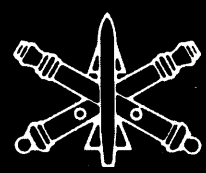
FM 44-15-1

(17 Feb 1987)

HEADQUARTERS
DEPARTMENT OF THE ARMY

Operations and Training Patriot



STATEMENT A
"APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION IS UNLIMITED"
PER TRADOC 13 SEP 94

DISTRIBUTION RESTRICTION: Distribution authorized to U.S. Government agencies only to prevent automatic dissemination of technical or operational information. This determination was made on 20 November 1986. Refer other requests for this document to Commandant, USAADAS, ATTN: ATZC-DS, Fort Bliss, TX 79902-5500.

DESTRUCTION NOTICE: Destroy by any method that will prevent disclosure of contents or reconstruction of the document.

FIELD MANUAL
NO. 44-15-1

***FM 44-15-1**
HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 17 February 1987

Operations and Training Patriot

*This publication supersedes FM 44-15-1, 13 June 1984.

PREFACE

This manual describes operations and training applications of the Patriot air defense missile system. This manual does not cover routine and detailed maintenance tasks. Consult the appropriate technical manual for these requirements. This manual is written for Patriot battalion personnel. However, emphasis is on the Patriot firing battery. As such, the firing battery personnel and their training receive considerable attention.

FM 44-15-1 is a companion manual to FM 44-15. FM 44-15 deals with unclassified doctrinal and tactical aspects of employing the Patriot system. FM 44-1A(S) contains classified information on Patriot, including system effectiveness performance data.

The proponent of this publication is HQ TRADOC. Submit changes for improving this publication on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward it to Commandant, USAADASCH, ATTN: ATSA-PD, Fort Bliss, Texas 79916-7180.

Operations and Training Patriot

Table of Contents

The provisions of this publication are the subject of international agreements:

NATO STANAGS

2002	Warning signs for the Marking of Contaminated or Dangerous Land Areas, Complete Equipments, Supplies and Stores
2047	Emergency Alarms of Hazard or Attack (NBC and Air Attack Only)
2103	Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas
2112	Radiological Surveys
2889	The Marking of Hazardous Areas and Routes Through Them

Unless otherwise stated, whenever the masculine gender is used, both men and women are included.

Patriot Air Defense Missile System

CHAPTER 1

Patriot is an air defense missile system designed to counter the air threat of the 1980s and beyond. This chapter discusses the role of the Patriot system, the mission of the Patriot firing batteries, and the major items of Patriot equipment. It also discusses the Patriot system's operational features.

MISSION AND ROLE

The Patriot system's role is to function against targets within the very low- to very high- altitude boundaries. The Patriot firing battery's mission is to provide very low- to very high-altitude air defense for ground combat forces and high value assets. Patriot performs this mission with less tactical equipment, improved technology, greater firepower, improved ECCM capability, simplified supply and maintenance, and high mobility.

Patriot requires fewer major items of equipment and personnel than other high- to medium-altitude air defense systems. For example, the Patriot phased-array radar performs the functions that nine HIMAD radars perform in other systems.

Patriot is the first fully automated, software-driven US air defense artillery weapon system. Software — a combination of associated computer programs and data — enables the Patriot computers to perform computational and control functions. These computers also regulate engagement actions and monitor the operational status of equipment subsystems. The Patriot system operates in an automatic or semiautomatic engagement mode and in an automatic or manual identification mode.

A maximum of 192 ready-to-fire missiles are in a Patriot battalion. These missiles provide the needed firepower to counter large numbers of attacking enemy aircraft. These missiles also perform well individually against single, highly maneuverable jet aircraft. The missile has a unique guidance system which uses a track-via-missile mode. TVM provides greater accuracy to the missile in flight. TVM guidance is discussed in the missile description part of this chapter.

The Patriot system is highly effective in an ECM environment. Special pulsing of the phased array radar transmitter is automatically selected to counter enemy ECM. Additionally, the connecting cables to the Patriot shelters, and the shelters themselves, are shielded against electromagnetic and radio frequency interference.

CONTENTS

Standardized electronic modules simplify supply and maintenance functions. These multiple-use modules reduce the number and types of required repair parts and are quickly replaceable. BITE, system status monitor, and diagnostics aid in isolating equipment faults to major assemblies, thereby reducing repair time.

Patriot's high mobility minimizes its susceptibility to targeting and attack. This mobility also enables the battalion to keep pace with rapidly flowing air and ground force operations.

FIRING BATTERY

Patriot fights as a battalion; however, its basic operational element is the firing battery. Normally, there are six FBs in a Patriot battalion. (The FB is also referred to as a FU or FP in the software).

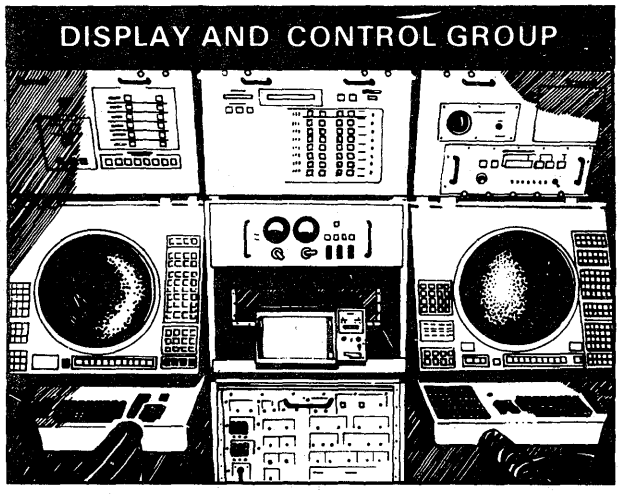
The firing battery consists of an engagement control station, radar set, electric power plant, and antenna mast group. These items make up the fire control section of the firing battery. The firing battery also has up to eight launching stations.

The firing battery is capable of —

- Searching a designated volume of air space to detect and place targets under track.
- Identifying targets as friend, true friend, assumed friend, special friend, unknown, or hostile.
- Arranging targets in priority order for engagement.
- Selecting and launching missiles.
- Guiding missiles to intercept and arming the proximity fuse.
- Evaluating and recording the results of each engagement.

ENGAGEMENT CONTROL STATION AN/MSQ-104

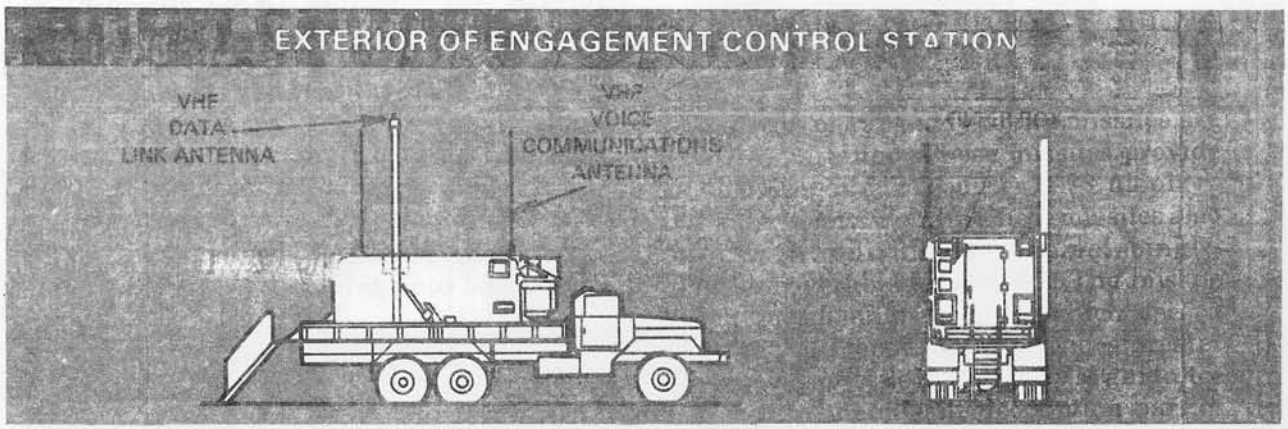
The ECS consists of a lightweight, weather-tight shelter mounted on an M814 5-ton cargo truck. The ECS is the fire direction center for Patriot firing battery operations and is the only manned station in the firing battery during the air battle. The ECS can control up to eight launching stations through a VHF radio data link. Radio data communications with the launching stations are made possible by a curb-side, telescoping VHF data link antenna. This antenna can be erected to a 42-foot maximum height. The ECS, through data and control cables, controls the AMG, RS, and EPP. The ECS communicates by UHF data and voice with the battalion information and coordination central and with ECSs in adjacent firing batteries using an AMG. A communications relay group is also used when distance or terrain obstacles are a factor.

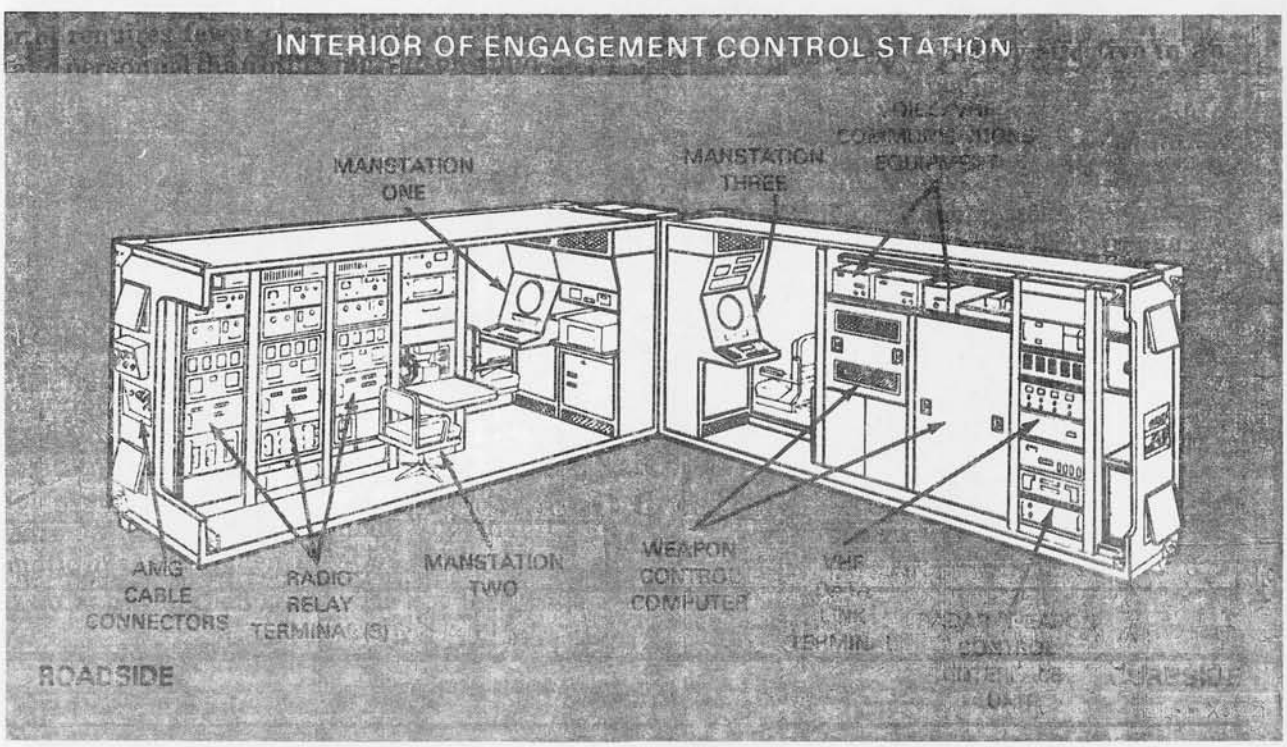


Two display and control consoles are located inside the ECS shelter. An enlisted Patriot operator and system mechanic, MOS 24T, and a Patriot air defense artillery officer, SSI 14E, monitor and/or activate displays, switches, and controls at the two operator stations. These two operator stations are designated manstation one and manstation three. Visual displays at MS1 and MS3 provide the operators with the data required to operate and control the system during engagement. The operators select the AUTOMATIC or SEMIAUTOMATIC engagement mode according to the TSOP. The automatic mode allows the sytem to automatically

select and engage targets. In this mode, the operators primarily monitor engagements but have the capability to manually override this mode and engage targets. In the semiautomatic engagement mode, the operators manually select and engage targets that the system has detected and processed. These modes are further described in Chapter 5.

On the roadside interior of the ECS, there are three UHF radio relay terminals, and a voice communications station — manstation two. MS2 is manned by an enlisted multichannel communications equipment operator, MOS 31M. On the right are the VHF data link terminal, radar/weapon control interface unit, weapon control computer, and VHF voice communications equipment.





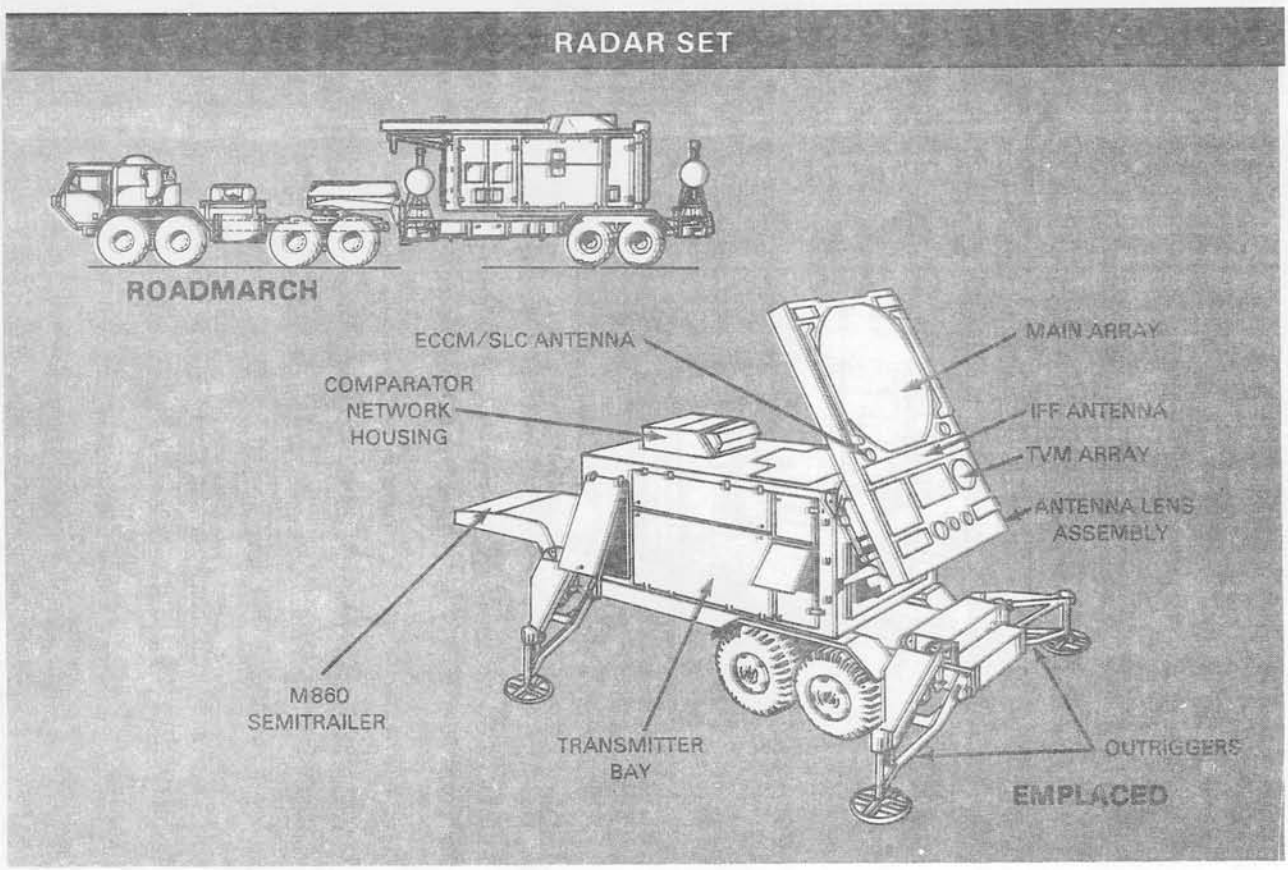
RADAR SET AN/MPQ-53

The RS is a multifunction, phased-array radar mounted on an M860 semitrailer. The prime mover is an M983 10-ton HEMTT tractor. The RS performs the following functions:

- Very low- to very high-altitude surveillance.
- Target detection.
- Target identification (SIF and IFF).
- Target track.
- Missile track.
- Missile guidance.
- Electronic counter-countermeasures action.

Built-in leveling equipment permits the RS to be emplaced on slopes of up to 10°. Once emplaced, the radar's phased-array radar antenna is elevated and locked at a 67.5° angle. The phased-array radar antenna does not rotate. For employment, the RS is positoned to an azimuth by means of a motor-driven pedestal which rotates the entire radar shelter. The radar beam itself is positioned electronically.

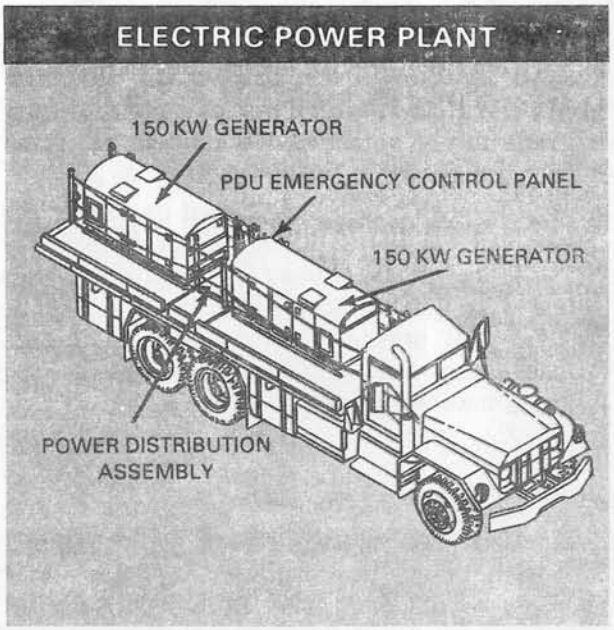
The radar set is not manned during operation. It is remotely controlled by the ECS. The WCC in the ECS controls the radar through its R/WCIU and a corresponding R/WCIU in the RS. The status monitor periodically checks the radar subsystems to verify their operating condition and reports their status to the WCC. The WCC shuts down the radar transmitter automatically in case of major system failures. The ECS operators can display, at their consoles, special radar diagnostic tests. Operators in the ECS turn the radar transmitter on and off, and train the RS in azimuth by using the display and control console controls.

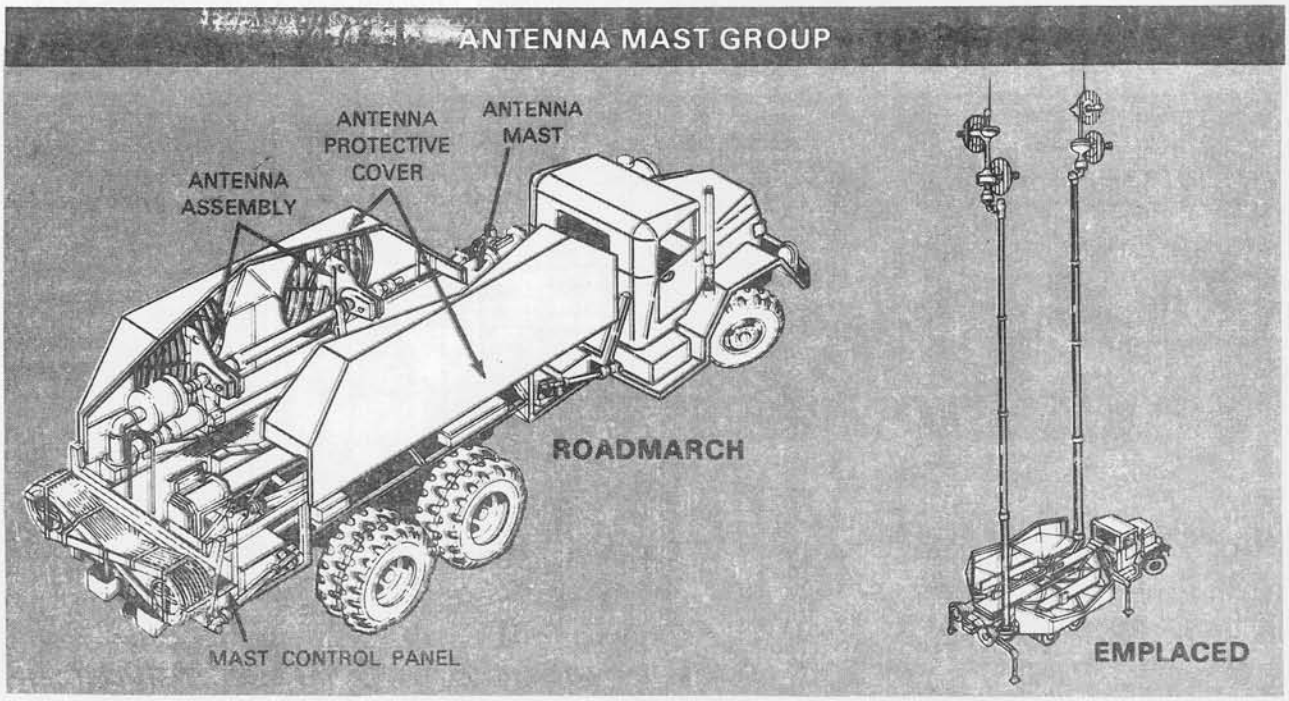


ELECTRIC POWER PLANT AN/MJQ-24

Electric power for operation of the fire control section is provided by the EPP. The EPP consists of two 150-kilowatt turbine generators mounted on an M811 5-ton truck chassis. These generators operate primarily on diesel fuel, but have a multifuel capability. Normal operations require that one generator be on-line while the other generator serves as a backup.

The EPP is connected to the RS by three power cables. The EPP is connected to the ECS by a power cable and a control cable. These cables are transported on racks mounted on the roadside of the EPP. The generator control panel furnishes the ECS operators with an indication of which generator is on-line, a low-fuel warning, and with an EPP emergency shutdown capability.





ANTENNA MAST GROUP OE-349/MRC

The AMG provides mobile, quick-erect antennas and amplifiers for UHF communications among the ICC, CRG, and the ECS. The AMG is cabled to its associated unit (ICC, CRG, or ECS) for power to provide RF signal circuits and to permit remote control of the antenna azimuths.

The AMG is mounted on an M811 5-ton truck chassis and consists of two masts with two antennas atop each mast. Each antenna mast can be preset which allows it to be extended in increments. The antenna masts extend to a maximum height of 100 feet 11 inches from

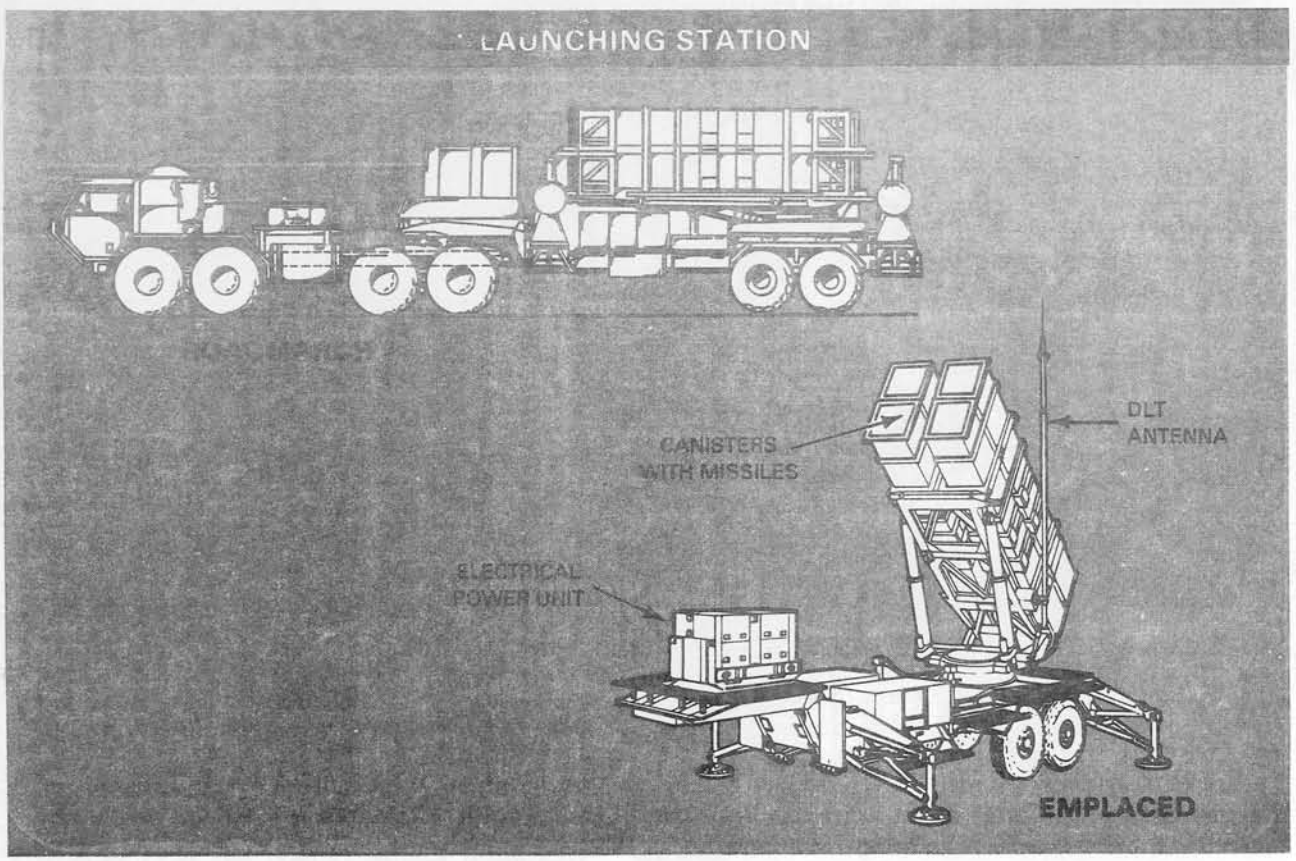
ground level. Wind conditions and the minimum elevation at which line-of-sight communications can be obtained determines the actual height the antennas will be raised.

The AMG has three modes of operation: bypass (no amplification), driver (low-power amplification), and driver/final (high-power amplification). Power amplification during peacetime is not normally authorized. In tactical situations, power amplification modes are used to minimize the effects of UHF ECM.

LAUNCHING STATON M901

The LS is a remotely operated, self-contained unit with its own power plant. The LS is under the operational control of the ECS via digital data link during firing and can fire up to four Patriot guided missiles at designated targets. The LS is mounted on an M860 semitrailer towed by an M983 10-ton HEMTT tractor. Onboard leveling jacks permit emplacement on slopes of up to 10°. The LS is trainable in azimuth (±110° from stowed position) and elevates to a fixed 38° launch position. The LS includes BITE and status monitor to monitor and test all critical electronic and guided missile functions. LS status reports are sent periodically to the ECS.

Each LS is capable of carrying four guided missiles. Each GM is housed within a reinforced, aluminum, launching canister. The GM is a certified round which requires no detailed checkout or maintenance by Patriot crew members. Preventive maintenance is performed on the GM in storage and prior to emplacement on the LS. This maintenance is limited to external inspection and replacement of the humidity indicator desiccant. Both procedures are covered in TM 9-1410-600-14.

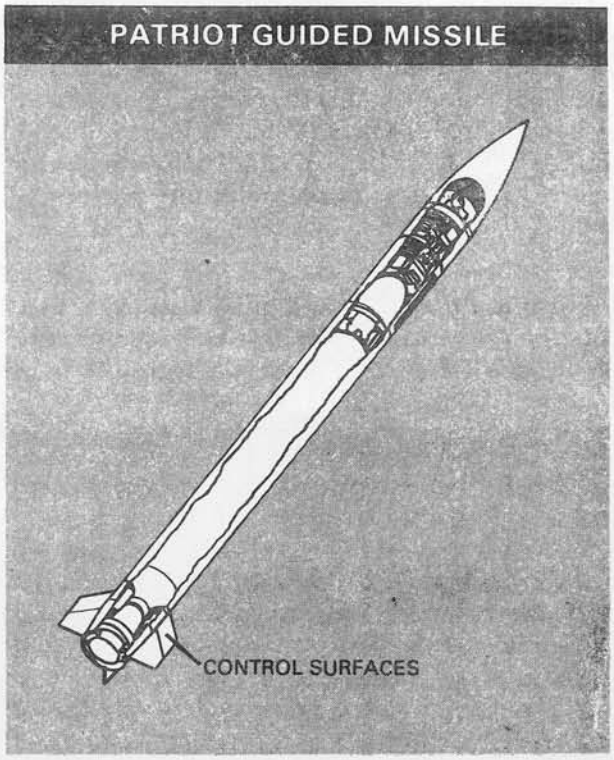


The *canister* functions as a shipping and storage container and launch tube. Each canister is equipped with external alignment pins and tiedown bolts for loading. For loading purposes, a GM canister is lifted by hoist fittings and lowered so that four alignment holes mesh with four locating pins in the support frame. Tiedown bolts secure two canisters side by side. These canisters, in turn, act as support and alignment structures for two additional canisters. When mounted on the LS, individual GMs are identified by their positions as viewed from the aft end of the GMs (upper left, lower left, upper right, and lower right). Canisters containing live GMs must be loaded and off-loaded separately. Empty canisters may be off-loaded separately or in a double-canister, stacked manner.

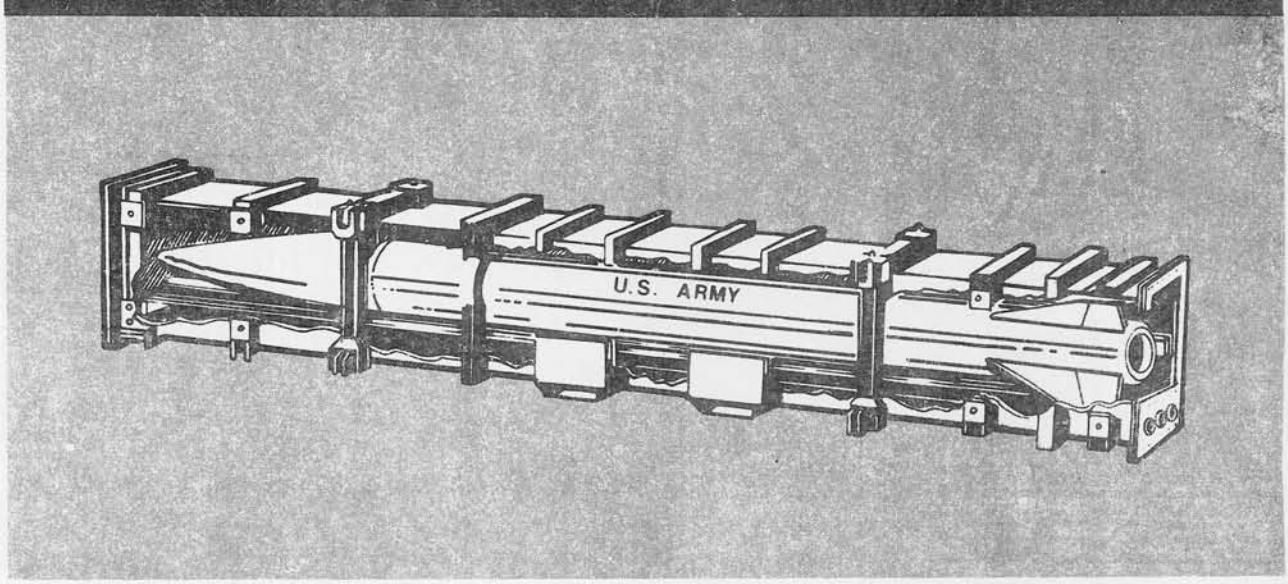
Once the canisters are loaded on the LS, status monitoring, preheating, and launching functions for each GM are provided through a data and power cable and a grounding cable connected between each canister and the launcher. Once the GM is electrically connected to the launcher, it must pass a local BITE test. Interconnection integrity is then monitored and reported to the WCC in the ECS.

The Patriot *guided missile,* MIM 104, is wingless. It does, however, have four tail control fins. It is propelled in flight by a single-stage, solid-propellant, rocket motor.

PATRIOT GUIDED MISSILE



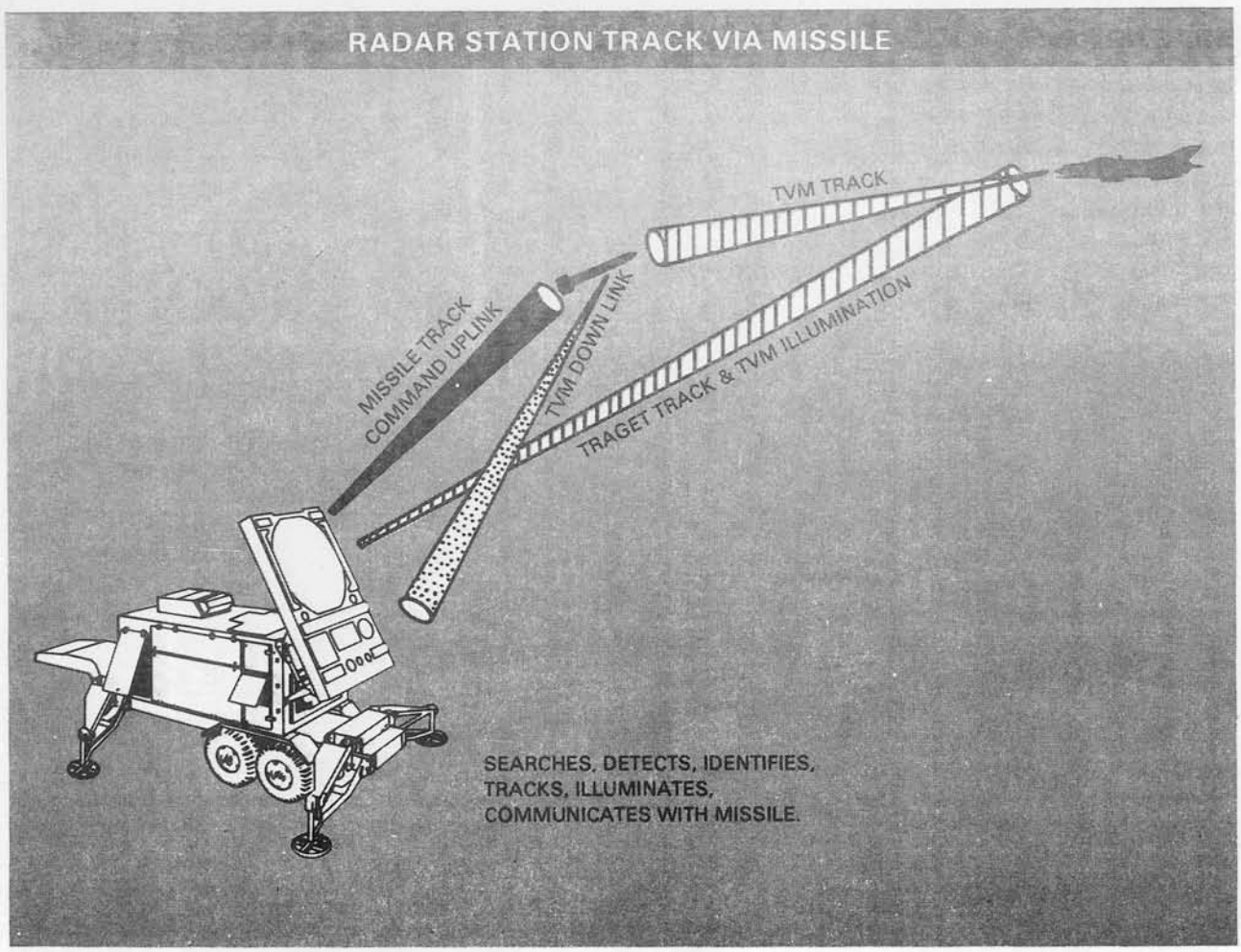
PATRIOT GUIDED MISSILE MIM 104 AND CANISTER



The ECS sends missile prelaunch guidance messages and launch timing instructions to the LS via the data link. Upon receipt of these instructions, the LS initiates an automatically sequenced missile countdown. During the countdown sequence, prelaunch guidance messages are loaded into the missile memory. After the missile is launched, it is electronically captured by radar. Any missiles failing to launch due to misfire or missile hazard conditions should be referred to the unit commander and personnel should await further direction from that commander.

The missile is command-guided by radar to a point just prior to intecept. It is at this point that the unique TVM guidance mode begins.

In the *TVM mode*, the radar set sends out a special waveform that illuminates the target. The radar sends an encoded uplink message to the missile that commands the missile to open its receiver for detection of the TVM waveform energy reflected from the target. The missile then encodes and sends boresight errors via downlink message back to the radar. Guidance computations are then made by the WCC and sent back through the radar to the missile via uplink message. This process continues until intercept. TVM guidance provides greater accuracy because its guidance is based on what the missile sees, in addition to what the radar sees. Since the missile is closer to the target than the radar, miss distances are reduced.



HEADQUARTERS AND HEADQUARTERS BATTERY

Headquarters and headquarters battery controls and supports up to six firing batteries in a Patriot battalion. Patriot peculiar items of the HHB consist of an information and coordination central, four communications relay groups, five antenna mast groups, six guided missile transporters, and five electrical power units.

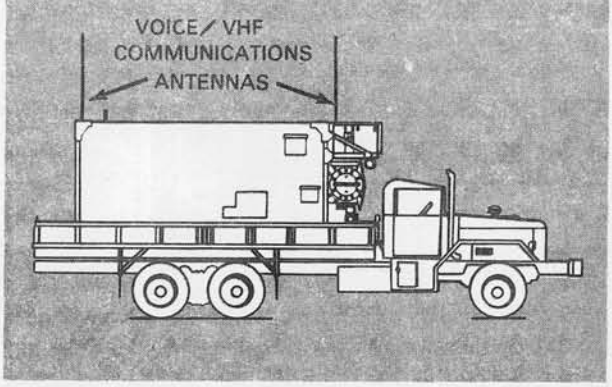
INFORMATION AND COORDINATION CENTRAL AN/MSQ-116

The ICC performs operational control and coordination of the Patriot battalion's firing batteries. In addition to battalion firing battery ECSs, the ICC provides communications with adjacent ICCs, the army air defense brigade's AN/TSQ-73 or the control and reporting center, and the Hawk battalion's AN/TSQ-73.

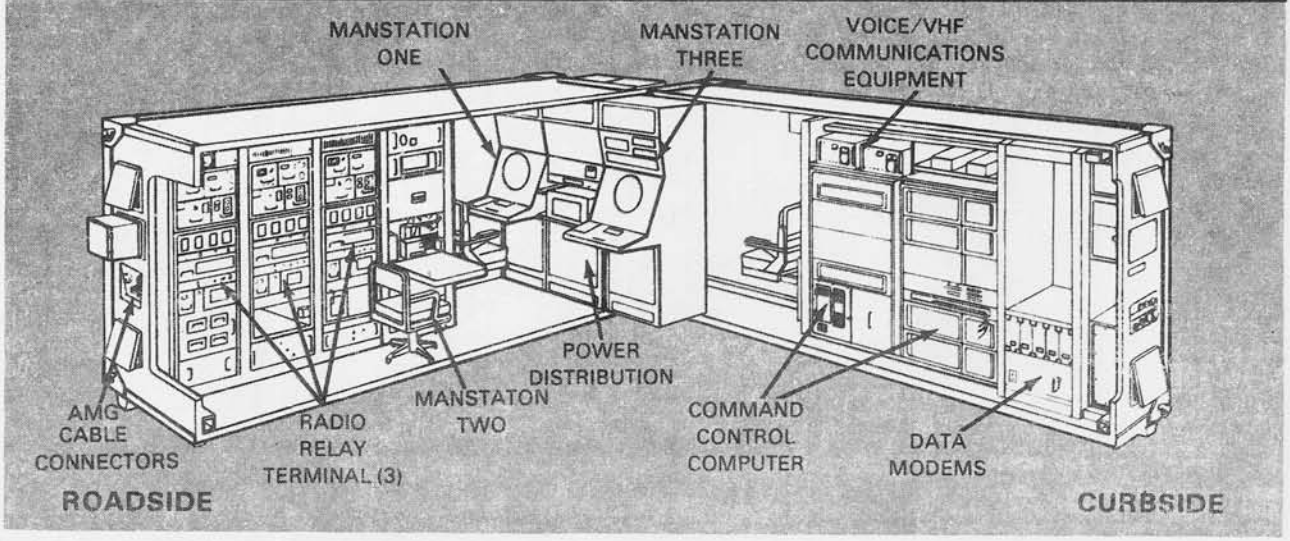
The ICC is similar to the ECS in many respects. Three crew members MOS 14E, 24T, and 31M are required for ICC operations. However, the display consoles at MS1 and MS3 have labeling and functions consistent with battalion operations as opposed to battery-level operations. An ICC status panel located between MS1 and MS3 displays the status of battalion firing batteries. The ICC command control computer corresponds to the weapon control computer in the ECS.

The primary physical difference between the ICC and ECS is that the ECS contains the R/WCIU and the VHF data link terminal, including the external VHF DLT antenna mast. The ICC does not have these. The ICC contains modem equipment to permit communications with higher echelon and adjacent units. The ECSs do not contain modems. Each ICC controls up to six ECSs. The following illustrations show exterior and interior views of the ICC.

EXTERIOR OF INFORMATION AND COORDINATION CENTRAL



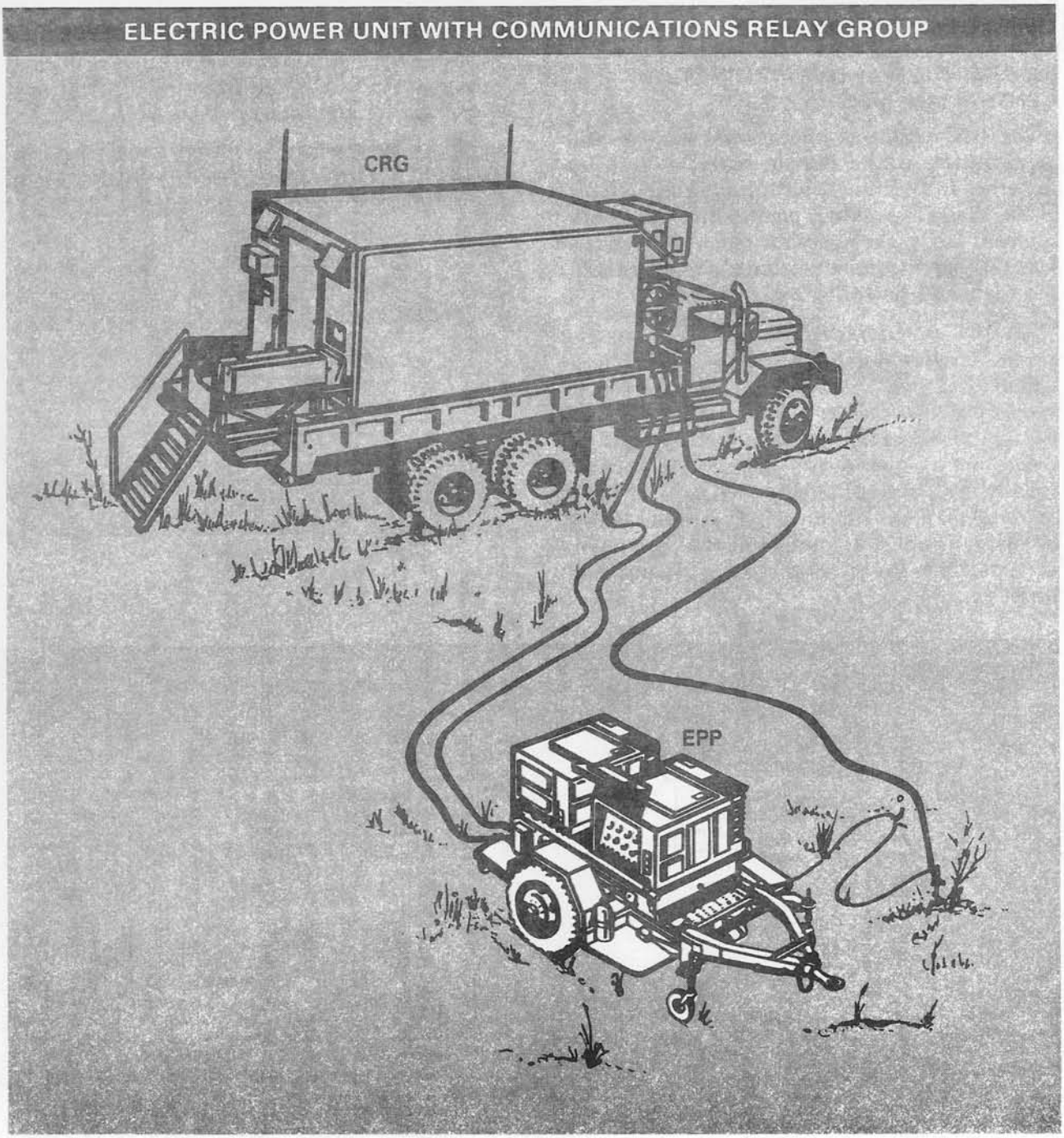
INTERIOR OF INFORMATION AND COORDINATION CENTRAL



ELECTRICAL POWER UNIT AN/MJQ-21

The prime power source for the ICC and the CRG is the electric power unit AN/MJQ-21. The EPU consists of two model EMU-30, 60-kilowatt, 400-hertz turbine generator sets, and a 200-gallon fuel tank. The generators and fuel tank are mounted on trailers towed by the ICC and CRGs. These generators operate primarily on diesel fuel but have a multifuel capability.

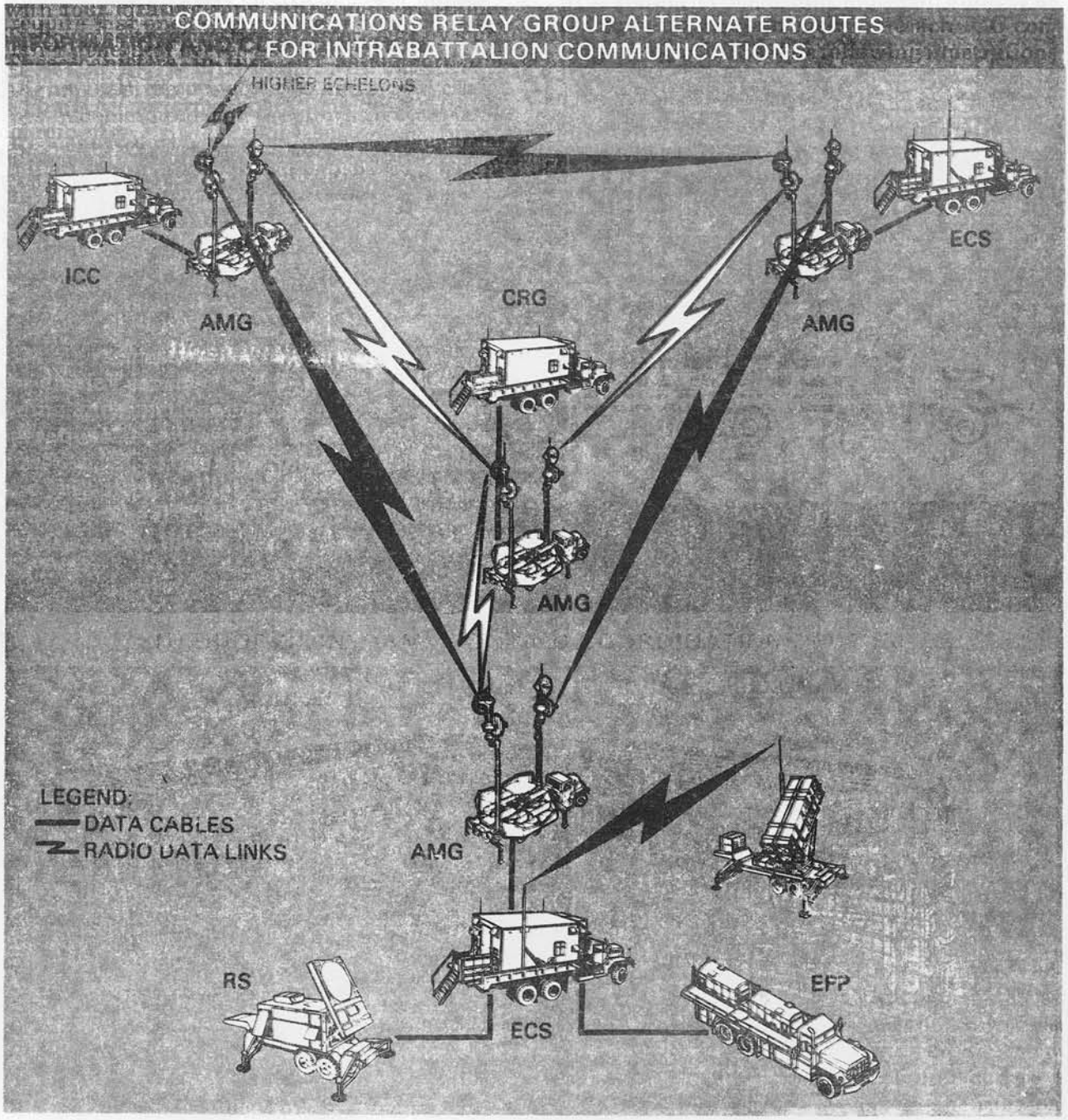
ELECTRIC POWER UNIT WITH COMMUNICATIONS RELAY GROUP



COMMUNICATIONS RELAY GROUP AN/MRC-137

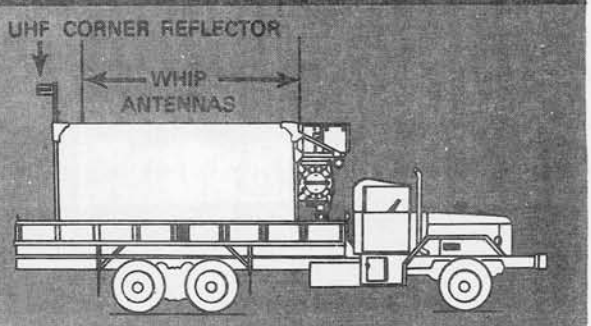
The CRG is a battalion-level item of equipment that enables non-line-of-sight deployment between the ICC and ECS by providing a means for communications relay. The CRG, in conjunction with the AMG, provides secure, two-way data and voice relay capability and provides alternate routes for communications within the battalion.

Since the CRG is equipped with modems, it may also serve as an entry and exit point for extrabattalion communications.

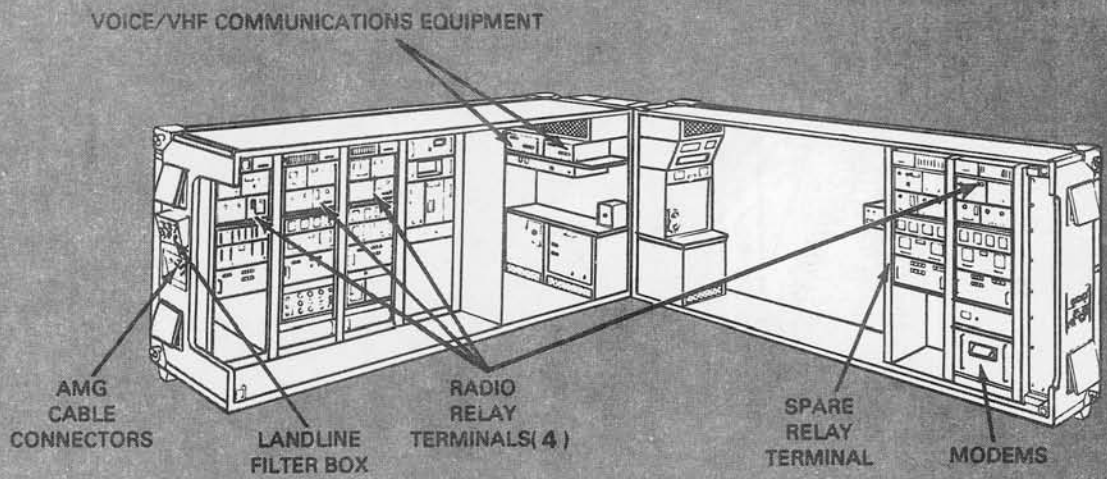


The CRG interior is arranged differently from that of the ICC or the ECS. The CRG does not have a computer nor does it have the two fordward-end operator stations. As shown below the forward end of the CRG has been rearranged, thus creating additional work space. There are four UHF radio relay terminals in the CRG and one spare.

EXTERIOR OF COMMUNICATIONS RELAY GROUP



INTERIOR OF COMMUNICATIONS RELAY GROUP



Organization

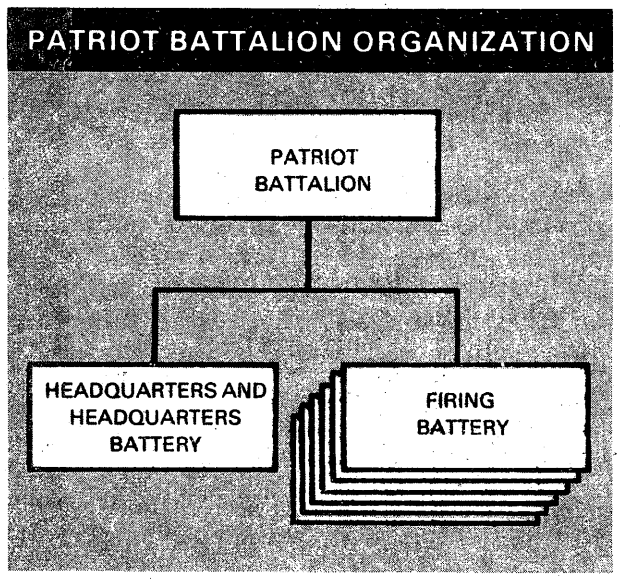
CHAPTER 2

This chapter provides an overview of the Patriot organization. Every Patriot crew member performs a task, function, or mission that is vital to the success of the Patriot battalion's mission. By knowing how the Patriot battalion is organized, crew members can better understand how their individually assigned duties contribute to the overall mission.

Since required and authorized strength figures are subject to change, they are not reflected here. Refer to the latest TOE 44-635L, 44-636L, or 44-637L to determine current strength figures.

BATTALION

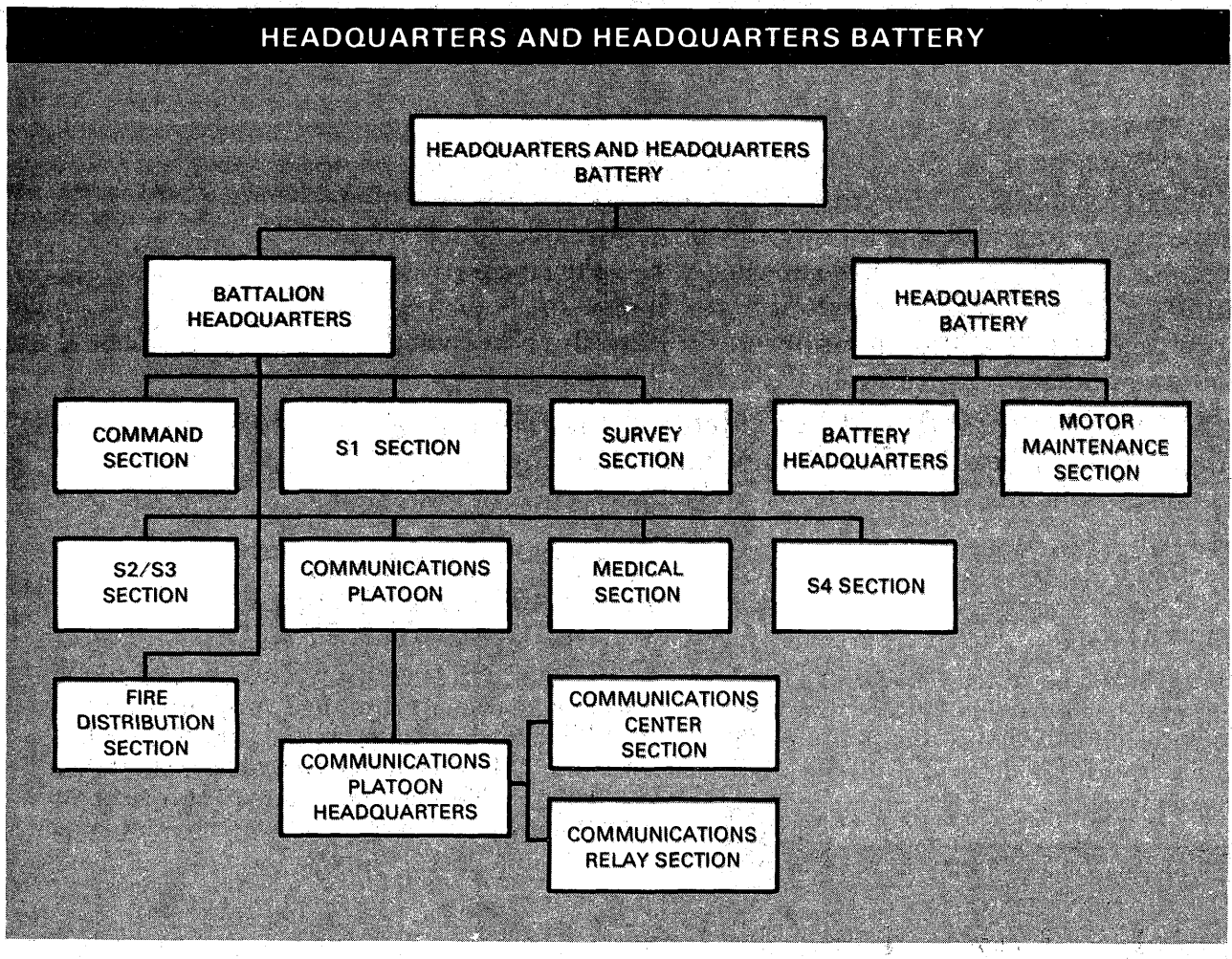
The Patriot battalion consists of a headquarters and headquarters battery and six firing batteries. The Patriot battalion is normally assigned to an air defense artillery brigade at theater level.



HEADQUARTERS AND HEADQUARTERS BATTERY

The HHB is both a tactical and an administrative organization and is organized with a battalion headquarters and a headquarters battery. Whenever tactically feasible, the HHB will be centrally located in relation to lower battalion elements. This enables it to provide responsive and timely support.

CONTENTS



BATTALION HEADQUARTERS

Battalion headquarters provides command and control, administrative, and logistic support for the battalion. The functions performed by the Patriot battalion headquarters are similar to those performed in other battalion-type organizations and are described fully in FM 101-5.

Command Section

The command section is composed of the battalion commander, battalion executive officer, and coordinating and special staff officers. Coordinating staff officers are the S1, S2, S3, and S4. Special staff officers are the battalion chaplain, the surgeon, a communication-electronics officer, and a ADA coordination officer. The command section is also staffed with a command sergeant major, a battalion signal NCO, and three radio operators. The radio operators also act as drivers for the battalion commander, executive officer and the ADA coordination officer. Staff officers have duties and functions similar to those described in FM 101-5 and have additional duties as follows:

The *commander* is responsible for exercising control of the battalion air battle tactical operations. He exercises command and control over his organic units and establishes liaison and communications with supported units and other command posts for execution of the ADA mission.

The *executive officer* functions as the battalion information officer, coordinates the establishment and organization of the battalion head-

quarters area and provides overall staff supervision of the battalion tactical operations center. The executive officer is required to command the battalion in the event the commander becomes a casualty or is not available to exercise command functions.

The *S3* supervises the day-to-day operation of the battalion operations center including the ICC.

The *ADA coordination officer* is the battalion representative (liaison) at the supported unit or unit in whose area the Patriot battalion is operating.

The *C-E staff officer* plans and manages the battalion communications networks. He is also custodian of the battalion COMSEC account. (The battalion signal NCO assists with these duties.)

S1 Section

The S1 section has coordinating responsibilities for maintenance of unit strength, personnel management, development and maintenance of discipline, law and order, and chaplain support. Five enlisted personnel are provided to assist the S1 officer.

S2/S3 Section

The S2 element is responsible for security and the collection, evaluation, and distribution of intelligence data in support of the battalion mission. The S3 element is responsible for the planning, organization, training, and operations of the battalion. The S3 develops the tactical operations data used in the initialization of the ICC and the firing battery ECSs. The S3 also supervises a system-evaluation team. This team conducts tactical and technical evaluations of the firing batteries and the battalion fire direction center. The system evaluation team also assists the S3 in developing and evaluating operator and maintenance training programs.

Fire Distribution Section

The fire distribution section exercises direct control and supervision of up to six firing batteries during the conduct of the air battle. The ICC exchanges data and voice information with the ADA brigade tactical operations center as well as each firing battery, adjacent Patriot battalions, and adjacent Hawk battalions. If the brigade AN/TSQ-73 is out of action, or the battalion is deployed to an area beyond the control of an ADA brigade, the ICC has the capability of establishing data-link communications directly with the control and reporting center.

Communications Platoon

The communications platoon is made up of a platoon headquarters, a communications center section, and a communications relay section. The communications platoon executes the battalion communications plan prepared by the C-E staff officer. The communications center section is responsible for battalion wire communications, operations and maintenance (less teletypewriters) of the radio teletypewriter set, control of COMSEC material, and unit maintenance of HHB communications equipment (less multichannel radio). The communications relay section operates up to four CRGs.

S4 Section

The S4 section is responsible for planning and coordinating supply, maintenance, movements, missile supply to the firing batteries, and other logistical services required by the battalion. This section has six guided missile transporters for missile resupply and reload. The S4 section provides unit maintenance support for the battalion's quartermaster and chemical equipment.

Medical Section

The medical section provides emergency medical treatment and operates the battalion aid station. An ambulance and two aid men from this section are provided to each FB.

Survey Section

The survey section provides survey data to the FB's and supporting elements for equipment emplacement. A survey information center and two survey teams make up the survey

section. Each team has a position and azimuth determining system as primary survey equipment.

HEADQUARTERS BATTERY

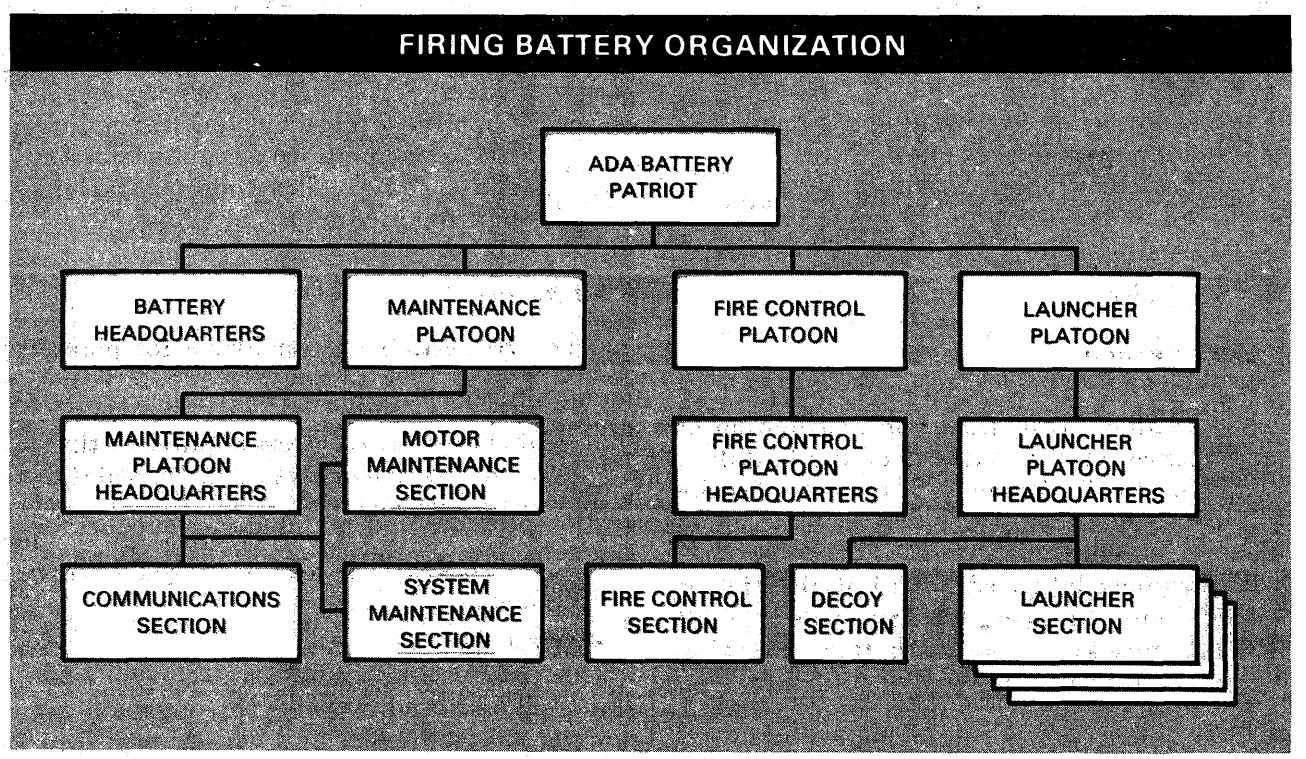
Headquarters battery provides support to the battalion. Headquarters battery provides the resources to support the entire headquarters for food service, and unit supply. It also provides refueling and unit maintenance support for vehicles, power generators, and engineer missile equipment. Headquarters battery is organized with a battery headquarters section and a motor maintenance section.

Battery Headquarters Section

The battery headquarters section is composed of the battery command element, unit supply element, and battery food service element. The battery commander also functions as the motor officer. MANPAD equipment is provided for one Stinger team. Stinger team duties are performed as an additional duty by selected battery headquarters personnel. Radiac meters, radiac chargers and chemical alarms are provided to the headquarters section.

Motor Maintenance Section

The motor maintenance section provides unit maintenance for HHB vehicles, power generation equipment and air conditioners. The section refuels all HHB fuel consuming equipment and provides vehicle recovery for HHB vehicles.



FIRING BATTERY

Each Patriot firing battery is capable of detecting and identifying targets and launching missiles to destroy hostile aircraft. Patriot firing batteries are deployed to form a battalion air defense network for a specified volume of airspace. The firing battery is highly mobile. Mobility allows for rapid emplacement, preparation for road march, and frequent moves to alternate positions, depending on the tactical situation and theater SOP.

Patriot firing batteries operate continuously, except for obvious nonoperational periods: such as during road march or emplacement.

MANPAD equipment for two Stinger teams is authorized to deter close-in, low-altitude air attacks. Battery personnel are selected to perform as Stinger team members as an additional duty.

The Patriot battery consists of a headquarters section, a maintenance platoon, a fire control platoon, and a launcher platoon.

HEADQUARTERS SECTION

A battery headquarters section provides the battery with command, unit administration, unit supply, and food service functions. Because of the amount of time spent on RSOPactivities and battery relocation, the commander and executive officer are each provided a vehicle. Due to frequent movement, rapid road march, and emplacement capabilities of the Patriot system, a 2 1/2-ton shop van is used as a mobile battery CP.

MAINTENANCE PLATOON

Effective communications, motor, and system maintenance are essential to the firing battery's mission. The maintenance platoon is organized to fill these needs. It consists of a maintenance platoon headquarters section, communications section, motor maintenance section, and systems maintenance section.

Maintenance Platoon Headquarters Section

The maintenance platoon headquarters section exercises command and control over the maintenance platoon. The platoon leader and platoon sergeant ensure that unit level maintenance is furnished in a timely and coordinated manner. The platoon leader is the battery motor officer and also performs duties as a tactical control officer in the ECS.

Communications Section

The communications secton supports the battery's wire communications requirements and performs unit level maintenance on field C-E equipment. Three tactical wire operator specialists operate two switchboards at the battery CP on a 24-hour basis to support the battery administrative, logistics, and operational wire requirements. They also lay, maintain and retrieve field wire.

Motor Maintenance Section

The motor maintenance section provides unit maintenance on all organic vehicles and generators (except turbine generators), vehicle recovery, and refueling. The section maintains the PLL for motor maintenance support. The section performs maintenance to the maximum extent possible at individual vehicle locations. This is because the vehicles are required at their deployed locations for tactical mission needs.

Systems Maintenance Section

The system maintenance section performs unit maintenance for Patriot system peculiar equipment — ECS, RS, LS, AMG, electronics, and maintenance test equipment. The section also maintains a PLL for the Patriot system.

FIRE CONTROL PLATOON

The fire control platoon is organized with a platoon headquarters and fire control section.

Fire Control Platoon Headquarters

This section exercises command and control of the fire control platoon and works with the maintenance and launcher platoons.

The platoon leader and assistant platoon leader serve as tactical control officers for the ECS, and, along with the platoon sergeant, also perform RSOP activities. A 1 1/4-ton vehicle serves as a mobile platoon CP. This truck pulls a 3/4-ton trailer containing Stinger equipment.

Fire Control Section

The fire control section is composed of the following major items of the firing battery: ECS, RS, EPP, and AMG.

The ECS is similar to the battalion ICC and requires three full-time positions manned by crew members in SSI 14E and MOSs 24T and 31M. The tactical control officer position at MS3 is manned by the platoon leader or assistant platoon leader of either the fire control, maintenance, or launcher platoon. The TCO position in the ECS corresponds to the tactical director position in the ICC. The tactical control assistant position at MS1 is manned by a Patriot operator and system mechanic. A multichannel communications operator mans the MS2 position and performs unit maintenance on the UHF equipment. He also aids in performing road march and emplacement duties on the AMG.

Although the RS is not manned during operation, four Patriot crew members are required for its emplacement and road march. These four crew members are the vehicle drivers for the ECS, RS, and platoon leader vehicles. They perform duties as RSOP team members when required and are designated as Stinger team members.

Two turbine generator mechanics road march, emplace, and operate the EPP as well as performing unit maintenance on the turbine generators.

LAUNCHER PLATOON

The launcher platoon consists of a launcher platoon headquarters, decoy section, and four launcher sections.

Launcher Platoon Headquarters

Launcher platoon headquarters is the command and control element for the launcher sections. The platoon leader and platoon sergeant are provided a 1 1/4-ton truck and a 3/4-ton trailer. The truck is used as a mobile platoon command post. It is also used for RSOP activities and to shuttle launching crews. The 3/4-ton trailer contains Stinger equipment and two portable chemical agent alarms.

Decoy Section

The decoy section consists of personnel assigned by the Launcher Platoon headquarters.

Launcher Sections

There are four launcher sections in the launcher platoon. Each section is supervised by a section chief and has two LSs. Each LS has three crew members for emplacement, GM reload, road march, RSOP activities, and sustained operations. The section chiefs perform duties as senior crew members.

Support

CHAPTER 3

System support provides the facilities, equipment, trained personnel, and procedures required to maintain the Patriot system in an operationally ready condition. This chapter provides an overview of support concepts and equipment used to supply and maintain the Patriot system.

MAINTENANCE CONCEPT

The Patriot System's on-site maintenance concept is enhanced by certified guided missile rounds, battery replaceable units, BITE and diagnostics, display-aided maintenance, and maintenance levels.

CERTIFIED GUIDED MISSILE

The Patriot guided missile is certified by the manufacturer and requires no detailed checkout or field maintenance by Patriot crew members. A defective missile is handled per local SOP and is sent to the Patriot missile facility for repair. The PMF is an automated missile test facility designed to test the Patriot missile to the same specifications that were used during production. The facility is capable of disassembly, testing, repairing as required, retesting, reassembling, final testing and recanning of the missile to bring it back to an operational certified round status.

BATTERY REPLACEABLE UNITS

Most of the Patriot-peculiar firing battery repair parts consist of plug-in assemblies called BRUs. After faulty BRUs have been isolated, the Patriot operator and system mechanic removes the defective BRUs and replaces them with working spares on site.

BITE

The BITE lamps, located throughout the Patriot equipment, assist in alerting crew members of equipment malfunctions. Through BITE, operator-mechanics can detect and localize a fault to the BRU needing replacement. During air defense operations, the WCCs in the firing batteries' ECSs and CCC at the battalion ICC monitor critical operational BITE circuits to assess equipment status. This is done by a software program called status monitor.

DIAGNOSTICS

The WCC and CCC are used primarily for air defense operations; however, they can also be used for maintenance diagnostics. The ECS or ICC operator at MS1 or MS3 selects a maintenance control software program to replace the

CONTENTS

operational program. Diagnostic programs within this system test the ECS, ICC, or RS equipment subassemblies to detect and locate faults. Once the faults are determined, a display-aided, maintenance feature is selected to aid in correcting the faults.

DISPLAY-AIDED MAINTENANCE

DAM eliminates the use of some manuals to perform routine maintenance tasks. DAM provides step-by-step procedures for an entire maintenance action. The procedures appear on either the MS1 or MS3 CRT display in the ECS or ICC. The program lists the method for removing and replacing the BRU as well as the tools required. The operator-mechanic reads the step aloud over his headset-microphone. The operator-mechanic at the site of the equipment fault performs the corrective maintenance as the instructions are read to him. Each completed step is acknowledged by an operator keyboard action before the next step is displayed. At the operator-mechanic option, the procedures may be printed by the hard copy unit. Maintenance procedures not covered by display-aided means are covered in Patriot technical manuals.

MAINTENANCE LEVELS

Patriot's system design makes extensive use of BITE, and BRUs. These features reduce the number of maintenance levels of Patriot-peculiar equipment to three: unit, intermediate, and depot.

Unit

Most of the expected failures in Patriot equipment are in BRUs which can be removed and replaced by unit level maintenance without soldering, complicated tools, or test equipment. Malfunctions beyond the capability of the operator-mechanic (MOS 24T) are referred to the missile system technician (MOS 222C) from the battery system maintenance section. If the malfunctions are beyond the capability or resources of unit level maintenance, they are referred to intermediate support element teams.

Intermediate

Intermediate maintenance repair is done by intermediate support elements. The ISE completes actions that cannot be performed at the unit level. A Patriot field army support center provides the base for the ISE maintenance operations. The PFASC provides support for Patriot-peculiar items, such as BRU screening, repairing, and maintaining operational readiness float equipment. Special PFASC intermediate support elements teams provide responsive intermediate support to the firing batteries. These mobile teams are dispatched to points of failure to provide on-site maintenance and assistance.

Depot

Patriot equipment requiring depot level maintenance, extensive rebuild, or repair is evacuated through PFASC to prime contractor facilities.

SUPPLY CONCEPT

The Patriot supply concept demands that repair parts support be provided at the point of failure by the fastest possible means. Many of the Patriot assemblies in the ASL and PLL are essential repair parts stockage list items because they are both mission-essential and required for unit level maintenance. A typical firing battery PLL will have these repair parts to correct the problems on-site. Intermediate maintenance will also maintain stocks of selected repair parts.

A maintenance support company provides support for each Patriot battalion. This Patriot maintenance support company provides one-stop DS maintenance for non-Patriot peculiar equipment such as engineer, signal, and automotive equipment. It also provides for a technical supply and direct exchange for selected items, maintains an ASL, has maintenance support teams for supported batteries, and supplies operational readiness float equipment.

Patriot missile resupply starts with the FB submitting a requisition for missiles. This requisition is then passed to the battalion S4 and then to the supporting special ammunition

supply point. The theatre Army supplies the missiles directly to the battalion ammunition transfer point. The battalion' s guided missile transporters are then used to reload the FB launching stations.

BATTALION SUPPLY AND MAINTENANCE EQUIPMENT

Battalion supply and maintenance equipment supports the Patriot maintenance and logistics concepts. BSME consists of battery supply and maintenance equipment, battalion supply and maintenance equipment, and calibration equipment.

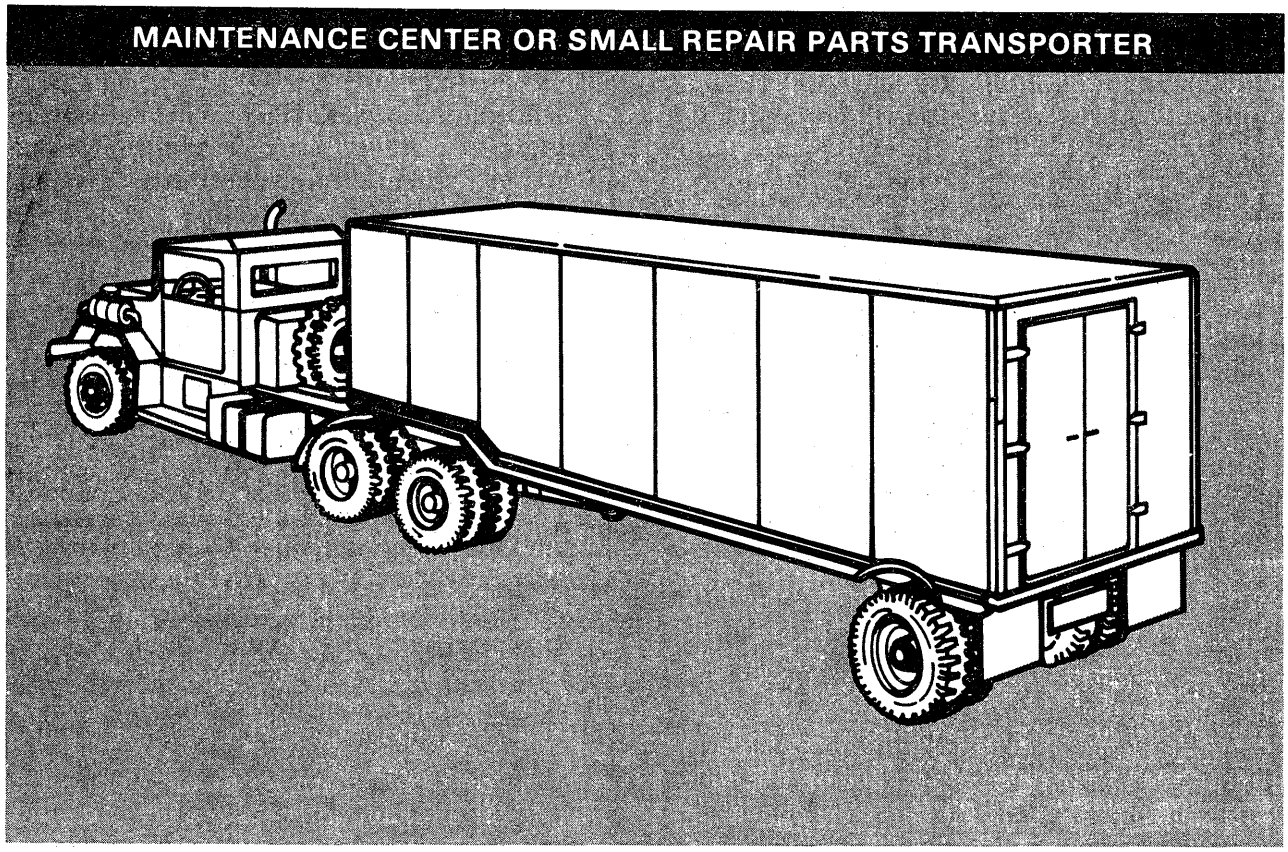
BATTERY

Battery maintenance equipment consists of the following items:

A *Maintenance Center.* The MC is a semitrailer van with a 5-ton truck tractor as a prime mover. The MC is manned by system maintenance section personnel. It provides space for the control, coordination, and scheduling of unit level maintenance functions for the Patriot battery. The MC provides storage for repair parts, test equipment, tools, and maintenance and inventory documentation. A work area is provided for the performance of light mechanical repair and assembly by system maintenance personnel. A voice radio provides communications for maintenance matters, while a remote terminal in the vehicle cab allows for communications during road march. Electrical power for the MC is provided by a trailer-mounted 15-kilowatt, 400-hertz, diesel generator set.

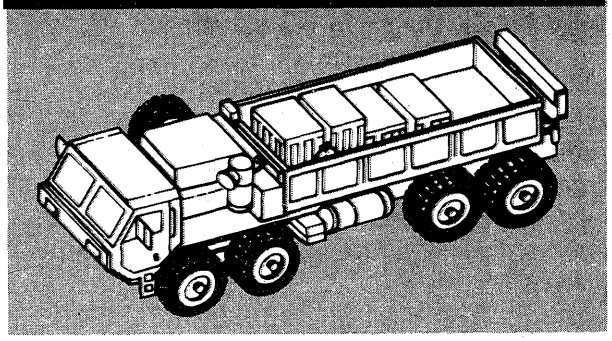
A *small repair parts transporter.* The SRPT is a semitrailer van towed by a 5-ton truck tractor. It stores and transports the small PLL repair parts for the firing battery.

MAINTENANCE CENTER OR SMALL REPAIR PARTS TRANSPORTER



A *large repair parts transporter.* The LRPT is a HEMTT, M977 cargo truck. The LRPT is used to store, transport, and handle the large, heavy repair parts of the PLL.

LARGE REPAIR PARTS TRANSPORTER



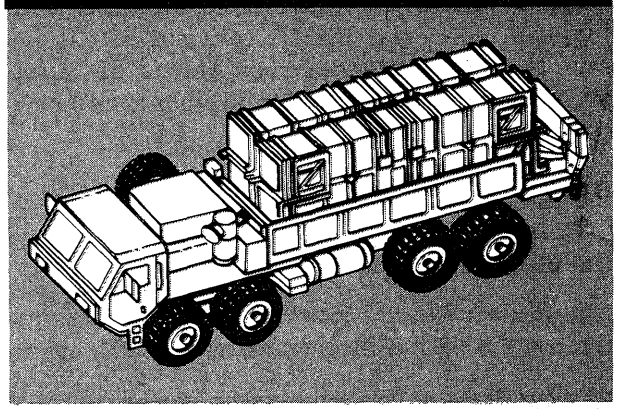
BATTALION

Battalion maintenance equipment consists of the following items:

A *maintenance center* with generator and 1 1/4-ton truck. The MC is required for unit level maintenance of the ICC, CRG, and AMG. It also provides storage and transportation for HHB Patriot system PLL. The 1 1/4-ton truck is provided for maintenance team mobility to remote relay sites.

A *Guided missile transporter.* A GMT consists of a 10-ton HEMTT, M985 with a crane. The S4 section at HHB operates six GMTs. Each GMT can transport four Patriot missiles. The missiles are delivered and transferred by GMTs to the individual LSs in the firing batteries as needed.

GUIDED MISSILE TRANSPORTER



CALIBRATION EQUIPMENT

Calibration equipment consists of cables and adapters to connect portable test equipment with those assemblies of the Patriot system requiring calibration.

Communications

CHAPTER 4

This chapter describes UHF communications for Patriot battalions. Patriot relies heavily on effective radio communications for proper command and control. The key to battalion operations is the UHF data multirouting communications net that ties the ICC to the FB ECSs and the UHF data link from the ICC to the brigade AN/TSQ 73. Data communications over the UHF data link are handled by computers at the ICC and ECS, and include track data and other input necessary for target engagement, as well as system status information. Tactical radios are also used between the ICC and ECSs and a radio teletypewriter, organic to the battalion, links the battalion with the brigade. Other radio communications nets and wire circuits are available throughout the battalion for command, administration and logistics, and are diagrammed in FM 44-15.

EQUIPMENT

Some items of equipment frequently referred to in this section are the radio relay terminals, routing logic radio interface unit, communications patching panel, corner reflectors, and AMG antennas and amplifiers.These items are all elements of the Patriot communications subsystem and are used in carrying out the battalion's communications plan.

RADIO RELAY TERMINALS

Radio relay terminals also called UHF stacks are located in the ICC, ECS, and CRG shelters. These shelters have identical RRT stacks. The ICC and ECS have three RRT stacks. The CRG has four.

Each RRT consists of an AN/GRC-103 radio, a TSEC/KG-27 security device, a TD-660G multiplexer, and a TD-1065 high-speed serial buffer. All of these items, together with one AMG

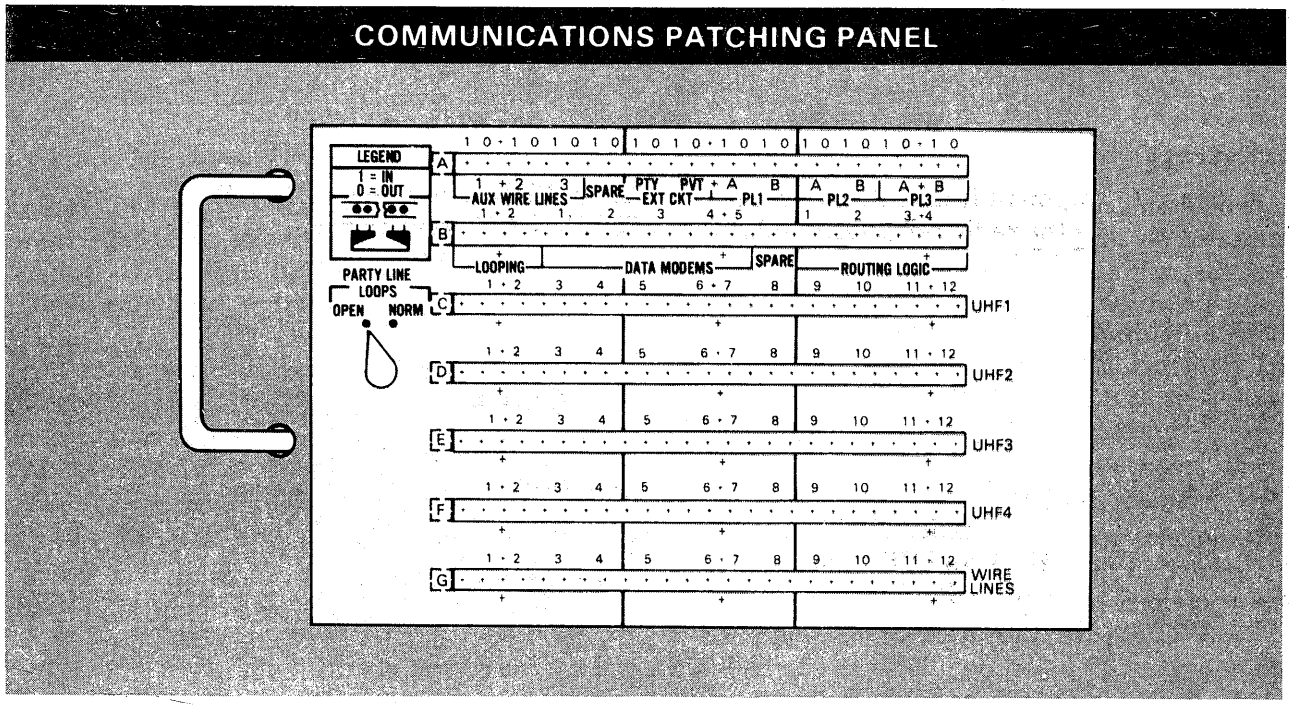
CONTENTS

antenna or shelter corner reflector antenna, form one terminal of a UHF line-of-sight radio link providing 12 communications channels. Each channel may be either voice or data. One channel of each UHF radio is dedicated for data and is connected via the patch panel to the RLRIU. The remaining 11 channels of each RRT are terminated on the CPP. These circuits can thus be interconnected to party-line hybrids, or to external wire lines by means of patch cords.

ROUTING LOGIC RADIO INTERFACE UNIT

RLRIUs are located within each ICC, ECS, and CRG shelter. The RLRIU serves as a digital message (not voice) interface among the WCC/CCC, RRTs, DLT, and up to five modems.

The main function of the RLRIU is to provide parallel routing of data traffic being transmitted over the battalion UHF network. When the RLRIU transfers a message to the RRT, it does so to all available RRTs in that shelter. The message is thus transmitted over every UHF link and ultimately transmitted over every available route (multirouted) within the battalion to its destination. A "first good message" check performed by the RLRIU prevents messages from circulating endlessly through the UHF network. Data messages are transferred from the WCC to the RLRIU via a block transfer mechanism that contains the source of the message, the RLRIU address, and instructions, as well as the text. In additon to performing multirouting, the RLRIU tests each message for errors and discards messages with errors. It processes messages by reformatting incoming and outgoing extrabattalion messages into the appropriate data transfer language. The RLRIU also acts as a central reporting point for alarm and BITE information concerning the communications equipment within the shelter.



COMMUNICATIONS PATCHING PANEL

A CPP is located in each ECS, ICC, and CRG shelters. It serves as the interface between the RLRIU, frequency shift keying modems, external wire, and RRTs. Each element of the CPP is described in the following paragraphs. Markings are as shown or displayed on equipment.

AUX WIRE LINES are connected by binding post connections to the landline communications panel at the rear of the ECS, ICC, or CRG shelters. An example of the use of an AUX WIRE LINE would be the coordinating wire line circuit to the battalion or battery maintenance section. The spare ports are not connected.

The *PTY EXT CKT* port is tied to the three communications system control panels. Two of which are located at the control keyboard assemblies at MS1 and MS2 and the other one is located behind and above the MS3 chair. When the operator places the circuit selector to the EXT CKT position, he will get whatever has been patched into this port. An example of this would be a voice only landline to the battalion TOC at the ICC or to the CP at the battery.

The *PVT EXT CKT* port is tied to the communications system control panel at MS2. When the operator places the circuit selector to the EXT CKT position, he will get whatever has been patched into this port. An example of this would be a voice only landline to the battalion C-E officer or NCO at the ICC.

PL1, PL2, and *PL3* are voice party lines selectable at each CCP. The A and B on the CPP represent the ports at which the party lines are patched to the radios.

LOOPING ports are primarily used for system troubleshooting. They allow an operator to loop back a channel or port.

ROUTING LOGIC ports are wired to the RLRIU and provide the interface for multirouting. A scheme is developed in patching the routing logic (data channels). This scheme is explained further under planning standardization.

DATA modems ports are wired to the analog side of the five data modems within the ICC or CRG. They may be patched to wire lines or RRTs. Brigade or CRC and adjacent battalion traffic is routed over these modems. The patching is from the DATA MODEMS port to a channel of one of the RRT, through or to, wire lines depending on the relay device used.

UHF1, UHF2, UHF3, and *UHF4* ports are in rows C through F and are connected to RRTs 1 through 4 in the CRG and RRTs 1 through 3 in the ICC and ECS. In the ECS and ICC, UHF row F is not used. The three remaining rows provide for 36 full duplex channels capable of 32,000 bits per second data or voice communications at the ICC and ECS and for 48 channels at the CRGs.

The *WIRE LINES* ports of row G provide the capability to patch 12 external wire lines into the UHF network. These 12 full duplex ports are connected through the CV-1548 telephone converter to channel 1 through channel 12 terminals at the LLCP mounted at the outside rear of the ECS, ICC or CRG. Wire lines connected to the LLCP may be two-wire or four-wire. Switches on the appropriate channels of the CV-1548 must be set accordingly: that is, two-wire or four-wire.

NOTE: If using the two-wire configuration (that is, a telephone set TA-312/PT at both ends), the patch cords at the originating and terminating stations must not be placed in reverse polarity to allow for ring-down capability.

PARTY LINE LOOPS consists of a switch that allows the serial aspects of the party line network to operate. It also prevents the voice circuit from going completely throughout the link and returning to the originator. To do this, all switches must be in the NORM position except the one at the ICC — it must be in the OPEN position. When used in an intrabattalion relay configuration, the CRG's PARTY LINE LOOPS switch must be in the OPEN position.

CORNER REFLECTORS AND AMG ANTENNAS AND AMPLIFIERS

Two corner reflectors are provided with each ECS, ICC, and CRG shelter for close-in communications. Corner reflectors have less gain and higher side lobes than the AMG antennas; they are, therefore, more susceptible to ECM jamming. Corner reflectors are not intended for normal tactical use. They are reserved for special emergency situations such as to replace a nonoperational AMG. If one of the UHF links is 10 kilometers or less and there is line of sight, a

corner reflector can be used for that link. However, the AMG should normally be used. The capability also exists of using corner reflectors in lieu of an AMG; that is, a corner reflector paired with a distant AMG. This procedure, however, is not recommended as there is considerable signal loss. Corner reflectors may be mounted in a vertical or horizontal position and must be adjusted for maximum signal strength. A compass is used to ensure that the antennas are properly positioned in azimuth.

The AMG has four antennas and amplifiers with three basic modes of operation that are used for UHF communications. The three basic types of operation are *bypass, driver, and driver/final.* The bypass mode has no amplification and will be the normal mode used in peacetime. The driver mode has low amplification and is used to overcome distance. The driver/final mode has high amplification and is used to combat the effects of UHF ECM jamming.

The three modes of operation for each antenna and amplifier are set at the AMG distribution box 7A1A1. For the bypass mode, the power, driver, and final switches are set to OFF. To use the driver mode, the operator must set the power and driver switches to ON and leave the final switch to OFF. For the driver/final mode, the operator would have the power, driver, and final switches set to ON.

PLANNING

The C-E officer, in conjunction with the S3, and by coordinating with the brigade staff and adjacent battalion communications officers, develops a communications plan prior to each move. A well-developed communications plan minimizes confusion and indecision and results in predictable actions. The C-E officer prepares the communications plan using the C-E annex to the TSOP, the CEOI, and frequency management personnel as primary sources of information. Within the ICC software, tab 62 (CRG/COMMUNICATIONS ASSIGNMENT+ SUMMARY) can assist him in developing several areas of the plan. Tab 62 is described later in this section.

CONSIDERATIONS

When developing the communications plan, the C-E officer must consider the following action items. (Note that the list is not all inclusive and will vary depending on the situation.)

Identify all network units — intrabattalion (1 to 6 fire units, 1 to 4 CRGs, the ICC), interbattalion (other ICCs), and extrabattalion (brigade AN/TSQ-73) elements — and their UTM coordinates. The system can utilize up to six CRGs.

Assign battalion identification numbers that cause system software to generate RLRIU addresses for local battalion elements. The RLRIU address defines the RLRIU that delivers the data block. RLRIU addresses are in two octal digits (00 through 77). The numbers 8 and 9 or any combination of 8 and/or 9 cannot be used. For each transfer received by the RLRIU (except those from the DLT), the RLRIU will compare the address code with the setting of the switches on the front panel of the RLRIU. If they do not agree, the message will be routed to the UHF network. If they agree, the RLRIU delivers the message in accordance with the routing word and does not pass it to the UHF network. Two restrictions that apply to assigning RLRIU addresses are that system software will not repeat RLRIU addresses within a battalion and it will not repeat RLRIU addresses for Patriot battalions communicating with each other by modem.

Evaluate site terrain for line-of-sight emplacement of AMGs or corner reflectors. For planning purposes, 40-kilometers is the effective line-of-sight range between AMGs in the bypass mode. The planning range for the corner reflector antennas on the ECS, ICC, and CRG shelters is 10-kilometers.

Consider antenna polarization as a vital part of link planning. Corner reflectors and AMG antennas must be properly polarized. Ultra-high-frequency radio waves transmitted from a vertical antenna are said to be vertically polarized and those from a horizontal antenna are said to be horizontally polarized.

The horizontal or vertical orientation of the receiving antenna should be the same as that of the transmitting antenna (horizontal to horiz-

ontal, vertical to vertical). Significant signal loss may result if polarization is not correct. Either horizontal or vertical polarization may be used, but the performance of each is different under certain situations (see TM 11-5820-540-12).

Cross polarization of corner reflectors on the same shelter (one horizontal, one vertical) is recommended to create greater isolation between antennas and to reduce the possibility of mutual interference between systems. Cross polarization is also recommended for the AMG antennas but note that cross polarization for the AMG refers to the two antennas on the same mast.

Assign the AMG antennas to specific RRTs at each location (ICC, ECS, CRG).

Identify the active RRTs at each location (ICC/ ECS/CRG) and assign UHF links and frequencies between them. UHF frequencies and channels for use by a Patriot battalion are limited to the frequencies allocated by the designated frequency manager in the theater of operations. Once frequencies have been allocated, the C-E officer or NCO assigns frequencies and channels to units within the battalion. Once assigned, the frequencies and channels are classified. In addition to the frequency restrictions imposed by the frequency manager, there are also inherent AN/GRC-103 frequency limitations. These are harmonic frequencies and minimum separation between send and receive channels (a minimum of 33 channels, 16.5 MHz) and between RRTs to prevent cross interference. TM 11-5820-540-12 provides radio propagation and system planning guidance that should be used by the battalion C-E officer or NCO.

Define the patching scheme for each battalion element (ICC, firing batteries 1 through 6, and CRGs 1 through 4).

Assign the antenna azimuths for each link.

Identify the interbattalion or extrabattalion exit/entry port (ICC or CRGs 1 through 4) and shelter modem (1 through 5) to be used for each interbattalion or extrabattalion link.

Include the ATDL-1 (tab display or printout will read ATDL-1 or ATDL1) address as assigned by brigade.

Identify the following circuits to be put on the network:

- Digital data.
- Party lines 1, 2, and 3.
- Internal point-to-point voice including PVT and PTY lines and external land lines to battalion or firing battery switch board.
- Adjacent battalion circuits (voice and modem).
- Higher echelon circuits (voice and modem).

Define each circuit (except digital data) by:

- Route.
- Channel on the links.
- Modem and modem location (if needed).

Develop contingency plans for reallocating and reconfiguring communications resources.

STANDARDIZATION

Standardization of communications tasks is essential for rapid system emplacement and operations. To the maximum extent possible, basic and redundant communications functions should be standarized as in the following areas.

CPP. Standardization at the CPP is achieved by the way the voice party lines and data channels are patched. PL1 is patched to channel 1, PL2 to channel 2, and PL3 to channel 3 of whichever RRT is being used. Data channels within the battalion would be patched; RLRIU port 1 to channel 4 of RRT 1, RLRIU port 2 to channel 4 of RRT 2, RRLIU port 3 to channel 4 of RRT 3, and at the CRG, if required, RLRIU port 4 to channel 4 of RRT 4. Remember, only the CRG is equipped with a fourth RRT.

Data Channel. Dedicate 1 of the first 11 channels (channels 1 through 11) as a data channel for intrabattalion data transmissions. Channel 12 should not be used for data transmission since a synchronized pulse is routinely sampled from this channel. Channel 12, however, may be used for voice communications.

Extra and Interbattalion Communications. The modems at the ICC and CRG (five each) are used for extrabattalion communications with brigade and interbattalion communiications with adjacent battalions. Standardization is achieved here by assigning MODEM 5 to channel 5 of whichever RRT is used by the ICC or CRG. If a wire line is used to link the battalion to brigade using a radio terminal set AN/TRC-145, the wire line from the AN/TRC-145, is connected to channel 5 at the landline filter box located at the rear of the CRG or ICC and then patched to MODEM 5 on the CPP. The incoming signal is routed through the CV-1548 telephone converter. The operator should turn off the ringer circuit for channel 5 so that the frequency shift keying produced by the modem will not activate the ringer circuit.

Remaining modems and channels are assigned for interbattalion communications.

RLRIU and voice communications addresses. The RLRIU address is entered by a thumbwheel switch on the front panel of the RLRIU. Voice communications address is entered by a thumbwheel switch behind the front panel of the CPP. To the maximum extent possible, both addresses should be the same; that is, FB1 RLRIU address 01, voice communications address 01; FB2 RLRIU address 02, voice communications address 02, ICC RLRIU address 07, voice communications address 07 and so forth.

Party Line Loops. Party line loops switch located on the front of the CPP is also considered in communications standardizing. Keep it in the NORM position at all FBs and in the OPEN position at the ICC and CRGs.

RRT. Use the same RRT at both ends of a link; for example, RRT1 at the ICC to RRT1 at FB1. By setting up links in this manner, troubleshooting the links using the *communications Fault Data* tab at the ICC is made easier.

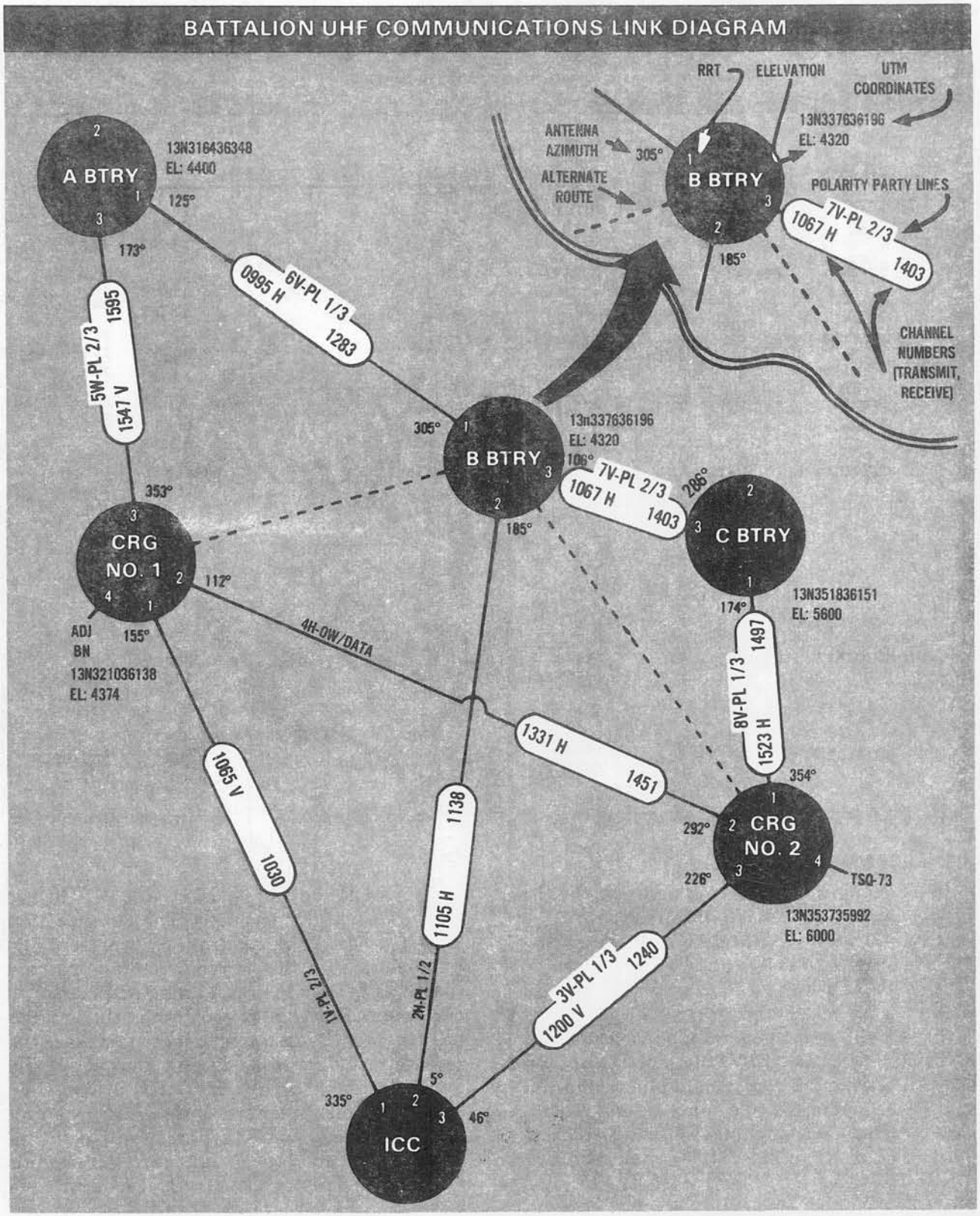
PLANNING

Communications network planning is a coordinated effort by the C-E officer and the S3 section. The S3 informs the C-E officer or NCO of proposed unit locations as determined by RSOP. The C-E officer or NCO, working with the command planners in the ICC, determines the need for CRGs based on the distance between units and terrain. Once the UTM coordinates of the deployed units are known, the C-E officer or NCO plots their locations on a map, again noting the elevation of each unit and terrain between units. The C-E officer or NCO should use the system planning guidance provided in TM 11-5820-540-12. Once the communications links and CRG deployment requirements have been completed, a battalion UHF communications link diagram is prepared for issue to all units (see illustration). The diagram should contain the UTM and elevation information for deployed ECSs, ICC, CRGs, and extrabattalion elements.

It should also contain the communications links between units listing —

- RRT assignments 1, 2, 3, (and 4 for CRGs).
- Send and receive channels.
- Alternate routes (altroutes).
- Antenna azimuth (in degrees) and polarity.
- Party line routing.

Along with the diagram, each station is given individual specific instructions including antenna height, patching instructions, and wire line interface. A separate worksheet is prepared for each individual station with these instructions. A suggested format for recording this information is shown in the illustration on page 4-8.


BATTALION UHF COMMUNICATIONS LINK DIAGRAM
RRT
ELELVATION
UTM COORDINATES
13N337636196
EL: 4320
ANTENNA AZIMUTH
305°
ALTERNATE ROUTE
B BTRY
POLARITY PARTY LINES
7V-PL 2/3
1067 H
1403
185°
CHANNEL NUMBERS (TRANSMIT, RECEIVE)
A BTRY
13N316436348
EL: 4400
125°
173°
6V-PL 1/3
0995 H
1283
5W-PL 2/3
1595
1547 V
305°
B BTRY
13n337636196
EL: 4320
106°
7V-PL 2/3
1067 H
1403
286°
C BTRY
185°
353°
CRG NO. 1
112°
13N351836151
EL: 5600
174°
ADJ BN
13N321036138
EL: 4374
155°
4H-OW/DATA
8V-PL 1/3
1497
1523 H
1331 H
1451
1065 V
1030
1138
1105 H
354°
292°
CRG NO. 2
226°
TSQ-73
13N353735992
EL: 6000
14V-PL 2/3
2H-PL 1/2
3V-PL 1/3
1240
1200 V
5°
335°
46°
ICC

PATRIOT COMMUNICATIONS PLANNING

CIRCUIT ROUTING LIST

SYSTEM: 0712PAA PRIORITY: 2A

Party Line Loops Switch Setting: 10-OPEN

CH	CIRCUIT	PR	TY	FROM	SYS 1	SYS 2	SYS 3	CHANNEL SETTING	TO	REMARKS
1	10701CB	IC	SU	PRIMARY BN	0712PAA-2			2W/ON	CP OPNS A BTRY	SYSTEM LOG WL5
2	2070101	2C	CU	BN SWBD	0712PAA-2	0112PAA-2		2W/ON	CP SWBD A BTRY	ADMIN LOG WL6
3	2070102	3B	CU	BN SWBD	0712PAA-3	0112PAA-3		2W/ON	CP SWBD A BTRY	ADMIN LOG WL7
4	10701EE	3A	SU	BTOC	0712PAA-4	0112PAA-4		SW/ON	CP OPNS A BTRY	MPL WL8
5	H0701RL	1B	DATA	ICC RLRIU	0712PAA-5	0112PAA-5			ECS RLRIU	RLRIU PORT-2 ADL
6										
7										
8										
9										
10	60701XTY	1A	SU	ICC PL2 TD	PL2-B 0712PAA-10	PL2-A 0112PAA-10			ECS TCO	PL2-B
11										
12	60701BB	1A	SU	ICC PL1 31M	PL1-B 0712PAA-12	PL1-A 0112PAA-12			ECS 31M	ENGINEER PL1-B

DEVELOPMENT

In developing the data link network, the C-E officer uses tab 62, CRG/COMMUNICATIONS ASSIGNMENT + SUMMARY, to determine CRG locations, to assign data/voice "partners" (both ends of a link), and to generate antenna azimuths for the partner assignments. The tab is displayed based on operator entries in tab 51, INITIALIZATION CONTROL, and is accessible only during the deployment phase of initialization or command planning. Firing battery and ICC locations previously entered in tab 58, ICC, SCC, DLRP, UTM MODEL, and tab 59, FP DEPLOYMENT SUPPORT AND LOCATION SUMMARY, also appear.

The firing batteries, ICC, and CRGs are shown with a 360° perimeter. The distance from a unit to its perimeter (radius) represents 20 kilometers (half the nominal communications planning range). In determining whether units can communicate with each other, the individual observes the situation display and notes the proximity of the units to one another. If the symbols touch or overlap each other, they should be able to communicate without having to relay through a CRG. This assumes that a AMG is used and line of sight exists. If the unit symbols do not touch (the overall separation is 40 kilometers or more) then a CRG is required.

The CRG's location is then determined by using the "floating" cursor and hook trial method or by map reconnaissance. In either case, the location must be checked on a map for accessibility and adequacy in terms of elevation and terrain to support line of sight.

CRG UTM coordinates (software or map reconnaissance generated) are then entered in the appropriate LOCATION UTM data field. Once the UTM locations and link identifiers (numeric or alpha) have been entered, the communications partners are assigned by the software. The software also computes the azimuth required by each partner to point the UHF antennas toward each other. It enters this data in the antenna fields of the display.

To clear the data for a CRG or link partner, place zeroes (0) in the data field. To delete the data associated with the CRG location, place the cursor under the first numeral of the CRG's UTM coordinate and press the CANCL HOOK Key. Data on that CRG will be deleted. Data that is not deleted will reappear whenever the tab is entered and displayed.

TAB 62, CRG/COMMUNICATIONS ASSIGNMENT + SUMMARY

```
CRG/COMMUNICATIONS ASSIGNMENT + SUMMARY                    ★62★

3 = BN DEPLOYMENT NO.   = HOOKED TRIAL LOCATION

LINKS ANT. AZIMUTHS  LINKS ANT. AZIMUTHS                LOCATION-UTM

ICC (   ) (   ) (   )CRG1A (   ) (   ) (   ) (   ) (   )      (      )

FP1 (   ) (   ) (   )CRG2B (   ) (   ) (   ) (   ) (   )      (      )

FP2 (   ) (   ) (   )CRG3C (   ) (   ) (   ) (   ) (   )      (      )

FP3 (   ) (   ) (   )CRG4D (   ) (   ) (   ) (   ) (   )      (      )

FP4 (   ) (   ) (   )CRG5E (   ) (   ) (   ) (   ) (   )      (      )

FP5 (   ) (   ) (   )CRG6F (   ) (   ) (   ) (   ) (   )      (      )

FP6 (   ) (   ) (   )FOR UNIT: ICC  BN A  BN B  BN C  HEU  AUX

                      USE CODE: H    J    K    L    Q    X
```

INITIALIZATION

Once a communications plan is developed, it is implemented. Manstation two operators at the ICC, CRG, and ECS use the previously discussed battalion UHF communications link diagram and Patriot communications planning worksheets as guides in their emplacement procedures.

CHANNEL ALIGNMENT

RRT initialization loop back channel alignment procedures are now performed to allow for the immediate setup of UHF links. The TSEC/KG-27 KOK cards should be set per CEOI before emplacement. They are visually checked at the time they are set. As soon as power is provided to the ECSs, ICC, and CRGs, loop back may be performed on each RRT. The procedure is as follows:

- Set loop back frequencies on AN/GRC-103 (receiver must be set 50 channels above transmitter; for example, transmitter-1065 receiver-1115.
- Connect loop back antenna (ensure loop back circuit breaker is ON).
- Tune transmitter-receiver. Check order wire; the receive signal should be quiet.
- Connect handset to TD-660/G. check to ensure channels are quiet. If a loud rushing sound is heard, recheck KOK cards.

Channel alignment of the TD-660/G must be accomplished after the UHF link is established and prior to attempting data transfer. (Ensure patch cords are removed from the appropriate RRT at the CPP. The procedure is as follows:

- After order wire communications have been established with the distant station, meet on channel 1 of the TD-660/G.
- Coordinate with the distant station as to sending and receiving of tone to accomplish channel gain adjustment.

  (This is done each time an RRT is initialized with a distant station. Improper gain adjustment affects party line conditions and data transfer.)
- After channel gain adjustment has been accomplished, finish patching in accordance with the communications plan and meet the distant station on party lines.

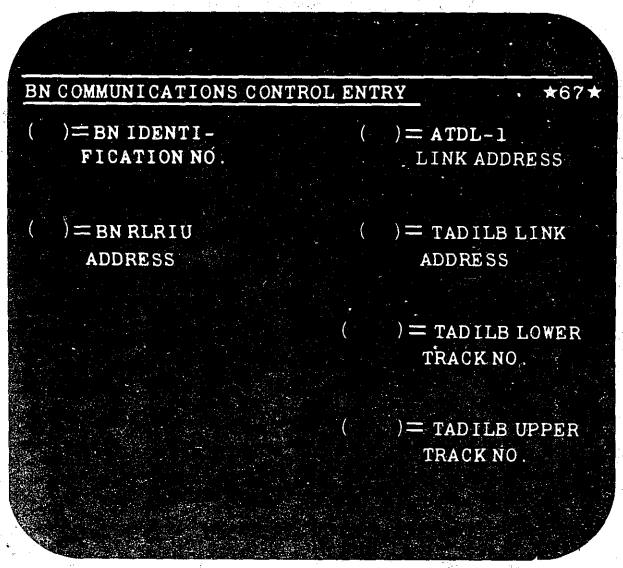
COMMUNICATIONS INITIALIZATION

Software communications initialization is done within the Patriot system by the computer, which is programmed with numerous data items. Computers within the battalion have to know who is in the battalion and external battalion nets, what their battalion identification numbers are, who the external stations are, and how to communicate with them. All this information is input during initialization at the ICC with a lesser set being input at each ECS. This section addresses the tab entries at each location and the interaction of this data.

Information and Coordination Central

ICC communications initialization is performed during normal system initialization, either manually or in the automatic mode. It is input at the ICC via tab 67, BN COMMUNICATIONS CONTROL ENTRY and tab 69, EXTRA-BN COMMUNICATIONS CONTROL DATA ENTRY. These communications tabs appear after the ASSESTS/VOLUMES and IFF CODE/CONTROL GROUPS tabs are entered.

TAB 67, BATTALION COMMUNICATIONS CONTROL ENTRY



The first tab to appear is tab 67, BN COMMUNICATIONS CONTROL ENTRY tab. This tab is used to input the battalion identification number, extra battalion link addresses, and track numbers. This tab also displays the BN RLRIU ADDRESS when this tab is recalled.

The battalion identification number is provided by brigade with an input of 1 to 4. This battalion identification number is also entered in ECS TACI tab 68, DATA COMMUNICATION CONTROL, in the ICC/BN field. When tab 67 is entered into the system by the operator, system software generates the BN RLRIU ADDRESS that is displayed on tab 67 based upon the battalion identification number. System software also generates all the battalion source codes and RLRIU addresses based upon the battalion number entered.

The BN RLRIU ADDRESS is a unique address assigned to the ICC as a type of mailbox address. This address is dialed in and appears on the ICC RLRIU panel. If the RLRIU thumb wheel is not set on the correct address, the alert, CHECK RLRIU ADDRESS appears. The operator must assure that the RLRIU panel address is on the correct setting. The following illustration is a list of the battalion RLRIU addresses by battalion number. It should be referred to in assuring that the battalion CRGs have the correct RLRIU address.

RLRIU ADDRESS ASSIGNMENTS

UNIT	BN1	BN2	BN3	BN4
FU1	01	21	41	61
FU2	02	22	42	62
FU3	03	23	43	63
FU4	04	24	44	64
FU5	05	25	45	65
FU6	06	26	46	66
ICC	07	27	47	67
CRG1	11	31	51	71
CRG2	12	32	52	72
CRG3	13	33	53	73
CRG4	14	34	54	74
CRG5	15	35	55	75
CRG6	16	36	56	76

The ATDL-1 LINK ADDRESS and the TADIL—B LINK ADDRESS (tab display or printout may read TADIL-B or TADILB) are the extrabattalion data link addresses assigned by brigade. The ICC must always have an ATDL-1 LINK ADDRESS. This address is input even if the battalion is operating autonomously. The range of values for the first character is A to Q (omitting O) and the second character A to H. The pairing of Q and H is not accepted. The TADIL-B LINK ADDRESS is in octal, and the restriction of not using 8s and 9s also applies. This data field does not need an entry unless the TADIL-B link is established.

The TADIL-B lower and upper track numbers are assigned by CRCs operating with the TADIL-B link. These numbers are also octal and the restriction associated with the use of 8s and 9s applies.

TAB 69, EXTRA-BATTALION COMMUNICATIONS CONTROL DATA ENTRY

EXTRA—BN COMMUNICATIONS CONTROL DATA ENTRY ★69★

CONTROL S/I	ICC/BN NUMBER	COMM POINT LOCATION	ATDL1/ TADIL	LINK ADDRESS	EXIT UNIT	EXIT MODEM
ADJ BN A	( )	( )			( )	( )
ADJ BN B	( )	( )			( )	( )
ADJ BN C	( )	( )			( )	( )
GROUP-HEU		( )	( )	( )	( )	( )
TOS-AUX		( )	( )	( )	( )	( )

The next tab to appear is tab 69, EXTRA-BN COMMUNICATIONS CONTROL DATA ENTRY. This tab is used for defining the exit and entry points for extrabattalion communications. It is the last ICC communications initialization tab. Each row represents one of the five modem ports that can be handled simultaneously by a battalion. These are normally one port to higher echelon and three ports to Patriot battalion. If there is no extra Patriot battalion communications, this tab is entered with no data entries.

A Patriot battalion cannot "talk" with two-higher echelon units simultaneously. It can "talk" ATDL-1 to a higher echelon and Patriot language to adjacent Patriot battalions. But it cannot "talk" ADTL-1 to one higher echelon unit and ATDL-1 or TADIL-B to another higher echelon unit. In the latter case, the software does not know which higher echelon unit's commands to accept and process.

The COMM POINT LOCATION data field is used to enter the UTM coordinates of the location of the extrabattalion's communications element through which it is linked to the local battalion exit/entry point. The position of the extrabattalion's communications element will appear as a CRG symbol on the display console

for CRG/COMMUNICATIONS ASSIGNMENT + SUMMARY, tab 62, during command planning. It is used for establishing communications links between the local battalion and its extrabattalion partners.

The ATDL-1/TADIL data field is used to define the data language that is to be used on a higher echelon link. The language selected depends on the extrabattalion partner. When talking with the brigade AN/TSQ-73 (GROUP-HEU), the language is ATDL-1 and when talking to the CRC (TOS-AUX), the language is TADIL-B.

The LINK ADDRESS is the primary battalion's address to the higher echelon unit. This address is provided by brigade or the CRC and is either ATDL-1 or TADIL-B, but not both. The range of values for ATDL-1 is A-Q (omitting O) for the first character and A-H for the second character. The data field does not accept a QH identity. The TADIL-B address is in octal and the range of values is 100 to 176.

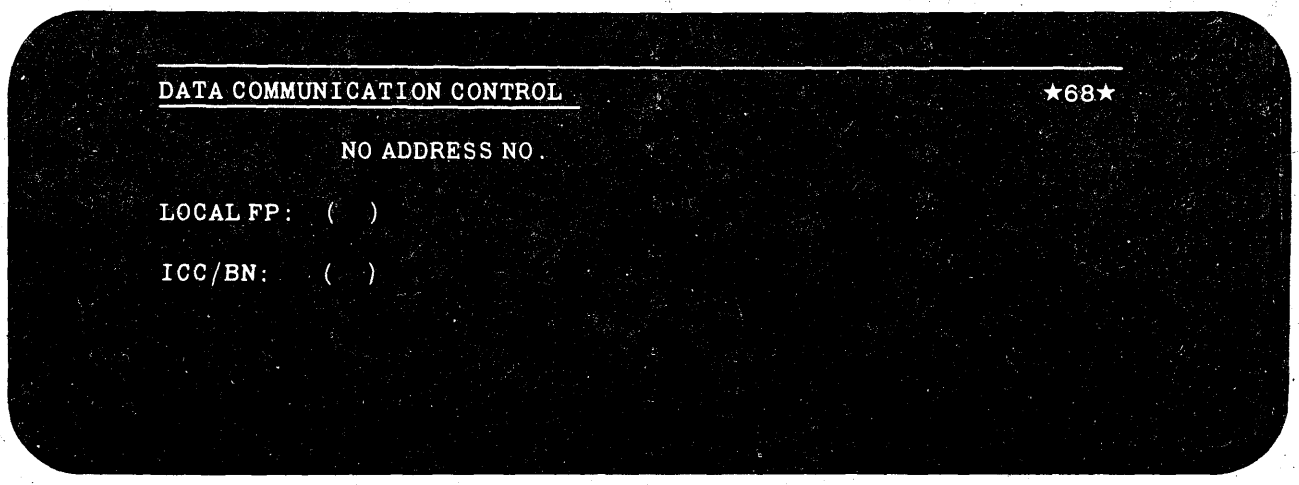
The EXIT UNIT data field is used to enter the location (ICC or CRG) of the modem for that particular extrabattalion link. If the ICC is the exit/entry point, ICC is entered and if the CRG is selected, CRG plus the number 1 to 6 is entered in the data field.

The EXIT MODEM is the modem in the shelter designated to be used for this external link. Entries for this data field are 1 through 5.

The CONTROL S/I column is the extrabattalion partner communicated with a modem and link. The partner types, ADJ BN A, ADJ BN B, ADJ BN C, GROUP-HEU, and TOS-AUX relate to the switch indicators on the ICC display console in the source/address portion.

The ICC/BN NUMBER data field is used to enter the battalion identification number 1 through 4 of the three adjacent Patriot battalions that the ICC communicates with at one time. Battalion identification numbers will not be duplicated on this tab or within the brigade.

TAB 68, DATA COMMUNICATION CONTROL



Engagement Control Station

ECS communications initialization at the FB is performed during normal system initialization, or reinitialization, via tab 68, DATA COMMUNICATION CONTROL.

Tab 68 is automatically displayed when the alert ENTER COMM CONT is acknowledged during standard emplacement or long term reinitialization. It is selectable by keyboard entry

during short term reinitialization. Standard emplacement and long- and short- term reinitialization are described in Chapter 5. The tab provides for the entry of the local firing battery's RLRIU address. It only affects intrabattalion communications.

The LOCAL FP (NO. ADDRESS) is the number of that firing battery. It is provided by the S3. A recommended numbering is scheme A battery 1, B battery 2, and so on.

The ICC/BN NO. is the number of the ICC which was entered in ICC tab 67 under BN IDENTIFICATION NO. The ADDRESS data is generated by system software. This is the local firing battery's RLRIU address and is displayed when tab 68 is entered. The RLRIU address is determined by the local firing battery number and battalion identification number. If the RLRIU panel address is not correct for the ICC number and local FP number entered, the alert, CHECK RLRIU ADDRESS appears. The operator then assures that the RLRIU panel address is on the correct setting.

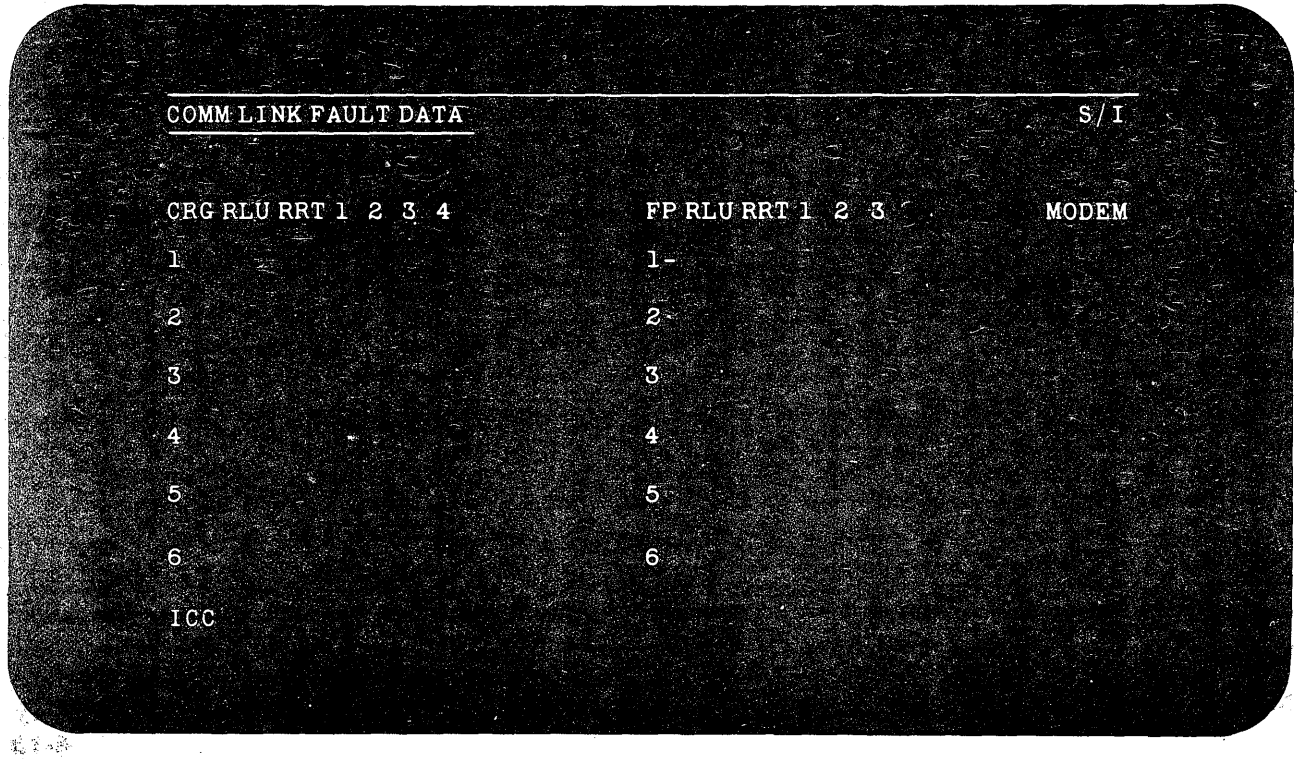
OPERATION

Once the system is initialized, several indicators show that the communications links are operational.

DATA LINK INDICATIONS

Operational data link indictators are status reports to the operator, supplied by the battalion operational software, that monitors and checks the RRTs, RLRIUs, and modems of all units (ECS/ICC/CRG). This information is displayed in the ICC by the COMM LINK FAULT DATA tab (by console switch selection). The tab, when used in conjunction with the battalion UHF communications link diagram, is an excellent tool in determining link and equipment status. The information on the tab becomes available the moment data communications links are established (RLRIU to RLRIU).

ICC COMMUNICATIONS LINK FAULT DATA TAB



As a general rule, if secure voice communications have been established over the UHF line (that is, party lines), the mechanical aspects of the circuit are correct; that is, radios aligned, codes correct, antenna azimuth correct, et cetera. If data transfer does not follow, troubleshooting should begin by checking the patching connections on the communications patching panel.

In addition to the ICC COMM LINK FAULT DATA tab, the COMM lights on the BN and FP status indicator panels are excellent indicators of the status of the data link. When the lights illuminate, they indicate that the software has been initialized properly and the link has been established. The color of the lights is a further indication as to the status of the link. *Green* is go, *amber* is degraded, *red* is no-go, and *no light* means inactive. The colors or status of the light indicators are triggered by status monitor and are combinations of several items, such as the status of RRTs, RLRIUs, and the percentage of messages acknowledged. This monitoring is done automatically by status monitor, and the results are displayed on the COMM light indicator, FP FAULT DATA tab, ICC COMM LINK FAULT DATA tab the ICC STATUS tab, and FP STATUS tab.

When the COMM light comes on, it indicates that data is being transferred over the link. Status monitor automatically transfers data from the ECS to the ICC as soon as the link is established. The color of the COMM light is an indicator of what percentage of messages sent is properly ackowledged. Green indicates 90 percent plus, of all messages sent are being acknowledged. Amber indicates 50 percent to 90 percent of all messages are being acknowledged. Red indicates less than 50 percent of all messages sent are acknowledged. A data transfer should not be attempted with a red COMM light.

Although the COMM light is an excellent indicator of the status of the communications links, a green light does not give the total communications network picture. Currently, the only mechanism to expediently isolate a link problem to a shelter, RLRIU, or an RRT is the ICC tactical software, as displayed on the ICC COMM LINK FAULT DATA tab. Using this tab display in conjunction with the battalion UHF communications link diagram greatly assists personnel in troubleshooting and isolating UHF communications problems. This tab also provides the tactical director with the current status (go, degraded, no-go, inactive) of the major communications components of each ECS, CRG, and ICC in the battalion.

NET CONTROL

The net control for the Patriot battalion's UHF communications links is the responsibility of the battalion C-E officer and NCO. They are individuals who, together with the S3 section and the ICC command planners, establish the UHF communications link requirements. During a battalion emplacement, one or both should be available at the ICC and on the FM administration/logistics net, supervising the establishment of the links. Alternate routes, which are planned for contingency purposes, can be implemented by the C-E officer or NCO in the event a battery or CRG cannot, for some reason, come on line; that is, delayed emplacement or generator problems.

It is conceivable that the net control responsibility could be delegated for a short period of time. For example, if a battalion march order called for ICC relocation but not the CRG, then the CRG would assume net control until the ICC was emplaced and its UHF links established. In summary, the primary responsibility of the Patriot battalion UHF net control is to direct immediate establishment of the UHF communications links, ensuring that all elements are following the communications plan and, if necessary, to direct alternate route links.

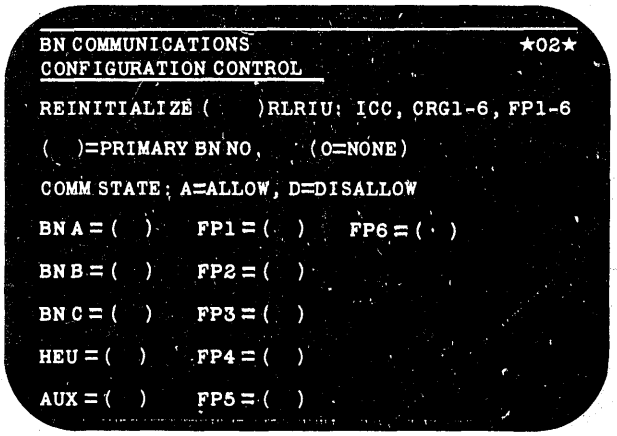
Once the links are established, the net control (BN C-E officer or NCO) monitors the operations through MS2 and the COMM LINK FAULT DATA tab at the ICC.

TACTICAL COMMUNICATIONS

Once the system is initialized for tactical communications, the only tactical tab available

to terminate (disallow) or maintain (allow) data communications between the ICC and its FBs, adjacent Patriot battalions, or higher echelon is tab 02, COMMUNICATIONS CONTROL. If data communications are disallowed with a particular FB or extrabattalion partner, the ICC will not process any data input from that element. The ICC RLRIU continues to perform its multirouting function by accepting data messages from the disallowed element and rerouting the data throughout the network. Tab 02 is also used to reinitialize the battalion RLRIUs. It is on this tab that you also indicate which battalion is the primary battalion when Patriot is configured in the primary-secondary role.

TAB 02, COMMUNICATIONS CONTROL

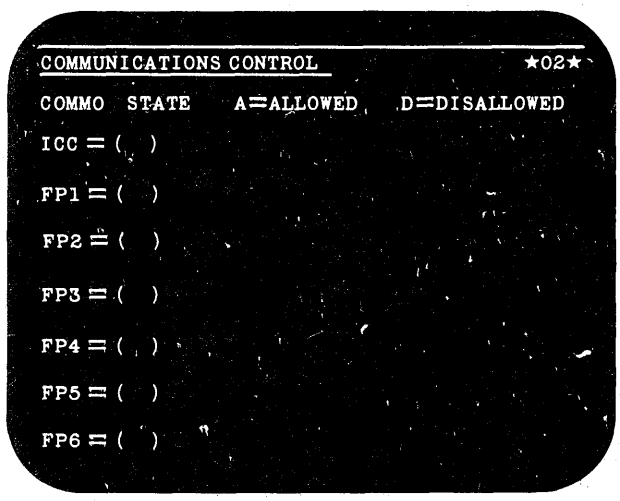


When operating in the primary-secondary configuration, Patriot is required to interface with higher echelon elements above brigade level, where no brigade AN/TSQ-73 is present. The Patriot primary-secondary role cannot be used in a mixed brigade. However, an ATDL-1 link would be established by the primary battalion with a Hawk Battalion AN/TSQ-73 configured in a master BATTALION CONFIGURATION. Each ICC operates with equal engagement authority. The primary battalion provides the path by which the higher echelon exercises command and control over the secondary battalion.

The decision of which battalion within the brigade is the primary battalion is the responsibility of the brigade S3. This decision is based on the brigade's current deployment and on which of the battalions has the best communications "shot" to the higher echelon unit if the brigade goes down.

The ECS has a corresponding tab to disallow or allow communications among the ICC, other FBs, and itself. Tab 02, COMMUNICATIONS CONTROL, will be used by the ECS, only during tactical operations.

ECS, COMMUNICATIONS CONTROL



The FBs at some time during the air battle may have to go to the FU to FU operation. The FU to FU capability is used when communications with the ICC has been severely interrupted because of jamming, or terminated because the ICC is relocating or has been destroyed. The FU to FU capability allows the FBs to perform triangulation, target correlation, and engagement support. Normal FU saturation alleviation is still performed at each FB and track data in terms of position, engagement decision, and weapons assignment is exchanged between the FBs. During transition to the FU to FU mode and back to the ICC/FU mode, tab 02 will be used to allow and disallow the exchange of tactical data.

Operations

CHAPTER 5

To be effective in combat, Patriot units must accomplish basically the same tasks required for other air defense weapon systems. In this chapter, the procedures used to prepare the Patriot system to perform its air defense role are summarized. FM 44-15 presents a complete description of planning considerations. Emphasis in this chapter is focused on the series of computer and crew member actions directing the system's air defense operations — in particular, the engagement sequence.

PREPARATION FOR ACTION

To accomplish the mission, the Patriot commander must know the geographical area. Positions must be evaluated and selected with care because of the unique size, weight, and firing characteristics of the Patriot sytem. Emplacement, activation and initialization actions must be taken to make the fire unit operational once the position has been selected.

POSITION EVALUATION AND SELECTION

Patriot firing batteries must move frequently to support movements of major maneuver forces. Patriot fires may disclose firing battery locations. Movements are also made to enhance the unit's survivability. Positions are evaluated and selected to provide a tactical position from which the units can deliver effective fire and accomplish their missions.

Proper RSOP facilitates the orderly, rapid, and safe movement of Patriot units. Battery, platoon, and section headquarters personnel are provided vehicles for RSOP activities. RSOP teams are normally designated and led by the executive officer. They accomplish RSOP by reconnoitering designated position areas and the routes thereto. The best march routes to, and tentative equipment sites within the positions are then selected and marked off. Because of the size, weight, and height of Patriot equipment and prime movers, care is taken when determining march routes. Special considerations must be given to road conditions, bridges, tunnels, arches, and other elements that might prevent passage. Planners as well as vehicle drivers must be conscious of the bridge classification system described in FM 5-36.

The RSOP party determines the site and north reference azimuth for the RS. This is necessary because the RS is normally the first major equipment item in the fire control section

CONTENTS

to be emplaced. Other major equipment items are emplaced in reference to it. Whenever possible, the survey section sends a position and azimuth determining system survey party to accompany the battery RSOP party. The PADS party provides timely survey control for UTM coordinates, height, and a true north orientation azimuth. This true north reference is then used to align the RS by using the M2 aiming circle. This gives the FB a more accurate azimuth reference. PADS should be the primary source for determining the NREF while the M2 aiming circle can be used as a secondary source.

After the NREF and the RS site are determined, radar coverage diagrams are made (see appendix). Sites for the AMG, EPP, and ECS are determined by cabling requirements or unit SOP. Cover and concealment are taken into consideration when choosing equipment sites. The RS and LS can be placed near woodlines as long as openings exist for tactical operation. Equipment in clearings should be placed near the edges to blend the camouflage with the woodline. Equipment should be parked and camouflaged where shrubbery would normally be found. Launcher sites are determined at this time and marked by the survey party in concert with the RSOP. The survey party provides the UTM location and true north reference for each LS.

Fire Control Section

The principal criteria for position selection are —

- Radar field of view for PTL and STLs.
- A 30- by 35-meter or 1,050-meter^2 area (98.4 by 114.8 feet).
- Level terrain for RS (a slope of not more than 10°).
- Accessibility.
- Location data (13-digit UTM coordinates).
- AMG has line of sight to ICC, CRG, or FB as appropriate.
- Cable restriction of 23 meters (75 feet) from EPP.
- AMG can be leveled to within one half degree in both pitch and roll.

Launching Station

Launching station position requirements are —

- A 6- by 15-meter area (20 by 50 feet). If missile reload is conducted or planned at the site, an additional 10- by 15-meter area at the side of the launcher is required.
- Level terrain (a slope of not more than 10°).
- Launching station deployed to support primary sector.
- Backblast area of approximately 90 meters — clear of personnel and equipment — behind the LS.
- Separation of from 120 to 1,000 meters between LSs and the RS.
- Separation distance of at least 90 meters between LSs.
- Site inside a vector no greater than 20° on each side of RS track sector.

EMPLACEMENT

Emplacement is defined as those tasks required to convert a fire unit from a road march configuration to a tactical configuration. Basically, emplacement consists of positioning vehicles at predetermined sites selected by the RSOP and/or survey teams, connecting the associated equipment cables, and aligning the RS and LS.

Fire Control Section

Once the firing battery has arrived at the position, care must be taken to ensure that *vehicles* are *sited* and *oriented* to line up exactly on RSOP and/or survey team markers. Vehicles are oriented to afford the RS the maximum field of view to support the primary target line and

secondary target lines. The PTL is the azimuth to which each firing battery's radar is oriented to counter the greatest expected threat. The battalion S3 assigns PTLs and STLs when planning the battalion defense. He considers threat data, terrain (see appendix for radar coverage considerations), defended assets, air defense doctrinal principles, and other factors in determining primary and secondary sectors of fire.

Minimize equipment obstructions to primary and alternate target search sectors by orienting the ECS, EPP, and AMG on a radial line from the RS.

Minimize RF radiation hazards by —

- Locating the ECS door away from the RS.
- Locating equipment within the radiation cut-off zone.
- Marking personnel entrance and exit routes.

RF RADIATION HAZARD

WARNING

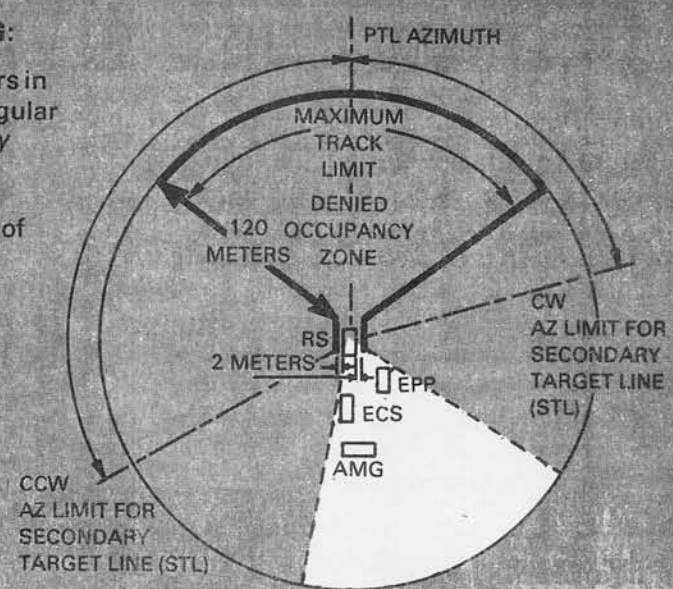
RF radiation from the radar set antenna and associated equipment is a potential hazard to personnel. RF is not cumulative, but it can be hazardous. It heats the body tissues and, if the radiation intensity is sufficiently high, will permanently damage the tissue. This damage is not immediately apparent. Crew members from the RS and ECS will conduct a visual inspection of the RS shelter roof and surrounding area to insure they are clear of personnel and obstructions before placing the RS in remote operation or initiating the radiate mode.

WHEN THE RADAR SET IS RADIATING:

1. Do not occupy the area within 120 meters in front of the RS and within the maximum angular track limits (shown as the *denied occupany zone* in the diagram).

2. Do not occupy an area within 2 meters of the sides of the RS.

3. Do not occupy the roof, ladder, or door platform area.



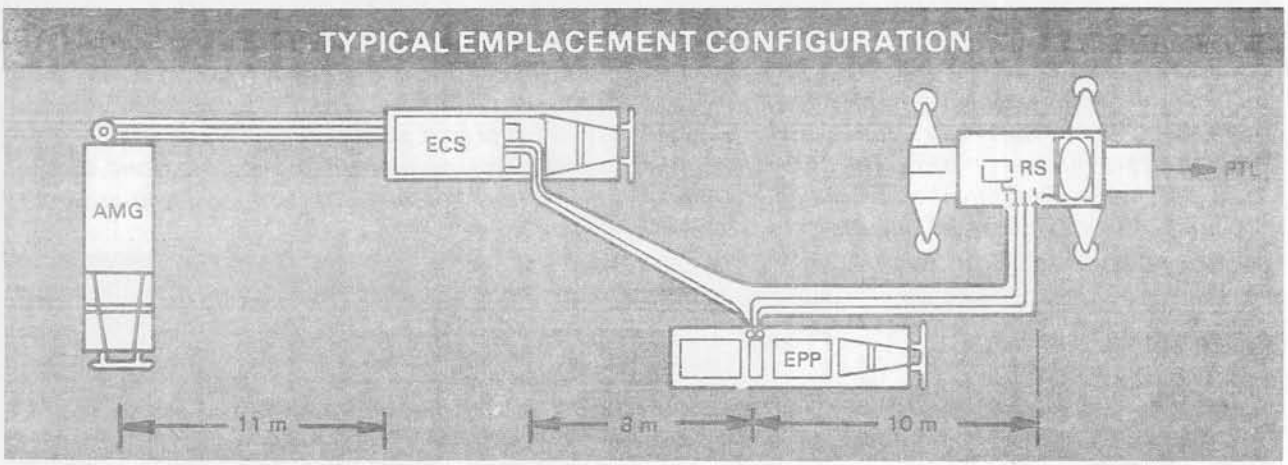
Cable Lengths

Cable lengths restrict the emplacement configuration of the Patriot FCS. Patriot cable lengths are as follows:

- Power cables from the EPP to the ECS and the RS are 23 meters (75 feet) long.
- R/WCIU cable linking the ECS and the RS is 38 meters (125 feet) long.
- UHF radio cables between the ECS and the AMG are 15 meters (50 feet) long.

The distances between cable connectors should not be greater than 11 meters (35 feet) from the EPP to either the ECS or the RS. This requirement permits sufficient slack in the cable to lay it on the ground and reach the connectors on each end. One end of all power cables and the signal cable should remain attached to the EPP during road march. The R/WCIU cable is carried on the ECS vehicle.

The antiradiation missile decoys are placed in an area 400 to 600 meters on either side of the RS. The decoys may be sited to the right or to the left of the RS but not both when emplaced. Each decoy should have a clear line of sight in the primary threat direction and the decoy furthest away from the RS should be the closest to the threat. Emplacement of the decoys should be in a diamond shape and none of the decoys should mask any of the other decoys. For more details on decoy siting information, refer to FM 44-1A(S).



RS and LS Alignment

Accurate target correlation, triangulation, and successful target engagement depend on proper FB alignment. Correct orientation of the RS and LSs to a NREF and subsequent orientation of the LSs to the RS is critical. The ECS relies on the NREF for RS location orientation and for remote azimuth training commands. Battle drills reflect procedures for aligning the RS and LS. LSs having line of sight to the RS will have priority for alignment over LSs not having line of sight to the RS.

The UTM coordinates and alignment data for the RS and LSs must be provided to the ECS for input into the WCC. If PADS survey party data is unavailable, other means (such as map resection, spotting, or measurements from benchmarks) must be made. An alternate procedure to determine UTM coordinates can be made if one known map reference point is visible from the site. Grid coordinates and azimuth reference to the RS for each LS are determined as time permits.

All data obtained during orientation and alignment are recorded on special data sheets. These sheets, are then hand carried to the ECS crew members for data input during initialization. Extreme care must be taken to ensure that alignment data collected is precise and input accurately during initialization. The following illustrations show the radar and launcher worksheets that a FB uses for alignment data.

RADAR LOCATION AND ALIGNMENT DATA WORKSHEET

RADAR LOCATION AND ALIGNMENT DATA FORM

LONGITUDE ——— [ ][ ][ ] [ ][ ] [ ][ ][ ][ ] [ ]

AND

LATITUDE ——— [ ][ ][ ] [ ][ ] [ ][ ][ ][ ] [ ]

OR z z h e e e e e e n n n n n n n

UTM ——— [3][2][N][5][0][7][2][2][9][5][4][9][2][0][9][1]

AND

METERS ALTITUTDE ——— [0][2][1][0]

EL RDR TO MIR:
Elevation of mirrors ——— [+][0][2][5][.][0]
from Radar M2.

BRNG RDR TO NREF:
Bearing of Radar M2 ——— [0][8][0][0][.][0]
sighted on North
reference M2.

* EL RDR TO NREF TOP:
Elevation of Range Pole ——— [+][3][0][.][0]
Top from Radar M2

* EL RDR TO NREF BOT:
Elevation of Range Pole ——— [+][2][0][.][0]
bottom from Radar M2

BRNG NREF TO RDR
Bearing of Radar M2 ——— [4][0][5][2][.][0]
from NREF M2.

ROLL: ——— [+][1][2][.][0]

CROSS ROLL: ——— [-][0][4][.][0]

AZIMUTH RING READING ——— [1][6][0][0]

UTM WORLD MODEL
Ø = INTERNATIONAL 3 = 1858 CLARK
1 = 1880 CLARK 4 = EVEREST
2 = 1866 CLARK 5 = BESSEL
[0]

LOCATION DATA CONFIDENCE LEVEL
Ø = SURVEY 1 = MODIFIED SURVEY 2 = MAP
[0]

ALIGNED BY: Ø = SURVEY 1 = COMPASS
[0]

WIND SPEED Ø = BELOW GALE 1 = GALE + ABOVE
[0]

CREW CHIEF CERTIFICATION SSG Sam Smith

*NOTE: Elevation measurements required only if at an unsurveyed site.

LAUNCHER LOCATION AND ALIGNMENT DATA: FORM 1

LAUNCHER LOCATION AND ALIGNMENT DATA: FORM 1
USED WHEN ALIGNING ON UNSURVEYED SITE

(1) LS NUMBER ——— [1]

(2) BRNG NREF TO LS
Bearing of Reference ——— [6][2][0][0].[0]
M2 Sighted on Launcher M2

(3) BRNG LS TO NREF
Bearing of Launcher ——— [2][3][2][0].[0]
Sighted on Reference M2

(4) BRNG LS TO RS
Bearing of Launcher M2 ——— [ ][ ][ ][0].[0]
Sighted on Radar M2

(5) EL LS TO RDR
Elevation of Launcher M2 ——— [ ][ ][ ][0].[0]
Sighted on Radar M2

(6) ROLL ——— [+][0][2].[0]

(7) CROSS ROLL ——— [—][0][1].[0]

(8) MISSILE UMBILICALS CONNECTED

UL [X][X] UR

LL [X][X] LR

NOTE

For LOS Emplacement, Fill in all items

LAUNCHER LOCATION AND ALIGNMENT DATA: FORM 2

LAUNCHER LOCATION AND ALIGNMENT DATA: FORM 2
USED WHEN LS UTM ALTITUDE AND ORIENTING LINE ARE PROVIDED AT A SURVEYED SITE

(1) LS NUMBER ——— 2

z z h e e e e e e n n n n n n n

(2) UTM ——— 32N5074855491972

(3) METERS ALTITUDE ——— 0203

(4) **ORIENTING AZIMUTH** ——— 1600.0
AZ M2 Stake to position stake

(5) BRNG NREF TO LS
Bearing of Reference ——— 3200.0

(6) **TRUE AZ OF LS** ——— 6400.0 / 4800.0
AZ from Launcher M2
thru canister alignment pins

(7) **BRNG LS TO NREF** ——— 1600.0
Subtract (6) from 6400
and enter here

(8) ROLL ——— +02.0

(9) CROSS ROLL ——— -01.0

(10) MISSILE UMBILICALS CONNECTED

UL XX UR

LL XX LR

Note:
For UTM Emplacement, fill in all items 1 thru 9

ACTIVATION

Once the fire unit is emplaced it must be activated. Activation consists of starting the generators, applying power, and enabling remote operation of the LSs and RS.

The Patriot system requires 208 or 120 volts, 3-phase, 4-wire, 400-hertz power. Power for the ECS and RS is provided by the EPP and vehicle batteries. The AMG draws its power indirectly from the EPP through the ECS. LSs obtain their power from on-board, 15-kilowatt generators.

System power must be applied in the proper voltages and phases and in the proper sequence to prevent damage to electronic components and equipment. Therefore, it is essential that ECS, EPP, and RS crew members coordinate and communicate with each other during power application procedures.

Launching stations emplaced with the fire control section are synchronized into the digital data link after each launcher crew has performed its own activation actions (less enabling remote operation). The launching station DTL is set to synchronize on the ECS DLT at the earliest possible time consistent with crew checkouts. Once the DLT link is established, the WCC in the ECS automatically performs periodic status checks of the LSs, including simulated launch tests. When each LS crew has completed its tasks, and when authorized by the commander, the crew places the LS LOCAL/RMT switch in the RMT position. after this key-type switch is activated, the LS is under control of the ECS.

WARNING

Launcher crew members have one minute after the LS LOCAL/RMT switch is switched to RMT to evacuate the area and move to a safe distance (90 meters minimum).

INITIALIZATION

Initialization is the computer-controlled sequence of ICC and ECS operator actions, hardware operations, and software processes required to advance the FB to a tactically operational state. When the ICC or ECS is said to be initializing, the MS1 and/or MS3 operator(s) are entering data values (parameters) in response to system cues displayed on their CRT consoles or from information generated within the FB or within the battalion. Data values entered at the ICC represent data common to all battalion units such as weapons control areas, defended assets, and target identification criteria. Values entered at the ECSs represent site-specific data such as radar site and orientation. The collection of all data is called the data base.

The preferred manner of initialization is for data common to all the FBs and the ICC to be entered at the ICC and sent by digital data link to each ECS. This is referred to as data buffer transfer. If the ICC is not on-line at the same time an FB has to initialize, then the ECS operator(s) manually enter the data. In this case, voice communications with the ICC is necessary for coordination and information.

Initialization at the battalion level is called battalion initialization, or BATI. Initialization at the battery level is termed tactical initialization, or TACI. Tab is the abbreviation for tabular-displays which appear on the ICC or ECS MS1 and MS3 consoles. Certain tabs are reserved for BATI and others for TACI: still others are used during battalion tactical operations or firing battery tactical operations. Tabs used in this chapter are identified as BATI, TACI, BTACOPS, or FTACOPS as appropriate.

Engagement Control Station

The three methods used in Patriot ECS initialization are standard emplacement, long-term reinitialization, or short-term reinitialization. All three methods can be augmented by data buffer transfer from the ICC.

Standard emplacement must be done after a move to a new location and is used to develop a data base tape.

Long-term reinitializaton is used if no movement was involved but a new radar map is desired, or if significant portions of the data base have changed. Long-term reinitialization is used after extended periods of maintenance or downtime to update the data base tape.

Short-term reinitialization is normally used after brief periods of maintenance or after short downtime when minor data changes are necessary, or when radar-mapping updates are not required. Data buffer transfer can be done as part of the initialization, reinitialization processes or during tactical operations.

Although not considered an initialization method, *recovery* may be used in special situations to reinitialize system operation. If the system experiences a program halt, keyboard lockout, or electromagnetic pulse, recovery may be performed by using the procedures in TM 9-1430-600-10-1.

Information and Coordination Central

Three initialization methods also are used to initialize the ICC: manual, automatic, and retrieve and compare. Like the ECS, *recovery* can be used to reinitialize the system following a program halt, keyboard lockout, or EMP.

Manual data input is used when minor changes to the existing data base are required. New volumes can be entered during tactical operations.

Automatic data input is used when a complete new data base is to be entered or major changes to the existing data base are required.

Retrieve and compare is used to develop an ICC data base by retrieving each FB's data base. However, its main purpose is to assure that each FB is operating with the correct data base.

Radar Mapping

When the RS is capable of radiating, and as part of TACI, the TCO and TCA perform radar mapping. This is a critical process in establishing the lowest level that the system will search. Radar mapping instructions are furnished by the battery commander. The extent of mapping to be performed is determined by battlefield conditions and time available. Guidance also includes the type of display to be used.

As a general rule, when the terrain is level, C display type mapping should be used. If the terrain is rolling hills and valleys, A display type mapping should be used to contour the lower search beams with the terrain.

During TACI, the TCO or TCA estabishes the initial search lower bound by entering the search elevation angle in tab 95. Care must be taken in establishing this initial angle. The value entered by the TCO or TCA must be based on a map reconnaissance and terrain observation.The ISLB is where the system will begin the lowest search when the mapping process is started. During mapping, the TCO or TCA can tailor the ISLB to the terrain (such as a small valley) and, by so doing, establish the operational search lower bound. This is the lowest point that the system will search during tactical operations. The objective of ISLB and OSLB is to ensure adequate low-level search coverage to detect pop-up and low-level targets, reduce clutter, and conserve radar resources by not attempting search into terrain obstacles.

Masked terrain areas are defined at this time. These areas are used during tactical operations to indicate that an engagement might be unsuccessful because the target may maneuver and enter a masked region before intercept. Proper setting of masked terrain will help to eliminate engagement aborts because of terrain masking. Presently, TACI tabs 92, 93, 95, and 97 control the mapping of masked terrain, as well as defining lower search limits, and generating clutter maps.

If the battlefield situation allows sufficient time, the TCA may perform the terrain mapping functions over the full azimuth coverage, PTL, and STL. The PTL-centered coverage must be mapped last. The clutter-mapping function (only at the PTL-centered coverage) is done automatically and in conjunction with the terrain mapping process.

Under imminent combat conditions, when the fire unit must become operational in minimum time, the mapping function can be omitted. When the system is allowed to radiate in tactical operations, the OSLB is whatever was set in tab 95 as the ISLB. If mapping was omitted and no clutter map generated, as soon as the

system transitions to tactical operations and out of passive surveillance, a clutter map is automatically generated.

AIR BATTLE OPERATIONS

Once the tactical data is loaded into the memory, the WCC becomes the focal point for air defense operations at the FB level. Stored computer programs within the WCC guide the entire sytem's operations. Tactical software implements air defense firing doctrine based on specific values and weights assigned during initialization. These parameters enable the WCC to correctly classify, identify, and engage hostile aircraft. However, the WCC does allow for human intervention from either MS1 or MS3. Generally speaking, the MS1 and MS3's actions during the engagement sequence fall into two distinct categories. The operator at MS1 initiates and monitors engagements. The operator at MS3 ensures that friendly aircraft are not engaged. This division of labor within the ICC and ECS is described further in FM 44-15.

ENGAGEMENT MODES

Two engagement modes based on the extent of computer and human element involvement are used in Patriot. These are the automatic mode and the semiautomatic mode.

Automatic

In the automatic mode, the system automatically engages targets from a list of the most threatening targets eligible for engagement — the to-be-engaged queue. Both the ECS and the ICC have TBEQs. TBEQs are displayed on both the MS1 and MS3 consoles. If the target at the top of the TBEQ cannot be engaged immediately, the next lower one on the TBEQ may be engaged. The TCA can still manually engage targets while the system is in the automatic mode. For the ICC to engage targets in the automatic mode, the ECS must be in the automatic mode and in the centralized method of control.

Semiautomatic

In the semiautomatic mode, the system defines the most threatening targets to the battalion, the defended asset, or firing battery via the TBEQ. However, each target must be engaged manually, primarily in the order of the TBEQ. At the ICC, the TDA may press the ENGAGE S/I or the PFE S/I. This action causes an nnn ENGAGE SCI alert to appear on the TCA console display at the appropriate ECS. The TCA ackowledges the alert which hooks the target. He engages each target by pressing the ENGAGE S/I.

ENGAGEMENT SEQUENCE

The following paragraphs describe the nine major events in the engagement sequence from search through kill assessment. Specific weight values and other classified information have been omitted from this discussion. Consult FM 44-1A(S) for a description of the engagement sequence in a detailed classified format.

Search

In the search process the software systematically directs each FB's RS to look for targets in its assigned search sector. Search processing can also be modified by the TCO or TCA during tactical operations. Since the ICC has no radar, the search process is an FB function. After the search process detects a target, the track is maintained in a target data record for the track process. Once the target has been detected and placed under stable track by the FB, the ICC is notified of that track.

The Patriot system provides the capability to search and track certain ECM targets in the passive surveillance mode. The FB search sectors are scanned in their normal frametimes, passively with no active radiation being transmitted. The receiver is open and processes external energy received (continuous jamming). The passive search capability provides the Patriot battalion the ability to remain RF silent and provide track data on ECM continuous jammers. This data is then triangulated at the ICC and target positions provided to the FBs. Normal system processing is performed on the target.

Passive search should be used when moving into a new position and the state of emission level is such that the FB is not to radiate. The passive search process is performed at the FB and is controlled via the passive search switch indicator. Whenever an FB goes to passive search, the ICC receives the alert, FPn SEARCH PASSIVE. The ICC operator may use the "TOLD IN" function to select a FB in passive search to engage a triangulated strobe track. The "TOLD IN" function can also be used to engage individual nonjamming tracks.

When the ICC operator hooks a track, presses the TRK DOWN TELL switch indicator, and selects an FB for this function, it causes the selected FB's RS to automatically radiate and send out an active search beam in the location of the told-in track. If the RS acquires the track, it is displayed on the CRT and processed by the FB software programs. All these functions are accomplished with no actions required by the FB operator. If the track is not acquired with a few search actions, the "TOLD-IN" function is terminated and the FB goes back to passive search.

ECS action. Normally, FBs should not modify their search sectors. Modifications can only reduce the search coverage from the nominal and may result in delayed target detections or no target detection. Modifications to search processing are done by TCA console switch action during tactical operations.

The ICC normally initializes the drop short-range, drop long-range and alternate search sector data or BATI tab 55 and sends it via data buffer transfer to the ECS. It appears as TACI tab 55 at the ECS. During tactical operations, the TCA can select drop short-range, drop long-range, and two alternate search sectors by switch action. Alternate sector 1 and alternate sector 2 cannot be selected at the same time. However, any combination of one alternate sector, drop long-range, and drop short-range can be selected. Search boundary lines on the ECS consoles situation displays will then change in response to the search sector modification. Note that these actions affect only search coverage. Once a target is detected by search, it will be tracked at the track boundary. The ICC will automatically forward targets to other firing batterys that can acquire the target in their track sector.

The RADIATE DISABLE S/I is an additional search control measure at the ECS. By deactivating the RADIATE DISABLE S/I, all radar actions are turned off (including search, track, and IFF). Any missiles in flight will be destroyed. The radiate mode may be resumed by activating the RADIATE DISABLE S/I once again.

ICC action. The ICC initializes search control parameters on BATI tab 55 for data buffer transfer to the FBs during their TACI (tab 55). It can also, by voice communications, direct an FB to change or alter its search sector based on a changing tactical environment. When a tracked target is dropped by all of the FBs reporting the track, the ICC determines if the target is within the track coverage of any other FB. If there is an eligible FB, it will direct that FB to search and attempt track on the target. By means of specific alerts or tabs, the TD and or TDA can monitor the following FB search actions:

- FPn SEARCH NOMINAL alert tells the ICC that an FB has selected a different search sector or has dropped long- or short-range search.
- FPn RADIATION alert notifies the ICC that an FB has enabled or disabled radiation.
- FPn REORIENTING alert tells the ICC that an FB is reorienting from its PTL, STL, or assigned azimuth.
- BN STATUS SEARCH MODE tab shows an FB's operational mode, radiation status, search status, current azimuth, and hot and cold missile count for review.

- TRACK SUMMARY of FP STATUS tabs indicate the status of each FBs search process and shows the current FBs search sector.

The FB sector bounds displayed on the ICC situation displays do not change with FB-initiated changes. Thus, the situation displays at the ICC do not reflect reduced FB search coverage.

Track

After a target has been detected, the software begins track processing. Track selects the optimal radar track rate and radar waveform to continue track on that target until it leaves the FB track coverage. When a good stable track has been obtained on a target, its position and status are reported to the ICC by data link. The ICC then attempts to correlate the target with targets from other FBs, adjacent battalions, and the brigade. If the track correlates with other track information, the available target identification history and other status are sent to the FB. If the target does not correlate, a new target track file is established. The track correlation process provides continuity of track between battalion, FBs, and adjacent battalions. This gives the FB the identification, identification history, and current engagement status on a new FB track.

If the FB cannot determine the target's range (strobe track) because of ECM, the target's azimuth and elevation are sent to the ICC. The ICC attempts to compute the target's range based on data from other FBs tracking the same target. If successful, it periodically sends the computed range to the FB. This process is called triangulation, because at least three FBs must have strobe tracks on the target for the ICC to reliably establish the target range. Once triangulated, the range computation is maintained with strobe track from two or more FBs. If the target is not range resolved or triangulated, it may be strobe correlated by the TD. If no range estimate is determined, a jammer symbol appears (see FM 44-1A(S)) with a strobe displaying the azimuth of the jammar from the FB. The TD at the ICC uses the JAMMER CORRELATION + TRACK NUMBER CHANGE, tab 15, if there is a jamming strobe from two FBs that intersect; or a jamming strobe from one FB and a skin track from another FB that intersect. The TD inputs the track numbers on tab 15 and enters the tab. If the two tracks that are entered on the tab meet the criteria for triangulation, the range resolved track appears and the strobe or strobes disappear. If they do not meet the criteria, the operator receives a FUNCTION REJECT message. The operator should use tab 15 on a jammer symbol only when the jamming strobes can be clearly defined as intersecting.

The track management process at the ICC performs automatic saturation alleviation. When the number of tracks at the ICC exceeds the track file capacity, track management begins dropping the least threatening tracks and continues until the track file is no longer saturated. It drops the remote tracks and then targets which have been identified as friends or low threat hostiles beyond the range limit. The automatic saturation alleviation level is shown to the left of the tabular display.

ECS action. The operator can influence the tracking process by dropping track on a target or by turning off the radar. During tactical operations, a hooked track can be dropped using the console DROP TRACK S/I. All information on the target is discarded at the FB. If the FB is searching and the target is in the search coverage, it will probably be redetected and placed back under track. If other FBs have been tracking the target during this time, the ICC will have retained all of the target status and identification history and will send it to the FB which dropped the target. (Note: The RADIATE DISABLE S/I also turns off all search and track actions resulting in the loss of all targets and any missiles in flight from that FB.)

A-scope operations can be used by the operator to assist him in determining target track type. The A-scope display presents two digitized, range versus amplitude traces on the tabular display area. The A-scope display is

associated with the nnn USE A SCOPE alert and the A-scope S/I. For an nnn USE A SCOPE alert to be displayed at a particular manstation, the operator must enable the ECCM ASSIST S/I on the console mode group. The nnn USE A SCOPE alert is generated when surveillance detects and tracks a jammer as a repeater track. The alert informs the operator that assistance is required to classify the jamming target. The alert appears once every minute if no action is taken. The operator should hook the target, acknowledge the alert, and select the A-SCOPE S/I. A dual trace will appear in the tab display area with a TGT definition data field. The operator reviews the dual trace and decides if the target is a quiet track, a repeater, or one that the operator does not know.

If the upper and lower traces are the same and the separation distance is the same, the track is probably quiet and an "O" should be entered in the data field. This causes the system to attempt to track the target as a quiet track.

If the upper and lower traces are the same and the separation distance is different, the target is probably a repeater and a "1" should be entered in the data field. The system will continue to track the target as a repeater. The alert nnn USE A SCOPE is displayed every two minutes on that track.

If the operator cannot determine what the target is (that is, quiet or repeater), then a "2" should be entered in the data field. The system continues as before but the alert is displayed every minute.

If a mass of many traces appears on both lines it is probably clutter and the operator should enter a "2" in the data field and should press the DROP TRACK S/I on that target.

Any target may be hooked and A-scope selected. If only a single trace appears, the target is being tracked as either a quiet, continuous, or noncontinuous jammer track. If a dual trace appears, the target is being tracked as a repeater. If a dual trace appears, an entry of 0, 1, or 2 must be made in the data field. To clear the A-scope, press the ENTER key, do not make any entries.

When A-scope is selected, it is mutually exclusive of the tab displays and static data displayed on the situation display. Volumes, assets, corridors, et cetera, if displayed, are not shown. If the clutter map update CMUP S/I is selected by the operator, the clutter map process is terminated. When the A-scope is cleared, the static data previously displayed will automatically be displayed. The tab area remains clear until a tab display is selected. If CMUP was previously selected and is to be continued, the TCA should press the CMUP S/I. The CMUP process begins where it was terminated.

A-scope is used to force the system to attempt a quiet track of a target being tracked as a repeater by the system. If numerous nnn USE A SCOPE alerts appear and the TCA's effectiveness is hampered by responding to these alerts, deactivate the ECCM ASSIST S/I. The system's capability is not degraded if the A-scope process is not used.

ICC action. Periodically, track management checks all target tracks to ensure that the correlation is correct. The TDA can, by activating the DECOR/RECOR S/I, while hooked on the target, cause a specific target to be checked for correct correlation. The result might be that nothing changes, two or more tracks might be correlated and merge, or a track might split into two separate tracks. Since track management is periodically checking correlation, normally the TDA should not intervene in this process. The track amplifying data tab shows which FBs are currently tracking a target, indicating that the FB tracks were correlated by track management.

Site calibration. This process is performed at the ICC to correct differences in position for a track reported by two or more FBs. These differences result from radar measurement errors, emplacement position and alignment errors, and computational errors. The process is initiated after an FB has completed emplacement

or reorientation and is performed on FBs that have large target azimuth errors. These errors are affected by the type of entries made on TACI tab 81 RADAR LOCATION/ALIGNMENT DATA ENTRY. Consequently, caution should be taken to ensure that the correct LOCATION DATA CONFIDENCE LEVEL and ALIGNED BY entries are entered. Site calibration will not be performed if a confidence level of survey and alignment of survey are input on tab 81.

Site calibration is performed by selecting two FBs that are tracking the same single, quiet track. The corrected-FB azimuth angle and accuracy level are transmitted to each FB for which the site calibration process has generated a change. The alert, FPn AZIMUTH CHNG, appears at the ICC informing the operator that a site calibration for that FB has been completed. The ICC operator can call up tab 12, FP LOCATION/BOUNDARIES, and observe the site calibration corrections in the CURR AZ data field.

If a large azimuth error correction is required at an FB, the alert SITE ERROR FP nnn and FP nnn appears at the ICC. The operator should contact the affected FBs and have them verify their alignment and emplacement data. This may require that the units perform a short-term reinitialization and verify the data entries on tab 81.

Identification

Once a target has been placed under stable track by the ECS and reported to the ICC, the target ID process begins. Target IDs can be assigned manually by MS1 or MS3 console switch actions at the ECS or ICC, automatically by the WCC, or automatically by the ICC in response to digital data link commands from brigade. The automatic identification mode is the preferred method of operation for Patriot. When ID criteria are employed properly, automatic IDs are made more rapidly, reliably, and consistently than manual IDs. This frees operators from performing the majority of IDs and allows them to devote their attention to identification of special situations and monitoring of the automatic IDs. When the ECS is in the automatic identification mode, target IDs are established by the ECS, evaluated for conflicts at the ICC, and then sent to higher echelons. Even when higher echelons have identification authority, Patriot should be in the automatic ID mode.

In the manual ID mode, the operator must assign an identity to each track. The FBs manually assign target IDs which are relayed to the brigade by the battalion.

Possible target identities for the Patriot system include the following:

- *True friend.* In both automatic and manual ID modes, this ID is assigned to a target which gives a valid Mode 4 IFF response when challenged. This ID cannot be assigned manually. However, once it is automatically assigned it can be manually revoked.
- *Friend.* This identity is assigned by either the ICC or ECS operator via the FRND switch. It can also be assigned automatically, in the automatic ID mode, by the ECS software if the target has accumulated enough positive points to be identified as a friend. The *friend* identity is assigned by higher echelon via the digital data link.
- *Assumed friend.* This identity is assigned by the ECS software (in the automatic identification mode) when a target has accumulated enough positive points to make it an *asssumed friend.* It can also be assigned by a higher echelon message or by the ICC or ECS operator by activating the SPECIAL switch while hooked on an unknown target and then activating the UNKNOWN switch.
- *Unknown.* This identity can be assigned by either the ECS or ICC operator via the UNKNOWN switch. It is assigned automatically by the ECS software for targets which have not accumulated enough negative points to be a *hostile* nor enough positive points to be an *assumed friend.*

An *unknown* identity can also be assigned by higher echelon. When the manual ID mode is specified in TACI tab 01 or FTACOPS tab 01, all targets are initially assigned an ID of *unknown*. The automatic ID processing is disabled for final ID assignment.

- *Special friend*. This identity can only be assigned by the ICC or ECS operator by activating the SPECIAL switch while hooked on a *friend* target, followed by activating the FRIEND switch.
- *Hostile*. This identity can be assigned by either the ECS or the ICC operator via the HOSTILE switch. It can be assigned automatically by the ECS software or by higher echelon.

Identities manually assigned by an ECS or ICC operator or by higher echelon will override any identity established by the ECS software in the automatic mode. There are two exceptions. When the target replies with a valid Mode 4 response to an IFF challenge, the target's identity is automatically changed to *true friend* . This also occurs in the ECS manual identification mode. The other exception is an ECS operator designation of *unknown*. The operator is essentially removing any previous identity of the target to allow the ECS automatic ID mode to establish an identity based on the software's evaluation of the ID history criteria.

The basis for the ECS automatic assignment of target identities is the target's location, speed, IFF response, and ECM emissions in comparison to criteria entered during initialization. Associated with each kind of criteria are positive or negative points called weight factors. When the target complies with friendly criteria, positive points are added to the target's point total. When the target violates criteria defined as a hostile indication, points are subtracted from the target's point total. In the automatic ID mode, targets will be evaluated every few seconds and an identity will be assigned based on a target's total number of points. Although the point values are fixed and cannot be changed, flexibility is provided by having three complete sets of points which are designed to correspond to varying states of readiness and levels of hostilities. The ID weight sets are designed for the following environments:

- Weight Set 1; peacetime.
- Weight Set 2; increased alert status or transition.
- Weight Set 3; wartime.

The illustration below lists those criteria used for determining point totals. FM 44-1A(S) contains weight factor values and how each is used in computing the point total. ID volumes and criteria should be set at initialization so that friendly targets can comply with enough criteria to build up sufficient number of positive points to be assigned a *friend* ID. Similarly, the volumes and criteria should be designed so that an enemy aircraft will compile enough negative points to be assigned a *hostile* ID.

PATRIOT ID WEIGHT SET CRITERIA

VOLUMES
- FRIENDLY ORIGIN VOLUME
- HOSTILE ORIGIN VOLUME
- PROHIBITED VOLUME
- RESTRICTED VOLUME

POP-UP

SAFE PASSAGE CORRIDOR

MINIMUM SAFE VELOCITY

ELECTRONIC COUNTERMEASURES (ECM) EMITTER

IFF/SIF

ECS action. The ECS operator defines the volumes and corridors via tab 71, ALL VOLUMES + POINTS ENTRY. The ICC operator also defines them via tab 71. TACI tab 71 or FTACOPS tab 05 is used to designate volumes and corridors as active or inactive. Inactive volumes are not displayed or considered by software processes.

The remaining target ID criteria are entered in tab 79. Using tab 79, the ID mode and weight set to be initially used during TACOPS can be specified. ECM emission and pop-up violations can be authorized as a *hostile* identity criteria via tab 79. Minimum safe velocity is entered as a friendly indicator on this tab. During TACOPS, the TCO or TCA can change ID modes, change weight sets, and revoke or authorize hostile criteria using FTACOPS tab 01, and activate and deactivate assets and volumes using FTACOPS tab 05, ASSET/VOLUME STATUS.

The FBs should all use the same identification weight set and hostile declaration authorization. Active identification volumes within the tracking coverage of more than one FB should be the same. The possibility exists that numerous ID conflicts will result if these guidelines are not followed.

The TCO or TCA can control IFF/SIF interrogations by using the SIF ENABLE, MODE 4 ENABLE, and HIGH THRESH/LOW THRESH S/Is. Tabs affecting IFF/SIF actions include TACI tabs 06, 73, and 74. FTACOPS tab 06 is also used to further define IFF/SIF data. Procedures for using these S/Is and tabs are described in FM 44-1A(S). If a system generated *hostile* or *unknown* ID responds with a positive Mode 3, it may require the TCO or TD to manually override the ID and identify the track as a *friend.*

ICC action. The ICC's role in identification is to resolve any conflicts between the ID data among FBs and between the Patriot battalion and the brigade. It then disseminates the resolved identification throughout the battalion, to adjacent battalions, and the brigade.

The battalion can initialize all ID volumes, hostile authorizations, and ID modes for battalion use and transfer this data to the FBs. During BTACOPS, the battalion operator uses BTACOPS tab 05 to activate and deactivate ID volumes and weapon control volumes at any or all FBs during FTACOPS. The TD or TDA uses tab 05 to change ID mode, weight set, and hostile authorization.

There are a number of IFF-related and ID-related alerts which can be generated at the battalion. The TD or TDA can be requested by voice from brigade to interrogate a target. After receiving the IFF REQUEST, the TD or TDA determines from the track amplification data tab which FBs are tracking the target. He then requests, via the IFF and SOURCE ADDRESS S/Is, that one of the FBs interrogate the target. The operator receives an ____ IFF COMPLETE alert if the FB has successfully challenged the target, or an ____ IFF INCOMPLETE alert if, after four seconds, the interrogation has not been successfully completed. In addition, the TD or TDA receives an ____ IFF EMERGENCY alert or ____ GARBLED IFF alert if the result of any FB interrogation (whether requested by the ICC or independently initiated by the FB) indicates these conditions.

In the manual ID mode, the operator receives an ____ ID HIS CHNG alert each time that additional ID history data is received from a FB or adjacent battalions. The operator will generally be required to intercede when a target has a previously established ID (other than *unknown)* and a FB, adjacent battalion, or higher echelon reports a different ID. When an ID conflict occurs between the different units which the system cannot automatically resolve, the TD or TDA receives aa nnn CONFLICT aaaa AT bbb alert and is required to decide which identity is correct and to direct the appropriate subordinate unit changes.

Engagement Eligibility

Once a target has an identity assigned, it is then processed for engagement eligibility. Based on its identity and location, the target may be considered eligible for automatic engagement and, if so, another process called threat assessment is performed.

Any target is eligible for manual engagement. However, the operator is required to change all forms of *friend* to *hostile*, and in certain instances, some *unknown* targets to

hostile, which implies that all *hostile* targets are manually engageable regardless of where they are located.

Weapons control statuses have an effect on target eligibilty. Of the three statuses, WEAPONS HOLD is the most restrictive and WEAPONS FREE the least restrictive. Weapons control statuses are applied to the entire FB area of coverage (called the residual zone) and to specific volumes within the FB's area. The specific volumes are input during initialization in tab 71. All active weapons control volumes are considered when the AREAS ENABLE switch is activated either during TACOPS by the operator, or by the battalion via the data link. An FB may have a residual zone of WEAPONS TIGHT and have several volumes of WEAPONS HOLD or WEAPONS FREE. The residual zone is the entire track sector, excluding the area contained in active weapons control volumes.

General engagement eligibility rules which apply to the various states are as follows:

- *Friends (special friend, true friend, assumed friend, or friend)* are never eligible for threat assessment and consequently are not engaged.
- *Unknowns* are eligible for automatic engagement only in a WEAPONS FREE area and will be threat assessed if this condition exists.
- *Hostiles* are eligible for automatic engagement in WEAPONS FREE or WEAPONS TIGHT volumes and are always threat assessed.
- No targets are automatically engaged in a WEAPONS HOLD area; however, *hostile* targets may be manually engaged in a WEAPONS HOLD area.

The weapons control status for the battalion and the FB overall (residual) areas are directed by higher echelons. In this regard, consideration is given to the protection of friendly aircraft by establishing WEAPONS HOLD volumes. These are used to cover aircraft refueling areas, combat air patrols, or no-fire zones for Patriot. Thus, for maximum protection of friendly or possibly friendly aircraft, a WEAPONS HOLD residual is recommended with few or no active WEAPONS FREE and/or WEAPONS TIGHT areas in the battalion's coverage. If the environment is not rich in enemy aircraft and a high degree of protection for friendly aircraft is desired, a WEAPONS TIGHT residual is recommended. To gain the maximum engagement potential against *hostile* and *unknown* targets, a free-fire zone is designated and a WEAPONS FREE volume is used. Using the general engagement eligibility rules provided, the battalion S3 can accommodate the weapons control status imposed by higher echelons and develop protective measures for friendly aircraft.

ECS action. Three switches on the system control group of the display console affect weapons control statuses for the FB's residual area. These switches are marked HOLD, TIGHT, and FREE. Activating the HOLD switch causes the overall FB area (residual area) to be assigned a WEAPONS HOLD status. Activating the TIGHT or FREE switches results in WEAPONS TIGHT or WEAPONS FREE weapons control statuses. The weapons control status in effect is displayed on the FB status panel. One status is in effect at all times. If no switch is selected, the system will be in a WEAPONS TIGHT status. The switches are mutally exclusive (activating one state deactivates the other).

The AREAS ENABLE switch activates and deactivates the weapons control volumes' input during initialization. The status of each of these volumes is set during initialization, but may be changed during TACOPS. For example, if a WEAPONS HOLD volume is defined during initialization, it may be changed to WEAPONS FREE during TACOPS. Individual weapons control volumes can be activated or deactivated via FTACOPS tab 05. When AREAS ENABLE is activated, that status is displayed on the FB status panel just below the FBs residual weapons control status. The AREAS ENABLE S/I

can be activated with any one of the weapons control switches. The weapons control volumes are considered by system software if they are activated via tab 05 and are turned on by the AREAS ENABLE switch. If they are deactivated via tab 05, the system will not consider or display them when AREAS ENABLE is selected.

ICC action. The battalion processes engagement eligibility independently, but in the same manner as described for the FB. The TDA, via switch action or BTACOPS tab 05, can change the weapons control status of any or all FBs, as well as activate or deactivate weapons control volumes. The FB automatically accepts the weapons control status and volume changes and alerts the ICC by an FBn WC AREAS ENABLED or an FBn WPN FREE, TIGHT, HOLD alert. The battalion and individual FB weapons control states are displayed on the battalion status panel. Weapons control status commands from higher echelons are relayed by the ICC to the FBs.

Threat Assessment

After a target is detected, placed under track, identified as *unknown* or *hostile*, and determined to be eligible for engagement based on weapons control restrictions, it undergoes a detailed threat assessment. The purpose of the threat assessment process is to evaluate whether the target is close enough to any of the FBs (or battalion, in the case of the ICC) defended assets to be considered a threat. At the FB up to 16 defended assets can be defined with 6 active at each FB. Each asset is assigned a priority from 1 to 8 with priority 1 being the most important and 8 the least (more than one asset can have the same priority). Once a target is found to be a threat to one or more assets, it is assigned a threat value equal to the priority of the most important asset threatened. A threat value is called the target's asset threat category. A target may have an ATC of 9 or 10 and is not considered a threat to an asset at that time. A target's ATC is used along with other factors to determine the order of engagement. The ATC can change as a target threatens different assets. If the missile fly-out time is subtracted from the time for the target to reach the asset, the difference is the time left to engage the target and defend the asset. This time is called time-to-last-launch. A positive TLL means there is a finite number of seconds left before the target must be engaged. A TLL equal to zero means that an engage command executed immediately just allows the missile to intercept the target at the asset boundary (assuming the target actually turns to attack the asset). A negative TLL indicates that the target could penetrate the asset before a missile could reach the target.

ECS action. Assets are defined to the FB by entries on tab 70. Assets can only be entered using a center point and radius. Assets are displayed as squares on the CRT, with sides equal to the diameter of the asset, but are considered as cylindrical volumes by the threat assessment process. If zero radius is entered by an asset, a small rectangle similar to the square for a general point is displayed. The PRI column is used to designate the priority (1 to 8) of the asset which is used to determine the target ATC. Assets only can be activated or deactivated during TACOPS by FTACOPS tab 05. Only active assets are displayed and considered in the threat assessment evaluation.

The FB will not defend itself as an asset unless it is defined as one on tab 70. The FB should be defined as the same priority as the highest asset priority. The FB will receive a self-defense threat alert if a target threatens the FB. Asset priorities are used for ordinal ranking only. That is, if assets A and B are active and are defined with A having priority of 2 and B a priority of 6, asset A is more important than B but is not 3 times more important. Assigning asset B a priority of 3 would result in the same threat assessment.

ICC action. The battalion independently assesses the threat level of each target using a process similar to that of the FB, but considers from 1 to 16 assets, in the coverage of any of its 6 FBs.

The TDA, using tab 05, page 1, can activate or deactivate ID volumes for any one of the FBs.

The FB automatically accepts the volume change and receives an ASSET ACTIVE or INACTIVE alert.

The threat assessment process is also performed for the hooked target or targets at either or both display consoles. The track amplifying data tab shows the asset threatened, ATC, and the TLL. The first time a target has a TLL less than 10 seconds against any asset, an aannn THREAT TO ASSET alert is generated.

Threat Prioritization

A target that is being tracked by at least one FB, which has been identified as eligible for engagement based on its identity and which has been threat assessed, is now ready to be prioritized. This means that it is placed in its appropriate position along with all other threats to determine the recommended order of engagement. If the queue is full, the target is added only if it is of higher priority than the least threatened target currently on the queue.

In the automatic engagement mode, the system will attempt to engage targets in the order of the TBEQ. If the target cannot be engaged immediately, the next one lower on the TBEQ may be engaged. In the semiautomatic engagement mode, the TCA should also engage targets in the order of the TBEQ when TLR (this is when intercept offering high kill probability can first occur) equals zero and before TLL reaches zero.

All targets on the queue are evaluated once per second and the queue is reordered if necessary. Part of the evaluation process is to compute the launch-now-intercept-point for each target. The LNIP is the prediction of the intercept location if the missile was launched immediately and is based on the target's current speed and heading. If the LNIP falls outside of the FB track sector, the target is removed from the queue.

There are two orders of targets on the TBEQ. At the top of the queue are those targets which have been manually designated by the operator for engagement (ENGAGE switch) but which have not yet had a missile launched. If there are more than one of these targets, the one designated first is on top, the second one designated is second, et cetera.

The remainder of the targets are ordered by ATC with the lower-numbered categories (more important) above higher-numbered categories. Targets which have the same ATC are further ordered by the estimated missile fly-out time to engagement with short-time-of-flight targets above longer ones. However, if a target's TLL is below 10 seconds (representing a critical engagement), it is ordered above the short-time-of-flight targets with smaller TLL targets first. The ordering of the queue may also be modified by the engagement status of the targets. Finally, targets with negative TLLs are ordered last within their ATC.

ECS action. The TCA can observe the TBEQ targets and parameters on the FB engagement data display. This display consists of two portions. The left side shows the TBEQ targets in priority order. The right side shows those targets currently under engagement (missile fired). The TCA calls up the engagement data display by activating the ENG DATA switch. This action causes a display of the TBEQ. The system continues to update and re-order the queue, but the TCA will not see the new order until he again activates the ENG DATA switch. He is notified by a blinking target number that the order of the queue he is observing is not the same as the current one. This indicates that the target and those below it are not in the correct order. TLR and TLL of 10 or less are automatically updated once per second for those targets on the queue.

ICC action. The battalion prioritizes targets in a similar fashion as the FB except it considers up to 16 battalion assets. The battalion does not know what targets are on each FB queue nor their order. Each ECS maintains its own priority ordered TBEQ based on active ECS assets and the targets being tracked by that FB.

The TBEQ is the primary source of information for the TDA to use in determining the order in which targets should be engaged. The order of the targets on the queue reflects the active assets and their priority. The TBEQ is displayed to the TDA when he activates the TBE 1 or TBE 2 S/I.

The data displayed for each target on the queue is automatically updated each second. However, the order of the targets on the queue is not changed until the TDA again activates the S/I. The ICC maintains a correctly ordered queue in the software and, if this is different from that being shown currently on the display, the TDA is notified by a blinking track number. The blinking track number indicates that the particular track, and possibly those below it, are in the wrong order. It is a signal for the TDA to activate the S/I again to see the proper order. The target in the tenth position on the TBE queue display (bottom right) is TBE data for the hooked target (if any) at that console.

Targets eligible for engagement are placed in priority order on the TBEQ by ATC. Within a group of targets having the same ATC, the ordering is based upon the target's TLL and the predicted missile fly-out time. All targets with negative TLLs are placed below those with positive TLLs. Among the targets with negative TLLs, those with the least negative are above those which are more negative. The targets with positive TLL are ordered by missile time of flight. Positive TLL targets having a critical TLL (less than 10 seconds) are ordered by TLL above other positive TLL targets which are in WEAPONS HOLD areas and those targets with CEASE FIRE or ENGAGE HOLD conditions. Within this group of targets, the ordering is the same as described above with respect to ATC, TLL, and missile time of flight.

Targets are taken off the TBEQ for the following reasons:

- The target is engaged by an FB.
- An identity or weapons control change makes the target ineligible for engagement.
- The target cannot be intercepted within the boundary of any FB.
- A confirmed kill or probable kill is reported on the target.
- A higher priority target bumps it off the queue.
- The TDA commands the target be processed for engagement by activating the PFE S/I.

Launch Decision

The purpose of the launch-decison process is to determine the best time to engage the target and to determine the LNIP. At the ICC, the launch decision determines which FB should carry out the engagement. The launch decision process determines which targets are ready to be engaged based on consideration of engagement authority, probability of successful kill, and urgency to protect an asset. The launch decision process calculations are performed on each TBEQ target once each second using the newest target data each time.

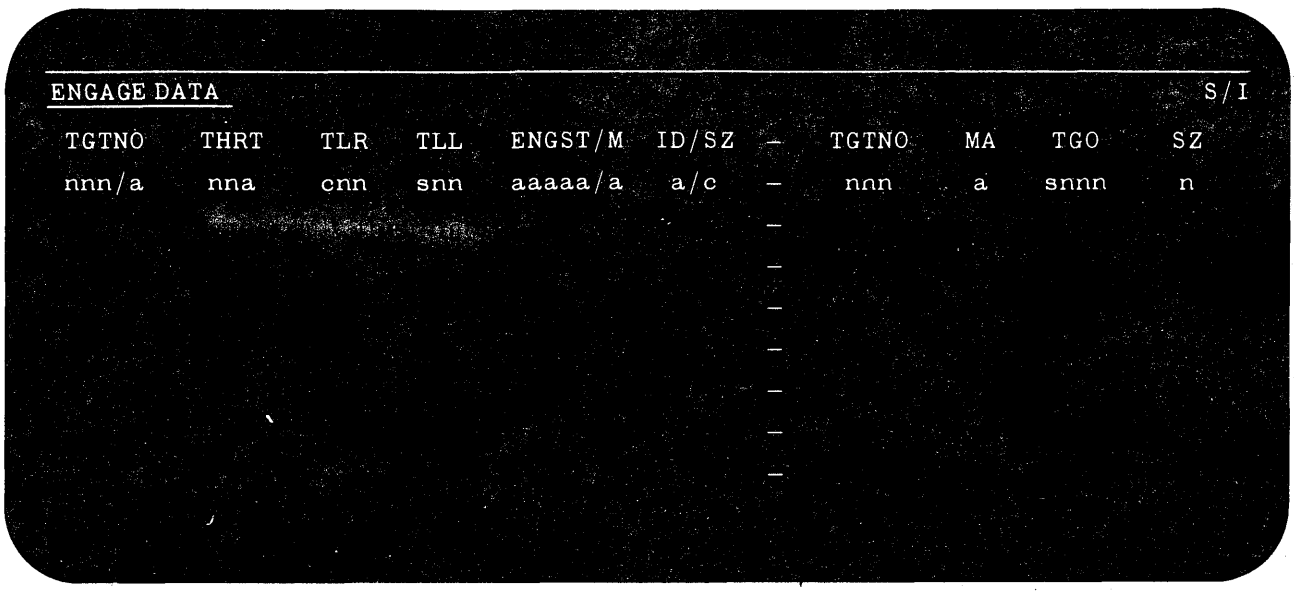
ECS action. The engagement data tab display is activated by the ENG DATA switch and is shown at right.

The first decision made by the launch-decision process is the prediction of the LNIP. The LNP is calculated for each of the TBEQ targets and for any hooked target. It is displayed on the situation display when the console LNIP switch is ON and when the LNIP switch is OFF, the hooked track only shows the LNIP. If the intercept point does not fall within the FB's track coverage, the target is not engaged and is removed from the TBEQ. The LNIP calculation also yields the missile's fly-out time to the LNIP and the time-to-intercept. TTI is equal to the missile fly-out time plus additional time allowed for system reaction.

The next launch decision process evaluation determines if it is possible for the target, based on its current speed and heading, to become masked from the radar by terrain before intercept can occur. Essentially, the masked terrain prediction determines whether any portion of

the target's predicted flight path, between its current position and its modified LNIP, is masked by the terrain data entered during TACI. A value can be set during initialization of tab 78 (MASKED EARLY WARNING TIME INTERVAL) which is added to the TTI before the masked terrain calculations are made. This moves the target LNIP further along the target's current heading. If the target angle at its current position is predicted to be higher than the highest masked terrain input during initialization of tab 78 (TARGET TO MASK ANGLE THRESHOLD), it is assumed that terrain masking will not occur. If the target angle is not that high, a detailed calculation is performed based on target position at TTI. Those targets which are predicted to be masked at intercept have the letter "M" written beside the TGTNO value on the TBEQ. A MSK indicator also appears on the situation display at the LNIP and under the TLL.

ENGAGEMENT DATA TAB



The system does not delay an automatic engagement due to the masked terrain prediction. It is recommended that the operator use his judgement and delay engagement of targets with masked-terrain predictions. For example, a target at a 40- to 50-kilometer range with an ATC of 9 which is predicted to be masked at intercept, should be delayed for engagement. The operator will wait for the opportunity to engage the target without the mask prediction. It is recommended that the MASKING EARLY WARNING TIME INTERVAL and the TARGET TO MASK ANGLE THRESHOLD be set to 0 seconds and 0° respectively.

The next value determined is the target's time-to-first-launch. TTFL is an estimate of how long it takes for the target to approach close enough to the FB to be engaged and intercept to occur with an acceptable probability of kill. The acceptable-kill-probability region is within the azimuth limits of the track sector and within a range value based on target altitude and the target ECM history. The boundary can be moved in and out by entering an engagement range bias on tab 78 or tab 01. This parameter is added to the boundary value and moves the acceptable kill region range in and out. Current TTFL is displayed as TLR to the operator on the TBEQ. A target which is detected at long range and flies toward the FB will initially have a large TTFL. As the target comes closer, the TTFL decreases and reaches 0 seconds when

the target's LNIP enters the high-kill-probability region. If the estimated target flight path does not cross into the acceptable region, TTFL is not displayed (crossing target). Also, if the target is presently in the engagement boundary, but the intercept point is outside of it, TTFL is not displayed (receding target).

The launch decison process next computes the TLR value displayed on the engagement data display for each TBEQ target. When the system is in the automatic engagement mode, TLR indicates the time remaining before the target is automatically engaged by the system. It takes into account TTFL and delays in launch because of radar guidance availability and ensures that the target is continuously displayed on the TBE queue for operator review before automatic engagement. If the launch is being delayed because of lack of guidance resources, the letter "D" appears in front of the release time on the display. The operator review time is initialized in tab 78 and can be changed via tab 10. With the system in the automatic engagement mode, a dash is shown in front of the release time if the operator review time is delaying the engagement. In the semiautomatic engagement mode, TLR is equal to TTLF.

The operator can request engagement of any target whether the system is in the automatic or semiautomatic engagement mode. The system rejects the engagement command and displays an nnnn CANT ENG-aaaaaa alert if any of the following conditions are true:

- No launchers are available.
- All targets on the TBEQ have already been requested by the operator for engagement.
- The target identity and/or weapons control status will not allow engagement.
- The LNIP is invalid.
- It has been less than 5 seconds since the operator last commanded engagement of target.

TAB 10, LOCAL ENGAGEMENT CONTROL

```
LOCAL ENGAGEMENT CONTROL PARAMETERS                          ★10★

(    ) KM =  FP1  ENGAGEMENT RANGE BIAS    50 KM TO +50
(    ) KM =  FP2
(    ) KM =  FP3
(    ) KM =  FP4
(    ) KM =  FP4
(    ) KM =  FP5
(    ) KM =  FP6
(  )    SECONDS    OPERATOR OVERRIDE TIME    00 TO 30 SECONDS
```

ICC action. The launch decision process at the ICC determines the most appropriate FB and the best time to carry out an engagement.

The first step in the ICC launch decision process is to predict the first time a target can be engaged, with the intercept occuring within an

acceptable range from the FB. The acceptable range represents a high probability of kill for intercepts occurring within the boundary defined by the FB track sector and the range from the FB. The time computed is called the TTFL. If a target is presently outside the boundary, TTFL is the time remaining for the target LNIP to cross the boundary based on the target's current speed and heading. If the estimated target flight path does not cross the boundary, TTFL is not computed. If the LNIP is presently within the boundary, TTFL is set to zero indicating that the target can be engaged and intercepted with a reasonable kill probability. If the target is within the boundary but its LNIP is outide (an outbound target for example), TTFL is not displayed. The range boundary for each FB can be moved in or out by adjusting the engagement range bias. The value of the engagement range bias is added to the high-kill-probability boundary. Notice that the bias is set separately for each individual FB. The engagement range bias is set on tab 10. The operator override time is also set on this tab.

The next step is to determine which FB is the best (primary) candidate for engagement assignment. If there are two or more FBs able to engage the target, they are compared against factors that decrease the probability of a succesful engagement. The factors are listed in FM 44-1A(S). From this comparison, the best FB is selected as the primary FB and the next best as the secondary.

The launch decision process computes the time a target should be engaged in the semiautomatic mode and when the system will engage the target in the automatic mode. This time is called the TLR and is computed separately for the primary and secondary FBs. In the semiautomatic engagement mode, target engagements must be commanded by TDA switch action. For this condition, TLR is set equal to TTFL. That is, the TDA must perform the engagement and TLR is set to TTFL to indicate to the TDA when the engagement can be initiated and to expect a high probability of success.

Because of the anticipated intensity of future conflicts, the preferred engagement mode for Patriot is the automatic engagement mode. In the automatic engagement mode, targets will be engaged automatically. TLR for these targets indicates the time remaining before the target will be automatically engaged and is based upon the following considerations:

- The target remains on the TBEQ prior to being engaged for at least as long as the operator override time set in BATI/ BTACOPS tab 10.
- The target is engaged in time to defend a threatened asset.
- The target is engaged when its LNIP is within the acceptable-kill-probability boundary.

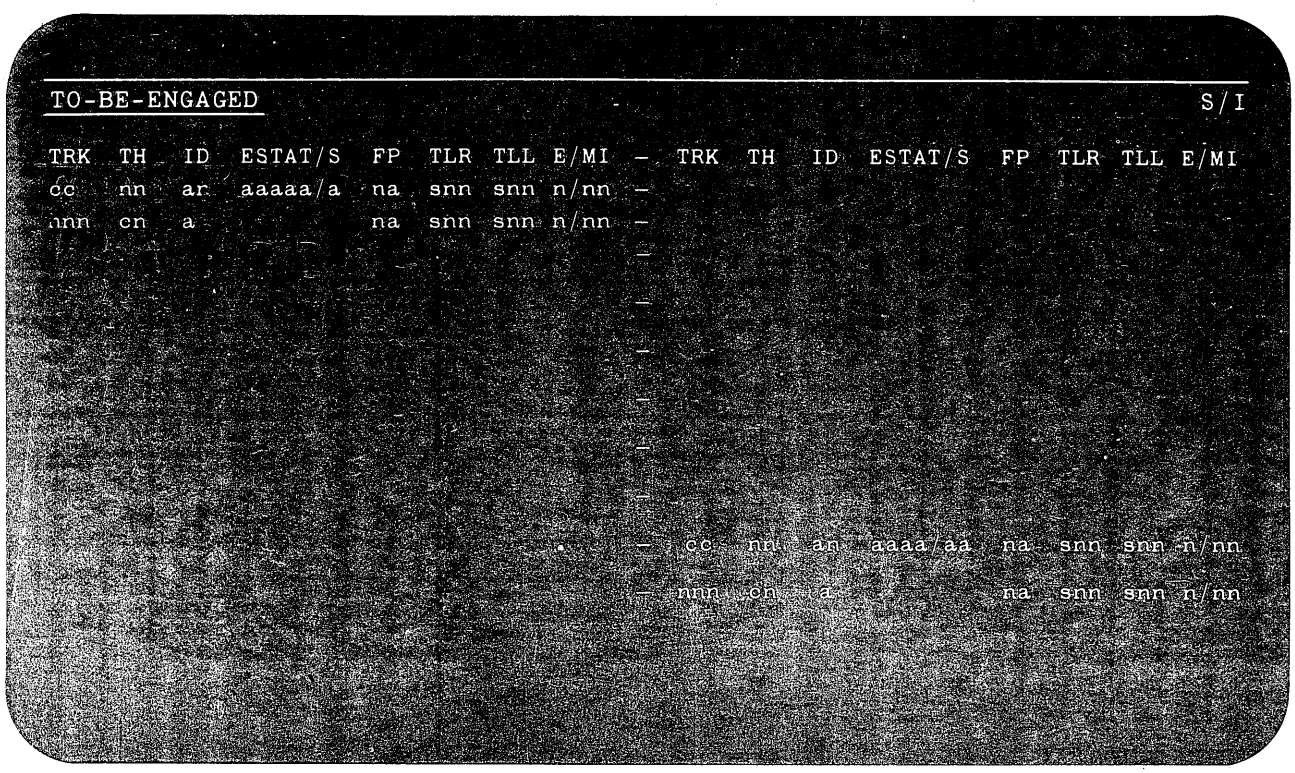
Notice that the target is not automatically engaged if the missile cutoff threshold is not met. Missile cutoff thresholds are defined in tab 78.

When the battalion is in the decentralized method of control and semiautomatic engagement mode (with the FBs centralized), the TDA initiates all engagements. The TDA should command engagements in the order given by the TBEQ when TLR goes to zero. He should normally use the primary FB as recommended by the system. The number of missiles each FB has is a factor in FB selection and the system tends to choose an FB with more missiles over one with fewer missiles. However, the TDA is responsible, in the semiautomatic engagement mode, for implementing the missile cutoff as a function of target ATC, if it is required. When the system is conducting automatic engagements, it obeys the missile cutoff thresholds set on BATI tab 78. Normally, the engagement range bias should be set to zero for all FBs. Selecting small positive values or zero for some FBs and negative values for others causes the positive range bias FBs to be selected for engagements more often than the negative range bias FBs.

When the battalion is in the decentralized or centralized method of control (either in automatic or semiautomatic engagement mode), the TDA by switch action can command a hooked target to be processed for engagement. The ICC automatically commands engagement of a PFE target when the engagement can be completed with a high probability of success. That is TLR for a PFE target is set to the smaller of TTFL or TLL. When PFE is requested for a target, any CEASE FIRE or ENGAGE HOLD conditions are taken off the target and if the target is on the TBEQ, it is removed. The primary FB is commanded to engage the target automatically by the WCC at the proper time without further operator action. The PFE switch is primarily used for engaging brigade assigned targets, which are outside the Patriot's high-kill region.

Engagements initiated automatically by the WCC or commanded by the TDA for a target on the queue with a TLR of zero should be valid engagements for the FB. That is, when an FB receives the command to engage the target, the FB should have missiles available, the target should be eligible for engagement, and the FB should have a reasonable chance of killing the target. The command is sent to the FB along with a method of fire. If the FB chooses a MOF other than that assigned by ICC, the ICC operator will receive an aannn FPn MOF = SLC NOT RIP or aannn FPn MOF = SLS NOT SAL alert. When the engage command is sent, cease fire instructions are sent to other tracking FBs and brigade is notified. The TBEQ tabular display shows the primary and secondary FBs and the TLL and TLR for each. Under the headings FP, TLR, TLL, and E/MI are two lines. The top line shows data for the primary FB and the second line shows data for the secondary FB. When in the automatic engagement mode and a target is ready for engagement but is being held only for operator review, a dash appears in front of TLR.

TBE DATA



Weapons Assignment

Weapons assignment performs a final engagement eligibility check: selects a launcher, assigns the exact times for guidance uplink, downlink, and TVM; requests a final IFF check; and initiates missile launch.

ECS action. The engagement eligibility check includes consideration of recent target changes such as CEASE FIRE, ENGAGE HOLD, HOLD FIRE, and identity changes to other than *hostile* or *unknown*. The target is not processed further for engagement if any of these conditions are true.

For those targets still eligible for immediate engagement, weapons assignment selects the best available launcher. If the engagement has a very shot-range intercept, the launcher pointing most directly toward the intercept point is selected. For normal engagements, the launcher is selected to fulfill the launcher depletion policy, which was designated during initialization on tab 78 or 85. During initialization on tab 78, the operator selects the missile depletion policy; depletion evenly across all launchers or depletion of one launcher at a time. In tab 85 the operator can select which launcher to deplete first, second, and so forth if he has selected deplete by launcher.

The weapons assignment process next attempts to determine the times for guidance uplink, downlink, and TVM for the engagement. If sufficient time cannot be found because of other engagements, weapons assignment determines if the engagement can be completed if the engagement initiation is delayed. If the engagement can be successfully delayed, the delay time can be reflected in the TLR column in the FTACOPS engagement data tab and the letter "D" will precede the time, indicating that the launch is delayed for guidance. Engagements are not delayed past the TLL.

For example, if a target has a TLL of 8 seconds and cannot be engaged for 10 seconds, the engagement is cancelled. The target is removed from the TBEQ and if the operator has engaged the target, he receives an nnn NO ENG-KILL RCVD, or CEASE FIRE, or MULT MSL, or NO TVM alert.

Weapons assignment then performs a final IFF check of those targets ready for engagement. A valid Mode 4 response cancels the engagement and changes the target ID to *true friend*. A valid Mode 1 and/or Mode 3A response sets an ENGAGE HOLD on the target. If the IFF equipment is unavailable, the IFF check is skipped.

Finally, a target passing all the preceding evaluations is engaged. The target then moves from the TBE side of the engagement data display to the engaged side. Also, the target modifier symbol will change from a broken hexagon (TBEQ target) to a solid hexagon. If the operator has selected display of predicted intercept points via the PIP S/I or if the target is hooked, the missile symbol appears and begins moving away from the FB, target-to-missile pairing lines are shown and time-to-intercept will be displayed alongside the intercept point.

When missile launch occurs, the ICC is notified by a data link message. For engagements initiated by the FB, the ICC then sends CEASE FIRE messages to other FBs tracking the target and to adjacent Patriot battalions that might be tracking the target. If the ICC commands the engagement, CEASE FIRE messages are sent to subordinate FBs tracking the target when the ENGAGE order is sent to the engaging FB. It also notifies higher echelons of the engagement. If the engagement fails, a no-kill message is sent to the battalion which relays it to appropriate units.

ICC action. The battalion has no input to the launcher selection of the weapons assignment process. Once an engagement is commanded by the battalion TDA and initiated by the TCA, the weapons assignment program in the FB carries out the engagement.

Kill Assessment

During the kill assessment process, the missile and target are monitored to determine if the engagement was successful.

ECS action. If communications with the missile are terminated (indicating detonation)

when TGO reaches 00, the target display symbol is marked as a probable kill and the appropriate message is sent to the ICC. The message appears until a kill or no-kill determination is made. The TCA can designate a confirmed kill or no-kill by console switch action. However, he should not intervene in the kill assessment process unless he has definite information on the target's status.

If a positive kill or no-kill has not been established after a specified time delay (see FM 44-1A(S), a no-kill is automatically set on the target, the ICC is notified, and the target is reevaluated for engagement. Probable kill and no-kill messages are sent to the battalion and relayed to other tracking FBs and adjacent battalions. Symbols on the consoles will change accordingly.

ICC action. At battalion level, the kill assessment process is actually an engagement monitoring process. This monitoring begins with the FB engagement command and follows through to engagement termination. The following kill assessment functions are performed:

- Determines if FB engagements have not been initiated, informing the operator, and updating engagement status parameters.
- Processes engagement announcements from other Patriot battalions and engagement reports from higher echelon and maintaining target engagement.
- Updates target/FB engagement status and initiating operator alerts for engagement failures or rejections.
- Processes kill assessment announce ments from FBs or adjacent battalions and from higher echelon.

The target is removed from the battalion TBEQ when an engagement has been commanded by the TDA or upon receipt of an engagement announcement message from an FB or adjacent battalion. If an engagement has been commanded and an FB does not respond within a specified period of time, the battalion operator is notified by the aannn FPn — NO ENGAGE alert and the target is reconsidered for engagement. If appropriate, a probable kill symbol will be placed on the target, as determined by FB messages.