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FIELD ARTILLERY TACTICAL

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FIRE DIRECTION SYSTEM

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TACFIRE

OPERATIONS

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 SPHERE: 1 /DIR: 3200 /DI
 AUF: /A/1 /1 /TYPE: A
 STR: 6 /RU: /LAS:
 UFFE: / / / /
 VOL: /OBX01 /CHG: /EOM:



34/23 /ID: 20 /A: /
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 STR: 6 / / / / /
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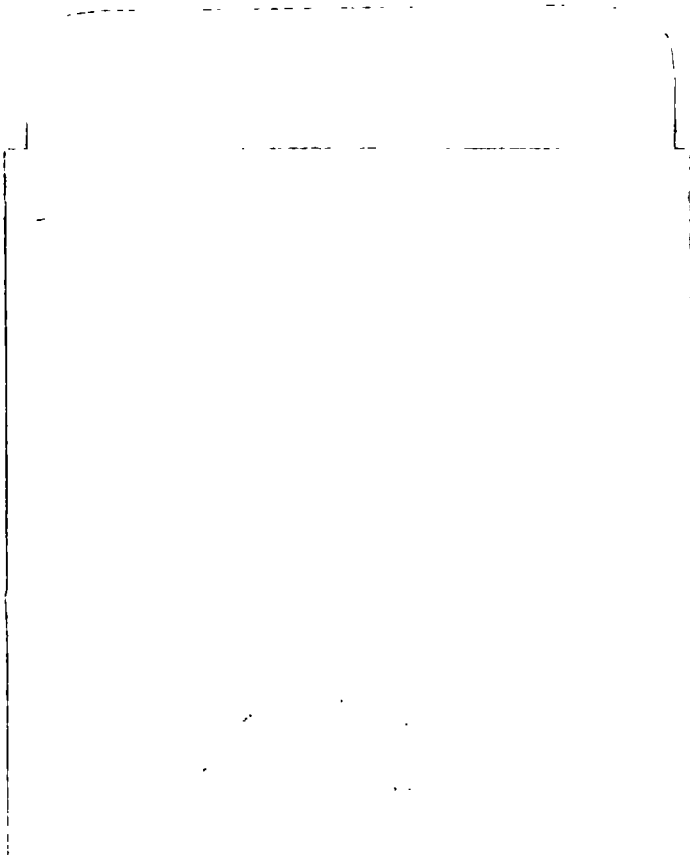
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No. FM 6-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 28 September 1979

FIELD ARTILLERY FIRE DIRECTION SYSTEM TACFIRE OPERATIONS

PURPOSE

This manual provides information and guidance for field artillery (FA) personnel, especially commanders and their staffs, on the tactical employment of the tactical fire direction system (TACFIRE).

SCOPE

Techniques and procedures for employment; command, control, and communication; fire support planning; fire support coordination; and training with TACFIRE are described.

This manual should be used with FM 100-5; FM 6-20; FM 6-20-1; FM 6-20-2; other field manuals in the 6- series; and with TACFIRE user manuals that explain the technical operations of equipment parts.

The information in this manual applies to all types of warfare unless otherwise stated.

TARGET AUDIENCE

This manual is for fire support system managers—field artillery officers (commanders, FSOs, FDOs, etc.) and FA noncommissioned officers in the speciality areas of field artillery operations/intelligence, targeting, and survey (MOS 13C/13E/13F/17C/82C).

*This publication supersedes TC 6-1, 15 July 1977.

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The word "he" or "his" in this publication is intended to include both the masculine and feminine genders and any exception to this will be so noted.

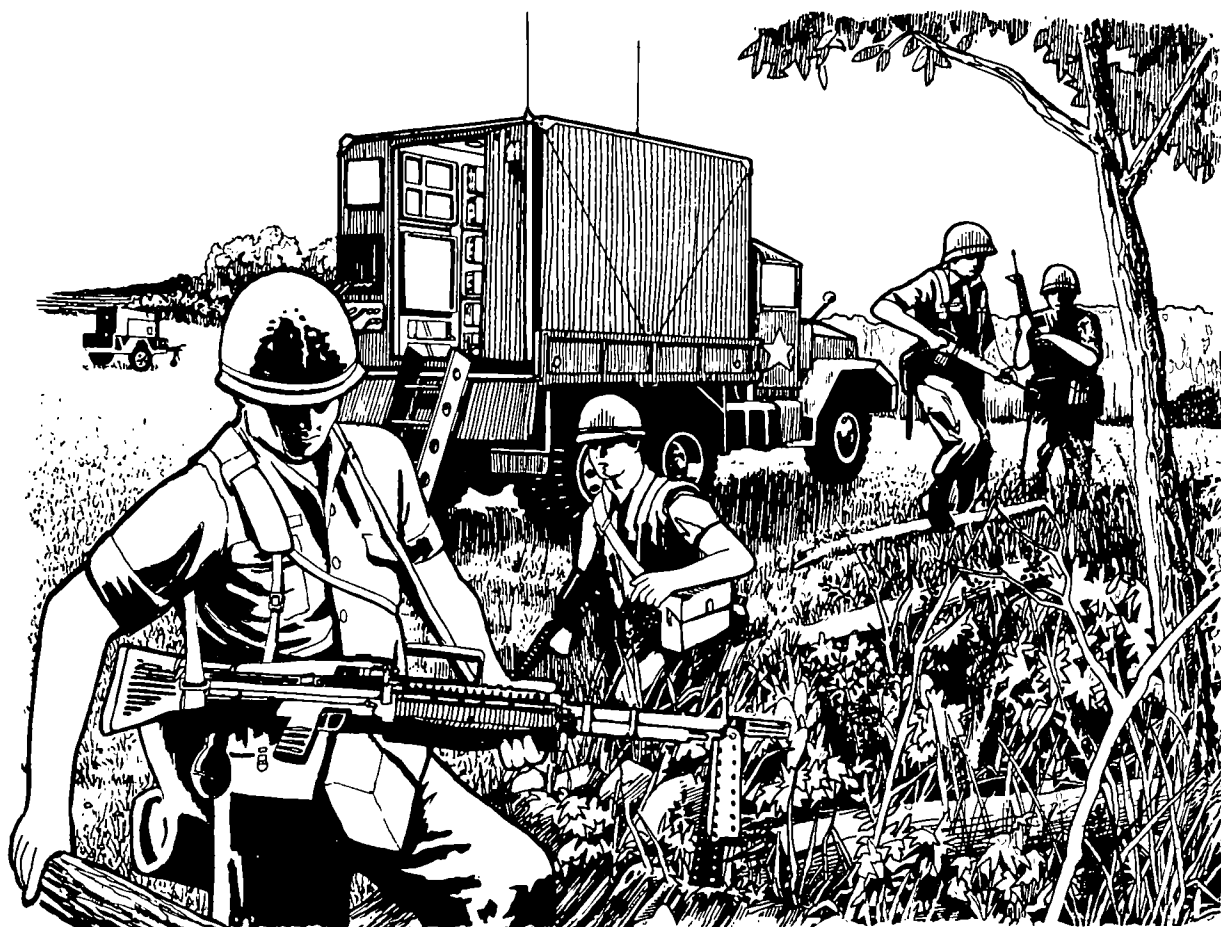


Figure 1-1. Personnel securing positions for TACFIRE battalion direction center.

CHAPTER 1

INTRODUCTION

1-1. DYNAMICS OF MODERN COMBAT

If there is a major conflict, the United States Army will face a tough, capable, well-trained, and numerically superior force. This force can operate in a nuclear, chemical, or conventional environment. It will be equipped with high quality materiel and

excellent weapons comparable to our own. This force stresses rapid movement and deep armored thrusts of about 50 to 60 kilometers per day. Large forces, massively supported and moving rapidly, provide combat momentum—a key element of threat doctrine. Moreover, the threat force will move under protection of a lethal air defense umbrella and is capable of extensive electronic warfare measures.

Applying technology to target acquisition (radars, signal intelligence (SIGINT) systems, unattended ground sensors, etc.), has increased the US division's ability to detect and locate the profusion of targets that will be encountered. Advances in weapon technology have given us the capability to attack targets at ever-increasing ranges.

The battlefield of the future will be characterized by fleeting, numerous targets requiring attack under severe time constraints. The amount of battlefield information available to the commander will also increase.

The field artillery must establish priorities for these targets and attack them with appropriate calibers and volumes of fire. Manual methods of fire support planning and coordination and technical and tactical fire control will be inadequate. Automatic data processing (ADP) must be used.

Using ADP technology to solve fire support problems increases the capability of our limited assets by making our most important combat multiplier—field artillery—available in overwhelming quantities at the critical time and place.

1-2. TACFIRE AND FIRE SUPPORT

The FA command and control system that meets the challenge of modern combat is the tactical fire direction system. TACFIRE, used with other FA equipment, provides the maneuver commander with a system capable of detecting targets, allocating firepower, and providing fire support within seconds. Highly automated equipment allows the rapid and accurate determination of target data and the transmission of that data to the command and control team. TACFIRE provides the means to receive targeting information, allocate firepower, compute

ballistic firing data, and send fire orders to FA weapons.

TACFIRE is a revolutionary fire control system. It is an electronically integrated command and control information system that also processes fire missions. It is the key to the fire support system. TACFIRE **receives, stores, combines, and sorts** target reports. TACFIRE selects units to fire and the correct shell-fuze combination to achieve the level of casualties that the commander desires. All of this can be accomplished routinely by TACFIRE at battalion to provide immediately responsive fires for the supported force. TACFIRE at all fire support echelons can send timely fire requests/orders for massed fire missions and prepare responsive fire plans for support of the maneuver force.

The FA battalion, division artillery, FA brigade, and the FA section at corps are provided with central computers. Digital communication over any standard Army communication means (radio or wire) provides for input of data into the computer centers and for the return of results. Forward observers, fire support officers, S3s, fire support elements, firing batteries, and counterfire elements are provided remote terminal equipment to obtain data processing services from the central computer.

TACFIRE remote terminal equipment is located to support the combined arms team. By increasing communication speed and accuracy, TACFIRE significantly increases the efficiency of the field artillery available to support maneuver forces. Besides the tactical and technical control functions, TACFIRE is capable of:

- Conventional and nuclear fire planning.
- Processing and dissemination of target data.

- Execution of fire support functions pertaining to the integration of close air support (CAS) and naval gunfire into fire support planning.

- Rapid dissemination of fire support coordinating measures and fire unit data.

When designated, messages that are received or transmitted by a TACFIRE computer center may be relayed automatically to other computer centers or remote terminal equipment. This "message of interest" function is a valuable tool in the fire support coordination process.

The value of TACFIRE to the combined arms team is strengthened by its hardware reliability characteristics and software provisions for alternate mode configuration and mutual support. TACFIRE equipment has proved to be reliable, but if a failure occurs, the system can be configured to operate in an alternate mode while organizational maintenance personnel diagnose the trouble and repair the defective component. Mutual support is the alternate method employed to continue a mission if there is normal computer displacement or a total TACFIRE computer failure. Mutual support consists of having two computers exchange data with each prepared to assume the duties of the other at any time. This insures continuity of computer operations and provides continuous support of maneuver forces.

The fire support system must provide for responsive and flexible support of a highly mobile combined arms team. To offset the numerical superiority of threat forces, the combined arms team must use superior tactics, modern equipment, and effective command and control measures. TACFIRE, as a computer-based management and information system, improves field artillery command and control to assist the maneuver commander in employing his assets more effectively. TACFIRE assists the full integration of fire support with maneuver by improving concurrent planning by all

elements of the combined arms team. Targets can be assigned a priority according to the potential threat, and all weapon systems and munitions available can be considered to defeat the threat. Decisions can be implemented effectively, enabling the fire support system to concentrate firepower rapidly and effectively in support of maneuver forces.

1-3. TACFIRE EQUIPMENT

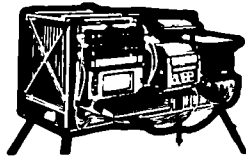
TACFIRE equipment consists of two types of central computers and three types of remote terminals. The principal function of TACFIRE is command and control. The division artillery type computer at corps field artillery section, division artillery headquarters, and field artillery brigade headquarters is used for tactical fire control—selecting unit to fire, choosing munitions to be used, and determining volumes of fire. It has no technical fire control capability. The computer issued to field artillery battalions is oriented on technical fire control—computation of firing data—but possesses a tactical fire control capability as well. The division artillery type computer has more components and a larger memory than the battalion computer and can therefore be programed to handle more tactical functions.



**DMD
(COMPUTER
TERMINAL)**

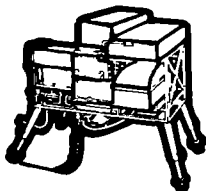
Remote terminals are issued to the elements of the field artillery system that require access to computers. The chief of each fire support team (FIST) uses a **digital message device (DMD)** to communicate (requests for fire/message to observer) with the battalion computers. Other remote

terminal users (fire support element (FSE) and FA S3) have a **variable format message entry device (VFMED)** to transmit to and



VFMED
(COMPUTER
TERMINAL)

receive digital traffic from the parent computer. A battalion fire support officer (FSO), for instance, can request and receive the current ammunition status of his supporting fire units or enter targets for fire planning. Each firing battery has a **battery display unit (BDU)**. This device receives only



BATTERY
DISPLAY
UNIT

and acknowledges operational data such as fire commands. A detailed discussion of TACFIRE equipment and equipment distribution is in appendix A.

1-4. TACFIRE CAPABILITIES

TACFIRE provides computerized digital communications and automated processing of normal fire support functions. These functions include fire planning, conduct of fire, target data, rapid dissemination of the results of processing, and feedback. TACFIRE's data collection and summary features free fire support personnel from many tedious, routine, and often error-prone tasks. This allows them to concentrate more fully on analyzing alternatives, allocating resources, and determining the best

combination of weapon system, munitions, and volume of fire for targets.

TACFIRE provides rapid, secure communications.

a. Addressed digital traffic. TACFIRE equipment converts standard field artillery messages to digital messages that are transmitted over standard Army communication equipment in a fraction of the time previously required. Under good conditions, a completed forward observer's (FO) call for fire can be sent and acknowledged in 6 seconds. A complete target list of up to 25 targets, to include description and grid coordinates, can be transmitted in less than 7 minutes. Before transmission, a message is addressed, either automatically or by the operator, so that only the intended elements receive it. Other stations, even if they are on the same frequency, will not receive the message.

b. Automatic encryption and decryption. TACFIRE computers, VFMEDs, and BDUs automatically encrypt and/or decrypt messages using standard Army COMSEC keying generators (KG) attached to each computer and terminal unit. The FO currently does not have encryption equipment. Messages sent to and from DMDs are not encrypted.

c. Automatic relay of messages. Each TACFIRE computer can automatically relay an incoming message to another operator. This helps overcome communication difficulties such as range or line of sight and gives authorized FSOs access to the division artillery computer. For example, a maneuver brigade FSO in the main battle area can

automatically receive copies of mission fired reports for all targets attacked by the fire support system in the covering force area. This is done by automatic relay from the division artillery computer through a field artillery battalion computer at the time the division artillery computer receives the mission fired report on a target. Such information will help the brigade FSO read the flow of the battle in the covering force area.

TACFIRE allows commanders to establish guidance for the battle.

a. Commander's criteria. These criteria are specific operational guidelines for tactical fire control, fire planning, and target data. They are entered into the computer during planning for use during the battle.

b. Tactical fire control. Commander's criteria statements normally are entered into the computer to control the way fire support is used. Some examples are:

- The volume of fire or desired percent of damage for different types of targets. If not entered, a standard volume of fire will be determined within prescribed constraints from the Joint Munitions Effectiveness Tables, which are programed into each computer.

- The priority for assigning missions to fire units, (e.g., Battery B, first; Battery C, second; Battery A, third). If this entry is not made, the computer will use the busy status and recency of assignment as the priority for use.

- Fire units, munitions, or munitions per fire unit to be excluded from mission assignment. If not excluded, all fire units and munitions in the ammunition and fire unit files will be available for use.

c. Fire planning. As a part of tactical fire control, the commander can establish criteria for the computer to follow when selecting the method of attacking targets. Besides the examples found in tactical fire control, the commander may desire to add such things as the reservation of fire units.

d. Artillery target intelligence program. Commander's criteria for artillery target intelligence include guidelines for things such as automatic generation of fire missions, target buildup reports, and target combination. Criteria may be entered in the division artillery computer to cause—

- An automatic recommendation for a fire mission on targets that meet specific criteria.

- Target buildup reports to be generated if a specific number of targets occur within a 1.5-kilometer radius.

- The joining of two targets into a unique third target when a certain proximity and degree of target type similarity exist.

TACFIRE processes target data.

The battalion computer receives data from all organic field artillery sources and forwards this information to the division artillery computer. The division artillery computer processes and sends out the targeting data. This processing includes receiving and storing intelligence data reported by field artillery elements. The division artillery computer stores up to 1,364 separate targets or target indicators, automatically joins targets by location and nature of target, notifies the counterfire officers of target buildup by area, and recommends fire missions based on target data when the commander's criteria are satisfied. When required, the division artillery computer will search its artillery target intelligence file to retrieve targets for use in fire planning by the division artillery tactical operations center (TOC), or will forward this list to the requestor. TACFIRE will also process shell reports, sort targets by desired target characteristics (e.g., type, size, location), and automatically disseminate targeting information to field artillery and maneuver organizations through the FSO.

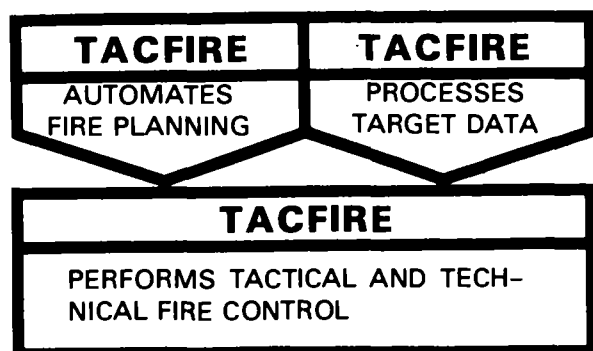
TACFIRE automates fire planning.

a. TACFIRE provides better integration of maneuver and fire support planning by improving the exchange of information and battlefield control measures between fire support and maneuver elements. This exchange is enhanced by high-speed fire support coordination through automated consideration of fire support coordination measures and the rapid dissemination of coordinating information to fire support

officers. Fire planning is improved through TACFIRE's capability to correlate bits of target intelligence and to produce targets. When the decision is made to attack a target, TACFIRE (at the division FSE) considers all fire support available; e.g., field artillery, naval, missile, and close air support and recommends the best weapons, munitions, and volume of fire to meet the commander's guidance for desired target damage. The commander is not required to enter attack criteria; however, he may modify any of the programmed criteria, such as percent of target damage required.

b. TACFIRE computers at battalion and division artillery can be used to store target lists, determine methods of attack, and prepare schedules of fires. The division artillery computer develops target lists for division artillery fire plans and allows direct support (DS) battalions to access the artillery target intelligence file to develop their own target lists. After the target list is received at the DS battalion, it is transmitted to the maneuver battalion and brigade FSEs for coordination, modified as required by the FSEs, and then computed as a schedule of fires. The division artillery computer also schedules the division artillery target list and transmits targets and schedules to the organic and attached battalions and artillery reinforcing the division artillery that will execute the division artillery fire plan. Fire commands are prepared and transmitted to the batteries, along with the schedule of fires, by the battalion TACFIRE computer. At times, battalions may perform autonomous fire planning by preparing target lists, determining methods of attack, computing schedules of fire, and preparing fire commands using their TACFIRE computers.

c. The computer at battalion or division artillery can store and hold ready for use as many as 31 fire plans simultaneously.



TACFIRE performs tactical and technical fire control.

a. At battalion, the TACFIRE computer performs both tactical and technical fire control. The forward observer prepares and transmits calls for fire with his digital message device. When the call for fire is received, the battalion computer immediately performs tactical fire direction by considering all fire units and **recommending** unit(s) to fire, munitions, and volume of fire. The computer then elevates the mission against fire support coordination measures such as unit boundaries and the coordinated fire line. When tactical fire control is completed, the computer performs technical fire control, to include fire commands, by determining firing data (deflection, fuze setting, quadrant elevation, and charge) for the **recommended** fire unit(s). If the volume of fire achievable by the available battalion fire units does not meet the commander's guidance, the computer automatically prepares a request for additional fire (RFAF). When this is done, the request for fire, any fire support coordination warnings, the initial solution (to include fire commands), and warning message (indicating that an RFAF is pending and stating the achieved and the

desired effects or volleys) are shown on a display scope located above the operator's keyboard.

b. In all cases, the fire direction officer (FDO) is required to review the initial solution. If the computer-recommended solution is unacceptable, the FDO may manually assign any fire unit, munition, and volume of fire combination he chooses and have the computer recalculate new firing data. To approve the mission, the FDO presses a button causing the computer to transmit the fire commands to the fire units, and the message to the observer.

c. At division artillery, the TACFIRE computer performs tactical fire control. The computer receives requests for additional fires from battalion computers or the division fire support element. Just as at battalion, the target is evaluated with respect to fire support coordinating measures. The computer then recommends additional unit(s), munitions, and volume of fire to attack the target, based on unit capabilities. Fire orders are then prepared for transmission to subordinate battalions. As required, requests for additional fire are transmitted to the division fire support element for analysis to determine if naval gunfire or tactical air (TACAIR) can defeat the target.

TACFIRE performs nuclear and nonnuclear target analysis.

a. Nuclear and nonnuclear target analysis is a major function of the fire support element located at the division's main command post. The division artillery computer does all processing required by the FSE. The FSE

requests and receives target analysis using its VFMED. The division artillery computer performs high explosive (HE), nuclear, and chemical target analysis and recommends to the FSE appropriate weapon systems, munitions, and volume of fire. The computer also does nuclear vulnerability analyses, nuclear fire planning, and fallout prediction and prepares effective downwind messages for manual fallout prediction.

b. Target analysis considers not only field artillery cannon delivery systems but also nonnuclear naval gunfire, all air-delivered munitions, and rockets and missiles such as Lance, Pershing, and Nike Hercules.

TACFIRE does survey computations.

TACFIRE will not reduce the time required to do the field work of survey operations, but often it may do the necessary computations. The TACFIRE computer at division artillery or battalion stores survey control point lists, transmits survey data to remote subscribers, and solves all forms of survey schemes. Survey control point data, normally entered into the TACFIRE computer from any VFMED terminal, is stored in the computer memories. This data may be transmitted to any other TACFIRE terminal upon request. Since survey personnel have no TACFIRE terminals, they share the use of the FSO's or S3's device to input or request information. They present the raw survey data or a request for information to the operator, who actually accesses the computer. The output report is then given to the survey personnel.

TACFIRE has message of interest function.

One of the most important features of TACFIRE is its ability to provide update information automatically to indicated remote terminal users, such as the FSO or FA S3, as events occur. For example, when the battalion computer receives a request for fire from a FIST chief, the computer automatically forwards a copy of the call for fire to the field artillery S3 and the FSO for whom the FIST chief works—if they are properly initialized in the FSO file. This function is done at the same time as the determination of firing data. If the S3 and the FSO remain silent, the fire direction officer allows the computer to continue with the conduct of fire. The TACFIRE computer automatic update/relay feature allows the field artillery battalion S3 to monitor all activities of the FSOs and FIST chiefs during fire planning and the conduct of fire.

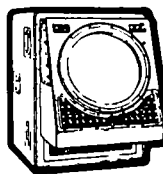
TACFIRE facilitates counterfire.

a. Counterfire (cf) is managed by the division artillery tactical operations center (DATOC). TACFIRE supports the mission of the DATOC in cf target development, cf fire planning, and engagement of cf targets. The DATOC, using the VFMED, receives targeting information from the division and corps FSEs, the target acquisition battery (TAB) assets, the division artillery aerial observers, and from subordinate battalions via the division artillery computer automatic update/relay function. If an aerial observer detects some activity of interest, he uses his

DMD to input it into the division artillery computer. The computer, depending on how it was initialized, will either automatically forward the message to the DATOC VFMED or will combine it with other reports and output an artillery target intelligence (ATI) report to the VFMED.

b. To perform cf management, the DATOC uses the division artillery computer's target combination, sorting, and retrieval functions to develop cf target lists. These target lists are then entered into a cf program stored within the division artillery computer. The program is developed and transmitted to the subordinate battalions where it is stored. Firing data is determined by the battalion computer and sent to the appropriate batteries. The program can be updated easily and rapidly by the DATOC as the situation develops.

c. TACFIRE helps implement the cf program. For example: In the defense, as the enemy approaches MBA positions, US forces are engaged by enemy indirect fire. The FIST chief prepares a very brief plain text message on his DMD indicating that he is receiving fire and the direction from which it appears to be coming. He transmits the message to the field artillery battalion computer where the FDO transmits the FIST chief's message to division artillery. The DATOC examines the report and selects cf targets from the target list. A message to fire the targets selected from the program is transmitted from the DATOC VFMED to the appropriate field artillery battalion via TACFIRE. The battalion relays the message to its batteries, which take the firing data from their TACFIRE printouts and open fire.



**ELECTRONIC
TACTICAL
DISPLAY**

TACFIRE assists in unit positioning.

a. The electronic tactical display (ETD), located at division artillery, field artillery brigade, and the corps field artillery section (FAS) is a device equipped with a circular 16-inch cathode-ray tube. This device is similar to a TV screen and depicts fire support coordination graphics, enemy and friendly units, targets, and fire unit capabilities fans.

b. The division artillery commander uses the ETD to war-game division alternative plans for the use of indirect fire weapon systems. The commander displays each plan graphically, and, by controlling fire unit locations on the scope, determines the best position for each unit to support the plans effectively. As target data and unit position updates come into the division artillery computer, they can be displayed on the ETD to give the commander the current picture. Whenever he desires, the division artillery commander or S3 can have the computer draw an overlay of the complete plan including fire support coordinating measures, units, and planned targets, using the digital plotter map.

TACFIRE has target data reporting function.

Continuous and automatic reporting of target data by the TACFIRE computer enables the division artillery commander to keep a close watch on the fight and gives him timely and accurate information on which to base decisions. The TACFIRE standing request for information feature enables agencies, such as a direct support battalion or the DATOC, to obtain targeting data simultaneously with input by the target acquisition agency.

TACFIRE is designed for interaction with new systems.

a. TACFIRE furnishes the basis for the complete integration and sending out of information developed by elements of the fire support system. This is of particular importance in view of sophisticated equipment being developed. Many of these items have been designed to interface with TACFIRE.

DEVELOPMENTAL ITEMS TACFIRE



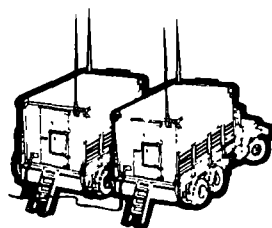
b. Developmental items that will communicate with TACFIRE include target acquisition radars AN/TPQ-36 and AN/TPQ-37, a new battery computer system (BCS), an automated met station (FAMAS), a laser rangefinder (GVLLD), and a remotely piloted vehicle (RPV). By providing a common executive system for control with which all of these will operate, TACFIRE will integrate them into an effective team. This team, through the field artillery executive system, will have the ability to interface/interoperate with other battlefield automated

executive systems such as the command and control tactical operations system (TOS) and the intelligence all-source analysis center to help provide fully integrated automation on the battlefield.

1-5. TACFIRE IN NUCLEAR AND CHEMICAL OPERATIONS

A tactical nuclear employment doctrine calls for the use of planned packages. A package consists of a discrete grouping of nuclear weapons by yield for employment in a specific area during a specific time period. Corps is the focal point for nuclear package planning. A package may consist of subpackages prepared by each division. The divisions plan aimpoints for the subpackage, update desired ground zeros with the flow of the battle, and execute on order. Upon release by the National Command Authority, the corps transmits release of the nuclear package. At corps and division, the G2, G3, and FSCoord constitute the principal advisory and action team for the preparation of the plan for nuclear weapon employment. They rely on other staff elements such as the FSE, direct air support center (DASC), air and naval gunfire liaison company (ANGLICO), engineer, division artillery TOC, and G5 to assist them in the preparation of the plan.

At division, the FSE uses the TACFIRE computer programs to identify nuclear targets, do analysis during the refinement phase, make and transmit nuclear schedules of fire, transmit warning messages, and prepare prestrike fallout predictions. The computer is also used for chemical target analysis and associated downwind hazard area reports for warning friendly elements.



DIV ARTY COMPUTER GROUP

Commander's Criteria

Before conducting nuclear target analysis (NTA), the FSE enters into the division artillery computer the corps commander's criteria for NTA.

Prehostility Subpackage Planning

Before hostilities begin, corps prepares the anticipated opposing force overlay. The G5 prepares a preclusion overlay to outline the towns, population centers, etc., to be avoided. This overlay and associated documents are made available to the divisions. The division main FSE uses its VFMED to access the division artillery computer to do nuclear target analysis for the preliminary nuclear target list. The results of the computer analysis are printed on the VFMED printer. These results include least safe distance (LSD) and minimum safe distance (MSD) per yield per target. Based upon TACFIRE determination of LSD and MSD and the manual preparation of the composite overlay, the FSE uses the VFMED to store the final nuclear target list in the division artillery TACFIRE computer's data base. The targets (aimpoints) are thus ready for instant issue to the proper firing unit.

Update of the Nuclear Subpackage Target List

As the situation changes, the division FSE uses the VFMED terminal to access the division artillery computer for NTA. TACFIRE is used by the FSE to aid in the development and analysis of new

contingency targets. The results of the analysis are printed out on the VFMED printer and specify several alternatives. Each alternative includes a munition, yield, delivery system, and new LSD and MSD data. If the FSE decides to incorporate the target into the subpackage, the TACFIRE VFMED is again used to transfer the target into the nuclear fire plan in the division artillery computer data base. The division artillery computer automatically sends an update to the corps computer. The LSD and MSD are used to update the subpackage composite overlay in the FSE. After hostilities begin and nuclear release is granted, the FSE can send out targets rapidly from the plan stored in the division artillery computer to any selected fire unit within the division's area. It can also continually update the nuclear fire plan.

Package Release and Firing

After release, the division commander, based upon the recommendation of the FSE, starts firing. The FSE, using the VFMED, instructs the division artillery computer to transmit the correct target to the chosen battalion. The nuclear fire mission warning is also issued. In the meantime, the FSE uses the division artillery computer to prepare a prestrike fallout prediction for the transmission to all FSEs and units, when required. When the battalion receives the nuclear fire mission, its TACFIRE computer prepares fire commands and transmits them to the battery and proper weapon section. The fallout prediction is received by all FSOs and batteries when it is transmitted by division artillery. The result of this activity is a vastly reduced nuclear preparation signature and greatly improved nuclear responsiveness.

Chemical Target Analysis

TACFIRE also performs chemical target analysis (CTA). The FSE uses its terminal to access the division artillery computer to

perform CTA. When chemical weapons are to be employed, the division commander specifies detailed guidance for use of chemical munitions. The FSE translates these statements into CTA criteria and enters them into the computer. For example, the division commander may state, "Do not employ any VX munitions." The FSE can then enter this criterion into the computer to prohibit the use of any VX thereafter. The FSE obtains contingency targets from the G3 and performs CTA using the division artillery computer. TACFIRE CTA determines the best weapon system and munition to meet the commander's criteria for damage. Solution of a CTA problem by the computer usually requires about 10 seconds. This speed permits war gaming many situations resulting in more effective and detailed planning for the use of chemical munitions. To complement CTA, TACFIRE prepares a downwind hazard area report for warning friendly elements. High-speed, secure communication of this report permits near immediate employment of chemical munitions by the maneuver commander.

1-6. CONTINUITY OF OPERATIONS

Continuous support of combined arms operations demands a high degree of reliability from the fire support command and control system. TACFIRE enhances this reliability because it is easily maintained at organizational level and because of a feature known as mutual support. The simple maintenance concept, coupled with the ability of one TACFIRE computer to perform its own functions as well as those of another system during mutual support operations, insures continuous command and control for the fire support system and operational continuity.

Organizational Maintenance

TACFIRE can be operated even if some of its peripheral components are down for maintenance. The system is easily maintained at organizational level because of self-tests performed under the control of **the operator**, and because its modular design allows the direct exchange of components at organizational level. The features of diagnostic programs and modularity support continuity of operations.

a. Diagnostic programs. Special programs stored within the computer's memory enable the computer to diagnose itself. These programs check components of the computer to detect and locate hardware faults. This technique defines which component has failed and what item within the component requires further evaluation by the operator. This information is printed out by the computer for the operator to use during repair procedures.



AUXILIARY
REMOVABLE
MEMORY
MEDIA
UNIT

b. Modularity. If the operator cannot repair a failed component by using spare parts from the mission essential parts kit, he can exchange that component. The use of individually removable components provides modularity for the TACFIRE computer. Modularity, in turn, enables the operator to correct most computer failures by exchanging the failed component with an operational one provided by a contact maintenance team.

Direct Support Maintenance

TACFIRE support in the division is composed of two elements: the light maintenance company and three forward support companies of the direct support maintenance (DSM) battalion, division support command (DISCOM).

a. Light maintenance company. The major DSM repair capability is in the light maintenance company. These personnel (34G) perform selected repair and replacement of components and end items using a van-mounted repair facility. Normally, the facility is located in the DISCOM area and is equipped with a battalion fire direction center (FDC) (less DPM) to allow troubleshooting, repair, and verification of items. In addition, the light maintenance company has a maintenance support team (MST) equipped with a mobile maintenance facility. The MST is capable of repairing selected components of FDCs and remote devices. Usually the MST vehicle is located in the vicinity of the division artillery FDC. The MST will respond to priorities set by the TACFIRE maintenance officer in division artillery.

b. DSM forward support company. Each DSM forward support company includes a TACFIRE forward support team (FST). Normally, the FST is located in the vicinity of the DS artillery battalion. Each FST is composed of technicians (34G) capable of locating faulty wiring, cabling, or connectors and malfunctioning circuit cards, modules, or end items within remote devices or a battalion FDC. The FST repairs VFMEDs or BDUs onsite or at the FDC as the situation dictates. If required, the FST will ask the MST for additional support.

Alternate Mode Configuration

The TACFIRE computer can be operated in an alternate mode configuration while organizational maintenance personnel diagnose and repair components. Operation in an alternate mode configuration is possible because if one component fails, the computer can be made to operate without it or its function can be assumed by a like component. The alternate mode configuration increases system reliability by allowing the computer system to operate even when some of its components are inoperable.

Mutual Support

a. Mutual support is the method employed to continue the mission in the event of normal computer (unit) displacement or a total TACFIRE computer failure. Mutual support is conducted between battalions or between division artilleries to support continuity of operations. Mutual support increases reliability and flexibility by keeping TACFIRE available during displacement or computer maintenance.

b. The mutual support data exchanged pertains to fire unit, fire mission, observers, FS coordination measures, fire planning, and communications. Once exchanged, mutual support data is updated as changes occur. This updating is accomplished automatically. For instance, when a DS battalion FDO updates a fire unit location, his computer automatically transmits a copy of the change to the mutual support battalion's computer. The reverse is also true.

c. If one of the computers is displacing or has a complete breakdown of more than one of the mass core memories, mutual support is implemented immediately. When mutual support is implemented, the remote terminals (FOs, FSOs, btry, etc.) of the displacing or failed computer communicate with and

obtain data processing services from the mutual support unit just as though it were their parent computer. When the displacing computer is again operational, its data base is updated by the mutual support unit so that it may resume control. The two units then resume automatic updating of their data bases to be ready for the next time mutual support is necessary.

d. At battalion, mutual support is having two computers exchange data with each being prepared to assume the duties of the other at any time. For example, a DS battalion and its associated reinforcing battalion may provide mutual support for each other. If the DS battalion's computer is being displaced, the reinforcing battalion's computer performs its own TACFIRE duties as well as those of the DS battalion.

e. The software for division artilleries, FA brigades, and corps FASs provides a limited

mutual support capability. When computers are fully automated, exchange of data is done the same way as in the battalion system. Normally, division artillery and its associated field artillery brigade will provide mutual support to each other.

1-7. SUMMARY

This chapter has provided an introduction to TACFIRE. The following chapters will discuss TACFIRE operations at each level from the FIST to the corps FAS. The chapters themselves are organized by level of command, but within each chapter a functional organization is used. Technical data on TACFIRE equipment, discussions of developmental items, communication charts, a glossary, and relevant references are included as appendixes.



Note: A model of TACFIRE is portrayed in figure 1-2.

CHANGES OR CORRECTIONS

Users of this manual are encouraged to submit recommended changes or comments for improvement. Comments should specify page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Forward comments to Commandant, US Army Field Artillery School, ATTN: ATSF-TD-TM, Fort Sill, Oklahoma 73503.

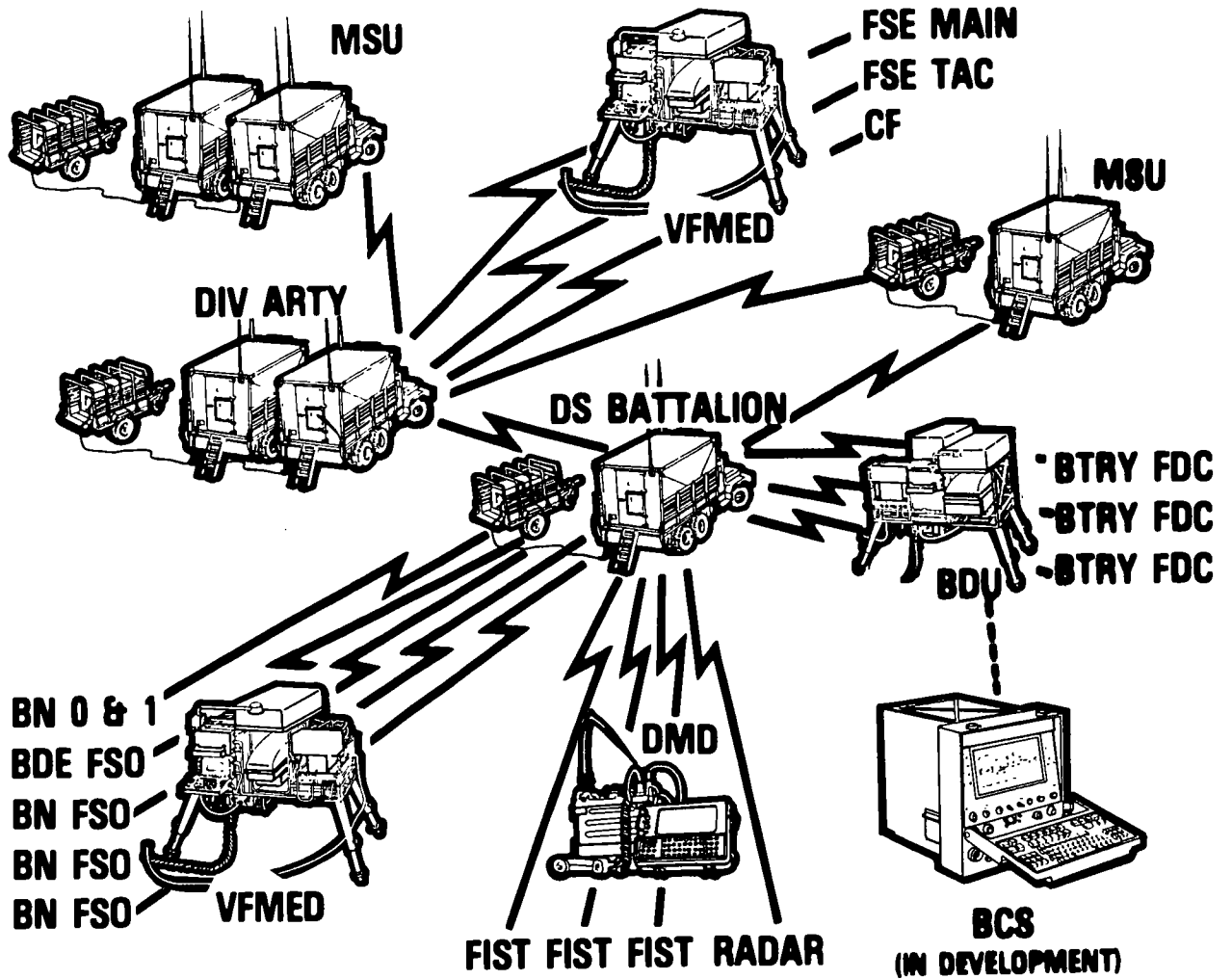


Figure 1-2. TACFIRE model.





Figure 2-1. Battery display unit in field position.

CHAPTER 2

FIELD ARTILLERY BATTALION

Section I. INTRODUCTION

The heart of the TACFIRE at the field artillery cannon battalion is the computer. The computer increases the effectiveness of the maneuver battalion fire support officer by providing more management data to make fire support more responsive. This increased effectiveness comes from the use of tactical automatic data processing. More comprehensive and rapid analysis of fire support capabilities, target data, and allocation of

fire, and safety to key installations, critical terrain, and exposed friendly troops is provided. The TACFIRE computer in cannon battalions provides for tactical and technical fire control functions. The computer is used to evaluate targets, select the units to fire, select the type and quantity of ammunition, and give the selected units the firing data they need to aim the weapons. The rocket and missile battalions will make use of the

battery computer system for technical fire control and will receive tactical fire control from the force headquarters.

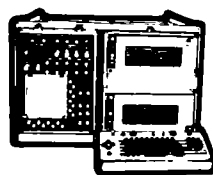
2-1. EQUIPMENT

The TACFIRE basic equipment in the battalion FDC are a main computer and peripheral equipment. The main computer and display group are housed in a shelter and normally will be operated in that configuration. The computer and display group operate with remote equipment and other TACFIRE FDCs to receive, process, display, and transmit data required to perform selected functions for field artillery operations. The field artillery battalion in the mechanized infantry division is organized and equipped with TACFIRE equipment as follows:

FA Battalion Organization	TACFIRE Equipment
Bn FDC	1 bn computer system OA-8398/GSG-10v
O&I	VFMED OA-8544/ GSG-10v
FSO (bn/bde)	4 VFMEDs OA-8544/ GSG-10v
FO/FIST (infantry company)	20 DMDs AN/PSG-2
(tank company)	8 DMDs AN/PSG-2
FA btry	3 BDUs OA-8543/ GSG-10v

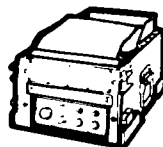
Display Equipment

Display equipment is provided to allow the personnel operating the computer to actively supervise the working of the battalion TACFIRE set.



ARTILLERY
CONTROL
CONSOLE

a. *Artillery control console (ACC).* This console is the portion of the battalion set used by the people controlling processing in the computer group. The ACC has two display scopes: one for displaying messages from external sources and results of processing and one for selection of formats and initiation of processing. The ACC is the TACFIRE device that must be checked for system functioning. The ACC is operated by the fire direction sergeant/artillery control console operator (ACCO) (E6, 13E). He is supervised by the fire direction officer (CPT, 13A) and/or the assistant S3. These personnel make decisions agreeing or disagreeing with TACFIRE solutions, operate the ACC, and insure that the system is working properly. The FDO must be physically near the console to tell the ACCO what action to take on the various messages processed. The ACCO can cause computer action, transmission of information to remote devices, and operation of other associated equipment. The ACCO is alerted to errors and violations by displayed computer warnings.



ELECTRONIC
LINE PRINTERS

b. *Electronic line printer (ELP).* The ELP provides a paper printout of the results of action accomplished by the computer. These printouts are used to review earlier computer actions and to provide copies of data stored in computer memory to interested personnel.

c. *Digital plotter map (DPM).* The DPM draws fire support coordination geometry (boundaries, frontline trace, fire coordination line (FCL), restrictive fire line (RFL), airspace coordination area (ACA), target tickmarks,

fire unit locations, and range capabilities) on standard Army maps or overlays. Also, the DPM automatically plots each fire mission received by the computer and each subsequent adjustment. This visual display of fire mission processing allows the FDO to follow mission progress. If target altitude is not given by the observer as it should be, then the DPM aids the determination of target altitude for entry at the ACC. The DPM display of boundaries is in the form of a zone of responsibility and must be input as a closed polygon; boundaries cannot be displayed without connecting the ends.

Computer Group

The equipment within the computer group is where all data processing takes place. Actions within the computer group are controlled by the ACC.



**CENTRAL
PROCESSING
UNIT**

a. Central processing unit (CPU). The CPU performs the processing, calculations, and file manipulation necessary for overall control of the system. In doing these functions, the CPU senses priorities, interrupting any lower priority program that is in progress. When a program is interrupted, information from that program is stored and retrieved upon resumption of the interrupted program. Priorities to keep the computer busy at the most important task may be pre-set in the data base or may be operator established.

b. Input/output unit (IOU). The IOU receives commands to provide data from the CPU, and in turn, passes the commands to the device that can provide the data. The IOU controls data flow to the CPU and will transfer incoming data to memory to await CPU use.

c. Mass core memory unit (MCMU). The MCMU stores programs, files, and data for use by the IOU and CPU. There are three identical MCMUs at battalion that provide a total capacity of almost 400,000 computer words. Although this capability seems enormous when compared to FADAC (field artillery digital automatic computer), it is possible to overwhelm the memory to a point where system functions are degraded. To preclude overextending the MCMUs, continuous and thorough file maintenance must be done. File maintenance at battalion should include, but not be limited to, deletion of previously fired targets no longer of interest, unnecessary fire plans, and outdated fire support coordination geometry.

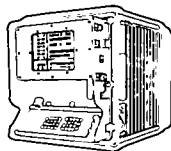
Other Devices

Also within the shelter at battalion, but not a part of the computer group or display equipment, are other computer equipment devices essential to system operation.

a. Auxiliary removable media memory (ARMM). The ARMM is used to transfer data to and from the computer group. The overall system program (data base) for battalion operation, for example, is stored on a magnetic tape cartridge. For initial startup of the battalion set, the ARMM reads and sends the data base to the computer group. During actual processing, the ARMM tape is available for reference by the computer and is also available to record working memory data currently in use; e.g., battery locations. The ACCO should periodically send all data currently in use to the ARMM tape. This technique is called a salvage point recording and gives a complete record of all data in use at the time the recording was made. If the computer should fail—"dump" all data—the ARMM salvage point recording can be used to return the computer to operation with all data available at the time of the last salvage point recording.

b. Digital data terminals (DDT). Digital communications over standard Army equipment is provided by DDTs, which are used as the computer/communication interface. All DDTs operate with a keying generator, KG-31 COMSEC device, so that battalion TACFIRE communications (except with the FIST) are not only digital but also encrypted.

COMM
CONTROL
UNIT



c. Communications control unit (CCU). Incoming and outgoing traffic over radio or wire is coordinated by the CCU. The operator of the CCU (TACFIRE equipment specialist; E5, 13E) can set up the CCU to integrate up to eight radio and wire communication nets. The computer will accept digital traffic over standard Army communication devices.

Remote Devices

Remote devices used by agencies other than battalion FDC will be discussed with the description of the operation of that agency.

2-2. TACFIRE PERSONNEL

Battalion operations section staff personnel operate the computer and display group and one remote terminal. FDC personnel operate the computer and display group from within a shelter. In the direct support field artillery battalion, two shifts of three people each are authorized. These three (CPT, FSO/assistant S3; E6, ACCO; E5, equip SP) are responsible for the overall control of TACFIRE at the battalion level. They must be alert and proficient and have an excellent knowledge of TACFIRE.

The operations element and the intelligence element share the use of a

variable format message entry device located outside the shelter and connected by wire to the computer. This VFMED allows the S3 to plan nonnuclear fires, keep up with ammunition and firing unit status, and use other computer functions. The intelligence element will use the same VFMED to request target intelligence information and for survey input to the computer. The S2/S3 VFMED will probably be legalized for a wider range of information within the computer than any other agency of the battalion.

2-3. COMMUNICATIONS

TACFIRE provides rapid, secure communication using standard Army communication equipment. The DDT and KG-31 allow digital traffic to be sent on the same nets that a battalion normally would operate. Since the TACFIRE system is a centralized battalion system, the battalion FDC must be the net control station (NCS) for all internal communication nets, including the bn cmd (FM) and bn op/F. Each digital device in TACFIRE must be connected to some standard Army communication equipment. TACFIRE equipment does not include radios; they are provided under the usual TOE line item numbers.

To begin digital traffic, the battalion FDC must establish subscribers and legalize those subscribers. Every remote terminal in the system has its own "digital call sign" or subscriber number. All of these subscriber numbers must be put into the battalion FDC set; this establishes a subscriber table. All FOs, FISTs, FSOs, and batteries are then subscribers. Not all subscribers need to enter the same type messages into the system. For example, the battalion operations section normally would enter the commander's criteria into the system and would be legalized to enter those appropriate messages. A battalion FSE, on the other hand, would normally not enter any

commander's criteria and would not be legalized to enter those messages. The computer is told which messages each subscriber is authorized to enter. This allows the FDC to control who has access to the files and programs. Setting up subscriber tables should be a matter of unit SOP. These tables can be established long before a unit is committed, stored on tape, and used when the unit begins operations.

Each digital message on a frequency is addressed to one subscriber and only that subscriber will receive and acknowledge the message. The readback technique, as used with many artillery voice messages, is not necessary with TACFIRE. Every digital message is acknowledged by the receiving station, and all TACFIRE stations must assume that the message transmitted was not received if they do not receive acknowledgement.

Although TACFIRE is not issued with radios, it is issued with communications security (COMSEC) devices for each station in the system (except observers). The system has the capability of either encoding all outgoing messages regardless of classification or only encoding classified messages. The KG-31 automatically encrypts outgoing digital messages and upon receipt at the receiving station automatically decrypts the encoded digital message. Observers do not have a means of encryption/decryption so traffic to and from the FIST, although digital, is not secure. Traffic to and from FSOs, batteries, reinforcing battalions, and division artillery is normally both digital and secure.

The battalion TACFIRE set is capable of automatic relay of selected categories of digital messages. Only limited amounts of target data can be maintained at battalion level. If the brigade FSO desires targets from division artillery and the brigade FSO is legalized to talk to division artillery, the brigade FSO can send a request to battalion

FDC and it is automatically relayed to division artillery. The automatic relay ability is not employed in all cases. In the conduct of a fire mission by voice, the FO sends the mission to the FDC and the FSO monitors in order to coordinate the mission. With TACFIRE's addressed digital traffic, the FO sends the mission only to the FDC; the FSO cannot "hear" the digital call for fire. The complete fire mission is **not** automatically relayed to the FSO. Instead, the TACFIRE at the FDC automatically generates, for the FSO, a message of interest that contains only the information the FSO needs to coordinate the mission.

2-4. INITIALIZATION

The actions required to put TACFIRE into operation are called initialization, a lengthy process that requires input of many parameters. Supplied with the computer is a master tape that enables the computer to solve ballistic and tactical problems. The master tape is generalized to the point that every battalion receives the same master tape. After loading the master, it is necessary to enter subscriber tables, legalize those subscribers, identify the general area of operations by giving map data, and establish a tactical data base. The tactical data base includes information from unit contingency plans such as fire support coordinating geometry, ammunition status (basic load), fire unit locations, and block of target numbers. In addition, information such as commander's criteria for attack methods, percent of effects desired, priority of selection of fire units, exclusion of any unit or shell/fuze combination, can be included. All of the above information is placed on a salvage point recording after initialization.

Initialization of the battalion TACFIRE to execute a previously stored contingency is accomplished easily. It consists of loading the master tape, loading the salvage point

recording, and performing checks and tests. If the planning and initialization homework have been done properly, the battalion TACFIRE can be "on the air" very rapidly.

2-5. COMMANDER'S CRITERIA

Commander's criteria are specific operational guidelines for use during the conduct of TACFIRE operations. They are crucial to the effective implementation of automatic data processing with TACFIRE. TACFIRE can help in fire planning, collation of intelligence, and tactical and technical fire control. TACFIRE provides this aid to conform with how the commander wants these things accomplished.

Commander's criteria are not just established during initialization and then forgotten. Great care must be exercised in carrying out commander's criteria because of the effect they will have on the TACFIRE solution and thus, the outcome of the battle. The master tape contains all the information available in the Joint Munitions Effectiveness Manuals (JMEM) concerning how much of what type of ammunition and the optimum number of units to fire (massed fires) for a particular target. This information enables the computer to select the best ammunition for a particular target. If the commander wants to reserve a selected ammunition for a future use, that type of guidance should be converted into commander's criteria statements and put into the computer long before the fight begins. When it has been, the computer will be able to carry out the criteria without delay in mission processing. As the situation changes, guidance will change and the commander's criteria should be changed. Moreover, commander's criteria may be manually overridden at any time an urgent situation warrants it.

Commander's criteria can be very specific. When a target of a given type is received, the computer will determine whether the target should be defeated on the basis of multiple volleys from one or more firing units or on the basis of the percent of effects desired. A hardened target, such as an OP in a bunker, normally will be selected for attack on the basis of volleys; a soft target, such as personnel in the open, normally will be selected for attack on the basis of percent casualties desired. The maximum number of volleys the computer should use in analysis before considering another firing unit can be specified in commander's criteria. Commander's criteria can also specify the percent of effects desired. The commander may influence the priority of fire mission processing by specifying his desires. If he desires that priority of fires should be to the 1-12 IN, for instance, during an operation, that parameter may be specified. Whenever a request for fire is received by TACFIRE and the target location is within the zone of the 1-12 IN, that fire request is moved to the front of the fire mission queue in the computer for the FDO's immediate review. Similar priority may be set for zone, a shell-fuze combination, or target type.

Other specific guidance that can be considered for modification includes:

- Placing batteries in priority for consideration.
- Excluding a particular battery from consideration.
- Excluding a particular ammunition type from consideration.
- Ignoring amount of ammunition on hand for a particular planning function.

All of the specific examples of commander's criteria mentioned above should be considered when following commander's guidance about how to fight in the current situation. Together, they will

make up a set of commander's criteria to use for current tactical and technical fire control.

Completely separate sets of commander's criteria can be entered into the computer for use in nonnuclear fire planning. This capability allows the conduct of current operations based upon the current situation and, at the same time, allows planning for future operations based upon projected situations.

2-6. TACTICAL AND TECHNICAL FIRE CONTROL

The battalion TACFIRE computer uses both stored commander's criteria and current ammunition/fire unit status to perform tactical and technical fire control (TTFC) to determine fire commands. The primary advantages of TACFIRE versus FADAC/manual are that TACFIRE has a high speed of operation and the ability to perform tactical fire control. With FADAC/manual, the battalion FDO had to consider an immense number of factors in a few seconds to issue a fire order. With TACFIRE, the battalion FDO only has to review the computer's fire order after it has considered all those factors for him.

Ammunition and Fire Unit (AFU) Data

The battalion TACFIRE computer maintains a file of the available fire units and data concerning each unit. This file is accessed whenever the computer is performing TTFC. At battalion, data found in this file include the following for each fire unit:

- Fire unit name; e.g., A/1/29
- Grid location
- Mission (DS, R, etc.)
- Zone of responsibility name
- Azimuth of lay

- Traverse limits
- Maximum and minimum range
- Mask data (piece-crest)
- Registration data (GFT setting per charge)
- Powder temperature
- Muzzle velocities per shell and lot
- Ammunition on hand (projectiles and weight, fuzes, propellant)
- Maximum and sustained rate of fire
- Reaction time
- Type of weapon sight; e.g., M12, M100, or bearing
- Weapon caliber
- Controlled supply rate
- Critical ammunition level

Fire Units, Munitions, and Volume of Fire

The battalion TACFIRE can control up to 15 fire units effectively. The TACFIRE computer selects fire units, munitions, and volume of fire in accordance with commander's criteria. The fire units are "ordered" 1, 2, 3, etc. for fire mission assignment according to the commander's desires. Munitions are selected by the computer from the attack methods table based upon the target description. The volume of fire is determined by the computer based upon commander's criteria or from the attack methods table. The attack methods table specifies preferred munitions in descending order of preference per target type and volume of fire to be used if no commander's criteria statement is entered. For example, if an observer has requested fire on a personnel target, the attack methods table will select type (ICM, HE/VT, HE/TI, or HE/Q) and the volume of the type selected (3 ICM). The FDO cannot alter the preferred munitions ordering as stored in the attack methods table—it is permanent. He can,

however, always change the computer recommended solution to specify his desired fire unit, munitions, and volume of fire.

Computer Warnings

a. Fire support coordinating measure violation warnings. The computer compares every incoming call for fire and every later correction to stored fire support coordination geometry. Such geometry includes:

- Coordinated fire line (no-fire line)
- No-fire area
- Zone of responsibility
- Airspace coordinated area

If firing on the target will violate any of these, the FDO is warned of this condition by the computer. This warning consists of the type of measure violated and its name. Warnings are included with the fire commands but are not transmitted to the battery. Geometry warnings alert the FDO that coordination of fire with an FSO may be necessary.

b. Fire unit capability warnings. The computer evaluates each incoming call for fire and every later correction with respect to fire unit capabilities. These capabilities include the following:

- Out of action—fire unit march ordered or silent
- Range
- Traverse limits
- Dead-space area
- Mask
- Ammunition quantity or type
- Critical ammunition level
- Controlled supply rate

If any of these are violated, the FDO is warned of which unit violates what measure. With the exception of critical ammunition level, controlled supply rate, and traverse limits, no fire commands will be prepared by the computer for a fire unit that violates these capabilities.

Request for Additional Fires

During tactical fire control processing, the computer will automatically prepare a request for additional fire whenever the volume of fire (volleys or effects) specified by commander's criteria cannot be met. This RFAF will be transmitted to a reinforcing artillery battalion if available, or to division artillery when the mission switches to fire for effect. The ability also exists for an initial request for fire to be handed off to the reinforcing battalion.

Ballistic Solution

After the computer has selected a firing unit and the munitions to be used, a ballistic solution to determine fire commands is computed. The ballistic solution used is similar in operation to a FADAC ballistic solution and includes effects of nonstandard conditions.

a. Data determined at the battery location such as muzzle velocity, powder temperature, projectile weight, and ammunition on hand must be sent to battalion by voice. Piece displacement and piece muzzle velocities for computation of special corrections must be available only at the battery level. TACFIRE does not compute piece corrections. Minimum quadrant due to masks and maximum quadrant must be sent to battalion along with the azimuth of lay and traverse limits.

b. The battalion TACFIRE digitally receives meteorological (met) information from division artillery. The met used in TACFIRE is in the same format as the

FADAC met and uses line numbers, wind direction, windspeed, temperature, and pressure. When the map model for the area of interest is inserted, TACFIRE obtains latitude for ballistic computations. Corrections manually obtained from a tabular firing table (TFT) or graphical firing table (GFT), such as drift and rotation corrections, are included on the master tape.

c. An alternate means (other than message fire commands received at the BDU) of determining firing data at the battery may be required for limited periods. When an alternate means is required, either a simplified manual system or the FADAC can be used. For either system, TACFIRE can provide registration and met data so that the alternate technical fire direction system used will apply the same corrections as TACFIRE. After registration, the TACFIRE will provide two forms of registration data—a GFT setting and registration corrections.

(1) The GFT setting message produced by TACFIRE provides an adjusted deflection, time, and elevation. This message is automatically displayed for review by the FDO and then transmitted to the registering battery. The FDO can direct that it be sent to other batteries as well. After the GFT setting message is received at the battery, the registering battery should measure the chart range and deflection to the registration point. The chart range (extracted from the initial fire commands), adjusted elevation, and adjusted time should be placed on the GFT, and the chart deflection should be compared to the adjusted deflection to determine a total deflection correction. This will allow the battery's manual system to use the same basis for corrections as TACFIRE, should an alternate means of technical fire direction be required.

(2) If the battery is equipped with FADAC, the battalion can send the

registration correction message to the registering battery. This message includes a chart range, range correction, time correction, and deflection correction. The three corrections are similar to FADAC residuals in that they reflect the correction applied **after** all effects of nonstandard conditions that were in the computer are stripped out. If a met was in the computer during the registration, effects such as those of weather, are not included in the three corrections. The deflection and time corrections provided by TACFIRE can be typed into FADAC as residuals for that charge. The range correction given must be divided by the chart range in thousands to convert it to a Range K, and then typed into FADAC for that charge.

(3) If the met message, which accurately portrays the weather at the time of registration (concurrent met), becomes available after the registration is complete, the registration corrections must be recomputed at battalion. When the residual corrections were first computed, they reflected inaccurate conditions of weather; the new, accurate met will allow accurate compensation for weather and thus, the residual corrections will be accurate. The same recomputation of residual registration corrections should be done if survey data describing the battery or registration point becomes available after the registration is complete.

(4) Registration corrections can be transferred to nonregistering batteries at battalion by entering the registering batteries registration correction message into the AFU files of the nonregistering unit.

(5) Prior to registration, GFT settings can be inferred from TACFIRE in a procedure almost identical to that used in FADAC.

d. Subsequent corrections are received by the TACFIRE computer and subjected to a

complete geometry and fire unit capabilities analysis. Subsequent fire commands are then determined. If no warnings are generated, the computer can automatically transmit the fire commands to the battery without FDO action. If any warnings are generated, the fire commands and warnings will be output to the FDO for his evaluation. This prevents subsequent adjustments from moving rounds into controlled areas. The TACFIRE computer thus insures troop safety. No subsequent fire commands that violate geometry or fire unit capabilities will be sent to the batteries by the computer without FDO approval.

e. Upon receipt of end of mission from the observer, the computer prepares an end of mission message from the fire units and a mission fired report. The mission fired report provides division artillery with a confirmed target to be included in artillery target intelligence and updates battalion and division artillery ammunition inventories.

f. Targets not numbered by VFMED operators are numbered by the computer. Both division artillery and battalion computers assign target numbers sequentially as targets are received. When an FO submits a call for fire, the computer assigns it the next number from its block. The target is then stored in its memories. At end of mission, the computer transmits this same target along with the final coordinates to division artillery via the mission fired report. In the sequential target numbering system used in TACFIRE, all target numbers consist of two letters and four numbers; e.g., AB0811. The block of target numbers to be used by the battalion TACFIRE computer must be input during initialization. The battalion and brigade FSEs may use their own blocks of target numbers when inputting targets or let the computer assign it from its block. FOs do not have the capability of assigning target numbers.

Fire Mission Processing

a. Fire missions received by battalion from any source will be processed almost entirely using digital traffic. The only voice transmissions necessary are those made by the firing unit; e.g., SHOT, SPLASH. Battalion receives calls for fire from its own observers, battalion and brigade fire support elements, and target acquisition agencies plus the div arty TOC. The FA battalion operations center originates fire missions based on target reports. The fire mission is processed by the tactical fire direction system. The preferred weapon/munition combination, volume of fire, and fire units are selected based upon predefined criteria. Fire support coordination checks are made, ballistic computations are completed, and fire commands can be received by the battery display unit. Individual piece corrections can be computed with the manual/FADAC method and individual commands can be transmitted to the guns by voice communications. Figure 2-2 shows the processing of a typical mission received from an observer. Missions originating with FSOs or div arty are processed the same way.

b. Nuclear fire missions normally are received from div arty. Prior to processing the mission for technical firing data, the battalion FDO must verify the location of the piece to fire and insure that this data is entered in the computer.

2-7. ARTILLERY TARGET INTELLIGENCE PROGRAM

The primary storage of ATI information is the div arty TACFIRE, not the battalion TACFIRE. The battalion set passes ATI reports to div arty from FOs, FSOs, or other sources after FDO review.

The battalion TACFIRE can request a div arty ATI fire search for fire planning

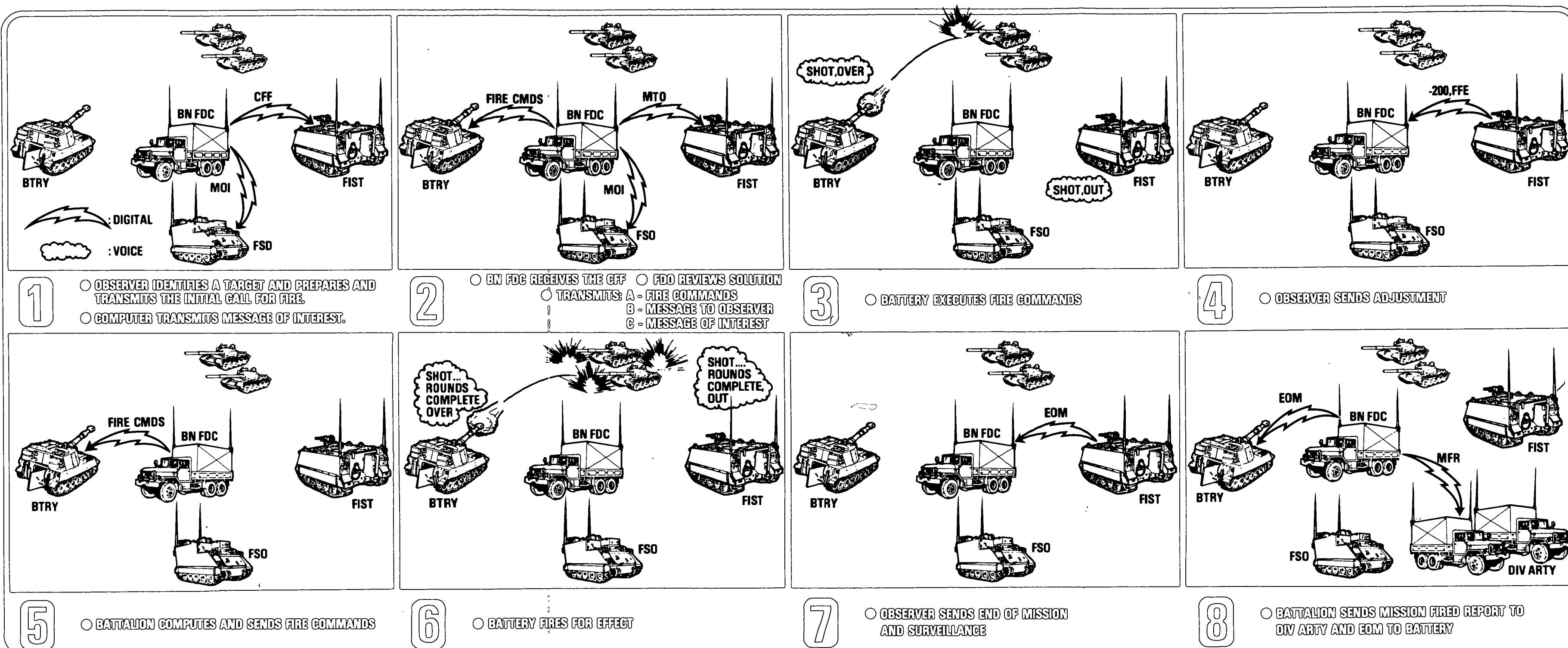


Figure 2-2. Fire mission processing (8 parts).

purposes. Target data reports that conform to a description specified in the request are extracted by the div arty computer from its ATI file and transmitted back to the requesting battalion. For example, a battalion may search the div arty ATI file for reports on heavy armor targets that are in the battalion's zone of responsibility. The div arty computer receives the request, searches its memory for armor targets within the specified zone, and returns the report to the requesting battalion.

In addition to specific search requests, the battalion TACFIRE can submit up to three standing requests for information (SRI). This function causes the div arty computer to automatically transmit to the requesting battalion all ATI reports that conform to a specified target description on a continuing basis.

2-8. SURVEY CAPABILITY

The battalion computer has two basic survey abilities: storage of known points and computation of survey schemes.

The survey function can store survey control points obtained from trig lists, ephememeris data for astronomical survey processing, and active scheme data from field measurements.

The computations available from the battalion computer include computation of azimuth and distance from coordinates, conversion of true azimuth to grid azimuth, zone-to-zone azimuth and coordinate conversion, traverse schemes, and triangulation schemes. The battalion computer can request from the div arty computer computations beyond the abilities of the battalion or files of SCPs not available at battalion.

Survey parties are not provided equipment for direct access to TACFIRE. To use the

computer, the survey party has to go to a VFMED and borrow it from its primary user. The battalion S3 or an FSO with a maneuver battalion normally are the users who could best allow the survey data to be processed.

2-9. ARTILLERY FIRE PLANNING

To support a given mission and the fire support plan, the battalion can use the TACFIRE to plan nonnuclear fires autonomously or with div arty.

The battalion can enter commander's criteria for each fire plan. If a specific set of criteria is not established for a fire plan, the computer will use the criteria in current use for processing fire missions.

Targets for inclusion in a fire plan are put into a preliminary target list. These targets can be received from div arty, put in at the battalion, or both. Targets can be retrieved from div arty by description or geographic area. The retrieval criteria will be determined by the S3 and input via the operations VFMED. After a preliminary target list has been established, the computer will consider commander's criteria and select fire units and methods of attack for each target. The DPM can be used to provide an overlay graphically depicting each target. After the preliminary target list is compiled, the targets are scheduled by the computer and fire commands are determined. Modifications to the fire plan are input using appropriate messages. The majority of the fire planning process will be performed by the S3 using his VFMED.

The FA battalion operations control who has access to the fire planning commander's criteria, targeting information, and scheduling ability of the computer by manipulation of legalizing various subscribers. It would not be normal for

maneuver battalion FSEs to be legalized for changes in commander's criteria. It would be normal for them to be legalized to obtain target lists for their sector.

Section II. DIRECT SUPPORT FA BATTALION OPERATIONS

A direct support field artillery battalion gives responsive field artillery fires in support of a maneuver brigade. The battalion operations element is the staff agency that gives the control necessary to use available field artillery resources effectively to destroy, neutralize, or suppress surface targets jeopardizing the accomplishment of the brigade mission.

The tactical fire direction system gives the battalion operations center an automated system for command and control. TACFIRE increases the effectiveness of the field artillery support to the brigade without materially affecting the command relationships or the doctrine and tactics governing employment of the direct support battalion. This increased effectiveness results from the use of tactical automatic data processing to achieve more comprehensive and timely analysis of fire support abilities, more efficient allocation of fire, and increased fire support responsiveness. TACFIRE also enables the battalion operations center to control more than three batteries effectively.

2-10. OPERATIONAL ENVIRONMENT

The battalion operations center of the direct support battalion is a part of an integrated and automated division artillery

command and control system. The principal function of the division artillery system is to provide efficient, effective, and timely command and control to all organic and supporting field artillery resources. The battalion operations center of the direct support field artillery battalion provides command and control to field artillery resources in support of the maneuver brigade.

2-11. RELATIONSHIP WITH OTHER ORGANIZATIONS AND ELEMENTS

Division Artillery

The operations center of the direct support battalion accesses the conventional and nuclear analysis and the fallout prediction capabilities of the div arty TACFIRE computer to support the fire support elements with the maneuver units. Additionally, the div arty computer system tactical data files contain operational, intelligence, and technical data. The battalion operations center may also access these files for information required to support current and future operations.

Reinforcing Field Artillery Battalion Operations Center

Tactical automatic data processing support is given by a TACFIRE identical to the tactical computer system of the direct support battalion. The battalion operations

center of the reinforcing field artillery battalion receives fire requests from the direct support battalion as well as the tactical data required for accomplishment of the reinforcing mission.

Continuity of Operations

Continuity of operations is achieved through mutual support; i.e., one battalion's TACFIRE assuming the functions of another battalion's TACFIRE. The mutual support unit assumes the functions of the down unit during displacement, computer failure, or damage to the computer. When mutual support is required, the supporting battalion continues its normal tactical mission while doing the additional functions of the supported battalion. Normally, the battalion that is reinforcing or general support reinforcing (GSR) to the direct support battalion will be its mutual support battalion. If a reinforcing battalion is not available to maintain continuity of operations, the divisional GS battalion can support one of the direct support battalions. It is not desirable to have two direct support battalions mutually supporting one another. The massive amount of data in a DS TACFIRE limits the capability of that unit to provide mutual support. If sufficient assets are not assigned or attached to division artillery to provide a mutual support unit (MSU) for each DS unit, arrangements between div arty and corps FAS should be made for corps artillery battalions to be the MSU for DS battalions. The requirement for TACFIRE mutual support should be considered when assigning tactical missions and positions. If a battalion has been specifically told to provide mutual support for another battalion, it is committed to provide the supported battalion a command and control headquarters whenever required. This commitment cannot be taken lightly; severing the link between mutually supporting battalions can severely degrade the automated advantage provided by

TACFIRE. Mutual support must be specifically addressed in the fire support paragraph of an operations order by a headquarters at the same time that standard tactical missions are assigned. It should be done on a case-by-case basis and should not be assumed as a portion of any standard tactical mission.

Fire Support Elements

The fire support elements with the maneuver forces are responsible for coordinating the use of all fire support resources available to the brigade. The fire support elements are each equipped with the variable format message entry device AN/GRC-21. The battalion operations center receives target data, friendly unit location and vulnerability data, fire support coordination data, and fire mission requests from the fire support elements. The battalion operations center automatically transmits fire mission data and fire planning data to the fire support elements as the information is processed by the tactical computer system. The brigade fire support element can query the files of div arty and battalion to obtain data required for the accomplishment of its mission. The battalion fire support elements are normally restricted to the battalion computer files.

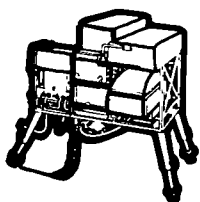


**DMD
(COMPUTER
TERMINAL)**

Fire Support Team

The FIST is equipped with the digital message device AN/PSG-2. Using the DMD, the forward observer digitally transmits fire missions, target data, forward observer location reports, and frontline trace reports to the battalion operations center. If the FO

desires to communicate the same information to a firing battery, he can have his message relayed (DMD relay) to the battery or the battery can be set up to receive the indicated information as a message of interest.



**BATTERY
DISPLAY
UNIT**

Firing Battery Fire Direction Center

The fire direction center of the firing battery receives the fire commands from battalion via the battery display unit. This receive-only piece of TACFIRE equipment initiates an automatic acknowledge, which is sent back to the computer indicating that the message be received at the BDU. Special corrections, if required, are computed with the FADAC/manual system and fire commands are relayed by voice to the firing sections. The battalion operations center can also digitally transmit the fire support coordination data, forward observer locations, target data, meteorological data, hazard and warning data, and registration data to the battery fire direction center. This information is used to manually update the charts, maps, records, and FADAC in the FDC. During decentralized operations and emergency conditions, the firing battery receives calls for fire from communications with the FO using FM voice and determines fire commands with the FADAC/manual system.

Survey Section

The survey section is responsible for establishing common survey control for all elements of the direct support field artillery battalion. The TACFIRE computer of the battalion operations center stores survey control points, performs survey computations, and digitally transmits survey control data to using organizations.

Radar Section

The weapon locating radar section is responsible for providing target locations of mortars in its area of concern. The TACFIRE computer of the battalion operations center will receive messages from the radar section, and the battalion can attack them or pass them on to the div arty TOC for attack or fire planning.

2-12. OPERATIONAL TASKS

FA Support Plan

Fire planning consists of using the battalion computer with div arty. Autonomous fire planning consists of using the battalion computer to develop a target list by entering FO/FSO targets into the computer. Later the computer is used to determine a method of attack, schedule of fires, and fire commands. After a fire plan has been prepared, the fire commands are transmitted to the batteries and printed out by the BDU. The fire plan may easily be updated prior to execution. Targets and fire units may be added or deleted and fire commands may be recalculated based upon a new met, registration, or other changes in ballistic parameters.

Commander's Guidance/Criteria

Commander's criteria are specific operational guidelines that impact on tactical fire control and fire planning. The criteria establish the volume of fire per target type, fire unit selection/ordering, and munitions or fire units to be excluded.

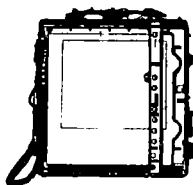
Status and Capabilities of Fire Support Resources

The battalion FDC maintains the current status and capabilities of all FA units and target acquisition resources organic and

reinforcing the direct support battalion. Status and capabilities data are maintained both visually (on maps and charts) and in the data files of the computer system. Examples of information kept on charts and maps include weapon capabilities, fire unit location, and ammunition status.

Friendly and Enemy Situation

This information must be kept manually; however, the DPM can provide overlays showing information stored in the computer.



**DIGITAL
PLOTTER MAP**

Fire Support Coordination

The battalion operations center maintains information on fallout and chemical hazard areas, air corridors, force boundaries, zone of responsibility, and fire support coordinating measures. This information is maintained on maps and in the data files.

Friendly Unit Location and Vulnerability

The location of friendly units and the vulnerability of each to fallout are reported to the div arty TOC. Reporting the data insures that the units are considered in automated fallout analyses conducted by the division FSE.

Registrations

The battalion operations center conducts registrations as dictated by the battalion SOP or by special guidance according to the tactical situation. Precision, mean-point-of-impact, high-burst, and radar registrations are conducted and the data is entered in the technical fire direction program. Registration data is disseminated to the firing batteries as corrections are determined.

Counterfire Operations

The battalion operations center supports the division counterfire effort by passing counterfire information to div arty TOC. Target data received from target acquisition agencies is evaluated only for immediate attack; counterfire information and action taken, if any, is reported to div arty TOC. The battalion operations center maintains the counterfire programs as provided by div arty TOC.

Quick Response Fire Mission Operations

The direct support battalion habitually uses quick response fire techniques in time-sensitive situations requiring responsiveness. The forward observer and other fire planning agencies plan on call fires in areas where a need is anticipated. The fire units maintain a capability for near immediate response to calls for fire on these prearranged targets.

Fire Planning

The battalion operations center retrieves target data from the div arty target intelligence files. This is accomplished by requesting target data meeting certain criteria be transmitted to the battalion computer. These requests are coordinated with the maneuver battalion and brigade FSEs to insure that all types of targets of interest are retrieved. The target data that is received is known as the preliminary target list. The maneuver battalion FSEs and brigade FSEs could receive a copy of each target that falls within their zones of responsibility when the data is received from div arty. The fire support officers consolidate target lists received from the forward observers, compare forward observer targets with those contained in the preliminary target list, and make necessary deletions, additions, and modifications. The fire support officer coordinates with the

supported maneuver battalion and identifies target priorities, phasing, and attack requirements. Upon consolidation of all requirements, the battalion operations center prepares the fire plan target list and the schedule of fires and transmits them digitally to the brigade fire support element for final coordination and approval. The ballistic data and fire commands are then computed and the fire commands digitally disseminated to the respective fire units.

Operations Under Emergency Conditions

Normal operations of the battalion operations center can be interrupted due to either a partial or complete failure of the TACFIRE computer. When partial failure occurs, reconfiguration of the computer system enables continuation of automated command and control with degraded capability. Depending on the unit SOP, partial computer failure may dictate the use of the optional technique of files transfer to the MSU. If the total system fails, automated data processing services are provided by the mutual support unit until the computer can be repaired.

Displacement Operations

During displacement of the battalion center, two alternative command and control configurations are possible: battalion level command and control can be assumed by the MSU battalion until operations are reestablished or command and control can be decentralized to battery level.

2-13. BATTALION OPERATIONS CENTER

The battalion operations center is organized into three elements to make the best use of the automated command and

control capabilities of TACFIRE. These elements are the fire direction center, the operations element, and the intelligence element.

Fire Direction Center

The fire direction center provides tactical and technical fire direction in support of current operations and tactical automatic data processing support to other organizations. This element initializes, operates, and maintains the computer. It establishes and maintains digital data and voice communications with higher, lower, and adjacent units. It also provides automatic data processing support for the operations, intelligence, and fire support sections.

a. Initialization. The operating system of the battalion TACFIRE must be initialized to render the computer system capable of accepting the dynamic tactical and technical data required for combat operations. During initialization, the fire direction center establishes the digital communication network, message and processing capabilities for all units and organizations interfacing with the battalion operations center computer, communication security authentication codes, and technical system operating parameters. The fire direction center obtains commander's criteria and other required data from the S3 and the battalion operations section. After initialization, a printout of all the initialization data is reviewed by the fire direction center and operations element for correctness.

b. Tactical data. To conduct combat operations, basic tactical data must first be entered into the system. Tactical data required includes the geographical area of interest, zones and boundaries of the supported force, fire unit operations data, ammunition basic loads, controlled

ammunition supply rates, fire support coordinating measures, and friendly unit vulnerability postures. The tactical data is entered through the joint efforts of the div arty TOC, battalion operations center, and fire support elements. Data entered by the fire direction center is obtained from the S3, the brigade operations order, and the battalion operations SOP. After the tactical data has been entered, the fire direction center prepares the graphical display on the digital plotter map. The digital plotter map display contains tactical data required for tactical and technical fire direction decisions. The data displayed includes the zones and boundaries of the brigade and maneuver battalion, fire unit locations and range fans, and the fire support coordinating measures in effect. The fire direction center prepares overlays of the tactical situation as requested by the operations element. When all tactical data is entered and preparation of graphical displays is completed, the fire direction center retrieves and prints all tactical data files and furnishes them to the operations element for validation.

c. Technical data. The fire direction center receives meteorological data digitally from the div arty computer. The data is stored for use in technical fire direction and is disseminated to the firing units. Survey control data is reviewed by the survey officer, entered into the system, and a printout of the survey files is provided to the survey officer for validation.

d. Occupation of position. The battalion operations center emplaces TACFIRE, related communication equipment, and the primary power source in an area designated by the S3. The fire direction center connects the primary power source; applies power to the TACFIRE components; establishes voice communications with higher, lower, and adjacent units; loads the master program

tape; loads the magnetic tape containing dynamic tactical and technical data; and establishes digital communications.

e. Fire mission operations. The fire direction center receives fire mission requests from its own observers, the intelligence element, the fire support elements, and the div arty TOC. Fire mission requests are automatically entered into TACFIRE. Initial target analysis is performed by the TTFC program to determine target location, assign a target number, and develop a method of attack that includes fire units, munitions, and volume of fire. Thereafter firing data is determined and fire commands are output. Not until tactical fire direction has finished processing does the computer perform technical fire control to determine firing data. After the mission request is received and printed on the digital plotter map, the fire direction officer conducts a visual assessment. TACFIRE considers target characteristics, weapons/munition effectiveness data, fire unit capabilities, and target attack parameters in preparing recommendations for units to fire, munition/fuze, and required volleys. If the fires of organic fire units are insufficient to achieve the desired effects, TACFIRE automatically prepares fire requests for additional fires for transmission to the reinforcing field artillery unit or the div arty TOC.

Upon completion of processing, the tactical fire direction system displays the initial request for fire, warning messages (why certain FUs were not selected, out-of-traverse status, met usage, and violations of fire support coordinating measures), fire commands, requests for additional fire (fire for effect missions), and message to observer (initial request). The fire direction officer reviews the recommendations and warnings and takes action, within delegated authority, to approve or

modify the fire commands, or to disapprove the original fire request. In cases involving violations of fire support coordination measures, the fire direction officer uses the digital plotter map tactical display to further evaluate the nature and extent of the violation and to determine the requirements for coordination.

f. Counterfire execution. The FDC provides automated data processing of counterfire targets from target acquisition assets. The support includes execution of counterfire missions and plans sent by division artillery.

g. Quick response fire mission operations. The fire direction center provides support to the forward observer and fire planning agencies in conducting quick response fire mission operations. When a need for fire is identified, the forward observer or fire planning agency initiates a request for immediate fire. The forward observer or fire planning agency transmits an immediate request for fire to the battalion FDC. This request is automatically processed and transmitted to the appropriate fire unit. No operator action is required at the battalion FDC.

h. Fire planning. The fire direction center provides automatic data processing support to the operations and intelligence elements and computes and transmits fire commands for a fire plan by developing a schedule of fires that includes fire units, number of rounds to be fired, ammunition type, and times for firing.

i. Survey operations. The fire direction center performs automated survey computations, stores survey control data, and disseminates survey information to higher, lower, and adjacent units. The fire direction center performs all survey support operations under the technical supervision of

the survey officer. Guidance and priority for conduct of survey operations are provided by the S3.

j. Operations under emergency conditions. When individual component failures occur, the fire direction center reconfigures TACFIRE in a degraded mode configuration and continues operations. If a computer failure occurs, automated data processing support is provided by the mutual support battalion until the computer can be returned to operation. As an alternate, the fire direction center passes tactical and technical fire direction to the firing batteries and strives to resume control as soon as practicable. The fire direction center conducts fault detection and fault isolation operations to locate the source of difficulty and conducts an aggressive preventive maintenance program to maintain all equipment in a high state of readiness.

k. Displacement operations. The fire direction center displaces in accordance with the S3's guidance and procedures in the battalion operations center SOP. In preparation for movement, the fire direction center passes responsibility for automated processing support to another predesignated battalion operations center. When the fire direction center is relocated and automatic data processing functions are resumed, the mutual support unit updates the FDC by transmitting the file data to them. When the files have been updated, the FDC will regain control of all of their subscribers.

Operations Element

The operations element is equipped with VFMED to access the data files and processing capabilities of the battalion computer system. The operations element uses TACFIRE to plan fires, maintain ammunition and fire unit status, and to stay

abreast of all changes to the tactical situation. This element provides operational data to the fire direction center and verifies that the data in the computer files is in conformance with the commander's guidance and the current situation. TACFIRE in no way reduces the responsibility of the operations element; however, the fire direction center will provide graphical support.

a. Occupation of position. The operations element emplaces the VFMED, power source, and maps and charts in an area designated by the S3. Additionally, the operations element establishes digital communications with the battalion computer system.

b. Fire planning. The operations element enters tactical data required for fire planning into the battalion computer system using the VFMED, to include guidance governing target attack and fire unit and ammunition selection. The operations element prepares the preliminary target list using the TACFIRE fire planning routine and transmits the list to the fire support officers with the maneuver battalions for

coordination. After receiving its input, the operations element, in coordination with the brigade FSO, resolves duplications and prepares the fire plan target list including target phasing, attack, and scheduling instructions. The brigade fire support officer reviews and approves the schedule of fires, and then the fire direction center computes fire commands and disseminates them to the fire units.

c. Operations under emergency and displacement conditions. If the battalion computer fails, automated processing support is assumed by the predesignated mutual support unit. If mutual support is not available, technical fire direction is decentralized to battery level. Until BCS is fielded, the FOs would have to revert to voice operations. In this case, technical fire control is decentralized to battery level.

Operations and Intelligence Section

This element uses the VFMED to receive and disseminate target data to keep abreast of the current tactical situation and provide fire planning support for the battalions.

Section III. BATTALION FIRE SUPPORT COORDINATION

A DS battalion provides fire support coordination throughout the zone of action of the supported force. To accomplish the mission, fire support elements are provided to the maneuver brigade and each of its attached battalions. Each fire support element is provided with a VFMED, which is initialized so that the battalion TACFIRE computer can provide the FSE with geometry, nonnuclear fire planning, and fire mission automatic data processing support. In addition, the brigade FSE can query the div arty files to obtain nuclear coordinating and target data. The FSEs may provide geometry information to the TACFIRE computer by updating the files for their areas of interest whenever changes occur. Additionally, the message of interest function at battalion automatically provides a copy of all messages to the FSEs that are of interest to them.

2-14. BRIGADE FIRE SUPPORT ELEMENT

The brigade FSE accesses the tactical data files of the FA battalion and div arty TACFIRE computers to obtain the tactical information required to accomplish the fire support coordination function. TACFIRE provides the brigade FSE with a digital communications interface with the maneuver battalion FSEs and with the div

arty computer. Moreover, the FSE has access to inputs from the battalion FSEs via message of interest (MOI) when so authorized.

The brigade FSO inputs (to the battalion TACFIRE) brigade coordination measures and friendly unit locations; these will be relayed to div arty. The brigade FSO, with the maneuver S3, defines the maneuver battalion zones for input to TACFIRE.

Various div arty TACFIRE functions are available to the brigade FSO to assist him in performing his mission. He can use the target analysis routines—conventional and nuclear—to evaluate fire requests, the damage assessment routines to determine damage and fallout danger to friendly units, the vulnerability analysis routine, and the div arty artillery target intelligence routine.

The brigade FSO can automatically receive messages of interest preselected by the fire direction officer. He inputs brigade level targets to the DS battalion to be included in fire plans.

The direct support battalion commander or his representative is responsible for explaining and recommending the importance of 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 the force.

2-15. BATTALION FIRE SUPPORT ELEMENT

The battalion FSE maintains communications with the DS battalion operations center, the brigade FSE, and the fire support teams. The battalion FSO, like the brigade FSO, accesses the files of the DS battalion computer to obtain tactical data to assist him in performing his fire support coordination mission. He can automatically receive copies of messages that are of value to the maneuver battalion. The DS battalion TACFIRE provides the FSO a digital communications interface with the brigade FSO.

The battalion FSO can receive copies of all fire mission requests and reports submitted by FOs in his zone. To receive copies of the indicated messages of interest, the FSO must be so designated by the computer operator. At times, the battalion FSO will be required to retransmit transmissions between the FO and DS battalion operations center using his AN/VRC-49 radio.

The FSO is responsible for updating the DS battalion TACFIRE files whenever fire support coordinating measures, unit status, or geometry changes within the maneuver battalion zone. In turn, the battalion FSE is automatically updated as changes occur due to inputs from other sources, if the FSOs are set up to receive the indicated messages of interest.

Information received from the maneuver battalion S2 is passed immediately to the DS battalion and the FSE automatically receives targeting data submitted by other agencies.

The battalion FSO is a principal participant in preparation of the direct support battalion fire plans. The FIST chief submits target lists to the maneuver battalion fire support officer through the DS battalion TACFIRE set. The battalion fire support element consolidates these target lists and resolves duplications. The battalion fire support element prepares a target list containing battalion level targets in coordination with the maneuver battalion S3. If division artillery target intelligence files are available, the battalion fire support element advises the direct support battalion S3 of maneuver battalion target search requirements. Upon receipt of the preliminary target list, the battalion fire support officer reviews the target list with the maneuver battalion S3. The battalion fire support element adds those targets from the consolidated target list prepared from input from the forward observers and battalion fire support elements. These changes and additions are forwarded to the direct support battalion digitally using the variable format message entry device. The battalion operations center of the direct support field artillery battalion completes the preliminary target list, enters scheduling and attack instructions, and transmits the final target list to the battalion FSEs and the brigade FSEs for final coordination.

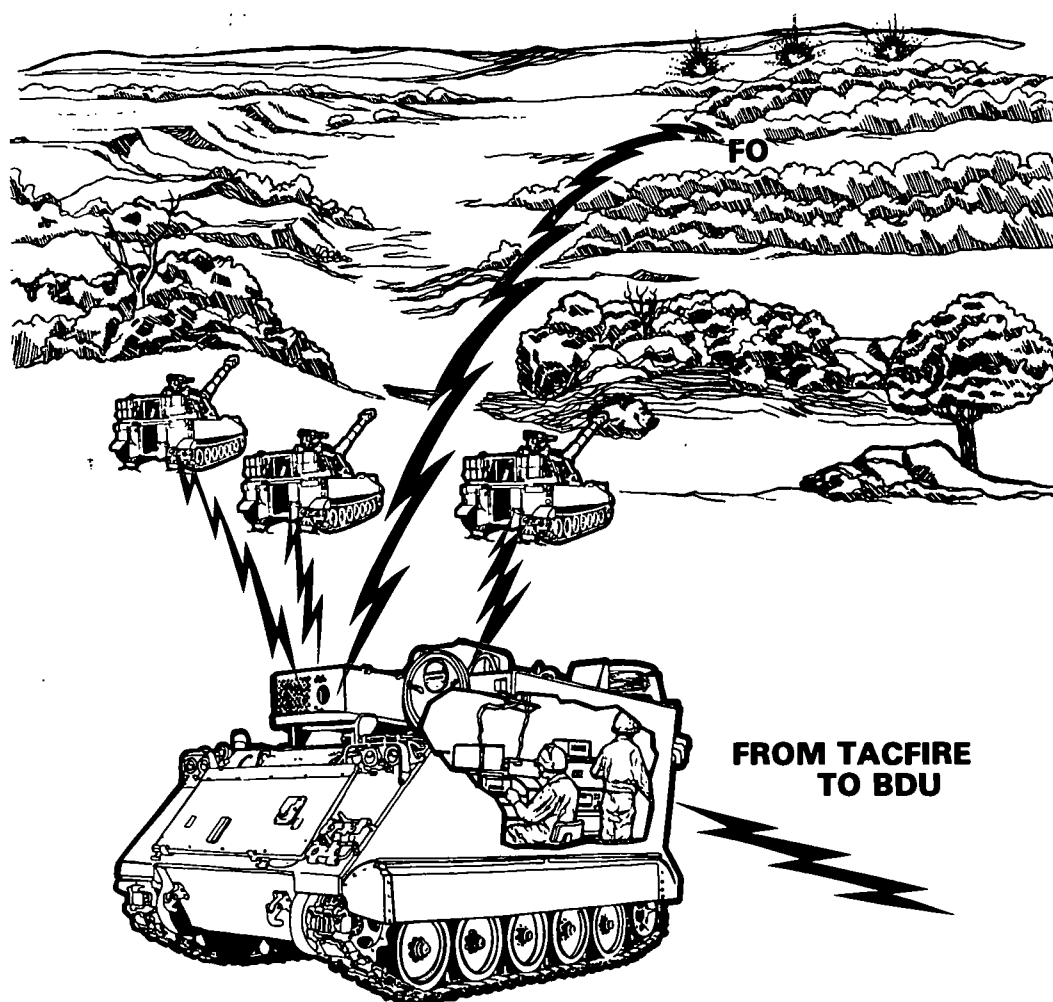


Figure 2-3. Battery display unit operations.

Section IV. FA CANNON BATTERY

The cannon battery is the basic organization for delivery of artillery firepower. The battery within TACFIRE usually receives fire commands from the battalion TACFIRE; however, the battery FDC does have the capability to receive calls for fire and produce fire commands independently by using FADAC/manual techniques.

2-16. EQUIPMENT

Battery Display Unit

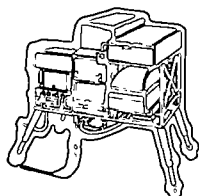
The battery display unit is the cannon battery's link with TACFIRE. Each firing battery within a TACFIRE-equipped battalion has one BDU.

FADAC/Manual Technique

The BDU will augment the equipment now in the battery FDC. The FADAC (with power) and manual equipment will be retained to allow computations at the battery level when necessary. If the BDU becomes inoperative, the battalion FDO has two options: send fire commands to the battery using voice or instruct the battery to compute the firing data using another means. The FADAC/manual technique will be used when the battery operates autonomously.

2-17. EMPLOYMENT

The BDU is usually located in the FDC, not in the BOC. Equipment in the BOC does not change from current doctrine with the exception of the battalion consisting of three 8-gun batteries which will have one BDU per firing platoon.



BATTERY
DISPLAY
UNIT

During fire mission processing, most of the mission will proceed within the digital network. Since the BDU only receives, the battery will, however, have to use voice communication to send SHOT after each adjustment and ROUNDS COMPLETE after fire for effect is executed. If the observer is on the same frequency, the battery can send SHOT directly to him—this will be the normal case. When the battery and observer are not on the same net, the battery must use a second radio on the FO's net to send SHOT and ROUNDS COMPLETE.

The BDU assists execution of fire plans by receiving and printing firing data for each

target that the battery will fire. The BDU can also receive check fire, cancel check fire, fire final protective fire (FPF), and end of mission. Plain text can be sent to the battery via BDU; for example, the S3 could tell the battery commander when reconnaissance is required, specify march routes, or send other operational messages.

After a registration is conducted, battalion can send the battery either registration corrections or adjusted data via the BDU. This will enable the battery to use the same basis for corrections as the battalion TACFIRE during the limited periods when battery technical fire direction is required. The same information can be sent when registration corrections are recomputed due to later receipt of concurrent met or survey data. The registration corrections sent by battalion will include a range correction, time correction, and deflection correction. The range correction should be converted to a Rg K by dividing by the chart range to the registration point in thousands of meters. When the Rg K has been computed at the battery, the Rg K, time correction, and deflection correction should be entered into FADAC as residuals for the shell and charge used if FADAC is the alternate means of producing firing data. The adjusted data provided by battalion can be used as a manual GFT setting if a manual system is the alternate means of producing firing data.

Upon occupation of position by a battery, the information contained in the executive officer's report (i.e., battery center grid and altitude, azimuth of lay, maximum elevation, minimum elevation, powder temperature, ammunition lots and amounts, projectile weight) must be sent to battalion. Elements are sent as soon as determined and the executive officer's report may arrive piecemeal at battalion. Since the BDU can only receive, all elements of the executive officer's report must be sent by voice or messenger.

Section V. FIST

The fire support team provides fire support coordination for the maneuver company commander. The FIST acquires and engages targets with all types of fire support means, then reports the effects of the fires delivered. The FIST chief is the company FSCoord—an adviser and planner; he advises on capabilities and limitations and plans fires to support the scheme of maneuver. The observers in the FIST report battlefield intelligence and surveillance; their reports are a key link to our picture of the fight. The FIST must be able to communicate with all supporting fire support agencies: mortar FDC, battery FDC, battalion FDC, and maneuver battalion FSE. In addition to artillery fires, the FIST must be able to provide control for close air support and naval gunfire. At division artillery, the preliminary target analysis function will select the most suitable available means to attack a target. If that tactical fire control analysis indicates either close air support or naval gunfire (NGF) as the best solution, the FIST will aid in the proper placement of the attack. In the case of close air support, the FIST will aid the forward air controller (FAC) in the delivery of airborne ordnance. When naval gunfire is used, the naval representatives at division artillery coordinate the mission with the vessels in the area that are capable of achieving the range of the target. TACFIRE provides tactical fire control for either close air support or naval gunfire; it does not have the capability of providing technical fire control for either. Further detailed description of FIST is in TC 6-20-10, *FIST*.

2-18. COMPOSITION

Personnel

a. The FIST is composed of a FIST headquarters and platoon FO parties. The FIST unifies all observer assets for overall support of the maneuver company. The FIST chief is responsible for all duties discussed in the preceding paragraph; he is the maneuver company fire support coordinator. The FIST headquarters operates much of the new sophisticated equipment described in *b* below and will coordinate the efforts of the platoon FOs.

b. Platoon FO parties are provided to insure continuous observation throughout the company zone. They contain a forward observer (E5) and a radiotelephone operator (RATELO) (E3). These personnel can call for any fire support means and their activities are controlled by the FIST chief.

Equipment

The transportation available to the FIST depends upon the type of company it supports. Platoon FO parties will depend upon the vehicles organic to the supported platoon; the FIST headquarters will have a vehicle similar to those of the supported company. For example, the FIST supporting a mech infantry company will have one forward observer vehicle (FOV), a specially configured M113A1.

a. The FIST will be equipped with vehicle position determining equipment, a laser

rangefinder, a laser target designator, and a ground/vehicle laser locator designator. These will allow the FIST to engage hard point targets with laser-guided munitions, to accurately locate area targets for fire for effect with the first rounds, and to conduct one round adjustment.

b. Both the FIST headquarters and platoon FO parties will be equipped with the digital message device. The DMD is a two-way device that allows observer interface with TACFIRE. It transmits and receives in digital bursts over any standard Army communication equipment. The DMD is a portable, battery-powered device that easily attaches to a PRC-77 or VRC-46 FM radio, AM radios, or WD-1 field wire. There are 21 formats available with the DMD that provide for digital transmission of all of the types of operational messages an observer needs to send.

observer must also estimate the target altitude and send it with the initial call for fire. Direction can be sent in the initial call for fire or with the first subsequent adjustment.

b. Shift from a known point. To use this method to locate a target requires, as a minimum, an authentication, the known point number, direction, and the shift (R/L, +/-, U/D). If any element of the shift is not given, that element will be considered as zero.

c. Polar plots. To use this method to locate a target requires that the observer's location has been previously transmitted. The minimum information necessary is an authentication, direction and distance.

2-19. CONDUCT OF FIRE MISSIONS

Most of the formats available with the DMD are concerned with processing of fire missions. Since the DMD is a two-way device, the observer can both send the fire mission and receive the message to observer digitally.

Formats Available

Formats are available for all three methods of target location.

a. Grid coordinates. Grid coordinates can be used to locate a target to the nearest 10 meters (eight-place grid). The minimum information required for sending a grid mission is an authentication and the grid, to include easting, northing, and altitude. If accuracy of the initial round is critical, the

Target Description

All formats for the initial call for fire allow the observer to provide:

- Target type and subtype.
- Strength.
- Degree of protection.
- Radius or length and width.
- Attitude.
- Requested shell/fuze.
- Method of control.

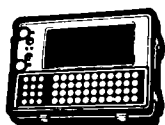
The target description should be as complete as possible in order to permit proper target analysis.

The message to observer, including the target number, will be received via the DMD.

Precision registration procedures remain the same with the DMD. The format used allows digital transmission of all adjustment situations including 2 LOT registration and destruction missions.

The DMD can also be used for HB/MPI registrations. Deviations from orienting data are reported.

Missions conducted with the laser rangefinder can be transmitted by direct interface with the DMD. Both the initial call for fire and subsequent lasings of bursts and target require direction, slant distance, and vertical angle.



**DMD
(COMPUTER
TERMINAL)**

Missions should be terminated with an EOM and surveillance report on the DMD. Good EOM reports by the FIST enable the FDO to refine volume of fire and munitions attack criteria in current use. The DMD also allows digital control of a mission by the observer by providing a format for transmissions such as CHECKFIRE, or FIRE (if in AMC status).

2-20. FIRE SUPPORT PLANNING

The role of the FIST in informal fire support planning can be facilitated by use of the DMD. TACFIRE allows the FIST to plan targets for support of the company and transmit them, via the DMD, to the maneuver battalion FSE where duplications are resolved. Even though the use of digital traffic speeds up the process, the FIST chief should not transmit a "measle sheet"—large numbers of targets; targets should be planned only where necessary. The DMD is not a secure device, targets needed hours in the future should be sent by secure means. Neither the DMD, nor any other portion of TACFIRE, is designed for use with the grid thrust line/hasty fire plan technique.

2-21. OPERATIONS AND INTELLIGENCE MESSAGES

A format is provided in the DMD for reporting observer locations and the frontline trace. There is a provision for digital transmission of FREETEXT messages; however, because of the time necessary to compose the message before transmission and because only 37 characters per message are available, the use of FREETEXT should be limited.

Reports of shelling (SHELREP) can be submitted via DMD to include grid of area shelled, direction to weapon, type of shelling, caliber, number of rounds, and time.

The DMD is also available for sound/flash (S/F) bases. The S/F base, or the FIST, can send artillery target intelligence reports with it. ATI reports include description and location by grid coordinates, geographic coordinates (latitude and longitude), or by polar plot.

2-22. DISPLACEMENT

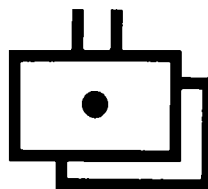
The DMD is completely portable and as long as communication is maintained, the observer can move and still use the DMD. When the FA battalion FDC displaces, the functions of that battalion TACFIRE are assumed by the mutual support battalion. If the FIST is operating with a DS battalion, normally a reinforcing battalion will be mutually supporting the DS battalion. As long as the FIST can communicate with the reinforcing battalion, the quality of FA support will not be degraded. Since there is more than one DMD per FIST, one nonoperational DMD will not put that FIST out of action.

Section VI. GENERAL SUPPORT FA BATTALION

TACFIRE provides nondivisional general support (GS) battalion operation centers with an automated system of command and control identical to the divisional battalion system. The hardware, software, and organization of the operations section are the same. As is the case with the divisional battalions, the fire direction element initializes and operates the computer, while the operations and intelligence element accesses the battalion computer with the VFMED they use on a timesharing basis.

Divisional Battalions

Divisional battalions will be included in the div arty TACFIRE command and control system when div arty is the force artillery headquarters for the division.



Nondivisional Battalions

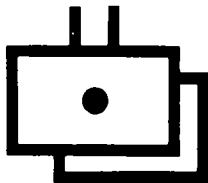
a. Nondivisional battalions may or may not be subscribers to a div arty TACFIRE system. Normally, they are attached to an FA brigade for command and control purposes. Consequently, the status or mission of the FA brigade dictates the relationship of the nondivisional battalions to the div arty TOC. When an FA brigade is attached to a division, the div arty commander recommends the assignment of a tactical mission for the FA brigade during the preparation of the division fire support plan. Any battalion assigned a mission differing from its parent FA brigade will be detached from that brigade and then become a subscriber of the appropriate force artillery TACFIRE. However, if an FA brigade is reinforcing a div arty, only the FA brigade headquarters is included as a subscriber to the div arty system; the nondivisional battalions are subscribers to the FA brigade TACFIRE. Consequently, neither div arty nor any of the divisional battalions may send a fire mission directly to a nondivisional battalion. Since the FA brigade is reinforcing div arty, the latter will send all fire requests to the FA

2-23. RELATIONSHIP WITH DIVISION ARTILLERY TOC

The battalions habitually assigned a GS/GSR mission normally provide fires in support of the force as a whole or augment the fires of close support battalions. Therein is the difference between the application of TACFIRE in GS/GSR and DS battalions. The GS/GSR fire direction center normally will receive commander's guidance or criteria from another FA headquarters—div arty, the FA brigade, or a reinforced battalion. Additionally, fire missions normally are received from force artillery headquarters and/or the reinforced battalion as opposed to FOs and FSOs. However, the GS/GSR battalion must be prepared and proficient in dealing directly with FOs and FSOs because of the requirement for the GS/GSR battalion to provide, on order, automated command and control for a close support battalion.

brigade operations center, which in turn will forward the mission to the nondivisional FA battalion it selects.

b. The corps commander should consider revising the standard tactical mission of reinforcing assigned to an FA brigade. A nonstandard reinforcing mission, included in the corps operations orders (OPORD), should preclude any misunderstanding on the part of commanders as to the intended relationships between an FA brigade and a reinforced division artillery. It may also provide for more responsive support and decrease the communications requirements within a division artillery zone should the nonstandard mission allow the FA brigade commander to subassign one or more battalions a reinforcing mission. Additionally, the nonstandard reinforcing mission should address whether or not the FA brigade and its battalions may provide MSU for div arty or its battalions.



2-24. CONTINUITY OF OPERATIONS

Divisional Battalion

The divisional GS/GSR battalion may be designated to provide mutual support for a close support battalion. The requirement should be on order from the div arty commander and written in the fire support paragraph of the division OPORD. If the GS/GSR battalion requires ADP backup, it may turn to a close support battalion. The fire support paragraph should state who will provide mutual support for the GS/GSR battalion.

Nondivisional Battalions

The nondivisional battalions may provide mutual support for each other or a divisional battalion provided the action has been coordinated and approved by the corps FA officer.

a. Division artillery may not plan on nondivisional battalions or the FA brigade to provide mutual support unless those battalions and/or brigades are attached or under the operational control of division artillery. These are the only two situations that would allow the division artillery commander to assign the mission of providing mutual support of his organic units. Under all other conditions, the corps commander retains operational control of these units and only he can assign additional missions such as mutual support.

b. The commander of the FA brigade reinforcing a division artillery may not assign his attached battalions any subsequent missions as all units inherently have the mission of the parent brigade. With the introduction of TACFIRE, the need has arisen for the fire support plan to include mutual support data to insure that whenever possible all battalions can readily exercise this capability during displacement or periods of degraded mode of operation of the system. The mission of reinforcing does not include the inherent responsibility to provide such mutual support with TACFIRE to the reinforced unit; however, it is advisable to work out such a procedure through frag orders early in a tactical operation. Mutual support between battalions attached to the FA brigade would be a matter of SOP. Because all FA battalions inherently contain the same computer capability with TACFIRE whether a close support or other battalion, an operational agreement or technique that provides for the greatest flexibility and responsiveness should be employed within the constraints of the status of the FA brigade and the tactical missions.

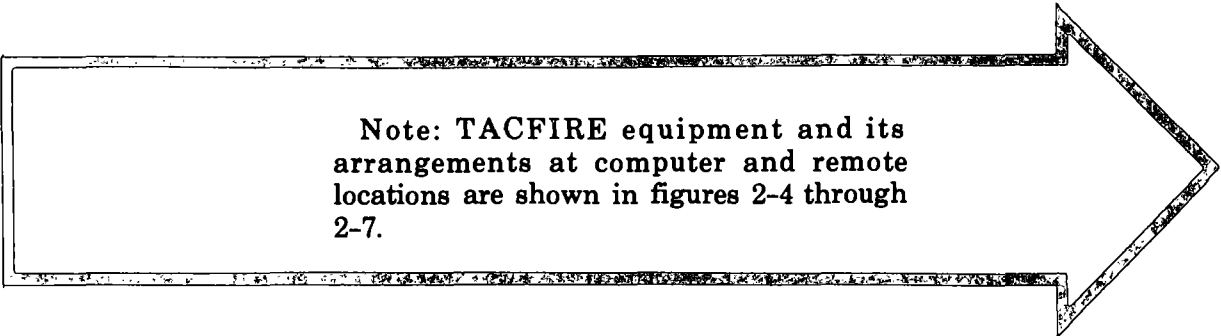
Section VII. MISSILE AND ROCKET SYSTEMS

2-25. LANCE BATTALION

Technical fire direction for Lance will be done at battery level using the battery computer system. Tactical fire control will be performed by TACFIRE at force artillery headquarters. Digital communications will be used to pass information and instructions between the force artillery headquarters, Lance battalion, FDC, and the Lance battery.

2-26. SUPPORT ROCKET SYSTEM

The general support rocket system (GSRS) battalion FDC will be the center for tactical fire control. The battery FDC with BCS will be the hub of technical fire control. Digital communication will be used to pass information and instructions between the GSRS battery, the battalion FDC, and the force artillery headquarters.



Note: TACFIRE equipment and its arrangements at computer and remote locations are shown in figures 2-4 through 2-7.

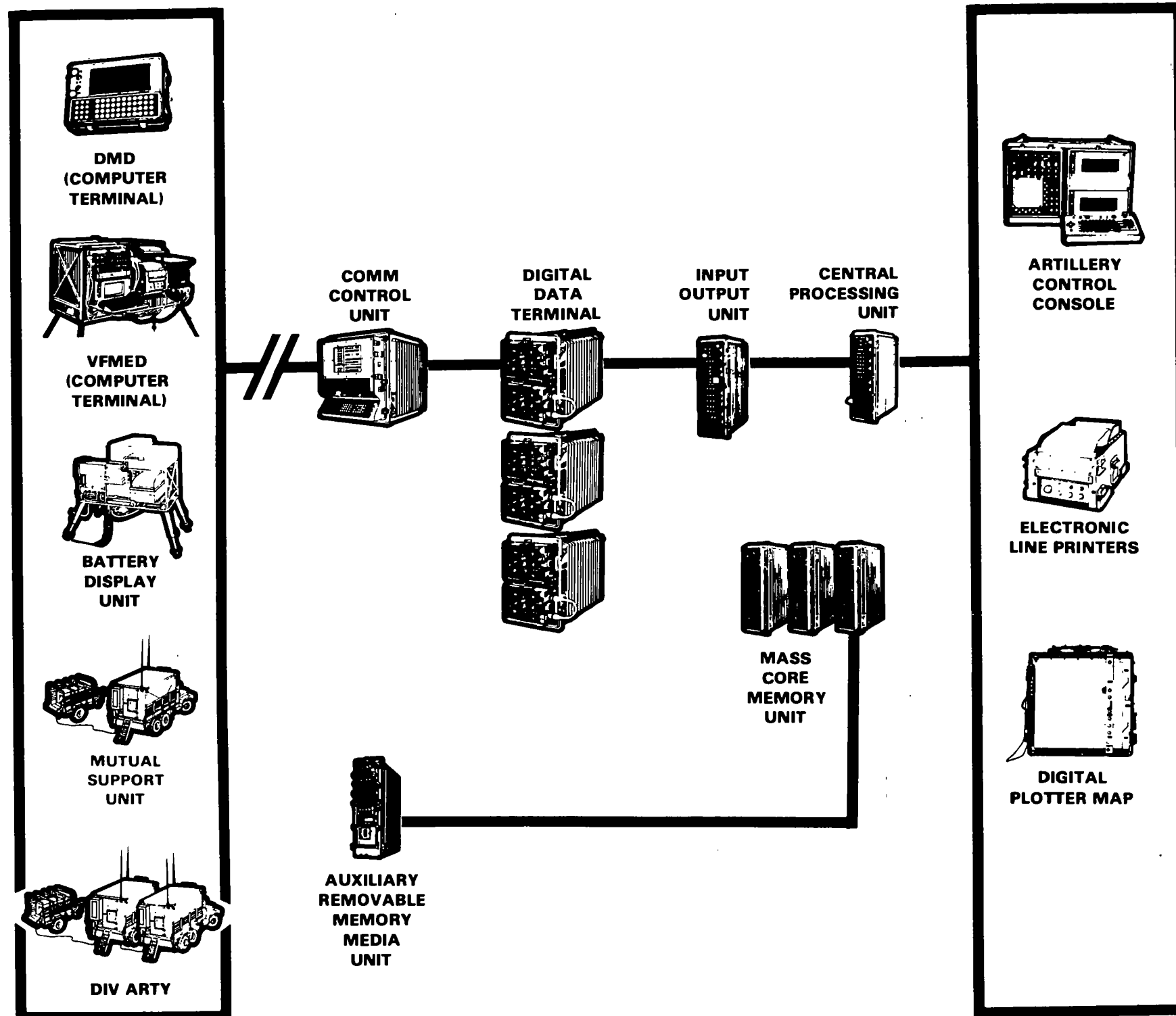


Figure 2-4. TACFIRE battalion system.

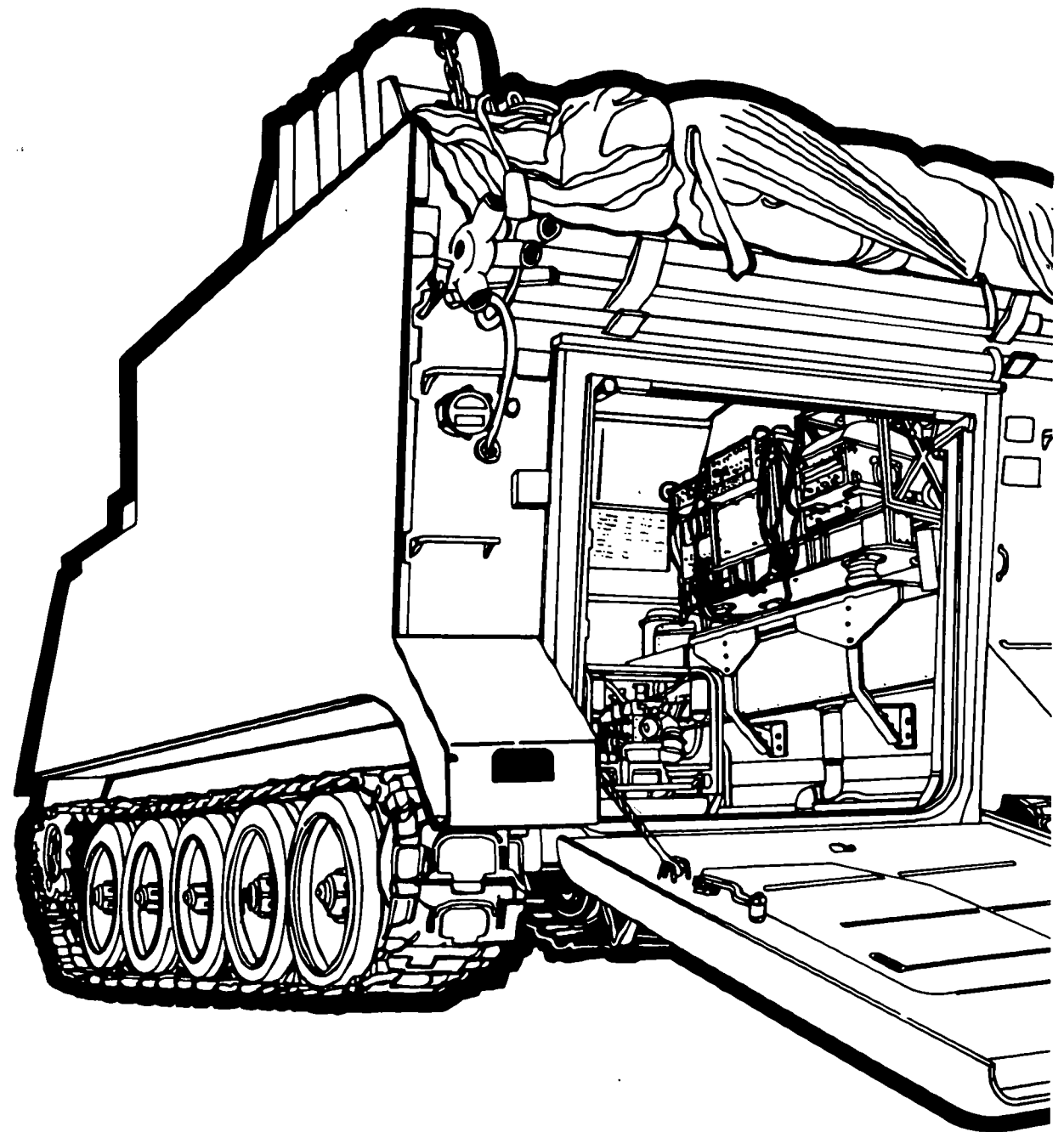


Figure 2-5. Battery display unit.

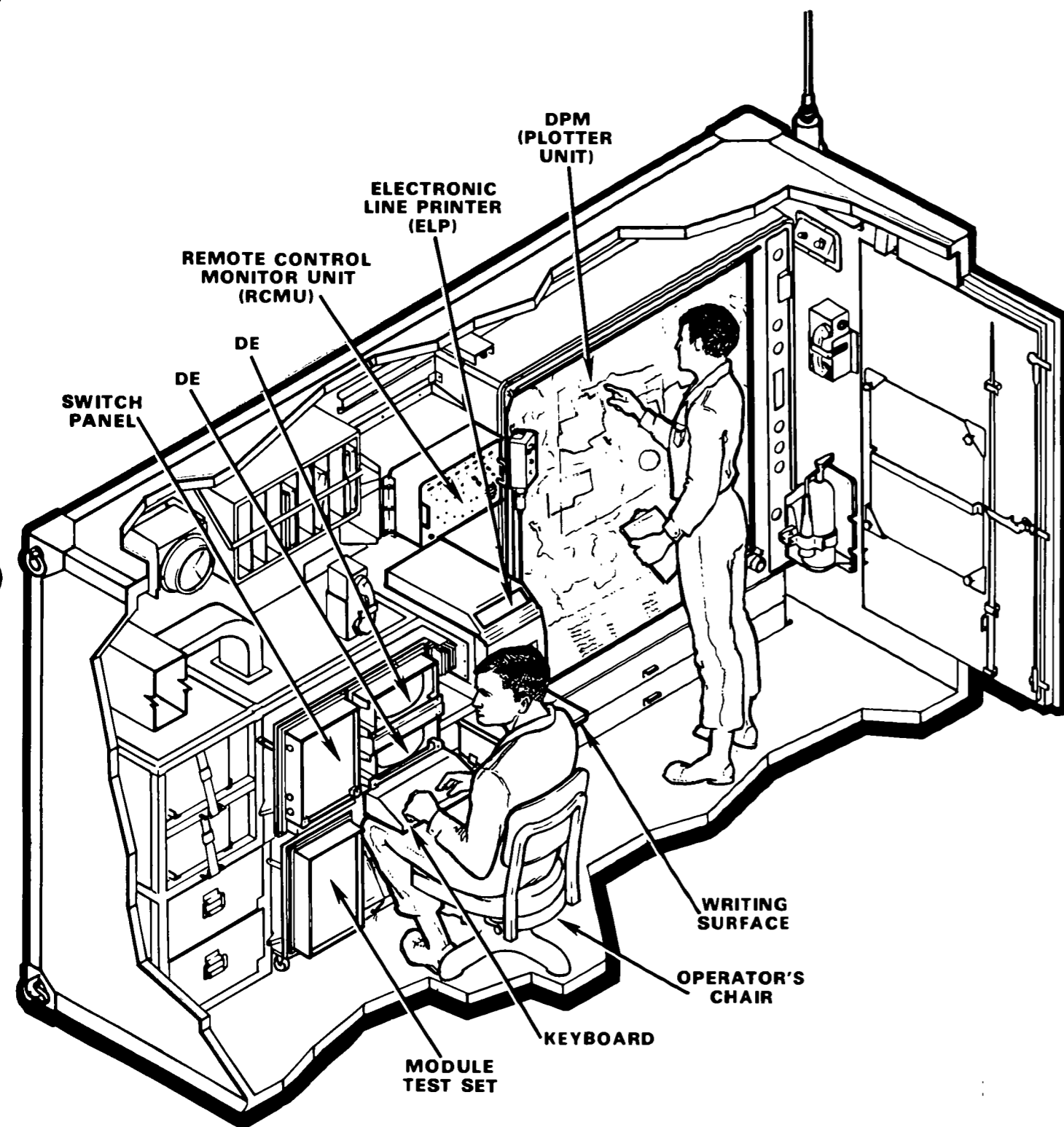
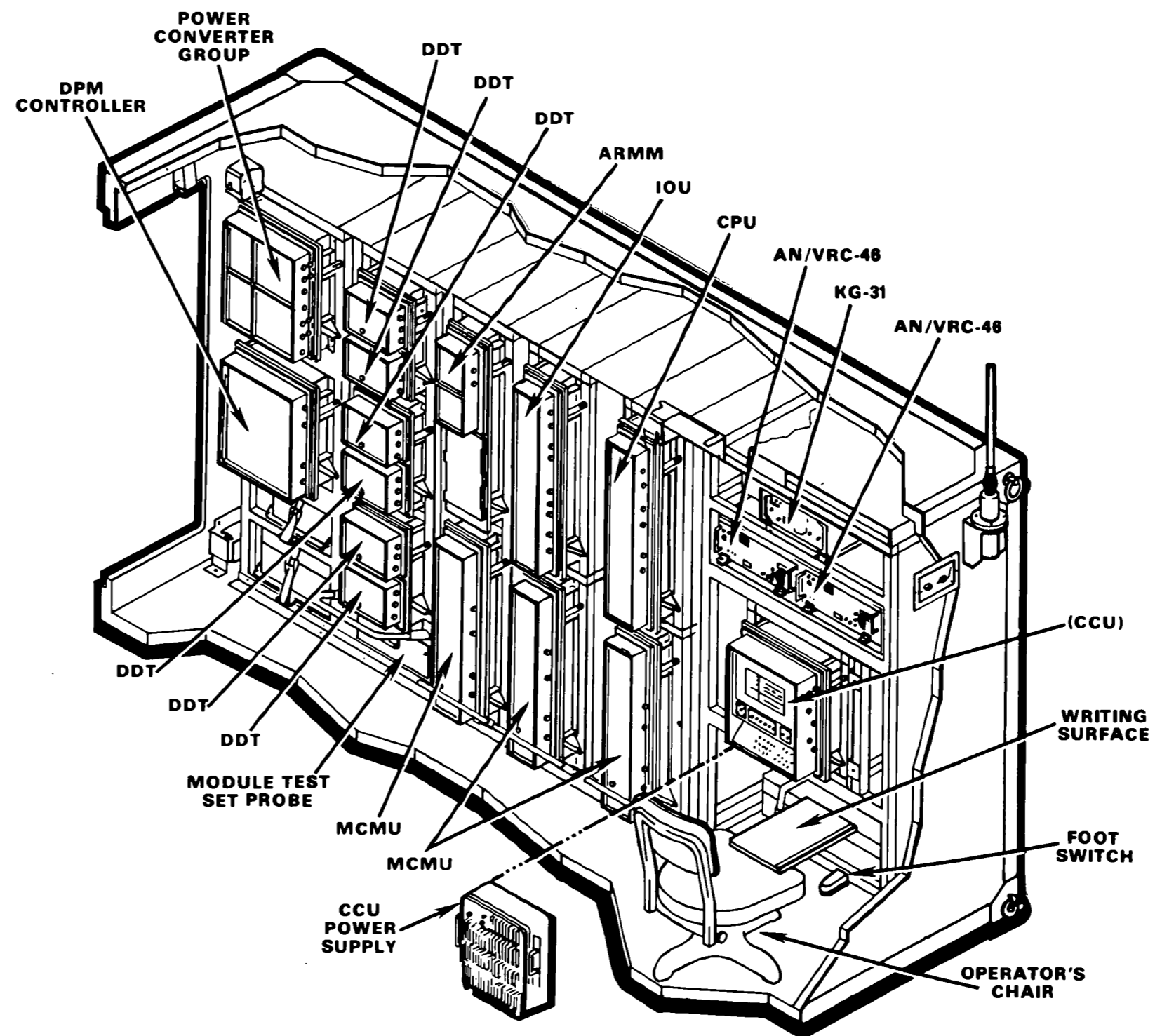


Figure 2-6. Battalion computer and display shelter.



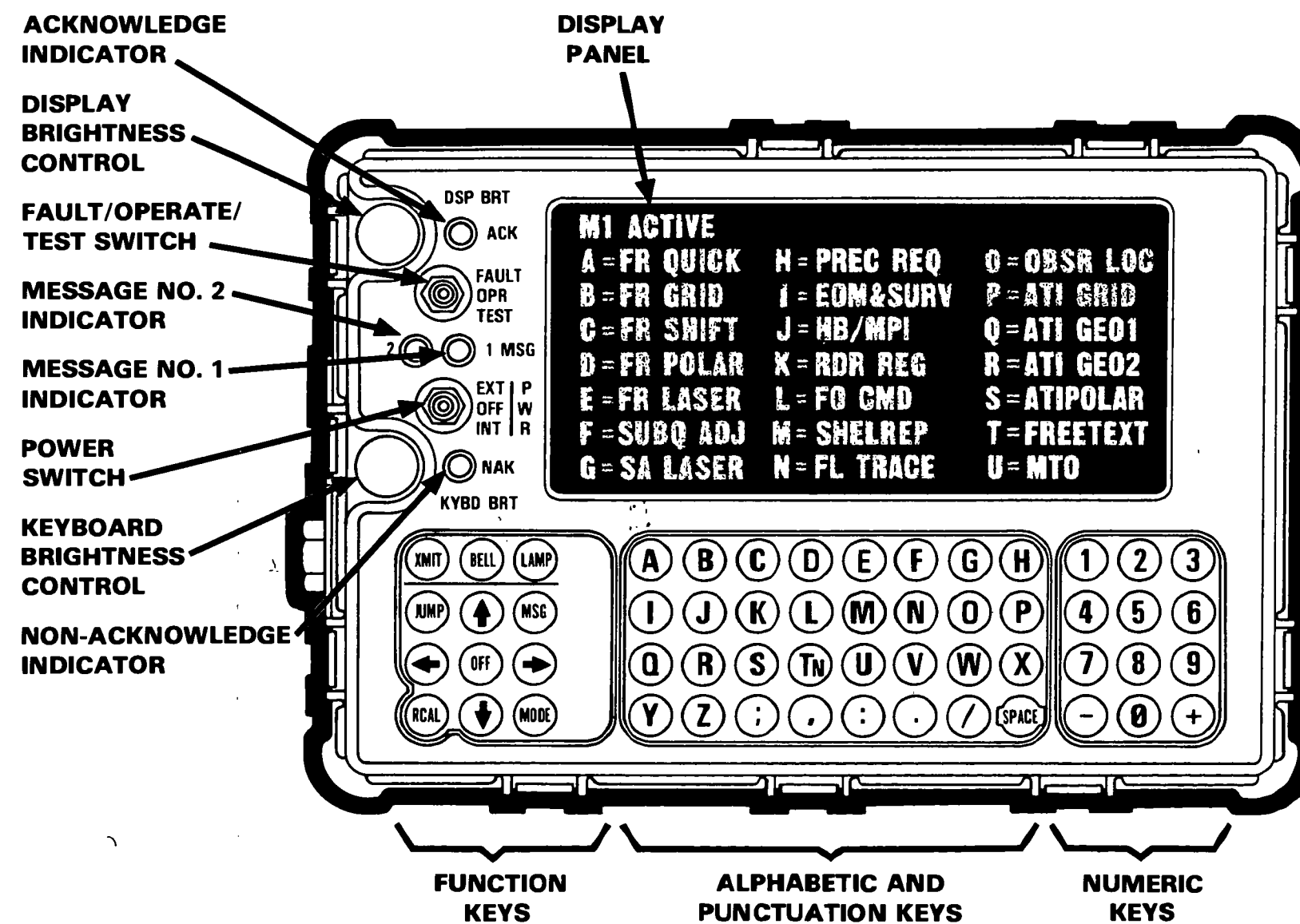


Figure 2-7. Digital message device controls and indicators.



Figure 3-1. Division artillery computer group shelter.

CHAPTER 3

DIVISION ARTILLERY

TACFIRE increases the effectiveness of field artillery support to the division without affecting the command relationships or the

doctrine and tactics governing employment of the field artillery supporting the division. This increased effectiveness comes from:

- The use of tactical automated data processing to achieve more effective use of target data.

- More comprehensive and timely analysis of fire support capabilities.

- More efficient allocation of fires.

- Increased fire support responsiveness.

- Greater safety and protection to key installations, critical terrain, and exposed friendly units.

Division artillery has the responsibility to—

- Provide the maneuver commander close support and counterfires.

- Acquire and develop targets.

- Provide for fire support planning and coordination.

- Command and control available field artillery.

- Keep the division commander informed of the capabilities of fire support assets.

The division artillery is organized and equipped with TACFIRE equipment as follows:

Division Artillery Organization	TACFIRE Equipment
Target acquisition battery	12 DMD AN/PSG-2
Aerial observer section	8 DMD AN/PSG-2
Div arty TOC	1 div arty computer system OA-8390/GSG-10V
O&I/CF	1 VFMED OA-8544/GSG-10V
FSE (Tac and Main)	2 VFMED OA-8544/GSG-10V
Liaison section	1 VFMED OA-8544/GSG-10V

Section I. TARGET ACQUISITION ASSETS

The target acquisition assets available to the division artillery include two sound/flash (S/F) platoons, the weapon locating radars and moving target locating radars of the target acquisition battery, and the aerial observers of the div arty headquarters and headquarters battery (HHB).

3-1. SOUND AND FLASH PLATOONS

Each of the two sound and flash platoons is equipped with six DMDs. One DMD is

provided to each of the four observation posts and two DMDs are located at the sound and flash central. These DMDs (12 across the division front) normally are used on the platoon net or the TAB command intelligence net. (See figure 3-2.)

The sound/flash central uses one of its DMDs to digitally communicate with and manage the platoon's S/F observation posts (OP). This digital communication includes target locations, OP target reports, surveillance of the battle area, flash rays, and shell rays. The free format message

capability of the DMD allows the OP to input administrative and operational information without regard to format. The S/F central can use its DMD to coordinate the looking azimuths of all OPs, position or reposition the OPs, and give other operational or administrative instructions. The DMDs of any of these stations can be used to input fire mission requests into a previously assigned firing unit. This normally occurs when only one OP sights the target and an accurate grid cannot be determined, or when the target is of such a fleeting nature that the use of normal reporting channels would be too slow to allow timely attack. In either case, guidelines are established to insure that these fire missions are transmitted to the direct support

battalion in zone or to a previously designated firing unit.

The second DMD in the sound/flash platoon central is used to communicate with division artillery or other supported headquarters. Normally, it is employed on the TAB command intelligence (CI) net. The platoon reports target locations, ray information, current status, and other administrative or operational messages by use of this DMD. The platoon receives cueing information, requests for registration or adjustment of friendly artillery, operations orders for current and future operations, and administrative messages from its controlling headquarters.

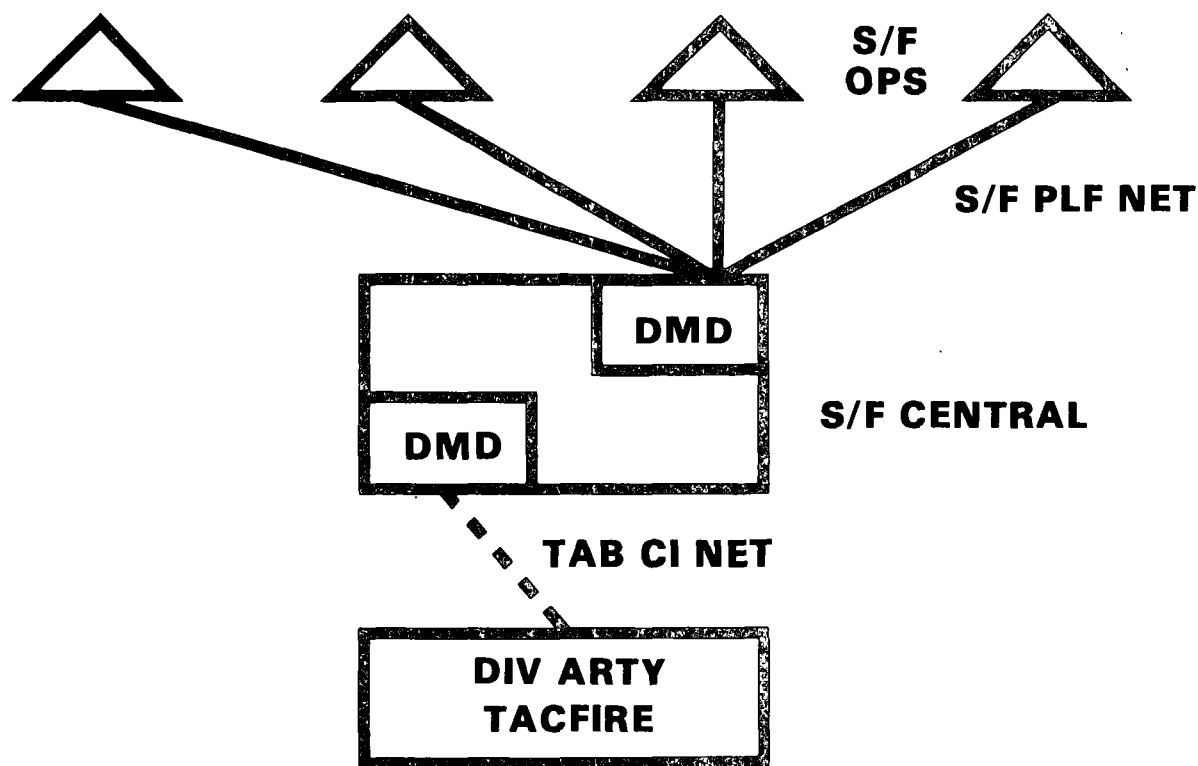


Figure 3-2. Target acquisition nets.

To maintain operations security (OPSEC), classified or sensitive messages are encoded before transmission via DMD using the free text message format.

3-2. AERIAL OBSERVERS

In the current force structure, there are eight aerial observers (AO) in the div arty headquarters battery. Each of these observers has a DMD and uses it to communicate with other TACFIRE-equipped units. The AO may be employed to cover areas that cannot be seen by ground observers. When so employed, the AO usually communicates with and works for the close support battalion in whose zone he is to observe. When on such a mission, the AO uses the DMD to perform the same functions as ground observers. These functions include conducting fire missions; reporting battlefield movements, and receiving cueing information. When employed in other missions (route reconnaissance, area security, battlefield information gathering, etc.), the AO communicates with div arty. The AO uses the standard formats in the DMD to

the maximum extent possible; but, by the nature of his missions, the AO frequently is forced to use the free text format. (When on such a mission, the AO usually will set the radio on an assigned div arty operations (FM) net or any other net specified by the operations officer.)

3-3. RADARS

The current FA radars; e.g., AN/TPS-25, AN/TPS-58, and AN/MPQ-4A, do not have the capability to interface directly with TACFIRE. These radar sections are not equipped with DMDs or other TACFIRE equipment and continue to operate with a voice only capability. When working directly for div arty, the radars will be on the TAB CI net and, when operating with an FA battalion, the radar will communicate over a net specified by the battalion commander. The nets in which the radars operate function with a mix of voice and digital traffic. FA radars fielded in the future; e.g., AN/TPQ-36 and AN/TPQ-37, will have the capability to interface with TACFIRE.

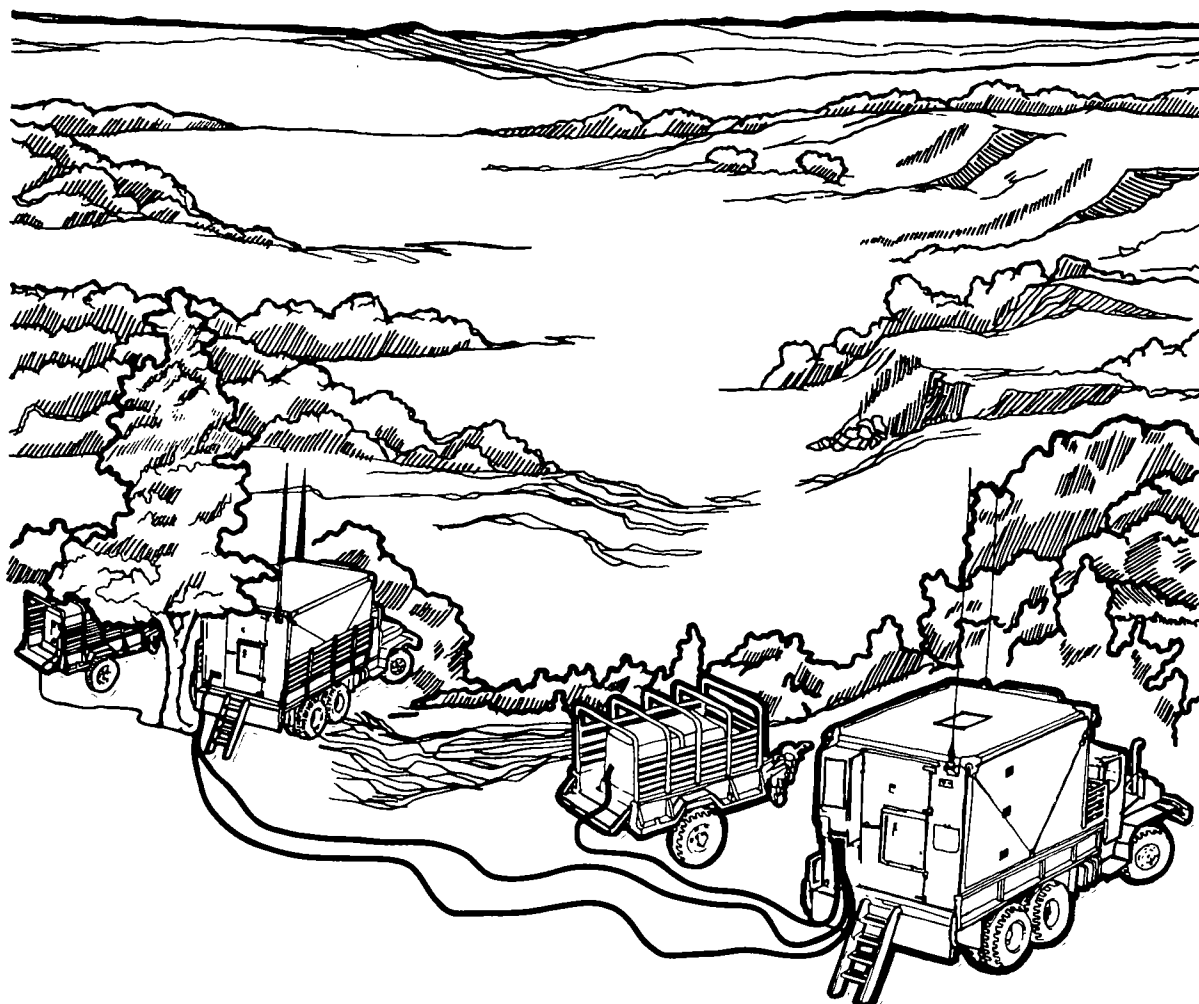


Figure 3-3. Division artillery tactical operations center in-shelter configurations.

Section II. TACTICAL OPERATIONS CENTER

3-4. FIRE CONTROL ELEMENT

The fire control element (FCE) provides the personnel to operate the div arty TACFIRE computer. FCE personnel prepare the TACFIRE computer for operation, operate the computer, and perform organizational maintenance on TACFIRE equipment. The fire direction officer supervises the FCE, insures engagement of targets, coordinates target engagement with the counterfire

officer (CFO), and has FCE personnel use the digital plotter to prepare overlays and electronic tactical display to show fire control information graphically. Specifically, the FCE performs the following functions:

Initialization of the Computer

The div arty computer must be initialized to render the computer capable of accepting tactical and technical data required for combat operations. During initialization, the FCE—

Establishes the digital communications with higher, lower, adjacent, and mutual support units.

Enters div arty's block of target numbers.

Establishes which units and organizations can use the computer and their operating nets.

Enters the application program data into the computer.

Inputs the communication security authentication codes to be used.

Establishes technical system operating parameters; e.g., commander's guidance on the percent of casualties to be achieved when attacking counterfire targets.

The FCE obtains the required data for initializing the computer from guidance provided by the div arty commander, S3, operations officer, FSEs (Tac and Main), and from the div arty operations SOP. After the computer has been initialized, the fire control element prepares the graphical display on the digital plotter map and the electronic tactical display. The data displayed can include the zones (boundaries) of the division and the maneuver brigades, fire unit locations and range fans, and the coordination measures in effect. Care must be used in the selection of data to be displayed on the ETD because the screen may become cluttered, making interpretation difficult. The FCE prepares overlays of the tactical situation displaying target arrays and targeting data for the target production element and other information as requested by the operations element. Upon completion of initialization and preparation of the graphical displays, the FCE will print the required tactical data files and provide them to the operations and targeting elements for validation.

Target Numbering

TACFIRE target numbering uses six characters in a target number (two letters and four numbers). When an FO, FSO, FDE, etc., assigns a target number for use in TACFIRE, he must always use six characters; e.g., AY0142. The div arty computer will automatically assign an appropriate target number from the div arty block to any target that arrives at the computer without one.

Fire Support Coordination

Although the fire control element is not a fire support coordination agency, the FCE will insure compliance with approved fire support coordination measures and assure the safety of friendly personnel from artillery fires. In processing fire requests from higher headquarters, div arty's own observers, adjacent units, and subordinate units, the electronic tactical display (ETD) automatically shows each fire mission received by the computer. This provides a visual display of the relative location of the target to fire support geometry.

In addition, the computer provides the operators with warnings when a measure is violated. The warning alerts the operators to the need for coordination by identifying the measure violated; e.g., coordinated fire line (CFL), boundary, or NFA and the unit with which coordination is required. (Airspace coordination area violations cannot be detected by the div arty computer.) Coordination within the supported division's zone is improved because the computer automatically provides warnings to the appropriate FSO of a fire mission on a target located in its zone of responsibility. (This can be accomplished by suitable entries in the FSO file.) FSE personnel must plot the target and obtain clearance if a fire support coordination measure is violated.

The fire direction officer at div arty will not engage a target unless engagement rules

allow firing, and coordination is accomplished. Should the target be located in an adjacent division zone, the computer automatically sends the fire mission to the VFMED-equipped liaison officer (LO). (This situation assumes that the LO is "legalized" and the adjacent division's geometry is in the computer.) The liaison officer effects fire support coordination with the adjacent division artillery.

Tactical Fire Direction

The division artillery computer performs tactical fire direction when requests for additional fire are received from subordinate or adjacent field artillery units (battalions or brigade). Tactical fire direction is initiated when computer action is taken on recommendations for fire generated by the artillery target intelligence program, or automatically when requests for FA fires are received from fire support elements. In processing the requests, the computer determines the method of attack in accordance with the commander's criteria and then transmits fire orders to the battalions (or FA brigade) after review by the fire direction officer.

The method of attack is determined by computer analysis of the target and fire unit capability, selection of fire unit, and allocation of ammunition by type and quantity to engage the target with the desired effects. If additional fire is needed beyond the division artillery's capability, the computer prepares a request for additional fire addressed to the division FSE for attack by other fire support means. A request may be addressed to the corps FAS for assistance in attacking the target with corps artillery assets.

a. Commander's criteria for tactical fire direction. The artillery commander or his designated representative must consider certain factors when deciding to attack a target. Commander's criteria are specific

items of data that allow the commander to exercise experience factors in control of fire units and ammunition for attack of targets and to comply with specific fire support requirements assigned by the division commander or his representative. Commander's criteria allow the override of the computer's stored default tables (JMEM). Some of the basic items of data within the computer that can be changed by the commander are:

(1) Ignore ammunition levels (IGAMMO). The computer will not check the ammunition status for each fire unit; therefore, during the target analysis, an unrestricted choice of ammunition is allowed. Generally, IGAMMO is used for future fire planning such as a prep or counterprep where it is desired that the initial schedule be computed without regard to actual ammunition on hand.

(2) Maximum battalion (MAX BN). The basic number of battalions the computer will consider, without modification, to fire on one target is three. This number may be increased or decreased; however, the change pertains to all types of targets.

(3) Exclusion of fire unit, weapon, ammunition or fuze (XCLU). This allows the commander to specify fire units, entire weapon calibers, and munitions to be excluded from analysis. Because TACFIRE will always use the best ammunition capable of achieving the desired degree of destruction against personnel targets with a minimum of ammunition expenditure, it normally will choose improved conventional munitions (ICM). If ICM is scarce, it may be necessary to limit the selection of ICM and use it only sparingly by manual override.

(4) Fire unit ordering (FUSEL). The computer determines the priority in which battalions are considered for target engagement based upon a weighting factor. This is established by considering the zone of responsibility (ZOR) of the battalion

(determined by the assigned tactical mission), an assigned battalion ordering number (commander's criteria input capability), and the battalion's tactical mission.

(5) Effects cutoff (ECOF). The effects cutoff is considered for a battalion firing alone. If additional effects achieved by adding a subsequent volley for a battalion's fire units are less than the effects cutoff factor, the effects computation is terminated for that battalion. The cutoff factor in the computer, unless modified, is 1 percent casualties/destruction per volley.

(6) Maximum volleys (MAX VOL). If ammunition expenditures, per fire unit, are to be limited, it may be desirable to reduce the maximum volleys from six (base data). When maximum volleys are reduced, no fire unit will be assigned more than the number specified. For example, if a maximum of three volleys is entered for 155-mm weapons, TACFIRE will assign no 155-mm battalion more than three volleys on any target.

(7) Desired percentage effects (EFF). The computer uses a default value of 10 percent effects for nonnuclear target attack. For any given nonnuclear effects target type/subtype, this figure may be changed by commander's criteria if the situation warrants it. Computer analysis determines the effects that can be achieved by the first choice fire unit using the most preferred ammunition available in that unit. The computer determines how many volleys are required, without exceeding maximum volleys established, while computing reduced effects being achieved by each volley after the first. If the initial fire unit cannot achieve the desired effects, another fire unit is analyzed; if it cannot achieve the desired effects, the capabilities of the previously considered units are combined. Other fire units are considered and assigned to the target as required to achieve the desired effects.

(8) Maneuver commander's guidance. The division commander's guidance, when

possible, is translated into TACFIRE terms and input into the computer. For example, the division commander has stated that for the attack, the 3d Brigade is to receive priority of fire support. This cannot be translated entirely into TACFIRE language; however, the tactical missions, controlled supply rate (CSR), artillery positions, etc., to accomplish this task can be input into the computer. When the DS battalion supporting the 2d Brigade submits an RFAF to div arty and the DS battalion supporting the 3d Brigade also submits an RFAF, the computer will process the first mission received. The operations officer must note that there are two fire missions in queue in the computer, cycle through the missions, and process the request supporting the 3d Brigade first. Although TACFIRE will develop fire orders based on data in the computer, the fire direction officer is not relieved of his responsibility, since unanticipated targets and technical limitations of TACFIRE will produce situations that require his individual attention.

b. Method of engagement, control, and adjustment. Div arty's fire order (RFAF) to the battalion(s) normally will not contain control instructions. Therefore the battalion(s) FDO will fire for effect when ready. It is thus necessary for the div arty fire direction officer to manually enter fire for effect control data into the RFAF message if an adjustment is to take place. If adjustment of fire is required, the div arty must provide the battalion with the necessary information to allow it to contact the adjusting unit; e.g., FO or AO, directly. If surprise massed fire is desired, div arty must also manually input time on target (TOT) control instructions into the RFAF message.

c. Request for additional fires. If div arty cannot achieve the effects desired, a request for additional fires will be generated by the computer for transmission to the Tac FSE or by readdressing to corps FAS. The request will include the effects div arty will achieve,

the effects div arty wants corps FAS or the FSE to achieve, and all available data pertaining to the target to allow the requested agency to analyze the target.

d. Mission fired reports. The div arty computer is not involved directly in end of mission processing. When the assigned battalion(s) completes its mission, it generates and transmits a mission fired report to div arty. This report updates the fire unit ammunition status and the artillery target intelligence files at div arty. The report will be automatically transmitted to the FSEs, corps FAS, and the liaison section, provided they have been initialized with the computer through a message of interest entry.

Automatic Data Processing Support to Subordinate Units

The div arty computer provides ADP support to its subordinate battalions and their FSOs, the Tac and Main FSEs, the targeting/operations elements, and the liaison section. The ADP provided each subordinate is as follows:

a. Subordinate battalions are provided access to the artillery target intelligence files for field artillery fire planning, and to the survey files for assembly; conversion functions, combined traverse, adjustment, and quadrilateral scheme computations.

b. FSOs at maneuver battalion and brigade may be allowed to extract targets that have been reported in their zones of responsibility and stored in the div arty computer. This service may be provided on a recurring basis as a result of a standing request for information or on a one-time basis as a result of a file query. Information the FSO may need about the status of a fire unit to allow him to plan fire support for his maneuver unit may also be provided on request. Normally, brigade FSOs are allowed access to the computer for single nuclear

target analysis, nuclear vulnerability analysis, fallout prediction, and preliminary target analysis.

c. The FSE at the division main and tactical command posts use the computer at div arty to search the ATI files for development of target lists and fire support planning and for target analysis to determine the most appropriate fire support system to assign to attack the targets. Both FSEs use ADP services provided by the computer to receive situation reports and reports of fire unit status and capabilities. The main FSE also uses computer processing for nuclear target analysis, fire planning, nuclear and chemical vulnerability analysis, and fallout prediction.

d. The computer, in providing support to the targeting/operations elements, receives and stores ATI reports, recommends target combination, generates target buildup warnings, generates a fire mission when an incoming intelligence report meets commander's criteria, searches the ATI files to extract targets, solves SHELREPs, determines method of target attack, prepares schedules of fire, provides fire unit status and capabilities data, reports friendly and enemy situations, and maintains ammunition accounting.

e. The liaison section is provided fire unit status and capabilities of the div arty, current and planned geometry, and targeting information.

3-5. TARGETING ELEMENT

The targeting element's primary responsibility is the production of valid artillery targets through the collection, processing, and dissemination of targeting information. The targeting element is supervised by the counterfire officer and is

organized into two shifts for 24-hour operation.

Initialization for Artillery Target Intelligence Programs

To perform the functions of the targeting element with TACFIRE, the artillery target intelligence program in the computer is initialized for the current situation (both friendly and enemy) and the commander's guidance for target selection, production, and attack. The target element provides the operations officer the criteria required to initialize the computer for the current operation. Some of these criteria are:

a. What output messages are needed in hard copy for analysis.

b. What standing requests for information are required to insure adequate information output at the counterfire VFMED (CF VFMED).

c. The number of targets in a given area that constitute a target buildup.

d. What target data inputs should automatically generate a fire mission without further analysis.

e. How similar two or more reports must be in location, type, and description before they should be considered one target rather than individual targets in the same area.

These criteria are changing in nature and must be constantly reevaluated in light of the current friendly target acquisition capabilities and the enemy deception measures and tactics. Failure to maintain the proper criteria for the current situation will result in lost opportunities for attack of enemy units and incorrect evaluation of intelligence reports.

Targeting With the Artillery Intelligence Program

The targeting element is relieved of some of the manual bookkeeping functions by the TACFIRE computer and is given capabilities not previously available. TACFIRE allows the targeting element to deal with masses of targeting information effectively using a minimum amount of time per piece of information. It eliminates the requirements for the targeting element to maintain a manually written target file and the ray overlay on the targeting map. The TACFIRE computer maintains a target file in the computer and performs ray analysis for both SHELREP ray intersections and correlates SHELREP ray and coordinate reports. The TACFIRE computer also alerts the targeting element to buildups of targets, recommends the combination of multiple reports on the same target, and automatically passes targets of sufficiently high quality directly to the fire control element with a recommendation for a fire mission. If so initialized, TACFIRE will not process incoming reports that are too old to be of use in the current situation.

These computer capabilities do not change the duties and responsibilities of targeting element personnel but merely aid in the performance of the targeting mission. The targeting element personnel are still required to use judgment and knowledge in the processing of target information. They must perform terrain analysis to refine targeting data for maximum effect on the target and use their knowledge of enemy doctrine, order of battle, and the situation to properly cue target acquisition assets to critical areas of the battlefield. The targeting element, because of TACFIRE's immediate data flow, can instantly key on target buildups, distribution of incoming targets, and surveillance reports and determine the need for repositioning of FA assets.

Example of Capabilities of Computer

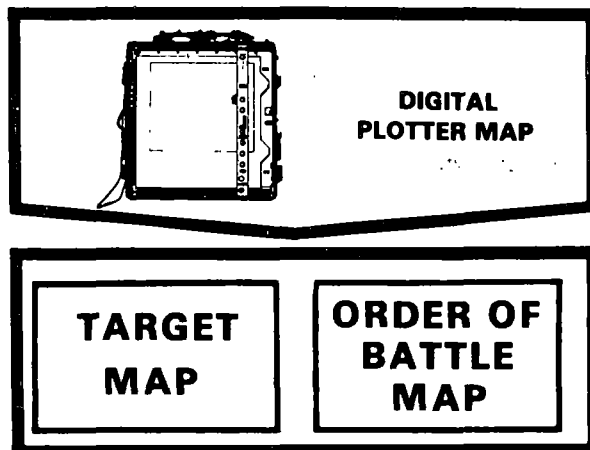
The CF VFMED prints out a recommendation for combination of two target reports 400 meters apart. Both reports describe the target as a 130-mm gun battery, and a new grid is recommended for the solution of these two targets. The targeting personnel must use their knowledge of enemy FA employment doctrine and terrain analysis to verify that the solution grid is a logical location for a 130-mm gun battery at this stage of the battle. If the targeting personnel determine that the computer solution is not suitable for a battery position, they may enter the most logical grid for this battery.

This is not the end of the responsibilities of the targeting personnel. Knowing that 130-mm gun battalions employ their batteries approximately 1,000 meters apart, the targeting element, using TACFIRE, would cue target acquisition assets to the area and request additional intelligence from the division FSE and corps FAS. If rapid attack of this battalion is determined to be critical, the location of the other two batteries could be determined by target prediction based on terrain analysis and knowledge of the current tactics. The machine only performs the basic analysis; the targeting personnel perform the detailed analysis and seek additional intelligence in order to complete the analysis.

Targeting Element Maps

The targeting element maintains two maps of the division zone, the target map and the order of battle map. The targeting section can greatly facilitate the posting of these maps by use of the digital plotter map to produce overlays of information stored in the computer: friendly fire control measures, target acquisition assets, target, and target indicators. This capability insures that the targeting element displays the same information on its maps as is stored in the

computer. It also eliminates most of the manual plotting and increases the speed and accuracy of the plotting.



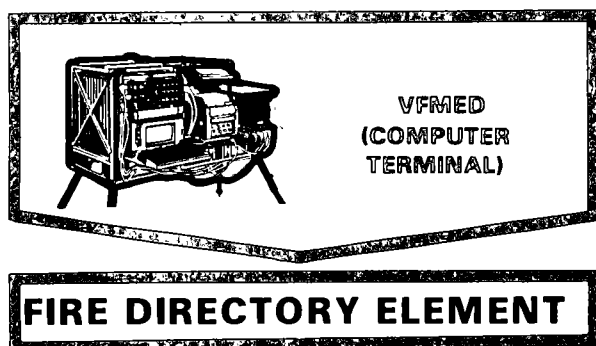
Artillery Target Intelligence File Maintenance

The div arty computer has the capability of storing and maintaining several times as many targets as was possible with the manual system. With TACFIRE, the ability of other fire direction centers to enter targets and targeting information is increased as well. The targeting element must conduct an aggressive file maintenance program to keep the div arty artillery target intelligence file from reaching its storage capacity. The computer gives the targeting personnel the ability to search the artillery target intelligence file and delete targets by type of report, zone and overlap, portions of the battle area, reliability of reports, grid zone, degree of protection of targets, type and subtype of target, targets that have been fired on, target size, target strength, target weighting factor, age of report, and target number. It also has the capability to search and delete by any of the above factors.

This tremendous flexibility for identifying information for deletion gives the targeting element the capability to periodically purge the files of outdated data. Coupled with this periodic purge should be a constant check of

information going into the target file and identification of individual targets to be deleted. These targets are maintained by target number and deleted by the CF VFMED operator as time permits and as approved by the counterfire officer. This combination of constant update and periodic deletion of outdated targets in the artillery target intelligence file allows operation in a target-rich environment with minimum loading of the target file. In medium and high intensity situations, it may be necessary to forego any attempts to delete individual targets and manage the files by deletions by target age.

3-6. OPERATIONS ELEMENT



The operations element, via the CF VFMED, furnishes the FCE with tactical data for entry into the computer. The operations element maintains a tactical situation map, prepares the field artillery support plan or portions thereof, recommends positions and repositioning of artillery units, recommends the organization for combat, develops the required supply rate, and recommends the CSR for div arty.

Field Artillery Fire Planning

The div arty nonnuclear fire planning program has the capability to prepare schedules of FA fires for all fire units in all

battalions that are organic, attached to, or reinforcing the division. Normally, div arty will schedule nonnuclear FA fires for those organic or attached battalions that have been assigned a mission of general support or general support reinforcing. Div arty also schedules fires for the battalion(s) of an FA brigade that has a mission of reinforcing the div arty. The battalions that have been given the mission of direct support of a maneuver force and the battalions that have been given the mission of reinforcing a direct support battalion normally are not included in the nonnuclear schedules prepared by div arty.

As discussed in chapter 2, the battalion nonnuclear fire planning routines in TACFIRE do not provide the capability to schedule groups of targets and series of targets by group or series name. The capability does exist through instruction messages to prepare portions of a schedule exactly as groups and series are currently scheduled using manual techniques. Any number of targets may be scheduled simultaneously, sequentially, or oncall depending upon the instructions received from the echelon that generated the scheduling requirement of the targets. The div arty computer provides the capability to compute and store up to 31 uniquely named schedules of fire, each consisting of up to 120 minutes and four phases. During the fire planning sequence, data from TACFIRE application programs are used in computing the final solution. For each schedule (plan), the ammunition and fire unit (AFU) program provides the firing units and ammunition inventories; the artillery target intelligence program is used to develop target lists; the support (SPRT) program provides coordinating measures checks, high-explosive effects, and orientation data; and the tactical fire control (TFC) program provides the tactical fire control solution for nonnuclear target analysis.

The operations element, using the CF VFMED, enters tactical data required for fire planning into the div arty TACFIRE computer. These data may include zones (boundaries) of the supported force; fire unit types, mission, characteristics, status, and locations; ammunition inventories; controlled supply rate; and fire support coordinating measures. The operations element also enters guidance governing methods of attack for targets and fire units and ammunition selection criteria.

The operations element, with the targeting element, prepares the preliminary target list and selects targets for inclusion in the final target list. Initial target lists are coordinated with maneuver to insure proper support of the scheme of maneuver or plan of defense. After targets have been selected, the operations element enters the target priorities, phasing and scheduling instructions when desired, and prepares the schedule of fires. When the schedule of fires (fire plan) has been approved, the operations element prepares the FA support plan documentation and transmits it to the battalions for execution.

a. Fire planning data base. Since the division artillery commander (as the FSCoord) has the ultimate responsibility for responsive fire support, he must be provided the flexibility to manage the resources under his command. During fire planning operations, he manages his resources by specifying the fire units that are to be used in the operation and the control under which they are to operate. This management may entail establishing a discrete planning modification file for each FA fire plan (schedule) or allowing current operating criteria to be used for new plans.

b. Nonnuclear fire plan commander's criteria. Because available battalions and munitions vary with the situation, the

artillery commander and his staff must be able to modify the standard computer solution. This modification is done by means of the nonnuclear fire plan modification file. Criteria manually entered in the nonnuclear fire plan modification file are used by the computer in all nonnuclear fire plan processing. Separate criteria files may be established for each discrete fire plan (schedule). If no modification file is built for a specific plan, the current modification file established for tactical fire control will be used. Nonnuclear fire plan modification file criteria take precedence over the programed default criteria of the computer. Four nonnuclear fire plan input messages are used to enter the commander's criteria.

(1) The commander's criteria modification input message. This message is used to establish criteria for all fire units in all fire planning functions. The modification and criteria are for planning purposes and will not be used by the computer until the computation of the specified plan is initiated. For planning purposes, the message may be used to ignore availability and type of ammunition, and to establish an effects cutoff factor if different from current operations. It is also a means to associate the name of the division zone of responsibility with the fire plan.

(2) Commander's fire unit exclusion input message. This message is used to exclude fire units by name (Btry A, 2-18 FA) or weapon type (175-mm) from planning considerations. It can also be used to exclude specific types of ammunition (shell and/or fuze) by either weapon type or fire unit.

(3) Commander's attack method input message. This message permits manual specification of desired effects or standard volleys to be fired against specific targets. Desired effects or standard volleys can be established for nonpersonnel targets of a given type and subtype, personnel targets of a given type, or personnel targets of a given type and degree of protection.

(4) Commander's fire unit selection criteria input message. This message is used to associate fire units (FU) with a battalion, to specify the maximum number of volleys to be fired by firing units with specified weapons, and to specify the ordering (priority of FU selection) of fire units within a battalion.

c. Related files. The commander's guidance for resource management is implemented by the establishment of appropriate computer files for each fire plan. The selected fire units and associated ammunition are provided by the ammunition and fire unit program, and the fire support coordinating measures are provided by the support program. The nonnuclear fire plan program also accesses the ATI and tactical fire control programs for specific target data and attack criteria.

(1) Ammunition and fire unit program. The AFU program provides for the maintenance of current information pertaining to the status, location, strength, capabilities, missions, and ammunition inventories of all fire units assigned to each plan. This program provides supporting information for FA fire planning and for tactical fire control processing. Each plan may be completely unique by fire units and ammunition.

(2) Fire plan build message. The AFU;BUILD input messages provide the means of associating AFU data with a fire plan. The data may be retrieved from either the current AFU file or from an existing fire plan file. Additions, modifications, and deletions can also be incorporated using AFU input messages.

(3) Support program. The support program provides for the maintenance of current information pertaining to the status and location of all fire support coordinating measures. When these measures are

developed they are entered in the support routine and, when applicable, are associated with fire plans (schedules).

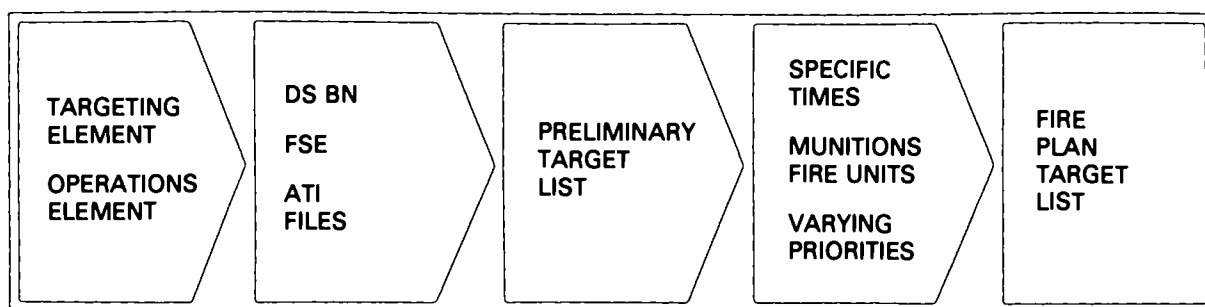
(4) Support build message. The SPRT;BUILD input message input is used to construct a new fire support coordination planning file from either the current file or other existing planning file. Data to be included in the new plan can be designated by type (frontline trace (FRLT), coordinated fire line (CFL), restrictive fire line (RFL), etc.) or by transferring all existing fire support coordinating measures to the new plan.

(5) Artillery target intelligence program. The ATI program is used by the div arty TOC and supported units to process and store target information received from all sources. The program stores all target reports, automatically combines or recommends combination of reports when appropriate, and provides the most probable location of each target. The div arty computer has the capability to store 1,364 targets and target indicators in the ATI file. Because the file contains all the gathered battlefield target data, it is the logical source for target data for nonnuclear fire planning.

(6) Tactical fire control program. The TFC function in FA fire planning in the div arty system determines the number of rounds to be used in attacking the targets. For criteria not specified or established for a specific fire plan, the data used is that used for current TFC processing.

d. Target lists. TACFIRE fire planning target lists are developed initially in the manner described below.

(1) Preliminary target list. The preliminary target list is prepared from an accumulation of individually entered targets from the DS battalions and FSE and/or from selected target data available from the ATI files at the div arty computer, plus individual targets entered from the computer console by



the operator. Normally, the preliminary target list is established using the artillery target intelligence program—prepare a fire plan (ATI;PREFP) message. This message is used to extract from the ATI files targets that meet certain criteria. More than one PREFP can be entered to establish the preliminary target list. The preliminary target list can be refined through deletion or addition of targets using the nonnuclear fire plan update (NN;FPTU) message.

Fire support coordinators consult with the maneuver commanders or their staffs to insure proper FA support of maneuver's plans. After the preliminary target list has been examined, it may be scheduled by nonnuclear fire planning exactly as it was received. If the NNFP:COMFP; (compute a fire plan) message is entered at this time, all targets will be scheduled with equal priority in the shortest possible time. This procedure is recommended for a program of targets such as a counterfire program or other hasty type schedules. This procedure works the same at battalions as at division artillery.

(2) Fire plan target list. Using the nonnuclear fire planning instruction message (NN;INST), all targets in the preliminary target list may be instructed with specific times for scheduling, with varying priorities, and for different phases of the schedule or with specific munition or specific fire units. Adding such instructions creates a new listing of targets, which is called a fire plan target list. For each target designated in the fire plan target list, the

location, type/subtype, degree of protection, size, and scheduling instruction are identified and stored under that plan name. The fire plan target list may be scheduled as a complete plan or it may be scheduled by priority.

It is recommended that initially the entire plan be scheduled, allowing sufficient time for each phase, up to 120 minutes for the entire plan. This computation will show the time required for each phase, approximately how much ammunition is required to execute the plan, and which targets appear to be very "hard" and warrant additional instructions before the final schedule is computed. After desired changes have been made to the plan it should be rescheduled using the realistic phase time determined from the first computations. There is no limit on the number of times a schedule may be computed. When time allows, it may be possible to improve a schedule by the procedures described above.

(3) Targets in the schedule of fires. The targets in the schedule of fires are those fire plan targets that have been scheduled for firing in accordance with a time sequence or have been designated as oncall targets. The fire plan targets make up the targets in the schedule of fires after the scheduling computations using the nonnuclear fire planning compute fire plan message (NN;COMFP) have been completed. All the data that identified the target when it was in the fire plan target list remains with the target, and in addition, all scheduling data to include firing unit, ammunition, specific

H-time, effects or volleys, and angle of fire is identified with the target. The targets in schedules of fire make up the final target list established prior to execution of the artillery fire plan (schedule).

(4) Fire planning target instructions (NN;INST). This message is used when scheduling instructions are to be applied to selected targets in the preliminary target list. When target instructions are entered, the target then becomes a portion of either the fire plan target list or the oncall target list depending on the instructions entered at any time after the target has been entered in the planning file for the specified plan (schedule). Instructions that may be applied to specific targets include:

- Designation as target in fire plan target list or oncall lists.
- Priority and phasing to be applied to the target during scheduling.
- Designation of time the target is to be engaged relative to H-hour if a specific time of attack is desired.
- The firing unit to engage the target if a specific unit is desired.
- The desired effects on the target or volleys to be used against the target if different from modification file.
- The shell, fuze, and angle of fire the target is to be engaged with if some restriction is known.
- H-time, the time relative to H-hour, + or - minutes, at which the target is to be scheduled.
- Series to which this target belongs, if appropriate.
- Series order (the time of attack of targets in relation to each other).
- Group name to which this target is assigned, if appropriate.
- Repeat targets (those targets to be attacked in more than one phase).
- Phase of the schedule where this target, group, or series is to be scheduled.

e. Computing a fire plan. The operations officer controls the conditions to be used in scheduling. These include the start time and the length of phases for the schedule and the target priorities desired to be included in this computation. Phases may be any length but the fire plan cannot exceed four phases and a total time of 120 minutes. If there is more than one phase in a fire plan, no one phase can exceed 60 minutes. If phase data is not entered, the schedule will default to one phase. When phase data is not entered, the total time duration of the schedule is calculated from the start of the first phase. An H-hour is required as all targets are scheduled in relation to the H-hour. A specific H-hour may be entered if known. Phase times, when specified, must not overlap and together cannot exceed 120 minutes. If the schedule is not computed using the preliminary target list as received, all fire plan targets and preliminary targets are ordered and scheduled according to instructions for those targets.

(1) Preliminary targets. Targets from preliminary target list are scheduled after all fire plan targets have been tried if the preliminary option is used. These preliminary targets, considered the lowest priority targets in the schedule (fire plan), use default instruction data (lowest priority, any phase, etc.). Oncall targets are ordered last because they are not subjected to the scheduling criteria.

(2) Scheduling. When instruction has been completed for all targets, scheduling begins with the input of the nonnuclear fire plan compute message. Use of a variable interval schedule allows the computer to consider targets for scheduling on a 1-minute basis, with multiple fire units to initiate fire at the same time. After a target has been scheduled, the fire unit is identified as busy until the time required to shoot the assigned volleys has elapsed. Time required is the function of the fire unit's sustained rate of fire

plus its reaction time. This action allows fire units with a small volume of fire or with a high sustained rate to engage other targets sooner than fire units firing on the same target with a larger volume of fire or a lower sustained rate of fire.

(3) Repeat targets. Repeat fire on a target is indicated by the entry of the target in more than one phase in the NNFP;INST message. The target is then scheduled in each specified phase with any combination of fire units available. If the target cannot be scheduled in any of the specified phases, it is considered a scheduling exception.

(4) H-hour. An H-hour for the schedule is required in computations since scheduling is constructed relative to H-hour. Prior to final computations of the schedule, the actual H-time may be specified, even if the schedule is oncall, to allow final print output reports to include the relative firing time for each target.

(5) Checks and tests. Certain checks and tests are made on each target. The support function determines if the target location falls within the zone of fire of any artillery units and will furnish the name of the zone to the nonnuclear fire planning program. If the target is not within the division zone, or if it violates the fire coordination and limiting measures (except ACAs and masks), the target will be scheduled but a warning message is printed with the scheduling data.

(6) Exceptions. Exceptions may result from scheduling, fire unit capability, or ammunition limitations. Targets may be exceptions for more than one of the above reasons; however, only one exception will be listed with the order of listing such as ammunition, capability, and scheduling.

f. Nonnuclear fire plan alteration. After the fire plan (schedule) has been computed and the schedule of fires reviewed, changes

may be required prior to execution. Major changes, such as adding targets or changing the duration of the phase lengths of a fire plan, require recomputation. Minor changes include adding new fire units to targets or altering the time for firing on certain targets. These minor changes can be incorporated without recomputing the fire plan.

g. Field artillery support plan. If time permits, a field artillery support plan may be prepared in order to accomplish the tasks assigned in the division's operations plan or order. Each FA support plan contains a written portion (prepared manually), a target list (prepared by TACFIRE), schedules (prepared by TACFIRE), and—by option—a target overlay (prepared by TACFIRE). The following documents will be used by the operations element in helping the assistant S3 prepare the FA support plan:

(1) Target list. The targets-in-schedule-of-fires report lists all targets that have been included in a fire plan. The target list for the FA support plan is a compilation of these target lists. The data contained in the report includes:

- Target location and description.
- Firing time, priority, and phase.
- Required and actual effects or volleys.
- Fire unit, shell, fuze, number of rounds and volleys, angle of fire, and effects.
- List of oncall targets with appropriate information.

(2) Schedules. The schedules of fires report provides scheduling results for each target in the fire plan. It also provides the status of each unit in the fire plan for the complete duration of the plan.

(3) Target overlay. Although the target overlay is not a required portion of the FA support plan, the overlays may be

mechanically plotted by the digital plotter map in the fire control element. All coordinating measures, fire unit locations, and targets may be plotted.

Required Supply Rate (RSR) and Controlled Supply Rate

The operations element can estimate the requirements for ammunition (shell/fuze) to support an operation or phase of an operation more quickly by employing TACFIRE than through manual computations. Operations personnel obtain the planned ammunition expenditures from the fire plans (schedules) prepared in support of the operation. They also obtain the estimated ammunition expenditures for targets of opportunity during a given time from reading the AFU;2206 situation reports from the battalions. They then consider these two figures to develop the RSR. The operations element also recommends a controlled supply rate based on the anticipated expenditure of ammunition for each fire plan (schedule) and for targets of opportunity.

Maps and Charts

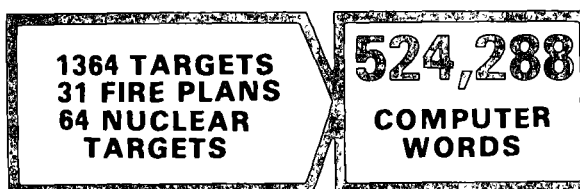
The operations element has responsibility for maintaining a situation map depicting the friendly situation; geometry in use; positions of organic, attached, and reinforcing field artillery; targets; and movement routes. This map can be prepared initially based on data provided the operations element by the fire control element through the CF VFMED and from overlays prepared by the fire control element using the digital plotter map. Fire unit status and capability charts can be prepared and updated based on data provided by the fire control element obtained from messages of interest established by the operations element. By reviewing the situation map and the status charts, the operations element makes timely recommendations for

repositioning the field artillery or for changes to the controlled supply rate for the battalions.

Requests for Non-FA Fire Support

If, during preparation of the FA support plan, it becomes evident that div arty is not capable of properly attacking a target (e.g., cannot achieve the required effects or the target is out of range), the operations element prepares a request for fire and sends the request to the Main FSE for attack by another fire support system. The request will inform the FSE of the effects div arty (if applicable) is capable of achieving and furnish all available target data. If the target is to be attacked at a particular time based upon a requirement provided by a DS battalion, div arty should so inform the FSE.

File Maintenance



The TACFIRE computer at div arty is capable of storing 524,288 computer words; therefore, it is possible to inundate the computer's memories to the point that the system cannot function. This computer capacity at division artillery allows for storage of 1,364 targets, 31 fire plans, 64 nuclear targets, and weapons description data for artillery, naval, and close air support weapons. To preclude saturating the memory capabilities of the system, continuous and thorough file maintenance is performed. Methods of file maintenance include:

- Deleting portions or all of the FA support plan that are no longer valid because of cancellation or modification of an OPORD/OPLAN.

- Deleting from the files those schedules by plan name that have been executed.

3-7. SURVEY OPERATIONS WITH TACFIRE

The survey function provides for the storage and retrieval of survey and ephememeris data, for survey scheme computation, and for dissemination of survey information to using agencies.

The survey function at div arty and that at battalion are the same except for certain capabilities that are unique to div arty. A battalion makes use of these capabilities by transmitting the appropriate data to div arty and receiving the resulting reports. The div arty peculiar capabilities include conversion functions, combined traverse adjustment, and quadrilateral scheme computations.

Input of survey computations into the TACFIRE computer at div arty by the div arty survey parties normally is accomplished at the CF VFMED. If time does not permit the party to return to the div arty location, it may input its data via a battalion computer in its area of operations for transmission to div arty. The survey function at div arty can store the following data:

- Survey control points obtained from Defense Mapping Agency.
- Trigonometric lists augmented by control points from other sources.
- Control points generated by the operational survey routines and transferred to the control point file.
- Ephemeris data for the processing of astronomical survey.
- Active scheme data containing field measurements and information derived from this data.

The maintenance of these survey files is the responsibility of the survey information center (SIC) personnel of the div arty survey platoon. They must insure that all data in the survey file is current and based on the best available control. The SIC personnel coordinate with the counterfire officer for access to the CF VFMED in order to perform their mission.

3-8. METEOROLOGICAL OPERATIONS WITH TACFIRE

The TACFIRE computer gives div arty the capability of storing and disseminating one computer met, one fallout met, and six forecast met messages. The computer met and the fallout met messages are generated by the meteorological section of HHB, div arty. These messages are passed to the div arty TOC by the most expeditious means for entry into the computer. The met message is then entered into the computer through the CF VFMED. The message is disseminated to the battalions and other required subscribers digitally via TACFIRE. The forecast met messages are entered from the VFMED at the division Main FSE after the messages are acquired from the Air Weather Service at division.

When operating with more than one meteorological station in the division zone, the div arty operations officer is responsible for insuring that the fire units receive the most valid computer met message for their location. Because the computer can store only one computer met message, the operations officer will have the CF VFMED operator, upon receipt of a computer met, transmit that computer met message to the FA units in that met stations's area of validity. As other met stations in the division zone input their computer messages, this procedure will be

repeated to insure that firing units have the met from the station that provides the most valid data for their zones.

Section III. FIRE SUPPORT ELEMENT

3-9. FSEs AT DIVISION

There are two FSEs at division. One at the division Tac CP and one at the division Main CP. The Tac FSE concentrates on current operations and is primarily a coordinating facility, which will request the Main FSE to plan fires on certain targets for future operations. The Main FSE obtains or develops targets and provides them to div arty; approves targets planned by the brigade FSEs for engagement by fire support means other than FA that are outside of brigade assets; analyzes targets to determine which fire support system to task (preliminary target analysis); performs nuclear and chemical target analysis, nuclear fire planning, fallout prediction, and vulnerability analysis; and enters computer fallout met as received from the div arty met section or Air Weather Service.

Both FSEs employ a VFMED, a remote input/output device to assist in accomplishing their fire support functions. The FSE uses the VFMED to access the div arty computer for the processing of data for the FSE program. This is accomplished on a time-shared basis with other div arty programs and subscribers. Both FSEs must insure prior to operation, that personnel in the FCE at div arty TOC have set up the division computer subscribers table so that the FSEs are identified as legal subscribers to

the computer, that the FSE VFMEDs are designated as remote devices to the computer, and that the FCE has legalized them for major application/operating program messages.

3-10. COMMANDER'S GUIDANCE

FSE operations are conducted within the framework of guidance and policy established by the division commander to direct the employment of the fire support resources available to the division. The fire support element must translate the commander's guidance into TACFIRE-related terminology (criteria) and enter the data into the files of the div arty computer via the VFMED. This guidance will govern conventional, nuclear, and chemical target analysis; nuclear fire planning; and fallout prediction. Commander's guidance entered into the computer can be overridden later if a change is needed. Commander's guidance may include:

a. Priorities assigned to targets for fire planning, by type, or by interest to the division; e.g., nuclear-capable delivery systems, assembly areas of battalion size or larger, and regimental or larger size headquarters.

b. The percent of target coverage and personnel response (immediate or delayed) for targets for each fire support system if different from current criteria.

c. Specific constraints within which target analysis is to be performed; e.g., ignoring of nuclear allocation, ignoring of ammunition on hand, safety and contingency distances, type of vegetation to be considered, maximum yield, maximum volleys, and exclusion of nuclear weapons.

d. SOP items; e.g., no fallout or friendly troop risks/vulnerability is negligible to unwarned exposed personnel.

3-11. FIRE SUPPORT PLANNING

The following five functions support the FSE task of fire support planning.

- Preliminary target analysis.
- Chemical target analysis.
- Nuclear target analysis.
- Nuclear fire planning.
- Fallout prediction.

These five functions interface with the ammunition and fire unit program, artillery target intelligence program, support program, tactical fire control program, and meteorology program at the div arty computer to obtain various data. The FSE also accesses the following files at div arty in performing its functions.

Fire Unit and Fire Unit Planning Files

The fire unit files provide data about the unit, including unit name, type weapon,

mission, location, number of weapons, and ammunition on hand. The planning file contains the same information except that it is associated with a particular fire plan (schedule).

Weapon Description File

This file contains data about the weapon such as rates of fire, traverse limits, probable error, and ranges.

ATI Target Report File

The ATI file contains data about the target, such as description, location, type, degree of protection, vegetation around the target, and permanency of the target.

3-12. FSE FILES

The FSEs must also set up the following FSE files in the div arty computer prior to being able to use the five previously mentioned FSE functions effectively. These FSE files and their purposes are as follows:

Commander's Criteria File

This file contains the commander's guidance within which a target is to be analyzed. The FSE VFMED operator enters the commander's criteria into the computer to insure that all FSE tasks are accomplished within the scope of the commander's guidance.

Friendly Unit File

The friendly unit file contains information about friendly units such as name, type unit, location, size, and degree of protection. A current file is maintained for use during current nuclear operations. A friendly unit file is also associated with each nuclear fire plan. Both are used to insure troops safety or to prepare a vulnerability analysis. Brigade

FSEs are responsible for entering the brigade level installations as well as the maneuver battalion units. Normally, maneuver battalion FSEs will not have access to the div arty files so brigade FSE enters battalion units. Artillery battalion S3s are responsible for entering the units of their battalions. The div arty operations/counterfire officer is responsible for entering all div arty installations and for coordination of the entry of all attached, reinforcing, and other artillery units in the division zone. The FSE Main is responsible for entering the division TOCs, rear, DISCOM and the other division units.

Nuclear Allocation File

This file contains, by weapon type, the number of rounds and yield per weapon system that have been allocated to the division for current operations or for a nuclear fire plan. Nuclear allocation, as used in TACFIRE, is that portion of the corps commander's guidance that makes available nuclear weapons by type and yield per weapon system for planning the sub-packages.

Nuclear Development File

The nuclear development file contains a record of all targets or aimpoints designated as nuclear and of nuclear targets that have been combined. It also contains relative and specific time restrictions to be considered in scheduling targets, and the results of nuclear analysis.

3-13. FSE FUNCTIONS

Preliminary Target Analysis (PTA)

PTA provides the FSE a hasty capability analysis of the best means and munitions available to defeat a target, considering all available high-explosive, chemical, and nuclear munitions and delivery methods.

After the analysis is conducted, the FSE may then task the selected fire support system to attack the target after appropriate discussion with other fire support representatives, air liaison officer (ALO), S3 Air, naval gunfire liaison officer (NGLO). The selection is made by FSE personnel after reviewing a listing provided by the computer. This listing includes all available fire units or all types of delivery means and their effectiveness, and specifies by fire unit the best munitions to use, the maximum percentage effects they can achieve, and a prescribed volume of fire. If chemical or nuclear munitions are selected, a detailed analysis should be performed using the chemical or nuclear target analysis function. If artillery is selected by the FSE to attack the target, a fire order is sent digitally to the battalion(s), with div arty receiving an information copy of the order. The PTA should be used by the FSE to analyze individual targets, such as targets of opportunity on which an attack decision has not already been made.



Chemical Target Analysis

The CTA function provides the FSE with the ability to analyze rapidly personnel targets for attack with chemical munitions (GB and VX), using the best delivery system. The CTA provides a listing of alternative delivery units, the number of rounds for the delivery systems, and percent of target coverage each system can achieve. This analysis insures compliance with commander's criteria and includes warnings if any troop safety or fire support coordination measures are violated. Hazard areas to friendly troops are computed for each target. The hazard areas are based on an effects radius, wind direction, and windspeed. The chemical hazard area is

input into TACFIRE and disseminated to all units in the div arty computer subscriber table. After the FSE receives the alternatives list from div arty, an alternative (fire support means) may be selected and then tasked by the FSE to attack the target. Tasking the artillery to deliver chemical munitions is done by fire mission through TACFIRE.



Nuclear Target Analysis

NTA is performed for efficient assignment of a fire unit and warhead to a target. Multiple fire units and targets can be processed and will result in a one-to-one assignment. The results of NTA processing are used to prepare schedules of nuclear fires, to determine an FA unit to fire a target of opportunity, to assign a fire support means to individual targets, and to perform vulnerability analysis. NTA is accomplished in phases:

- Preanalysis phase that establishes criteria to be used in the second phase, the analysis phase.
- Analysis phase that determines the weapons/fire units/yield available to attack the target(s) without violating constraints such as tree blowdown, troop safety, or other specified commander's criteria.

a. NTA can be used to provide an analysis of the capability of one yield/warhead to attack more than one target, methods of attacking a target to obtain desired effects, and a list of yields that will satisfactorily attack a set of targets.

b. FSE personnel perform nuclear target analysis by—

- Establishing the commander's criteria in the computer's memory.
- Entering targets to be analyzed into the nuclear development file.
- Having the computer analyze the target(s).
- Reviewing the solutions of the analysis.
- Selecting fire unit(s).

Nuclear Fire Planning

Normally, only the Main FSE will perform nuclear fire planning. The FSE, when performing nuclear fire planning, will use TACFIRE to determine a method of attack (for nuclear-target-oriented analysis) and a schedule of fires. Those analyzed targets that are to be attacked by the Air Force, after being analyzed, will not be included in TACFIRE nuclear schedules but will be passed to the air liaison officer. The FSE must insure that the Air Force has sufficient time to attack its assigned nuclear targets before the FA begins execution of its portion of the nuclear fire support plan. Nuclear fire planning includes processes of nuclear target analysis (discussed in *b* above) as well as two additional processes: determining and entering nuclear fire planning restrictions into the computer and preparing the nuclear schedule of fires.

a. Nuclear fire planning restrictions. The FSE enters into the computer any nuclear fire planning restrictions required to insure proper support of the division's plan of operation. Three such restrictions are discussed below.

(1) **Relative time restriction.** This restriction is used to specify that a particular target is to be attacked before, after, or with another target. For instance, it may be decided that an enemy tank battalion 2 kilometers from the forward edge of the battle area (FEBA) must be attacked before another tank battalion presently in an assembly area 14 kilometers away, or that all close targets are attacked before deeper targets.

(2) **Target priorities.** Target priorities are based on the threat the target poses to the support division. Targets are assigned priorities 1 through 4. Enemy nuclear-capable delivery systems might be assigned priority 1 and a logistical complex might be assigned priority 3. The computer will schedule the higher priority targets first.

(3) **Preinitiation.** Preinitiation by a warhead that is preinitiation sensitive may be precluded by specifying the attack of a target at a specific time (i.e., at or so many minutes before or after H-hour). Also, preinitiation may be precluded by specifying that a specific target be attacked before or after another target. The computer prints out a warning whenever it determines that preinitiation is likely to occur. (FSE personnel must visually consider cloud drift parameters.)

b. Nuclear fire plan scheduling. After the nuclear fire support planning restrictions have been entered, the FSE uses the div arty computer to prepare a schedule of nuclear fires. This procedure is similar to nonnuclear fire planning. The FSE can review the schedule prepared by the computer and make necessary alterations as discussed above, prior to forwarding the schedule to corps FAS for inclusion in the corps package and to div arty for later execution. TACFIRE prepares and disseminates strike warnings to all units potentially affected by the planned nuclear strikes.

c. Key points in nuclear fire planning. TACFIRE can assist in the refinement and scheduling of a nuclear package, and it is capable of performing preclusion analysis, package scheduling, and individual target numerical analysis, as discussed in FM 6-20, *Fire Support in the Combined Arms Team*. TACFIRE will perform nuclear target analysis and provide a list of target attack recommendations for the employment of the largest yield warheads against aimpoints within specified preclusion criteria. Current doctrine requires the analysis of the largest yield for multiyield warheads that can safely produce the desired effects on the target without violating preclusion constraints. The system allows using smaller yields of a multiyield weapon in the case where larger yields cannot be employed.

Vulnerability Analysis and Fallout Prediction

a. The FSE continuously evaluates the vulnerability of critical installations and friendly units to enemy nuclear strike. The FSE conducts these analyses using the capabilities of the div arty computer. Based upon predictions about the location and size of an enemy nuclear burst, the computer can determine potential damage which can be inflicted on selected installations and friendly units whose location, size, name, and other data are stored in the computer. The FSE considers the results of the vulnerability analysis in recommending positioning and repositioning of field artillery units and in advising the division G3 on the vulnerability of non-FA forces.

b. The fire support element maintains, in the div arty computer, locations and degrees of protection on all friendly units and installations. This information is used for nuclear fallout prediction purposes. After a

target has been analyzed for attack by friendly forces or when a nuclear surface burst sighting report is received and confirmed, the FSE, using TACFIRE, will prepare and transmit 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.

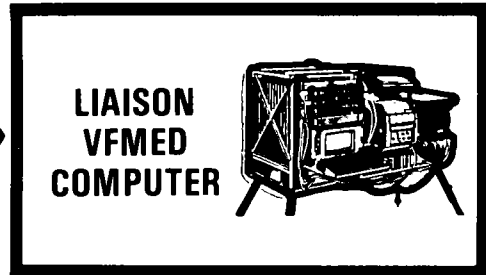
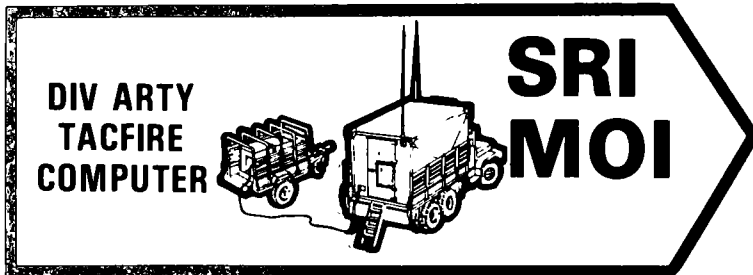
Prescribed Nuclear Load (PNL) and Prescribed Chemical Load (PCL)

The PNL and PCL assigned to the division by corps can be subassigned to div arty firing units based upon recommendations of the Main FSE after the FSE has determined which units will most likely be tasked to fire these munitions. Also, recommended changes to a fire unit's PNL or PCL can be made by the FSE when it receives AFU reports from div arty that affect a fire unit's capability to execute planned fires. For example, a fire unit that was assigned to deliver chemical weapons may have its howitzers destroyed or severely damaged by enemy counterfire. That unit's remaining chemical munitions should be reassigned to another fire unit.

3-14. FIRE SUPPORT COORDINATION

The FSEs maintain current data on situation maps and in the div arty computer data files pertaining to the boundaries, fire support coordination measures, frontline trace, position areas, and targets of division and its subordinate units. During target analysis, the computer provides warnings if coordinating measures or commander's guidance is violated. The FSE can override the warnings, if necessary, and continue with the planning and advise the commander of the potential effect upon friendly forces. The FSE can recommend and (upon approval of the commander) disseminate, via TACFIRE, to all FSOs and artillery units changes to existing or establishment of new fire support coordinating measures, boundaries, and other geometry.

Either of the division FSEs may transmit requests for additional fire support to the corps FAS via automatic relay through the div arty computer when it is determined that the fire support assets available to the division are not capable of providing the required support. This could include a request for FA conventional fires or tactical air.



Section IV. LIAISON SECTION

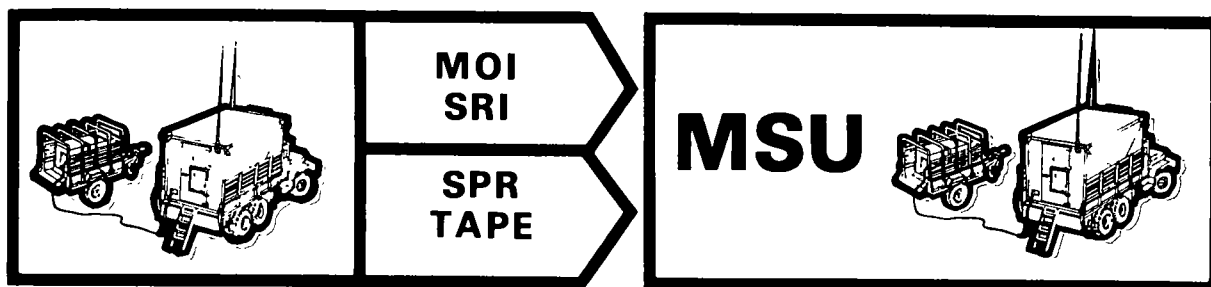
The liaison section is responsible for coordination with an adjacent div arty. This section coordinates fire unit and ammo status, unit positioning, clearance of fires across the division boundaries, targeting data and intelligence, fire support coordination measures, boundaries, fire support plans, and requests for FA fire support. The section is equipped with the VFMED and performs the liaison function by use of TACFIRE computer support from its div arty TACFIRE computer.

When the section's VFMED is initialized by the div arty, it must be provided access to

standing requests for information (SRI) and the message of interest (MOI) functions. The SRI and MOI functions allow the liaison section to be provided the information from the div arty computer automatically.

The liaison section insures that the div arty with which they are operating receives the parent div arty's geometry, fire unit status, current target and intelligence of concern to the adjacent div arty, fire support measures in effect and planned, fire support plans, and other information as needed.

The liaison section will provide similar information and services to its div arty.



Section V. CONTINUITY OF OPERATIONS

Mutual support is a method employed to continue the mission in event of normal computer displacement or a total TACFIRE computer failure. Mutual support is conducted between two units with like computers to support continuity of operations. Normally, an FA brigade will be the mutual support unit for a div arty and vice versa. For example, the FA brigade will be the MSU for div arty when the brigade is attached to the division or, while under corps control, when authorized to be the div arty's MSU by the corps FA support plan.

The div arty commander should determine if the battalions of the FA brigade can provide mutual support for div arty battalions. He does this by reviewing the corps operations order and then providing specific instructions in the div arty FA support plan or by frag order. The MSU assumes the mission and responsibilities of the supported unit during displacement of the computer or if the computer fails. The div arty will attempt to maintain operations during partial failures of its equipment through alternate or degraded mode operations. Only in the case of catastrophic failure or displacement of div arty headquarters will the div arty have its MSU assume control.

The necessary information flow to the MSU could be accomplished by either of the following methods:

- a. The FA brigade can receive the required information through constant update of its files and data base from div arty. This update is accomplished by messages of interest from and standing requests for information in the supported div arty computer. These provide an automatic flow of data from div arty to the FA brigade. Additional data must be provided by the div arty to cover items of information that cannot be automatically passed by MOI and SRI processing. The MSU should have identical commander's criteria (with the exception of ATI target combination criteria) as the supported div arty. The FA brigade's target combinations criteria should be set to preclude any combinations since target combinations will be at div arty and the results sent by SRI. If the FA brigade is not attached or reinforcing the div arty, coordination must be made with corps on the exact nature of the commander's criteria the brigade computer is to employ. This method of providing continuity of operations requires a continuous effort by both the FA brigade and the div arty from

initiation through conduct of the battle, but will allow immediate assumption of control by the FA brigade at any time.

b. The second method is to transfer all div arty data to the FA brigade by salvage point recording (SPR) tape. When employing this method, the div arty will, just prior to having the MSU assume control, produce an SPR tape containing the div arty data base, target files, support files, commander's criteria, and all other stored data. This tape is then taken to the MSU by the most expeditious means and fed into the MSU computer. At that time, the MSU could assume control with all the div arty information on hand. This method insures that the MSU has exactly the same data when it assumes control that the div arty was using when it began displacing. A disadvantage to this system of continuity of operations is that if the div arty computer has an equipment failure that precludes production of the SPR tape or if the computer is physically destroyed, the MSU, without the SPR tape, will be unable to perform its

backup role immediately. Another disadvantage of this method is that when the div arty SPR tape is loaded into the MSU computer, the MSU's data base will be lost. It will be necessary to completely reconstruct the MSU's subscriber table and other initialization data just to reestablish communications with the MSU's firing battalions and other subscribers.

If a mutual support unit is not available, div arty will have to revert to manual operations until the computer has been repaired or displacement completed.

When the method of continuity of operations is chosen, the unit to provide MSU support must have adequate communications to assume the communications responsibilities of the div arty computer. This may include having to pre-position communications equipment at the MSU, particularly if a battalion computer is chosen for the role. A battalion computer has less communication capability than a div arty computer because it has one less digital data terminal.

Note: TACFIRE equipment and its arrangements at computer and remote locations are shown in figures 3-5 through 3-6.

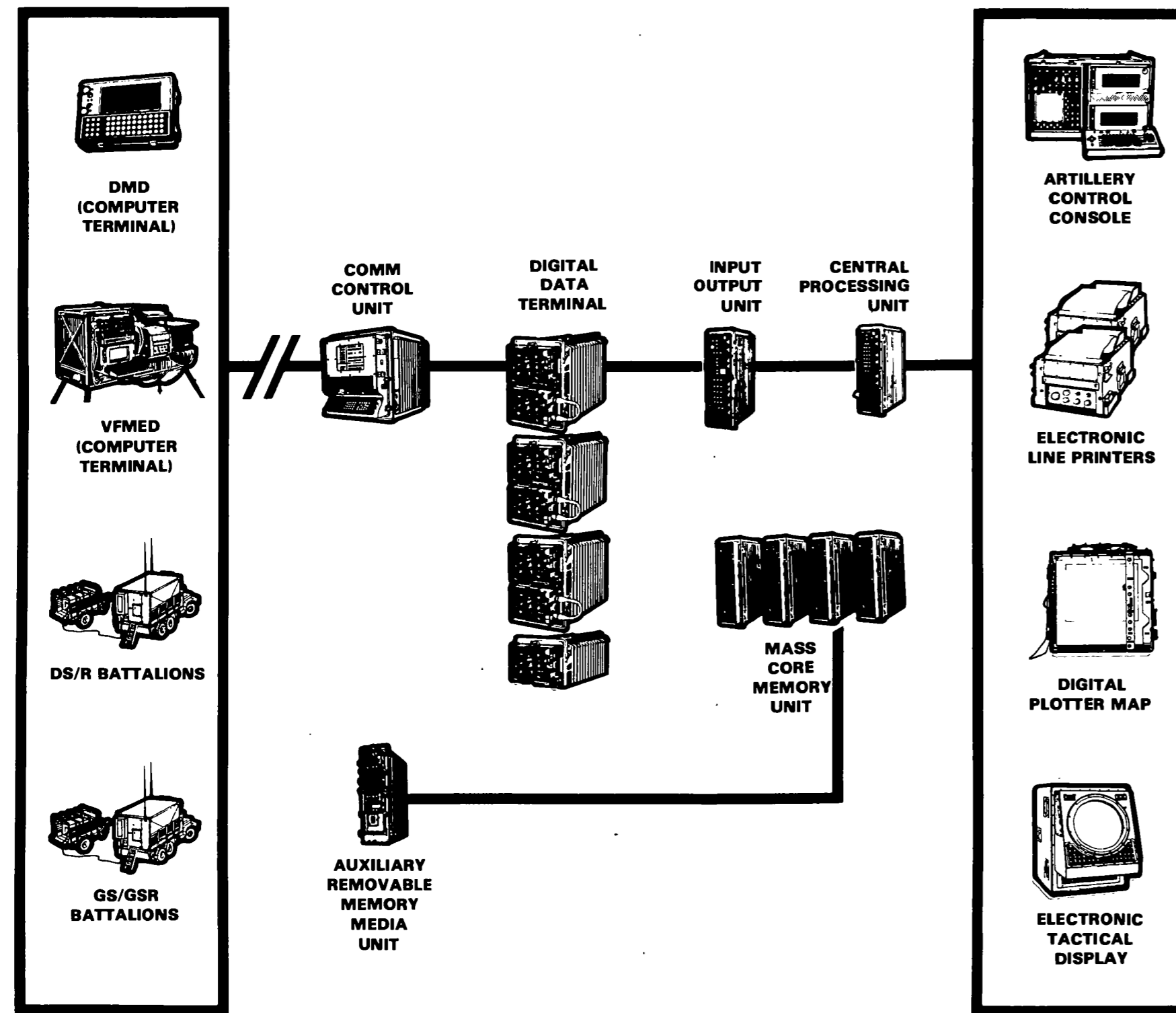


Figure 3-4. TACFIRE division artillery system.

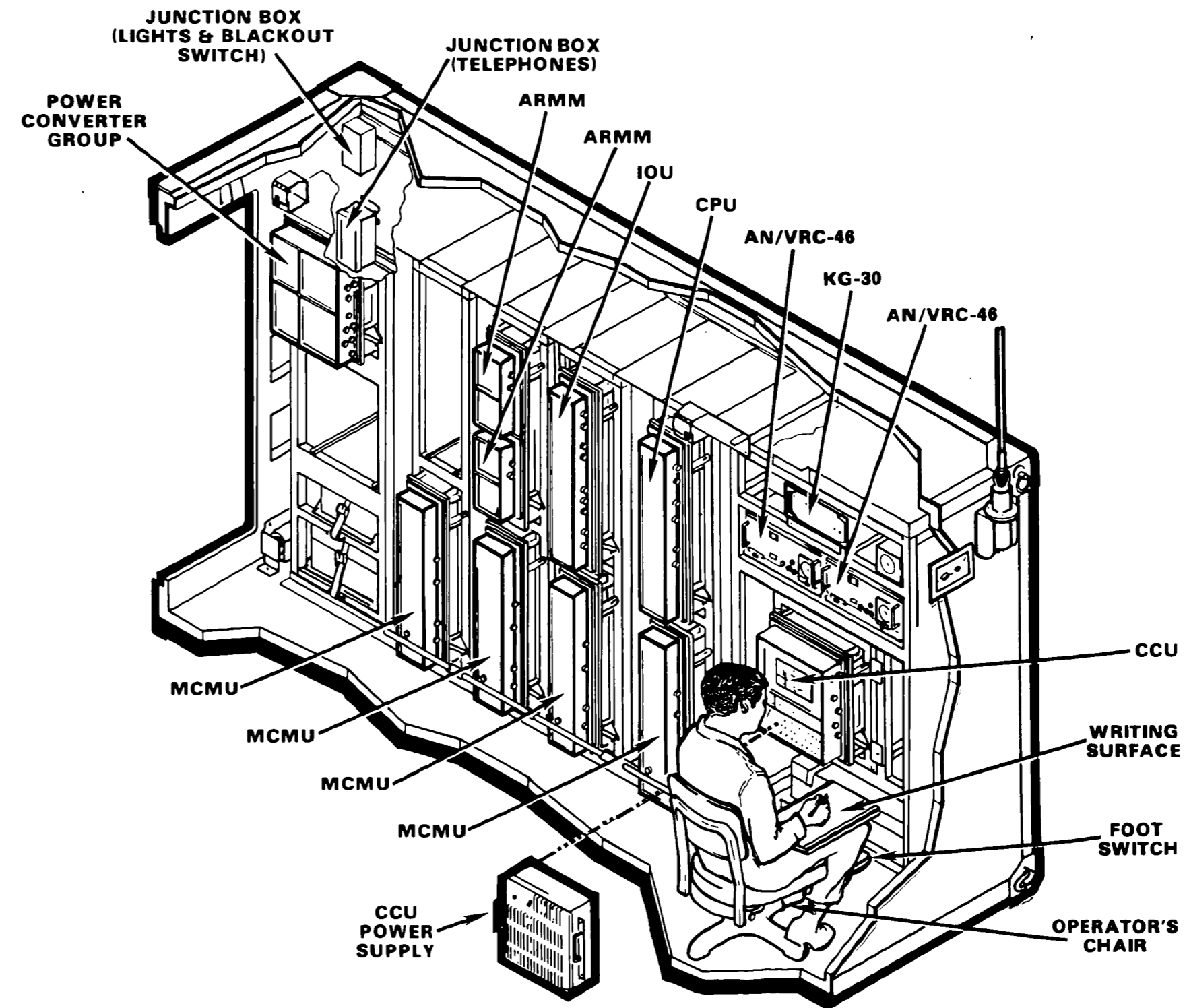
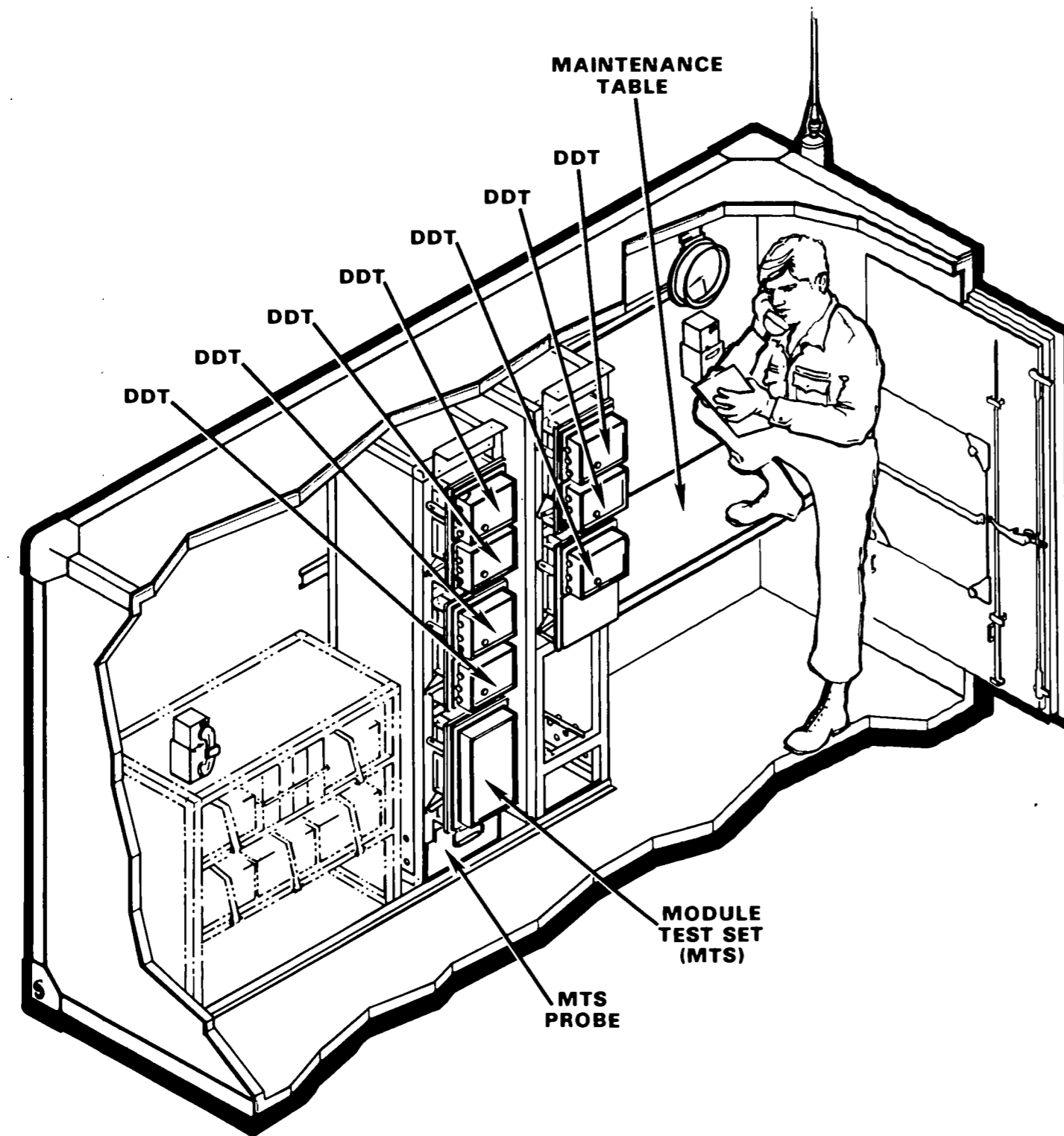


Figure 3-5. Division artillery computer group shelter.

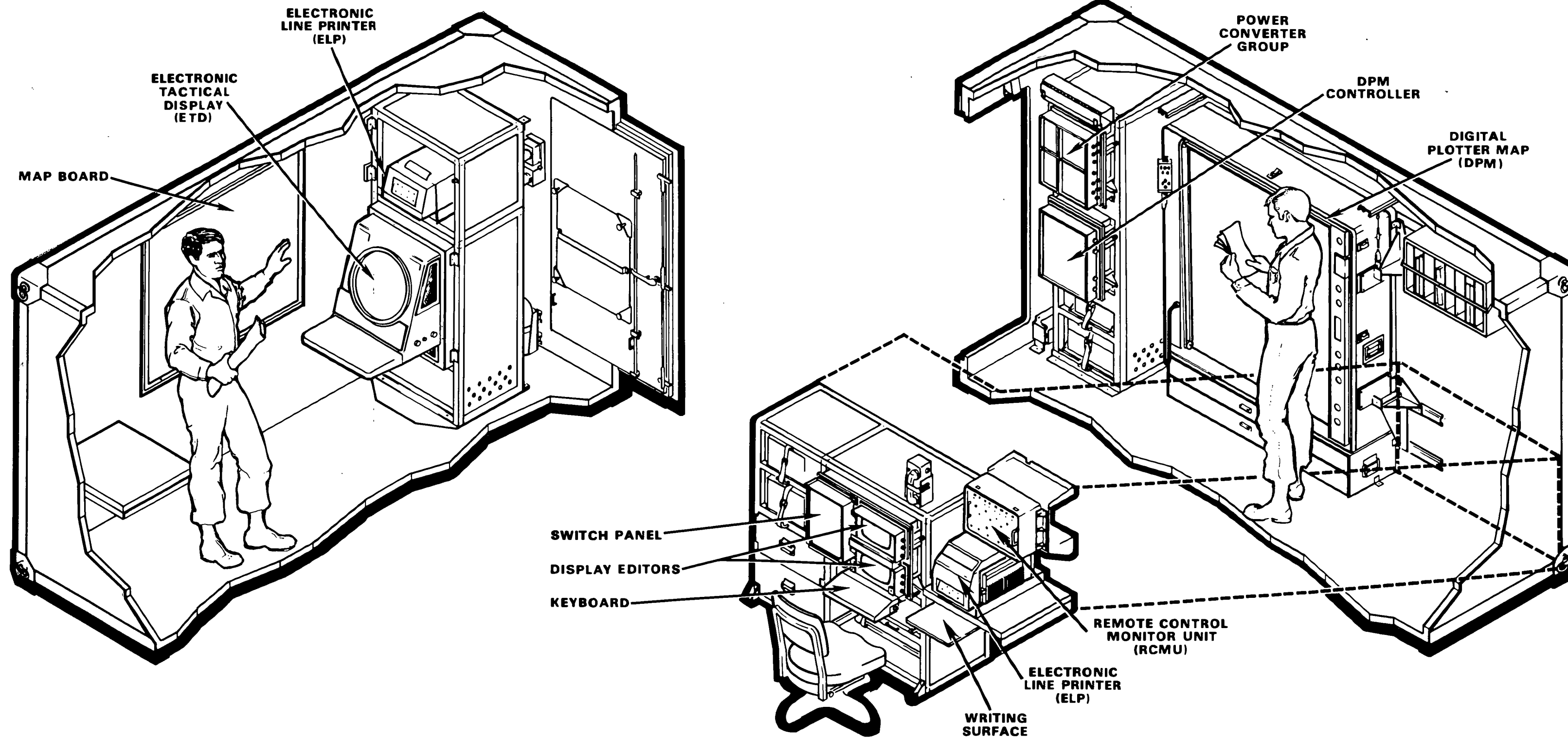
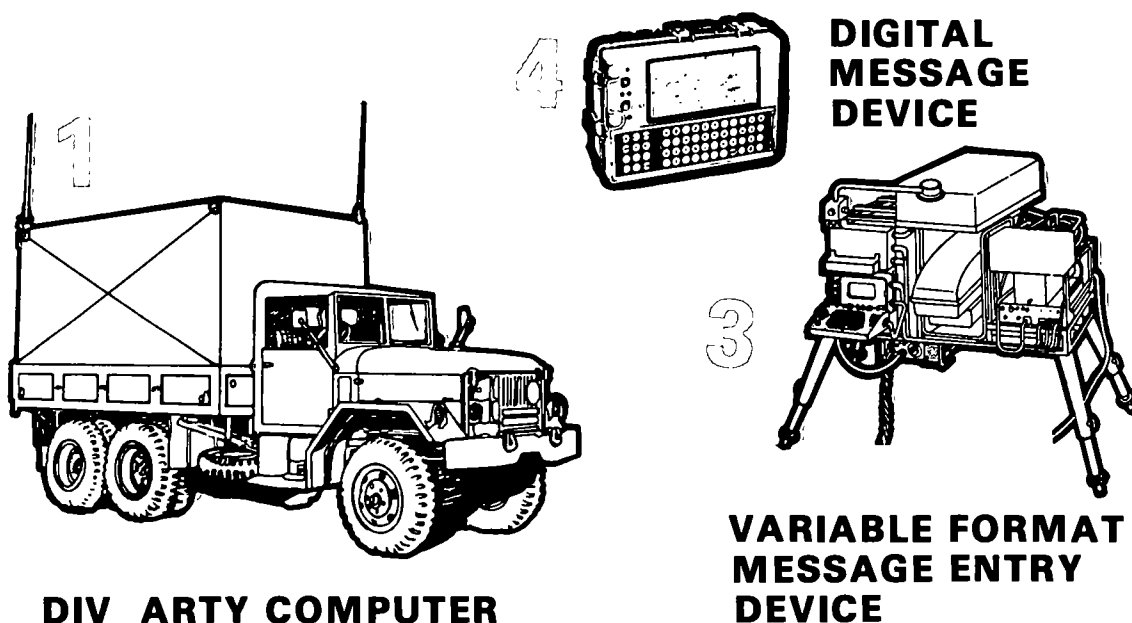


Figure 3-6. Division artillery display group shelter.



CHAPTER 4

FIELD ARTILLERY BRIGADE

4-1. General

The FA brigade HHB is very similar to a div arty HHB. The brigade has four aerial observers, no fire support element, a liaison section capable of fielding two liaison teams (which can provide the nucleus of a fire support element), and all the personnel necessary to establish a brigade TOC similar to the div arty TOC. The FA brigade headquarters is responsible for commanding and controlling the organic HHB and all attached FA elements, developing targets and distributing targeting information, and coordinating general positions, fire planning, and displacement of the FA brigade. The FA brigade headquarters has the following TACFIRE equipment:

Organization	TACFIRE Equipment
Brigade TOC	1 div arty computer system OA-8390/ GSG-10V
O&I/CF	1 VFMED OA-8544/ GSG-10V
Liaison section	2 VFMED OA-8544/ GSG-10V
Aerial observers	4 DMD AN/PSG-2

The FA brigade TOC is composed of a fire control element, targeting element, and operations element.

Fire Control Element

The FCE provides the personnel to prepare the TACFIRE computer for operation, operate the computer, and perform organizational maintenance on TACFIRE equipment. Specifically, the FCE initializes the computer, provides for limited fire support coordination, conducts tactical fire direction, and provides automatic data processing support to subordinate units.

Targeting Element

Primarily, the targeting element provides for the production of 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 artillery target intelligence file maintenance, and maintains targeting and order of battle maps.

Operations Element

The operations element 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.

The liaison section is capable of simultaneously providing liaison teams, equipped with VFMEDs, to two separate units. The teams exchange data between the FA brigade and supported unit on geometry, plans, requirements for FA support, and capabilities and limitations of the FA brigade. When augmented, the liaison section can establish a fire support element with a maneuver unit.

There are four AOBSRs in the TOE (table of organization) of the FA brigade. They acquire and provide artillery targets and intelligence to the FA brigade.

The FA brigade, organized for and equipped with TACFIRE equipment, will employ TACFIRE to perform required tasks while:

- In general support of a corps.
- Reinforcing a division artillery.
- In direct support of a maneuver brigade.
- It is a covering force artillery headquarters for a division.

The FA brigade, while performing these missions uses TACFIRE to accomplish targeting, target analysis, liaison, fire support planning, FA fire planning, etc. The brigade functions in much the same way that div arty and its subordinate units and elements do as explained in chapter 3. Therefore, only significant variations from the techniques and procedures discussed in chapter 3 will be covered in this chapter.

4-2. IN GENERAL SUPPORT OF A CORPS

An FA brigade may be retained under the immediate control of the corps commander to attack targets of interest to corps and to provide the corps commander the flexibility to influence the battle as the tactical situation changes. The assignment of a tactical mission of general support to an FA brigade provides this responsiveness to the corps commander.

Fire Control Element

The FCE obtains the required data for initializing the computer from the FA brigade

commander, FA brigade staff, corps FA support plan, and corps FAS. Considering data from all these sources insures that the FCE complies with specific FA support requirements assigned by the corps FAS.

Targeting Element

When the FA brigade is in general support of the corps, the targeting element is responsible for passing AOBSR reports, SHELREPs, and other intelligence from the subordinate elements of the FA brigade to the corps FAS. It is also responsible for storing and disseminating targets from the corps FAS to the subordinate elements of the FA brigade. Initialization of the FA brigade computer for the artillery target intelligence function should be based on the criteria used by the corps FAS computer. This insures that the targeting element of the brigade carries out the corps FAS guidance, allows the FA brigade to maintain the same artillery target data as the corps FAS, and allows the FA brigade to analyze targeting information in the same manner as the corps FAS. Any development of targets by the targeting element is passed to corps FAS for update of the corps target file and for attack clearance. The targeting element coordinates with the corps FAS when purging the target file to insure that the brigade and the FAS have compatible target files.

Operations Element

The operations element, using the nonnuclear fire planning program, prepares fire plans (schedules) based on preliminary target lists and attack guidance (e.g., desired degree of destruction or target attack sequences) provided by the corps FAS that has fire planning responsibility for FA brigades with a general support mission. The operations element employs TACFIRE to prepare these plans in the same manner as the div arty operations element except that,

because the preliminary target list is provided by corps FAS, preparation of the list is omitted by the operations element.

Continuity of Operations

A div arty or the corps FAS computer can provide mutual support for the FA brigade by constant update of its files and data base from the FA brigade by message of interest. Continuity of operations via use of an SPR tape is not applicable for the corps FAS or a div arty computer. When the FA brigade SPR tape is fed into the MSU computer, the MSU computer loses all operating data input prior to the SPR tape. To input this lost data again requires several hours.

4-3. Reinforcing a Division Artillery

Corps may have a requirement to retain control of a field artillery brigade while at the same time giving one of its divisions additional field artillery support. The corps commander can satisfy both requirements by assigning an FA brigade the mission of reinforcing the division's artillery. This mission allows the corps artillery commander to retain command and control over the FA brigade while giving the division artillery commander tactical control (fire planning, positioning, and first priority on calls for fire) of the brigade. The FA brigade has a requirement to establish liaison with the reinforced division artillery. The FA brigade employs TACFIRE while assigned this mission much as it did when assigned the general support mission discussed in paragraph 4-2, except that the division artillery will use its TACFIRE equipment to plan the fires of the FA brigade.

Fire Control Element

To insure that the FA brigade is capable of accomplishing its reinforcing mission, the FCE must initialize the computer, provide for the attack of targets on request of the reinforced div arty and corps FAS, insure

safety of friendly forces when attacking targets, and provide computer support to the targeting and operations elements and subordinate battalions. The FCE obtains the required data for initializing the computer from guidance provided by the FA brigade commander, S3, operations officer, targeting element, corps FAS, and the reinforced division artillery.

Targeting Element

a. When the FA brigade is reinforcing a division artillery, the targeting element is responsible for passing AOBSR reports, SHELREPs and other intelligence from the subordinate elements of the brigade to the supported div arty and to the corps FAS. The targeting element is also responsible for storing and disseminating targets from the corps FAS and the supported div arty to the subordinate elements of the brigade.

Initialization of the computer for the artillery target intelligence program should be based on the reinforced div arty computer initialization data. This insures that the FA brigade will comply with the supported division's target selection standards. Combinations of targets and production of targets must be coordinated with the reinforced div arty and, in the case of targets of corps interest, with the corps FAS. Due to the limited target acquisition assets of the FA brigade, the actual production of targets will be limited. The targeting element, when it recognizes a need for a change in the target selection standards, must recommend the change to the supported div arty and receive approval prior to implementation of the change.

The targeting element also constructs and maintains the target map and the order of battle map. These maps are used to keep the FA brigade commander and his staff updated on current targets and the enemy situation. The targeting element uses the digital plotter map to produce detailed overlays for posting on these maps.

b. When the FA brigade is reinforcing a division artillery, the targeting element must insure that all deletions from the artillery target intelligence file are coordinated with the headquarters originating the target. This means coordinating with corps FAS 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 within the liaison section will be tasked to establish liaison with the reinforced div arty. The team will be equipped with a VFMED. When the team's VFMED is initialized with the FA brigade computer, it must be initialized as an FSO, on the FA brigade op/F net, so that it may have access to standing requests for information and the message of interests functions. By having the SRI and MOI functions, the liaison team will be automatically provided information it requires to perform liaison.

The liaison section will insure that the reinforced div arty 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 will provide the FA brigade, via its VFMED, positioning and movement instructions, future plans, and other information needed by the FA brigade to properly reinforce the div arty. Calls for fire, ATI data, coordination measures, survey data, and fire planning data will be transmitted directly from the reinforced div arty computer to the FA brigade computer on a sole user circuit routed through a multichannel system between the FA brigade and div arty TOC. The FA brigade computer will pass information on fire unit status and capabilities, SHELREPs, and other information about the brigade needed by the div arty directly to the div arty computer.

4-4. IN DIRECT SUPPORT OF A MANEUVER BRIGADE

An FA brigade that has been attached to a division may be assigned a tactical mission of direct support to a maneuver brigade. The FA brigade should have attached to it the div arty close support battalion that habitually supports the maneuver brigade now being supported by the FA brigade. If the FSOs and FISTs were not already in place, this battalion would then be tasked by the FA brigade to provide the appropriate support to the maneuver brigade headquarters and its subordinate units. The FA brigade headquarters will employ its TACFIRE equipment when assigned a direct support mission much as a div arty would, including use of its ATI program, survey program, meteorological program, and nuclear fire planning.

Fire Control Element

a. The FCE obtains the required data for initializing the computer from guidance provided by the FA brigade commander, S3, operations officer, FSEs, the div arty operations SOP, and from the supported brigade OPLAN.

b. The FCE will provide computer support to FSOs so that they may extract targets that have been reported in their zones of responsibility and stored in the FA brigade computer. This service may be provided on a recurring basis as a result of a standing request for information or on a one-time basis as a result of a file query. Information the FSO may need about the status of a fire unit to allow him to plan fire support for his maneuver unit may also be provided on request. Normally, the brigade FSO is allowed access to the FA brigade's computer for single nuclear target analysis, nuclear vulnerability analysis, and fallout prediction. Nuclear target analysis is

performed by the FSO for the purpose of recommending to the division main FSE the inclusion of certain targets or aimpoints in the division's subpackage.

Targeting Element

The targeting element of the FA brigade may have the same responsibility as the div arty targeting element. The FA brigade's targeting element is concerned with only the supported maneuver brigade's zone of responsibility and may assume the div arty counterfire responsibilities for that zone. The targeting element's primary responsibility is the production of valid artillery targets through the collection, processing, and dissemination of targeting and order of battle information from all sources available to the FA brigade.

Continuity of Operations

When the FA brigade is in direct support of a maneuver brigade, the mutual support unit for the FA brigade will be specified by the div arty. The MSU would normally not be the div arty because div arty is concerned with the whole division and cannot accept the additional mission of direct support of a maneuver brigade.

4-5. COVERING FORCE ARTILLERY HEAD-QUARTERS FOR A DIVISION

An FA brigade may be attached to a division, subsequently attached to the div arty, and then given the task of managing the fire support effort for a division covering force. In accomplishing this task, the FA brigade controls the battalions assigned tactical missions of direct support to task forces of the covering force as well as those assigned missions of general support to the covering force. A div arty close support

battalion would have to be tasked by div arty to provide the FSEs and FISTs required to support the covering force headquarters and its subordinate maneuver elements. The FA brigade establishes liaison with an adjacent covering force artillery headquarters and the div arty TOC in the main battle area.

Target Acquisition Assets

The TA assets available to the FA brigade, while serving as the covering force artillery headquarters, will be the FA brigade's organic AOBSRs and those TA assets attached from div arty. Div arty will give the brigade such assets as the tactical situation dictates.

Fire Control Element

The FCE obtains the required data for initializing the computer from guidance provided by the FA brigade commander, S3, operations officer, and the covering force FSE.

Targeting Element

The targeting element's primary responsibility is the production of valid artillery targets through the collection, processing, and dissemination of targeting and order of battle information. The targeting element may receive personnel augmentation from div arty while in the covering force role. When conducting file maintenance operations, the targeting element must insure that div arty is constantly updated as to the targets currently on file and those purged. This update greatly facilitates the handoff of the fire support responsibility from the FA brigade to the div arty when the covering force mission ends.

FA Brigade Liaison Section

a. The liaison section of the FA brigade will send one team to establish liaison with the covering force artillery on the left or right as directed by division. The team is

responsible for coordination between the two covering force artillery headquarters.

b. The div arty TOC in the main battle area will be kept updated on all ATI information, FA fires planned, boundaries and coordinating measures in effect and planned, enemy situation and order of battle, ammunition and fire unit status, current and planned positions of FA units, and any other data required by the div arty to enable it to take over the fire support task when the handoff of the covering force fight occurs. This information will be provided directly from computer to computer. The FA brigade computer will initialize the second liaison team as a subscriber and, through messages of interest and direct plain text messages, provide the above information to the team. This enables the team to keep the div arty abreast of the situation. It also provides the information necessary for the div arty to prepare plans for a smooth handoff of the covering force artillery support from the FA brigade to div arty and to prepare plans for support of the main battle area (MBA).

Continuity of Operations

While the FA brigade is operating as a covering force artillery headquarters, the div arty will be constantly updated on the situation in order to effect the handoff of fire support responsibility.

4-6. SUMMARY

Because of the requirements of the assigned tactical mission, the FA brigade may not always establish liaison with another unit, prepare FA support plans, establish a fire support element, or perform other tasks normally accomplished by a div arty. When the requirement exists, the brigade will employ TACFIRE in much the same manner as discussed in chapter 3 for a div arty except for those significant variations discussed above.

DIGITAL PLOTTER MAP



CHAPTER 5

CORPS FIELD ARTILLERY SECTION

Organic to the corps HHC, the corps field artillery section provides FA tactical control, staff support, and fire support coordination for the corps. The section has a section headquarters, an operations intelligence element, and a fire support element for tactical control and limited administrative supervision of assigned and attached field artillery units.

The corps field artillery section provides tactical and technical field artillery expertise to the corps commander and provides tactical control of assigned and attached field artillery units that are retained under corps control.

The corps FAS is dependent upon appropriate corps support units for personnel

and administrative support, financial services, and logistical and communications support. The corps field artillery officer is a special staff officer who advises the corps commander and his staff on all field artillery matters and is the corps fire support coordinator (FSCoord). In the name of the corps commander, he exercises operational control of all field artillery not assigned or attached to subordinate units.

Operating in the corps TOC, the FSE manages the attack of deep targets, which are beyond the range capabilities of the divisions, by using cannons, missiles, tactical air, and other fire support means under corps control.

The FSE coordinates fires on targets short of the fire support coordination line (FSCL) within the corps zone and plans fires beyond the FSCL to the extent of the area of influence/responsibility of the corps.

Depending on the situation and the number of targets, a target production element may be established using the assets of the fire support element. Targets of primary interest to the corps; e.g., the enemy's nuclear delivery systems and enemy air defense sites, will be developed and their engagement directed through the integration of all-source intelligence available from the corps fusion center.

Since corps is the focal point for planning the employment of nuclear weapons, development and refinement of nuclear packages is a major planning and employment responsibility of the corps FA section. Determination of field artillery support requirements, recommendation of field artillery organization for combat, supervision of field artillery training within the corps, and monitoring of the operational readiness of corps field artillery units are also major functions of the section.

5-1. FUNCTIONS

The TACFIRE-equipped FAS provides the following:



**TACFIRE
FAS**

- Tactical control and supervision of chemical and nuclear weapon planning and employment within the corps.

- Staff planning, coordination, command and control of tactical operation, and employment and supervision of FA units attached or assigned to the corps.

- Fire support planning for the corps.

- Fire support coordination for the corps.

- Fire support elements as required.

- Storage and dissemination of meteorological data to include distribution of fallout met to USAF elements.

- Storage and dissemination of survey data for the corps.

- Recommendations for the organization for combat of field artillery units assigned or attached to the corps.

- Coordination of air defense suppression by FA of targets within the corps zone of operation.

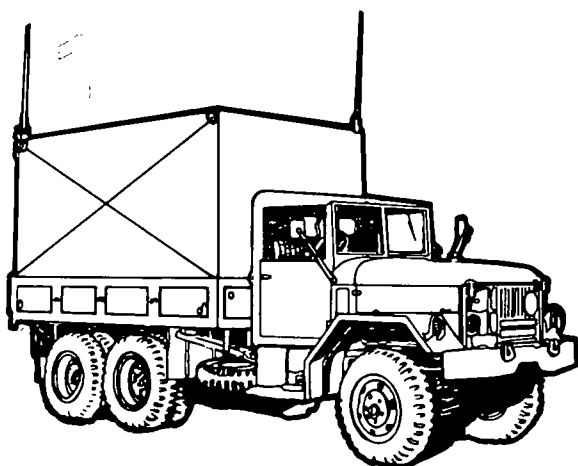
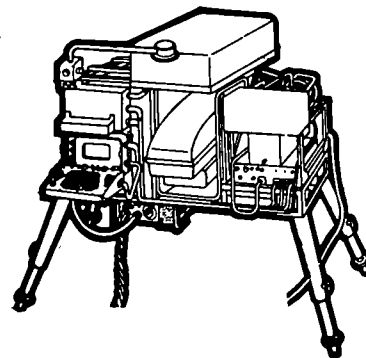
- Determination of FA required supply rate and recommendation of the controlled supply rate for subordinate commands.

- Supervision of preparation and evaluation of field artillery portion of training programs and training evaluation of field artillery with the corps.

- Augmentation fires for division, as requested, with available missile and rocket systems and any cannon artillery controlled by the corps.

- Assistance in developing the corps airspace utilization plan in conjunction with the airspace management element.

- Collection and dissemination of targets and targeting intelligence from corps and national level sources.

**DIV ARTY COMPUTER****VARIABLE FORMAT
MESSAGE ENTRY
DEVICE**

5-2. EQUIPMENT

To accomplish the tasks outlined above, the corps FAS is provided the following TACFIRE equipment:

Quantity	Equipment
1	Div arty computer system OA-8390/GSG-10V
2	VFMED OA-8544/GSG-10V

The corps FAS TACFIRE uses the existing hardware of a division artillery TACFIRE set. This system is designed with maximum modularity and commonality with other echelons of TACFIRE. This compatibility insures interface between systems (corps/div arty, corps/FA brigade, corps/battalion). The corps system has the capability of

controlling up to five division artilleries as well as FA brigades and separate field artillery battalions.

Inputs to the FAS TACFIRE at corps are made through the ACC and VFMED. Digital data links are established through standard Army communication means as follows:

- Div arty, multichannel or AM.
- FA brigade, multichannel or AM.
- Missile battalions, multichannel or AM.
- Cannon battalions, AM.

The corps FAS subsystem provides appropriate error and warning messages to facilitate operator control and continuity of operations under all conditions of system degradation. The software contains default values for application programs similar to those used in division artillery software. The design and operation of the corps FAS TACFIRE software aids operator training and operation. The corps FAS computer does not differ significantly from the division TACFIRE set.

Based upon initialization, the TACFIRE at corps FAS is compatible and can interface with all computer centers. The corps set can operate with div arty, FA brigade, and battalion TACFIRE computers as well as the battery computer system.

5-3. FIRE CONTROL

The corps FAS provides the fire control element personnel to operate the corps FAS TACFIRE computer. They prepare the TACFIRE computer for operation and also perform organizational maintenance on TACFIRE equipment.

The FDO supervises the FCE, insures engagement of targets, and coordinates target engagement. FCE personnel use the digital plotter map to prepare overlays and the electronic tactical display to show fire control information graphically. Specifically, the FCE performs the following functions:

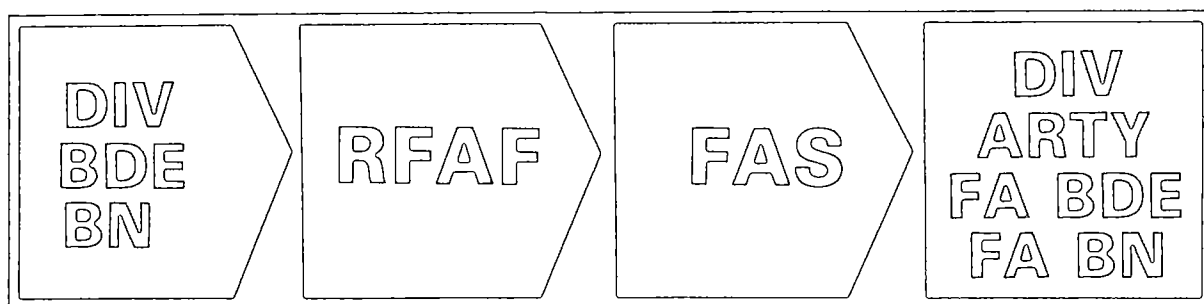
Initialization of the Computer

Like the other TACFIRE sets, the corps FAS computer must be initialized or loaded with the constant data from the master tape. During initialization, the FCE establishes digital communications and determines which units and organizations can use the computer and their operating nets. It inputs into the computer the application programs data (ammunition and fire unit, nonnuclear fire planning, tactical fire control, map mod, geometry checks, survey and meteorological); the communication security authentication codes to be used; and the technical system operating parameters (e.g., commander's guidance). The FCE obtains the data required for initializing the computer from guidance provided by the corps field artillery officer and assistant fire support coordinator (AFSCORD). After the computer has been "initialized," the fire control element

prepares the graphical display on the digital plotter map and the electronic tactical display. The data displayed could include the zones and boundaries of the corps, division, and the maneuver brigades; fire unit locations and range fans; and the fire support coordination measures in effect. Care must be exercised when using either the DPM or the ETD because display of several of these geometry features at one time causes clutter making interpretation difficult. The FCE prepares overlays for the tactical situation displaying target arrays, targeting data, and other information as requested by the operations element. Upon completion of initialization and preparation of the graphical displays, the FCE prints all the tactical data files and furnishes them to the operations and target production elements for validation.

Fire Support Coordination

Although fire support coordination is not the fire control element's primary function, the FCE will insure compliance with established fire support coordination measures. When processing fire requests, the electronic tactical display automatically plots each fire mission received by the computer. This provides the FDO a visual display of the relative location of the target to geometry (boundaries and effective fire support coordination measures). In addition, the computer provides the operator with warnings when a fire support coordination measure is violated. The warning alerts the operators to the need for fire support coordination by identifying the measure violated and the unit with which coordination is required. Coordination within the supported corps zone is aided by the computer automatically notifying the appropriate FSE that a request for fire on a target located in its zone of responsibility is being processed.



Tactical Fire Direction

At corps level, only tactical fire direction is accomplished. The corps artillery computer performs tactical fire direction when requests for additional fire are received from subordinate field artillery units (division, brigade, or battalion). RFAFs are initiated automatically at the corps FAS console when requests for fire are generated by the artillery target intelligence program or when requests for FA fires are received from fire support elements. In processing the requests, the computer determines a method of attack in accordance with the commander's criteria. It then transmits fire orders to div arty, FA brigade, or battalion after review by the assistant operations officer. The method of attack is determined by computer analysis of the target and fire unit capability, selection of fire unit, and allocation of ammunition by type and quantity to defeat the target. If additional fires beyond the corps artillery's capability are needed, the computer will prepare an RFAF for forwarding to the corps FSE for attack by another fire support system.

a. Commander's criteria for tactical fire direction. The corps FA officer, or his designated representative, must consider certain factors when deciding to attack a target employing TACFIRE. Commander's criteria are used to allow the commander to exercise experience factors in control of fire units and ammunition; thus overriding the computer's tables (JMEM) for attack of

targets. Additionally, the corps commander's guidance must be converted to TACFIRE terms so it can be input into the computer.

b. Mission fired reports. When a corps artillery battalion or FA brigade under corps control completes a mission, it generates and transmits a mission fired report to corps FAS. This report updates the fire unit ammunition status and the artillery target intelligence files at corps FAS.



5-4. MAINTENANCE OF MAPS AND CHARTS

The corps FAS has responsibility for maintaining a situation map depicting the friendly situation, geometry in use (coordinating measures, boundaries, etc.) positions of field artillery assigned to the corps, targets, and movement routes. This map can be prepared by using the digital plotter map. Fire unit status and capability charts can be prepared and updated based on data provided by the fire control element. The FSE obtains this data from message of interest requirements established by the

corps FAS. A review of the situation map and the status charts permits timely recommendations for repositioning the field artillery or for changes to the controlled supply rate for the battalions.

5-5. REQUESTS FOR NON-FA FIRE SUPPORT

If field artillery assigned to the corps is not capable of properly attacking a target; e.g., cannot achieve the required effects or the target is out of range, the corps FAS will refer the target to another fire support system for attack. The RFAF contains the effects corps artillery is capable of achieving and all available target data. If the target should be attacked at a particular time based upon a division artillery requirement, corps artillery informs the FSE of this via plain text message or by voice communications.

5-6. SURVEY OPERATIONS

The survey function provides for the storage and retrieval of survey data, for survey scheme computation, and for dissemination of survey information to using agencies. Certain survey processes that were performed manually are now automated by use of TACFIRE. This automation provides corps and division artillery, as well as battalion elements, more rapid and accurate reports. The survey function can store the following data:

- Survey control points obtained from Defense Mapping Agency.
- Trigonometric lists augmented by control points from other sources.

- Control points of third-order accuracy generated by the operational survey routines and transferred to the control point file.

- Ephemeris data for the processing of astronomical survey.

- Active scheme data containing field measurements and information derived from this data.

All stored points should also include associated data such as point name, grid location, and orienting azimuth data. The maintenance of these files is the responsibility of the survey personnel of the corps FAS. They must insure that all data in the survey file is current and based on the best available control. The survey personnel coordinate with the operations officer at the corps FAS for access to the corps computer in order to perform their mission.

5-7. FIRE SUPPORT

General

The fire support element at corps FAS obtains or develops targets provided by the corps FAS. It approves targets planned by the division FSEs for engagement by fire support means other than FA that are outside of division assets, and it analyzes targets to determine which fire support system to task with attacking the target. This analysis is called preliminary target analysis (PTA). The FSE also performs nuclear and chemical target analysis, nuclear fire planning, fallout prediction, and vulnerability analysis and provides effective downwind messages.

Initialization

The FSE at corps FAS employs a VFMED, a remote input/output device, to assist in

accomplishing fire support functions. The FSE VFMED accesses the FAS computer for the processing of data for the FSE programs and subscribers. The FSE must insure, prior to operation, that personnel in the FCE have set up the corps computer subscriber table so that the FSE is identified as a legal subscriber to the computer and that the FCE has legalized it for major application program messages. FSE operations are conducted within the framework of guidance and policy established by the corps commander to direct the employment of his fire support resources. The fire support element must translate the commander's guidance into TACFIRE-related terminology (criteria) and enter the data into the files of the corps computer via the VFMED. This guidance will govern conventional, nuclear, and chemical target analysis; nuclear fire planning; and fallout prediction.

Fire Support Planning

There are five functions that support the FSE task of fire support planning and coordination.

- Preliminary target analysis.
- Chemical target analysis.
- Nuclear target analysis.
- Nuclear fire planning (NFP).
- Fallout prediction (FP).

These five functions interface with the following programs at the corps FAS computer:

- Ammunition and fire unit.
- Artillery target intelligence.
- Support.
- Tactical fire control.
- Meteorology.

a. Preliminary target analysis. PTA provides the FSE a hasty, rough analysis of the best means available to defeat a target. To do this, PTA considers all available high-explosive, chemical, and nuclear munitions and delivery methods; i.e., cannon, naval gunfire, rocket missile (RKTMSL), and aircraft munitions.

b. Chemical target analysis. The CTA provides data for determining the best chemical agent, GB or VX, to attack a personnel target; the best available delivery means; number of rounds for the delivery means; the damage to be achieved; and safety checks or restricted fire areas.

c. Nuclear target analysis. NTA is performed for efficient assignment of a fire unit and warhead to a target. Multiple fire units and targets can be processed and will result in a one-to-one assignment. The results of NTA processing are used to aid in preparation of packages, to assign a fire support means to individual targets, and to perform vulnerability analysis. New doctrine is evolving in the employment of nuclear weapons. TACFIRE FSE programs that are affected will be rewritten appropriately. Until these changes to doctrine and to TACFIRE are made, the computer will require some manual override to insure that current doctrine for nuclear employment is met in regard to yield selection and primary damage effects. NTA is accomplished in two phases:

(1) *Preanalysis phase.* This phase consists of NTA preliminary processing that establishes criteria to be used during the second phase. These criteria are based on commander's guidance, a target file, a fire unit file, weapon description file for available fire units; and an allocation file for available fire unit and nuclear weapon combinations.

(2) **Analysis phase.** During this phase, it is determined what methods are available to attack the target(s) with nuclear warheads without violating constraints, such as tree blowdown, troop safety, and risk to personnel. Damage assessment is the major function performed in NTA. All target, fire unit, height of burst, and yield combinations are analyzed to determine weapon selections that exceed required damage as specified in the corps commander's guidance. Included in the processing are provisions for producing efficient use of weapons by displacing ground zero for a single weapon to cover multiple targets.

5-8. NUCLEAR FIRE PLANNING

The NFP function provides the capability to analyze and schedule nuclear fires for all fire units retained under control of the corps FAS. The system will provide for multiple nuclear fire plans with a total capability of 64 targets per plan. To aid nuclear package planning, the system will need to store the div arty nuclear subpackages for display and plotting capability. Corps must integrate nuclear and nonnuclear packages into a corps package. Those targets that have been assigned to the Air Force for attack, after being analyzed, will not be included in TACFIRE nuclear schedules. Nuclear fire planning includes those processes discussed under nuclear target analysis (paragraph 5-7c above) as well as two additional processes: determining and entering nuclear fire planning restrictions into the computer and preparing the nuclear schedule of fires.

Nuclear Fire Planning Restrictions

The FSE must enter into the computer any nuclear fire planning restrictions required to insure proper support of the corps plan of operation.

a. Time. Relative time restriction specifies that a particular target is to be attacked before or with another target. For instance, it may be decided that any enemy tank battalion 2 kilometers from the FEBA must be attacked before another tank battalion presently in an assembly area 14 kilometers away.

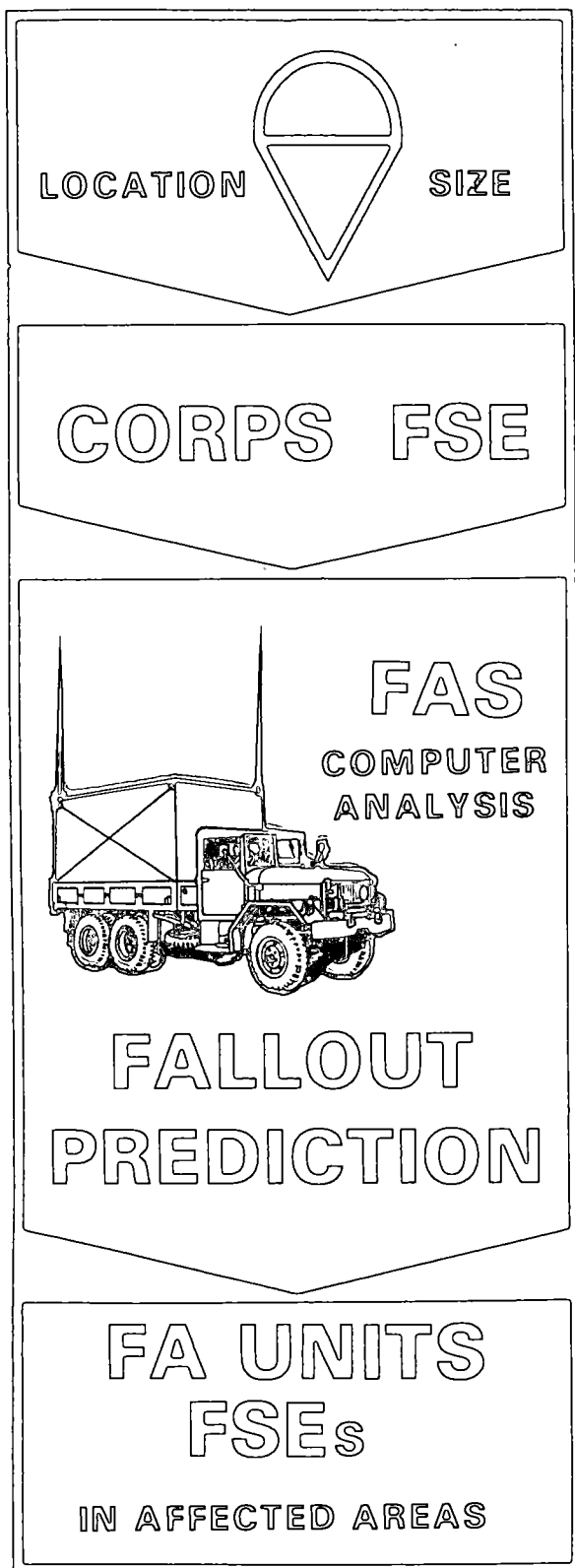
b. Target priorities. Based on the threat the target poses to the support division, targets may be assigned priorities 1 through 4 by the operator. Enemy nuclear-capable delivery systems might be assigned priority 1 and a logistical complex might be assigned priority 3. The computer will schedule the higher priority targets first.

c. Preinitiation. Preinitiation may be precluded by specifying the attack of a target at a specific time. The computer will print out a warning whenever it determines that preinitiation is likely to occur. FSE personnel must visually consider cloud drift parameters.

Nuclear Fire Plan Scheduling

After the nuclear fire support planning restrictions have been entered, the FSE uses the corps FAS computer to prepare a schedule of nuclear fires. This procedure is similar to nonnuclear fire planning. After the FSE reviews the schedule prepared by the computer and makes necessary alterations, as discussed above, the schedule becomes the corps package and is sent to firing units for execution on order. TACFIRE prepares strike warnings and disseminates these to all units potentially affected by the planned nuclear strikes.





5-9. VULNERABILITY ANALYSIS AND FALLOUT PREDICTION

The FSE continuously evaluates the vulnerability of critical installations and friendly units to friendly and enemy nuclear strikes. The FSE conducts these analyses using the automated capabilities of the computer. Based upon predictions about the location and size of any enemy nuclear burst, the computer can determine potential inflicted damage on selected installations and friendly units whose location, size, name, and other data are stored in the computer. The FSE considers the results of the vulnerability analysis in recommending positioning and repositioning of field artillery units and in advising the corps G3 of the vulnerability of non-FA forces.

For nuclear fallout prediction, the fire support element maintains, in the corps FAS computer, locations and degrees of protection on all friendly units and installations. After a target has been analyzed for attack by friendly forces or when a nuclear burst sighting report is received and confirmed, the FSE, using TACFIRE, prepares fallout prediction data. This data includes an effective downwind report (wind speed and direction for zones I and II) and the friendly units and locations in the area of the predicted fallout. The results of fallout prediction are disseminated by TACFIRE to FA units and FSEs in the affected areas.

5-10. METEOROLOGICAL FUNCTION

The personnel operating in the main computer monitor meteorological coverage for the corps. Active coordination with division artilleries and FA brigades is required to insure best coverage of the entire

corps zone, collection of all met messages through the TACFIRE system, and selection of met stations to produce fallout met messages. The air weather services, through FSE, provide forecasts, which must be disseminated to all lower echelons.

5-11. AIR DEFENSE SUPPRESSION

The corps FAS works with Air Force personnel to develop plans for suppression of enemy air defense. Each division artillery TACFIRE sends the corps TACFIRE all confirmed or suspected enemy air defense targets. Air defense suppression can be done by field artillery assigned to the corps or it can be passed to a division artillery. Suppression of enemy air defense increases the survivability of not only close air support, but all aviation assets.

5-12. CONTINUITY OF OPERATIONS

Continuity of operations (CONOPS) of TACFIRE at corp FAS is such that automatic exchange of data during operation allows the mutual support unit to assume the processing function. The communication assets of the MSU may preclude assumption of the total corps FAS mission. Therefore, some division artilleries, FA brigades, and battalions will continue to operate their own TACFIREs without interface with the corps computer. The corps FAS may assume some manual functioning until a failure can be corrected.

Upon repair and restart of the corps FAS TACFIRE, the latest SPR is used to reload the computer and place the corps FA system back into its full automatic data processing mode. An attempt is made to evaluate data that accumulated while the system was inoperative for relevancy of input. Relevant information is then placed in the computer.

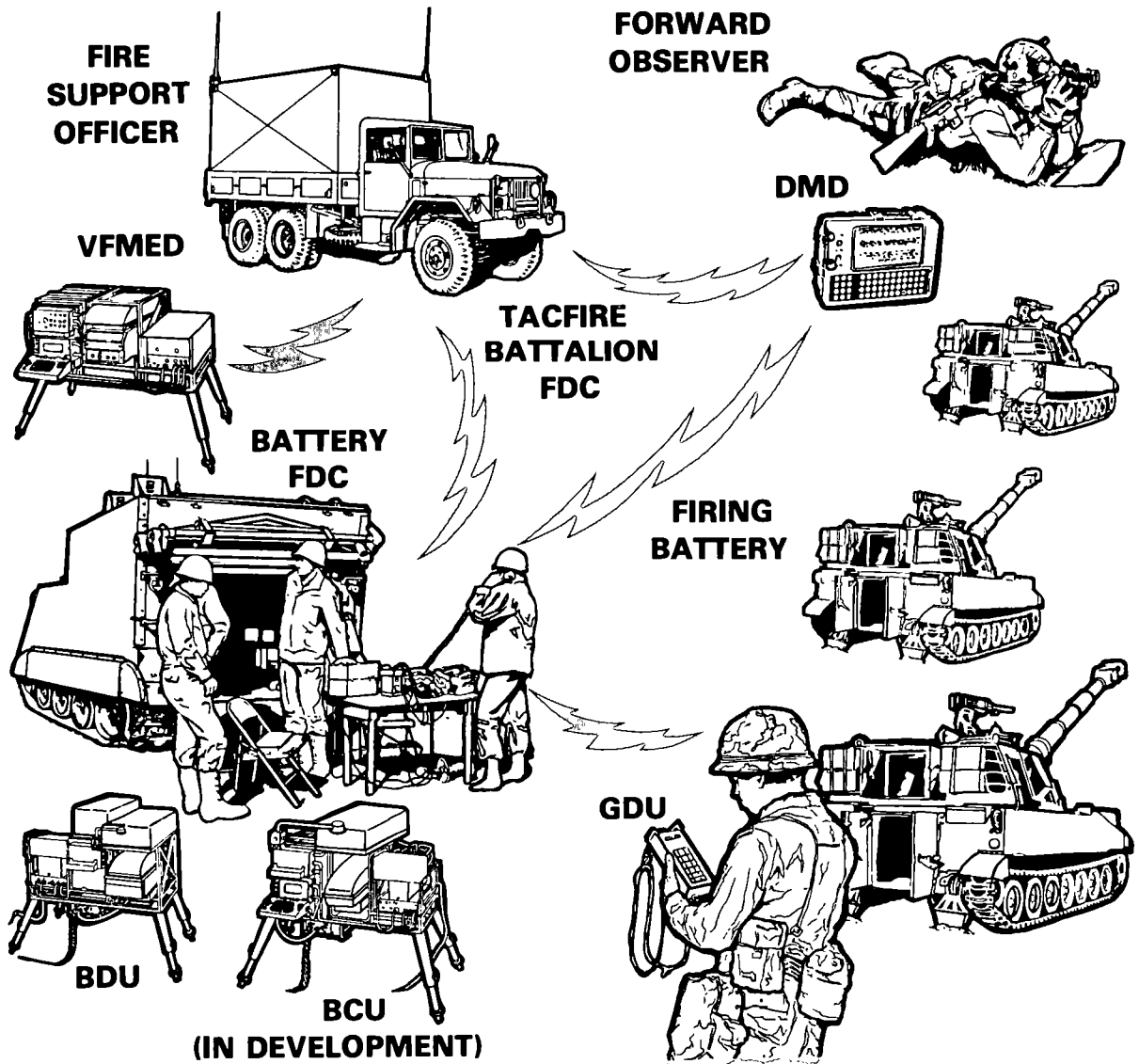


Figure 6-1. TACFIRE gunnery team.

CHAPTER 6

TRAINING WITH TACFIRE

TACFIRE is a complex and sophisticated computer system that will impose revolutionary training requirements upon the unit. Operators and system managers must be highly proficient if they are to make maximum use of TACFIRE's capabilities.

Incorrect procedures, ill-considered or incomplete command guidance, or erroneous data will affect the whole system. A thorough, carefully managed training program is required to develop and maintain the technical proficiency of operators, system

manager, and commanders. When the training manager develops a program, he must consider the newness of TACFIRE. Few, if any, individuals will have much TACFIRE experience. Therefore, the training manager of a unit that has just received TACFIRE must plan to train commanders, system managers, supervisors, and operators concurrently.

Key system personnel at all levels, such as the fire direction officers, the artillery control console operators, and the TACFIRE equipment specialists (TES), must work with the system on a daily basis. If the skills required to operate the system are not used frequently, they will deteriorate quickly. Insuring that key people can train despite various duties, on-duty education requirements, details, and other activities will tax the resourcefulness of the best

training officers. TACFIRE training must be continuous if TACFIRE is to function, because the equipment and the procedures are too complex to be relearned in a month prior to a scheduled formal evaluation.

6-1. THE FOUR-STEP TRAINING MANAGEMENT MODEL

The training management model in figure 6-2 illustrates a simplified method of approaching training problems. It represents the steps of the training process. This process begins with the realization that training is needed in a given area and ends when the training goals have been met. It is a

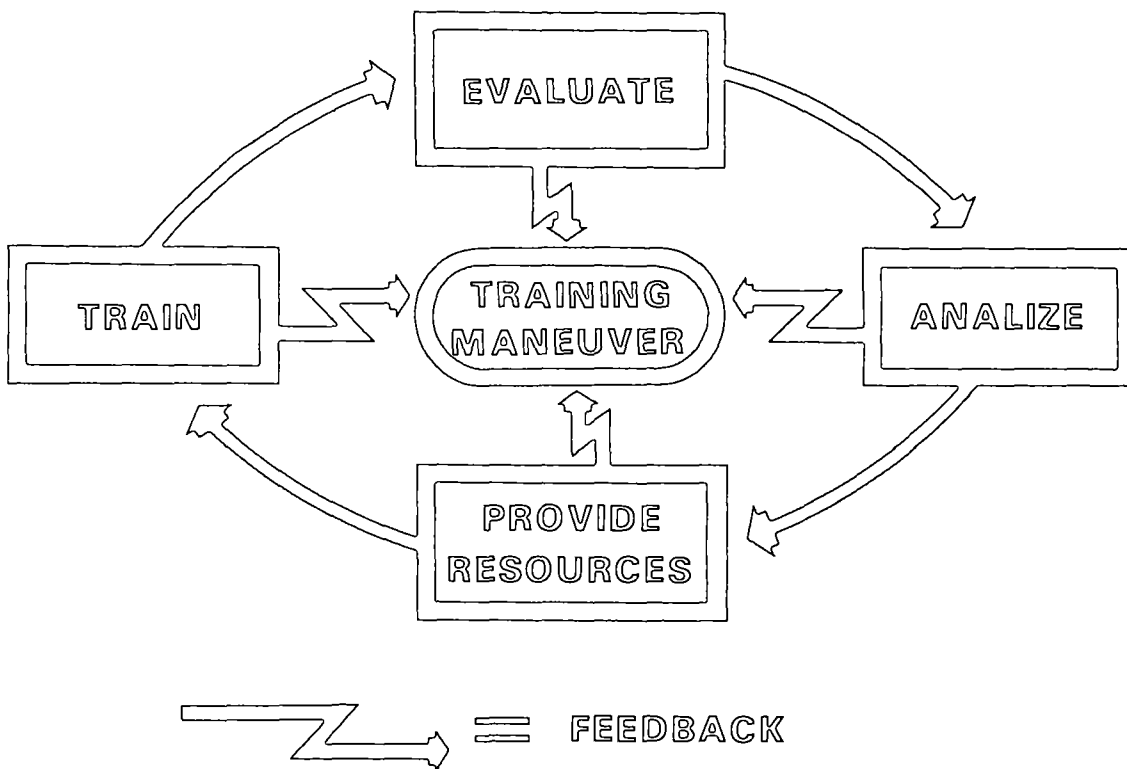


Figure 6-2. Four-step training management model.

continuing process at all levels; the higher the organizational level, the more formal the process. For example, a battalion commander's directions to a battery commander are given as training manager to trainer and constitute a list of training objectives and the resources to support that training. When the battery commander receives these directions, he takes the role of training manager, begins his own analysis, and directs his subordinates to conduct training based upon his analysis. The training management process may occur simultaneously at various organizational levels. It may be formal or informal depending upon the complexity of the training management problem.

An example of informal training management is a TACFIRE div arty fire direction officer correcting the way one of his FDC members performs daily maintenance checks on the computer group. First, he mentally conducts his analysis and allocates resources. That is, he recognizes what is wrong with the way the crewman conducts the checks when compared with the procedure in chapter 13 of TM 11-7440-241-10-9, *TACFIRE Operator's Manual*. He instructs the soldier on the correct way to perform the maintenance in question, insuring the soldier knows how to do it. In terms of the model, he has recognized and analyzed the training need, allocated resources (his own time and expertise), conducted training, and evaluated the training.

A formal approach to the training management process includes detailed analysis of demonstrated performance deficiencies, allocation of training resources, conduct of training at various sites, and evaluation of the training conducted. As the training process becomes more complex, the training manager's approach becomes more methodical.

6-2. ACTIVITIES OF TRAINING MANAGER AND TRAINER

Although the steps of the four-step training model appear to be distinct, they actually merge and overlap. Each step represents a grouping of similar activities involved in managing training. All actions by training managers and trainers are grouped into one of the following four kinds of activity:

Analyze

The training manager must first determine the tasks that the unit or individual must perform using TACFIRE or identify those areas in which there is a demonstrated lack of proficiency. Primary sources for these critical tasks are ARTEPs, soldier's manuals, and mission statements written for TACFIRE-equipped units. Using past evaluations under ARTEP standards, results of SQTs, and his own observations of the unit or individual's performance, the training manager judges which tasks can be done satisfactorily and which require additional training. Based on this analysis, a list of tasks requiring additional training and the priority of each is prepared.

Provide Resources

The training manager compares his list of TACFIRE training requirements to the resources available to support training. He may lack essential resources to conduct some kinds of training. If so, the training manager informs his higher headquarters of the additional support he needs and provides a list of training that cannot be accomplished because of resource constraints. If additional resources cannot be provided by the parent headquarters, the training manager's job is to make the training he can conduct as effective as possible. He works the remaining tasks into a program that he can support with

the resources available to him. He also considers that some training must be completed before other training can be started and that some training requirements are more critical than others. He then prepares a statement of training requirements and the resources to support each requirement. Those training requirements that can be supported with training resources become training objectives.

Besides the resources normally available to any unit, special materials have been prepared to support all of TACFIRE training under the skill performance aids program. These materials include programed texts, audio cassette lessons, Beseler Cue-See audiovisual lessons, job performance lessons, and computer-assisted instruction. Computer-assisted instruction is particularly significant, since it allows the operator to train directly on the part of the system he operates.

Train

The training manager provides the trainer a list of training objectives and resources. These training objectives are stated as specific **tasks**, **conditions** under which the tasks are to be accomplished, and specified **standards** for performing the task. For example:

Task	Conditions	Standard
Perform system initialization	Battalion is preparing for combat operations, communication with mutual support unit has been established, necessary data is available.	Within 150 minutes
Initiate mutual support procedures	The battalion has been designated to provide mutual support and the supported battalion has experienced catastrophic equipment failure.	Within 5 minutes

The trainer then has the information he needs to conduct the training and to get the materials to support that training. When the trainer does not know exactly how proficient the trainee is in a given task, especially a task with several subtasks, the trainer should give the trainee a pretest. This orients the trainer on the trainee's demonstrated weaknesses. After training is conducted, the trainer gives a performance test under the conditions and to the standards furnished him by the training manager. The effective trainer must evaluate the trainee's performance throughout the course of training. He can then modify his subsequent training to insure that the training objective is met.

Evaluate

The training manager evaluates the training to answer two questions:

- Have the training objectives been met?
- Have the training resources been used efficiently?

The first question is answered by the trainer or through objective measures of training proficiency, such as evaluations to ARTEP standards, performance on end-of-training testing, and SQT results. The answer to the second question comes from information supplied by the trainer. The final result of evaluation is one group of training requirements that were met and a second group of training requirements that were not met. This second group of training requirements, information concerning the use of the training resources provided, and the amounts and kinds of resources remaining after training was conducted are inputs for the continuing employment of the training model.

6-3. FEEDBACK AND THE TRAINING MANAGEMENT MODEL

Feedback is the information that tells the training manager how well he is doing the job he set out to do. Without feedback, no model of training management will work. Feedback tells the training manager something about each decision he makes. Without feedback, he makes his training decisions without knowing all the facts. Therefore, training managers and trainers must consider carefully the effects of decisions dealing with priority of training requirements, choice of instructional media, and effectiveness of concurrent training. Any training program can provide desired results if the manager receives effective feedback.

6-4. TRAINING TOOLS AND MATERIALS

Available training resources will greatly influence the success of TACFIRE training programs. Training resources include training areas, fuel, ammunition, training devices, and time. In addition, there are two major training resources that deserve special consideration—training tools and training materials. Some items can be used as training tools and as training material; however, training tools are used primarily by the training manager, training materials by the trainer.

Training Tools

Training tools are aids the training manager uses to determine the training proficiency of an individual or unit. These tools provide a listing of critical individual or collective TACFIRE training objectives. The objectives consist of tasks, the conditions

under which the tasks must be performed, and the standards to which the tasks must be performed. Other tools tell the training manager who is responsible for providing initial and refresher training. Training tools to support TACFIRE include soldier's manuals, commander's manuals, skill qualification tests for each of the enlisted MOSs that work with TACFIRE equipment, and Army training and evaluation programs for TACFIRE-equipped FA units.

a. Soldier's manuals. Soldier's manuals are field manuals written for the individual soldier. They list the critical skills he must master in order to be proficient in his MOS at his skill level. Soldier's manuals provide the conditions and standards associated with each task as well as a list of references that support training in each task.

b. Commander's manuals. Commander's manuals give the training manager a complete listing of critical skills for skill levels 1 through 4 in a given MOS. The list gives tasks, references for each task, and the agency responsible for providing the individual with his initial and refresher training in that task.

c. Skill qualification tests. The SQT measures the soldier's proficiency at his current skill level and determines if he is qualified for advancement to the next higher skill level. The SQT consists of a written portion, hands-on portion, and commander's certification. SQT results are returned to the soldier's commander. They show which tasks were done satisfactorily and which were not. Using SQT results, the training manager and trainer can determine individual training weaknesses. The tasks in the SQT come from the soldier's manual.

d. Army training and evaluation programs. The ARTEPs are the training manager's primary diagnostic tool in

evaluating the unit's training proficiency. As with previous ARTEPs, the TACFIRE ARTEPs will be modularly structured with section outlines specifying tasks that individual sections can use when training independently. Major mission outlines will list tasks for the unit as a whole. Scheduled for production in support of TACFIRE are ARTEP 6-865, *DS/GS Cannon Battalion*; ARTEP 6-802, *Division Artillery*; and ARTEP 6-807, *Target Acquisition Battery*.

Training Materials

Broadly defined, training materials are all those items that impart information to the trainee in support of his training. Field manuals, technical manuals, skill performance aid manuals, training circulars, training extension course (TEC) materials, computer-assisted instruction (CAI), service school instructional material, training aids, and war games all fall under this definition. Each of these various kinds of training material supports some kinds of training better than others. For example, skill performance aid manuals provide the information needed in operator training, whereas field manuals are sources for training system managers and commanders.

a. Field manuals. Field manuals, such as this one, provide the basic doctrinal support for TACFIRE. Information on overall system employment and the manner in which it ties into the field artillery and the fire support systems is in a field manual.

b. Technical manuals. Technical manuals provide technical information about the operation and maintenance of a given piece of equipment. Technical manuals for TACFIRE provide operator and maintenance personnel with technical information such as operating instructions, message formats, input requirements, and diagnostic

procedures for troubleshooting. These manuals will be supplemented by job performance manuals (JPM).

c. Job performance manuals. Job performance manuals are part of a program to make TACFIRE technical information more usable to operators and maintenance personnel. These manuals contain fully detailed, illustrated instructions to guide soldiers in using and maintaining a piece of equipment. Job performance manuals are supported by extension training materials (ETM). Job performance manuals and ETM lessons provide all the information needed to operate and maintain a piece of equipment. ETMs are developed to be compatible with the training extension course program.

d. Training extension courses. TECs are being produced to support training in TACFIRE operator skills. TEC lessons come as programed texts, audio cassettes, and Beseler Cue-See audiovisual programs. TEC lessons, each of which is independently structured, provide the training manager with a flexible method of conducting training. TEC also provides an excellent vehicle to conduct individual refresher training and makeup training.

e. Computer-assisted instruction. TACFIRE has a unique capability for computer-assisted instruction. CAI gives the training manager considerable flexibility in planning operator training. With CAI, the computer is loaded with a special program tape. The operator responds to computer-generated instructions as the program exercises all of the skills the operator is required to demonstrate. The program is designed so that mistakes are noted as they happen, and additional training is presented to upgrade those deficiencies. CAI programs are designed to provide a running report of the performance of the operator. CAI has the

potential to train all personnel throughout TACFIRE. Programs are being developed to train the FDO/ACCO/TES team in the TACFIRE shelter. Programs are planned that will provide an entire scenario to use all critical skills in the system. It is possible that, in the future, evaluations of TACFIRE units will be conducted by a senior evaluator who puts a tape on the auxiliary memory (ARMM) and lets the computer conduct the evaluation and maintain a record of performance.

f. Training and Audiovisual Support Center (TASC). TASC can supply the training manager and trainer with various types of audiovisual aids, graphic training aids, and training devices.

g. War games. War games such as Broadsword, Longthrust, First Battle, and CAMMS can be used by commanders and their staffs in the use and modification of the various programs of TACFIRE. Manual war games allow the training manager to replay a given scenario using changed commander's criteria and guidance in each successive iteration. Seeing how these program modifications change TACFIRE's output in otherwise identical conditions gives insight into the effects of changing criteria. To be used in this manner, however, a war game must use a grid system that will allow targets and fire units to be input into the computer; and it must involve at least an artillery battalion as a controlling headquarters.

6-5. TRAINING THE OPERATORS

The field artillery TACFIRE includes approximately 80 to 100 duty positions requiring varying degrees of specialized knowledge to operate the system. Personnel operating TACFIRE must be trained to

perform at each duty position and, in addition, they must practice in working together as a team to refine interaction skills and increase the speed at which they perform their jobs.

Phases of the TACFIRE Advanced Training Program

The three-phased TACFIRE advanced training program (TATP) has been developed to expedite training of the individual and the team. Each phase is a necessary prerequisite to the next phase.

- Phase 1. Individualized skills and knowledges.
- Phase 2. Subsystem training (team training).
- Phase 3. System exercises (ARTEP).

TACFIRE personnel are not completely trained and battle-ready until they have completed all three phases of training. The individualized training in phase 1 forms the basis for all training in phases 2 and 3.

a. Each TACFIRE training module generally consists of from 1 to 15 lessons. A number of different media, including audiovisual aids (Beseler Cue-See), programed texts, job performance manuals, computer-mediated practice, and computer simulation team practice, are used to teach different lessons.

b. Each lesson is individualized; therefore, the soldier can take each lesson without outside assistance. The instructional media will teach and test the content of each lesson. At the end of each lesson, the soldier will take a self-administered test to measure the attainment of the lesson objectives. If he passes the lesson test, he will be instructed to proceed to the next lesson. If he fails the

lesson test, he will be instructed to repeat the lesson. The lesson test items and answers are built into the lesson itself.

c. When the soldier has completed the lessons in a module, he must report to the instructor to take the module test. Module tests are administered and scored by the instructor. If the soldier passes the module test, he is directed to the next module. If he fails the module test, the instructor will take action to correct the student's deficiencies before advancing him to the next module.

d. The instructor's role in the individualized program is somewhat different from what it would be in a platform-oriented course. The lesson media rather than the instructor is responsible for teaching the course content. The instructor is responsible for testing and evaluating the student, directing him from module to module, and providing additional help as required. The instructor will occasionally answer questions asked by the student and redirect the student if he has difficulty.

e. Students taking lessons in the audiovisual and programed text formats will be able to operate completely on their own without instructor assistance. Students receiving computer-mediated practice may require instructor assistance to initially call up the program on the ACC or the VFMED consoles.

f. There are some lessons that are taught by a job performance manual and require the student to perform operations on the actual TACFIRE hardware. For these lessons, the instructor will insure that the equipment is in the correct configuration to begin the lesson and will coordinate the lesson activity with training actions taking place on other parts of the system.

Features of the TACFIRE Advanced Training Program

The TACFIRE advanced training program is an individualized program of training with the following characteristics:

a. *Operational objectives.* All training is translated into measurable student performances. At the end of a lesson, the soldier must be able to say or do certain things that indicate that he has mastered the lesson. These objectives have been defined in the individual performance module and lesson design approach documents that guide the actual lesson development, test, and validation.

b. *Self-pacing.* Each soldier progresses through the lesson at his own pace. Different people have different learning rates. In a group instruction, these individual differences are ignored. This forces everyone to learn at the group pace, which is too fast for some and too slow for others. With self-pacing, how fast or slow a student learns is of little or no importance. What is important is that when he completes a module or lesson he has mastered the skills taught.

c. *Active responding.* Some instructional scientists claim that the amount a student learns is directly proportional to the number of responses he makes in the form of answering questions and doing exercises. The best learning conditions exist when the student spends half of the lesson time performing practice exercises. The lessons contain frequent exercises to give the student practice in what he has just learned, resulting in greater learning effectiveness.

d. *Sequencing.* TACFIRE skills are taught in an orderly sequence starting with elementary behaviors and gradually building up to the more complex concepts and

procedures. The student is tested at the end of each lesson and at the end of each module to insure that he has mastered the prerequisite skills before learning the new skills.

e. Student control. The student controls the rate of presentation of the information being taught. He can slow it down or speed it up depending on his own individual preference. He also can repeat certain sections of the lesson. The student becomes an active part of the learning experience instead of passive as in other forms of instruction.

f. Real-world practice. The student is trained under actual job conditions to every extent possible. All ACC operators and VFMED operators are given extensive practice on the consoles that, for training purposes, are connected to computer simulators. Personnel who work with equipment are given practice on the equipment. Students are prepared for equipment operation via audiovisual and programed text lessons.

g. Progress checking and corrective feedback. The student must demonstrate mastery of each module before beginning the next module. He demonstrates this mastery by means of the module test administered by the instructor. If the student fails the test, the instructor must analyze test results and redirect the student to correct his performance deficiencies.

Role of the Instructor

In the more traditional approaches to training and education, the instructor is responsible for presenting the course content to the students. In the most common form, the instructor or teacher talks and the students listen. Most of the instructor's time is spent

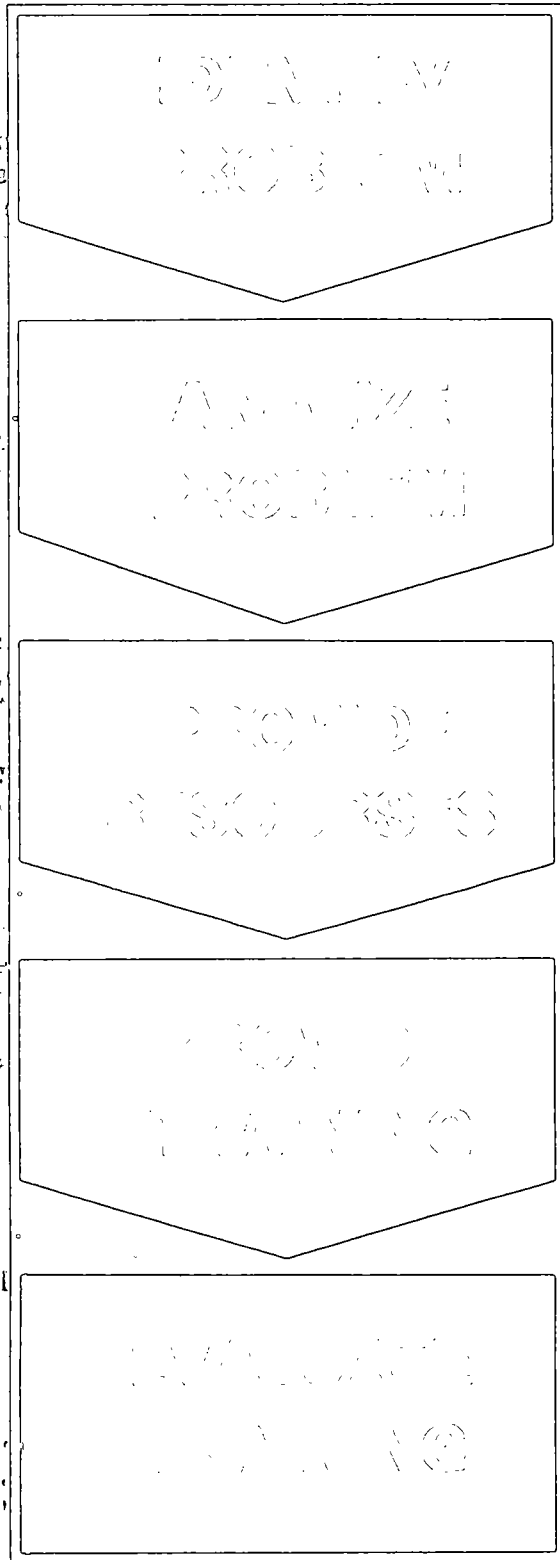
giving lectures or preparing lectures. In an individualized program, the course content is presented by various media. There are few if any lectures. Although the task of planning and giving lectures is eliminated for the instructor, a number of new tasks must be performed in an individualized system.

a. The instructor in an individualized system should see himself as a learning manager. He must manage the learning environment for the 15 to 20 students assigned to him to help them learn. He directs the students to the appropriate lessons, evaluates their performance, redirects them when they make mistakes, and keeps records on the progress of each student. It may be difficult for some instructors to let the student progress by himself. The idea that a student can learn without the teacher or instructor telling him something is a new concept for many. However, after a few days of experience observing the results of individualized instruction, most instructors will adapt to their new roles.

b. There is a great deal of personal contact between student and instructor. This contact occurs in testing and evaluation, in answering of questions, and in assisting students when special problems arise.

Training Scenario

The scenario will show how the model helps the recognition and solution of a training problem. In this particular situation, the operator's supervisor is both the training manager and the trainer. The training model is developed as follows:



a. The problem. During a div arty command post exercise (CPX), while the CF VFMED was down for maintenance, MAJ Richardson directed SFC Franks, the artillery control console operator, to modify the current standard values in the artillery target intelligence program by values which he (MAJ R) provided, to allow a greater number of target combinations. MAJ Richardson determined that SFC Franks applied the modification values incorrectly. This fact and the time taken to complete the task convinced MAJ Richardson that SFC Franks had difficulty in modifying the ATI criteria.

b. Analyze. Recognizing certain tasks that SFC Franks could not do was the start of the analysis process. Because MAJ Richardson is completely knowledgeable of the skills required of his ACCO, his analysis was based primarily upon his observations of the operator's performance. If MAJ Richardson had not known these required skills, he would have relied upon some objective measure of proficiency, such as evaluation under the conditions and to the standards listed in the soldier's manual. Having identified the problem, MAJ Richardson's training objective is that SFC Franks know how to modify the criteria values in the ATI program correctly.

c. Provide resources. In considering support for his operator's training, MAJ Richardson knows that time and access to the div arty computer are the two most critical resources needed. The task of identifying suitable self-paced instructional material has already been done for him in the training handbook that came with the TACFIRE extension training materials. The training handbook defines the training SFC Franks needs and recommends the most efficient way to conduct this training using TEC

pamphlets, audio cassettes, audiovisual Beseler Cue-See lessons, and computer-assisted instruction.

d. Train. After securing the prescribed training materials, access to the computer, and relief from some duties for SFC Franks, MAJ Richardson has SFC Franks go through the program of instruction outlined in the training handbook. Some of the basic material is in the form of audiovisual TEC lessons that are viewed in the individual learning center. The remainder of the training may be accomplished at the artillery control console using CAI. The program outlined is basically in two parts. The first part is a review of the fundamentals of modification of the ATI program and employs programed texts, cassettes, and audio tapes as the primary training materials. The second part uses computer-assisted instruction tapes which, when fed into the computer, generate a series of instructions and practical exercises designed to carry SFC Franks through all the ATI criteria modifications. The basic exercises act as pretests. If SFC Franks answers correctly, the computer goes on to the next exercise. If not, the computer branches him into a series of short lessons designed to remedy shortcomings.

e. Evaluate. The computer-assisted instruction program tells MAJ Richardson the number of correct or incorrect responses SFC Franks has given, thus allowing him to judge if his training objective has been met. Maintaining this information—the student summary—is part of the TACFIRE CAI program. If MAJ Richardson wants to know which replies were incorrect, he refers to the student history file of the program, which lists each response and shows where SFC Franks was branched into diagnostic lessons.

6-6. TRAINING THE TEAM

Because of its complexity and flexibility, TACFIRE can continue to operate even when a portion of its equipment is disabled. This ability is one of the strengths of the system. To fully use this capability, operators and supervisors must be completely familiar with each piece of equipment, and must know what to do if a piece of equipment fails, and must function as a team. Training managers and trainers must devote as much care to this team training as they devote to operator training. The technique is simple: Make a piece of equipment inoperable by the physical insertion of a "bad card." This causes the operators to perform fault isolation (FI) and fault detection (FD) to find the problem. If the individuals in the shelter are working as a team, the system will be functioning again, usually within 20 minutes. If they are not, it will soon become very obvious, and appropriate remedial maintenance training should be planned for and conducted to insure the operators are thoroughly trained.

The following example demonstrates the teamwork required of the battalion fire direction officer, the artillery control console operator, and the TACFIRE equipment specialist. In it, the battalion S3 introduces an artificial equipment failure requiring the team to reconfigure the computer to operate in an alternate mode.

a. The battalion S3 decides that he will call out the communications control unit. The FDO and the ACCO must isolate the problem, and the TES must isolate the fault within the malfunctioning piece of equipment. The FDO discovers that he has a problem when he can no longer send digital messages to his subordinate stations. He begins a methodical process to isolate the inoperable equipment. He has the ACCO check to see if he can

communicate by voice from the radio and digitally from a digital data terminal and the communications control unit. He discovers that communications break down at the CCU. The FDO directs the TES to perform fault isolation tests on the CCU. At this point, the S3 steps in and declares the CCU unreparable and directs the FDO to take appropriate action. The FDO then recommends to the S3 that the computer be reconfigured to operate in an alternate mode, and the S3 agrees. The FDO directs the TES to reconfigure to the "CCU-off" mode and tells the ACCO to help. The FDO then directs the TES to reroute the communications terminal box on the outside of the shelter to correspond to the current net structure. When this is completed, the FDO checks to see that he has voice and digital communications with all of his subscribers. Because of the many things required by this exercise, it tells the S3 how familiar the FDO, ACCO, and TES are with their equipment and how well they function as a team.

b. A similar but more complex exercise is to interject a failure of IOX B in the input/output unit. This renders the artillery

control console inoperable and, once the fault is located, requires the rerouting of most of the computer's peripheral devices.

6-7. TRAINING THE COMMANDERS AND THEIR STAFFS

Finding ways to train commanders and their staffs in the input of TACFIRE program modifications will be one of the most difficult problems facing the training manager. One possible approach is the use of TACFIRE with war games such as Longthrust and First Battle. The scenarios of these war games can be replayed many times, each time varying a tactic or a procedure or the allocation of units. These war games will help the commander to better understand the effects of his guidance and criteria in terms of the system. The skill of commanders in issuing guidance and criteria that maximize the effectiveness of the system is as important as the skill of operators in using the various pieces of TACFIRE equipment.

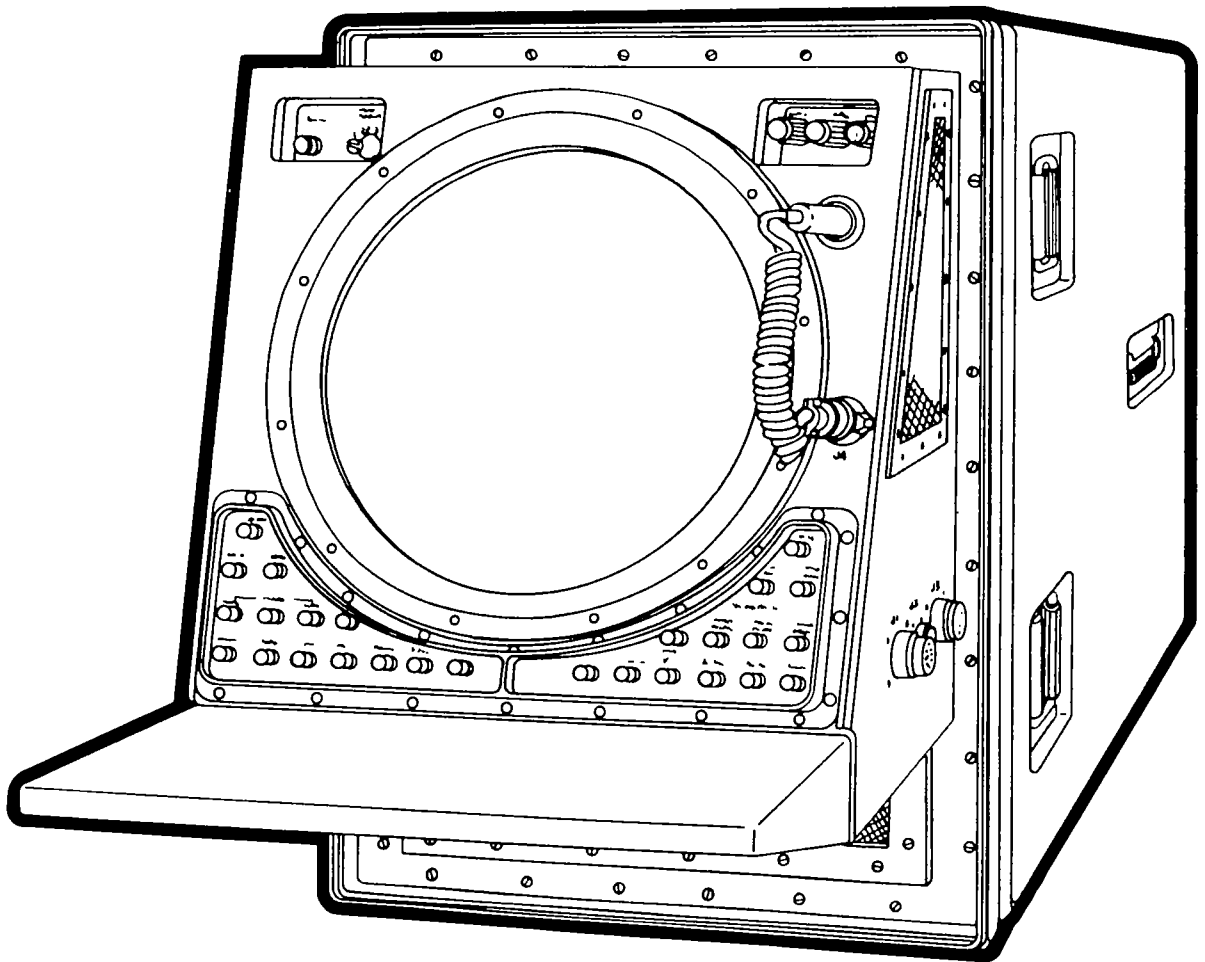


Figure A-14. Electronic tactical display.

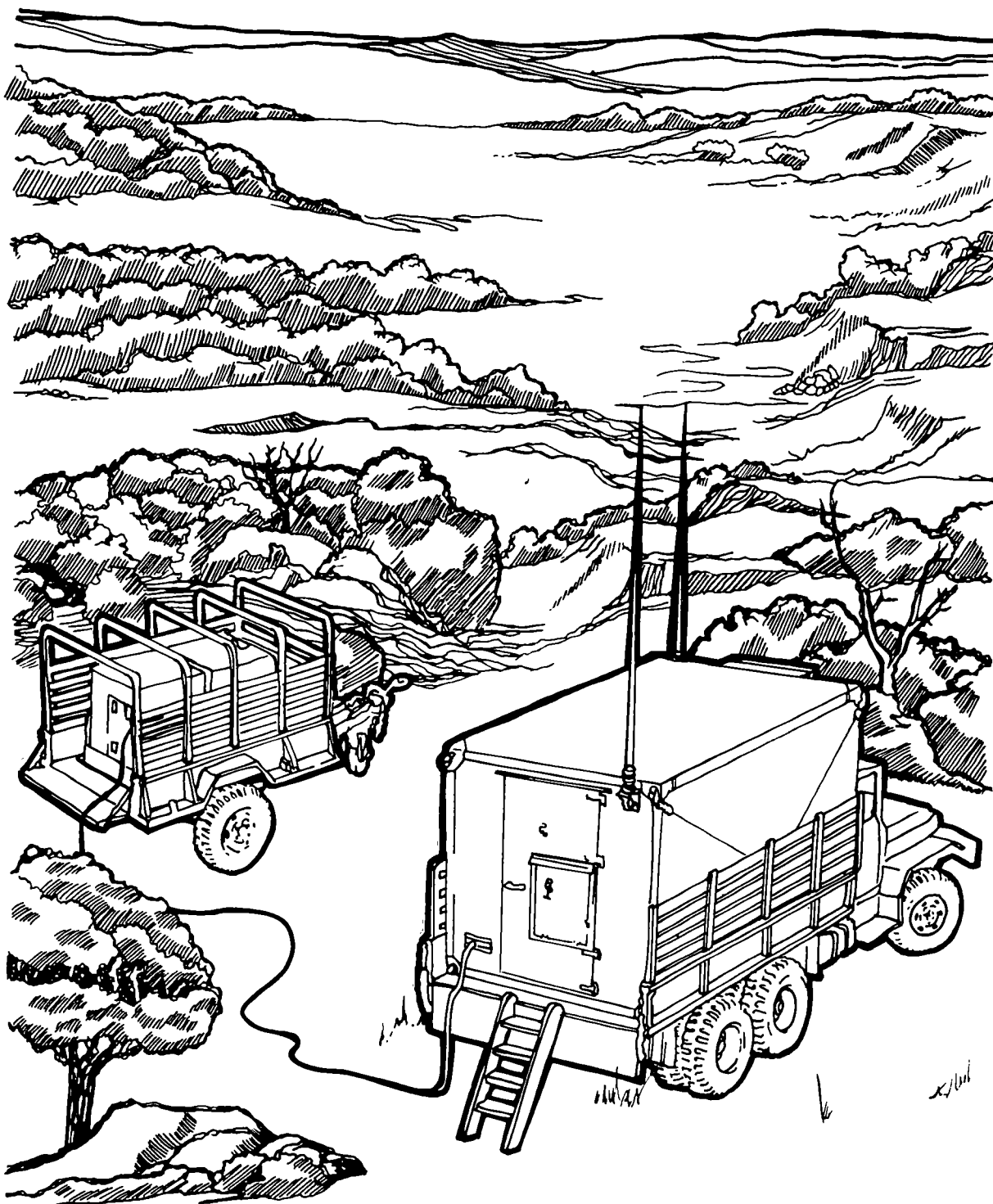


Figure A-15. Fire direction center in-shelter configuration.

APPENDIX A

HARDWARE

TACFIRE consists of two major subsystems: a TACFIRE division artillery subsystem and a TACFIRE battalion.

Div arty subsystem (FCE) plans and controls artillery fire support for the entire division and is housed in two S-280 shelters, a computer group shelter and a display group shelter.

The battalion subsystem (FDC) plans and controls artillery fire support for a battalion and is housed in one S-280 shelter.

Power is provided by trailer-mounted generator sets (120v/208v ac, 3 phase) located away from the shelters. The alternate source of power is 28-volt dc battery-supported alternators in the trucks used to carry the S-280 shelters.

A-1. COMPUTER GROUP

Computer

The computer is the central active element of the div arty automatic data processing subsystem. Under program control, it responds to varied types of inputs, producing results that are displayed in several different ways. The computer contains three main elements: the central processing unit, the input/output unit, and four mass core memory units.

a. Central processing unit. The central processing unit is responsible for the arithmetic and control functions of the system.

b. Input/output unit. The input/output unit, independent of the CPU, largely controls communication between the memory and the peripheral equipments.

c. Mass core memory unit. The hardware implementation of the IOU is complete to the point that it operates almost in parallel with the central processing unit. The mass core memory units reduce the probability of conflict for access between the CPU and the IOU. The MCMUs provide 524,288 words of memory or 131,072 words per bank.

Removable Media Memory Unit

The removable media memory unit (RMMU) at div arty contains two auxiliary removable media memories. There is only one auxiliary removable media memory unit at battalion. The ARMM is a magnetic tape control. It is a single unit containing tape control electronics and is used with the tape transport cartridge (TTC). TTC provides a magnetic tape ½ inch wide and 234 feet long. The TTC has a drive motor, a read/write head assembly, and the beginning-of-tape and

end-of-tape sensors. The ARMMs, with their associated TTCs, are used to store and load computer programs and also to record dynamic situation data. The computer controls the tape movement using operator commands and computer-generated instructions that are decoded and converted into tape movement and read/write functions. The ARMM is used for loading master computer programs, storing data unique to the specific unit, and recording dynamic data. Generally two TTCs are used: one for loading the master computer programs and one for loading unit unique data and for recording dynamic data. This procedure of recording unique unit data is called salvage point recording.

Communications Terminal Equipment

a. The data terminal unit (DTU) consists of two digital data terminals mounted in a transit case. The div arty computer group contains three standard DTUs as well as one additional DTU that contains a single DDT mounted in a transit case. The computer group at battalion contains three DTUs each containing two digital data terminals. The VFMEDs of the fire support elements as well as the BDUs of the firing batteries each contain a remote data terminal (RDT). The DDT provides interface (via the communications control unit) between the computer and a communications device in order to link the div arty FCE to the battalion FDCs and remote devices. The digital data terminals at computer centers convert outgoing messages from digital form to frequency shift keying (FSK) signals for transmission. They transform received FSK signals to digital form for use by the computer. With the exception of the FO, all subscribers encrypt and decrypt messages using keying generators. The opposite end of the link functions in the same way. The DDT is the device that makes communication between computers and between computers and

remote devices possible. The digital data terminal does this by converting the digital data to usable audio signals for use in transmission. There is a COMSEC device with the computer and with each VFMED and BDU. These COMSEC devices encrypt the messages prior to their transmission and decrypt received messages. The DDT and RDT also perform signal error detection and correction. The DDT/RDT has a digital data transfer rate of 600 or 1200 bits per second, and single or double blocks/modes of 15 characters per block. This serves as an ECCM when jamming is received.

b. The communications control unit is a communications facility that provides for monitoring, control, and integration of voice and data communications. This unit manages all nets terminating with the TACFIRE computer center by allowing the operator to connect a DDT to any desired communication device in much the same way he would connect a switchboard. A foot switch is provided to allow for hands-free, push-to-talk operation. The CCU offers communications not previously available. It allows integration of wire, AM/SSB radio, and FM radio, or any combination of these communication means to be netted. The CCU also provides rapid net configuration and reconfiguration. This net configuration capability is provided for eight nets and is accomplished using any standard Army communication device. The CCU will allow the FDO to monitor or talk on any net by turning a single switch on the remote communications monitor unit (RCMU) to the desired net.

c. The remote communications monitor unit provides monitoring capabilities on any data net or combination of nets. An intercom circuit is provided for communications with up to four other RCMU operators and the CCU operator. The RCMU functions as a local subscriber to the CCU and can be

located up to 100 meters from the CCU. The RCMU permits a remote operator to enter any or all nets, on voice, for command control purposes. At div arty, one RCMU is located within the display group shelter while two additional RCMUs, each with a headset, are usually located remote from the shelter. At battalion, one RCMU is located within the computer and display shelter and a second RCMU with a headset is located at a remote position.

d. Communications terminal box (CTB) is the centralized terminal for wire (including remotored radios) or cable communications entering the shelter(s) housing the computer center. The CTB connects external communication circuits, remote control monitor units, and the CCU. The external wires are connected to spring-loaded binding posts on the CTB. In addition, the CTB is the terminal for the data exchange signal cables that connect the computer and the display shelters at div arty. The CTB also contains in-line filters for each wire circuit. These filters provide electromagnetic interference (EMI) filtering and lightning arrestor protection.

The Power Converter Group

The power converter group (PCG) is found at both div arty and battalion and enables the distribution of primary power to the computer group equipment via interconnecting cables. It contains power distribution equipment, protection devices, and connections for all equipment. The PCG 120v/208v ac power from military generator sets and/or 28v dc power from one or two 100-ampere 28-volt dc military vehicle alternators. The PCG and its associated cables connect the computer to these power sources via the power entry panel (PEP) when installed in a shelter or directly when installed out of a shelter. The PCG provides the required control and current protection for FCE/FDC equipment, lighting, and convenience outlets.

Module Test Set

The module test set (MTS) is used to isolate malfunctions in the electronic equipment by testing circuit cards and displaying test results. The TACFIRE equipment specialist employs a go/no-go circuit card test set to test each indicated circuit card. A hand-held circuit card test probe is cabled to the side flange of the front panel. When the no-go indication appears, that circuit card is checked by the operator and replaced as necessary. Many replacement circuit cards and repair parts are provided to each computer center in the mission essential parts kit. If the operator cannot repair the piece of equipment, he can exchange the entire item. The use of individually removable components provides modularity for the TACFIRE. Modularity, in turn, enables the TACFIRE equipment specialist to correct at least 90 percent of the computer failures within 30 minutes by exchanging the failed part with one from the spare parts provided with the system.

A-2. DISPLAY GROUP

The Artillery Control Console

The ACC consists of an alphanumeric keyboard, two display editors (DE), a switch panel assembly (SPA), and connecting cables.

a. Keyboard. The keyboard is used to type in changes and corrections to standard messages displayed on the lower display editor. The keyboard unit consists of a standard four-row keyboard plus several additional keys and switches. The keyboard generates American Standard Code for Information Interchange (ASCII) characters. The character set consists of the alphabet, 10 numbers, and several special

symbols. These symbols include acknowledgment (ACK), end of transmission (EOT), dollar sign, and asterisk. The special switches control functions such as cursor control, power, compose mode, transmit, print, repeat, and erase.

b. Display editors. Two identical DEs are provided. They are mounted on the right side of the artillery control console. The upper DE is called the receive display (RD) editor and is used to display incoming messages and messages that have been processed by the computer. The lower one, called the compose/edit display (CED) editor, is used to display messages while they are being edited, composed, or changed.

c. Switch panel assembly. The SPA on the left side of the artillery control console permits manual control of the computer. The SPA provides for accessing formats and messages required to implement artillery functions, transmitting messages to other computers, and controlling computer operations. A matrix of 64 message formats and message directories is provided with eight row and eight column selector switches. Pressing a row switch and a column switch and the FORMAT COMMAND switch permits display of a selected message format on the compose/edit display editor.

d. Artillery control console. The ACC is the primary device used to control the computer. As digital messages or data are received from external sources such as other computers, the messages are displayed on the receive display editor. The operator also receives a printed copy of the same message on the electronic line printer (ELP) if the computer has been redirected to print that type of message. If the operator wishes to change the data or begin additional computer processing of the message information, he can, by pressing the proper switches, cause the computer to perform the desired

processing. After the processing is finished, the ACC again displays the finished message on the RD. The artillery control console operator can then cause the data to be selectively transmitted to batteries, FSOs, or other computers by pressing the proper switches. In this manner, the ACCO controls the processing performed by the computer.

Electronic Line Printer

The ELP prints all incoming and outgoing information. A helix assembly receives high voltage pulses that cause the helix assembly to generate arcs from the helix coil. The arcs cause oxidation (burning) of the paper's white surface layer, exposing dots (in character patterns) on the black background. Each character printed is a combination of a five-column, seven-row dot matrix. The printing speed varies from 1 to 600 characters per second. When 72 characters are printed per line, the printing rate is 600 characters per second. The printers in computer centers and at remote locations provide hard copy printouts of all incoming and outgoing messages for inclusion in staff journals and historical records. The printer prints out details of the fire mission requests and the fire mission processing results so that the computer-recommended solution can be reviewed by the FSO, FDO, S3, or commander.

Digital Plotter Map

The digital plotter map is an electro-mechanical assembly used to draw symbols on a map or an overlay. The DPM consists of a recorder; plotting display, called the display plotting unit (DPU); and a controller assembly, known as the display control unit (DCU). The DPU is an electromechanical assembly that positions a write head at any point on a 48- by 48-inch plotting surface. Positioning of the write head is controlled by the computer in the automatic mode or by the operator in the manual mode. The DPM draws military symbols, unit designations, target numbers, and other tactical data. For

example, when a fire request is received at battalion, a blinking indicator on the DPM will alert the operator that the DPM has data to be displayed. Extinguishing the blinking indicator will cause the write head to move and make a dot at the target location. Should the AUTO switch be set at ON, the write head will move without operator action. Additionally, the ACCO may use application program messages to command the DPM to display tactical data, or the DPM operator may, by entering coordinates, command the DPM to draw or connect points he has entered manually. It is necessary for the ACCO to enter orienting data for the DPM, and the DPM operator must physically orient the DPM relative to the area of operations. The DPM is capable of generating approximately 100 different standard Army symbols and alphanumeric characters. When appropriate, the ACCO will enter coordinates of several points that form coordinated fire lines, no fire areas, etc. After these sets of coordinates are entered, the DPM will draw and label connecting lines.

Electronic Tactical Display

The ETD displays tactical data on a 16-inch cathode-ray tube. Data consisting of standard Army symbols and alphanumerics is collected in a special buffer and sent to the ETD for display. Front panel controls permit the operator to select the type of display. Character generator circuits provide the characters and symbols for display under control of the display programmer and display controller of the computer. Finally, the analog circuits trace the requested information on the cathode-ray tube. A light pen, which is part of the ETD, is used to remove data from the screen or to cause the display to be offset (shifted) to permit detailed picture display. The display is refreshed continuously. The ETD is found at corps FAS, div arty, and FA brigade and provides the artillery commander, operations officer, and the fire direction officer with an

electronic depiction of the tactical situation. The ETD provides blinking displays for rapid operator alert and action. Fire requests sent to corps FAS, div arty, and FA brigade may be displayed on their ETDs in the same manner that battalion fire requests are handled by the digital plotter map. Up to 250 complete sites may be displayed on the ETD scope. The ETD will display fire support coordination geometry, fire units, fire plan targets, fire unit fans, and selected classes of data such as all armor or all artillery targets.

A-3. REMOTE DEVICES

Variable Format Message Entry Device

The VFMED consists of a message entry group (MEG), an electronic line printer, and an extendable mounting base. The MEG consists of a keyboard, display element, and remote data terminal (RDT). The VFMED RDT is connected to a KG-31 COMSEC device for secure digital transmissions. The VFMED is a two-way device providing for encryption, transmission, receipt, acknowledgment, and decryption of messages. The VFMED is used at unit sites supported by field artillery. These include FSEs at the supported unit command posts. The VFMED permits the user to input to and receive output from a TACFIRE computer in order to utilize computer processing from remote locations. The interchange of classified data via standard communication circuits is provided by the KG-31 device. The VFMED is only a terminal; operated much like the ACC, it performs no processing. The operator can access messages directly from the computer, make entries, and transmit the messages back to the computer for processing and action. Only those messages that were established as being legal will be received and processed without an error and warning message attached. Messages received by the

VFMED are printed on the ELP and can be simultaneously displayed on the display element. The VFMED keyboard generates ASCII-coded characters for display on the DE during message composition and editing. An RDT, which is part of the VFMED, converts the digital signals to FSK form for use with a tactical field artillery radio or wire communication circuit. The VFMED communicates with the computer over any standard Army tactical communication equipment. The VFMED is transportable by any vehicle $\frac{3}{4}$ ton or larger. Power (28v dc) is supplied by the batteries of a vehicle with a 100-ampere kit or a portable generator through the power distribution box.

Digital Message Device

The DMD is a two-way, one-man, portable tactical digital message communication terminal used to provide communications with standard data entry and reception formats. The DMD is used by FIST observers, air observers, sound and flash observers, and sound and flash centrals to communicate with the TACFIRE computer, VFMEDs, BDUs, and other digital message devices. Normally, they will communicate directly with the fire direction center. The capability exists where the DMD can relay through the FDC to an FSE or BDU automatically. If the DMD and another device (VFMED, DMD, or BDU) are on the same frequency, messages can be transmitted directly to that device if the destination address is changed on the originating DMD to that device's address. This is not normal and should be used only in emergencies. The DMD has the capability to interface with the ground/vehicular laser locator designator (GVLLD). The DMD may be used with tactical FM single channel radios such as the AN/PRC-77, AN/VRC-12, and AN/ARC-54. The tactical AN/GRC-106 single sideband radio, the AN/TRC-145 multichannel radio, and standard Army WD-1/TT field wire may also be used with

the DMD. The DMD does not have a COMSEC device, but messages may be manually encrypted, if required, using free text message format. The DMD is powered by either internal or external 24v dc batteries. A primary characteristic of the DMD is that it "prompts" the operator. For example, the FO indicates on the DMD that he is initiating a fire mission by grid coordinates. The DMD then presents the word "EASTING" on the scope and blank spaces for numeric entry. When the FO has input the final digit of the easting, the DMD presents the word "NORTHING" and spaces for entry. This process continues through each element of the standard call for fire ending with method of control. The observer is required to make only one entry—the target location. He may omit any remaining data if he desires. The message to observer is returned to the observer by the TACFIRE computer.

A-4. BATTALION SUBSYSTEM

Only one piece of equipment associated with battalion was not covered in the div arty equipment description. This is the battery display unit.

Battery Display Unit

The BDU consists of an electronic line printer, a remote data terminal, and a COMSEC device, which is a separate piece of equipment used for secure digital communication. During combat operations, the cannon battery delivers fires in response to a call for fire from the battalion FDC. Normally, the battalion FDC receives the call for fire and prepares fire commands via the computer. If this mission is approved, the FDC causes the computer to digitally transmit these fire commands to the cannon battery. At the FA battery, the fire commands

are received and printed by the battery display unit. The BDU is used at field artillery firing battery sites as a one-way device capable of receiving, acknowledging, decrypting, and printing messages received from a TACFIRE computer. It provides a printed copy of all firing commands and other artillery information received via a digital data link from the battalion FDC. For example, during fire planning, the battalion FDC determines fire commands to support the schedule of fires. This data is also transmitted to the battery. The battery executes the fire plan in accordance with the prescribed schedule. The BDU is mounted in racks on a universal mount for use on various military vehicles or fixed-table installation. Equipment that is used with the BDU, but is not part of the BDU, includes two tactical radio sets (AN/VRC-46 or equivalent), an electronic tactical keying generator (KG-31), and a power distribution box that is part of the universal mount. The power distribution box receives 28v dc power from an external generator or batteries in a vehicle that has a 100-ampere kit.

Equipment Inventory

The battalion subsystem has a different equipment inventory from that of div arty. The battalion has the following equipment:

Three MCMUs
One ARMM
One ELP
No ETD

A-5. COMMUNICATION EQUIPMENT

Communications between computer centers as well as between computer centers and remote devices will be over radio and wire nets. Communication security equipment is the KG-30 series keying generators.

Appendix C of this manual describes communications in greater detail.

Note: TACFIRE equipment and its interchangeability and basis of issue at computer and remote locations are shown in figures A-1 through A-17.

Equipment Identification	Equipment Utilization			
	Counterfire FSE Operations and Intelligence (VFMED)	Btry (BDU)	Bn Computer Center	Corps FAS/ Div Arty/ FA Bde Computer Center
Auxiliary removable media memory			1	2
Central processing unit			1	1
Communications control unit			1	1
Digital data terminal			6	7
Digital plotter map			1	1
Display editor	1		2	2
Electronic line printer	1	1	1	2
Electronic tactical display				1
Input/output unit			1	1
Keyboard	1		1	1
Keying generator	1	1	1	1
Mass core memory unit			3	4
Module test set			1	1
Power converter group			1	2
Remote communications monitor unit			3	4
Remote data terminal	1	1		
Tape transport cartridge			2	2

Figure A-1. Interchangeable TACFIRE equipment table.

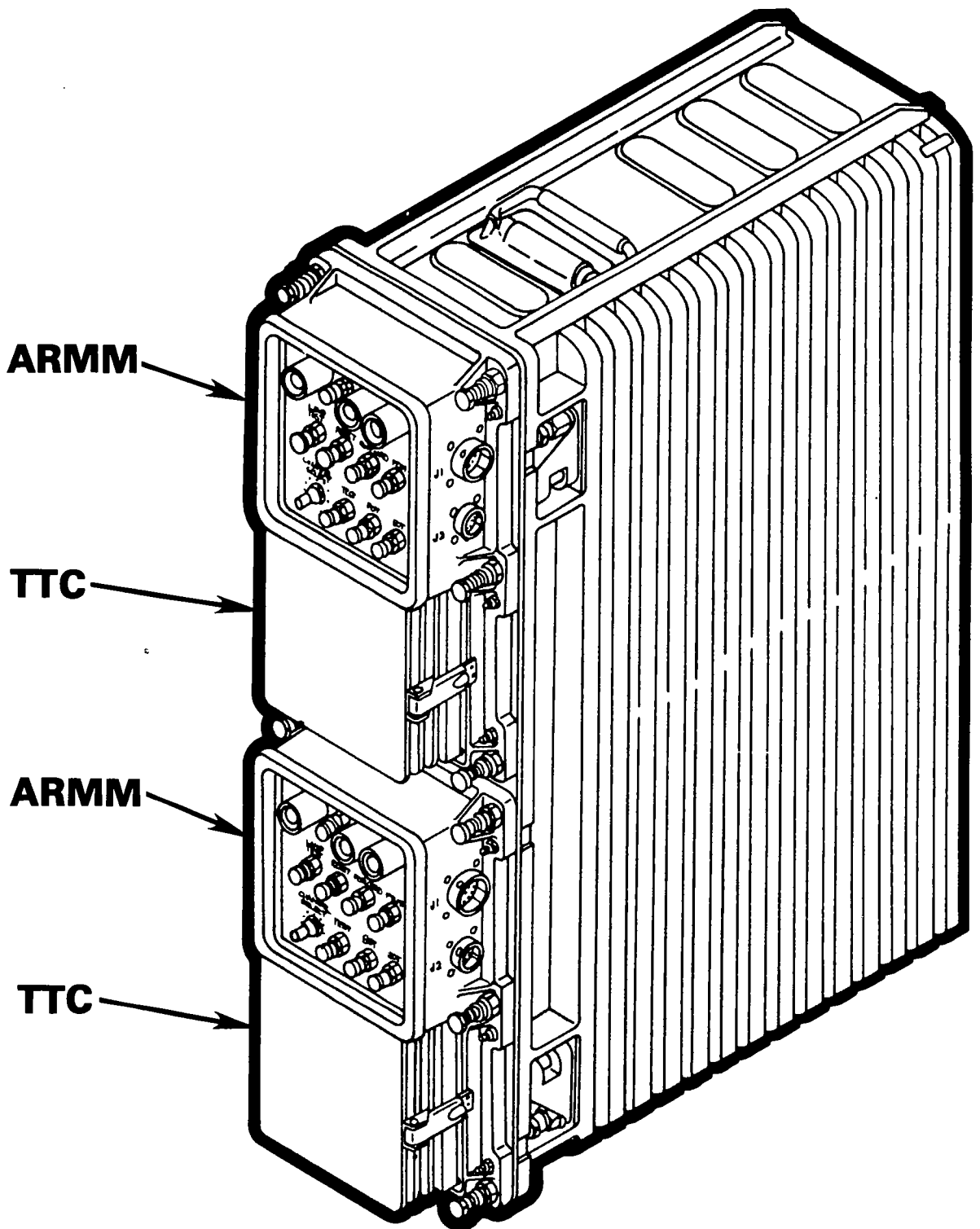


Figure A-2. Division artillery removable media unit with associated tape transport cartridges.

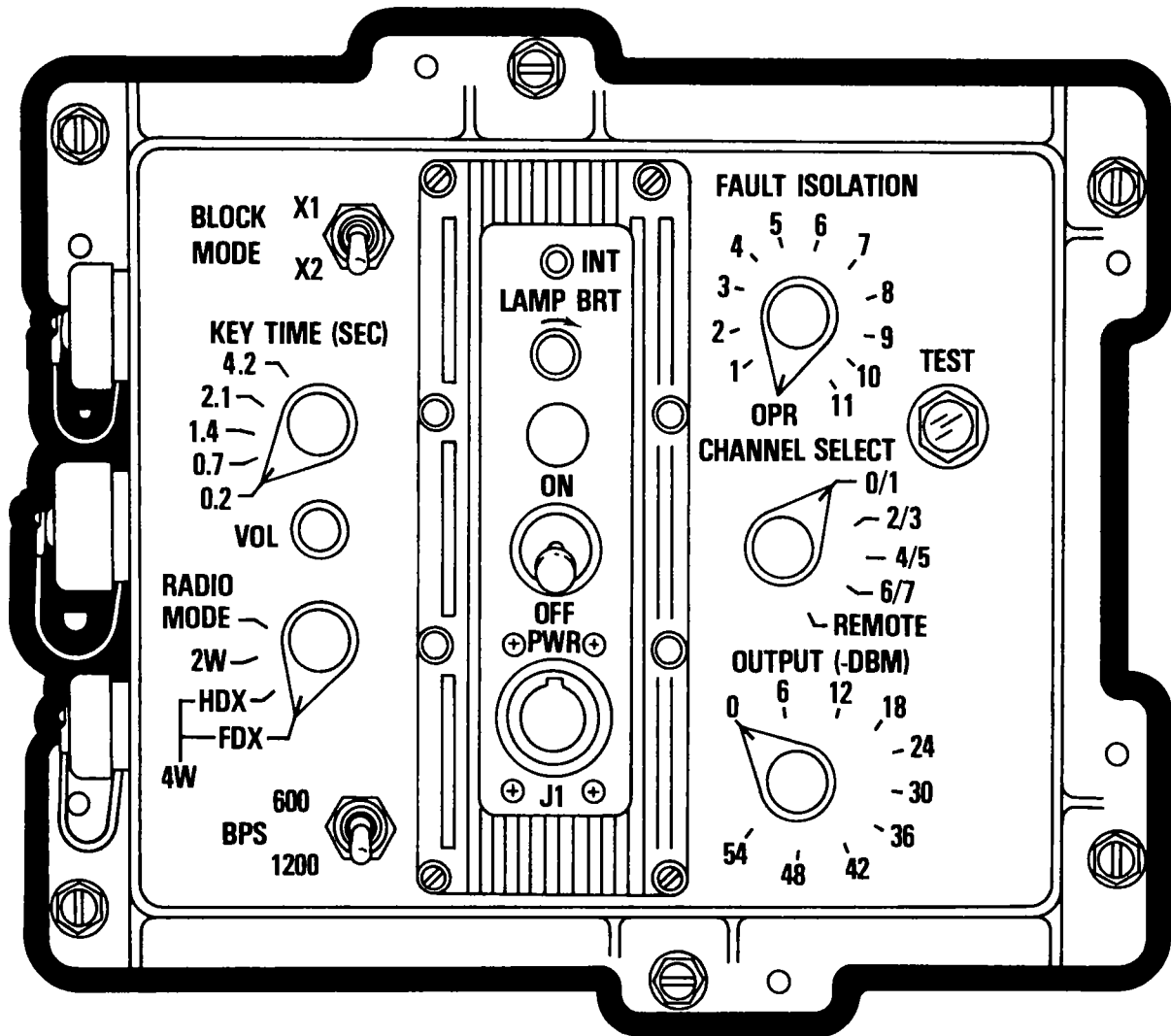


Figure A-3. Digital data terminal.

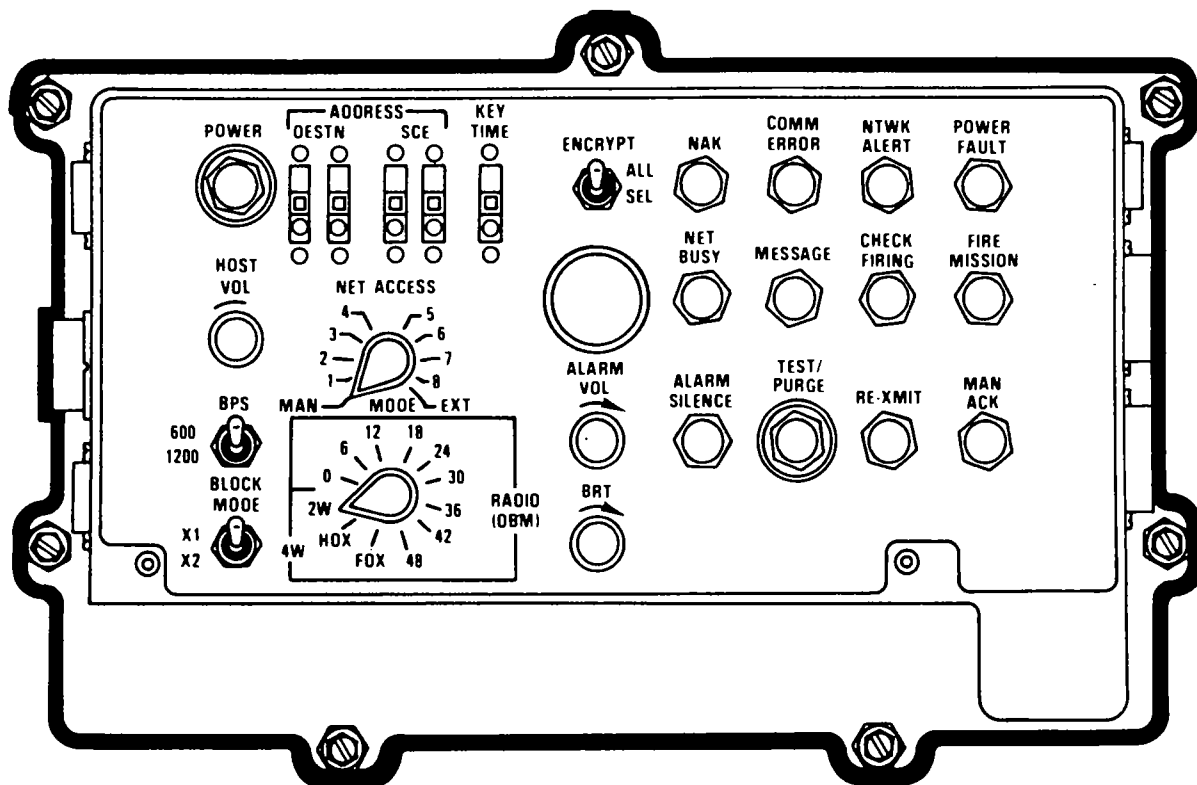


Figure A-4. Remote data terminal.

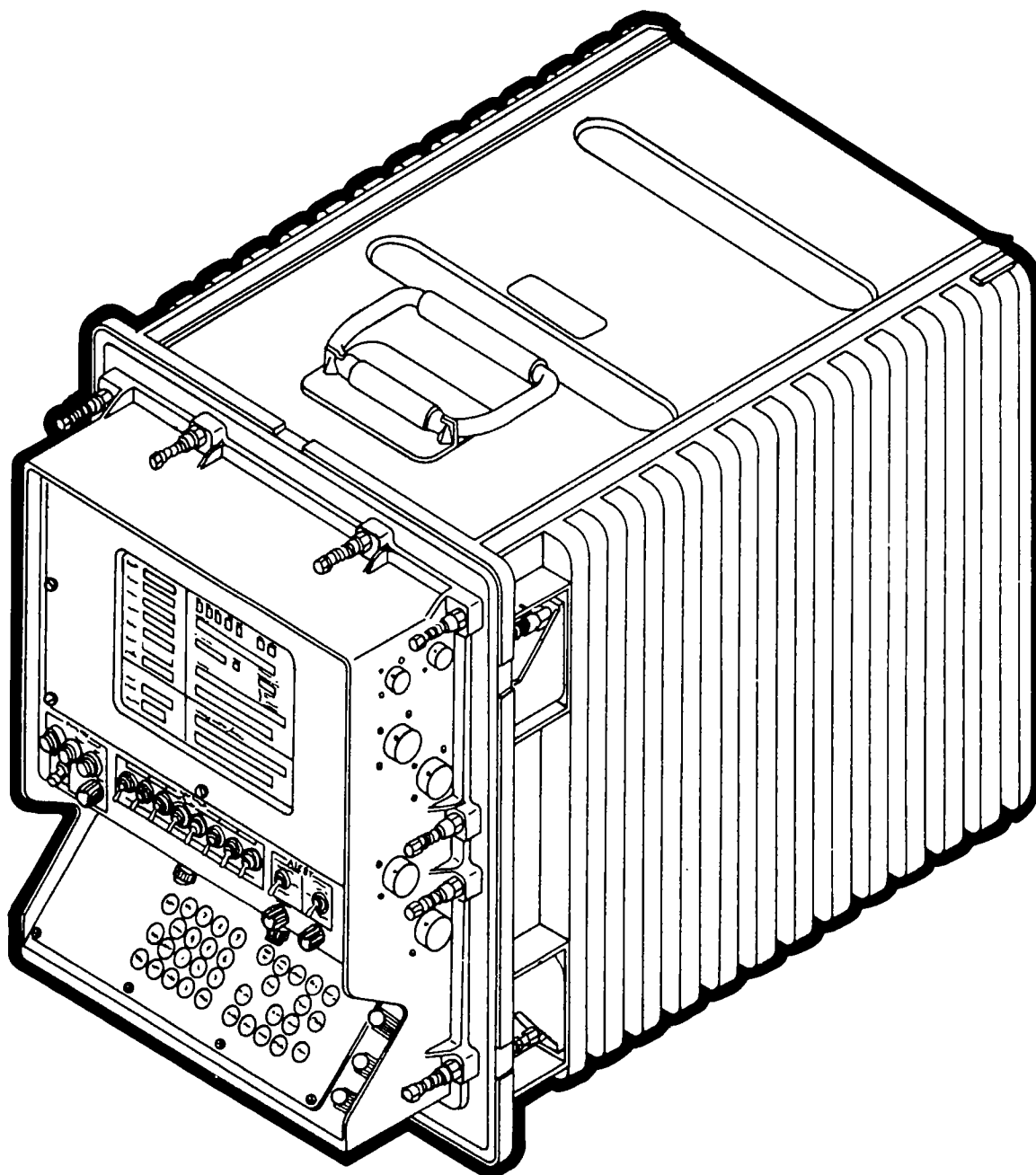


Figure A-5. Communications control unit.

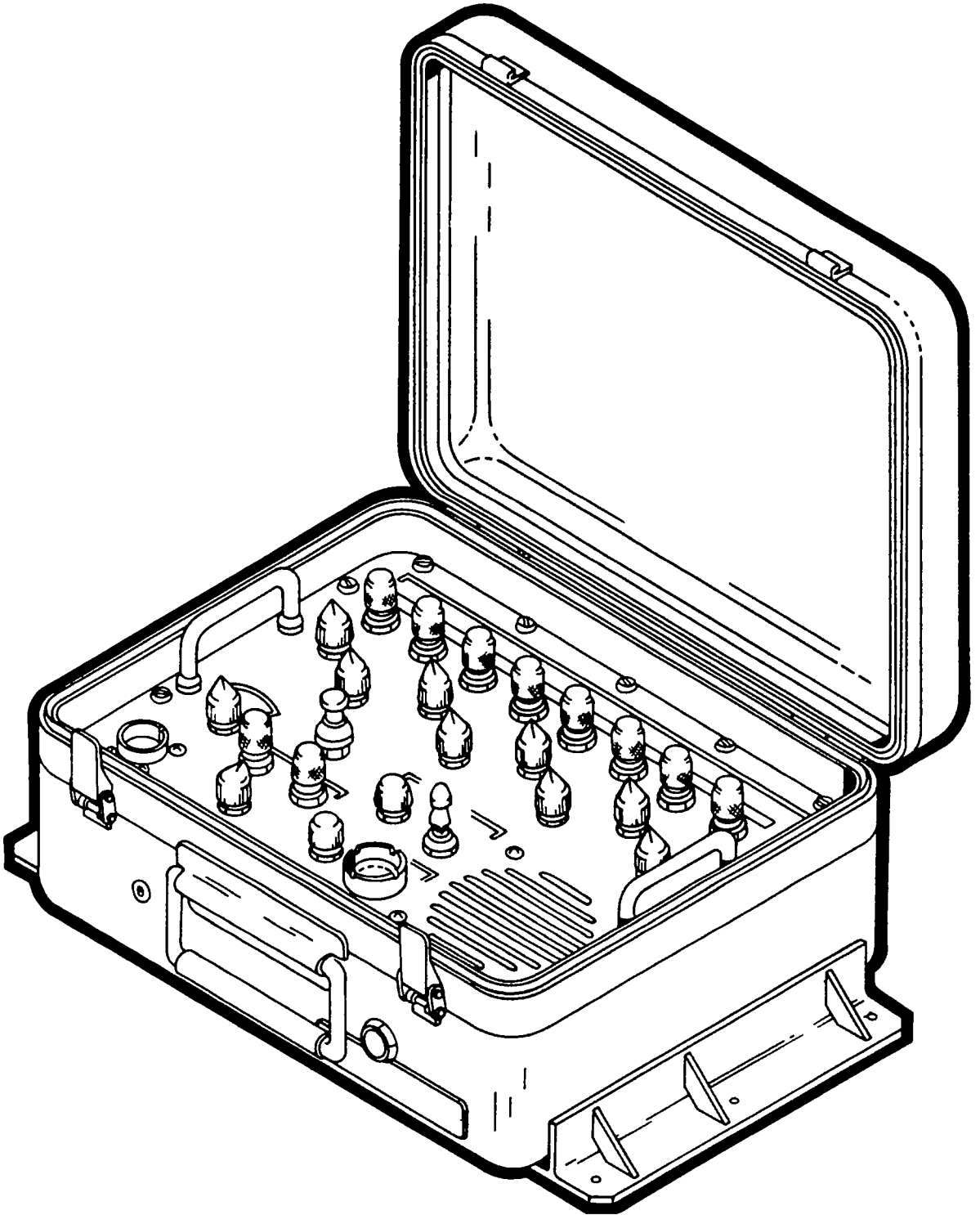


Figure A-6. Remote communications monitor unit.

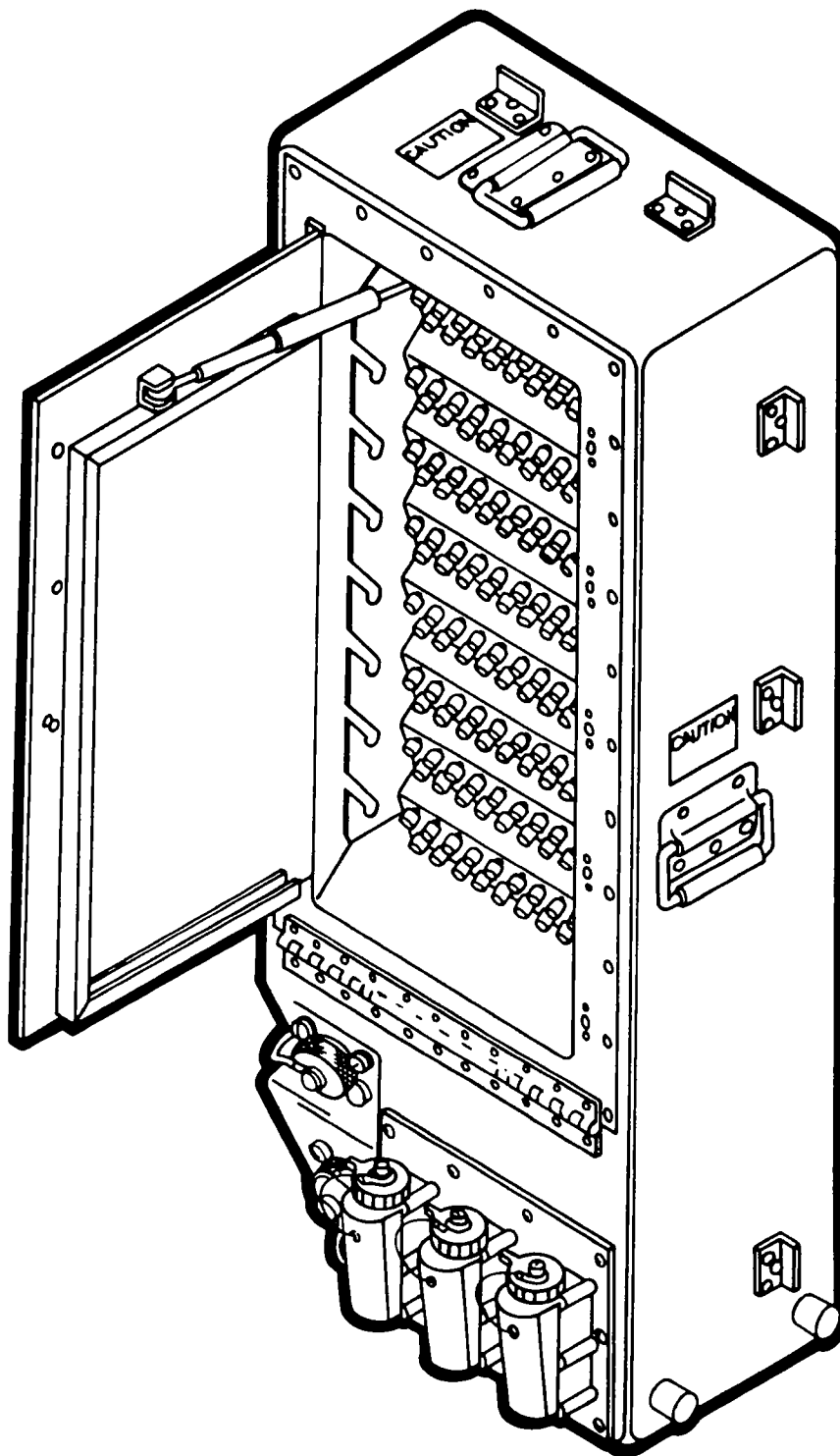


Figure A-7. Communications terminal box.

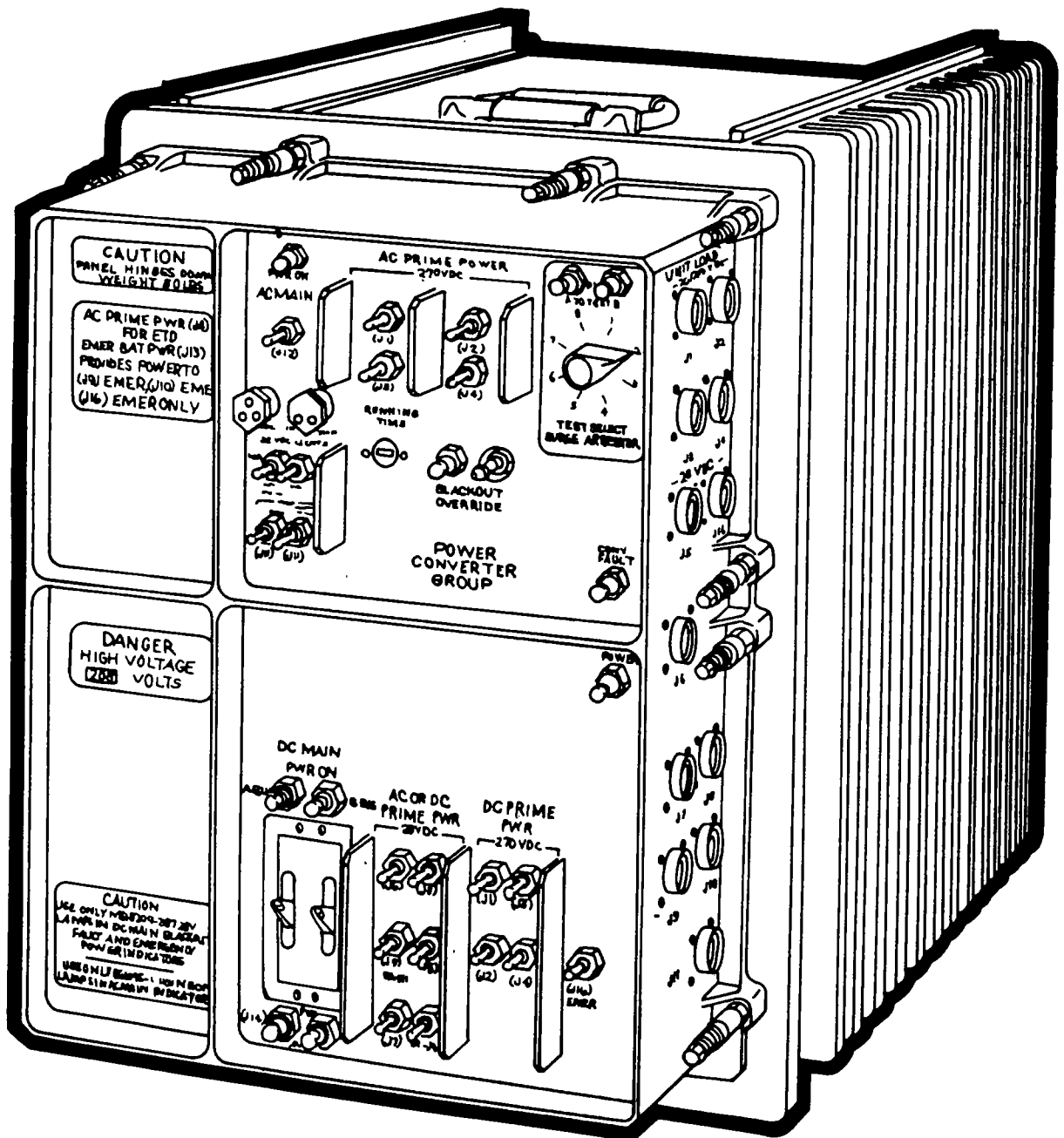


Figure A-8. Power converter group.

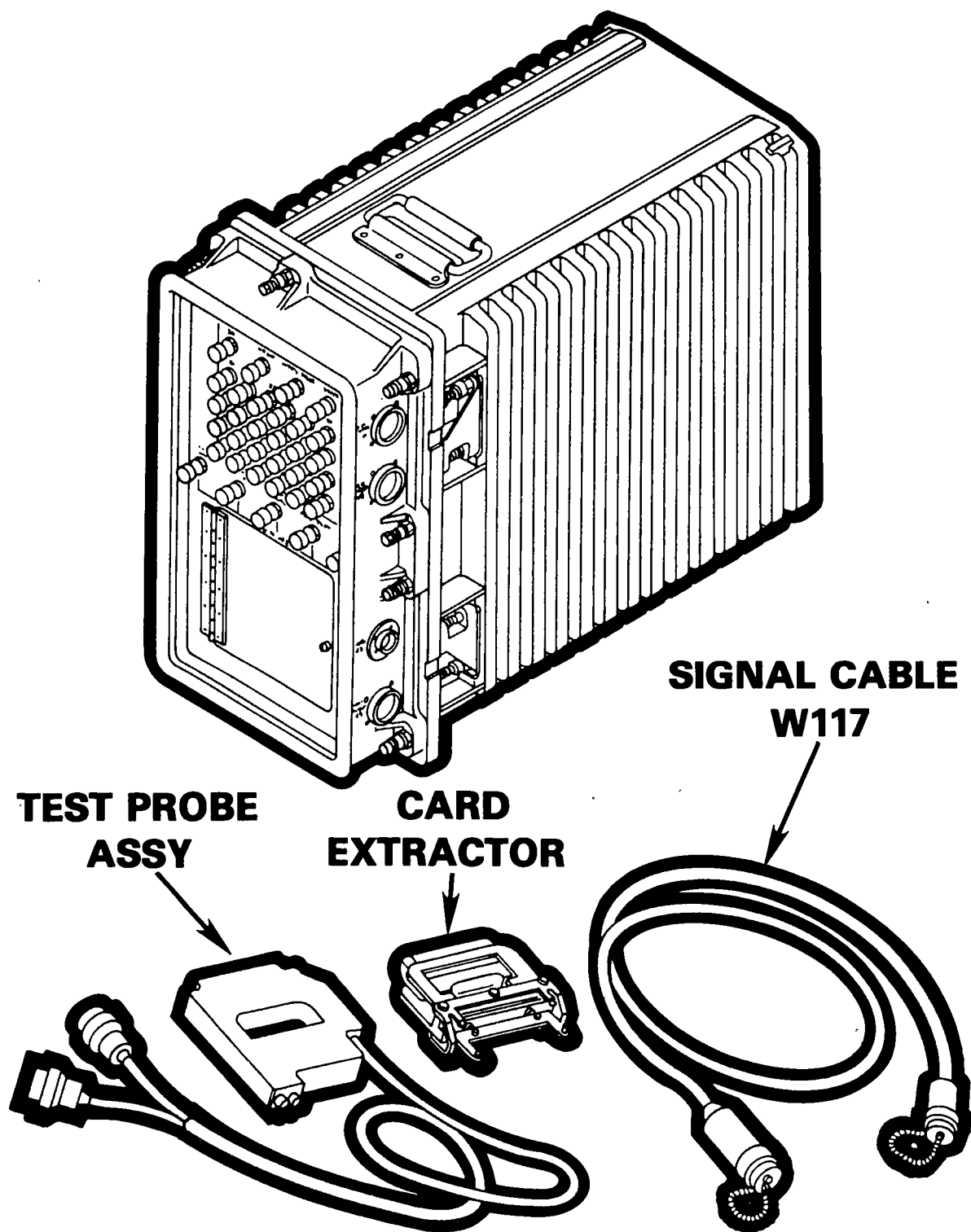


Figure A-9. Modular test set.

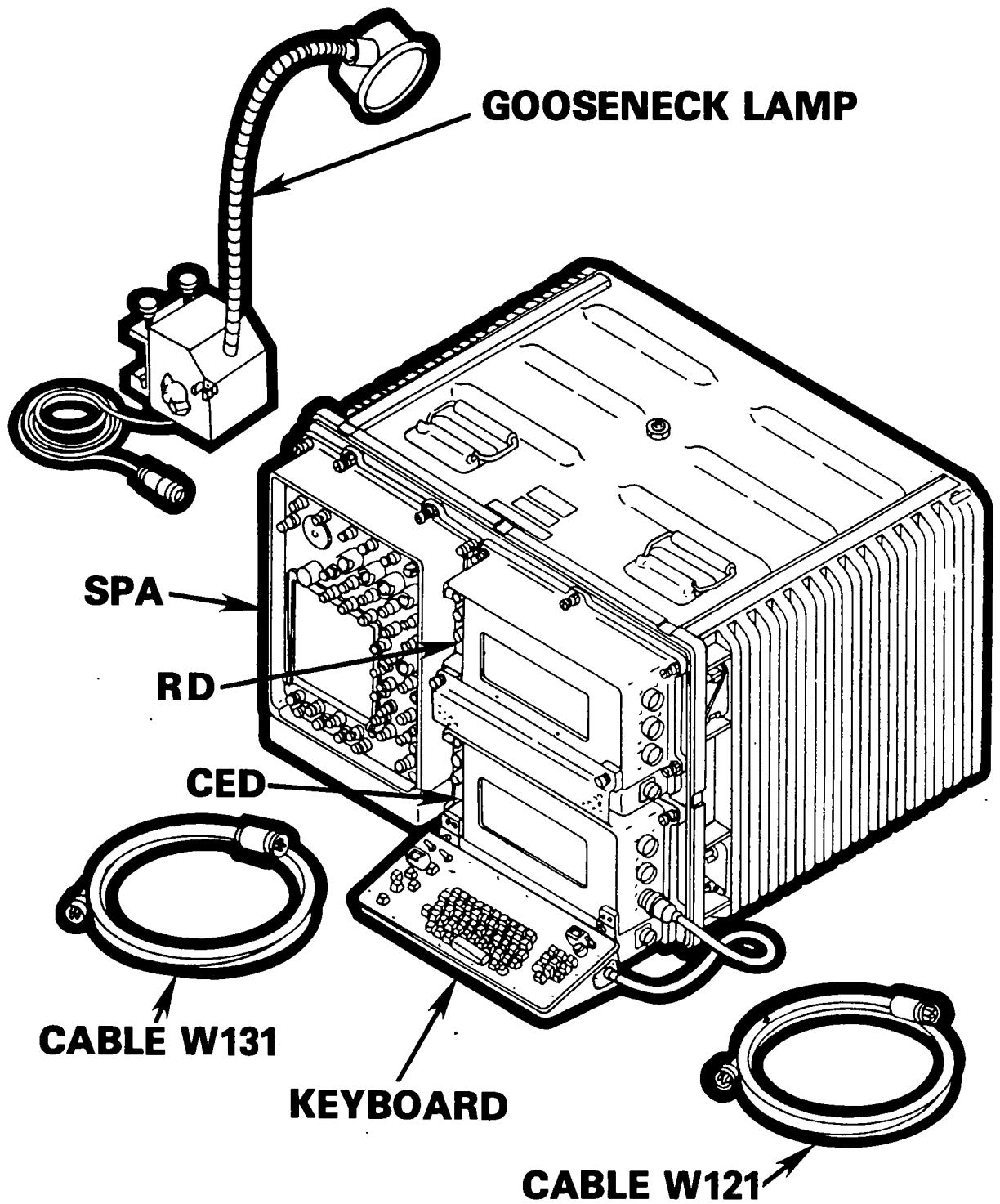
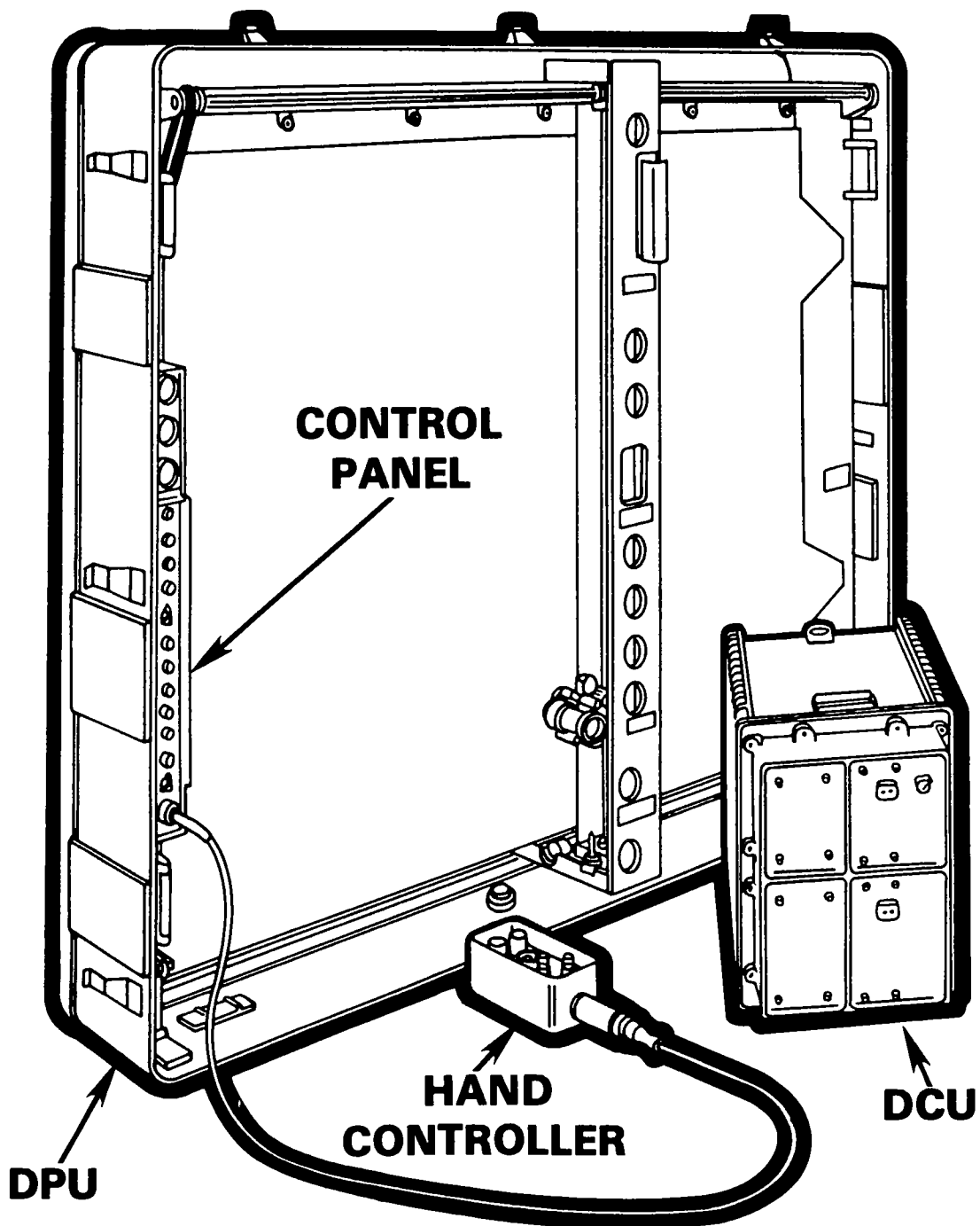


Figure A-10. Artillery control console.



NOTE: DPU COVER AND LAMPS NOT SHOWN.

Figure A-11. Digital plotter map.

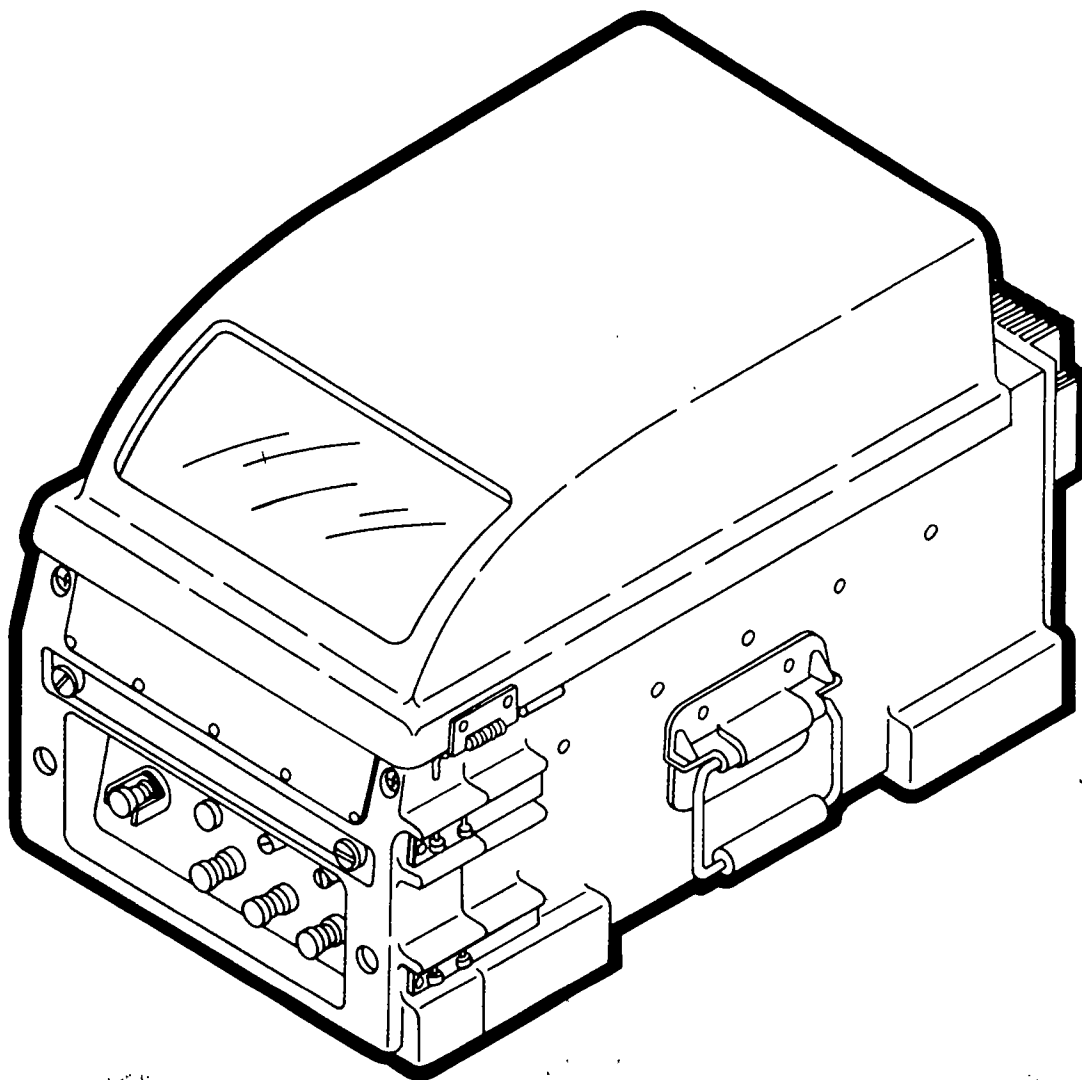


Figure A-12. Electronic line printer.

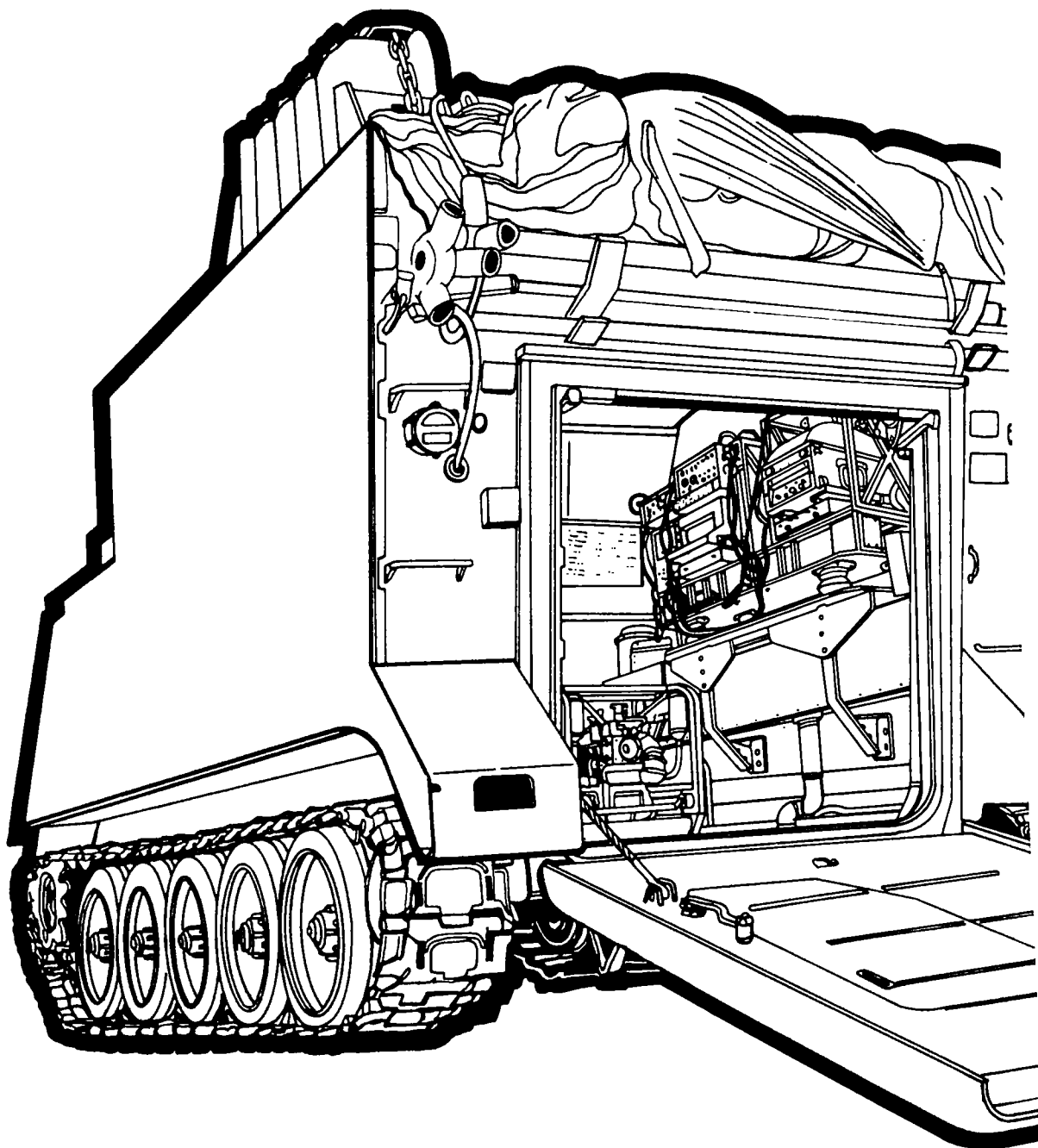


Figure A-13. Variable format message entry device.

INFANTRY (MECH) DIVISION

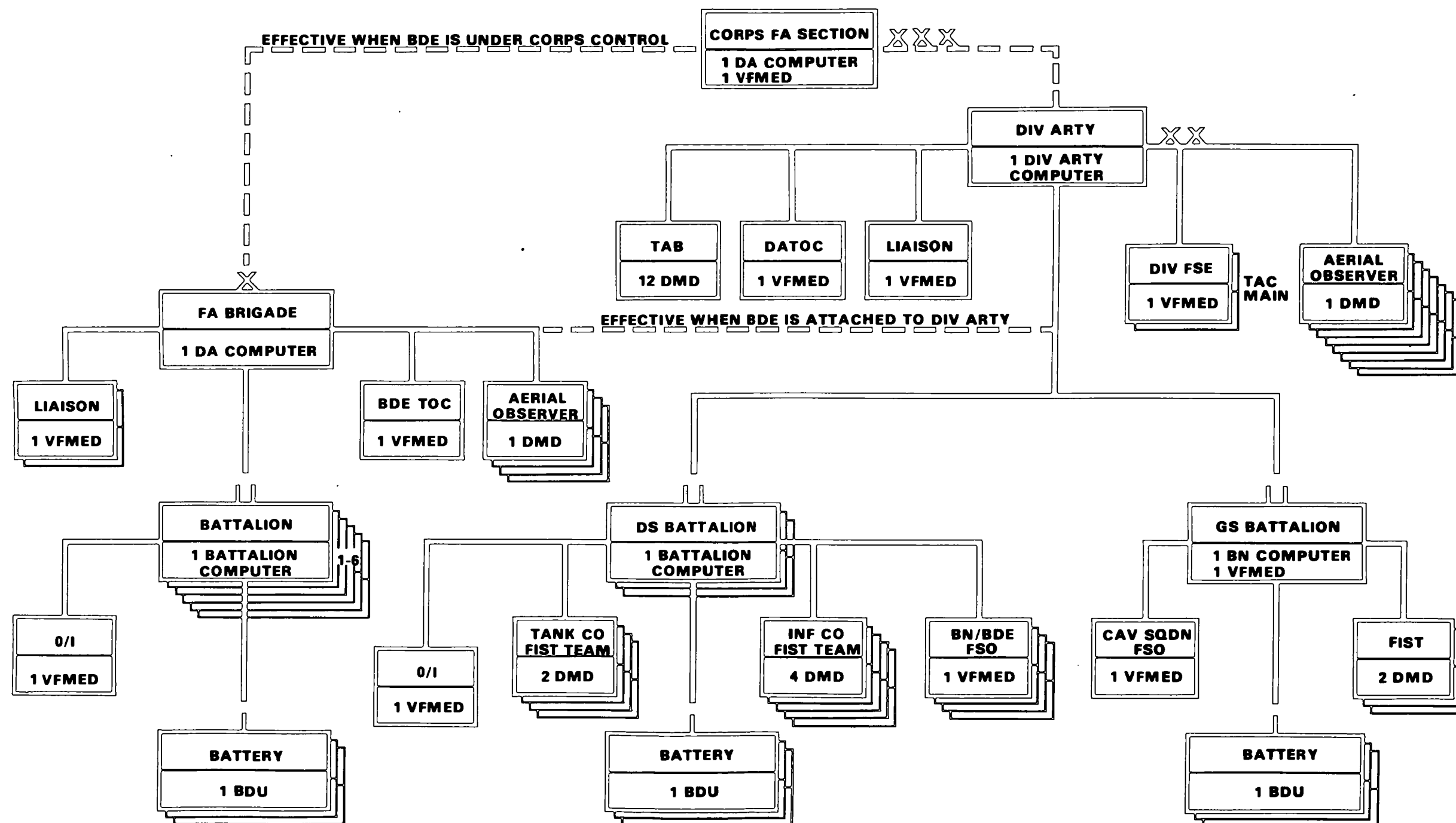


Figure A-16. Basis of issue of TACFIRE equipment.

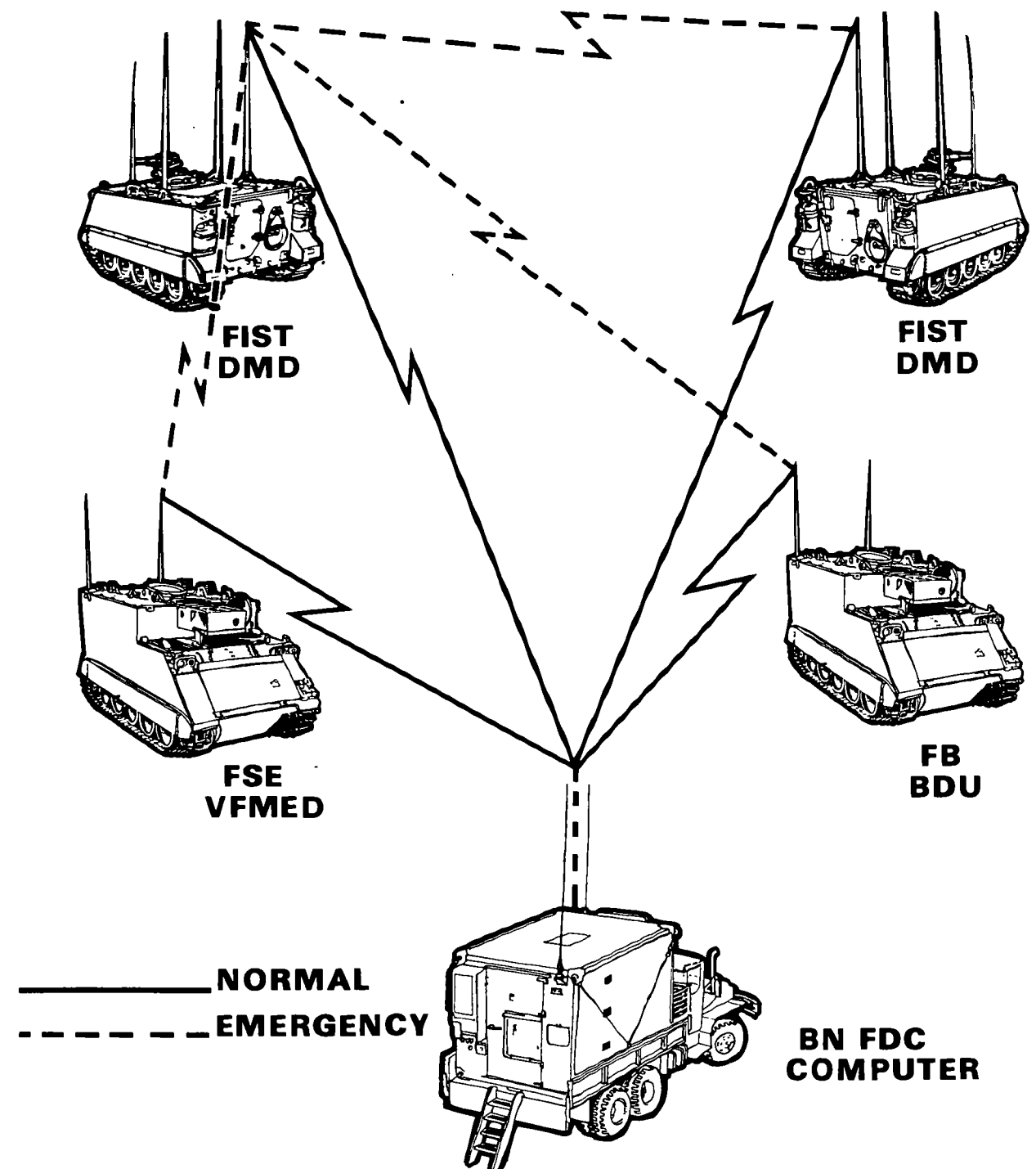


Figure A-17. Digital message device in operation.

APPENDIX B

BATTERY COMPUTER SYSTEM

The battery computer system will increase field artillery mission effectiveness by providing two-way digital communication between TACFIRE and the battery, and by enabling accurate and rapid individual piece firing data computations. The BCS provides two-way digital, source data input and will replace FADAC and the battery display unit. It will be issued to all cannon artillery and Lance missile batteries. The BCS provides a digital communication link between the firing battery and other elements involved in the fire mission (i.e., bn, FDC, FSO, FO, and guns). The battery computer system is made up of two major components—the battery computer unit (BCU) and gun display units (GDU).

B-1. BATTERY COMPUTER UNIT

The central element of the BCS is the battery computer unit, which interfaces with radios, COMSEC devices, and up to 12 gun display units. The battery computer unit can be operated in any of three standard military

vehicles (M577, M151, and M561) or dismounted in the field. The system is powered by vehicle batteries or a dc generator. The BCU consists of the following sections:

Front Panel

The front panel is a plasma type display on which 24 lines of 72 characters each can be displayed. The front panel also contains indicators (fire mission, checkfire, message), volume and brightness controls, power switch and power indicator, and maintenance indicators.

Keyboard

The BCU has an alphanumeric, special function keyboard. It is the principal means for manual entry of data. The operator uses the alphanumeric keys with a list of operator options presented on the front panel display. Special function keys allow special tasks to be initiated by the operator; i.e., gun command keys (FPF, FIRE), display operations keys (PRINT, DELETE, SAVE), and EXECUTE key.

Program Load Unit

The program load unit (PLU) will load the magnetic tape containing the software program in less than 1 minute. A cartridge will be supplied by caliber or missile type (105-mm, 155-mm, 8-in, 175-mm, 14.5-mm, or Lance).

B-2. GUN DISPLAY UNITS

The gun display units are issued in the cannon application. The GDU consists of a section chief assembly (SCA) and two gun assemblies (GA). Each section chief receives his gun firing orders on the SCA while the deflection and quadrant elevation are simultaneously displayed on the gunner and assistant gunner GAs. Currently only wire (WD-1) connects the BCU to the GDUs, but future incorporation of the interbattery radio (PRC-68) function will allow wireless transmission of digital data.

Section Chief Assembly

The SCA is a small hand-held unit similar to a modern pocket calculator weighing approximately 2 pounds. It has an eight-character alphanumeric display. An LED (light emitting diode) panel allows the section chief to see the firing data under all light conditions. Firing data is sequentially displayed, one element at a time, under control of the section chief or randomly selected for recall via the keyboard controls, which allow direct access of any element at any time.

Gun Assemblies

The GA can be mounted on the cannon or positioned nearby for viewing by the gunner and assistant gunner. One GA displays deflection; the other displays quadrant elevation. The LED display fades out to conserve power but can be recalled by a reset button that refreshes the display.

Carrying Case

The carrying case is the box for storage of the SCA, GA, and the interconnecting cables during transport. It also contains the communication interface and the battery power supply for the gun display units. The audio alarm is located in the carrying case. Total weight of the carrying case with all equipment is approximately 25 pounds.

B-3. RADIOS

Three communication channels are provided. Two channels provide communications to external subscribers (i.e., FOs, battalion FDC, and FSO). The third provides communications to the gun display units. These channels can operate on wire or radio; however, the GDU channel is presently wire only. All three channels provide digital communication with a voice capability as needed.

B-4. BCS FUNCTIONS

The BCS will operate with TACFIRE or it can operate autonomously. The essential difference is availability of tactical fire control data inputs from TACFIRE. In autonomous employment, tactical fire control parameters are manually inserted by the BCU operator; with TACFIRE, they are transmitted in the digital message.

With TACFIRE

The intended use of the BCS is as an integral part of TACFIRE. When used with TACFIRE, the BCS will complement TACFIRE capabilities. The BCS takes the firing data from TACFIRE and computes fire commands for individual weapons. If the observer is out of communication range of battalion FDC, the observer can send his fire request to the BCU where it is automatically

relayed, without operator action, to battalion TACFIRE for processing and fire unit selection.

Autonomous

Autonomous operation by the battery is essentially a very rapid computer solution to the gunnery problem. In processing fire requests from either an FO or FSO, the tactical fire control parameters (fire order) are input manually by the BCU operator. Upon completion of fire order inputs, computation of individual piece firing data and execution of the mission proceeds as with TACFIRE.

B-5. COMPUTER TECHNOLOGY

The BCS applies state-of-art computer technology to the field artillery system.

Processing Time

The speed of computation and transmission of firing data to individual guns will be greatly improved. Computation time with FADAC is two-thirds the time of flight (TOF). Using BCS and a TOF of 60 seconds, all pieces should receive data in 17 seconds or less.

Accuracy

In cannon application, the BCU will produce, for all weapons and munitions, solutions that match the check trajectories.

Reserve Storage Capability

The proliferation of munitions in the field artillery requires that the BCS design allow for a 50-percent increase in memory storage capacity to accommodate future growth.

Technical Fire Control

Individual piece corrections are applied for all weapons in the battery computed by the BCU.

a. The BCU stores two computer mets and the standard met.

b. Up to 150 individual muzzle velocities can be stored in the BCU.

c. BCU will apply special, parallel, open, closed, or converged sheaf to all missions.

d. The BCU provides data to the operator/FDO on three concurrent fire missions and FPF.

e. The BCU can determine firing data for a moving target mission.

f. The BCU will store 60 targets, 60 known points, and 10 FO locations.

g. The BCU can receive a fire plan, compute firing data, automatically record the proper time for firing of each target, and alert the operator of the fire mission.



APPENDIX C

COMMUNICATIONS/ELECTRONICS

C-1. COMMUNICATION CONCEPT

TACFIRE communicates via standard contemporary wire and radio communication means. The digital output is converted to audio tones, allowing TACFIRE to use the same transmission means as that used for voice or RATT communications. The composition of the means is dependent on the personnel, equipment, and transportation provided by the unit TOE. The prime requirement for TACFIRE is adequate means to pass digital communications; however, voice or RATT communications may be substituted to pass essential traffic. TACFIRE transmissions are compatible with Army multichannel (12 and 24) pulse code modulation (PCM). Maximum use should be made of existing multichannel (mchan) resources. Communication security equipment is provided for TACFIRE traffic, except for the FO link, to protect artillery communications from enemy intercept.

C-2. COMMUNICATION REQUIREMENTS

The communication system of an artillery unit, regardless of the size of the unit, must satisfy two types of communication requirements—internal and external.

Internal Requirements

Internal communication requirements include the facilities for control and

coordination of the activities of the unit. The installation and maintenance of the internal communication system is the responsibility of the unit commander. In a higher headquarters, such as battalion or a division, the internal communication system serves as a portion of the external communication system of the subordinate units. For instance, a division artillery command net (voice) (FM) is a portion of the division artillery internal communication system. It also serves as a portion of the external communication system of the battalions that are organic or attached to the division artillery. An internal communication system must furnish an artillery unit with communication facilities to perform functions listed below. These requirements will vary when missions are modified.

- Fire direction and fire control.
- Tactical and administrative control.
- Collection, exchange, and dissemination of combat information and intelligence.
- Dissemination of warnings.
- Dissemination of meteorological data.
- Dissemination of accurate time.
- Coordination of survey.

External Requirements

External communications are those by which a unit maintains communication with

its next higher headquarters, adjacent units (as required), and supported or reinforced units for the purpose of receiving necessary information. The commander of any unit is responsible for the installation of his communication system and for its effective integration into the communication system of the next higher headquarters. An external communication system must furnish an artillery unit with communication facilities to perform the functions listed below. These requirements will vary when missions are modified.

- Receipt of fire missions and requests for and coordination of fire support.
- Tactical and administrative control.
- Collection, exchange, and dissemination of information and intelligence.
- Receipt of warnings.
- Receipt of meteorological data.
- Receipt of accurate time.
- Coordination of survey.
- Communications with reinforced or supported unit.
- Communications with mutual support unit.

C-3. RADIO NETS

Titles of radio nets usually contain three elements: the controlling headquarters, designated purpose, and modulation. For example, for the battalion command net (FM), the controlling headquarters is the battalion, the purpose is command and control, and the radio carrier wave is frequency modulated. Additionally, the title may indicate the type of intelligence transmitted and received via the net (voice, digital, or teletype). The FM nets may pass

voice and digital traffic. The AM-SSB nets may have the added designation RATT/voice/digital, since the AN/GRC-106 radio set used with radioteletype equipment may be used to transmit/receive voice and digital traffic. Following is a discussion of the nets normally used to pass digital data using TACFIRE:

Command Net (comd) (FM)

This is a secured FM radio voice net at the field artillery brigade, division artillery, and field artillery and missile battalion levels. This net is a multipurpose net used for command and control; administrative matters; the collection, exchange, and dissemination of information and intelligence; and the coordination of fire support.

Division Artillery Operations Net (op-) (FM)

This is a tactical fire direction digital net at division artillery. Div arty has three of these nets (op 1, op 2, and op 3) to transmit tactical orders, fire missions, and meteorological data to the battalions. The battalions use these nets to request additional fire support from div arty. Normally, each net contains a direct support battalion, its reinforcing battalion, and a general support or general support reinforcing 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.

Battalion Operations/Fire Net (op/F) (FM)

Located in the direct support and general support battalions, this net is used for command and control; tactical fire direction;

the collection, exchange, and dissemination of intelligence; and the coordination of fire support between the direct support field artillery battalion and the brigade FSE and radar sections.

Fire Direction Net (F or FD) (FM)

This is the technical fire direction digital net used in all cannon and missile battalions. DS battalions have three fire directions nets (F1, F2, and F3), and type general support battalions and missile battalions have one each. Battalion and battery FDCs, FSOs, and FOs use the fire direction net to request, plan, and coordinate field artillery support for maneuver. This net is the critical net, because in a highly mobile environment it will probably be the FO's only link with an FDC. The F nets must be uncluttered, responsive, and protected from early exposure to enemy electronic warfare activities. The general rule of thumb is one battalion FD net for each supported maneuver battalion task force.

Target Acquisition Battery Command Intelligence Net (CI) (FM)

This is an FM radio net in the target acquisition battery. The net is used for command and control of elements of the battery, cuing of target acquisition assets, and reporting targets and targeting information.

Sound/Flash Platoon Net (S/F) (FM)

The S/F net is an FM radio net located in each S/F platoon of the target acquisition battery. This net is used for command, control, and coordination of the S/F operations by the S/F platoon central.

C-4. RADIO NET DIAGRAMS

Radio net diagrams are shown in figures C-1 through C-3.

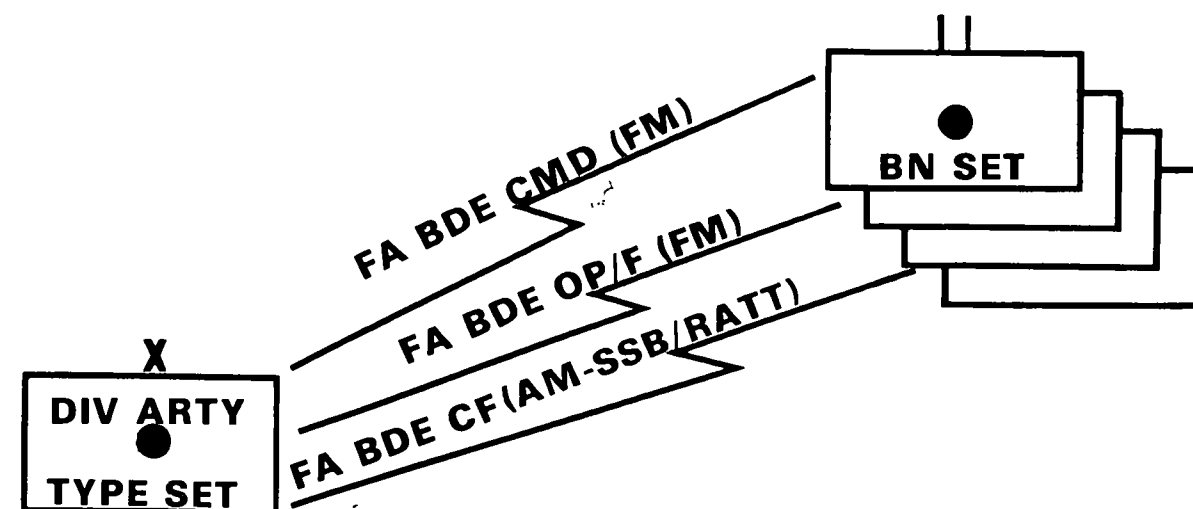


Figure C-1. Field artillery brigade internal radio nets.

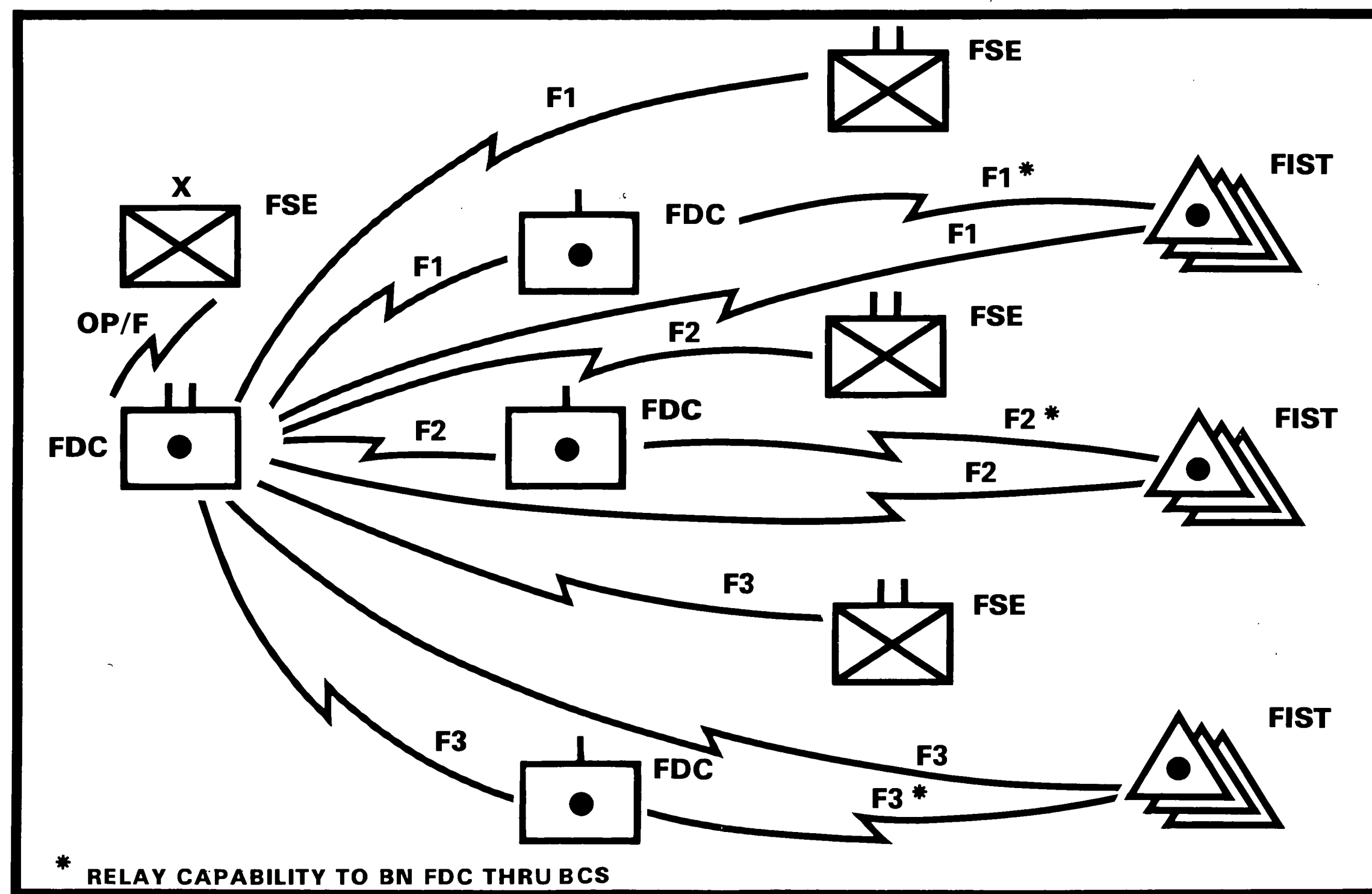


Figure C-2. Direct support battalion internal radio nets (digital).

C-5. WIRE COMMUNICATIONS

TACFIRE will function on all contemporary wire and cable systems to include phantom circuits and pulse code modulated and multichannel carriers. Use of wire and/or multichannel carrier should be made when feasible. Recent doctrinal changes (TC 6-10-1, *Field Artillery Communications*), provide for the extension of communications from the DS battalion FDC to the div arty TOC over the multichannel system between div arty and (through division main) the maneuver brigades. The DS battalion wire team does this by installing a wire circuit to the supported brigade to interface with a prerouted PCM circuit at the brigade multichannel radio terminal. This will allow the battalion FDC to complete a direct sole user circuit into the div arty TOC. Numerous benefits to be gained from this include the following:

- PCM/mchan link is highly directional, thus not susceptible to enemy electronic warfare techniques.
- Reliance on AM/SSB and FM radio can be reduced.
- Radio assets can be made available for an increased backup capability.

Wire net diagrams are shown in figures C-4 and C-5.

C-6. COMMUNICATIONS DURING UNIT DISPLACEMENTS

There are two methods of providing continuity of operations during displacements. The one chosen depends on the tactical situation. Movement routes and geographical features are useful to the enemy to determine where artillery units are going and to interdict movements; such information should be encrypted.

Transferred to Mutual Support Unit

a. Both battalions maintain contact with division artillery on the division artillery command net (FM).

b. The mutual support unit establishes the supported battalion's subscribers on the designated F1, F2, and F3 to enable the transfer. The backed up battalion will notify its subscribers that they are to transfer to the MSU frequency if required.

Decentralized to Firing Batteries

Procedures are the same as current method.

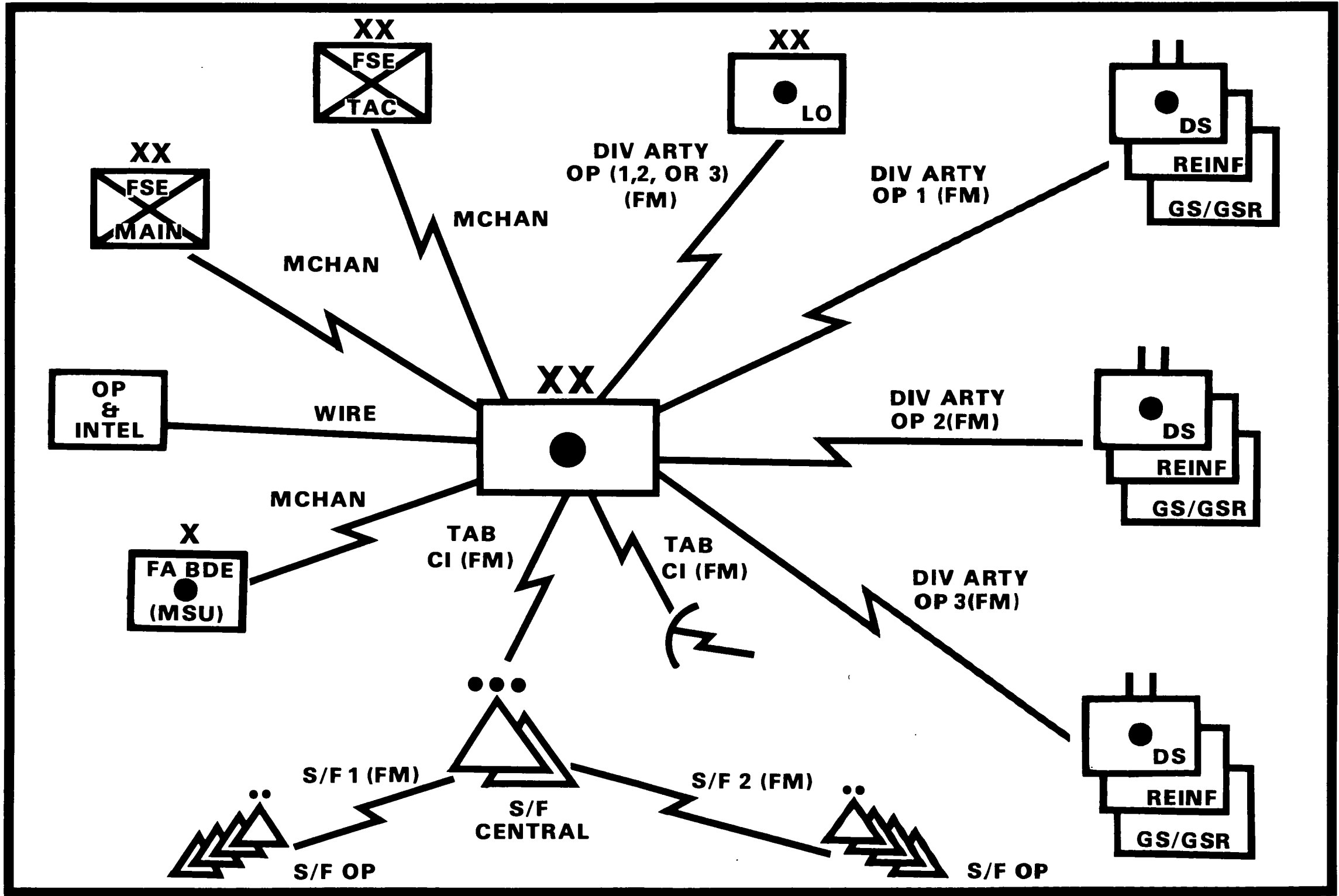


Figure C-3. Division artillery digital communication.

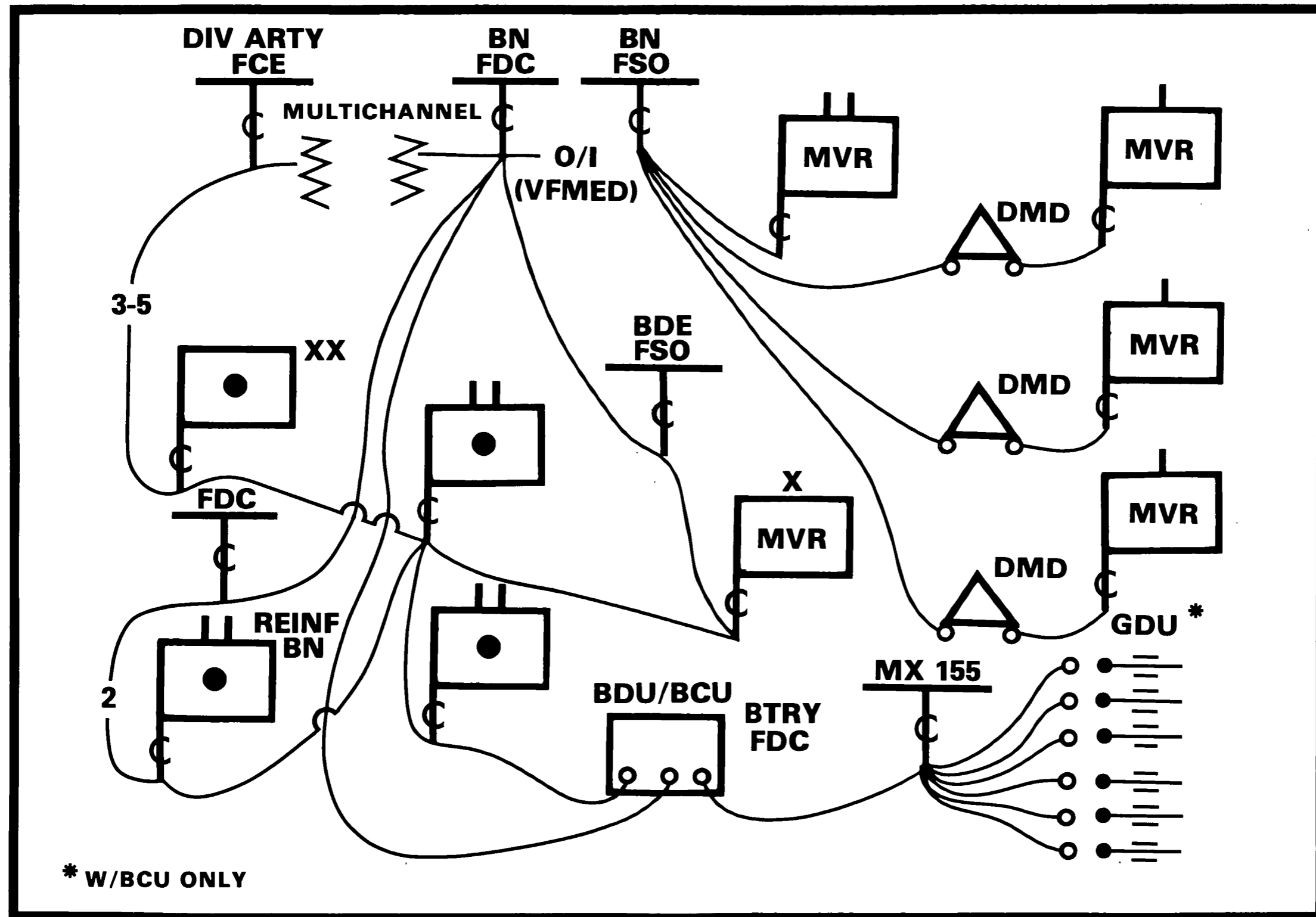


Figure C-4. Direct support battalion fire system.

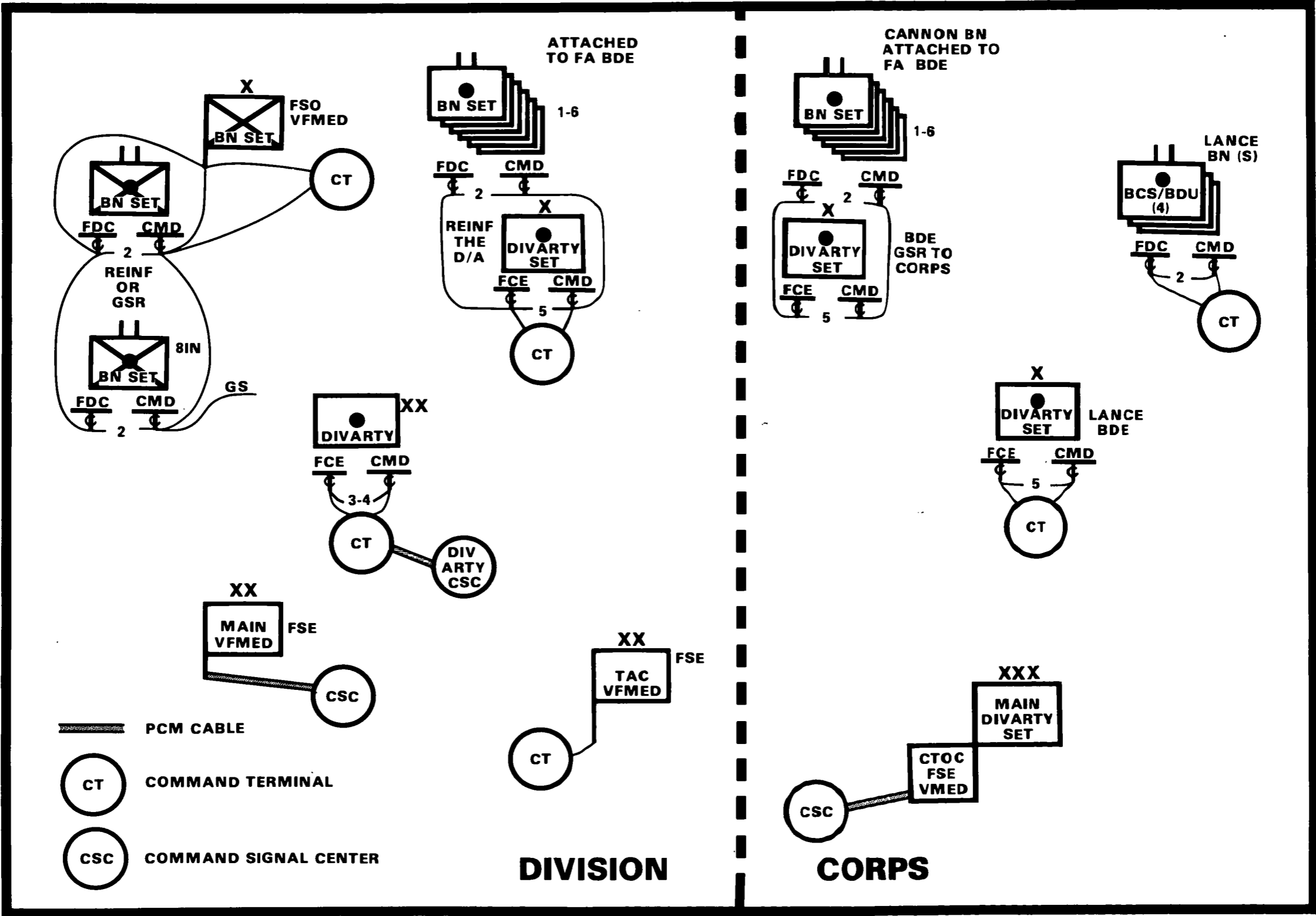


Figure C-5. Artillery wire communications system.

C-7. EMPLOYMENT OF THE COMMUNICATION CONTROL UNIT

Employment of the communication control unit will offer communication options not previously available. The CCU, which is a part of TACFIRE, will allow integration of wire, AM/SSB radio, FM radio, or any combination thereof on the same net. The

CCU also provides wire relay capabilities. The CCU provides rapid net configurations and reconfigurations. While the radio net configurations depicted in this appendix are not vastly changed by the introduction of TACFIRE, the capabilities of the CCU afford the user opportunity for great flexibility. Figure C-6 shows examples of possible CCU employment. Assuming the communication nets are the only ones available, the options in the following examples are possible.

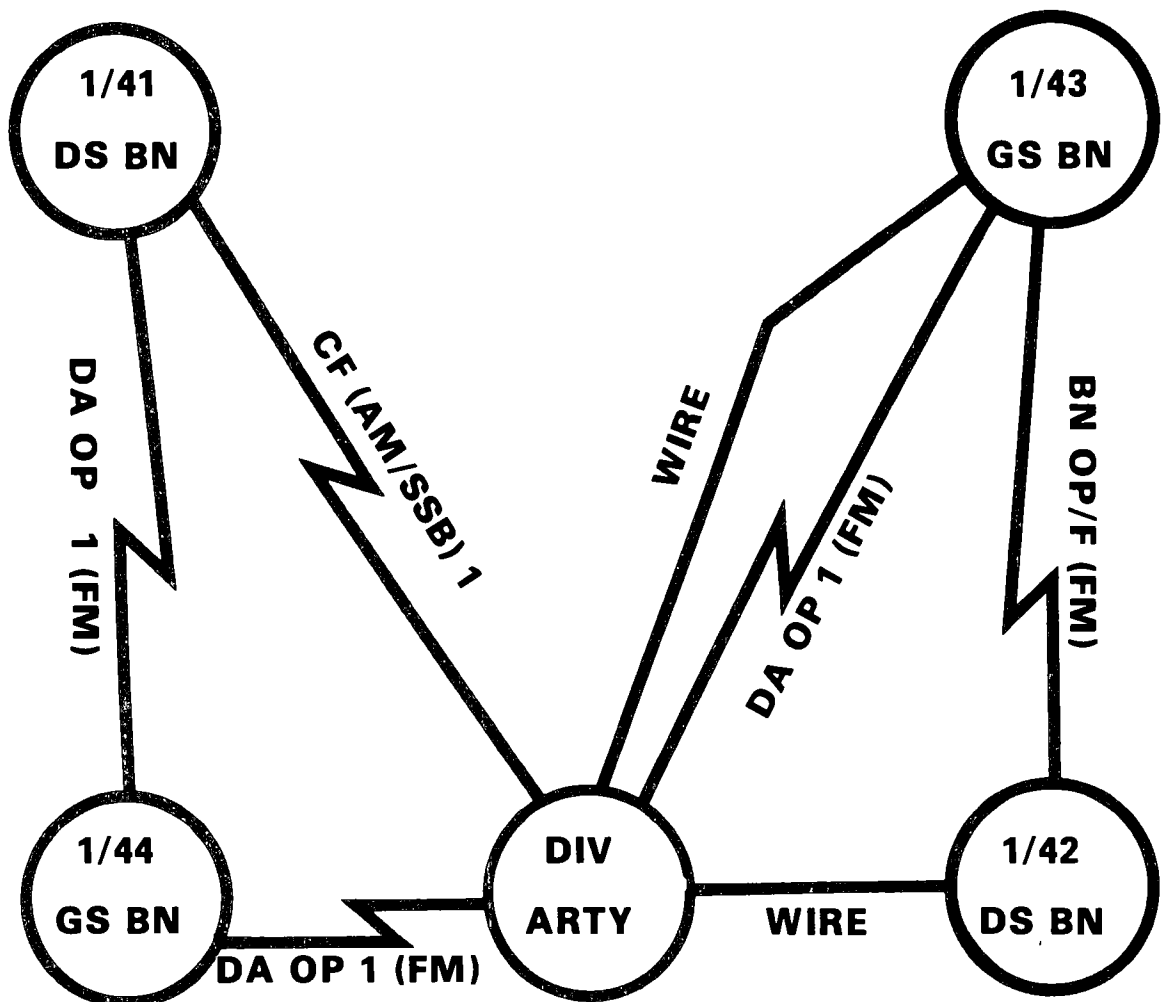


Figure C-6. Type employment using communications control unit flexibility.

a. If the div arty to 1-41 link fails, traffic can be relayed through 1-44.

b. If the div arty to 1-44 link fails, div arty can send an AM/SSB signal to 1-41, which can relay via FM to 1-44.

c. If there is a need for the 1-44 (on FM) to send traffic to 1-42 (connected by wire to div arty), the traffic can be relayed through div arty.

d. If the FM link from 1-42 to 1-43 should fail, div arty CCU can establish a wire-to-wire relay to connect the two battalions. Div arty should use the FM link to talk with 1-43 while 1-42 and 1-43 are linked by wire to avoid net error conditions. Subscriber table or CCU changes will be required at 1-43. This link should be established either for short periods of time, since div arty will have no contact with 1-42 while it is operational, or it should be implemented permanently with corresponding subscriber table and delay time changes at all computers.

Through the use of the remote communication monitoring unit (RCMU), monitoring stations can be satellited 300 feet from the FDC with the capability to enter any of eight nets with both talk and monitor capability.

C-8. SPECIAL ECCM GUIDANCE FOR TACFIRE

TACFIRE-peculiar ECCM functions are specified in the classified draft SOP, USAFAS, ATTSF-CD-T (Annex Q (EW) to Div (Mech) Artillery TSOP, 76). The following additional guidance is provided.

Use lower power.

Transmit on low power to reduce the opportunity for an enemy to intercept the signal. Turn the radio power switch to LOW or reduce effective radiated power (ERP) further by first pointing whip antenna sideways or toward the ground. Another method to be considered by ground observers is to carry a tactical radio upside down with the antenna a foot above the soil. This technique can provide a good, strong local surface wave within a 5-km radius while reducing the direct wave radius.

Use a mobile antenna.

A reduced height VHF ground plane (RC-292) antenna can be mounted into a pole holder welded to the front bumper of a vehicle and secured with guy wires. The antenna should be guyed vertically and the radiating end ground plane elements should be "cut" for the proper operating frequency. This procedure provides a highly mobile command net antenna that can be rapidly relocated. The mobile RC-292 has excellent applications in desert operations.

Remote transceivers.

There is no practical advantage gained by installing the radio set away from the command post (remoting) unless the distance is 750 meters to 1,000 meters. The error inherent in radio direction finding (RDF) equipment does not provide for a consistent

accuracy less than 500 meters to 750 meters in normal tactical employment. During most battlefield situations, threat force RDF analysts can be expected to regard the RDF fix and its attendant circular error probable (CEP) as a clue to a transmitter's location. Map analysis and operator comments are applied to refine the fix for targeting data. In some instances, radiation-leaking cable arrays provide a better target than the antenna. (Deceptive command post location is more important than remoted radios unless the remoted distance is at least 1 km.).

Construct decoy antennas.

Whenever possible, construct decoy antennas in credible antenna locations within 750 meters to 1,000 meters of the command post. Decoys should be camouflaged, but only to the extent necessary to maintain authenticity. Avoid shadows of the real antennas on flat ground.

Reduce communication time.

To reduce the chance your signal will be intercepted by the enemy, use radio communication only when necessary. Messages should be short and concise. TACFIRE data signals will enhance this effort. Whenever possible, substitute with wire communication. Use personnel as guides rather than giving directions over the radio. Use free-text messages if possible to transmit low precedence messages digitally and reduce net time. Do not use voice if it can be avoided.

Use encryption system.

Do not assist the enemy by making approximate RDF locations precise through poor electronic counter-countermeasures (ECCM). Do not discuss past, present, or future locations in plain text. Whenever automatic, secure devices are not available, use the manual encryption system.

Authenticate.

Be aware of potential imitative communication deception (ICD). Authenticate! ICD is frequently used by an enemy to prolong communications; do not be caught by the lure.

Use horizontally polarized antennas.

Precedent established over a period of 20 years and personal convenience have led to the habitual and unimaginative use of omnidirectional VHF whip or ground plane antennas that are vertically polarized (the waves travel vertically to the Earth). The flexibility provided by omnidirectional antenna is important to maneuver commanders during the attack when it is difficult to maintain correct orientation for horizontally polarized, directional antennas. Vertically polarized, omnidirectional antennas are required for communication between moving vehicles. However, when

ECCM is considered, the omnidirectional antenna has one chief disadvantage: omnidirectional antenna signals radiate 360° and usually well across the FEBA where they are subject to intercept and RDF. Directional, horizontally polarized antennas should be considered for lateral communication whenever possible.

*a. End- or center-fed, half-wave or half-wave directional, dipole antennas offer many advantages with VHF radios. A doublet antenna for example, provides a more directional signal that can reduce the enemy's ability to intercept the signal by 20 to 40 percent while providing a 20-percent greater range by increasing ERP in the desired direction. This is a useful ECCM technique. See TC 11-5, *What's Up? Know How to Repair & Fabricate Antennas*.*

b. A VHF directional antenna is small, only 9 feet long for a frequency of 50 MHz, or 6.5 feet for a frequency of 70 MHz. An antenna of this size is easily concealed. Doublets are also easily constructed from copper wire (or WD-1 landline), a "cobra head," and two plastic C-ration spoon insulators. There are drawbacks; when one station uses a horizontally polarized antenna, the other station must also use a horizontally polarized antenna. Correct antenna orientation between both stations is also important, but the advantages warrant consideration of this technique wherever practical. Care must be taken to insure that all stations on the digital net can hear every other station transmit. If they cannot, a station may transmit a digital message into a busy net, resulting in loss of messages.

Know advantages of half-wave horizontally polarized VHF antennas in comparison to vertically polarized antennas.

a. The horizontal antenna produces a more stable signal in the presence of interference (jamming).

b. The horizontal antenna produces a more stable signal when used in or near dense woods.

c. The horizontal antenna is more readily camouflaged without loss of signal.

d. Small changes in antenna location do not cause large variations in signal strength.

e. The horizontal antenna is more difficult to direction find because of polarized and because its signal can be directed to intended receivers and away from enemy RDF locations.

Use terrain masking.

Terrain masking is the technique of masking or hiding radio signals behind terrain. It is an inexpensive method to beat RDF. VHF radio waves bend; they are reflected by buildings and mountains. When this happens, it is difficult to determine the original direction from which the waves were transmitted, but the ability to hear the signal is affected very little. A radio operator can use this principle to his advantage by placing terrain obstacles between the transmitter and the FEBA while affording an unblocked path to the intended receivers. Hills and dense forests also provide terrain obstacles. Terrain masking also occurs when antennas are positioned on the back slopes of hills. A radio operator should also erect antennas as

low as adequate communication permits. In all cases, antennas should be camouflaged to blend with terrain.

Practice ECCM techniques.

- a.* Use encryption devices.
 - b.* Authenticate properly.
 - c.* Change to the alternate frequency; continue to work primary frequency when jamming is present.
 - d.* Use proper callsigns. Use short callsigns when using voice backup.
 - e.* Reduce transmit power to minimum level required to permit communications.
 - f.* Use decoy load (antenna) for maintenance and tuneup procedures.
 - g.* Employ random transmissions, rather than working on a schedule, to reduce enemy's ease of interception.
 - h.* Use alternate communication means; e.g., wire, microwave, or AM.
 - i.* Use directional antennas if all stations on a digital net can still monitor all other stations.
 - j.* Site radio station with obstacle between it and enemy to reduce possibility of interception.
-

 TAB A

 DIVISION ARTILLERY COMMUNICATIONS

TACFIRE/PRIMARY DIGITAL

DDT	COMM MEANS	TYPE SUBSCRIBERS
A	Div arty op 1 (FM)	DS bn, R bn, GS/GSR bn
B	Div arty op 2 (FM)	DS bn, R bn, GS/GSR bn, AOBSRs
C	Div arty op 3 (FM)	DS bn, R bn, GS/GSR bn
D	Mchan	Corps FAS
E	Mchan	FSE (Tac), FSE (Main)
F	Mchan	FA bde (MSU)
G	Wire/TAB CI	CFO/Radar, S/F

VOICE/PRIMARY VOICE

FM—Div comd	(External)
FM—Div intel	(External)
AM—Div TOC	(External)
FM—Div arty comd	(Internal)

RATT/PRIMARY RATT

AM—Div op	(External)
AM—Div intel	(External)
AM—Div admin/log	(External)
AM—Corps F	(External)
AM—Div arty CF1	(Internal)
AM—Div arty CF2	(Internal)

COMMENTS

1. There is also a div arty retransmission frequency; survey teams will operate on the corps artillery survey channel.

2. The multichannel interfaces are the doctrinal (FM 11-50) sole user circuits established with equipment provided at the div arty, FA brigade, and Main/Tac CPs by the division signal battalion. The sole user circuit from Tac FSE must be wired to the Main FSE-div arty TOC circuit at division main.

3. The internal RATT nets, div arty CF1 and div arty CF2, will continue to operate primarily as RATT. If one or both are required for use with TACFIRE, the teletypewriter will be turned off and the radio used on a designated DDT. If one AM radio is needed, one RATT net will continue to operate and all RATT stations within the div arty will be directed to enter that net, while the AM radio of the other RATT is used in TACFIRE.

4. The TAB processing section, collocated with the div arty TOC, provides the FM radio

and frequency for the target acquisition interface with the div arty computer.

5. The corps FAS link must be either multichannel or AM, SSB since there is no FM net to the field artillery section.

6. Using a staff radio at both the FA brigade and div arty and using an FA brigade frequency, it is possible to establish a temporary FM COU link until the multichannel sole user circuit is installed.

7. The div arty comd net (voice) removes most voice from primarily digital nets.

8. The FSE, using AM or FM assets, may be required to enter a div arty digital net if the sole user circuit is lost for any reason.

9. The div arty aerial observers (AOBSR) can access the div arty TACFIRE and/or one of the three DS battalion TACFIRE computers without a change of subscriber address by operating on one of the three div arty op nets. The number of AOBSRs on each div arty operations net will vary based upon the situation and the direction of the div arty commander.

 TAB B

 FIELD ARTILLERY BRIGADE COMMUNICATIONS
 (AS DIVISION ARTILLERY TOC)

TACFIRE/PRIMARY DIGITAL

DDT	COMM MEANS	TYPE SUBSCRIBERS
A	Div arty op 1	DS bn, R bn, GS/GSR bn
B	Div arty op 2	DS bn, R bn, GS/GSR bn, AOBSRs
C	Div arty op 3	DS bn, R bn, GS/GSR bn
D	TAB CI/mchan	Radars, S/F plts, corps FAS
E	Mchan	FSE (Tac), FSE (Main)
F	Mchan	Div arty TOC (COU)
G	Wire	CFO

VOICE/PRIMARY VOICE

FM—Div comd	(External)
FM—Div intel	(External)
AM—Div TOC	(External)
FM—Div arty comd	(Internal)

RATT/PRIMARY RATT

AM—Div op	(External)
AM—Div intel	(External)
AM—Div arty CF2	(Internal)
AM—Corps F	(External)
AM—Div arty CF1	(Internal)

COMMENTS

1. For continuity of operations the FA bde uses the div arty's frequencies and the doctrinal sole user circuits established IAW FM 11-50, *Combat Communications within the Division (How to Fight)*.

2. The FA brigade has two FM frequencies and one RATT net of its own that are not used when the FA brigade is performing the mission of the div arty. However, when configured for continuity of operations while

the div arty is functioning, certain situations may require the FA brigade to use a frequency (bde ops/F) of its own to bring selected units into its computer. Additionally, there may be a need for the FA brigade to have its own secure voice frequency (bde comd) and its own RATT net (bde CF) during certain operations.

3. Comments 2, 3, 5, and 6 in tab A, concerning the div arty also apply to the FA brigade.

4. The FA brigade also has a retransmission frequency.

 TAB C

 FIELD ARTILLERY DIRECT SUPPORT BATTALION COMMUNICATIONS

TACFIRE/PRIMARY DIGITAL

DDT	COMM MEANS	TYPE SUBSCRIBERS
A	Div arty op- (FM)	Div arty TACFIRE
B	Bn op/F (FM)	Bde FSO, radars
	Wire	Bn O/I
C	Bn op/F (FM)	COU bn
D	F1 (FM)	Btrys, FSO, FOs
E	F2 (FM)	Btrys, FSO, FOs
F	F3 (FM)	Btrys, FSO, FOs

VOICE/PRIMARY VOICE

FM—Div arty comd (External)
 FM—Bn comd (Internal)

RATT/PRIMARY RATT

AM—Div arty CF1 (External)
 FM—Div arty CF2 (External)

COMMENTS

1. The battalion designated as the DS battalion's MSU provides the frequency for the computer-to-computer link required for TACFIRE continuity of operations.

2. Wire lines to the batteries and brigade should be installed and used for TACFIRE communications as often as possible. Wire line priorities to the brigade are:

- First Priority, brigade FSO to connect his VFMED to the DS battalion computer.
- Second Priority, multichannel terminal at brigade to pick up the prerouted sole user

circuit to division artillery and provide a computer-to-computer link.

- Third Priority, brigade switchboard for common user telephone service throughout the division communication system.

3. At times, the DS battalion and its MSU may share the battalion command (voice) frequency.

4. The DS battalion has a retransmission frequency and the battalion survey teams operate on the corps artillery survey channel.

5. FIST net coverage is in accordance with TC 6-20-10, *The Fire Support Team (FIST)*.

TAB D

FIELD ARTILLERY GENERAL SUPPORT BATTALION COMMUNICATIONS
(AS COU FOR DIRECT SUPPORT BATTALION)

TACFIRE/PRIMARY DIGITAL

DDT	COMM MEANS	TYPE SUBSCRIBERS
A	Div arty op- (FM)	Div arty TACFIRE
B	Bn op/F (FM)	Bde FSO, radars
	Wire	Bn O/I
C	Bn op/F (FM)	COU bn
D	F1 (FM)	Btrys, FSO, FOs
E	F2 (FM)	Btrys, FSO, FOs
F	F3 (FM)	Btrys, FSO, FOs

VOICE/PRIMARY VOICE

FM—Div arty comd, FM (External)

FM—Bn comd, FM (Internal)

RATT/PRIMARY RATT

AM—Div arty CF1 (External)

AM—Div arty CF2 (External)

COMMENTS

1. The GS battalion uses one of its two frequencies (bn op/F) for the computer-to-computer continuity link.

2. When the GS battalion assumes the role of the DS battalion, its most demanding mission and the one for which this net configuration is applicable, the GS battalion will use the DS battalion's op/F, F1, F2, F3, and command nets.

3. The GS battalion has a frequency for voice, the bn command net. However, when the GS battalion computer is being used to control several batteries and the DS battalion computer is operational and using all of its frequencies, the GS battalion voice frequency must be used for the battery-to-computer interface and the battalion must share the DS battalion command frequency or the division artillery command frequency for voice traffic.

4. The GS battalion has a retransmission frequency; the battalion survey teams operate on the corps artillery survey channel.

TAB E

FIELD ARTILLERY GENERAL SUPPORT BATTALION COMMUNICATIONS
(GS TO THE DIVISION — MSU TO A GS BATTALION)

TACFIRE/PRIMARY DIGITAL

DDT	COMM MEANS	TYPE SUBSCRIBER
A	Div arty op- (FM)	Div arty TACFIRE
B	Bn op/F (FM)	Three firing btrys
	Wire	Bn O/I
C	Bn op/F (FM)	COU Bn

VOICE/PRIMARY VOICE

FM—Div arty comd	(External)
FM—Bn comd	(Internal)

RATT/PRIMARY RATT

AM—Div arty CF2	(External)
-----------------	------------

COMMENTS

1. The MSU GS battalion is providing the frequency for the computer-to-computer continuity link.

2. To control three firing batteries in its computer, the MSU battalion must use its battalion command frequency for data and either share the internal voice net of the battalion for which it is MSU or share the

internal voice net of the division artillery or FA brigade.

3. If both GS battalions are operating under control of an FA brigade, FA brigade nets will be used instead of division artillery nets for digital and voice links between the FA brigade and the GS battalions.

4. All divisional and nondivisional GS battalions with TACFIRE will be equipped to provide continuity of operations to a DS battalion. This is a GS battalion's most demanding configuration.

TAB F

COMMUNICATIONS FROM THE FIRING UNIT TO THE FO

FIRE MISSION

The FO number will be contained in the fire mission sent to the selected firing battery. The battery will initiate necessary voice communications with the FO for adjustment. This will be accomplished by the battery FDC changing the radio normally on the command net to the adjusting FO's frequency. The battery FDC will keep its second radio on its assigned F net frequency. The auxiliary receiver provided by the BOC concept may be used to monitor the command net if desired.

REQUEST FOR ADDITIONAL FIRE

If a request for additional fire is generated and results in a fire request to a reinforcing

battalion, and this request requires adjustment of fires, the following steps apply:

a. Parent battalion of FO forwards requests to the reinforcing battalion. Request contains FO number.

b. The reinforcing battalion, which has FOs of reinforced battalion already in its subscriber table, turns subject FO "on," establishes voice and digital contact with FO, and informs FO that the reinforcing battalion will fire for him. The FO will change computer address to new battalion to conduct mission.

c. Firing battery of reinforcing battalion conducting adjustment will contact FO by voice on the FO's F net for necessary voice traffic.

APPENDIX D

GLOSSARY

The following sections contain a glossary of abbreviated terms and nomenclature used in TACFIRE. Section I lists common terms and abbreviations found in all TACFIRE technical manuals. Section II lists terms that are of a more technical nature and require further explanation for correct, clear interpretation when associated with tactical data processing equipment such as TACFIRE. Because of constant changes in tactical concepts, the terms and professional language also have changed. TACFIRE was designed, and the software programed, with several terms that have become obsolete or have actually changed in meaning. This

dichotomy can cause confusion. Section III will describe current definitions and explain how the TACFIRE computer makes use of a different but—to the computer operator—a completely meaningful term. A few examples of dichotomies in TACFIRE vs doctrinal terms include:

TACFIRE

FCL

NFL

FCA

ASR

FM 6-20

RFL

CFL

FFA, RFA, NFA

CSR

Section I. COMMON TERMS AND ABBREVIATIONS

A			
ACA	airspace coordination area	AFU	ammunition and fire unit (message category or function)
ACC	artillery control console	ALO	air liaison officer
ACCO	artillery control console operator	AM	amplitude modulation
ADP	automatic data processing	ANGLICO	air and naval gunfire liaison company

AO	area of operations
AOBSR	air observer
ARMM	auxiliary removable media memory
ASCII	American Standard Code for Information Interchange
ASP	ammunition supply point
ASPC	all source production center
ATI	artillery target intelligence (message category or function)

B

BGS	battery computer system
BCU	battery computer unit
bde	brigade
BDU	battery display unit
bn	battalion
BOT	beginning of tape

C

CAI	computer-assisted instruction
CAMMS	computer-assisted map maneuver program
CAS	close air support
CCU	communications control unit
C/E	compose/edit
CED	compose/edit display
CEOI	communications-electronics operation instructions
CEP	circular error probable
cf	counterfire
CFL	coordinated fire line
CFO	counterfire officer
CI	command intelligence
comm line	communications line
COMSEC	communications security

CONOPS	continuity of operations
corps arty	corps artillery
COU	continuity of operations unit
CPU	central processing unit
CSIN	COMSEC interface
CSR	controlled supply rate
CTA	chemical target analysis
CTB	communications terminal box

D

DASC	direct air support center
DATOC	division artillery tactical operations center
DCU	display control unit
DDT	digital data terminal or digital data transmission
DE	display editor
DEC	data exchange channel
DGZ	desired ground zero
DISCOM	division support command
div arty	division artillery
DMD	digital message device
DPM	digital plotter map
DPU	display plotting unit
DS	direct support
DSA	dead space area
DSM	direct support maintenance
DTU	data terminal unit

E

ECCM	electronic countercounter- measure
ECOF	effects cutoff
EFF	desired percentage effects

ELP	electronic line printer
EMI	electromagnetic interference
EOM	end of mission
EOT	end of tape (or end of trans- mission)
ERP	effective radiated power
ETD	electronic tactical display
EXCLU	exclusion of fire unit, weapon, ammunition, or fuze

F

F	fire net
FAC	forward air controller
FADAC	field artillery digital automatic computer
FAS	field artillery section
FCE	fire control element
FCL	fire coordination line
FD	fault detection
FDC	fire direction center
FDE	fire direction element
FDO	fire direction officer
FEBA	forward edge of the battle area
FI	fault isolation
FIST	fire support team
FM	frequency modulated
FO	forward observer
FOV	forward observer vehicle
FP	fallout prediction
FPF	final protective fire
FRLT	frontline trace
FSCL	fire support coordination line
FSCoord	fire support coordinator
FSE	fire support element
FSK	frequency shift keying
FSO	fire support officer

FST	forward support team
FU	fire unit (battery)
FUSEL	fire unit ordering

G

GA	gun assembly
GDU	gun display unit
GFT	graphical firing table
GS	general support
GSR	general support reinforcing
GSRS	general support rocket system
G/VLLD	ground/vehicular laser locator designator

H

HE	high explosive
HE/Q	high explosive/quick
HE/TI	high explosive/time
HE/VT	high explosive/variable time
HHB	headquarters and headquarters battery
Hz	hertz

I

ICD	imitative communications deception
ICM	improved conventional munitions
ID	identity number (subscriber or message)
IGAMMO	ignore ammunition levels
I/O	input/output

IOC	input/output control	MDSI	maintenance and diagnostic interval (minutes)
IOU	input/output unit	MEG	message entry group
IOX	input/output data exchange	MET	meteorological (message category or function)
J		MFR	mission fired report
JMEM	joint munitions effectiveness manual	MISC	miscellaneous operating system data entry message type
K		MOD	modifications criteria message type
keyboard	alphanumeric/editor keyboard	MOI	message of interest
KG	keying generator (cryptographic device)	MSD	minimum safe distance
L		MST	maintenance support team
LED	light emitting diode	MSU	mutual support unit
LF	line feed	MTS	module test set
LLTI	local loop test interval (minutes)	MTU	magnetic tape unit
LO	liaison officer	MWO	modification work order
LP	limited procurement (TACFIRE equipment)	N	
LSD	least safe distance	NCS	net control station
M		NFA	no fire area
MAC	maintenance allocation chart	NFP	nuclear fire planning
M&D	maintenance and diagnostic	NGF	naval gunfire
MAXVOL	maximum volleys	NGLO	naval gunfire liaison officer
MBA	main battle area	NNFP	nonnuclear fire planning (message category or function)
MCMU	mass core memory unit	NTA	nuclear target analysis
MDS	maintenance and diagnostic message type	O	
		OP	observation post
		OPORD	operations order
		OPSEC	operations security

P

PCG power converter group
 PCL prescribed chemical load
 PCM pulse code modulation
 PEP power entry panel
 PLU program load unit
 PM preventive maintenance
 PNL prescribed nuclear load
 PTA preliminary target analysis

SOP standing operating procedures
 SPA switch panel assembly
 SPR salvage point recording
 SPRT support (message category or function)
 SQT skill qualification test
 SRI standing request for information
 SURV survey (message category or function)
 SYS operating system (message category or function)

R

RCMU removable media memory unit
 RD receive display
 RDF radio direction finding
 RDT remote data terminal
 RFAF request for additional fire indicator and fire request message type or function
 RFL restricted fire line
 RKTMSL rocket missile
 RLPI remote loop test interval (minutes)
 RMMU removable media memory unit
 RPV remotely piloted vehicle
 RSR required supply rate

T

TAB target acquisition battery
 TACFIRE tactical fire direction system
 TATP TACFIRE advanced training program
 TES TACFIRE equipment specialist
 TFC tactical fire control
 TFDMD TACFIRE digital message device
 TFT tabular firing table
 TGR target report
 TOC tactical operations center
 TOF time of flight
 TOS tactical operations system
 TOT time on target
 TRN transmission repeat number
 TTC tape transport cartridge
 TTFC tactical and technical fire control

S

SCA section chief assembly
 S/F sound/flash
 SHELREP shelling report
 SIC survey information center
 SIGINT signal intelligence

U

UTM universal transverse mercator

V	Z
VMED variable format message entry device	ZOR zone of responsibility

Section II. TECHNICAL TERMS AND DICHOTOMIES IN TACFIRE

Aimpoint	A point on the ground where the employment of a nuclear weapon(s) will achieve the desired effects against the enemy without violating the commander's guidance.
Available supply rate (ASR)	TACFIRE makes use of the mnemonic ASR for what is currently defined as controlled supply rate (CSR). See CSR.
Auxiliary memory	The memory or storage provided by a device other than the computer. In TACFIRE, the ARMM is an auxiliary memory device.
Bit	1. Abbreviation for binary digit. Binary digits are 0 and 1. 2. Device or media for storing a binary digit. In TACFIRE the computer word length is 32 bits plus a parity bit for a total of 33 bits all stored on magnetic cores.
Catastrophic failure	An equipment failure that precludes further operation of a subsystem.
Circular access	Method of retrieving survey control points by input of a center coordinate and radius to the survey-application function.
Commander's criteria	Standing processing guidelines automatically considered by TACFIRE in the preparation of recommendations. Examples are ammunition restrictions and volume of fire criteria.

Commonality	Having common features and characteristics.
Compute	Associates fire request with unit(s), target, and time to fire. Used in nonnuclear fire planning to indicate the computer generations of the schedule of fires.
Computer	A TACFIRE computer consists of three main elements: the central processing unit (CPU), the input/output unit (IOU), and the memory.
Computer center	The equipment that is the nucleus of the computerized operation. At battalion level, all equipment is housed in one shelter, which includes the computer group and display group. At division artillery level, two shelters house the computer group and display group separately.
Computer group	The group of equipment including the computer, auxiliary storage devices, and communication equipment.
Coordinated fire line (CFL)	A coordinated fire line is a line beyond which conventional fire support means (FA, NGF, and mortars) may fire at any time within the zone of the establishing headquarters without additional need for coordination. It is designated to expedite fires across boundaries and to enhance rapid fire support reactions to targets in those areas. In TACFIRE the coordinated fire line is specified by use of the NFL mnemonic. See NFL.
Continuity of operations	Continuous command and control provided by a mutual support unit during normal displacements of a computer center or failure of a computer center.
Controlled supply rate (CSR)	The number of rounds per tube per day per weapon system made available by the commander for expenditure for a specific time period. (Previously known as ASR. ASR is used by TACFIRE.) See ASR.
Core memory	A storage unit composed of magnetic cores and associated wiring. Each core stores a single bit.
Data base	The complete dynamic and static data required for subsystem operation.
Data management	Processing accomplished by an operating system to provide storage space and data to computer programs.

Data security	Measures taken to preclude unauthorized access to data or files by a program.
Desired ground zero (DGZ)	TACFIRE makes use of the mnemonic DGZ for what is currently defined as aimpoint. See aimpoint.
Digital data	Data represented by binary digits. In digital transmission, a 1200-hertz tone represents 1 and a 2400-hertz tone represents 0. See frequency shift keying.
Digital interface	An interface where digital information flow takes place.
Display group	The group of equipment including the ACC, DPM, ETD, and ELP.
Duplex	A term applied to a circuit that makes possible the simultaneous transmission of two messages in opposite directions.
Dynamic data	See operational data.
Dynamic storage	The ability to allocate or store varying amounts of data based on varying requirements.
Echelon	One of the different levels of a command.
Execute	Used in nuclear and nonnuclear fire planning to indicate the computer generation desired of the ballistic solutions for the plan.
Fault detection	The determination that a faulty condition exists in equipment.
Fault isolation	The location of a fault in equipment to the extent that repair is possible.
File maintenance	Since the TACFIRE computer memories are not infinite, it is possible to inundate the memories to a point where system functions become degraded. File maintenance is the process of validating computer data to insure only accurate and current information is stored in the computer.
Fire coordination area (FCA)	An area in which specific restraints have been imposed and into which fires in excess of those restraints will not be delivered without approval of the establishing authority. The FCA is a closed area specified by a minimum of three points, or a point and radius, the name of the agency establishing the area, and the name of the area.

The TACFIRE FCA is used to designate free fire area (FFA), restrictive fire area (RFA), and no fire area (NFA).

Fire coordination line (FCL)	TACFIRE makes use of the mnemonic FCL for what is currently defined as restrictive fire line (RFL). FCL will appear on all TACFIRE geometry and output reports instead of RFL. See RFL.
Fire support coordination line (FSCL)	The fire support coordination line is a line beyond which all targets may be attacked by any weapon system (including aircraft and special weapons) without endangering troops or requiring additional coordination with the establishing headquarters. This expedites the attack of targets. The FSCL is established by the force commander (normally corps).
Fire unit	The basic unit (battery) used in TACFIRE for status reporting such as location, ammunition, etc.
Free fire area (FFA)	Free fire area is an area into which any fire support means may deliver fires without additional coordination. This speeds reaction to targets in the FFA. It can be used for an area where neutralization by fire support is preferred to the use of maneuver forces or where friendly aircraft can jettison ammunition. TACFIRE makes use of the mnemonic FCA for what is currently defined as the free fire area (FFA). See FCA. (Using a TACFIRE FCA to define an FFA can inhibit chemical target analysis by FSE.)
Frequency shift keying	A method of transmitting the mark and space elements of a data code by shifting the carrier frequency a fixed amount. The TACFIRE DDT (RDT) will convert the digital data information which is in the form of 1's and 0's to a usable medium for wire transmission or modulation for radio transmission.
Frontline trace (FRLT)	It is the most forward location of friendly maneuver forces on line, specified by a minimum of two points. The line is designated from left to right, facing the enemy. The TACFIRE FRLT is used to designate the forward edge of the battle area (FEBA).
GB	Chemical nerve agent.
Geometry	Control lines, boundaries, and areas used to coordinate fire and maneuver.
Hardware	General term applied to equipment and equipment components.
Hertz	Unit of frequency that is cycles per second.

Initialization	The procedure for preparing a TACFIRE subsystem for operation. Includes turning on power, equipment checks, and input of operational data into the system.
Interrupt	A signal that creates computer program intervention and refers the computer to another operation.
K	K is a term used to abbreviate large numbers associated with memory or auxiliary memory capabilities. The value of 1K is 1024 which is 2^{10} . Examples are: 32K = $32 \times 1024 = 32,768$; and 64K = $64 \times 1024 = 65,536$.
Light pen	A device held against a point on the ETD to indicate data for processing.
Link	General term used to indicate the existence of communication facilities between two points.
Magnetic tape	A tape or ribbon of any material impregnated or coated with magnetic or other material on which information may be placed in the form of magnetically polarized spots.
Map module	The computer program that maintains coordinates defining the general area of operations. It provides high order digits, grid zone, and spheroid to form complete coordinates.
Memory	The core memory of the computer.
Memory word	The TACFIRE memory word consists of 32 bits plus a parity bit for a total of 33 bits.
Message validation	The comparison of input message entries with stored file entries to confirm that the input is meaningful. For example, a message to update the status of a specific fire unit is meaningful only if that fire unit is in the AFU file.
Modularity	Constructed in modules.
Mutual support	The term applied to the techniques employed to continuously update a computer with information from another computer so that the first may assume the duties of the second should the second computer fail or displace and vice versa.
No fire area (NFA)	The no fire area is a designated area into which neither fires nor effects from fires will occur. Normally, the NFA is established by a division or corps commander. TACFIRE makes use of the

mnemonic FCA for what is currently defined as no fire area (NFA).
See FCA.

No fire line (NFL)	TACFIRE makes use of the mnemonic NFL for what is currently defined as coordinated fire line (CFL). NFL will appear on all TACFIRE geometry and output reports instead of CFL. See CFL.
Operational data	Data input to TACFIRE during initialization or normal operations.
Ordering	Placing items in a particular sequence. For example, ordering of fire units is accomplished considering weighting factors established as commander's criteria.
Parity bit	A bit in a group of bits that is set so that the total number of 1-bits is either even or odd. The parity bit in a TACFIRE memory word is set so that the number of 1-bits is odd.
Parity error	The error detected when a sum of 1-bits does not agree with the parity bit indication of an even or odd total.
Peripheral equipment	Equipment that is attached to and/or communicates with a computer. TACFIRE peripherals include the ACC, DPM, printer, and DDT.
Priority scheme	The overall definition of processing priorities to programs and messages. For example, a fire mission has high priority in TACFIRE and is processed before lower priority functions. Individual message priorities can be set by the operator.
Program security	Measures taken to preclude alteration of a program as a result of normal processing.
Program sequence	A sequence in which programs must be performed to accomplish a specified task.
Queue	A waiting line. In TACFIRE, messages are placed in a queue to wait for processing in accordance with the priority scheme.
Rectangular access	Method of retrieving survey control points by input of two corner coordinates and a width to the survey application.
Remote station	Input or remote equipment operated from a location outside a computer center.

Response time	The time from receipt of initial fire commands or a warning order at the fire unit until ready to fire is reported.
Restrictive fire area (RFA)	The restrictive fire area establishes constraints on fire support. Fires in excess of these constraints must be cleared with the establishing headquarters (battalion or higher). The RFA applies to conventional ammunition outside the constraints imposed. TACFIRE makes use of the mnemonic FCA for what is currently defined as restrictive fire area (RFA). See FCA.
Restrictive fire line (RFL)	A restrictive fire line is a line established between two friendly forces and across which fires and their effects cannot extend without prior coordination with the affected force. The RFL is established by the commander of both forces and applies to all types of ammunition and fires. In TACFIRE the restrictive fire line is specified by use of the FCL mnemonic. See FCL.
Salvage point recording	Periodic recording of operational data on the ARMM for use in system recovery.
Simplex	The operational characteristics of a circuit that permit communications in only one direction at a time; half duplex.
Software	General term applied to computer programs.
Static data	Data placed on the system tape used to initialize TACFIRE computer centers. The static data on the system tape cannot be altered in the field. Except for a few special cases, static data once initialized cannot be altered.
Subsystem TACFIRE	The TACFIRE equipment, programs, and personnel that are associated with a computer center. Remote stations are included in subsystems.
System recovery	Resumption of operation with all equipment after degraded mode operation due to an equipment failure.
System (TACFIRE)	The TACFIRE equipment, programs, and personnel that support the command and control structure throughout an organization. A system is made up of two or more subsystems.
System tape	The tape (tape transport cartridge) that contains programs and static data base used to initialize TACFIRE subsystems.

Tape transport cartridge (TTC)	A sealed cartridge containing magnetic tape, a drive motor, and read/write circuitry. This cartridge is plugged into the ARMM when in use.
Task	Processing necessary to accomplish a function. A task may be interrupted and restarted and may require processing from several program modules.
Task priority	The priority of a task in a group of tasks.
Task scheduling	The scheduling of a group of tasks so that all tasks will be accomplished in accordance with the priority scheme.
Thrust access	Method of retrieving survey control points by input of two end point coordinates for a line and distances either side of that line to the survey application function.
User commands	Commands that permit operators to transmit, edit, delete, and print files and file entries.
VX	Chemical nerve agent.



APPENDIX E

REFERENCES

E-1. FIELD MANUALS (FM)

6-20	Fire Support in Combined Arms Operations
6-20-1	Field Artillery Cannon Battalion
11-50	Combat Communications Within the Division (How to Fight)

E-2. TRAINING CIRCULARS (TC)

6-10-1	Field Artillery Communications
6-20-10	The Fire Support Team (FIST)
11-5	What's Up? Know How to Repair & Fabricate Antennas

E-3. TECHNICAL MANUALS (TM)

The following is a breakdown by volume and chapter of the proposed TACFIRE technical manuals.

11-7440-240-10 Fire Direction Center, Artillery, Processing and Display OA-8389/
GSG-10 (V) (Battalion)

Volume 1	Chapter 1	Introduction
	Chapter 2	Service Upon Receipt and Installation
	Appendix A	References
	Appendix B	Basic Issue Items
Volume 2	Chapter 3	Equipment Operation
Volume 3	Chapter 4	System Initialization and Shutdown
Volume 4	Chapter 5	Special Operating Instructions
Volume 5	Chapter 6	Support Function
	Chapter 7	Ammunition and Fire Unit Function
	Chapter 8	Meteorological Function
Volume 6	Chapter 9	Tactical and Technical Fire Control Function
Volume 7	Chapter 10	Nonnuclear Fire Planning Function
Volume 8	Chapter 11	Artillery Target Intelligence Function
Volume 9	Chapter 12	Survey Function
Volume 10	Chapter 13	Maintenance Instructions

11-7440-240-12 Fire Direction Center, Artillery, Processing and Display
OA-8389/GSG-10V (Battalion)

Volume 1	Chapter 1	Introduction
	Chapter 2	Service Upon Receipt and Installation
	Appendix A	References
	Appendix B	Basic Issue Items
Volume 2	Chapter 3	Equipment Operation
Volume 3	Chapter 4	System Initialization and Shutdown
Volume 4	Chapter 5	Special Operating Instructions
Volume 5	Chapter 6	Support Function
	Chapter 7	Ammunition and Fire Unit Function
	Chapter 8	Meteorological Function
Volume 6	Chapter 9	Tactical and Technical Fire Control Function
Volume 7	Chapter 10	Nonnuclear Fire Planning Function

Volume 8	Chapter 11	Artillery Target Intelligence Function
Volume 9	Chapter 12	Survey Function
Volume 10	Chapter 13	Operator/Organizational Maintenance
Volume 11	Chapter 14	Fault Catalog
Volume 12	Appendix C	Reference Data

11-7440-241-10 Fire Direction Center, Artillery OA-8390/GSG-10 (V) (Division)

Volume 1	Chapter 1	Introduction
	Chapter 2	Service Upon Receipt and Installation
	Appendix A	References
	Appendix B	Basic Issue Items
Volume 2	Chapter 3	Equipment Operation
Volume 3	Chapter 4	System Initialization and Shutdown
Volume 4	Chapter 5	Special Operating Instructions
Volume 5	Chapter 6	Support Function
	Chapter 7	Ammunition and Fire Unit Function
	Chapter 8	Meteorological Function
Volume 6	Chapter 9	Tactical Fire Control Function
Volume 7	Chapter 10	Nonnuclear Fire Planning Function
Volume 8	Chapter 11	Artillery Target Intelligence Function
Volume 9	Chapter 12	Survey Function
Volume 10	Chapter 13	Maintenance Instructions

11-7440-241-12 Fire Control Element, Artillery, OA-8390/GSG-10V (Division)

Volume 1	Chapter 1	Introduction
	Chapter 2	Service Upon Receipt and Installation
	Appendix A	References
	Appendix B	Basic Issue Items
Volume 2	Chapter 3	Equipment Operation
Volume 3	Chapter 4	System Initialization and Shutdown

Volume 4	Chapter 5	Special Operating Instructions
Volume 5	Chapter 6	Support Function
	Chapter 7	Ammunition and Fire Unit Function
	Chapter 8	Meteorological Function
Volume 6	Chapter 9	Tactical Fire Control Function
Volume 7	Chapter 10	Nonnuclear Fire Planning Function
Volume 8	Chapter 11	Artillery Target Intelligence Function
Volume 9	Chapter 12	Survey Function
Volume 10	Chapter 13	Operator/Organizational Maintenance
Volume 11	Chapter 14	Fault Catalog
Volume 12	Appendix C	Reference Data

11-7440-242-23-1 Organizational Maintenance, Fire Direction System Artillery,
AN/GSG-10 (V)

11-7440-242-23P Repair Parts and Special Tools, Fire Direction System Artillery,
AN/GSG-10 (V)

11-7440-243-13 Fault Catalog, Fire Direction System Artillery, AN/GSG-10 (V)

11-7440-244-10 Reference Data, Fire Direction System Artillery, AN/GSG-10 (V)

11-7440-251-10 Data Display, Artillery Battery, AN/GSQ-122 (BDU)

Volume 1	Chapter 1	Introduction
	Chapter 2	Service Upon Receipt and Installation
	Chapter 3	Equipment Operations
	Chapter 4	Operator/Crew Maintenance

11-7440-253-10 Message Entry Device, Variable Format, AN/GSC-21 (VFMED)

Volume 1	Chapter 1	Introduction
	Chapter 2	Service Upon Receipt and Installation
	Chapter 3	Equipment Operations
	Chapter 4	Operator Maintenance
Volume 2	Chapter 5	Division FSE
Volume 3	Chapter 6	Bde/Bn FSE, Bn Operations
Volume 4	Chapter 7	Div Arty Operations
Volume 5	Appendix C	Reference Data

NOTE: Advance copies of Technical Manuals to be issued with the TACFIRE system.
Availability status may be obtained from:

Commander
US Army Communications-Electronics
Materiel Readiness Command
ATTN: DRSEL-ME-MQ
Ft Monmouth, NJ 07703



28 SEPTEMBER 1979

By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

Official:

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Major General, United States Army
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Additional copies can be requisitioned from the US Army Adjutant General Publications Center, 2800 Eastern Boulevard, Baltimore, MD 21220.



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