirements. Upon receipt of the preliminary target list, the FSO reviews the target list with the maneuver battalion S3. The battalion FSS adds those targets from the consolidated target list prepared from input from the company FSOs and forwards the changes and additions to the DS battalion. The DS battalion operations center completes the preliminary target list, enters scheduling and attack instructions, and transmits the final target list to the battalion and brigade FSSs for final coordination.

ARTILLERY TARGET INTELLIGENCE

An FSS can use either the VFMED or the FIST DMD to submit target information to the DS battalion computer. The FSS collects intelligence from all available sources, to include the maneuver battalion S2 and all fire support teams. When a div arty computer is on line, the FSS can use the VFMED to extract target information from the div arty ATI files. With a standing request for information, the div arty computer automatically informs the FSS every time a target meeting specified criteria is reported from anywhere throughout the system.

FIRE SUPPORT ELEMENT PROGRAMS

The battalion FSS can use its VFMED to report and receive FSE program information when a div arty computer is on line. By use of the FSE;FRIEND message, the FSS must report the locations of the supported maneuver unit CP and each subordinate unit and their nuclear fallout vulnerability status. The FSS can also report enemy nuclear bursts and receive nuclear fallout predictions.

BRIGADE FIRE SUPPORT SECTION

The brigade FSS uses a VFMED to coordinate the maneuver brigade fire support requirements by submitting information to and extracting it from the DS battalion computer. Using the relay function, a brigade FSS can communicate digitally with the battalion fire support sections and extract information from the div arty computer files.

MESSAGES OF INTEREST

The brigade FSS can receive MOIs from the DS battalion computer. The FSS can establish up to 28 messages of interest to help section personnel keep up with intelligence, fire support, and planning information. The VFMED receives and prints information copies of fire mission requests, AFU data, target intelligence, and reports submitted by fire support agencies within its zone. The FSS can also use MOI processing to get up-to-date status reports on fire units.

TACTICAL DATA

The brigade FSS keeps the DS battalion computer up to date on all fire support coordination data that apply to the maneuver brigade, to include zones and boundaries for each maneuver battalion. Through MOI processing, the FSS can keep abreast of changes in the FLOT. The FSS can extract the DS battalion AFU data, as needed. The FSS can use the VFMED to establish an ACA, a coordinated fire line, a free-fire area, a no-fire area, a restrictive fire area, and other FSCOORD data in the battalion computer.

FIRE MISSIONS

The brigade FSS can initiate artillery fire missions using the VFMED. When the FSS receives a fire request, it can evaluate the request by using the div arty preliminary target analysis function of the FSE programs to determine whether FA, air, or naval assets can defeat the target.

NONNUCLEAR FIRE PLANNING

Using the VFMED, an FSS can develop a fire plan target list, disseminate and coordinate it throughout the maneuver brigade fire support agencies, refine it, and submit it to the DS battalion to execute. When participating in the preparation of the DS battalion fire plan, the brigade FSS can incorporate the battalion targets into the brigade-level fire plan.

ARTILLERY TARGET INTELLIGENCE

As the brigade FSS collects intelligence information from the maneuver brigade S2, it can submit it to the DS battalion computer. When a div arty computer is on line, the FSS can extract target information from the div arty ATI files. With a standing request for information, the div arty computer automatically informs the FSS every time a target meeting specified criteria is reported from anywhere throughout the system.

FIRE SUPPORT ELEMENT PROGRAMS

The brigade FSS can use its VFMED to report and receive FSE program information when a div arty computer is on line. The FSS must report the location and nuclear fallout vulnerability status of the brigade CP and other brigade-level units by using the FSE;FRIEND message. The FSS can also report enemy nuclear bursts and receive/transmit nuclear fallout predictions. The brigade FSO can use the nuclear, chemical, and conventional target analysis routines to evaluate fire requests and the damage assessment function to predict damage and fallout danger to friendly units. The FSS can use TACFIRE to screen intelligence data to identify potential targets for nuclear attack. When nuclear strike recommendations are approved by the brigade commander, the FSS can coordinate the nuclear fire mission, strike warnings, tactical damage assessments, and fallout warnings. Upon receipt of a verified nuclear burst sighting report, the FSS can analyze the enemy's nuclear strike to determine the damage and fallout danger to selected friendly units and critical installations.

COMMANDER'S CRITERIA

The DS battalion commander or his representative is responsible for explaining

and recommending commander's criteria to the brigade commander. Therefore, the brigade FSO must know what criteria the commander must establish and have a thorough understanding of how each criterion impacts on the fire support provided to the maneuver force. When the maneuver commander approves COMCRIT for an operation, the DS battalion commander may require the brigade FSS to transmit the COMCRIT to the TACFIRE computer.

FIRE SUPPORT TEAM

The FIST headquarters uses a FIST DMD to coordinate the maneuver company fire support requirements. The FIST HQ communicates digitally with its FO parties, the battalion FSO, and the DS battalion TACFIRE computer (or autonomous firing battery) by using the FIST DMD four-channel net structure. If in a manpack configuration, the device can be connected to only one radio (with current radios). The FIST DMD connects to the G/VLLD to facilitate laser-related missions, to include self-location, target location, and Copperhead/Hellfire missions. The FIST HQ also has an FO DMD (AN/PSG-2A), which the company FSO can carry when away from the fire support vehicle (FSV). The FIST digital communications are not encrypted.

TACTICAL DATA

As directed by the battalion FSO, the FIST HQ uses the FIST DMD to collect, consolidate, and transmit FLOT data. Since the FIST does not encrypt digital traffic, FOs and FISTs should manually encrypt FLOT data on a plain-text message format. This requires users to manually decipher the data and type it into a data system.

FIRE MISSIONS

The FIST HQ uses the FIST DMD to send fire missions to the mortars (MBC-23), the battalion FSO, the DS battalion computer, or an autonomous firing battery. The FIST HQ can process missions received by platoon observers and initiate missions of its own. If the battalion TACFIRE computer or BCS has the location of each FO and FIST on file, the FIST can forward polar missions.

NONNUCLEAR FIRE PLANNING

The FIST HQ can transmit targets for use in a fire plan directly to the battalion FSS DMD or by relay through the TACFIRE computer to the VFMED.

ARTILLERY TARGET INTELLIGENCE

The FIST can report targets and combat intelligence by using grid, polar, combat intelligence, and SHELREP formats.

CONTINUITY OF OPERATIONS

If the FIST HQ cannot process calls for fire, FO parties can send calls for fire to (in order of preference) the battalion FSO, the TACFIRE computer, or the autonomous BCS.

The FIST HQ is equipped with a standard DMD in addition to the FIST DMD. Should the FIST DMD fail for some reason, the FIST HQ would revert to one of the following procedures for using its single-channel DMD:

- *Option 1:* The FIST HQ may use a voice/digital mode of operation. In this mode, the FO notifies the FIST HQ by voice of a fire request. The FIST HQ then directs the FO to the proper fire net. The FO begins his fire mission, either a voice request to the mortars or a digital request to the FA FDC. This option can be applied to all FIST HQ modes of operation. In the centralized mode, initial requests are submitted on the net. In the predesignated or decentralized mode, the FO uses either the CFC or the battalion heavy mortar FD net directly. Voice requests for FA fires are passed over the battalion fire support net. The FIST HQ ensures that voice traffic is not placed on the FA fire net. The decentralized mode of control is used only during surge periods of the battle when the FIST HQ is inundated with activity.

- *Option 2:* The FIST HQ requires the FO to use only voice requests for fire. The FIST HQ composes and transmits all FA fire missions by using its DMD. This option can be applied to all FIST HQ modes of operation. The difference from option 1 is that the FIST HQ converts voice requests for fire into digital requests for field artillery. The advantage of this option is that it allows the

FO to operate by voice only (battalion fire support net), which he can preset on his AN/PRC-77 or AN/GRC-160 radio. Option 2 allows the FIST HQ to efficiently manage company fire support assets with its single-channel DMD. In the digital world of TACFIRE, subscribers continually must inform the system of their entry/departure from the digital net. This is overcome by the use of option 2. This option centralizes all digital requests at the company level.

In the digital environment, sufficient radios may not be available for the FIST to monitor all required radio nets. Various radio nets should be monitored as follows:

- If only one radio is available, fire support is degraded significantly. The single radio is used with the FIST DMD to monitor the FA fire net. This option requires that the FIST HQ collocate with the company commander. Thus, it can respond to the fire support needs of the company. The company FSO should consider using the decentralized or predesignated method of control, allowing his observers to go directly to fire support agencies.

- If only two radios are available, fire support is moderately degraded. There are two options for the FIST—collocation with the supported commander or separate operations. If collocation is possible, the FIST HQ monitors the FA fire net (with FIST DMD) and the battalion fire support net. Thus, it can monitor the fire support nets while maintaining contact with the supported commander to keep up with his fire support needs. When collocation is impractical, the FIST HQ monitors the FA fire net and the company command net. All requests for fires must be submitted digitally on the FA fire net. If voice communications are needed, the FIST HQ must shift from the company command net to an appropriate new frequency and notify the supported commander of this action.

- If only three radios are available, there are two options for the FIST HQ—collocation with the supported commander or separate operations. When collocation is possible, the FA fire, the company command, and the battalion fire support nets are monitored. Traffic for the heavy mortars could be placed on either the FA fire net or the battalion fire support net, or the FIST HQ could predesignate the use of heavy mortars by one of its observers.

FIELD ARTILLERY AERIAL OBSERVERS

The FAAOs use a standard FO DMD (AN/PSG-2A) with a special cable (NSN 5995-01-110-6945) to interface with an aircraft FM radio. There is presently no way to plug the FO DMD into the aircraft power supply; however, the FAAO can mount batteries on the FO DMD both internally and externally. The FO DMD sits on the FAAO's lap, attached to his legs and back by the carrying straps. During daylight operations, bright light can make the FO DMD display very difficult to read. Under these conditions, the FAAO should develop a means to shade the display from direct sunlight. The FAAO can use the FO DMD to report targets and combat information, conduct fire missions, and transmit unencrypted plain-text messages. When working with a battalion TACFIRE computer, the FAAO can adjust fire on targets. If he needs to report his location, the FAAO should manually encrypt a plain-text message, since he does not use a COMSEC device.

FIREFINDER RADARS

The AN/TPQ-36 is normally attached to a DS artillery battalion and reports targets to TACFIRE. The AN/TPQ-37 is normally employed in the vicinity of a GS artillery battalion and reports targets to the div arty or GS battalion TACFIRE as directed. Both radars are currently capable of only a limited nonsecure digital interface with TACFIRE or BCS. Firefinder uses DMD emulation; therefore, the message formats currently used are modified DMD messages. Only 6 types of messages can be transmitted from Firefinder to TACFIRE, and only 10 messages can be received. Since the radar does not use a COMSEC device, operators should manually encrypt messages containing such critical information as radar/battery locations, search zones, and operating frequencies. Firefinder also can communicate directly with BCS.

NON-FIREFINDER RADARS

Non-Firefinder radars, to include the AN/TPS-25, AN/TPS-58, and AN/MPQ-4A, cannot interface directly with TACFIRE. When not equipped with a DMD, these radar sections report targets by voice to the targeting element, which can use a VFMED to either add the target to TACFIRE target files or initiate a fire mission. The radar section should use a voice net when reporting targets by voice. When equipped with a DMD, radar sections can report targets and initiate fire missions digitally. When reporting critical information (such as radar site location) on the DMD, the operator should manually encrypt it and send it as part of a plain-text message, since he does not use a COMSEC device.

MULTIPLE LAUNCH ROCKET SYSTEM

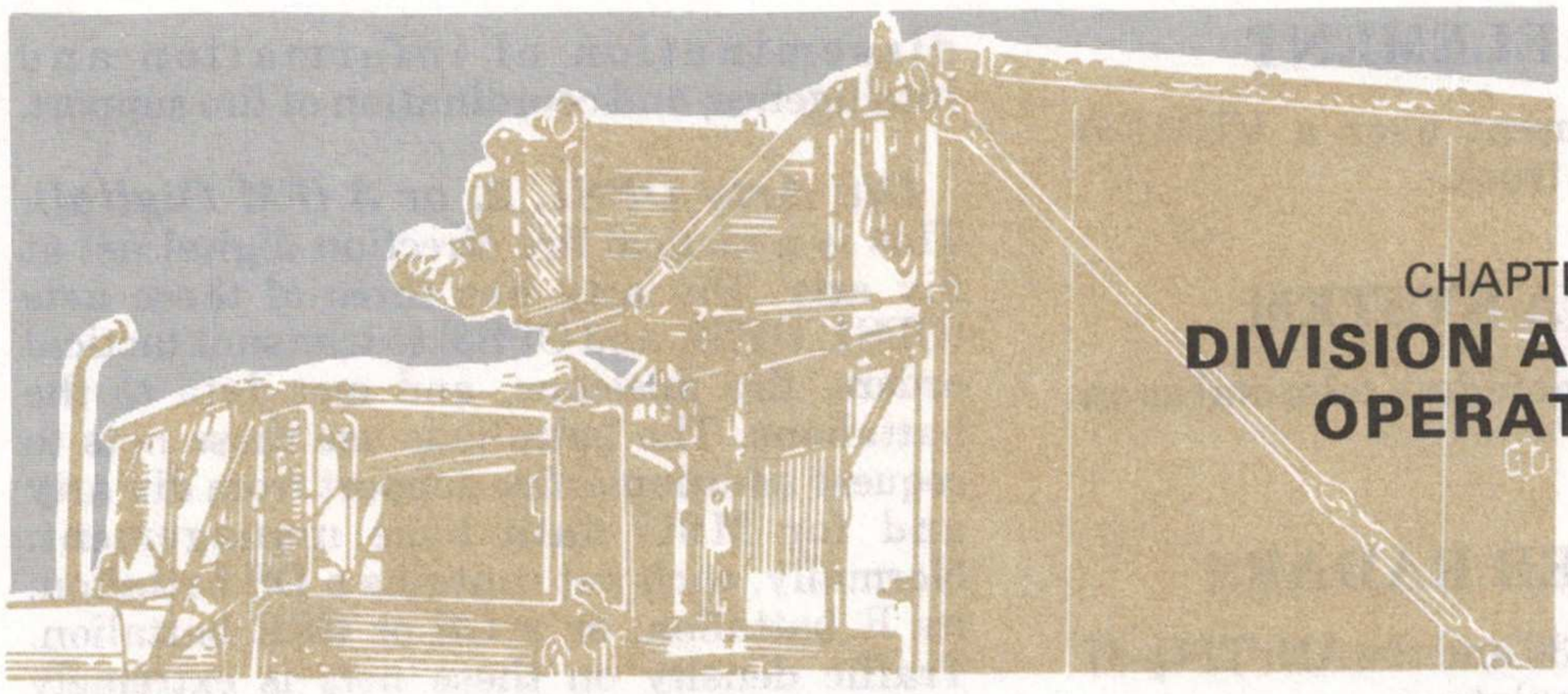
Each division artillery has one battery of MLRS launchers with three firing platoons of three launchers each. The battery uses an FDS much like a BCS. In addition, each corps artillery has a battalion of three MLRS batteries with a total of 27 launchers. The MLRS battalion uses an FDS with different software initialization to tactically control its batteries. When the battery FDS receives a fire mission from either the division artillery TACFIRE computer or the MLRS battalion FDS, it computes a tactical fire control solution to select the launcher, or launchers, to fire; firing positions to be used; and, for certain types of targets, the number of rockets and aimpoints to be used to attack the target.

Each SPLL (launcher) has an on-board fire control system (OBFCS) that computes the actual technical data required to lay, arm, and fire the rockets. The MLRS FDS is initialized much like a BCS. Operators extract information from the OPORD, SOP, CEOI, overlays, maps, and other sources to account for all tactical fire limitations.

MLRS FDS STORAGE AND UPDATE CAPABILITIES

- 5 downrange masks.
- 6 air corridors.
- 10 fire support coordinating measures.
- 81 targets.
- 18 fire units (launchers).
- 45 firing positions.
- 10 ammunition resupply points.
- 10 survey control points.
- 10 rendezvous points.
- 4 fire plans[1].

[1]The total number of targets stored in the four fire plans cannot exceed 54.



CHAPTER 8

DIVISION ARTILLERY OPERATIONS

The div arty TACFIRE computer provides a comprehensive and responsive command and control system for the div arty commander, his staff, and the division fire support elements. This chapter presents operational guidance to help personnel of each functional element in a div arty or TAB understand how TACFIRE enhances mission accomplishment.

SECTION I
ORGANIZATION AND EQUIPMENT

The computer not only calculates tactical fire control solutions but provides automated data processing of other functions by use of remote terminals. It stores many forms of command information and can prompt operators to initiate fire support coordination. The div arty computer operated by the fire control element typically processes information from the targeting element, operations element, fire support elements, radar sections, FAAOs, FA battalions, mutual support computer, corps artillery, and other FA assets as available.

NOTE: *The following paragraphs highlight TACFIRE-related equipment only.*

FIRE CONTROL ELEMENT

The computer group and most of the communications group are inside an S-280 shelter mounted on a 5-ton truck. This is called the computer shelter. Some communications equipment and the display group are in a second S-280 shelter also mounted on a 5-ton truck. This is called the display shelter. Two additional 5-ton trucks carry cargo. Two AN/MJQ-15 power plants, consisting of four trailer-mounted generators, provide power for both shelters.

TARGETING ELEMENT

The targeting element uses a VFMED. The operations element shares its use.

OPERATIONS ELEMENT

The operations element shares the use of a VFMED with the targeting element.

FIRE SUPPORT ELEMENTS

The fire support elements at the division main and tactical command posts each use a VFMED.

LIAISON ELEMENT

Each liaison element uses a VFMED mounted in an M880 truck.

MET DATA SYSTEM

The MDS uses a remote data terminal as on a VFMED.

FIREFINDER RADARS

Both the AN/TPQ-36 and the AN/TPQ-37 radars use a DMD emulator.

NON-FIREFINDER RADARS

The AN/TPS-25, AN/TPS-58, and AN/MPQ-4A can interface with TACFIRE by use of a DMD AN/PSG-2A.

FIELD ARTILLERY AERIAL OBSERVERS

Each FAAO uses an FO DMD AN/PSG-2A.

MULTIPLE LAUNCH ROCKET SYSTEM

Each MLRS battalion and battery FDC uses a fire direction system equipped with a battery computer unit and the platoon leader's DMD.

LANCE

Each Lance battalion and battery FDC uses a fire direction system that is identical in hardware to the battery computer system.

COMMUNICATIONS

NETS

The div arty computer communication control unit controls and integrates communications on eight separate nets.

Div Arty Command (FM Voice). The div arty command (CMD) net is a secure FM radio multipurpose voice net. It is used for command and control; administrative matters; collection, exchange, and dissemination of information and intelligence; and coordination of fire support.

Div Arty OPS1, 2, or 3 (FM Digital). This is a tactical fire direction digital net at div arty. Div arty has three of these nets (OPS1, OPS2, and OPS3) to transmit tactical orders, fire missions, and met data to the battalions. The battalions use these nets to request additional fire support from div arty and for MSU data base management. Normally, each net contains a DS battalion, its R battalion, or a GS or GSR battalion. Traffic density on these nets is extremely high, because they are also used for coordination of extensive fire support plans and collection, exchange, and dissemination of information and intelligence. The FCE is the net control station for all three nets.

TAB Command/Intelligence (FM Digital). The TAB command/intelligence (CI) net is for digital traffic only. While the net can be used for TAB assets only, its potential uses require some amplification. The NCS is the div arty fire control element, which operates the div arty computer. Since TAB assets report information directly to the FCE with no intermediary TAB processing element, the div arty commander has the flexibility to expand the net to a more general OPS net configuration and/or place one or more TAB assets on the other three OPS nets. Principles to facilitate control of TAB assets are outlined later.

Corps Artillery Fire (SSB/Multichannel Digital). The corps artillery fire (F) net is for digital traffic to the corps artillery computer. Corps artillery must specify what communications means to use. Corps artillery uses multichannel provided by the corps signal brigade to tie into the division multichannel link to div arty.

FA Brigade OPS (FM Digital). This is a tactical fire direction digital net at FA brigade. When an FA brigade is attached to or reinforcing a div arty, the div arty can use this net to communicate with the FA brigade, its targeting element (by relay), and liaison elements.

Div Arty Administration/Logistics Net (FM Voice). The div arty administration/logistics (ADMIN/LOG) net is a secure

FM radio multipurpose net used for administration and logistics traffic. One of the few full-time stations in this net is the NCS at the div arty TOC. Subordinate elements must switch frequencies on the existing radio to pass traffic on this net.

DIVISION FIRE SUPPORT ELEMENTS

The division main and tactical FSEs use multichannel circuits, if available. Backup communications means include SSB and FM.

DIV ARTY NET STRUCTURES

A div arty net structure depends on how an FA brigade supports the division.

The following table shows a recommended net configuration for a div arty to which an FA brigade is attached.

DIV ARTY NET CONFIGURATION (FA BRIGADE ATTACHED)

CCU NET	DDT	DIV ARTY		FA BDE	
		NET	SUBSCRIBERS	NET	SUBSCRIBERS
1	A	Div arty OPS1	DS bn 1 (div arty) GS bn 1 (bde)	Div arty OPS1	Same
2	B	Div arty OPS2	DS bn 2 (div arty) GS bn 2 (bde)	Div arty OPS2	Same
3	C	Div arty OPS3	DS bn 3 (div arty) GS bn 3 (bde)	Div arty OPS3	Same
4	D	Div arty OPS4 (TAB CI)	GS bn (div arty) GS bn 4 (bde) GS bn 5 (bde) Radar[1] FAAOs[1]	Div arty OPS4 (TAB CI)	Same
5	E	Div arty multi-channel	FSE (tactical) FSE (main)	Div arty multi-channel	Same
5	E	Wire	CFO/LO Div arty O/I	Wire	Bde O/I, CFO
6	F	FA bde OPS	MSU (FA bde) (LOs)	FA bde OPS	MSU (div arty) Bde LOs
7	G	Corps arty F	Corps arty	Corps arty F	Corps arty
8		CMD	All battalions, FSEs, O/I, LO/CFO	CMD	All battalions, LOs, O/I

[1]*Radar, sound, and FAAOs can be distributed throughout the four OPS nets to equalize net densities.*

The following table shows a recommended net configuration when a div arty is reinforced by an FA brigade or when an attached FA brigade acts independently of the div arty, as in a covering force operation. This net configuration provides for not only operational independence but also rapid and continuous mutual support operations between the div arty and the FA brigade TACFIRE computer centers.

DIV ARTY NET CONFIGURATION (FA BRIGADE REINFORCING OR INDEPENDENT)

CCU NET	DDT	DIV ARTY		FA BDE	
		NET	SUBSCRIBERS	NET	SUBSCRIBERS
1	A	Div arty OPS1	DS bn 1 DS bn 2	Div arty OPS1	Same
2	B	Div arty OPS2	DS bn 3 Div arty GS bn DMDs	Div arty OPS2	Same
3	C	Div arty OPS3	Same	Div arty OPS3	FA bde bn 1 FA bde bn 2 Bde FAAOs
4	D	Div arty OPS4 (TAB CI)	Radars Div arty FAAOs	Div arty OPS4 (TAB CI)	FA bde bn 3 FA bde bn 4
5	E	Div arty multi-channel	FSE (tactical) FSE (main)	Div arty multi-channel	Same
5	E	Wire	CFO/LO Div arty O/I	Wire	Bde O/I, CFO
6	F	FA bde OPS	MSU (FA bde)	FA bde OPS	MSU (div arty)
7	G	Corps arty F	Corps arty	Corps arty F	Corps arty
8		CMD	All battalions, FSEs, O/I, LO/CFO	CF	All battalions, LOs, O/I

MULTICHANNEL

Multichannel assets provide responsive, directional, and flexible communications means for digital traffic. When the divisional signal battalion can support div arty operations, the div arty CESO should recommend using sole-user circuits for div arty digital internal nets to service each battalion and both division FSEs. The TAB assets should use FM or wire means. When an FA brigade is attached or reinforcing, the CESO should also recommend using sole-user circuits to service the FA brigade OPS net to div arty and mutual support operations throughout the div arty network.

CESO RESPONSIBILITIES

The div arty CESO must coordinate with the TACFIRE operations officer to supervise and coordinate all TACFIRE-related

communications requirements. His responsibilities are:

- He is the custodian for all div arty COMSEC equipment and material. He coordinates and supervises the battalion COMSEC custodians.
- He assigns unique digital equipment addresses for TACFIRE users throughout the division, to include corps assets that are reinforcing or attached to the div arty.
- He develops the div arty net structure to support the mutual support plan and digital communications requirements.
- He coordinates all div arty communications requirements, to include CEOI and multichannel requirements, with the divisional signal elements.

TAB ASSETS

When attached to a battalion, a TAB asset uses the battalion frequency. When reporting targets to div arty, a TAB asset using digital communications can operate on either the TAB CI net or any of the three div arty OPS nets. Under some circumstances, it is preferable to put all TAB assets on the TAB CI net. Under other circumstances, it is preferable to distribute the TAB assets among the three OPS nets and the TAB CI net.

Firefinder Radar. Firefinder can inundate TACFIRE with target information in a moderate-intensity combat environment. Even with TACFIRE, target information is of little value unless the targeting element has the time and tenacity to use it. Also, Firefinder has limited capability to identify the number and type of rounds detected. Therefore, Firefinder inputs should be prioritized in terms of all digital communications requirements. The CESO, in conjunction with the S3, the TACFIRE operations officer, the TAB commander, and the CFO, establishes the communications procedures to optimize target acquisition efforts in the context of div arty total communications requirements. As conditions warrant, Firefinder inputs can be limited by using the following options.

Option 1. The CFO, in conjunction with the S3, specifies to the Firefinder radars specific areas from which targets will be generated.

Option 2. The CESO specifies the message delay time for each Firefinder to use. These delay times implement a transmission protocol for the net by giving each device using a net sensor a programmed period to wait on a clear net before transmitting digital traffic. This permits the most important element to transmit first on a clear net. Since FO DMDs used by FAAOs do not have net-sensing devices, FO FMD operators must implement transmission protocol according to SOP do as to not interfere when radars have higher priority.

Option 3. When the radars report more information than the targeting element can process, the CFO can direct the radars to delete a specified percentage of acquisitions to reduce the load on the net.

Net Structure Options. There are two basic considerations to account for when developing a net structure to use TAB assets: mutual support requirements and net density.

Mutual support requirements. If div arty does not have an FA brigade HQ as a mutual support unit, MSU considerations do not apply. When the FA brigade is attached and the FA brigade TOC is the alternate div arty TOC and the div arty computer MSU, mutual support operations normally require the use of the TAB CI net. When the FA brigade is reinforcing and the FA brigade computer is the div arty computer MSU and maintains control of its battalions, mutual support operations usually enable the TAB assets to operate on the TAB CI net.

Net density. Net density refers to the percentage of real time that a digital net passes traffic. The optimum condition is for all nets to have equal net densities. Under normal conditions, the three OPS nets and the TAB CI net are all high-density nets. When necessary, however, the TACFIRE operations officer can recommend or implement a net structure change for specified subscribers to balance the net densities of the four nets. It is more efficient to change nets of using target acquisition agencies than those of most other subscribers.

MUTUAL SUPPORT

This paragraph highlights mutual support considerations that apply to a div arty

computer. A general discussion of mutual support is in Chapter 5. When an FA brigade is attached to or reinforces a div arty, the div arty commander can use the FA brigade computer for mutual support operations unless the corps artillery commander specifies otherwise.

FA BRIGADE ATTACHED TO DIV ARTY

When an FA brigade is attached to div arty, the div arty commander can task organize and specify mutual support relationships for all computer systems. The FA brigade computer can function as the div arty computer MSU whether the brigade is used as an alternate div arty TOC or as a force FA HQ for a covering force operation.

FA BRIGADE REINFORCING DIV ARTY

When an FA brigade has a tactical mission of reinforcing or general support reinforcing a div arty, the div arty commander can use the FA brigade computer as an MSU to the div arty computer with the div arty MSU parameters. However, unless the corps artillery commander specifies otherwise, the div arty commander cannot use the FA brigade battalions as MSUs for div arty battalions. In this situation, the div arty mutual support planner establishes mutual support relationships among two pairs of div arty battalions.

LIAISON OFFICERS

When a mutual support computer takes control of the subscribers of a displacing/failing computer, the commander of the displacing/failing computer in effect delegates operational control of his unit to the MSU. To better provide continuity, a commander can choose to send either a liaison section with a VFMED or other TOC personnel to the MSU TOC to monitor and help in the MSU operations.

TACTICAL CONFIGURATIONS

There are two ways that a div arty S3 can configure a TACFIRE-equipped tactical operations center. The discussion here is based on the position requirements listed in Chapter 2.

OPTION 1

The S3 collocates the TACFIRE computer shelter and display shelter with the targeting van. This option features face-to-face coordination and communication among staff personnel. If radios are not remoted out of the TOC, the TOC is very susceptible to enemy counterfire. Being near the FCE, targeting element and operations element personnel tend to make unnecessary appearances in the computer and display shelters. These disrupt the operations of the FCE.

OPTION 2

The S3 separates the FCE shelters from the targeting and operations elements. The CFVFMED communicates with the computer by wire. Also, the FCE may need one or more radios remoted out of the targeting element. This arrangement enhances the survivability of a TOC against counterfire and keeps personnel working in designated areas.

FIRE SUPPORT CONSIDERATIONS

REINFORCING FIRES

When an FA brigade is reinforcing or general support reinforcing a div arty, it must furnish a liaison section with a VFMED to the div arty TOC. The div arty S3 should collocate this section near the FCE to facilitate rapid coordination. For mutual support operations, div arty FCE personnel should enter the FA brigade fire unit AFU data into the computer but exclude them from TFC processing, since, in this tactical situation, the FCE does not transmit fire requests directly to the FA brigade battalions. With the FA brigade AFU data entered in this fashion, neither the FCE nor the division FSE can initiate capabilities analyses (or PTA) to determine if FA brigade assets can defeat a target. The FA brigade LO can initiate capabilities analyses of FA brigade assets and requests for fire by using his VFMED. TACFIRE software does not fully support this particular command relationship. Therefore, the S3 must give the FCE clear guidance on the types of targets to pass to the FA brigade LO to initiate fire requests.

FIRE COMMANDS

The div arty computer does not issue an FM;FC format giving fire commands to a battery. It is unlikely that a tactical situation will require a BCD computer to send missions directly to a cannon battery. However, operators at TACFIRE and the BCS need to develop a procedure to process missions in case the situation arises. The div arty computer will send missions to the MLRS battery FDS by use of the FM;RFAF message format.

SECTION II

OPERATIONS

The guidance in this section only touches the surface in terms of TACFIRE capabilities; however, for personnel with little or no TACFIRE experience, it presents a basic framework of how each element uses TACFIRE for data processing for its functions.

FIRE CONTROL ELEMENT

The div arty fire control element initializes, operates, and maintains the div arty computer. It supports each of the div arty subscriber ADP requirements, computes the tactical fire control solutions, and directs and controls the fires of organic and supporting FA units in support of current operations. It is the NCS for each of the div arty internal digital nets. The FCE regularly exchanges data with the MSU and corps artillery headquarters. Also, FCE personnel may advise the battalion operations element of TACFIRE-related situations.

FIRE CONTROL OFFICER

According to the current MTOE, the FCE does not have an officer to supervise and coordinate the activities of the element. The counterfire officer has difficulty managing both the FCE and the targeting element. Most field units see the need for taking the operations duty officer or a senior lieutenant or captain with a solid TACFIRE background out of another duty position and making him a full-time fire control officer responsible for training and operations of the total TACFIRE. He coordinates TACFIRE-related requirements with the S3, CESO, battalion FDOs, and other staff personnel as required. He advises the S3 and comments on all TACFIRE-related activities, situations, and capabilities. Throughout this manual, the "fire control officer" refers to the individual that directly supervises and coordinates the activities of the TACFIRE computer.

OPERATING SYSTEM

The FCE personnel program the operating system to establish the digital communications network, processing capabilities for each subscriber, COMSEC parameters, MOI processing, relay functions, and technical system operating parameters. The fire control officer or ACCO receives guidance for input of operating system data from the unit SOP, OPORD, OPLAN, FA support plan, or S3.

TACTICAL DATA

The computer must have basic elements of tactical data stored in memory to effectively process combat information. This tactical data base includes the functions of the SPRT, AFU, and MET programs. The programs include the geographical area of interest, zones and boundaries of the supported force, fire unit operations and technical data, ammunition status, controlled supply rates, fire support coordinating measures, friendly unit vulnerability postures, MAP MOD, and met data. This information should be entered into the computer through the joint efforts of the operations elements, battalion FDCs, met

station, FSEs, mutual support unit, and other subscribers as available. The FCE may also check battlefield geometry data and some graphical firing unit data by making a graphical display on the DPM or ETD. The data displayed include the zones and boundaries of the supported force, fire unit locations and range fans, and fire support coordinating measures. The FCE can prepare overlays of the tactical situation for use by the operations and targeting elements. When all tactical data have been submitted and stored in the computer, the ACCO can direct the computer to print a hard copy of all tactical data and pass it to the operations element to review and resolve discrepancies. The FCE can transmit changes to battlefield geometry and computer met data to battalions and other subscribers as required.

FIRE MISSIONS

The FCE receives fire mission requests from battalions, FSEs, radars, FAAOs, force artillery headquarters, and the targeting element. The ATI program generates fire missions based on fire mission modification (FMMOD) criteria. The computer displays warnings of violations of fire support coordinating measures with the tactical fire control solution for each mission. Using the warnings in conjunction with the target plot on the DPM, the ACCO or fire control officer can quickly initiate coordination by contacting the FSE or operations element. After reviewing the fire control solution, the ACCO can either recompute, delete, or transmit the fire commands and request for additional fire. As required, FCE personnel can coordinate the engagement of targets with the targeting element.

FIRE PLANNING

The FCE provides the ADP support for all the div arty fire planning efforts, to include the fire planning inputs of the FSEs.

ARTILLERY TARGET INTELLIGENCE

The computer can be instructed to forward information copies of all intelligence reports as the div arty ACCO processes incoming intelligence messages. Also, the computer forwards information copies to all subscribers set up for MOI processing for that format. The FCE provides the ADP support for all the targeting element ATI-related functions. The FCE also processes requests for preliminary target lists from subscribers throughout the division zone. When an incoming target intelligence report passes the FMMOD criteria established by the CFO, the computer generates the fire mission at the ACC. The FCE processes the mission IAW the guidance given by the CFO.

TARGETING ELEMENT

The targeting element, consisting of a target processing section and an order-of-battle section, works in a 5-ton expandable van equipped with a VFMED. The targeting element uses TACFIRE as an automated file system and target processor.

TACTICAL DATA

The targeting element maintains an order-of-battle map and a target production map. The DPM can provide overlays of fire control measures, target acquisition assets, and target indicators. However, the usefulness of the DPM in routine operations is limited to providing initial overlays depicting zones and fire support coordinating measures. Targeting element personnel still need to map-spot and plot vital information to keep mapped information current. When remoted into the targeting element van, the ETD is a useful tool for managing visual tactical data; but it is not a substitute for accurate and current map boards.

FIRE SUPPORT COORDINATION

When the targeting element locates and confirms a target, it can initiate a fire mission from the VFMED and transmit it to the FCE. When the computer automatically generates a fire mission on an incoming target intelligence message based on FMMOD criteria, the request for fire appears at the ACC in the FCE. The FCE ACCO can initiate or analyze the mission at that point.

NONNUCLEAR FIRE PLANNING

The targeting element can create, maintain, and update fire plans to support both planned requirements and various on-call contingency needs.

ARTILLERY TARGET INTELLIGENCE

The targeting element at div arty is the primary user of the ATI programs. The CFO recommends and implements ATI commander's criteria to support current targeting operations. These COMCRIT specify the following parameters:

- Which output reports the computer should generate automatically.
- The maximum age of an intelligence report that will be accepted for storage.
- How many targets constitute a buildup.
- The criteria that the computer can use to judge when incoming targets should automatically generate fire missions at the FCE.
- How similar two target reports must be in terms of type, location, and time of report for the computer to automatically combine them.

These COMCRIT parameters specify how the computer can prompt the targeting element selection, production, and attack of targets.

The targeting element may extract targets from the div arty computer file by area, type/subtype, time, or other specified parameters. Also, the targeting element can use the SRI function to specify to the computer what types of target data to forward to the CFVFMED as the computer receives it. This function gives the targeting element automatic access to ATI data as they come into the div arty computer. As the element develops targets, it can use the VFMED to enter targets in the computer. The ETD may be used to enhance the quality of target information and reports by providing a means to graphically examine buildup areas or any other target criteria.

It is essential that the targeting element maintain the ATI target file by regularly purging the file of outdated and/or nonessential targets and target indicators. An aggressive file maintenance program keeps the ATI target file from reaching its storage capacity and ensures that only accurate data are in the file.

TACFIRE helps the targeting element effectively process targeting information by using a minimum amount of time per piece of information. By establishing timely and effective ATI commander's criteria, the targeting element enables the computer to automatically process and develop targets. However, targeting element personnel must use sound judgment and doctrinal principles to effectively use the information that TACFIRE generates.

CUING TARGET ACQUISITION ASSETS

The targeting element can relay plain-text messages through the div arty computer to each target acquisition asset. These messages can contain cuing instructions or other data, as required.

OPERATIONS ELEMENT

The operations element shares the use of the VFMED in the targeting element. The S3 can specify how much the operations element uses the CFVFMED so as to not overload the device or give the VFMED operator more work than he can handle.

MESSAGES OF INTEREST

The operations element can receive MOIs from the div arty computer. The MOI helps the section keep up with fire support and planning information. The VFMED receives and prints information copies of reports submitted to the TACFIRE computer by fire support agencies throughout the div arty network, to include up-to-date reports on fire units.

TACTICAL DATA

The operations element normally enters OPORD-generated AFU data, such as CSR and critical ammunition levels, into the computer. The operations element can check and correct AFU files. It can check all battlefield geometry measures, to include zones, for accuracy and completeness. When time permits, the S3 can request the FCE to produce tactical overlays. Personnel involved in planning for future operations can use the ETD to develop visual displays of planning data, to include zones, fire support coordinating measures, and fire unit data. The operations element enters met data received by carrier or voice. When working with FA units not equipped with TACFIRE, the operations element establishes AFU files for them.

NONNUCLEAR FIRE PLANNING

The operations element can use the CFVFMED to plan fires for the division. After specifying all tactical data and COMCRIT to apply to a fire plan supporting a maneuver operation, the operations element, in conjunction with the targeting element, prepares a preliminary target list and selects targets to include in the final target list. After targets have been selected, the operations element enters the target phasing and scheduling instructions and prepares the schedule of fires. When the schedule of fires has been approved, the operations element prepares the FA support plan documentation and transmits fire orders to the fire units involved. By computing a fire plan for a future operation, the S3 can closely estimate the RSR for that operation.

FASCAM FIRE PLANNING

Most FASCAM processing is accomplished at battalion. Processing of FASCAM fire planning at div arty only determines the battalion to fire. The div arty computer does not store any FASCAM data.

FIRE SUPPORT ELEMENT PROGRAMS

The operations element should report changes to div arty level (including TAB assets) unit locations and vulnerability categories to the TACFIRE computer on the FSE;FRIEND message.

COMMANDER'S CRITERIA

The div arty S3 normally develops and recommends a COMCRIT scheme to support each operation. When new COMCRIT are approved by the maneuver commander, the operations section enters them into the computer by use of the VFMED.

DIVISION FIRE SUPPORT ELEMENT

The division FSE consists of two elements, the tactical FSE at the division tactical CP and the main FSE at the division main CP. The tactical FSE concentrates on current operations and is primarily a coordinating facility. It may ask the main FSE to plan fires on certain targets for future operations. The main FSE provides target data to the div arty FCE; coordinates engagements of targets with fire support assets other than field artillery; performs preliminary target analysis; and performs nuclear and chemical target analysis, fire planning, fallout prediction, and vulnerability analysis. Both FSEs use a VFMED to accomplish their fire support functions.

MESSAGE OF INTEREST

Using the VFMED, the FSE can receive MOIs from the div arty computer. Each FSE can establish up to 28 messages of interest to help keep up with intelligence, fire support, and planning information. The FSE uses MOI processing to obtain current status reports on fire units, fire requests, and reports submitted within its zone of operations.

FIRE SUPPORT COORDINATING MEASURES

The FSE maintains current fire support coordinating measure data on maps for visual reference and in the data files of the div arty TACFIRE computer for consideration during automated target analysis.

FRIENDLY AND ENEMY SITUATIONS

The FSE maintains maps reflecting the current friendly and enemy situations. Artillery target information is maintained in the ATI files of the div arty computer. The FSEs continually receive intelligence information from the G2 element or, through query, from the ATI files of the div arty computer.

FIRE SUPPORT REQUESTS

The FSE receives requests from subordinate units for fire support when the subordinate unit does not have adequate means to attack the target. The requests are evaluated, and a decision is made whether to furnish the required support or to disapprove the request. The evaluation is conducted by use of the automated target analysis capability of the div arty computer. The FSE, using the div arty computer, prepares target attack alternatives in preferred priority. Consideration is given to the commander's guidance, target data, fire unit data, and munition effectiveness. Depending on the commander's guidance, the div arty computer system automatically considers all Navy, Air Force, and FA units and nuclear,

chemical, and conventional munitions. Also, the div arty computer lists all target attack alternatives not selected for reason of weapon/munition nonavailability, safety, or failure to meet minimum acceptable effects criteria.

Fire support selections involving Navy and Air Force units are referred to the tactical air support element or the naval gunfire officer as fire support requests.

NUCLEAR AND CHEMICAL TARGET ANALYSIS

Commander's Guidance. Fire support operations are conducted within the framework of guidance and policy established by the commander. The FSE enters current commander's guidance into the data files of the div arty computer. These criteria govern conventional, nuclear, and chemical target analysis; nuclear fire planning; and fallout prediction.

Friendly Unit Data. The FSE maintains locations and degrees of exposure of all critical units and installations for nuclear fallout prediction purposes. As a minimum, front-line maneuver units should be included. Locations and degrees of exposure are maintained both on visual displays at the FSEs and in the data files of the div arty computer. It is essential that friendly unit data be accurate and current.

Nuclear Strikes. The FSE continually evaluates all available intelligence to identify potential targets for nuclear attack. It conducts the nuclear target analysis of potential nuclear targets by using the automated target analysis capabilities of the FSE programs at the div arty computer. In conducting the nuclear target analysis, the FSE considers commander's guidance; fire unit, weapon, and yield availability; weapon effectiveness; target characteristics; troop safety; and damage limiting factors. The FSE program provides a list of attack alternatives in order of preference as well as a list of safety and contingency distances and exceptions. The FSE conducts supplemental analysis as required and then chooses the preferred alternatives. It conducts an automated prestrike fallout and vulnerability analysis to evaluate the fallout danger to critical installations and friendly units from the proposed nuclear strike. The nuclear strike recommendations, once formulated and approved by the commander, are forwarded through the div arty TOC to the nuclear delivery unit as a fire mission. Strike warnings are disseminated to all units potentially affected by the nuclear strike. Target damage assessment requests are forwarded to the G2 element. After the strike when information on the actual burst point is available, the FSE conducts automated analyses to determine damage to friendly units and fallout danger to friendly units and critical installations. Also, it prepares and disseminates fallout warnings to maneuver and support units, as required.

Nuclear Fire Planning. The FSE prepares and schedules nuclear fire plans in support of the division scheme of maneuver. It prepares the nuclear target list based on target intelligence from the G2 element and ATI data files of the div arty computer. The FSE selects fire units; fire unit locations; weapons, yields, and allocations; troops safety and damage limiting factors; and target scheduling and phasing factors. Using the div arty computer, the FSE conducts required nuclear target analyses and prepares a nuclear schedule of fires. It conducts automated friendly unit vulnerability analyses and fallout predictions to determine potential danger to critical units and installations. The nuclear fire plan, once approved by the commander, is forwarded to the div arty TOC for execution. The FSE prepares strike warnings and disseminates these to all units potentially affected by the planned nuclear strikes. Target damage assessment requests are forwarded to the G2 element. After execution of the nuclear fire plans and availability of information on actual burst points, the FSE conducts automated analyses to determine fallout danger to friendly units. The FSE prepares and disseminates fallout warnings for each burst, as required.

Vulnerability Analysis. The FSE continually evaluates the vulnerability of critical installations and friendly units to enemy nuclear strike. It conducts these analyses by use of the automated capabilities of the TOC computer system. On the basis of postulated enemy nuclear bursts, the FSE determines the potential damage inflicted on selected installations and friendly units by using the div arty computer system. The FSE considers the results of the vulnerability

analyses in recommending positioning of FA nuclear and chemical delivery units.

Poststrike Analysis of Enemy Nuclear Strike. The FSE conducts poststrike analyses of enemy nuclear strikes. Once a nuclear burst sighting report is received and confirmed, the FSE conducts an automated fallout analysis by using the div arty computer system to determine the fallout danger to selected friendly units and critical installations. Damage to friendly units and installations is predicted by conducting automated vulnerability analyses.

Chemical Strike. The FSE continually evaluates all available intelligence to identify potential targets for chemical attack. It conducts chemical analysis by use of the automated analytical capabilities of the div arty computer system. In the chemical target analysis, the FSE considers commander's guidance, delivery unit, munition and agent availability, munition effectiveness, troop safety, and damage limiting factors. The div arty computer system provides a list of attack alternatives in order of preference with resulting chemical hazard areas. Once the strike recommendations are formulated and approved by the commander, the FSE prepares and disseminates the strike warnings and forwards the fire mission request to the delivery unit.

LIAISON SECTION

The div arty liaison section can be dispatched with its VFMED to another headquarters to coordinate fire support requirements. The section can give the commander continuity during mutual support operations. When dispatched to a unit not equipped with TACFIRE, the liaison section gives the associated unit operations elements access to TACFIRE ADP functions.

COMMUNICATIONS

If within FM radio range of the div arty computer, the liaison section can use its own radios for communications. If outside FM radio range, the liaison section needs to use multichannel or SSB communications supplied by the headquarters to which the liaison section is dispatched.

TACTICAL DATA

The section can coordinate or recall fire unit and ammunition status, unit positioning, met data, fire support coordinating measures, and other battlefield geometry information.

FIRE SUPPORT COORDINATION

The LO can use the VFMED to clear fires across boundaries and initiate fire missions.

NONNUCLEAR FIRE PLANNING

If necessary, the LO can plan fires by using the VFMED. When working with an FA brigade not equipped with TACFIRE, the LO can receive and disseminate fire plans.

ARTILLERY TARGET INTELLIGENCE

Liaison section personnel can submit ATI messages and use the SRI function to automatically receive timely ATI reports.

MISCELLANEOUS COORDINATION

The LO must use plain-text messages when coordinating issues that do not use standard formats. When using these messages, the VFMED operator must ensure that the KG-31 is encrypting all messages. The LO can also use the MOI function to automatically receive specified messages as they are processed through the div arty computer.

FIREFINDER RADARS

Both the AN/TPQ-36 and the AN/TPQ-37 Firefinder radar systems use DMD emulators. The AN/TPQ-36 radars most often are attached to DS battalions to locate enemy indirect fire systems. During rapidly moving situations, an AN/TPQ-37 radar could be attached to a cannon battalion to enhance rapid counterfire. The radar can operate in either a voice or a digital mode. It can transmit fire missions and target information to either a TACFIRE or a BCS. The radar operator types in an authentication code for each digital transmission. Since the radar does not use a COMSEC device, operators should manually encrypt messages containing such critical information as radar location. The DMD emulator can receive up to 36 characters of a plain-text message. The

TACFIRE computer with which it operates can send Firefinder the computer met using a preformatted message.

NON-FIREFINDER RADARS

Non-Firefinder radars, to include the AN/TPS-25, AN/TPS-58, and AN/MPQ-4A, cannot interface directly with TACFIRE. When not equipped with a DMD, these radar sections report targets by voice to the targeting element, which can use a VFMED to either add the target to TACFIRE target files or initiate a fire mission. The radar section should use a voice net when reporting targets by voice. When equipped with a DMD, radar sections can report targets and initiate fire missions digitally. Since he does not use a COMSEC device, the operator should manually encrypt critical information (such as radar site location) on the DMD and send it as part of a plain-text message.

FIELD ARTILLERY AERIAL OBSERVERS

The FAAOs use a standard FO DMD (AN/PSG-2A) with a special cable (NSN 5995-01-110-6945) to interface with an aircraft FM radio. There is presently no way to plug the FO DMD into the aircraft power supply; however, the FAAO can mount batteries on the FO DMD both internally and externally. The FO DMD sits on the FAAO's lap, attached to his legs and back by the carrying straps. During daylight operations, bright light can make the FO DMD display very difficult to read. Under these conditions, the FAAO should develop a means to shade the display from the direct sunlight. The FAAO can use the FO DMD to report targets and combat information, conduct fire missions, and transmit unencrypted plain-text messages. When working with a div arty TACFIRE computer, the FAAO can only fire for effect on targets. If he needs to report his location, the FAAO should manually encrypt a plain-text message, since he does not use a COMSEC device.

MULTIPLE LAUNCH ROCKET SYSTEM

The MLRS fire direction system is responsible for the tactical fire direction of the pure MLRS battalion and battery.

MLRS FDS STORAGE AND UPDATE CAPABILITIES

	BATTERY	BATTALION
• Downrange masks	5	5
• Air corridors	6	6
• Fire support coordinating measures	10	20
• Targets	81	81
• Fire units	15	12
• Firing positions	45	36
• Ammunition points	10	NA
• Survey points	10	NA
• Rendezvous points	10	NA

Tactical fire control is concerned with determining the number of rockets to engage the target, which launchers can fire on the target, and which launch areas should be used. Technical fire direction (data used to lay, arm, and fire the rocket) is not performed with the MLRS fire direction system. This is done with the on-board computer on the SPLL. The on-board computer is part of the fire control system.

The MLRS FDS can be configured in either the battalion or the battery mode. This can be done without the use of any new software or equipment. Only a change in initialization procedures is required.

When in the battalion mode, the FDS is primarily concerned with transmitting fire missions to the battery, selecting which firing platoon is to fire the mission, performing target analysis, accepting requests for fire, and performing downrange mask checks. The battery FDS is primarily concerned with accepting requests for fire, performing target analysis, selecting the launcher to fire, performing an optional mask check, establishing multiple aimpoints within a target, transmitting the call for fire

to a launcher, and controlling the conduct of the fire mission. The battery FDS maintains digital communications with the SPLL through the fire control system and with the platoon leader through the use of the PLDMD. There are three launchers per MLRS platoon.

LANCE

The Lance FDS interfaces at battalion level with TACFIRE and receives calls for fires from either corps, brigade, or div arty FSE. The Lance FDS can process both nuclear and conventional fire missions. It allows tactical fire control and technical fire direction at both battalion and battery levels. Tactical fire control is concerned with determining which launchers can fire on the target and which firing points should be used. Technical fire direction is the process of computing the technical firing data necessary to lay, arm, and fire the missile. It should be noted that the Lance FDS is the nomenclature for the BCS set up and equipped for Lance.

The Lance *battalion* FDS is concerned mainly with performing tactical fire control. When a fire mission is received by the Lance battalion, the FDS first determines the best launcher and firing point combination for accomplishment of the mission. To select a launcher and firing point, the battalion FDS considers the following:

- Launcher-target range.
- Availability of the launcher.
- Warhead type currently on the launcher.
- Response time of the launcher.

After determining an acceptable launcher and firing point, the battalion FDS transmits a fire mission message to the battery FDS controlling the selected launcher.

The Lance *battery* FDS is concerned mainly with performing technical fire direction. When a fire mission is received at the Lance battery, the battery FDS verifies that the launcher named in the fire mission message can execute the mission at the assigned firing point. To verify the launcher and firing point, the battery FDS determines the following:

- The named launcher is available.
- It has the appropriate warhead.
- It can meet the required response time.
- It is within range of the target.

Once an acceptable launcher and firing point solution is determined, the battery FDS computes the technical firing data required to lay, arm, and fire the missile. These data are then sent to the firing platoon by FM secure, or the firing platoon is given a hard copy of the fire mission. When the fire mission is completed, end-of-mission processing is accomplished. At this time, the battery FDS transmits to the battalion FDS information concerning the fire mission.

The Lance FDS can store and update ammunition status in the ammunition summary message (AMOSUM) for up to seven subordinate units. The AMOSUM constitutes the ammunition file for the unit.

FIELD ARTILLERY BRIGADE

The FA brigade operates its TACFIRE computer in the exact same manner as does div arty. Div arty communicates to only an FA brigade when the brigade supports the div arty in some way. Normally, the FA brigade is the div arty mutual support unit. For discussions of mutual support requirements, refer to Chapter 5 and page 8-5.

LANCE FDS STORAGE AND UPDATE CAPABILITIES (DATA BASE SUMMARY MESSAGE [DBSUM])

	BATTERY	BATTALION
• Fire unit status	4 launchers	9 launchers
• Unit identification	6	9
• Targets	20	75
• Fire units	6	20
• Firing points	15	75
• Zone of responsibility	4	4
• Air corridors	6	6
• Fire support coordinating measures	0	10

CORPS ARTILLERY

Corps artillery, equipped with a computer system, plans and coordinates fire support of the corps. It provides tactical control of the FA units retained directly under corps. Corps artillery TACFIRE can input a MAPMOD that encompasses an area of 299,999 by 299,999 meters.

LIAISON ELEMENT

Each liaison element uses a VFMED mounted in an M880 truck.

MET DATA SYSTEM

The MDS uses a remote data terminal as on a VFMED.

FIREFINDER RADARS

Both the AN/TPQ-36 and the AN/TPQ-37 radars use a DMD emulator.

NON-FIREFINDER RADARS

The AN/TPS-25, AN/TPS-58, and AN/MPQ-4A can interface with TACFIRE by use of a DMD AN/PSG-2A.

FIELD ARTILLERY AERIAL OBSERVERS

Each FAAO uses an FO DMD AN/PSG-2A.

MULTIPLE LAUNCH ROCKET SYSTEM

Each MLRS battalion and battery FDC uses a fire direction system equipped with a battery computer unit and the platoon leader's DMD.

LANCE

Each Lance battalion and battery FDC uses a fire direction system that is identical in hardware to the battery computer system.

COMMUNICATIONS

NETS

The div arty computer communication control unit controls and integrates communications on eight separate nets.

Div Arty Command (FM Voice). The div arty command (CMD) net is a secure FM radio multipurpose voice net. It is used for command and control; administrative matters; collection, exchange, and dissemination of information and intelligence; and coordination of fire support.

Div Arty OPS1, 2, or 3 (FM Digital). This is a tactical fire direction digital net at div arty. Div arty has three of these nets (OPS1, OPS2, and OPS3) to transmit tactical orders, fire missions, and met data to the battalions. The battalions use these nets to request additional fire support from div arty and for MSU data base management. Normally, each net contains a DS battalion, its R battalion, or a GS or GSR battalion. Traffic density on these nets is extremely high, because they are also used for coordination of extensive fire support plans and collection, exchange, and dissemination of information and intelligence. The FCE is the net control station for all three nets.

TAB Command/Intelligence (FM Digital). The TAB command/intelligence (CI) net is for digital traffic only. While the net can be used for TAB assets only, its potential uses require some amplification. The NCS is the div arty fire control element, which operates the div arty computer. Since TAB assets report information directly to the FCE with no intermediary TAB processing element, the div arty commander has the flexibility to expand the net to a more general OPS net configuration and/or place one or more TAB assets on the other three OPS nets. Principles to facilitate control of TAB assets are outlined later.

Corps Artillery Fire (SSB/Multichannel Digital). The corps artillery fire (F) net is for digital traffic to the corps artillery computer. Corps artillery must specify what communications means to use. Corps artillery uses multichannel provided by the corps signal brigade to tie into the division multichannel link to div arty.

FA Brigade OPS (FM Digital). This is a tactical fire direction digital net at FA brigade. When an FA brigade is attached to or reinforcing a div arty, the div arty can use this net to communicate with the FA brigade, its targeting element (by relay), and liaison elements.

Div Arty Administration/Logistics Net (FM Voice). The div arty administration/logistics (ADMIN/LOG) net is a secure

The following table shows a recommended net configuration when a div arty is reinforced by an FA brigade or when an attached FA brigade acts independently of the div arty, as in a covering force operation. This net configuration provides for not only operational independence but also rapid and continuous mutual support operations between the div arty and the FA brigade TACFIRE computer centers.

DIV ARTY NET CONFIGURATION (FA BRIGADE REINFORCING OR INDEPENDENT)

CCU NET	DDT	DIV ARTY		FA BDE	
		NET	SUBSCRIBERS	NET	SUBSCRIBERS
1	A	Div arty OPS1	DS bn 1 DS bn 2	Div arty OPS1	Same
2	B	Div arty OPS2	DS bn 3 Div arty GS bn DMDs	Div arty OPS2	Same
3	C	Div arty OPS3	Same	Div arty OPS3	FA bde bn 1 FA bde bn 2 Bde FAAOs
4	D	Div arty OPS4 (TAB CI)	Radars Div arty FAAOs	Div arty OPS4 (TAB CI)	FA bde bn 3 FA bde bn 4
5	E	Div arty multi-channel	FSE (tactical) FSE (main)	Div arty multi-channel	Same
5	E	Wire	CFO/LO Div arty O/I	Wire	Bde O/I, CFO
6	F	FA bde OPS	MSU (FA bde)	FA bde OPS	MSU (div arty)
7	G	Corps arty F	Corps arty	Corps arty F	Corps arty
8		CMD	All battalions, FSEs, O/I, LO/CFO	CF	All battalions, LOs, O/I

MULTICHANNEL

Multichannel assets provide responsive, directional, and flexible communications means for digital traffic. When the divisional signal battalion can support div arty operations, the div arty CESO should recommend using sole-user circuits for div arty digital internal nets to service each battalion and both division FSEs. The TAB assets should use FM or wire means. When an FA brigade is attached or reinforcing, the CESO should also recommend using sole-user circuits to service the FA brigade OPS net to div arty and mutual support operations throughout the div arty network.

CESO RESPONSIBILITIES

The div arty CESO must coordinate with the TACFIRE operations officer to supervise and coordinate all TACFIRE-related

computer. A general discussion of mutual support is in Chapter 5. When an FA brigade is attached to or reinforces a div arty, the div arty commander can use the FA brigade computer for mutual support operations unless the corps artillery commander specifies otherwise.

FA BRIGADE ATTACHED TO DIV ARTY

When an FA brigade is attached to div arty, the div arty commander can task organize and specify mutual support relationships for all computer systems. The FA brigade computer can function as the div arty computer MSU whether the brigade is used as an alternate div arty TOC or as a force FA HQ for a covering force operation.

FA BRIGADE REINFORCING DIV ARTY

When an FA brigade has a tactical mission of reinforcing or general support reinforcing a div arty, the div arty commander can use the FA brigade computer as an MSU to the div arty computer with the div arty MSU parameters. However, unless the corps artillery commander specifies otherwise, the div arty commander cannot use the FA brigade battalions as MSUs for div arty battalions. In this situation, the div arty mutual support planner establishes mutual support relationships among two pairs of div arty battalions.

LIAISON OFFICERS

When a mutual support computer takes control of the subscribers of a displacing/failing computer, the commander of the displacing/failing computer in effect delegates operational control of his unit to the MSU. To better provide continuity, a commander can choose to send either a liaison section with a VFMED or other TOC personnel to the MSU TOC to monitor and help in the MSU operations.

TACTICAL CONFIGURATIONS

There are two ways that a div arty S3 can configure a TACFIRE-equipped tactical operations center. The discussion here is based on the position requirements listed in Chapter 2.

OPTION 1

The S3 collocates the TACFIRE computer shelter and display shelter with the targeting van. This option features face-to-face coordination and communication among staff personnel. If radios are not remoted out of the TOC, the TOC is very susceptible to enemy counterfire. Being near the FCE, targeting element and operations element personnel tend to make unnecessary appearances in the computer and display shelters. These disrupt the operations of the FCE.

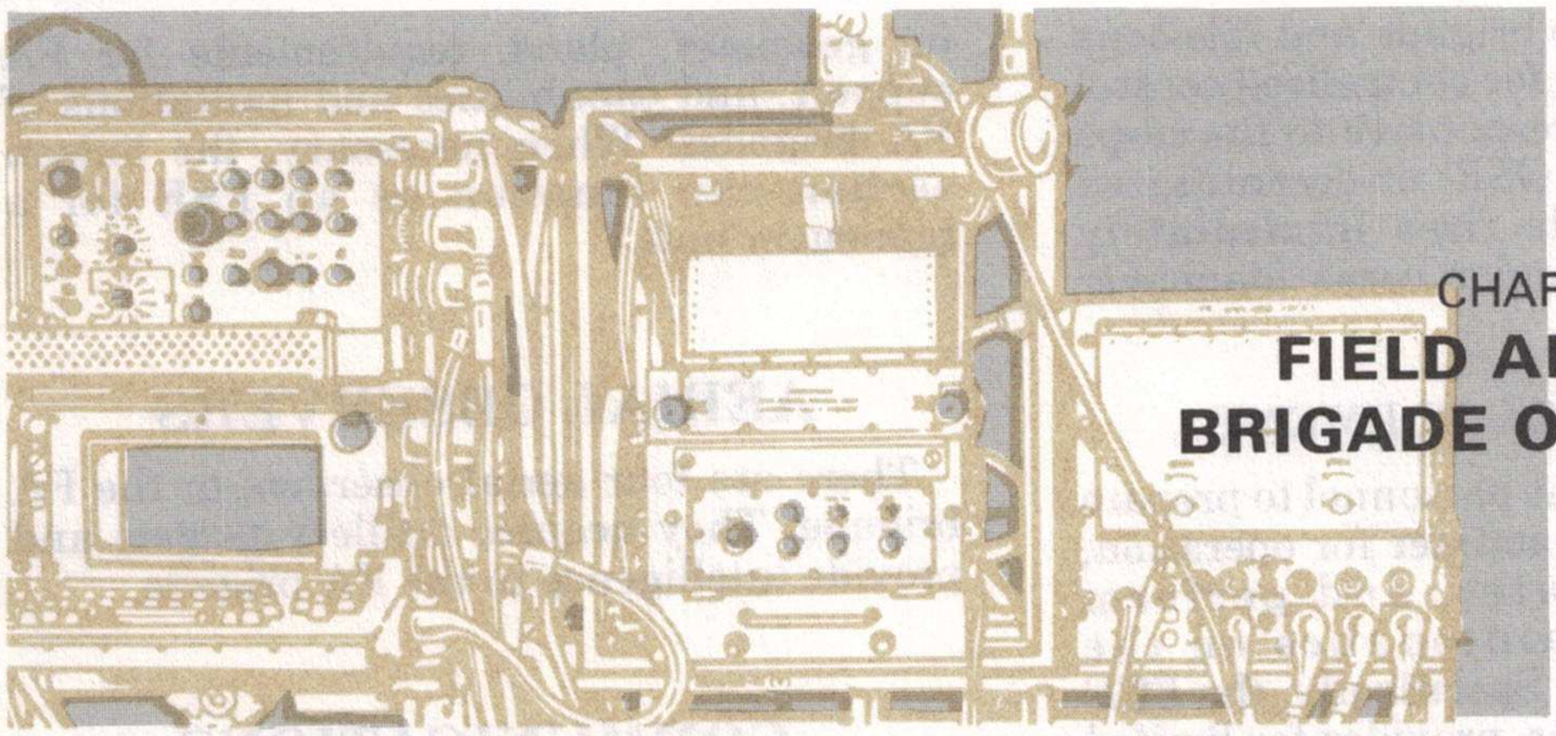
OPTION 2

The S3 separates the FCE shelters from the targeting and operations elements. The CFVFMED communicates with the computer by wire. Also, the FCE may need one or more radios remoted out of the targeting element. This arrangement enhances the survivability of a TOC against counterfire and keeps personnel working in designated areas.

FIRE SUPPORT CONSIDERATIONS

REINFORCING FIRES

When an FA brigade is reinforcing or general support reinforcing a div arty, it must furnish a liaison section with a VFMED to the div arty TOC. The div arty S3 should collocate this section near the FCE to facilitate rapid coordination. For mutual support operations, div arty FCE personnel should enter the FA brigade fire unit AFU data into the computer but exclude them from TFC processing, since, in this tactical situation, the FCE does not transmit fire requests directly to the FA brigade battalions. With the FA brigade AFU data entered in this fashion, neither the FCE nor the division FSE can initiate capabilities analyses (or PTA) to determine if FA brigade assets can defeat a target. The FA brigade LO can initiate capabilities analyses of FA brigade assets and requests for fire by using his VFMED. TACFIRE software does not fully support this particular command relationship. Therefore, the S3 must give the FCE clear guidance on the types of targets to pass to the FA brigade LO to initiate fire requests.



CHAPTER 9

FIELD ARTILLERY BRIGADE OPERATIONS

The FA brigade functions in much the same way that div arty and its subordinate units and elements do as explained in Chapter 8. Therefore, this chapter highlights only significant variations from the functions and procedures discussed in Chapter 8. This chapter presents operational guidance to help personnel in the FA brigade to perform TACFIRE functions in any assigned mission.

SECTION I
ORGANIZATION AND EQUIPMENT

The FA brigade headquarters and headquarters battery (HHB) is very similar to a div arty HHB. The brigade has four aerial observers, an MDS section, a liaison section that can field two liaison teams, and all the resources necessary to establish a brigade TOC similar to a div arty TOC. The FA brigade HQ is responsible for commanding and controlling the organic HHB and all attached FA elements; developing targets; distributing targeting and met information; and coordinating general positions, fire planning, and displacement of the FA brigade. The FA brigade can function as a mutual support unit for a div arty, as an alternate div arty TOC, or as a force FA headquarters.

BRIGADE TACTICAL OPERATIONS CENTER

The FA brigade TOC is composed of a fire control element, an operations element, and a targeting element. Because of the requirements of the assigned tactical mission, the FA brigade may not always establish liaison with another unit, prepare an FA support plan, establish an FSE, or perform other tasks common to div arty.

FA BRIGADE TACFIRE EQUIPMENT

ELEMENT	EQUIPMENT
Fire control element	1 div arty computer system
Operations/targeting	1 VFMED
Liaison section	2 VFMEDs (1 per team)
Aerial observers	4 DMDs

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Organization of the brigade and missions assigned may provide for centralized control of fires immediately responsive to the corps commander (GS and GSR) or decentralized control with brigade fires immediately responsive to a particular corps maneuver force (DS or R).

FIRE CONTROL ELEMENT

The FCE provides the personnel to prepare the BCD TACFIRE computer for operation, operate the computer, and perform organizational maintenance on the TACFIRE equipment. Specifically, the FCE initializes the computer, provides for limited fire support coordination, conducts tactical fire direction, and provides ADP support to subordinate units. The configuration of the FA brigade computer system is similar to that of a div arty computer system as described in Chapter 8.

OPERATIONS ELEMENT

The operations element shares the use of a VFMED with the targeting element. It provides initialization data to the FCE, prepares the FA support plan (when required), controls positioning of FA brigade assets, maintains a tactical situation map, and recommends the organization for combat (when required). The operations element also reviews data retrieved from the computer to validate the accuracy of tactical data files.

TARGETING ELEMENT

The targeting element, consisting of the target processing section and the order-of-battle section, shares the use of a VFMED with the operations element. Primarily, the targeting element produces valid artillery targets through the collection, processing, and dissemination of targeting information. It provides data to the FCE for initialization of the computer for artillery target processing, recommends positioning and control of attached and organic target acquisition assets, conducts ATI file maintenance, and maintains targeting and order-of-battle maps.

LIAISON SECTION

Each of the two liaison sections has a VFMED. The sections can exchange data between the FA brigade and supported unit on geometry, plans, requirements for FA support, and capabilities and limitations of FA brigades. When necessary, the liaison section can function as an FSE for a maneuver unit.

AERIAL OBSERVERS

There are four aerial observers in the FA brigade. They acquire artillery targets and provide intelligence to the FA brigade.

COMMUNICATIONS

The communications requirements for the FA brigade are based on the missions it will be required to perform. Each mission has its specific communications requirements. Different communications channels are necessary. Hence, the communications means of the FA brigade must meet the minimum needs for its most demanding mission—alternate div arty tactical operations center.

Communications configurations for the FA brigade when it is acting as a div arty TOC are as follows:

- Three div arty OPS (FM digital) frequencies performing the same function as at div arty.
- One TAB CI (FM digital) frequency performing the same function as at div arty.
- Three (digital) multichannel circuits to corps, the FSEs (tactical and main), and div arty. For MSU operations, the FA brigade uses the div arty frequencies and sole-user circuits.
- The counterfire officer communicates on a standard wire circuit to the TACFIRE computer. This provides both voice and digital modes.

To further reduce the amount of voice traffic on the digital nets, the FA brigade enters the following nets:

- Two external FM voice nets (division CMD/OPS and division intelligence [INTEL]).
- One external AM voice net (division TOC).
- One internal FM voice net (div arty CMD).

FA BRIGADE COMMUNICATIONS (AS DIV ARTY TOC)

CCU NET	DDT	NET	SUBSCRIBERS
1	A	Div arty OPS1	DS bn, R bn, GS/GSR bn
2	B	Div arty OPS2	DS bn, R bn, GS/GSR bn
3	C	Div arty OPS3	DS bn, R bn, GS/GSR bn, bde FAAOs
4	D	TAB CI multichannel	Radars, sound platoons
5	E	Multichannel	FSE (tactical and main)
6	F	FA bde OPS multichannel	Div arty TOC (MSU)
7	G	Corps arty F	Corps arty

- Three external AM RATT nets (division OPS, division INTEL, and corps F).
- Two internal AM RATT nets (div arty CF1 and CF2).

The FA brigade has two FM frequencies (FA brigade CMD [voice] and FA brigade OPS/F [digital]) and one RATT net (FA brigade CF [SSB]) that are not used when brigade is acting as a div arty. However, when configured for MSU operations when the div arty is operational, the brigade OPS/F net may have to be used to establish communications between selected subscribers and the brigade computer. Also, the FA brigade may have to have its own secure voice CMD net and its own RATT net.

A detailed discussion of communications nets is in Chapter 8. The brigade net structure (as div arty TOC) discussed thus far is only a recommended net configuration. Net configurations vary from one brigade to another and are based on the assigned tactical mission and the number of organic/attached elements. Unit tactical SOPs establish the communications structures for each situation.

MUTUAL SUPPORT

This paragraph highlights mutual support considerations that are unique to an FA brigade (and a div arty of an uncommitted division that corps employs as an FA brigade). For a detailed discussion of mutual support, refer to Chapter 5. When in general support of corps artillery or reinforcing a div arty, the FA brigade commander specifies the mutual support relationship of each attached battalion in the TACFIRE tab to the FA support plan. Positioning can impact heavily on mutual support capabilities. Therefore, the FA brigade commander should establish mutual support relationships on a case-by-case basis. He also provides for continuity of operations for his own TOC complex and computer system. To effect the orderly transfer of responsibilities to the mutual support unit, the FA brigade commander can choose to send either a liaison section with a VFMED or other TOC personnel to the MSU TOC to monitor and help in the MSU operation.

The following subparagraphs summarize brigade mutual support options under various situations.

GENERAL SUPPORT OF CORPS

A div arty or the corps artillery computer can provide mutual support for the FA brigade by constant update of its file and data base through the brigade MOI function.

REINFORCING A DIV ARTY

Normally, the reinforced div arty is the mutual support unit for the FA brigade. The FA brigade can update its files and data base at the div arty computer through its MOI function. This provides an automatic flow of selected data from the FA brigade to the div arty computer. Additional data must be provided by the FA brigade to cover information that cannot be automatically transmitted by MOI processing.

DIRECT SUPPORT OF A MANEUVER BRIGADE

When the FA brigade is in direct support of a maneuver brigade, the MSU for the FA brigade will be specified by div arty. The MSU would normally be other than div arty, because div arty is concerned with the whole division and cannot accept the additional mission of direct support of a maneuver brigade.

COVERING FORCE ARTILLERY HEADQUARTERS FOR A DIVISION

While the FA brigade is operating as a covering force artillery headquarters, the div arty will be constantly updated on the situation to effect the hand-off of fire support responsibilities.

TACTICAL CONFIGURATIONS

On the basis of habitual roles of the FA brigade, the FA brigade S3 configures the brigade TOC similar to a div arty TOC as described in Chapter 8. The tactical situation or the tactical mission assigned to the FA brigade may cause the brigade TOC configuration to be modified to facilitate better management of fire support.

MULTIPLE LAUNCH ROCKET SYSTEM

An MLRS battalion is assigned to corps, and MLRS batteries are organic to armored and mechanized infantry divisions. Although not organic, MLRS batteries may be attached to support an FA brigade. MLRS operations are discussed in Chapter 8 of this field manual and in FC 6-60.

LANCE

Lance is the corps commander's primary long-range artillery capable of nuclear/nonnuclear fire support. Lance is normally positioned anywhere within the corps zone of responsibility. Lance adds depth to combat with its ability to engage targets beyond the range of cannon. Lance operations are discussed in Chapter 8 of this field manual and in FM 6-42.

SECTION II

OPERATIONS

This section presents a basic framework of how each FA brigade element uses TACFIRE for data processing while in general support of corps, reinforcing a div arty, in direct support of a maneuver brigade, or acting as an artillery headquarters for a division covering force.

GENERAL SUPPORT OF CORPS

An FA brigade may be retained under the immediate control of the corps commander. Thus, it can attack targets of interest to corps and give the corps commander the flexibility

to influence the battle as the tactical situation changes. The assignment of a mission of GS or GSR ensures this responsiveness.

FIRE CONTROL ELEMENT

The FCE gets the data to initialize the computer from the FA brigade commander, his staff, the corps FA support plan, and the corps artillery computer. Input must be received from these sources to ensure the FCE complies with specific FA support requirements directed by corps.

TARGETING ELEMENT

When the FA brigade is in general support (or GSR) of corps, the targeting element disseminates aerial observer (AO) reports, SHELREPs, and other intelligence from subordinate elements of the FA brigade to the corps. It also stores targets from the corps artillery computer and disseminates them to the subordinate elements of the FA brigade. Any targets developed by the targeting element are passed to the corps artillery computer for an update of the corps target file and for attack clearance, if needed. This element must coordinate with the operations element of the corps artillery when purging portions of its target file to ensure that the brigade and corps artillery computers have compatible target files.

OPERATIONS ELEMENT

The operations element prepares fire plans (schedules) for FA fires based on preliminary target lists and attack guidance from the corps artillery operations element. Once a preliminary target list is received, TACFIRE is used to prepare these plans in the same manner as in a div arty operations element.

REINFORCING DIVISION ARTILLERY

Corps may have to retain control of an FA brigade and at the same time provide one of the divisions additional fire support. The corps commander can satisfy both needs by assigning an FA brigade the mission of reinforcing div arty. The FA brigade must establish liaison with the reinforced div arty. The TACFIRE is used in the same manner as when the brigade is assigned the mission of GS, except that the div arty plans the fires of the FA brigade.

FIRE CONTROL ELEMENT

To ensure that the FA brigade can perform its reinforcing mission, the FCE must provide for the attack of targets when requested by the reinforced div arty and corps artillery. The FCE gets the data to initialize the computer from guidance from the FA brigade commander, S3, targeting element, corps artillery, and reinforced div arty.

TARGETING ELEMENT

When the FA brigade is reinforcing a div arty, the targeting element processes AO reports, SHELREPs, and other intelligence information from subordinate elements of the FA brigade and disseminates them to the supported div arty and the corps artillery. The targeting element also stores targets from the corps artillery operations element and the supported div arty and disseminates them to the subordinate elements of the FA brigade. The targeting element must ensure that all deletions from the ATI files are coordinated with the headquarters originating the target. This means coordinating with corps artillery for deletion of targets of corps interest and with div arty for targets that originated in the division.

LIAISON SECTION

One of the two liaison teams of the liaison section is tasked to establish liaison with the reinforced div arty. It receives information on FA brigade fire unit status and capabilities as well as other information about the FA brigade needed by div arty. The liaison team provides the FA brigade, via its VFMED, positioning and movement instructions, future plans, and other information needed to properly reinforce the div arty.

DIRECT SUPPORT OF A MANEUVER BRIGADE

An FA brigade that has been attached to a division and further attached to a div arty may be assigned a mission of DS to a maneuver brigade. Also, the div arty DS battalion that habitually supports the maneuver brigade should be attached to the FA brigade. This places all DS field artillery

assets for that brigade under one FA commander. If the FISTs and FSOs were not already in place, the FA brigade would task the close support battalion to provide the appropriate support to the appropriate elements of the maneuver brigade. When assigned a DS mission, the FA brigade uses its TACFIRE equipment in the same manner as does a div arty.

FIRE CONTROL ELEMENT

The FCE obtains guidance for initializing the computer from the brigade commander, S3, FSEs, div arty tactical SOP, and supported brigade OPLANs.

TARGETING ELEMENT

The targeting element of the FA brigade has the same responsibilities as the div arty targeting element. However, the FA brigade targeting element is concerned only with the supported maneuver brigade zone of responsibility. The FA brigade may assume the div arty counterfire responsibilities for that zone.

ARTILLERY HEADQUARTERS FOR A DIVISION COVERING FORCE

An FA brigade may be attached to a division, subsequently attached to a div arty, and then assigned the task of managing the fire support effort for the division covering force. In performing that task, the FA brigade controls the battalions in direct support of task forces of the covering force as well as those in general support of the covering force. A div arty close support battalion would have to be tasked by div arty to provide the FISTs and FSEs needed to support the covering force headquarters and its subordinate maneuver elements. The FA brigade establishes liaison with an adjacent covering force FA headquarters and the div arty TOC in the main battle area (MBA) of its division zone.

TARGET ACQUISITION ASSETS

Target acquisition assets available to the FA headquarters are the FA brigade organic aerial observers and those assets attached from the div arty. Div arty will give the FA brigade such assets as the situation warrants.

FIRE CONTROL ELEMENT

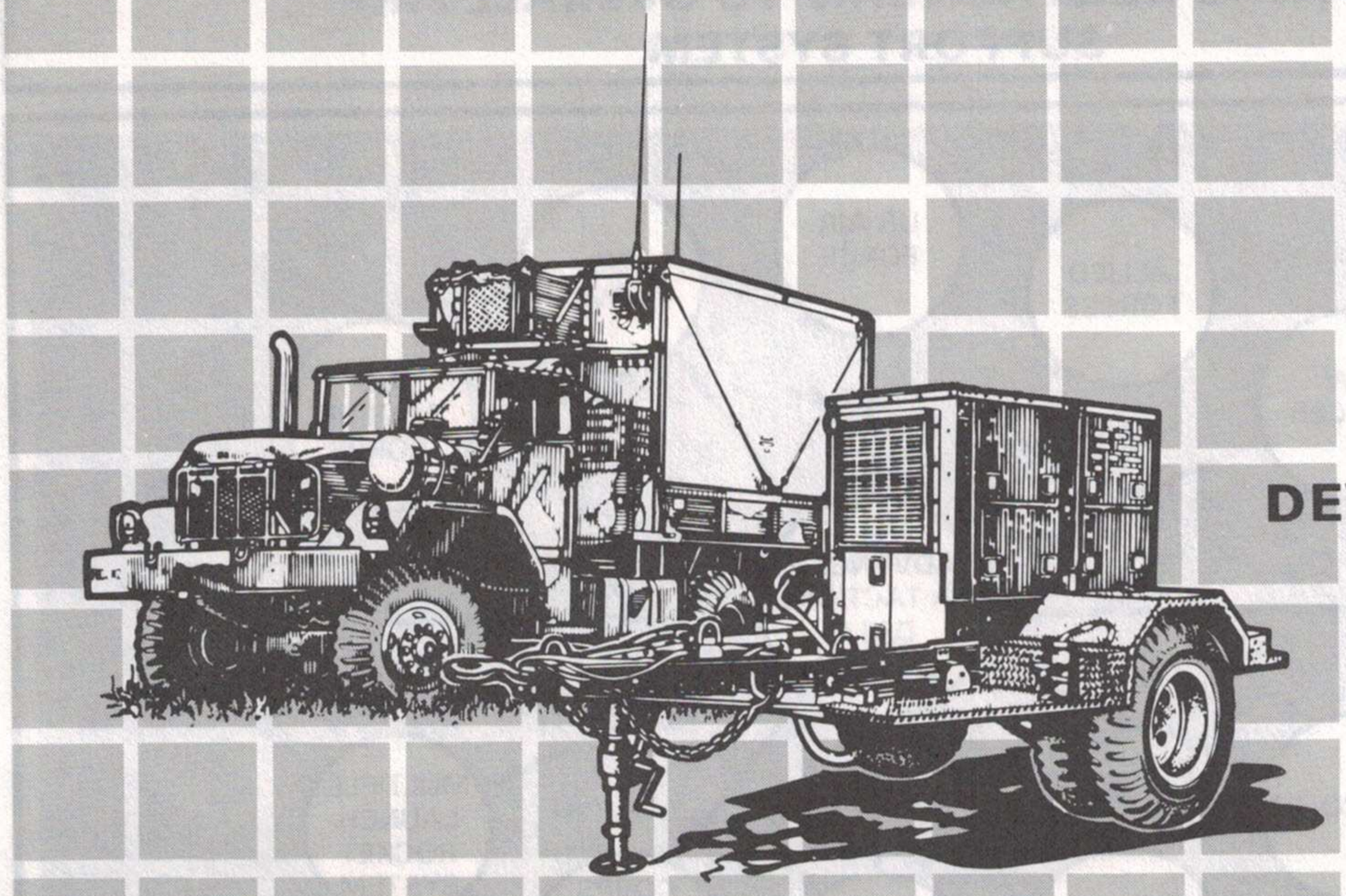
The FCE gets the data for initialization from guidance from the FA commander, the S3, and the covering force FSE.

TARGETING ELEMENT

The primary responsibility of the targeting element is the production of FA targets affecting the covering force. The targeting element may receive personnel augmentation from div arty while in the covering force role.

LIAISON SECTION

The liaison section of the brigade sends one team to establish liaison with an adjacent force artillery as dictated by division. The team coordinates between the two covering force FA headquarters. The second liaison team keeps the div arty abreast of the situation and should position itself near the div arty TOC.



APPENDIX A

FUTURE DEVELOPMENTS

In the air-land battle of the future, a serious threat to the United States and its allies will be imposed by potential adversaries that are numerically superior. These Threat forces will employ tactical, nuclear, chemical, and conventional weapons; maneuver and fire support; and air and land operations. They will use numerical force superiority, speed and penetration, and echelonment tactics. These Threat capabilities, plus anticipated improvement in their forces, dictate that our fire support system be able to engage numerous targets, to the width and depth of enemy deployment, with a wide variety of attack means. Some of the new fire support systems, currently in the development stage, which will counter this threat are described in the following paragraphs. Additional system-specific threats to the advanced field artillery tactical data system (AFTADS) are in Appendix F of ATC-PD-1720-003-83.

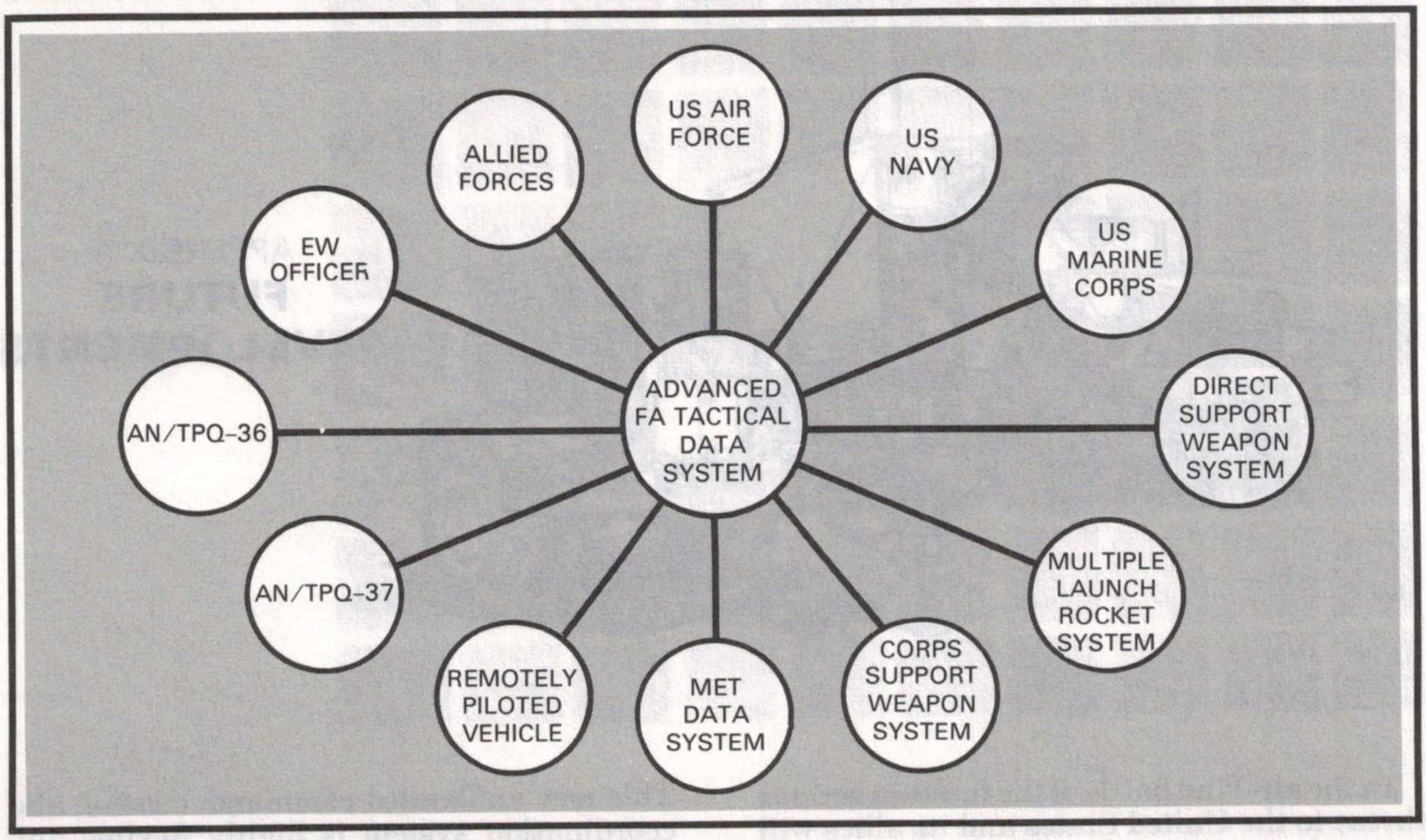
ADVANCED FIELD ARTILLERY TACTICAL DATA SYSTEMS

The advanced FA tactical data systems development is an evolutionary process that starts with the current baseline TACFIRE. This new automated command, control, and coordination system is highly flexible and will significantly increase capability by virtue of multiple processors. It will also increase mobility through decreased size and weight. The AFATDS is scheduled for worldwide deployment in the early 1990s.

The AFATDS hardware will consist of processors, intelligent terminals, electronic displays, and line printers that will maximize use of the military computer family development. The number of computer components will be kept to a minimum to ensure commonality throughout the system. A single self-contained processing device for each subsystem is the AFATDS overall goal.

As a control system, AFATDS must be able to perform multiple missions. First, it must enable the fire support functional segment to process and analyze selected data for internal FA command and control functions. Next, it must share selected information with other control systems. Finally, it must provide information to support the force commander's decision process. It should be noted here that AFATDS is only a *part* of the total fire support system and *not*, of itself, *the* fire support system.

AFATDS RELATIONSHIP TO OVERALL FIRE SUPPORT SYSTEM



COMMUNICATIONS CONTROL SYSTEM

The communications control system (CCS) is a communications processor to be retrofitted into current TACFIRE computer centers. It will better manage current communications and enable the use of future systems such as position location reporting system (PLRS)/joint tactical information distribution system (JTIDS) hybrid (PJH) and single channel ground/air radio system (SINCGARS). The CCS will be available in the 1987–1990 time frame.

The current FA communications system is based on the net structures used with manual procedures/field artillery digital automatic computer (FADAC), which were carried over into those used with TACFIRE/BCS. The original design of this communications system was based on an estimate of digital traffic that was sparse compared to the anticipated traffic loads of the tactical environment of the 1990s. Extensive testing of the current system with scenario loads of the 1990s resulted in severe overloads, extensive message queuing, and unacceptable mission delays.

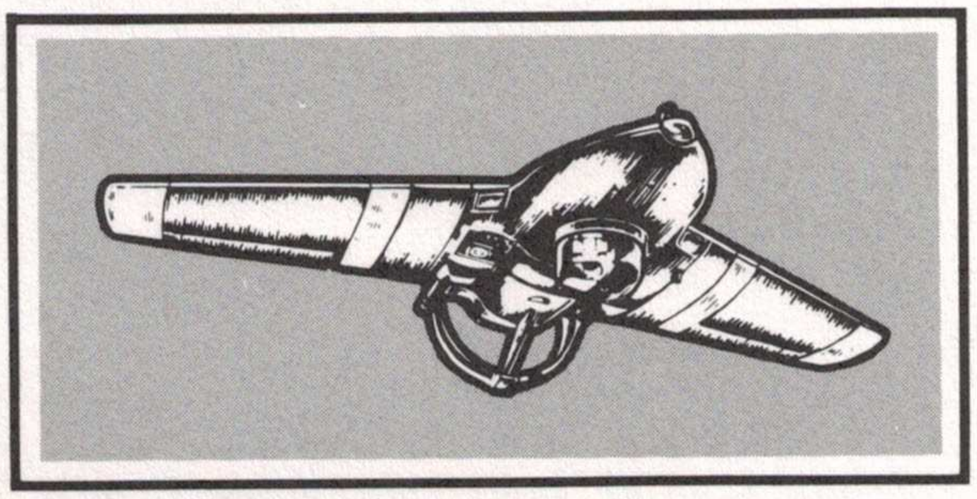
The AFATDS communications architecture will be controlled by a network of communications management processors. They will exploit current development trends to achieve a multilayer, EW-resistent, responsive network. The concept of layers is associated with bands of electromagnetic frequency spectrum. The interoperation of four layers of primary communications system will be necessary to tailor responsive communications support to the varying requirements, volume, and message formats generated by AFATDS at each corresponding command and control level. These four systems are PLRS/JTIDS hybrid, SINCGARS, high-frequency radios, and multichannels.

REMOTELY PILOTED VEHICLE

The remotely piloted vehicle (RPV), an unmanned air vehicle, is designed to provide

TACFIRE with targets and combat information beyond the line of sight of supported ground forces. The RPV system can detect, recognize, and identify targets 20 kilometers beyond the FLOT accurately enough for engagement by a selected weapon of the fire support system.

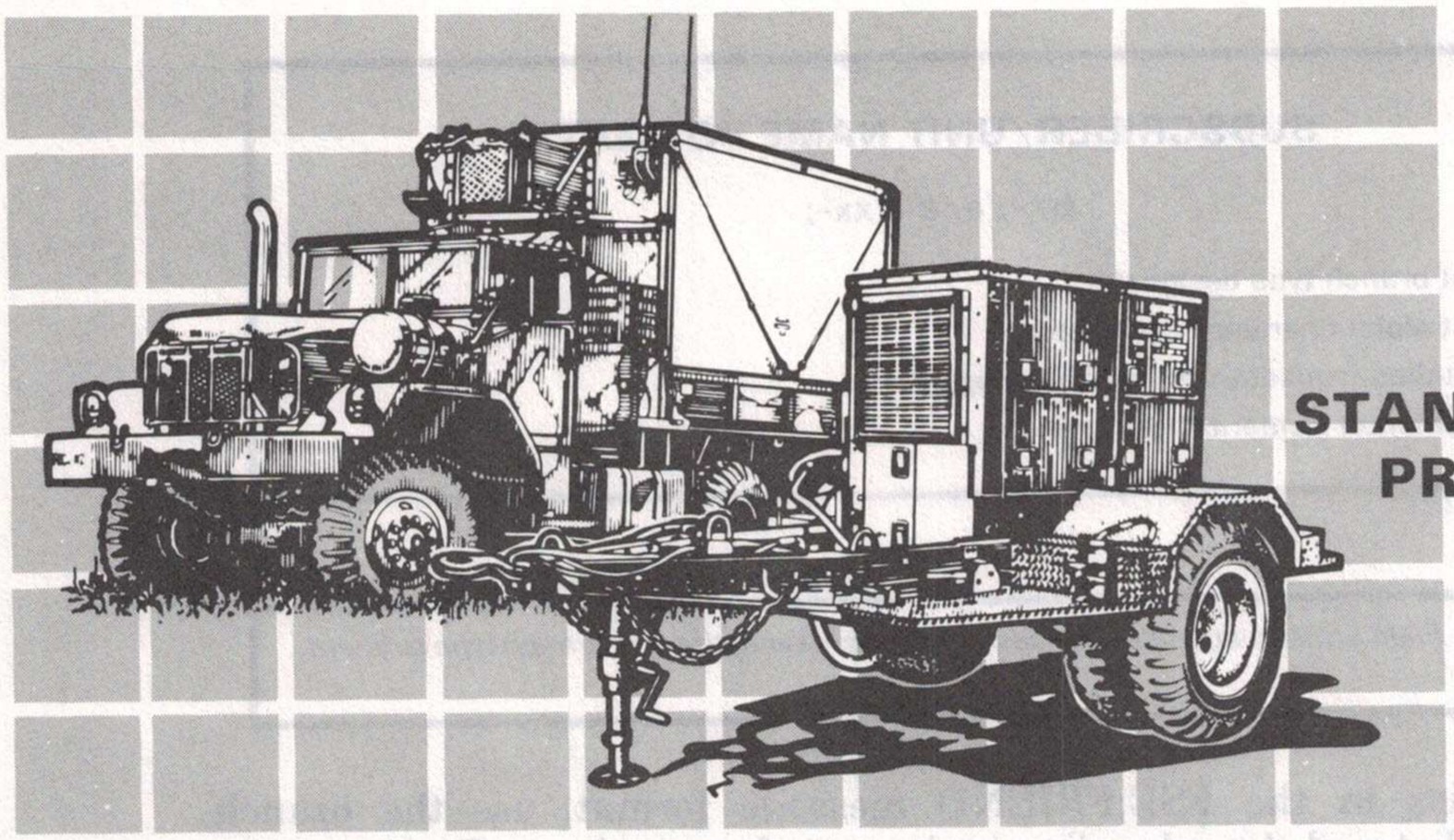
REMOTELY PILOTED VEHICLE



The RPV system communications capability includes both wire and voice (FM secure) interface with the parent organization and the supported maneuver force. A DMD allows exchange of digital traffic with TACFIRE as prescribed by that system.

METEOROLOGICAL DATA SYSTEM

The MDS is a mobile ADP and met data acquisition system with nonradiating ground-based components. It will automatically collect, process, and transmit met data to FDCs via TACFIRE and/or plain text for use in ballistic calculations. It also provides met data for use in nuclear fallout prediction and air weather service (USAF) support.



APPENDIX B
STANDARD ENTRY PROCEDURES

This appendix establishes procedures for standardizing computer entries in the unit designation, PLAN, NEWPLN, FU, and L1 fields of various TACFIRE message formats. This information is provided to eliminate confusion and duplication of effort made by different agencies.

GENERAL

Fire plans, zones, and areas, are designated at and by the highest artillery coordination agency involved with the planning of a particular requirement.

When designating a particular plan, zone, or area, ensure that the name has not been used previously. Check the master plan file by printing existing plans using SYS;MISC;MPLIST:X.

- Ensure that the fire plan name identifies the fire planning agency.
- Check for battlefield geometry using SPRT;COMD;PRINT:X.
- Compare fire unit names with the subscriber table.

Left justify all entries that are less than six characters in PLAN, NEWPLN, and all geometry measures.

FSE;FRIEND MESSAGE

BRANCH DESIGNATOR LIST

A = armor
I = infantry
C = cavalry
M = mechanized
P = airborne
H = air assault
E = engineer
R = mortar
S = signal
T = trains
D = air defense artillery
O = tactical operations center
G = command post

SUBSCRIBER/UNIT NAME FORMAT

b/-/a/#-/xx-;

b = unit branch type designator
a = unit alpha character designator
# = battalion/squadron numerical designator
xx = regimental numerical designator

NOTE: *Field artillery agencies are designated by leaving the unit branch type subfield blank.*

For entries in the FSE;FRIEND message format, use the branch designator list and the subscriber/unit name format above. Entries are as follows:

- In the first subfield, enter the branch designator.
- Leave the second subfield blank. It can be used for elements smaller than company, if desired; but it must be coordinated to avoid duplication.
- In the third subfield, enter the unit alpha designator.
- In the fourth subfield, enter the battalion/squadron numerical designator.
- In the fifth subfield, enter the regimental numerical designator.

EXAMPLES: UNIT: A/_/C/2_/35_; Co C, 2d Bn, 35th Armor

UNIT: I/_/B/3_/33_; Co B, 3d Bn, 33d Inf

UNIT: E/2/A/1_/17_; 2d Plt, Co A, 1st Bn, 17th Engr

NOTE: *If a duplication exists, the final responsibility to resolve it rests with the fire support element.*

FIRE PLAN NAMES

The following procedure identifies the type of fire plan and the establishing agency.

__ØØxx

__ = type of plan (see list below)
ØØ = numerical designator from the target number block of the establishing agency.
xx = alpha designators from the target number block of the establishing agency

PLAN DESIGNATOR LIST

PP = preparation
CP = counterpreparation
SA = suppression of enemy air defense (SEAD)
QK = quick-fire plan
CM = countermortar
CB = counterbattery
CF = counterfire

NOTE: *Other two-letter designators can be established as needed.*

EXAMPLES: CMØ1AB = first countermortar program planned by Fire Support Section, 2d Bde, 1st Div

CPØ2AY = second counterpreparation planned by Div Arty TOC, 1st Div

QK31AC = first quick-fire plan planned by 2d Bn FSO, 3d Bde, 1st Div

FU AND UFFE FIELDS OF APPROPRIATE MESSAGE FORMATS

_/_/a_/#_/xx_;

a = unit alpha character designator
# = battalion/squadron numerical designator
xx = regimental numerical designator

EXAMPLES: FU: _/_/_/2_/2__; 2d Bn, 2d FA

UFFE: _/_/C/1_/31_; Btry C, 1st Bn, 31st FA

FU: _/_/H/1_/1__; How Btry, 1st Sqdn, 1st ACR

NAME FIELD OF SPRT;ZNE MESSAGE FORMAT CORPS ZONE

NAME:##CORP;

= corps numerical designator

EXAMPLE: NAME:3CORP_; 3d Corps

DIVISION ZONE

NAME:##BB__;

= division numerical designator
BB = division type:

AD = armor	HD = air assault
ID = infantry	PD = airborne
CD = cavalry	MD = mechanized

EXAMPLE: NAME:41MD__; 41st Mech Inf Div

BRIGADE ZONE

NAME:xBDE__;

x = brigade numerical designator

EXAMPLE: NAME:3BDE__; 3d Bde

TASK FORCE ZONE

NAME:TF#-xx;

\# = battalion numerical designator
xx = regimental numerical designator

EXAMPLE: NAME:TF2-23; Task Force, 2d Bn, 23d Regt

BATTALION ZONE

NAME:#-xxx/b;

\# = battalion numerical designator
xxx = regimental numerical designator
b = maneuver branch type from branch designator list

EXAMPLES: NAME:3-33I_; 3d Bn, 33d Inf

NAME:2-509P; 2d Bn, 509th Abn

COMPANY ZONE

NAME:a#-xxb;

a = unit alpha designator
# = battalion numerical designator
xx = regimental numerical designator
b = maneuver branch type from branch designator list

EXAMPLE: NAME:B2-21M; Co B, 2d Bn, 21st Mech Inf

UNITS AND AGENCIES IN SUBSCRIBER TABLE AND OTHER APPROPRIATE MESSAGE FORMATS

FIRE SUPPORT OFFICERS AND FIRE SUPPORT ELEMENTS

EXAMPLES: L1:F/S/O/2_/21_; FSO for 2d Bn, 21st Regt

L1:F/S/O/2_/BDE: 2d Bde FSO

L1:F/S/E/41/MD_; Main FSE for 41st Mech Inf

L1:T/A/C/41/MD_; Tactical FSE for 41st Mech Inf

DIVISION ARTILLERY/FA BRIGADE

EXAMPLES: L1:_/_/_/1_/CDA; 1st Cav Div Arty

L1:_/_/_/82/PDA; 82d Abn Div Arty

L1:_/_/_/2_/ADA: 2d Armd Div Arty

L1:_/_/_/52/BDE; 52d FA Bde

OTHER SUBORDINATE ARTILLERY ELEMENTS

EXAMPLES:

FISTs	L1:F/I/S/##/___;
FOs	L1:_/F/O/##/___;
Aerial observers	L1:_/A/O/##/___;
Countermortar radar	L1:C/M/R/##/___;
Counterbattery radar	L1:C/B/R/##/___;
Battalion O&I	L1:_/O/I/#_/xx_;

Ground surveillance radar	L1:G/S/R/##/___;
Sound platoon	L1:_/S/N/##/___;
Division artillery targeting	L1:T/G/T/##/bDA;
Division artillery operations	L1:_/O/I/##/bDA;
Corps FSE	L1:F/S/E/##/COR;
Corps O&I	L1:_/O/I/##/FAS;

b = branch designator from the branch designator list

MORTAR FIRE UNITS

R/a/#_/xx_;

R = mortar
F = mortar type:

4 = 4.2 inch
8 = 81 mm
6 = 60 mm

a = unit alpha designator
# = battalion numerical designator
xx = regimental numerical designator

EXAMPLE: FU:R/8/A/2_/21_; 81-mm mortars from Co A, 2d Bn, 21st Regt

NAVAL UNITS

FU:w/w/w/ss/iii

w/w/w/ = weapon caliber
ss = ship type:

DD = destroyer
CC = cruiser

iii = ship ID number

EXAMPLES: FU:5/5/4/DD/489; destroyer 489 with 5-inch 54 caliber guns

FU:5/3/8/CC/713; cruiser 713 with 5-inch 38 caliber guns

NOTE: *Enter a separate entry for each weapon type if the ship has more than one type of gun.*

AIRCRAFT UNITS

FU:A/I/R/CR/AFT;

FIRE SUPPORT COORDINATING MEASURES

FIRE SUPPORT COORDINATION LINE

FSCLxx

xx = alpha designators from the target number block of the establishing agency

FORWARD LINE OF OWN TROOPS

FLOTxx

xx = alpha designators from the target number block of the establishing agency

RESTRICTIVE FIRE LINE

RFLØxx

Ø = numerical designator
xx = alpha designators from the target number block of the establishing agency

COORDINATED FIRE LINE

CFLØxx

Ø = numerical designator
xx = alpha designators from the target number block of the establishing agency

RESTRICTIVE FIRE AREA (NO-FIRE AREA, FREE-FIRE AREA)

_FAØxx

_ = F, N, or R, as appropriate
Ø = numerical designator

xx = alpha designators from the target number block of the establishing agency

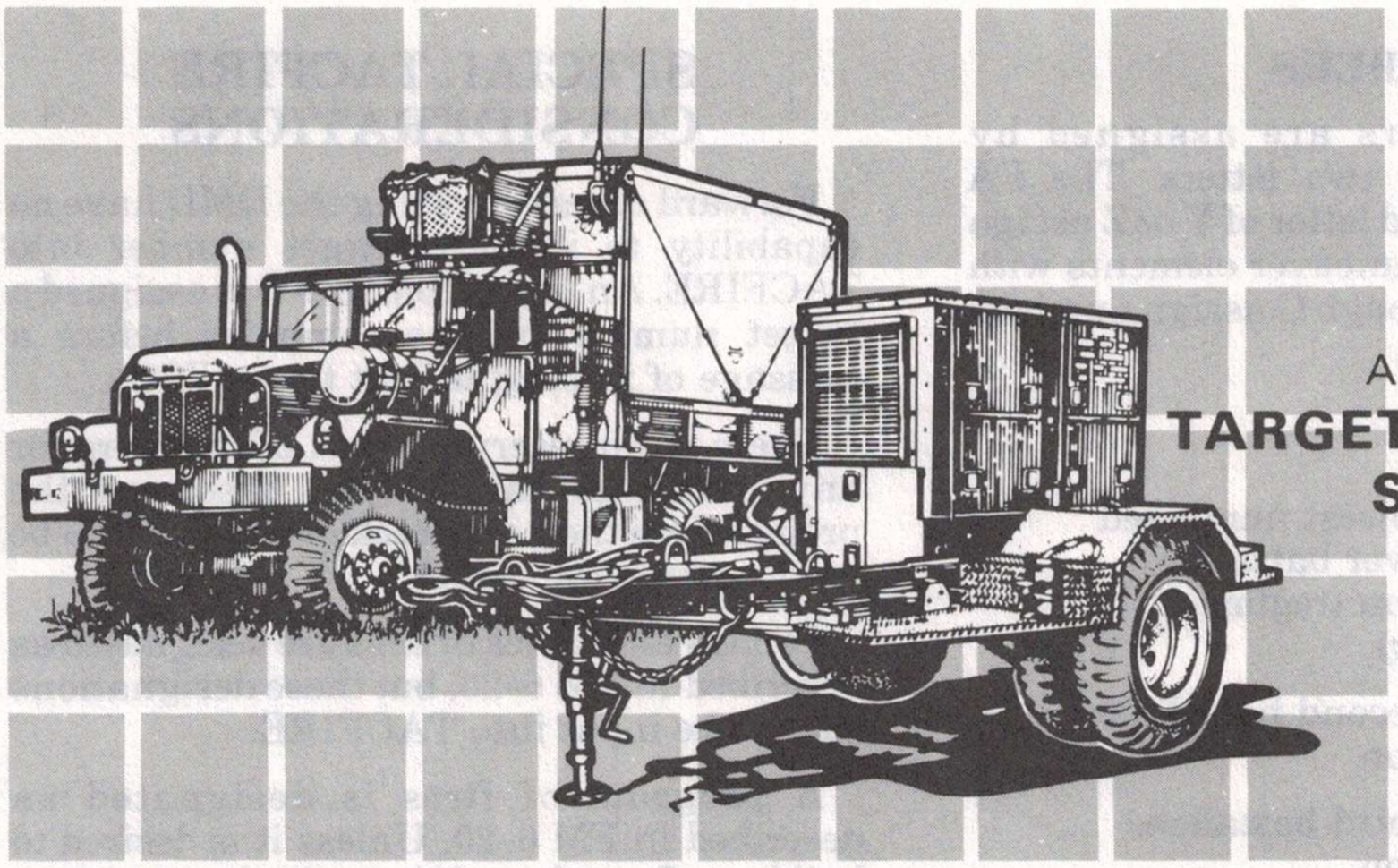
If the restriction applies to a specific munition:

--- = restricted munition; for example, ICM, VT, SMA (WP)
Ø = numerical designator
xx = alpha designator from the target number block of the establishing agency

AIRSPACE COORDINATION AREA

ACAØxx

Ø = numerical designator
xx = alpha designator from the target number block of the establishing agency



APPENDIX C
TARGET NUMBERING SYSTEM

The target numbering system described in this appendix complies with the provisions of STANAG 2147/QSTAG 221.

PURPOSE

This target numbering system provides for—

- Identifying the planning source. The planning source of each target should be readily identifiable so that each artillery and force echelon can obtain or provide additional information, eliminate conflicts and duplications, and notify the originator of the action taken on requests.

- Excluding duplication. With TACFIRE, it is not necessary that any agency assign a target number for a target being input. TACFIRE automatically assigns a number to any incoming target that does not contain a number. TACFIRE accepts any legal number coming into the system if it is not a duplicate of a number already used and has not been reserved by the system. In case of a complete system failure and initiation of the manual mode, target numbers are assigned beginning with the next unassigned number. When the system is again operational, the target number block in the SYS;INIT message is updated to reflect the numbers assigned manually. Targets generated while the computer was nonoperational are entered into the system (with their existing target numbers) as required.

SYSTEM

A target is designated by two elements: two letters and four numbers.

LETTERS

The two-letter group denotes the originator of the target in the US system as follows:

1st Letter	
A—G	Divisions within a corps in numerical order from low to high
2d Letter	
A—G	Maneuver brigades within a division in numerical order from low to high
Y	Division artillery TOC
Z	Division FSE
Other	
XA—XG	Separate regiments/ brigades within a corps in numerical order from low to high
XY	Corps O/I, corps arty TOC
XZ	Corps FSE

NUMBERS

Blocks of numbers are assigned by headquarters having two letters. The FA elements with a second letter of Y or Z assign blocks as required. Maneuver elements with second letters of A through G assign numbers as follows:

0001—1999	FSE
2000—2999	FSO, lowest numbered maneuver battalion/ squadron (regiment number)
3000—3999	FSO, second battalion/ squadron
4000—4999	FSO, third battalion/ squadron
5000—5999	Additional FSOs
7000—7999	FDC, DS FA battalion
8000—9999	As required

Maneuver battalion size elements suballocate numbers as follows:

000—199	FSE
200—299	FIST, Co A
300—399	FIST, Co B
400—499	FIST, Co C
500—699	Additional FISTs
700—799	Mortar platoon/ How Btry FDC
800—999	As required

SPECIAL TACFIRE CONSIDERATIONS

Forward observers using the DMD have no capability to input a target number into TACFIRE. An input from an FO is assigned a target number by the computer before a message of interest is sent to the FSOs.

There is no reserved block of numbers for any particular target type based on the proposed method of attack or munition to be used against the target.

Groups and series of fires are designated as described in FM 6-20, but these designations cannot be input into TACFIRE.

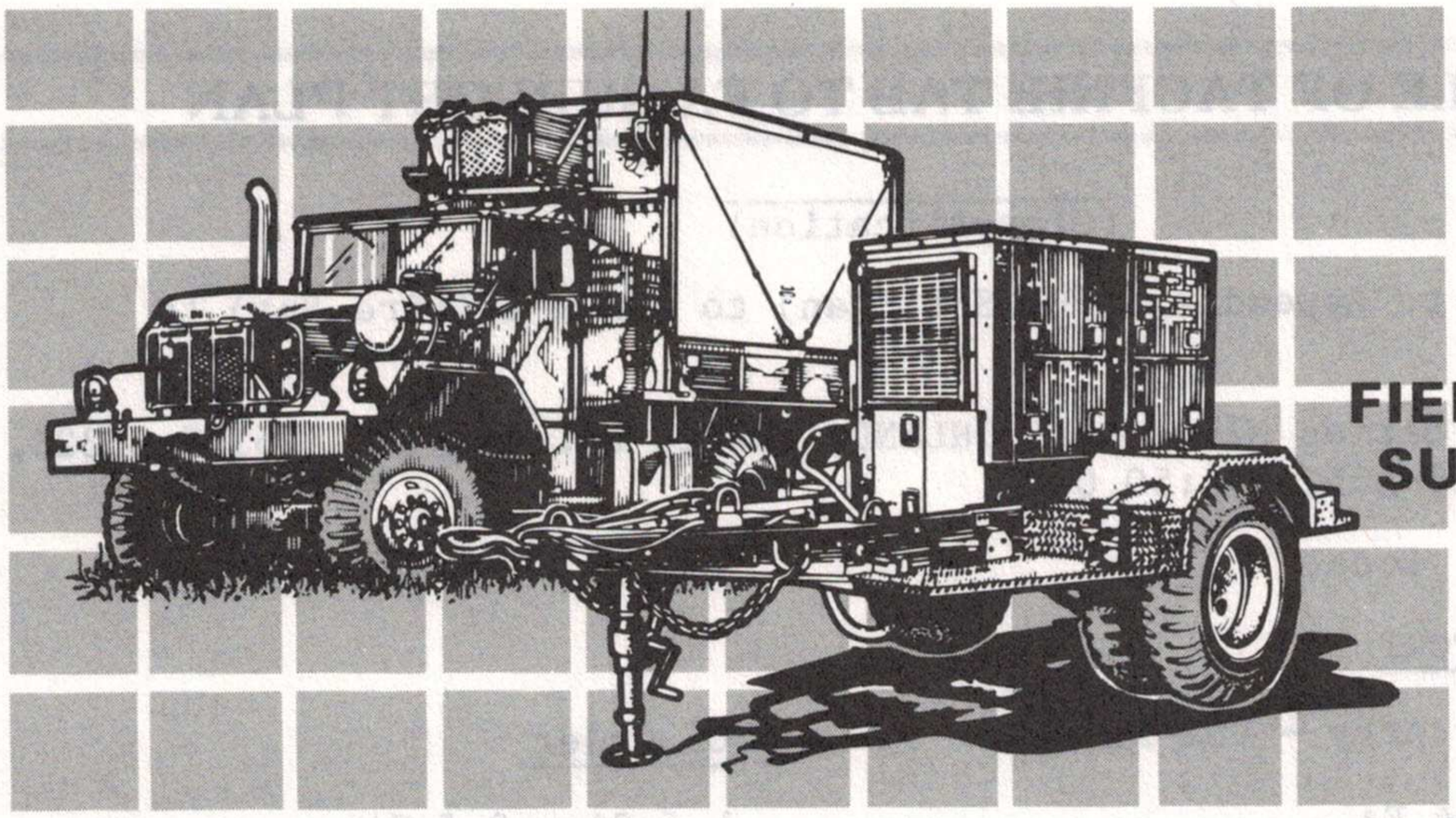
A program of fires is designated as described in FM 6-20. Unless it is desired to build a fire plan for a single program, program names cannot be input into TACFIRE.

The SYS;INIT is initialized with the assigned unit target block.

If shortened target numbers are used by anyone (see FM 6-20), they must be expanded to six characters before being input into TACFIRE; for example, AH102 becomes AH0102.

Battery FDCs enter target numbers in the BCU as follows:

- First and second letters same as battalion TACFIRE computer.
- Battery A: 9100—9399
- Battery B: 9400—9699
- Battery C: 9700—9999



APPENDIX D

FIELD ARTILLERY SUPPORT PLAN

The FA support plan is the force artillery commander's tactical plan for employing the fires of all available supporting artillery. The FA operations officer (S3) prepares this plan. It is based on guidance, targets, and instructions included in the fire support plan of the OPORD or on verbal information from the FSE. The FA support plan ensures the most efficient use of available field artillery to support the maneuver forces and disseminates the FA commander's guidance on how to accomplish the FA portion of the fire support plan. This guidance may include designation of specific units to attack critical targets that are a threat to the accomplishment of the mission of the supported commander and the manner in which the supporting FA will engage the target. Because of the fluidity of the battle, the written FA support plan may follow the oral dissemination of those key elements needed by the units for timely execution. When completed, an FA support plan normally contains a written portion, a target list, and the schedule of fires.

Since TACFIRE provides fire planners throughout the artillery system with instantaneous access to target files and FA schedules, the S3 writing the FA support plan no longer has to attach a target list and schedules of fire to the written portion. Instead, he can initiate, coordinate, and monitor the development of the FA schedules in accordance with the standard nonnuclear fire planning capabilities and procedures that apply to TACFIRE. In the written portion, he can reference FA schedules by plan name, and if necessary, targets by target number only. An element using a VFMED can then extract detailed information as needed from a TACFIRE computer.

The following example depicts a formatted TACFIRE tab to an FA support plan designed for use with a contingency plan. It presents the initialization requirements, commander's criteria, mutual support relationships, fire support coordinating measures, and other data important to TACFIRE command and control functions.

EXAMPLE OF TACFIRE TAB TO FA SUPPORT PLAN

(Classification)

Tab A (TACFIRE) to Appendix 3 (FA Spt Plan) to Annex B (Fire Spt) to OPORD 2-86

Reference: Map series M745; DEUTSCHLAND; sheets L5118-L5126, L5318-L5326, L5518-L5526; 1:50,000

Time Zone Used: Local

1. MUTUAL SUPPORT

53 Mech Div Arty - 102 FA Bde	On Order
1-5 FA - 1-6 FA	1-5 FA - 2-5 FA
2-5 FA - 2-6 FA	3-5 FA - 4-5 FA
3-5 FA - 3-6 FA	1-6 FA - 2-6 FA
4-5 FA - 4-6 FA	3-6 FA - 4-6 FA

2. FSO - FO/AO/RADAR ASSIGNMENTS

a. Covering Force Area

FSO 1-2: FIS Ø1, Ø2, Ø3, Ø4	FSO 2-2: FIS 23, 24, 25, 26
1-3: FIS Ø5, Ø6, Ø7, Ø8	2-3: FIS 27, 28, 29, 3Ø
FSO 3-2: FIS 45, 46, 47, 48,	FSO 4-2: FIS 67, 68, 69, 7Ø
3-3: FIS 49, 5Ø, 51, 52	4-3: FIS 71, 72
	1-11: FIS 73, 74

1-5 FA: CMR 97	1-6 FA: AO 91	53 DA: CBR 95, 96
2-5 FA: CMR 98	2-6 FA: AO 92	
3-5 FA: CMR 99	3-6 FA: AO 93	
	4-6 FA: AO 94	

b. Main Battle Area

FSO 1-1: FIS Ø1, Ø2	FSO 2-1: FIS 23, 24
1-2: FIS Ø3, Ø4	2-2: FIS 25, 26
1-3: FIS Ø5, Ø6	2-3: FIS 27, 28
1-4: FIS Ø7, Ø8	2-4: FIS 29, 3Ø
FSO 3-1: FIS 45, 46	FSO 4-1: FIS 67, 68
3-2: FIS 47, 48	4-2: FIS 69, 7Ø
3-3: FIS 49, 5Ø	4-3: FIS 71, 72
3-4: FIS 51, 52	4-4: FIS 73, 74

1-5 FA: CMR 97	53 DA: AO 91, 92, 93, 94
2-5 FA: CMR 98	CBR 95, 96
3-5 FA: CMR 99	

(Classification)

(Classification)

3. COMMANDER'S CRITERIA (IN ADDITION TO SOP)

a. Commander's MODs

(1) FM;MOD
PZONE: 3BDE
PTYPE: RKTMSL/APERS
PSHEL: CPH

(2) NNFP;MOD
ECOF: Ø3

(3) FSE;CRITER
IGRANG:X WPN:155MM;MAXVOL:5
IGSFTY:X WPN: 8IN;MAXVOL:4
EFF:3Ø CHMEFF: 5/1Ø/2Ø
EFFP:8Ø MAXYLD: 5ØØ

(4) ATI;FMMOD
RV:2ØØ WDOP:5Ø
WTYP:5Ø WSIZE:5Ø

(5) ATI;TBMOD
TC:6

(6) ATI;SVMOD
TIMEX:ØØ/Ø4/ØØ
TIMEY:4
DNARV:1Ø

b. Exclusions

FM;XCLUDE - None
NNFP;XCLUDE - HEC/HEF from all preparations/counterpreparations (except five-target or less antiarmor programs/groups/series at clearly defined choke points)
FSE;XCLUDE - All aircraft from CTA

c. Attack Methods

FM;ATTACK	VOL
ARMOR/APC	2
ARTY/	3
MORT/	2

(Classification)

(Classification)

d. Fire Unit Selection

FM;FUSEL
WPN:155MM;MAXVOL:5
WPN: 8IN;MAXVOL:4

e. MAPMOD

SPRT;MAP - 58ØØØØ, 48ØØØ1, 566ØØØØ, 556ØØØ1;GZ:32;SPHERE:2;

f. Matrix/CAV Change Schedule

Effective DTG	Set
* ØØØ1 AUG 86	*
* ØØØ1 AUG 86	*
* ØØØ1 AUG 86	*
* ØØØ1 AUG 86	*

(* As scheduled by unit)

g. Artillery SITREP

AFU;COMD: transmit SITREP:X to DA/BDE at 12ØØ, and 24ØØ hours daily.

AFU;SR: submit as changes occur.

h. Available Supply Rate

		MBA	CFA
AFU;ASR:	155mm:	1128	564
	8in:	6ØØ	3ØØ

i. Critical Ammunition Level

AFU;AMOL: Do not violate AMOL without authority of force artillery commander.

	HEA	HEC	HEF	SMA	SMB	ILA	HER	APL	APS
155MM	96	48	48	48	12	24	24	12	12
8IN	96	96	96	-	-	-	18	-	-

	AML	AMS	CPH	PDA	TIA	TIB	TIC	VTE
155MM	12	12	6Ø	6Ø	48	108	72	60
8IN	-	-	-	42	34	96	96	32

j. Special Instructions

(1) Ensure continuous update of friendly file and battlefield geometry.

(Classification)

(Classification)

(2) While the covering force, div arty/FA bde may build DS battalions for DACF1 and CF2; after passage of lines, only GSR battalions may be used.

k. Geometry

(1) Zones (both covering force and MBA)

(a) Division zone: 53 DA

1.	871 289		14.	739 968	
2.	Ø1Ø 313		15.	713 952	
3.	Ø86 334		16.	618 934	
4.	2Ø6 34Ø		17.	513 923	
5.	248 348		18.	437 896	
*6.	333 343		*19.	347 898	
7.	527 398		20.	232 878	
8.	755 44Ø		21.	144 875	
9.	796 4Ø4		22.	983 841	
10.	77Ø 335		23.	9Ø4 Ø52	
11.	71Ø 2ØØ		24.	9Ø2 158	
12.	792 19Ø		25.	876 219	
13.	79Ø 988				

ADJC; 2ID, 13AD
BDRY: 6/2XX53, 19/54XX13

(b) Covering force zones

NOTE: *Covering force zones may be deleted after passage of lines.*

1. Div arty/brigade

ZONE:53CFA		:CF1BDE		:CF2BDE		:CF3BDE		:CF4BDE	
1.	423 369	1.	423 369	1.	413 254	1.	48Ø 155	1.	5ØØ Ø37
*2.	527 398	2.	527 398	*2.	77Ø 335	2.	516 169	2.	54Ø Ø41
3.	755 44Ø	3.	755 44Ø	*3.	71Ø 2ØØ	*3.	71Ø 2ØØ	3.	622 Ø98
4.	796 4Ø4	4.	796 4Ø4	4.	516 169	4.	792 19Ø	*4.	755 138
5.	77Ø 335	*5.	77Ø 335	5.	48Ø 155	5.	791 152	5.	791 152
6.	71Ø 2ØØ	6.	413 254	6.	48Ø 17Ø	*6.	755 138	6.	79Ø 988
7.	792 19Ø	7.	424 277	7.	448 2ØØ	7.	622 Ø98	7.	739 968
8.	79Ø 988	8.	4Ø4 3Ø9			8.	54Ø Ø41	8.	713 952
9.	739 968					9.	5ØØ Ø37	*9.	618 934
10.	713 952					10.	483 Ø55	10.	513 923
*11.	618 934							11.	5Ø6 92Ø
12.	513 923							12.	526 965
13.	5Ø6 92Ø							13.	515 Ø2Ø
14.	526 965								
15.	515 Ø2Ø								
16.	483 Ø55	:2ID, CF2BDE		:CF1BDE,CF3BDE		:CF2BDE,CF4BDE		:CF3BDE,13AD	
17.	48Ø 155	:2/2XX53, 5/1X2		:2/1X2, 3/2X3,		:3/2X3, 6/3X4		:4/3X4, 9/54XX13	
18.	48Ø 17Ø								
19.	448 22Ø								

(Classification)

(Classification)

ZONE:53CFA :CF1BDE :CF2BDE :CF3BDE :CF4BDE

20. 413 254
21. 424 277
22. 4Ø4 3Ø8

ADJC: 2ID, 13AD
BDRY: 2/2XX53, 11/54XX13

2. Task force zones

ZONE:CF1-2	:CF1-3	:CF2-2	:CF2-3
1. 423 369	1. 4Ø4 3Ø8	1. 413 254	1. 457 2Ø6
*2. 527 398	*2. 449 317	2. 47Ø 268	*2. 486 218
3. 755 44Ø	3. 796 4Ø4	*3. 77Ø 335	3. 735 258
4. 796 4Ø4	*4. 77Ø 335	4. 735 258	4. 71Ø 2ØØ
*5. 449 317	5. 47Ø 268	*5. 486 218	5. 516 169
6. 4Ø4 3Ø8	6. 413 254	6. 457 2Ø6	6. 48Ø 155
	7. 424 277	7. 448 22Ø	7. 48Ø 17Ø
ADJC:2ID,CF1-3	:CF1-2,CF2BDE	:CF1BDE,CF2-3	:CF2-2,CF3BDE
BDRY:2/2XX53,5/2II3	:2/2II3,4/1X2	:3/1X2,5/2II3	:2/2II3,4/2X3

ZONE:CF3-2	:CF3-3	:CF4-2	:CF4-3
1. 48Ø 155	1. 481 Ø95	1. 5ØØ Ø37	1. 519 ØØØ
2. 516 169	*2. 528 1Ø8	2. 54Ø Ø41	*2. 79Ø Ø82
*3. 71Ø 2ØØ	3. 792 19Ø	3. 622 Ø98	*3. 79Ø Ø25
4. 792 19Ø	4. 791 152	*4. 755 138	4. 526 965
*5. 528 1Ø8	*5. 755 138	5. 791 152	
6. 481 Ø95	6. 622 Ø98	*6. 79Ø Ø82	
	7. 54Ø Ø41	7. 519 ØØØ	
	8. 5ØØ Ø37	8. 515 Ø2Ø	
	9. 483 Ø55		
ADJC:CF2BDE,CF3-3	:CF3-2,CF4BDE	:CF3BDE,CF4-3	:CF4-2,CF1-11
BDRY:3/2X3,5/2II3	:2/2II3,5/3X4	:4/3X4,6/2II3	:2/2II3,3/3II11

ZONE:CF1-11
1. 526 965
*2. 79Ø Ø25
3. 79Ø 988
4. 739 968
5. 713 952
*6. 618 934
7. 513 923
8. 6Ø6 92Ø
ADJC:CF4-3,13AD
BDRY:2/3II11, 6/54XX13

(Classification)

(Classification)

(c) MBA zones

1. Brigade zones

:1BDE	:2BDE	:3BDE	:4BDE
1. Ø1Ø 313	1. Ø29 196	1. Ø63 ØSØ	1. Ø9Ø 963
2. Ø86 334	2. 171 2Ø6	2. 182 Ø83	2. 142 987
3. 2Ø7 34Ø	3. 2Ø2 215	3. 2Ø5 Ø88	3. 255 987
4. 248 348	*4. 3Ø9 228	*4. 287 1Ø3	*4. 348 993
*5. 333 343	5. 413 254	5. 429 138	5. 447 Ø18
6. 423 369	6. 47Ø 268	6. 48Ø 155	6. 5ØØ Ø37
7. 46Ø 379	7. 489 25Ø	7. 516 169	7. 54Ø Ø41
8. 45Ø 344	8. 488 24Ø	8. 521 138	8. 55Ø Ø19
9. 442 33Ø	9. 483 225	9. 528 1Ø8	9. 552 987
10. 449 317	10. 486 218	10. 52Ø Ø73	10. 561 96Ø
11. 461 294	11. 5Ø1 194	11. 54Ø Ø41	11. 566 928
12. 47Ø 268	12. 516 169	12. 5ØØ Ø37	12. 513 923
13. 413 254	13. 48Ø 155	13. 447 Ø18	13. 5Ø6 92Ø
*14. 3Ø9 228	14. 429 138	*14. 348 993	14. 437 896
15. 2Ø2 215	*15. 287 1Ø3	15. 255 987	*15. 347 898
16. 171 2Ø6	16. 2Ø5 Ø88	16. 142 987	16. 281 887
17. Ø29 196	17. 182 Ø83	17. Ø9Ø 963	17. 232 878
18. Ø3Ø 273	18. Ø63 ØSØ	18. Ø66 Ø15	18. 144 875
BDRY:5/2XX53, 14/1X2	:4/1X2,15/2X3	:4/2X3,14/3X4	:14/3X4,15/54XX13
ADJC:2ID,2BDE	:1BDE,3BDE	:2BDE,4BDE	:3BDE,13AD

2. Battalion zones

:1-1M	:TF1-2	:TF1-3	:TF1-4
1. 2Ø6 34Ø	1. 196 3Ø7	1. 195 269	1. 2Ø7 242
2. 248 348	2. 264 31Ø	*2. 3Ø1 288	*2. 349 267
*3. 333 343	*3. 32Ø 319	3. 4Ø4 3Ø8	3. 421 282
4. 423 369	4. 413 337	4. 449 317	4. 461 294
5. 46Ø 379	5. 45Ø 344	5. 461 294	5. 47Ø 268
6. 45Ø 344	6. 442 330	6. 421 282	6. 413 254
7. 413 337	7. 449 317	*7. 349 267	*7. 3Ø9 228
*8. 32Ø 319	8. 4Ø4 3Ø8		
9. 264 31Ø	*9. 3Ø1 288		
10. 196 3Ø7	10. 195 269		
BDRY:3/2XX53,8/1II2	:3/1II2,9/2II3	:2/2II3,7/3II4	:2/3II4,7/1X2
ADJC:2ID,TF1-2	:1-1M,TF1-3	:TF1-2,TF1-4	:TF1-3,2BDE

(Classification)

(Classification)

:TF2-1	:TF2-2	:TF2-3	:TF2-4
1. 171 2Ø6	1. 182 18Ø	1. 181 145	1. 197 118
2. 2Ø2 215	2. 235 187	2. 24Ø 159	2. 281 132
*3. 3Ø9 228	*3. 3Ø8 196	*3. 316 17Ø	*3. 335 146
4. 413 254	4. 438 23Ø	4. 443 199	4. 422 168
5. 47Ø 268	5. 488 24Ø	5. 456 2Ø6	5. 457 176
6. 489 25Ø	6. 483 225	6. 486 218	6. 473 182
7. 488 24Ø	7. 486 218	7. 5Ø1 194	7. 5Ø1 194
8. 438 23Ø	8. 457 2Ø6	8. 473 182	8. 516 169
*9. 3Ø8 196	9. 443 199	9. 457 176	9. 48Ø 155
10. 235 187	*10. 316 17Ø	10. 422 168	10. 429 138
11. 182 18Ø	11. 24Ø 159	*11. 335 146	*11. 287 1Ø3
	12. 181 145	12. 281 132	12. 2Ø5 Ø88
		13. 197 118	
BDRY: 3/1X2,9/1II2	:3/1II2,10/2II3	:3/2II3,11/3II4	:3/3II4,11/2X3
ADJC: 1BDE,TF2-2	:TF2-1,TF2-3	:TF2-2,TF2-4	TF2-3,3BDE
:TF3-1	:TF3-2	:TF3-3	:TF3-4
1. 2Ø5 Ø88	1. 215 Ø63	1. 235 Ø38	1. 248 Ø15
*2. 287 1Ø3	2. 275 Ø73	2. 278 Ø5Ø	2. 298 Ø2Ø
3. 429 138	*3. 412 1Ø6	*3. 36Ø Ø63	*3. 383 Ø38
4. 48Ø 155	4. 48Ø 124	4. 431 Ø8Ø	4. 481 Ø63
5 516 169	5. 521 138	5. 481 Ø95	5. 52Ø Ø73
6. 521 138	6. 528 1Ø8	6. 528 1Ø8	6. 54Ø Ø41
7. 48Ø 124	7. 481 Ø95	7. 52Ø Ø73	7. 5ØØ Ø37
*8. 412 1Ø6	8. 431 Ø8Ø	8. 481 Ø63	8. 447 Ø18
9. 275 Ø73	*9. 36Ø Ø63	*9. 383 Ø38	*9. 348 993
10. 215 Ø63	10. 278 Ø5Ø	10. 298 Ø2Ø	10. 255 987
	11. 235 Ø38	11. 248 Ø15	
BDRY: 2/2X3,8/1II2	:3/1II2,9/2II3	:3/2II3,9/3II4	:3/3II4,9/3X4
ADJC: 2BDE,TF3-2	:TF3-1,TF3-3	:TF3-2,TF3-4	TF3-3,4BDE
:TF4-1	:TF4-2	:TF4-3	:TF4-4
1. 242 987	1. 236 964	1. 249 938	1. 273 917
2. 255 987	*2. 349 972	2. 34Ø 951	2. 343 927
*3. 348 993	3. 478 998	*3. 4Ø8 958	*3. 424 932
4. 447 Ø18	4. 516 Ø13	4. 485 97Ø	4. 521 955
5. 5ØØ Ø37	5. 55Ø Ø19	5. 522 982	5. 561 96Ø
6. 54Ø Ø41	6. 552 987	6. 552 987	6. 566 928
7. 55Ø Ø19	7. 522 982	7. 561 96Ø	7. 513 923
8. 516 Ø13	8. 485 97Ø	8. 521 955	8. 5Ø6 92Ø
9. 478 998	*9. 4Ø8 958	*9. 424 932	9. 437 896
*10. 349 972	10. 34Ø 951	10. 343 927	*10. 347 898
11. 236 964	11. 249 938	11. 273 917	11. 281 887
BDRY: 3/3X4,10/1II2	:2/1II2,9/2II3	:3/2II3,9/3II4	:3/3II4,1Ø/54XX13
ADJC: 3BDE,TF4-2	:TF4-1,TF4-3	:TF4-2,TF4-4	TF4-3,13AD

(Classification)

(Classification)

(2) Maneuver coordinating measures (phase lines [PL])

PL MBA	PL BOB	PL WAR	PL RED
1. 423Ø 369Ø	1. 46Ø 379	1. 665 423	1. 333 432
2. 413Ø 337Ø	2. 45Ø 344	2. 72Ø 355	2. 3Ø9 228
3. 4Ø4Ø 3Ø8Ø	3. 442 33Ø	3. 67Ø 3Ø6	3. 4ØØ 14Ø
4. 421Ø 282Ø	4. 449 317	4. 65Ø 237	4. 437 896
5. 424Ø 277Ø	5. 461 294	5. 642 175	
6. 413Ø 254Ø	6. 47Ø 268	6. 622 137	
7. 438Ø 23ØØ	7. 489 25Ø	7. 621 Ø97	
8. 457Ø 2Ø6Ø	8. 488 24Ø	8. 7ØØ Ø83	
9. 473Ø 182Ø	9. 483 225	9. 72Ø 95Ø	
10. 48ØØ 17ØØ	10. 486 218		
11. 48ØØ 155Ø	11. 5Ø1 194		
12. 48ØØ 124Ø	12. 516 169		
13. 481Ø Ø95Ø	13. 521 138		
14. 481Ø Ø63Ø	14. 528 1Ø8		
15. 483Ø Ø55Ø	15. 52Ø Ø73		
16. 5ØØØ Ø37Ø	16. 54Ø Ø41		
17. 515Ø Ø2ØØ	17. 55Ø Ø19		
18. 516Ø Ø13Ø	18. 552 987		
19. 522Ø 982Ø	19. 561 96Ø		
20. 526Ø 965Ø	20. 566 928		
21. 521Ø 955Ø			
22. 5Ø6Ø 92ØØ			

PL CUT	PL TIP	PL SAM
1. 525 4ØØ	1. 6ØØ 41Ø	1. 248 348
2. 51Ø 33Ø	2. 595 355	2. 24Ø 159
3. 53Ø 28Ø	3. 6ØØ 3ØØ	3. 33Ø ØØØ
4. 555 23Ø	4. 59Ø 24Ø	4. 347 898
5. 58Ø 18Ø	5. 58Ø 18Ø	
6. 575 125		
7. 585 Ø8Ø		
8. 61Ø Ø25		
9. 615 97Ø		
10. 62Ø 93Ø		

(3) Fire coordination areas

(a) No-fire areas

NAME: NFAØ7	:NFAØ5	:NFAØ8	:NFAØ2
APPL: AL	:AL	:AL	:AL
FCORD:5COR	:5COR	:5COR	:5COR
1. 47Ø Ø1Ø	5Ø5 355 RAD 8ØØ	281 Ø97 RAD 5ØØ	192 224 RAD 5ØØ
2. 49Ø Ø1Ø			
3. 49Ø 99Ø			
4. 48Ø 99Ø			

(Classification)

(Classification)

NAME: NFA12
APPL: AL
FCORD: 5COR
542 14Ø RAD 3ØØ

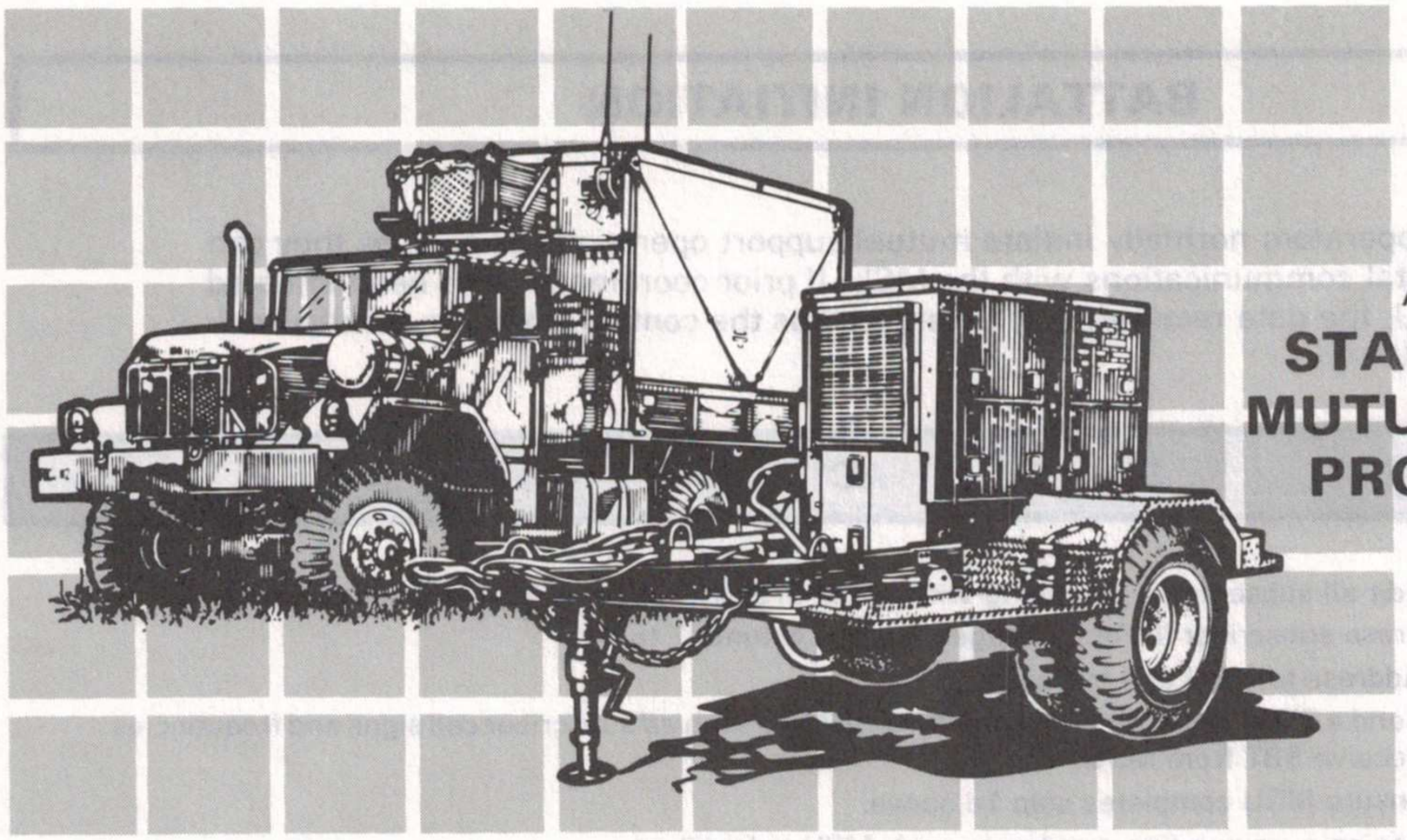
(b) Restrictive fire areas

NAME: NUA21	:NUA24	:NUA25	
APPL: NU	:NU	:NU	
FCORD: 5COR	:5COR	:5COR	
496 ØØ5 RAD3ØØØ	5Ø5 355 RAD 2ØØØ	542 14Ø RAD 12ØØ	

(c) Free-fire areas (for registration only)

NAME: FFAØ1C	:FFAØ2C	:FAAØ3C	:FFAØ4C
APPL: HE	:HE	:HE	:HE
FCORD: 53DA	:53DA	:53DA	:53DA
443 285 RAD 2ØØ	467 23Ø RAD 2ØØ	515 113 RAD 2ØØ	553 969 RAD 2ØØ

(Classification)



APPENDIX E
STANDARDIZED MUTUAL SUPPORT PROCEDURES

This appendix standardizes mutual support procedures to streamline and unify those procedures Armywide. These procedures help to establish, maintain, initiate, and exercise mutual support during displacement or failure of either mutually supporting computer system.

There are several basic approaches and a proliferation of specific procedures to successfully initiate and maintain mutual support operations. Mutual support is a demanding and complex operation that requires high standards of readiness and tactical flexibility. Since tactical tailoring of corps artillery assets can be relatively fluid, GS battalions and FA brigades must be able to support a number of corps and division contingencies. Division artilleries must be prepared to accept the mutual support of corps FA units other than those with whom they are habitually associated. The mutual support procedures herein will enhance continuity of operations for TACFIRE-equipped corps and divisions Armywide.

These procedures eliminate the requirement for remote subscribers to make changes to either hardware or software when used with the communications schemes specified in Chapters 7, 8, and 9.

Even when using these procedures, MSUs must closely coordinate their communications means, codes, subscriber table entries, and SOP items before initiating mutual support. The CEOI, KG keylist, and CAV matrix system must be centralized so that all units have the same material.

These procedures are used in conjunction with the appropriate TMs, FMs, CEOIs, OPLANs, and OPORDs.

BATTALION-LEVEL PROCEDURES

Mutual support for a battalion requires procedures for initiation, transfer of known point (KNPT) files, file maintenance, displacement (or catastrophic failure), and recovery. The following graphics highlight the actions of a battalion to enhance div arty mutual support operations.

BATTALION INITIATION

Computer operators normally initiate mutual support operations as soon as they can establish digital communications with the MSU. If prior coordination has been effected with the MSU, the data received may be entered as the computer system is initialized.

STEP	ACTION
1	a. Edit all subscribers, beginning with line 9 in SBT (except multisubscriber groups).
	b. Erase subscriber ID, and change status in column T to D.
	c. Address to MSU and transmit.
	d. Send a SYS;PTM in an encrypted mode to MSU with *all* subscriber call signs and frequencies.
2	a. Receive SBT from MSU.
	b. Ensure MSU completes step 1d above.
	c. Assign a unique line number to each MSU subscriber.
	d. Compute each message.
	e. Transmit the SYS;PTM received from MSU (with data from step 1d above) to all fire units.
3	a. Edit all MSU subscribers to be sent to FUs, to include FISTs, FOs, AOs, and radar.
	b. Transmit the SYS;SBT(s) to all FUs so that the BCS operator can extract necessary data and enter them in BCS;SBT.

NOTE: *The SIDs for noncomputer subscribers, to include relay subscribers, must be identical in both computers, or SYS;BACKUP will fail.*

4	Print and review SBT. Establish multisubscriber group(s) for all MSU subscribers. Transmissions to multisubscriber groups will fail if SIDs are not entered for *all* subscribers in the group. This includes SB:A/L/L/--/---.
5	Enter legal subscriber message (LGSB) for MSU subscribers IAW tactical SOP or other guidance.
6	a. Send DMD relay information using a SYS;PTM so MSU can establish SYS;ADDR.0
	b. Resolve conflicts and inform subscribers of changes.
7	a. Transmit AFU files if they have not been sent through MOI (AFU;COMD;XMIT, TO,).
	b. Ensure MSU AFU files have been received. If not, direct MSU to complete step 7a. (Ensure all MSU fire units are excluded from TTFC processing—FM;XCLUDE—when not in control of those units.)
	c. Print and review AFU file.
8	Direct O/I to transmit ASR and AMOL to MSU.
9	Transmit commander's modifications by SYS;PTM if different from SOP or OPORD. Resolve conflicts.
10	a. Use SYS;FSO; XMIT:X; TO:; to send *only* FSO MOI files to MSU.
	b. Use SYS;FSO to input MOI files for MSU subscribers.

NOTE: *A maximum of 12 MOI files is available. Priority for MSU subscribers should be FSOs, FUs, and LOs.*

11	a. Use SPRT;COMD; XMIT:X; TO:; PLAN:ZOR to send MOI zones to MSU.
	b. Take computer action on ZORs received.
12	a. Use SYS;PTM to request missing geometry from MSU.
	b. Take computer action on geometry received.

BATTALION INITIATION (Continued)

STEP	ACTION
13	a. Use SYS;PTM to notify MSU that OBSR file is about to be transmitted. b. Transmit OBSR file (FM;COMD;XMIT,TO,OBF,). c. OBSR file (FM;5208) prints on ELP. d. Use FM;OBCO to enter FOs into OBSR file.
	NOTE: *Ensure FM;OBCOs are received by all FUs.*
	e. If FO is associated with FU, use FM;QF to establish FPF association.
14	a. Notify subscribers who have fire plans in file to build their plans into the MSU computer. b. Have O/I transmit TISF for fire plans from higher HQ to MSU.
15	a. Transfer KNPT file. This step is optional. If KNPT files are not transferred, *all* observers must be notified not to conduct shift missions while mutual support is in effect.

BATTALION TRANSFER OF KNOWN POINT FILES

A battalion has three options with respect to exchanging known point files:

- Establish and maintain identical known point files in both computers. This is very complicated and time consuming and rarely works.
- Establish and maintain identical known point files in both battalions, but restrict the establishment of known points to the DS battalion computer. This is easier than the first option and should be used whenever possible.
- Do not establish common known point files, and instruct observers to use and record known points only when talking to their organic computers. This is the easiest option but may not always be tactically sound.

STEP	DS BATTALION ACTION	STEP	GSR BATTALION ACTION
			GSR Battalion Does Not Have a KNPT File
1	Transmit the KNPT file.	1	Receive KNPT file (FM;5207) on ELP.
		2	Use FM;5207 to establish KNPT file.
		3	Enter the following data on FM;RFAF for each KNPT: TGT: CORD: SH: FZ: EOM:X; RAT:K;
		4	To ensure BCS KNPT number assignments remain identical, have each FU delete any KNPTs on file. Then transmit each FM;RFAF (with target number) to all FUs. Delete all messages pertaining to these FMs from the RDE.
		5	Print and compare KNPT file with DS bn KNPT file.
		6	If KNPT numbers are not identical, purge KNPT file and do again.

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BATTALION TRANSFER OF KNOWN POINT FILES (Continued)

STEP	DS BATTALION ACTION	STEP	GSR BATTALION ACTION
			Non-DS Battalion has a KNPT File
1	Receive KNPT file (FM;5207) on ELP.	1	Transmit the KNPT file.
2	Use FM;5207 to add to your KNPT file. a. Verify that battery and battalion KNPT files are identical prior to start of procedure. b. Enter the following data on FM;RFAF for each KNPT to be added: TGT: CORD: SH: FZ: EOM:X; RAT:K; c. Press CED CMPTR ACTION switch.	2	*Do not enter new KNPTs until new KNPT file is established.*
3	Print KNPT file and ensure MSU KNPT data are correct.		
4	If not correct, delete and reenter or update MSU KNPTs as appropriate.		
5	Transmit KNPT file to MSU.	3	Receive KNPT file (FM;5207) on ELP.
6	*Do not send shift fire missions to MSU bn until MSU notifies you that new KNPT file is established in its computer.*	4	Purge the KNPT file in your computer. Require each fire unit to delete all KNPTs on file.
		5	Use FM;5207 to establish new KNPT file.
		6	Print KNPT file and compare it with DS bn KNPT file.
		7	If KNPT numbers are not identical, purge KNPT file and do again.
		8	Notify MSU that KNPT file is established.
		9	Notify appropriate observers when their KNPT number(s) change.

NOTE: *Ensure that identical known point files are maintained throughout MSU operations.*

Use the following procedures to add new known point to known point file.

STEP	ESTABLISHING BATTALION ACTION	STEP	RECEIVING BATTALION ACTION
1	Send PTM that new KNPT follows.	1	Receive KNPT file (FM;5207) on ELP.
2	Use FM;COMD; KNPT:; KNPTF:X;XMIT:X;TO:; to send KNPT file.	2	Use FM;RFAF to enter new KNPT.
		3	Review the output messages in RDE for KNPT number assigned.
		4	If different, use appropriate procedures to reestablish KNPT file.

MAINTAINING MUTUAL SUPPORT DURING NORMAL OPERATIONS

STEP	ACTION
1	When *any* changes are made to SBT, transmit the subscriber lines to MSU *immediately.*
2	Changes to AFU data are automatically transmitted to the MSU through MOI processing.
3	Changes to observer locations, ACAs, friendly unit locations, and some FM MODS can be programed to be automatically transmitted through MOI. Data not listed must be sent manually.
4	When maintaining files, transmit command messages manually to MSU.
5	Review messages received, and take appropriate action.
6	Build and maintain fire plans in both computers. O/I maintains fire plans from higher HQ in both computers.

DS BATTALION DISPLACEMENT

Both DS and GSR battalions should have one or more DDTs assigned for MSU subscribers. (DDTs should be off at this time.) Appropriate computer lines (1–6) should have MSU address in P field(s) and MSU logical name in L field(s).

STEP	DS BATTALION ACTION	GSR BATTALION ACTION
1	a. Send PTM to all subscribers: X–XX moving in 30 min. b. Notify MSU by voice. c. Make RFAF and QF display YES.	Receive movement notice from MSU. Make FM;RFAF and FM;QF messages display YES.
2	a. Hand off all FMs that cannot be completed before shutdown. b. Recalculate to eliminate RFAF:X c. Complete FMs in progress.	
3	Inform wire subscribers to switch to radio and establish communications with DS bn.	a. Ensure DS subscribers are in D status in SBT. b. Verify that appropriate SBT computer lines have MSU address in P field.
4	None	Notify DS bn by voice that you are ready for SYS;BACKUP.
5	Send SYS;BACKUP using SYS;COMSEC when last fire mission in progress is complete.	a. Press SPARE and RD CMPTR ACTION SYS;BACKUP. b. Notify DS bn by voice that SYS;BACKUP was received. c. If SYS;BACKUP fails for SIDs, resolve conflict if time permits and request new SYS;BACKUP. d. Turn on DS bn subscribers in SBT. e. Notify DS bn that you are ready to assume control.
6	On receipt of message that MSU is ready to assume control, turn off appropriate DDTs.	Turn on appropriate DDTs.

NOTE: *Step 6 must be accomplished as soon as possible after receipt of SYS; BACKUPS to minimize net error conditions.*

DS BATTALION DISPLACEMENT (Continued)

STEP	DS BATTALION ACTION	GSR BATTALION ACTION
7	a. If a jump CP was sent to the new location with a VFMED, notify the O&I personnel manning it to change to the MSU frequency, change the VFMED SCE address to the DS bn address, change the DEST address to the MSU bn address, and contact the MSU. b. Shut down.	a. Establish communications with DS bn subscribers. b. Notify the DS bn and div arty/FA bde that you have assumed control (PTM: Y-YY has control of X-XX.) c. Delete TTFC processing exclusions for DS fire units.
8	None	a. Process all fire missions. b. Make RFAF and QF display NO. c. Synchronize DS bn subscribers as required. d. Change DS bn device type to V in SBT if appropriate.

GSR BATTALION DISPLACEMENT

Both DS and GSR battalions should have DDT(s) assigned for MSU subscribers off at this time. Appropriate computer lines (1-6) should have MSU address in P field(s) and MSU logical name in L field(s).

STEP	DS BATTALION ACTION	GSR BATTALION ACTION
1	Receive movement notice from GSR bn.	Send PTM to all subscribers: Y-YY moving in 30 min.
2	Make RFAF and QF display YES.	Make RFAF and QF display YES.
3	a. Do not hand off any new fire mission(s). b. Recalculate to eliminate RFAF:X missions. c. Delete REFU after all hand-off and RFAF:X FMs are complete.	a. Establish DS bn as REFU in FM;MOD so that fire mission(s) may be handed off. b. Complete all FM in progress.
4	a. Ensure GSR bn subscribers are in D status in SBT. b. Verify that appropriate SBT computer lines have MSU address and logical name.	Direct wire subscribers to switch to radio, and establish communications with the GSR bn.
5	Notify GSR bn that you are to receive SYS;BACKUP.	Send SYS;BACKUP using SYS; COMSEC after the last fire mission in progress is complete.
6	a. Press SPARE and RD CMPTR ACTION SYS;BACKUP. b. Notify GSR bn that SYS;BACKUP was received. c. If SYS;BACKUP fails for SIDs, resolve the conflict if time permits and request a new SYS;BACKUP. d. Turn on GSR bn subscribers in SBT. e. Notify MSU that you are ready to assume control.	None

GSR BATTALION DISPLACEMENT (Continued)

STEP	DS BATTALION ACTION	GSR BATTALION ACTION
7	Turn on appropriate DDTs.	On receipt of message that DS bn is ready to assume control, turn off appropriate DDTs.
8	a. Establish communications with GSR subscribers. b. Notify MSU and div arty/FA bde that you have assumed control (PTM: X-XX has control of Y-YY). c. Delete the TTFC exclusions for the GSR fire units. d. Make RFAF and QF display NO. e. Synchronize GSR subscribers as required. f. Change GSR bn device type to V if required.	If a jump CP was sent to the new location with a VFMED, notify the O&I personnel manning it to change the VFMED SCE address to the GSR bn address and the DEST address to the DS bn address and to contact the DS bn.

NOTE: *Step 7 must be accomplished as soon as possible after receipt of SYS; BACKUP to minimize net error conditions.*

CATASTROPHIC FAILURE

STEP	DS BATTALION ACTION	GSR BATTALION ACTION
1	a. By voice, notify all subscribers of failure. b. Direct observers and FUs to continue all fire mission(s) by voice until contacted by MSU.	Turn on appropriate DDTs.
2	a. Notify wire subscribers to change to radio and contact MSU. b. Direct O&I to change SCE address of VFMED to bn address and DEST to MSU computer address and establish communications.	a. Change status of failed bn subscribers to Y in SBT. b. Change device type of failed bn to V in SBT.
3	None	a. Establish communications with failed bn subscribers. b. Direct failed bn fire units to send current AFU;BAMOUP. c. Delete failed bn fire unit exclusions from TTFC. d. Notify div arty/FA bde that you have control of failed bn fire units.

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DS BATTALION RECOVERY

STEP	DS BATTALION ACTION	GSR BATTALION ACTION
1	a. Turn on div arty/MSU and O&I DDTs only. b. Establish communications with O&I on wire. c. Establish contact with MSU and Div Arty/FA bde.	a. Receive PTM that DS bn is up. b. Change DS bn device type to C if necessary.
2	Make RFAF and QF display YES.	Make RFAF and QF display YES.
3	Update OBF and KNPTF.	a. Send PTM that OBF and KNPTF follow. b. Transmit OBF and KNPTF.
4	Update SPRT and MET data.	Transmit SPRT and MET data.
5	Update AFU data.	Transmit AFU data.
6	a. Ensure all subscribers above line 9 are in D status in SBT. b. Notify MSU that you are ready for SYS;BACKUP.	Exclude DS fire units from TTFC processing.
7	a. Press SPARE and RD CMPTR ACTION SYS;BACKUP. b. Notify MSU that SYS;BACKUP was received. c. If SYS;BACKUP fails for SIDs, resolve conflicts if time permits and request new SYS;BACKUP. d. Turn own subscribers on in SBT. e. Notify MSU that you are ready to assume control.	Transmit SYS;BACKUP using SYS;COMSEC when the last FM for all DS FUs are complete.
8	Turn on appropriate DDTs.	On receipt of message that DS bn is ready to assume control, turn off appropriate DDTs.

NOTE: *Step 8 must be accomplished as soon as possible after receipt of SYS;BACKUP to minimize net error conditions.*

9	a. Establish communications with own subscribers. b. Notify div arty/FA bde and MSU that you have assumed control (PTM: X-XX has control of Y-YY).	None None
10	a. Process all fire missions. b. Make RFAF and QF display NO. c. Synchronize with own subscribers as required.	Make RFAF and QF display NO. None Change DS subscribers status to D in SBT.

GSR BATTALION RECOVERY

STEP	DS BATTALION ACTION	GSR BATTALION ACTION
1	None	Turn on div arty/MSU and O&I DDTs only.
	a. Receive PTM that GSR bn is up.	a. Establish contact with DS bn and div arty/FA bde.
	b. Change GSR bn device type to C if necessary.	b. Establish contact with O&I on wire.
2	Make RFAF and QF display YES.	Make RFAF and QF display YES.
3	a. Send PTM that OBF and KNPTF follows.	None
	b. Transmit OBF and KNPTF.	Update OBF and KNPTF.
4	Transmit current SPRT and MET data.	Update SPRT and MET files.
5	Transmit current AFU data.	Update AFU files.
6	None	a. Ensure all subscribers above line 9 are in D status in SBT.
		b. Notify DS bn that you are ready for SYS;BACKUP.
7	Transmit SYS;BACKUP using SYS; COMSEC when the last fire mission for GSR bn FU is complete.	a. Press SPARE and RD CMPTR ACTION SYS;BACKUP.
		b. Notify DS bn that SYS;BACKUP was received.
		c. If SYS;BACKUP fails for SIDs, resolve conflict if time permits and request new SYS;BACKUP.
8	On receipt of message that GSR is ready to assume control, turn off appropriate DDTs.	Turn on appropriate DDTs.

NOTE: *Step 8 must be accomplished as soon as possible after receipt of SYS;BACKUP to minimize net error conditions.*

9	Establish GSR unit as REFU in FM;MOD.	a. Establish communications with own subscribers.
		b. Notify div arty/FA bde that you have control (PTM: Y-YY has control of X-XX).
		c. Delete DS bn as REFU in FM;MOD if established when control was passed to DS bn.
10	a. Make RFAF and QF display NO.	a. Process all fire missions.
	b. Change GSR subscribers status to D in SBT.	b. Make RFAF and QF display NO.
		c. Synchronize with own subscribers as required.

BATTALION PARTICIPATION IN DIV ARTY/ BRIGADE MUTUAL SUPPORT

STEP	BATTALION ACTION
	When informed by div arty that they will be transferring control to the FA brigade in 30 minutes—
1	Minimize inputs to div arty.
2	Notify FSOs, LOs, and O/I to do the same.
	When contacted by FA brigade—
3	Change device type of FA brigade to D and device of div arty to C in SBT.
4	Change logical name of div arty O/I to brigade O/I, and relay address from div arty to brigade in SBT.
5	Notify FSOs/LOs and O/I to address relay messages to FA brigade and to reestablish SRIs in brigade computer. Uncompleted ATI;QUERY, ATI;PREFP, and other analyses must be reinitiated in the brigade computer.

POINTS TO REMEMBER

The SYS;BACKUP automatically synchronizes the other battalion subscribers with your computer. This will work *only* if—

- The sending battalion has these subscribers in Y status in the SBT and the receiving battalion has them in D status.
- The SIDs for noncomputer subscribers (including relay subscribers) are identical in both computers.

Print the AFU file after transfer of control to ensure that all FUs are properly designed as READY or OUTTIL.

When referencing DS–DS or GS–GS mutual support operations—

- Disregard references to REFU and hand–off FMs.
- The battalion with the lower regimental number follows the procedures for the DS battalion. The battalion with the higher number follows GSR procedures.

When control of own and MSU units is being transferred (FDCs leapfrogging), references to *own* and *MSU* subscribers should read *all* subscribers.

During transfer of control (during *net error conditions*), subscribers often use *illegal authenticators. DO NOT DELETE.* ACCOs should page each message and press either the SPARE or the RD CMPTR ACTION switch or delete as appropriate. When *net error conditions* cease, resynchronize subscribers. A subscriber cannot be synchronized with two computers at the same time.

DIVISION ARTILLERY/FIELD ARTILLERY BRIGADE PROCEDURES

Mutual support for div arty type computers requires procedures for initiation, file maintenance, displacement (or catastrophic failure), and recovery. The following graphics show what the force FA HQ computer operator must do to support mutual support operations by battalions.

DIV ARTY/FA BRIGADE INITIATION

Computer operators normally initiate mutual support operations as soon as they can establish digital communications with the MSU.

STEP	FORCE ARTY ACTION	MSU ACTION
1	Edit line 9 of the SBT, and enter the logical name of the MSU and the SID. Take CED computer action.	Edit line 9 of the SBT, and enter the force arty logical name and SID. Take CED computer action.
2	Ensure initialization data and SBT are set up IAW the current mutual support plan procedures.	Ensure initialization data and SBT are set up IAW the current mutual support plan procedures.
3	Transmit force arty SBT to MSU.	Receive force arty SBT, and change subscriber status to D for all force arty subscribers on DDTs that are not turned off. Take computer action.
4	None	Turn off DDTs designated solely for force arty subscribers.
5	Receive MSU SBT, change each sub-scriber status to D, and take computer action.	Transmit MSU SBT to force arty.
6	Use SYS;LGSB and enter legal messages for all MSU subscribers. Take computer action.	Use SYS;LGSB and enter legal messages for all force arty subscribers. Take computer action.
7	Establish SYS;FSO for MSU.	Do not establish SYS;FSO for force arty.
8	Use SPRT;COMD and transmit all current geometry.	Take computer action on all geometry data.
9	Use AFU;COMD:WPN:155mm;XMIT: X;TO:MSU and WPN:8IN;XMIT:X;TO: MSU. Take computer action on both messages.	Receive AFU data, and enter them into the computer.
10	Use NNFP;COMD and transmit all fire plans (by name), AFU BUILD messages, and SPRT BUILD messages to the MSU. Specify OVRIDE:X.	Receive force arty fire plans, and enter them into the computer.
11	Transmit any changes to commander's criteria to MSU.	Receive commander's criteria, and take RD computer action.
12	Use MET;COMD to transmit all met data to MSU.	Receive met data, and press the RD CMPTR ACTION switch.
13	Use ATI;CMD:PRINT:X;MODF:X. Give ATI;8213 to MSU LO for entry through his VFMED into MSU computer.	Use ATI;SVMOD to input QMOD of +99. Save force arty QMOD for entry when assuming control. Enter all other ATI MOD file criteria. Deactivate all SRIs to force arty subscribers before entering.
14	Use FM;COMD:PRINT:X;MODF:X. Give FM;5204 to MSU LO for entry through his VFMED into MSU computer if MSU is attached to or reinforcing force arty. If LO is not available, send FM MOD file by courier or PTM.	Receive MODF, and enter into the computer those entries that are different from current data.
15	None	Change all FSE input messages except FSE;FRIEND to display YES in SYS;PCLD. This will allow FSE messages from force arty to be deleted rather than computed again in the MSU computer.
16	Use FSE;FILE:PRINT:X;FRIENF:X. Give FSE;9234 to MSU LO for entry through his VFMED into MSU computer.	Receive friendly unit file, and enter it into the computer.

DIV ARTY/FA BRIGADE FILE MAINTENANCE

At Force Artillery. FSE, counterfire, and O/I personnel must be familiar with messages that automatically go to the MSU and those messages that must be transmitted separately. Messages that go automatically are listed in the SYS;FSO message for each subscriber.

- *Operations.* Operations element personnel should build fire plans and make changes to COMCRIT in *both* computers. All target deletions should be transmitted to the MSU computer after they are entered into the force arty computer.
- *Counterfire.* The CFO should build fire plans and make changes to ATI MODs in *both* computers. File maintenance activities should apply to both computers. All ATI deletions should be transmitted to the MSU computer after they are entered into the force arty computer.
- *FSE.* FSE personnel should build and maintain the NUCD file and all fire plans in both computers. Fire plans should be computed in only one computer (to preclude different solutions) and the results (after transfer to NNFP) transmitted to the other. File maintenance activities should apply to both computers.
- *FCE.* All changes in FM MOD, FM;FUSEL, MET (except MET;CW), SYS;FSO, SYS;LGSB, SYS;PCLD, and so forth are duplicated in the MSU computer by keyboard transmission of the data to the MSU after the force arty ACCO has taken CED computer action at force arty. These changes are input by O/I VFMED.

At MSU. Normally, the MSU ACCO computes each message received from force arty. However, special handling is required in the following areas:

- When SYS;PCLD changes are received, the ACCO must ensure they do not change FSE messages to display NO. If so, the display must be changed to YES.
- The ACCO must check SYS;SBT changes received from force arty for possible line number changes and status changes to D.
- The ACCO must determine if ATI;SRCH messages received from the force arty targeting element are reasonable. The ACCO must erase the SB and ID fields to compute each message.
- All FSE messages except FSE;FRIEND require special handling. Since force arty is not designated as a remote FSE, the FSE program considers force arty as an FSO with only limited access to FSE functions. Almost all messages that are input by the FSE and sent to the MSU by force arty by MOI are rejected with the warnings "not authorized" or "RNA required" if the SB field is not erased before entry.

FORCE ARTY PLANNED DISPLACEMENT

Before displacement of the force arty TOC, the force arty S3 announces one of three methods of displacement:

- *Method A.* The force arty commander directs selected staff officers to establish an advance CP, with a VFMED, at the location selected for the new TOC. The VFMED is used to enter the MSU computer and to establish the appropriate SYS;FSO and SYS;LGSB messages. When the advance CP is operational, force arty passes control to its MSU. The MSU initiates tactical fire control, conducts counterfire, and provides the data processing support for the force arty elements normally provided by the force arty computer. Command, however, is exercised from the advance CP by use of the LO VFMED digital link into the MSU. When the main force arty TOC joins the advance CP and becomes operational, it can resume control.
- *Method B.* Force arty exercises command and control from the MSU. In this mode, the force arty commander sends selected staff officers to the MSU headquarters. This mode requires no VFMED and supplements the MSU staff with critical personnel. After

FORCE ARTY PLANNED DISPLACEMENT (Continued)

the staff members are in place, control is passed to the MSU, and the force arty TOC displaces. When the force arty TOC is in the new position and is fully operational, it resumes control and the staff members rejoin the force arty TOC.

- *Method C.* Because of quick displacement, no advance CP is established and no staff officers are moved. Operations are turned over to the MSU. The force arty commander, through key staff officers, exercises command on the move, mainly by voice communications.

STEP	FORCE ARTY ACTION	MSU ACTION
1	Notify all subscribers of pending displacement in 30 minutes and to minimize digital traffic.	Ensure radios and CCU are configured IAW the mutual support plan.
2	None	Change force arty relay subscribers to V device type. Establish the FSE VFMEDs as an Agency 23 and the CFO VFMED as an Agency 22.
3	None	Notify force arty that you are ready to assume control and receive SYS;BACKUP.
4	None	Turn on DDTs and radios.
5	Using SYS;COMSEC, enter BACKUP:X; TO:MSU and take CED computer action.	SYS;BACKUP RECEIVED will be displayed on the RDE. Page past error and warning; press SPARE and RD CMPTR ACTION switches.
6	None	Make all force arty subscribers' status on.
7	None	Note system time that force arty turned over control.
8	Turn off all DDTs as soon as all messages in queue are processed.	Make voice and then digital communications checks with all force arty subscribers.
9	Record two SPRs. Leave one in the MTU, and carry one by separate vehicle.	Change the QMOD in ATI;SVMOD to force arty values. Enter ATI;DPMOD.
10	None	Activate all force arty subscribers' SRIs.
11	None	Print ATI MOD file, and ensure all SRIs are activated.
12	None	Change all FSE messages to display NO in SYS;PCLD.
13	None	Print and verify all files (AFU, SPRT, FM;COMD;MODF,ATO;COMD;MODF,).

FORCE ARTY EMERGENCY DISPLACEMENT

Operations initiates the following steps when directed by the S3 when force arty is located by enemy artillery or is threatened with being overrun. No time is available for a 30-minute warning, establishment of an advance CP, or moving force arty staff to the MSU location.

STEP	FORCE ARTY ACTION	MSU ACTION
1	Direct MSU to assume control.	Receive warning of movement. Turn on DDTs and radios.

FORCE ARTY PLANNED DISPLACEMENT (Continued)

STEP	FORCE ARTY ACTION	MSU ACTION
2	Use SYS;COMSEC and enter BACKUP: X;TO:MSU and take CED computer action.	SYS;BACKUP RECEIVED will be displayed on the RDE. Page past error/ warning and press SPARE and RD CMPTR ACTION switches.
3	Turn off all DDTs.	Make all force arty subscribers' status on. Change computer addresses in SBT to force arty address.
4	None	Change force arty relay subscribers to V device type. Establish the FSE VFMEDs as an Agency 23 and the CFO VFMED as an Agency 22.
5	Record SPR and purge system, if time permits.	Note system time that force arty turned over control.
6	None	Change ATI;SVMOD to force arty values. Enter ATI;DPMOD.
7	None	Make voice and then digital communications checks with all force arty subscribers.
8	None	Change all FSE messages to display NO in SYS;PCLD.
9	None	Activate all force arty subscribers' SRIs.

FORCE ARTY CATASTROPHIC FAILURE

The operators initiate the following steps when the force arty computer fails without warning and the operators cannot immediately resume operations.

STEP	FORCE ARTY ACTION	MSU ACTION
1	Notify MSU by voice that the force arty computer has failed and to assume control.	Turn on DDTs and radios. Note system time force arty failed.
2	Turn off all DDTs.	Change all force arty subscribers' status to on.
3	None	Change force arty relay subscribers to V device type. Establish the FSE VFMEDs as an Agency 23 and the CFO VFMED as an Agency 22.
4	None	Make voice communications with all force arty subscribers, and initiate manual resynchronization.
5	None	Activate all force arty subscribers' SRIs.
6	None	Change QMOD in ATI;SVMOD to force arty values.
7	None	Enter force arty values for ATI;DPMOD.
8	None	Change all FSE messages to display NO in SYS;PCLD.
9	None	Update AFU files, if necessary, by requesting the battalion to transmit its files.

FORCE ARTY RECOVERY

Operators follow these steps when the force arty computer becomes operational again.

STEP	FORCE ARTY ACTION	MSU ACTION
1	Load and restore SPR.	None
2	Set up CCU and net structures IAW the mutual support plan. Establish digital communications with MSU on MSU OPS net. *Leave all other DDTs off!*	None
3	Deactivate all subscribers' SRIs.	None
4	Change QMOD in ATI;SVMOD to +99. Delete ATI;DPMOD.	None
5	Receive number of targets from MSU. If excessive, request MSU initiate another search with new criteria.	Input a LEVEL 1 search for all ATI targets newer than the time force arty turned over control. Transmit to force arty.
6	Allow time to receive all ATI targets from MSU.	Input a LEVEL 3 search to send ATI targets newer than the time force arty turned over control.
7	None	Enter an SRI to force arty for all ATI targets. This keeps force arty up to date until it assumes control.
8	Press RD CMPTR ACTION switch.	Transmit any new geometry to force arty (e.g., FLOT).
9	Press RD CMPTR ACTION switch.	Using AFU;COMD:WPN:155mm;XMIT:X;TO:FORCE ARTY and WPN:8IN;XMIT:X;TO:FORCE ARTY, take computer action on both messages to transmit updated AFU data to force arty.
10	Press RD CMPTR ACTION switch.	Transmit to force arty any changes in SBT. If there are no changes in SBT, tell force arty no change to SBT.
11	Press RD CMPTR ACTION switch.	Transmit any new met data to force arty.
12	Check all information to ensure it is complete. Update maps and charts.	None
13	Notify MSU that force arty is ready to resume control and receive SYS;BACKUP.	None
14	Receive SYS;BACKUP with error/warning. Page past error/warning messages and press SPARE and RD CMPTR ACTION switches.	Use SYS;COMSEC:BACKUP:X;TO:FORCE ARTY; and take computer action.
15	Turn on all DDTs.	Turn off all DDTs designated solely for force arty subscribers.
16	None	Change force arty subscribers' status to D for those subscribers who are on DDTs that are not turned off.
17	None	Change force arty relay subscribers back to R device type.
18	Make digital communications checks with all force arty subscribers.	Ensure CCU and net structures are configured IAW the mutual support plan. Make digital communications checks with all MSU subscribers.
19	Activate all SRIs.	Deactivate all force arty subscribers' SRIs.
20	Change QMOD to force arty values in ATI;SVMOD. Enter force arty values for ATI;DPMOD.	Change QMOD to +99 in ATI;SVMOD. Delete force arty values in ATI;DPMOD.
21	None	Change all FSE messages except FSE;FRIEND to display YES in SYS;PCLD.

FORCE ARTILLERY ACTIONS TO SUPPORT BATTALION-LEVEL MSU OPERATIONS

When force artillery is notified of a battalion-level MSU change of control, the ACCO changes the displacing (failed) battalion and all its relay subscribers to become relay subscribers of the battalion assuming control. All other processing continues normally. When the displacing (failed) battalion resumes control, the ACCO changes the SYS;SBT back to its original structure.

GLOSSARY

SECTION I
TACFIRE MNEMONICS

A

ACK	acknowledge
ACT	auxiliary communications terminal box
AD	armored division
ADJC	adjacent
AFU	ammunition and fire unit
AGCY	originating agency for targets
AGZ	actual ground zero
AIRCOR	air corridor
AL	all applicable ammunition
ALLOCF	nuclear allocation file
ALTERN	number of alternatives
ALU	alter indicator
AML	antimateriel long
AMMO	ammunition type
AMOE	ammunition expended
AMOH	ammunition on hand
AMOL	critical ammunition level
AMOR	ammunition received
AMOUPD	div arty ammo update message
AMS	antimateriel short
AP	additional points to follow (SPRT)
APC	armored personnel carrier
APERS	antipersonnel
APL	antipersonnel long
APPL	authorized ammunition
APS	antipersonnel short
ARTY	artillery
ASF	adjusting shell/fuze combination
ASGORD	battalion assignment order number
ASR	available supply rate of ammunition
ASRLVL	the rounds a fire unit may fire per day
ATI	artillery target intelligence
ATMS	atmospheric pressure at met station
ATT	attitude of target
AUF	adjusting unit to fire
AZ	azimuth
AZMIN	minimum azimuth
AZR	azimuth report
AZREF	reference direction for first observer HB/MPI registration
AZSEP	azimuth separation

B

BAMOUP	battalion ammunition update message
BDRY	boundary labels
BEGPT	beginning point
BKUP	automatic backup transmission indicator
BN	battalion name
BOT	beginning of tape
BPLOC	base piece location

C

CALBR	caliber of weapon on shell report
CAS	casualties
CAV	communications authentication variable
CBR	counterbattery radar
CBTI	combat intelligence
CDR or CDRP	coordinate report
CF	check fire

CFA	covering force area
CFL	fallout met message type
CFL	coordinated fire line
CHA	chemical hazard area
CHMEFF	chemical effects
CKFIRE	checkfire
CLDHT	cloud height
CM	computer met
CMD	command number of rounds for precision registration
CMR	countermortar radar
COMB	combine targets message type
COMD	command message
COMSEC	communications security
CONOPT	contact option for nuclear fuzes
CONT	method of control
COORD	coordinate location points
COR	corps
CPH	Copperhead
CRITER	criteria
CSIN	COMSEC interface
CTA	chemical target analysis
CURMET	current met

D

DA	division artillery
DAA	damage avoidance area
DDT	digital data terminal
DEFLCR	deflection corrections
DELOFF	delta recording off
DELTA	date-time of expected burst (nuclear)
DELTAS	delta recording sequence number
DEN	density
DF	referred deflection
DGZ	desired ground zero
DISPO	disposition of target
DIST	distance
DNA	do not adjust target location
DNARV	do not adjust report value criteria
DNC	do not combine with other targets
DOP	degree of protection
DPM	digital plotter map
DPMOD	data print criteria message
DSA	dead space area
DTI	valid time period for met

E

ECOF	effects cutoff factor
EFF	desired effects
EFFP	desired effects point targets
ELERR	elevation error
ENDPT	ending point
EOM	end of mission
EOT	end of transmission
ETD	electronic tactical display
EWIND	effective wind message
EXCEPT	exceptions
EXECFP	execute the fire plan
EXPEND	expended rounds

F

FAN	fire unit fan of coverage
FASCAM	family of scatterable mines
FCL	fire coordination line
FCORD	coordinating agency
FD	fault detection
FFA	free-fire area
FIS	fire support team
FLOT	forward line of own troops
FLOUT	fallout prediction message
FM	fire mission
FMCAP	FM capabilities analysis
FMFILE	FM file designator
FOCMD	forward observer command message
FOFRND	friendly fallout prediction message
FP	fallout prediction
FPA	fire plan alteration message
FPAMMO	NNFP ammunition report designator
FPF	final protective fire
FPLAN or FPLN	fire plan designator
FPLST	preliminary target list
FPTGT	fire plan target list
FPTU	fire plan target update message
FR	fire request
FRIENF	friendly unit file
FSCL	fire support coordination line
FSE	fire support element
FSO	fire support officer
FSP	force supported
FST	fire support team

FU	fire unit
FUGZ	grid zone of fire unit
FULAT	fire unit latitude
FUSEL	commander's fire unit selection message
FUSPH	spheroid at fire unit
FZ or FZE	fuze type
FZOPT	fuze option

G

GD	grid declination
GZ	grid zone

H

HBMPI	high-burst/mean-point-of-impact registration
HE	high explosive
HEA	high-explosive normal cavity
HEC	high-explosive antipersonnel grenade
HEF	high-explosive dual-purpose grenade
HEMEF	HE missile effective units
HEO	Copperhead, motor off
HER	Copperhead, motor on
HHOUR	time on which fire plan is based
HOB	height of burst
HTIME	time interval relative to H-hour
HUMID	relatively humidity

I

ID	identity, infantry division
IGALLO	ignore nuclear allocations
IGAMMO	ignore ammunition
IGRANG	ignore range
IGSFTY	ignore safety
ILA	illumination
INIT	initialization message

K

KG	keying generator
KNPT	known point
KNPTF	known point file

L

LAS	laser mission
LATD	latitude
LCH	launch site for missiles
LCHR	launcher
LGSB	legal subscriber message
LISTYD	list nuclear yields
LLPI	local loop test interval
LOC	location
LONGD	longitude

M

MAJX	major axis for spheroid 8
MAPMOD	map modification
MASKTI	level of enemy's CBR training
MAXALT	maximum altitude
MAXBN	maximum number of battalions
MAXD	maximum displacement distance
MAXEL	maximum elevation
MAXRNG	maximum range
MAXRTE	maximum rate of fire
MAXVOL	maximum number of volleys
MAXYLD	maximum yield
MDSI	maintenance and diagnostic test interval
ME	method of engagement
MEG	message entry group
MET	meteorological
MFI	mission fired indicator
MFR or MFN	mission fired report (N=Nuke)
MFREX	exclude ATI processing of MFRs and MFNs
MGS	military grid system
MINALT	minimum altitude
MINEID	minefield identification
MINRNG	minimum range
MINX	minor axis for spheroid 8
MISC	miscellaneous message
MKMOD/MMA	mark/model number for main missile assemblage (motors)
MMD	nuclear ammunition
MOD	modification
MODF	commander's mod file
MOI	message of interest
MORT	mortar
MPLIST	master plan list

MSD	minimum safe distance
MSL	missile unit selection
MSN	mission of fire unit
MSU	mutual support unit
MTO	message to observer
MVE or MV	muzzle velocity
MYEFF	my effects on RFAF message
MYIELD	mark yield for nuclear FM

N

NAL	no analysis
NANAL	nuclear target analysis
NAVAIR	naval air delivery
NBC1NU	nuclear burst sighting report message
NEFF	desired nuclear effects
NETMDE	net mode
NEWPLN	new plan name
NFA	no-fire area
NI	nuclear interest
NNFP	nonnuclear fire planning
NONREC	do not record
NOVMBR	estimated yield (kilotons)
NOWARN	noncritical warning
NSCD	nuclear schedule of fires message
NTA	nuclear target analysis
NTGT	nuclear target message
NTGTOP	nuclear target of opportunity
NTIME	nuclear firing time
NU	nuclear ammunition
NUCAL	nuclear allocation summary
NUCAM	nuclear ammunition
NUCD	nuclear development file
NUCEF	nuclear effects
NUCEX	nuclear exceptions
NUTYP	nuclear type of friendly units

O

OB or OBSR	observers of interest
OBCO	observer location
OBCORD	observer or crater location (shell report)
OBF	observer file
OBINFO	observer information
OBSN	target position adjustment for laser
ONCALL	on-call target indicator
OPT	modification option
OUTIL	fire unit out until (not ready)
OVERLP	overlap distance for zones

P

PCLD	priority, classification, logging, display message
PDA	point-detonating fuze (M557, M739, M572)
PDS	peripheral device status message
PERMNC	target permanence (how long will target be there)
PL	phase line
PLOT	powder lot and characteristics
POSI	position or name of met station
PREC	precipitation in division area
PRECIP	precipitation
PREFP	prepare a fire plan message
PRNTCE	print safety and contingency report
PROJ	projectile (shell)
PT	plain text (stored in data base)
PTA	preliminary target analysis
PTAXCL	PTA exclusions message
PTEMP	powder temperature
PTGTOP	preliminary target of opportunity designator
PTM	plain-text message

Q

QF	quick fire message
QMOD	combination comparison limit
QUERY	request for target information

R

RAC	report accuracy table
RAD	radius of damage or effects
RARP	record as registration point
RAT	record as target
RATI	record as time registration
RD	rounds on FSE ALLOC message
RDT	good rounds for HB/MPI registration

RECIN	recommended for inspection reports
RECOMB	recombine target number
REFU	reserve fire unit
REG	registration message
REGFIL	registration file
REJ	reject
REL	reliability of target report
REPL	replace
REPP	replot polar command
REPR	replot–rectangular command
REQTGB	time period required for GB effects
REQTVX	time period required for VX effects
RER	range error table
RESF	reserved fire unit print designator
RESFU	reserve FU or interval message (NNFP)
RESPON	response posture
RESTR	relative time restriction message
RFA	restrictive fire area
RFAF	request for additional fire
RKTMSL	rocket/missile
RLPI	remote loop test interval
RNA	remote nuclear analysis designator
RNGCR	range correction
RNGERR	range error
RPF	relative proximity factor
RT	fire unit response time
RV	report value

S

SB	subscriber
SBT	subscriber table
SCDFIR	schedule of fires report
SERRPT	series of fires report
SH	shell
SHEF	shell in effect
SHELS	shell description
SHFCOR	correction of last-entered shift
SHL	shell type
SHR	shell report message
SHRPT	shell report indicator
SITR	situation of round
SITREP	situation report
SMA	smoke, white phosphorus
SMB	smoke, base ejection
SMRN	system message reference numbers
SOLRPT	solution report indicator
SPHERE	spheroid
SPLIT	split target message
SPR	salvage point recording
SPRI	salvage point recording interval
SPRT	support
SR	situation report
SRI	standing request for information
ST	type of sight
STDMET	standard met
STDODD	standard odd lot
STNA	single target nuclear analysis indicator
STR	strength of target
SUBS	subsequent commands message
SUMS	ammunition inventory summary
SUPPRT	suppress print
SURF	surface burst (nuclear)
SURFWN	surface wind (met)
SURV	survey
SUSP	suspected target
SUSTRTE	sustained rate of fire
SVL	surveillance
SVMOD	standard value criteria message
SVY	surveyed location
SYM	symbol

T

TBMOD	target buildup criteria message
TC	test criteria number
TD	target descriptor
TEMGRA	temperature gradient (met)
TEMP	temperature
TEMPF	temperature 2 meters above surface in Fahrenheit
TGR	target report message
TGT	target or target number
TGTFIL	target file
THERM	thermal shielding (FSE;FRIEND)
TIA	time fuze (M564)
TIB	time fuze (M577)

TIC	time fuze (M548)
TIMECR	time correction
TIMEX	maximum acceptable time difference between computer time and time of incoming report
TIMEY	maximum time difference between reports of same target
TIRPT	time repeat for precision registration
TISF	targets in schedule of fires
TOC	tactical operations center
TOT	time on target
TRAV	traverse
TRAVLR	traverse limits
TRN	transmission repeat number
TRPSAF	nuclear troop safety violations
TRY	trial combination message
TYPE or TYP	target type

U

UFFE	unit to fire for effect
UFFES	units to be used
UPFPF	update final protective fire
UREINF	unit being reinforced

V

VEGTAT	vegetation type
VERT	vertical shift (ATI)
VOL	desired number of volleys
VOLAC	volleys achieved (NNFP)
VOLACT	actual volleys for each UFFE (NNFP)
VOLRQ	required volleys (NNFP)
VTE	variable time fuze (M728)
VTIME	valid time of target
VULAN	nuclear vulnerability analysis message (FSE)
VULCAT	vulnerability category

W

WDOP	combining weight for degree of protection
WPDF	weapon descriptor file
WPFL	weapon descriptor file message
WPN	weapon type
WPNS	weapon system exclusions (FSE)
WSIZE	combining weight for size (ATI)
WSTR	weapon strength
WTYP	combining weight for type target

X

XCLUDE	exclude
XMIT	transmit request
XRDS	number of rounds that have impacted (ATI)
XT	exclude target
XTEL	automatic transmission to reinforcing battalion

Y

YLD(S)	yield combination(s) for nuke

Z

ZF	zone fire
ZNE	zone of responsibility message
ZON/ZOR	zone of responsibility

SECTION II

ABBREVIATIONS AND ACRONYMS

A

ABCA	America, Britain, Canada, and Australia
AC	alternating current
ACA	airspace coordination area
ACC	artillery control console
ACCO	artillery control console operator
ACR	armored cavalry regiment
ADMIN/LOG	administration/logistics (radio net)
ADP	automatic data processing

AFATDS	advanced field artillery tactical data systems
AFU	ammunition and fire unit (program)
ALLOCF	allocation file
ALTERN	number of alternatives
AM	amplitude modulated
ammo	ammunition
AMOL	critical ammunition level
AMOSUM	ammunition summary
amp	ampere
AO	aerial observer
ASGORD	battalion assignment order number
ASR	available supply rate
ATI	artillery target intelligence
AUTOPS	autonomous operations

B

BCD	field artillery brigade, corps artillery, division artillery
BCS	battery computer system
BCU	battery computer unit
bde	brigade
bn	battalion
BPS	bits per second
btry	battery
BUCS	backup computer system

C

C	confidential
CA	case assembly
C&C	confidential-crypto
CAI	computer-assisted instruction
CAS	close air support
CCS	communications control system
CCU	communication control unit
CED	compose/edit display
CEOI	communications-electronics operation instructions
CESO	communications-electronics staff officer
CF	command/fire direction (radio net)
CFC	company fire control (radio net)
CFL	coordinated fire line
CFO	counterfire officer
CFVFMED	counterfire VFMED
CHA	chemical hazard area
CI	comand/intelligence (radio net)
CJB	communications junction box
CMD	command (radio net)
CMSC	communications mode selector control
COMCRIT	commander's criteria
COMSEC	communications security
COSCOM	corps support command
CP	command post
CPE	collective protective equipment
CPP	communications patch panel
CPU	central processing unit
CSIN	COMSEC interface
CSR	controlled supply rate
CTA	chemical target analysis
CTB	communications terminal box

D

DAA	damage avoidance area
DBSUM	data base summary message
DC	direct current
DCU	display control unit
DDT	digital data terminal
DE	display editor
DEC	data exchange channel
DF	direction-find
DGZ	desired ground zero
DISCOM	division support command
div arty	division artillery
DMD	digital message device
DNA	do not adjust
DNC	do not combine
DPM	digital plotter map
DPU	display plotting unit
DS	direct support
DSA	dead space area
DSM	direct support maintenance

E

ECCM	electronic counter-countermeasures
ECOF	effects cutoff factor
ELP	electronic line printer
EMI	electromagnetic interference
EMP	electromagnetic pulse

EOM end of mission
ETD electronic tactical display
ETM exportable training material
ETO encrypt for transmission only
EW electronic warfare

F

F fire (radio net)
FA field artillery
FAAO field artillery aerial observer
FADAC field artillery digital automatic computer
FASCAM family of scatterable mines
FCE fire control element
FD fire direction (radio net)
FDC fire direction center
FDO fire direction officer
FDS fire direction system
FFA free-fire area
FFE fire for effect
FIST fire support team
FLOT forward line of own troops
FM frequency modulated, field manual, fire mission
FMMOD fire mission modification
FO forward observer
FP fallout prediction
FPF final protective fire
FPLST preliminary target list
FPTGT fire plan target list
FRA fire request approval
FRIENF friendly unit file
FSCL fire support coordination line
FSCOORD fire support coordinator
FSE fire support element
FSK frequency shift keying
FSO fire support officer
FSS fire support section
FST forward support team
FSV fire support vehicle
FU fire unit

G

GA gun assembly
GB chemical agent
GDU gun display unit
GFT graphical firing tables
GS general support
GSR general support reinforcing
G/VLLD ground/vehicular laser locator designator

H

HB high burst
HC hexachloroethane
HE high explosive
HF high frequency
HHB headquarters and headquarters battery
HOB height of burst

I

ICAO International Civil Aviation Organization
ICM improved conventional munitions
ID identification
IGALLO ignore nuclear allocations
IGAMMO ignore ammunition
INTACS integrated tactical communications systems
INTEL intelligence (radio net)
IOU input/output unit

J

JMEM Joint Munitions Effectiveness Manual
JTIDS joint tactical information distribution system

K

KNPT known point
KNPTF known point file
kw kilowatt

L

LGSB legal subscriber message
LO liaison officer
LOC location

M

M&D maintenance and diagnostic
MAP MOD map modification
MAXD maximum displacement distance
MAXVOL maximum volleys
MBA main battle area

MCHAN multichannel
MCMU mass core memory unit
MDS meteorological data system
MEP mission-essential parts
MET meteorological (program)
met meteorology
MFCC mortar fire control calculator
MFR mission fired report
MGS military grid system
MLRS multiple launch rocket system
MLRSIZ MLRS size
MOI message of interest
MOPP mission-oriented protection posture
MOS military occupational specialty
MPI mean point of impact
MPLIST master plan list
MST maintenance support team
MSU mutual support unit
MTC magnetic tape cartridge
MTO message to observer
MTS module test set
MTU magnetic tape unit

N

NATO North Atlantic Treaty Organization
NBC nuclear, biological, chemical
NCS net control station
NFA no-fire area
NFP nuclear fire planning
NGF naval gunfire
NNFP nonnuclear fire planning
NSN national stock number
NTA nuclear target analysis
NTOP nuclear target of opportunity
NUCD nuclear development

O

OBFCS on-board fire control system
O/I operations and intelligence
OP observation post
OPCON operational control
OPLAN operations plan
OPORD operations order
OPS operatons (radio net)
OPS/F operations/fire direction (radio net)
OS operating system

P

PCG power converter group
PCLD priority, classification, logging, and display
PCM pulse code modulation
PDU power distribution unit
PEP power entry panel
PJH PLRS/JTIDS hybrid
PL phase line
PLDMD platoon leader's digital message device
PLRS position location reporting system
PM preventive maintenance
PTA preliminary target analysis
PTM plain-text message

Q

QSTAG Quadripartite Standardization Agreement

R

R reinforcing
RATT radioteletypewriter
RCMU remote communications monitoring unit
RDE receive/display editor
RDF radio direction-finding
RDT remote data terminal
REGFIL registration file
RFA restrictive fire area
RFL restrictive fire line
RNA remote nuclear analysis
RPF relative proximity factor
rpm revolutions per minute
RPSTL repair parts and special tools list
RPV remotely piloted vehicle
RSOP reconnaissance, selection,and occupation of position
RSR required supply rate
RV report value

S

S secret
S&C secret-crypto

SBT	subscriber table
SCA	section chief assembly
SCP	survey control point
SEAD	suppression of enemy air defense
SFZ	safety zone
SHELREP	shell report
SID	sequence identification number
SINCGARS	single channel ground/air radio system
SITREP	situation report
SMRN	system reference number
SPLL	self-propelled launcher-loader
SPR	salvage point recording
SPRT	support (program)
sqdn	squadron
SRD	secret restricted data
SRI	standing request for information
SSB	single sideband
STANAG	NATO Standardization Agreement
STNA	single target nuclear analysis
SVF	standard volleys factor
SYSDUPE	system duplication

T

TAB	target acquisition battery
TACAIR	tactical air
TACFIRE	tactical fire direction system
TC	target buildup criteria
TDB	tactical data base
TES	TACFIRE equipment specialist
TF	task force
TFC	tactical fire control
TGTFIL	target file
TISF	targets in a schedule of fires
TOAD	Tobehanna Army Depot
TOC	tactical operations center
TOE	tables or organization and equipment
TOT	time on target
TTFC	technical and tactical fire control

U

UFFE	unit to fire for effect
UHF	ultrahigh frequency
UN	unclassified
UTM	universal transverse mercator

V

VAC	volts alternating current
VDC	volts direct current
VFMED	variable format message entry device
VHF	very high frequency
VSF	volley size factor
VT	variable time
VULCAT	vulnerability category
VX	chemical agent

W

WP	white phosphorus

X

XO	executive officer

Z

ZOR	zone of responsibility

REQUIRED PUBLICATICATIONS

Required publications are sources that users must read in order to understand or to comply with this publication.

COMMAND PUBLICATIONS

NOTE: *Command publications cannot be obtained through Armywide resupply channels. Determine availability by contacting the address shown. Field circulars expire 3 years from the date of publication, unless sooner rescinded.*

FC 6-1-3	Battalion TACFIRE Operating Procedures. June 1985. Commandant, US Army Field Artillery School, ATTN: ATSF-G-PMB, Fort Sill, OK 73503-5600
FC 6-1-4	Division Artillery/Field Artillery Brigade TACFIRE Operating Procedures. January 1986. Commandant, US Army Field Artillery School, ATTN: ATSF-G-PMB, Fort Sill, OK 73503-5600
FC 6-40-2	Battery Computer System, BCS Job Aids. March 1985. Commandant, US Army Field Artillery School, ATTN: ATSF-G-PMB, Fort Sill, OK 73503-5600
FC 6-60	Multiple Launch Rocket System Operations. December 1984. Commandant, US Army Field Artillery School, ATTN: ATSF-G-PMB, Fort Sill, OK 73503-5600

FIELD MANUAL (FM)

6-42	Field Artillery Battalion, Lance

TECHNICAL MANUALS (TMs)

11-7440-240-10 (Volumes 1 through 10)	Operator's Manual: Fire Direction Center, Artillery, Processing and Display, OA-8389/ GSG-10(V) (Battalion)
11-7440-241-10 (Volumes 1 through 10)	Operator's Manual: Fire Direction Center, Artillery OA-8390/GSG-10(V) (Division)
11-7440-242-23P	Organizational and Direct Support Maintenance Repair Parts and Special Tools Lists for Fire Direction System, Artillery, AN/GSG-10(V) Including Fire Direction Center, Artillery, OA-8390/ GSG-10(V) (Division), Fire Direction Center, Artillery Processing and Display, OA-8389/ GSG-10(V) (Battalion), Message Entry Device, Variable Format, AN/GSC-21

	(VFMED) and Data Display, Artillery, Battery, AN/GSQ-122 (BDU)
11-7440-243-13	Operator's, Organizational, and Direct Support Maintenance Manual: Fault Catalog for Fire Direction Center, Artillery, Processing and Display, OA-8389/ GSG-10(V) (Battalion) and Fire Direction Center, Artillery, OA-8390/GSG-10(V) (Division)
11-7440-253-10 (Volumes 1 through 4)	Operator's Manual: Message Entry Device, Variable Format, AN/GSC-21 AN/GSC-21(VFMED)
11-7440-281-12&P	Operator's and Organizational Maintenance Manual Including Repair Parts and Special Tools Lists for Digital Message Device, AN/PSG-2A
11-7440-283-12-1	Operator's and Organizational Maintenance Manual for Computer Groups, Gun Direction, OL-200/GYK-29(V)
11-7440-283-12-1-1	Operator's Manual for Cannon Battery Computer System Computer Group, Gun Direction, OL-200/GYK-29(V)
11-7440-283-12-1-2	Operator's Manual for Lance Fire Direction System, AN/GYK-29(V)
11-7440-283-12-1-3	Operator's Manual for Multiple Launch Rocket System Fire Direction System, AN/GYK-29(V)
11-7440-283-12-2	Operator's and Organizational Maintenance Manual for Data Display Groups, Gun Direction, OD-144(V)/GYK-29(V), and OD-144(V)3/GYK-29(V)

RELATED PUBLICATIONS

Related publications are sources of additional information. They are not required in order to understand this publication.

ARMY REGULATIONS (ARs)

34-3	Battlefield Automated Systems Interoperability Management
105-24	Radio Frequency and Call Sign Assignments for US Army Communications-Electronics Activities
380-5	Department of the Army Information Security Program
380-40	(C) Policy for Safeguarding and Controlling COMSEC Information (U)

380-380	Automation Security
385-9	Safety Requirements for Military Lasers
385-64	Ammunition and Explosives Safety Standards
525-22	(S) Electronic Warfare (EW) Policy (U)
530-2	Communications Security
530-3	(C) Electronic Security (U)

DEPARTMENT OF ARMY (DA) FORM

2028	Recommended Changes to Publications and Blank Forms

FIELD MANUALS (FMs)

3-10	Employment of Chemical Agents
3-22	Fallout Prediction
6-15	Field Artillery Meteorology
6-20	Fire Support in Combined Arms Operations
6-20-1 (HTF)	Field Artillery Cannon Battalion
6-20-1J	Field Artillery Battalion
6-20-2 (HTF)	Division Artillery, Field Artillery Brigade, and Field Artillery Section (Corps) (How to Fight)
6-20-2J	Division Artillery, Field Artillery Brigade, and Corps Artillery Headquarters
6-30	Observed Fire Procedures
6-40	Field Artillery Cannon Gunnery
6-40-4	Field Artillery Lance Missile Gunnery
6-50	The Field Artillery Cannon Battery
6-121	Field Artillery Target Acquisition
6-122	Field Artillery Sound Ranging
6-141-1	Field Artillery Target Analysis and Weapons Employment: Nonnuclear
6-141-2	(C) Field Artillery Target Analysis and Weapons Employment: Nonnuclear (U)
6-161	Field Artillery Radar Systems
11-50 (HTF)	Combat Communications Within the Divison (How to Fight)
19-30	Physical Security
21-26	Map Reading
24-1	Combat Communications
24-17	Tactical Communications Center Operations
24-18	Tactical Single-Channel Radio Communications Techniques

24-20	Field Wire and Field Cable Techniques
24-21	Tactical Multichannel Radio Communications Techniques
30-5	Combat Intelligence
100-5 (HTF)	Operations (How to Fight)
100-50	Operations for Nuclear-Capable Units
101-5	Staff Organization and Operations
101-5-1	Operational Terms and Operations
101-10-1	Staff Officers' Field Manual: Organizational, Technical, and Logistic Data
101-31-1	Staff Officers' Field Manual: Nuclear Weapons Employment Doctrine Employment Doctrine and Procedures
101-31-2	(SRD) Staff Officers' Field Manual: Nuclear Weapons Employment Effects Data (U)
101-60-2	(C) Joint Munitions Effectiveness Manual Surface-to-Surface: Effectiveness Data for Howitzer, 105-mm: M101A1 (U)
101-60-3	(C) Joint Munitions Effectiveness Manual: Surface-to-Surface: Effectiveness Data for Howitzer, 155-mm. M109 (U)
101-60-4	(C) Joint Munitions Effectiveness Manual: Surface-to-Surface Effectiveness Data for Howitzer, 8-Inch, M110 (U)
101-60-6	(C) Joint Munitions Effectiveness Manual: Surface-to-Surface Effectiveness Data for 5-Inch/38-Inch Naval Twin-Gun Mount MK-28, -32 and With Gun, Fire Control System MK-37 (U)
101-60-17	(C) Basic Effectiveness Manual, Surface-to-Surface (U)
101-61-3	(C) Joint Munitions Effectiveness Manual/ Surface-to-Surface: Ammunition Reliability (U)
101-62-1	(C) Joint Munitions Effectiveness Manual Surface-to-Surface Safe Distances for Fragmentary Munitions (U)
101-62-3	(C) Joint Munitions Effectiveness Manual/ Surface-to-Surface: Manual of Fragmentation Data (U)

MISCELLANEOUS PUBLICATIONS

AAP 6	NATO Glossary of Terms and Definitions for Military Use
ADAP P2	NATO Glossary of Automatic Data Processing (ADP) Terms and Definitions in English and French
ADAP P3	NATO Message Text Formatting System (FORMETS)

ATC-PD-1720-003-83	(S) Threat to Army Integrated Tactical Communication System (U)
DST-1740S-385-81	(S) Reconnaissance, Surveillance, and Target Acquisition - USSR (U)
DST-1730S-009-81	(S) The Soviet Radioelectronic Combat Capability (U)
KAM 240C/TSEC	(C) Maintenance Manual, TSEC, KG-31/31A/35/35A/36/36A (U)
KAO 137E/TSEC	Operating Instructions for TSEC/KG-30 Series of Equipment

NATO STANDARDIZATION AGREEMENTS/ QUADRIPARTITE STANDARDIZATION AGREEMENTS (STANAGs/QSTAGs)

2031/515	Proforma for Artillery Fire Plan
2099/531	Fire Coordination in Support of Land Forces
2101/533	Principles and Procedures for Establishing Liaison
2144/225	Call for Fire Procedures
2147/221	Target Numbering System (Nonnuclear)
2875	Calls for Destruction, Smoke, Illumination, and Danger Close Missions
2887/217	Tactical Tasks and Responsibilities for Control of Artillery
4061/332	Adoption of a Standard Ballistic Meteorological Message
4082/252	Adoption of a Standard (Cannon) Artillery Computer Meteorological Message
4103/386	Format of Requests for Meteorological Messages for Ballistic and Special Purposes
4140/389	Standard Target Acquisition Meteorological Messages
5036/432	Parameters and Practices for the Use of the NATO 7-Bit Code
5061/263(B)	Standards to Achieve Interoperability of ABCA Armies Very High Frequency Combat Net Radio Equipments
5500/674	NATO Message Text Formatting System (FORMETS)
5620	Standards for the Interoperability of Fire Support ADP Systems

NOTE: *STANAGs and QSTAGs can be obtained from Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120. DD Form 1425 may be used to requisition documents.*

TECHNICAL MANUALS (TMs)

11-7440-242-23 (Volumes 1 through 3)	Organizational and Direct Support Maintenance Manual: Fire Direction System, Artillery AN/GSG-10(V)
11-7440-242-40	General Support Maintenance Manual: Fire Direction System, Artillery, AN/GSG-10(V)
11-7440-242-40P	General Support Maintenance Repair Parts and Special Tools Lists for Fire Direction System, Artillery, AN/GSG-10(V) Including Fire Direction Center, Artillery, OA-8390/GSG-10(V) (Division); Fire Direction Center, Artillery Processing and Display, OA-8389/GSG-10(V) (Battalion): Message Entry Device, Variable Format, AN/GSC-21 (VFMED) and Data Display, Artillery, Battery, AN/GSQ-122 (BDU)
11-7440-244-10	Operator's Manual: Reference Data for Fire Direction Center, Artillery, Processing and Display, OA-8389/GSG-10(V) (Battalion) and OA-8390/GSG-10(V) (Division)

TRAINING CIRCULARS (TCs)

6-1-2	Battery Computer System
6-20-5	FA Delivered Scatterable Mines
24-1	(O) Communications-Electronics Operation Instructions, The CEOI