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FM 44-1

DEPARTMENT OF THE ARMY FIELD MANUAL

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U. S. ARMY  
AIR DEFENSE EMPLOYMENT

RECOMMENDED  
FOR REFERENCE USE ONLY

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HEADQUARTERS, DEPARTMENT OF THE ARMY  
OCTOBER 1965

## **FOREWORD**

The information in this manual regarding Army air defense operations in CONUS and the theater of operations is of a transitional nature.

Although control of many Army air defense engagement operations is currently centralized at high echelons of command, provisions exist for rapid decentralization as may be required in combat; thus, the Army concept of air defense tactical operations is based on the principle of decentralized execution. This manual should not be construed to restrict this concept; Army air defense commanders at all levels must prepare their units to adjust to rapid transition from one control mode to the other, and to operate autonomously if centralized control facilities fail or are destroyed during battle.

As secure, reliable means of identification are developed, the requirement for centralized control of Army air defense engagement operations will be minimized and control may be decentralized as necessary for fully effective air defense operations while providing adequate freedom of action for friendly aviation operating in defended airspace.

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FIELD MANUAL  
No. 44-1

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 11 October 1965

## U.S. ARMY AIR DEFENSE EMPLOYMENT

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## PART ONE

### GENERAL

#### CHAPTER 1

##### INTRODUCTION

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###### **1. Purpose and Scope**

a. This manual is a guide for commanders and staff officers concerned with the organization, training, deployment, and employment of Army Air Defense (AD) units and the integration of the Army air defense capability with that of other U.S. forces.

b. Part one provides general information concerning Army AD doctrine, materiel, organization, and employment principles. Part two presents doctrine for the organization and operations of U.S. Army AD forces in the United States. Part three presents similar information for U.S. Army AD forces in a theater of operations.

c. This manual pertains primarily to the employment of U.S. Army AD *missile* systems; appendix II presents detailed guidance for establishment of missile defenses. However, appendix III presents an abbreviated coverage of U.S. Army AD automatic weapon system employment.

d. Appendix IV presents considerations for local security of AD units. Appendix V includes sample formats for selected AD SOP, reports, and plans.

e. The information presented is applicable to both nuclear and nonnuclear warfare.

f. FM 44-1A supplements this manual by presenting certain classified information on U.S. Army AD materiel and employment.

###### **2. Recommended Changes or Comments**

Users are encouraged to submit recommended changes or comments to improve this manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to Commanding Officer, U.S. Army Combat Developments Command Air Defense Agency, Fort Bliss, Tex. 79916.

###### **3. References, Conversion Tables, and Glossary**

References listed in appendix I should be consulted for details beyond the scope of this manual. Appendix VI provides conversion tables for convenience in converting between the English and metric measuring systems. The glossary defines certain nonstandard terms used in this manual.

## CHAPTER 2

### MISSION, RESPONSIBILITIES, AND DOCTRINE

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#### 4. Air Defense Mission

a. The mission of air defense elements is to destroy hostile airborne aircraft and missiles, or to nullify or reduce their effectiveness. This mission is accomplished by the active air defense means and by those passive air defense measures employed by all U.S. forces.

b. Army air defense units equipped with weapons capable of engaging surface targets may be assigned a ground support mission.

#### 5. Air Defense Objective

The air defense forces in being contribute to a military posture which deters attack. Should deterrence fail, air defense forces deployed in defense of the United States must insure, as their primary objective, the survival of the U.S. as a nation by limiting the damage inflicted on the basic elements of our national strength. When deployed in defense of oversea land areas, air defense forces must have the objective of limiting the effectiveness of enemy offensive air efforts to a level permitting freedom of action to friendly forces of all types.

#### 6. Air Defense Concepts

a. *Overall Air Defense System.* The air defense system is composed of a mix of manned interceptors and ground-based air defense weapons to permit the advantages of one type weapon to offset the limitations of the other and to insure a defense in depth. Manned interceptors normally operate to the front, flanks, and rear of Army area defenses, effecting maximum attrition and breaking up concentrated attacks before they reach vital defense areas. They provide tactical flexibility to permit the rapid concentration of air defense capability at crucial locations and

the quick restoration of capability to degraded areas. Ground-based air defense weapons add depth to the defense by providing terminal defense of priority target areas.

b. *Army Air Defense.* Active Army air defense is obtained by the deployment in depth of a family of complementary weapon systems. This deployment must be quantitatively and qualitatively balanced against the probable enemy threat. Friend-or-foe identification procedures should permit flexible and effective employment of both the air defense means and friendly aviation.

c. *Army Air Defense Fire Unit.* The air defense fire unit is the key element for effective air defense in combat. Therefore, air defense fire units must have the capability to autonomously accomplish all engagement functions —

- (1) *Detection* of potential targets.
- (2) *Identification* of unknown objects.
- (3) *Interception* of enemy forces.
- (4) *Destruction* of the hostile threat.

#### 7. Air Defense Forces

a. Forces used in the active air defense effort are those employing surface-to-air weapon systems, air-to-air weapon systems, electronic warfare systems, fire distribution systems, identification systems, and information and warning systems.

b. Passive air defense is provided by those measures other than active defense, taken to minimize the effects of hostile air action. These measures include the use of cover, concealment, camouflage, dispersion, and protective construction.

c. This manual concerns itself with U.S. Army elements of the active air defense forces.

## 8. Army Air Defense Responsibilities

As stated in UNAAF JCS Pub 2, specific U.S. Army responsibilities with respect to air defense operations are —

- a. Organizing, training, and equipping Army air defense units.
- b. Providing Army forces as required for air defense from land areas, including air defense of the United States, in accordance with doctrines established by the Joint Chiefs of Staff.
- c. Participating with the other services in the development of joint air defense doctrine, and in joint air defense training and exercises as mutually agreed by the services concerned, or as directed by competent authority.

## 9. Army Air Defense Doctrine

a. *Air Superiority.* Air superiority is a desirable prerequisite for successful large scale land operations. However, considering worldwide U.S. deployments and giving the enemy the capability of striking the first blow, there is a great probability that Army forces will be forced to fight without air superiority. Further, in the situation where friendly forces have air superiority but an enemy air threat exists, the enemy must be credited with the capability of establishing control of the airspace over a specific portion of the battlefield for a limited period of time. Air superiority is an accepted prerequisite for large scale air assault, airborne, or amphibious operations. Air superiority is gained and maintained by the combined efforts of active air defense and offensive firepower.

### b. Command and Control.

- (1) The U.S. Army position for command and control of air defense forces is based on the approved doctrine for joint operations specified in paragraph 30205, Unified Action Armed Forces JCS Pub 2, which is quoted below.

"The mission to be accomplished and the objectives to be attained in accomplishment of the mission are the two most fundamental of all considerations in the establishment of command organization. Sound command organization should provide for —

- (a) Centralized direction.
- (b) Decentralized execution.
- (c) Common doctrine.

Centralized direction is essential for coordinating the efforts of the forces commanded.

Decentralized execution is essential because no one commander can control the detailed actions of a large number of units or individuals. Common doctrine is essential for mutual understanding and confidence between a commander and his subordinates and among the subordinates themselves, so that timely and effective action will be taken by all concerned in the absence of specific instructions."

- (2) This concept, as it pertains to air defense, requires that the authority to act be delegated to the lowest practicable level. The ability to exercise supervision should be incorporated at all command echelons. The commander should implement his air defense responsibilities through the basic functions of planning, assignment of objectives, allocation of forces, provision of early warning, initial weapon release, establishment and change of standing operating procedures, and prescription of rules for engagement and for airspace utilization.

c. *Organization.* Air defense organizations at all levels must be capable of being tailored to the mission of the supported force in any locale under any type of warfare.

### d. Maintenance.

- (1) Organizational maintenance of AD weapon systems must be performed properly in the shortest time possible consistent with unit responsibility. Repairs must be made at the fire unit to the fullest extent allowed by authorized personnel, tools, test equipment, and repair parts.
- (2) The level of organic maintenance in AD missile units must be higher than is ordinarily required in other units. The maintenance concept pertinent to Army AD missile unit operations is —
  - (a) Those repair parts, tools, test equipment, and personnel required on a continuing basis to maintain AD missile units in the required readiness posture will be organic to the AD missile organization.
  - (b) Direct support units will provide on an area basis the repair parts, tools, test equipment, and person-

nel which are not habitually and continually required in an AD missile organization on a day to day basis.

*e. Combat Data.* Army AD units must record sufficient engagement data to provide a basis for subsequent determination of the effectiveness of Army AD combat operations.

## **10. Critical Definitions**

Certain terms, although defined in JCS Pub 1, warrant repetition in this manual —

*a. Command.* The authority vested in an individual of the forces for the direction, coordination and control of military forces.

*b. Operational Command.* Those functions of command involving the composition of subordinate forces, the assignment of tasks, the designation of objectives and the authoritative direction necessary to accomplish the mission. Operational command should be exercised by the use of the assigned normal organizational

units through their responsible commanders or through the commanders of subordinate forces established by the commander exercising operational command. It does not include such matters as administration, discipline, internal organization, and unit training, except when a subordinate commander requests assistance. (The term is synonymous with operational control and is uniquely applied to the operational control exercised by commanders of unified and specified commands over assigned forces in accordance with the National Security Act of 1947, as amended and revised (10 U.S.C. 124)).

*c. Operational Control.* See Operational Command.

*Note.* Although the terms "operational command" and "operational control" are synonymous, they are not used interchangeably in this manual. *Operational command* is used to describe the control exercised by a specified or unified commander over assigned forces; *operational control* is used to describe the control exercised by a combined commander over assigned forces.

## CHAPTER 3

### ARMY AIR DEFENSE MATERIEL

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#### 11. General

Army air defense materiel presently includes surface-to-air missile systems, fire distribution systems, and automatic weapon systems.

#### 12. Nike Hercules Weapon System

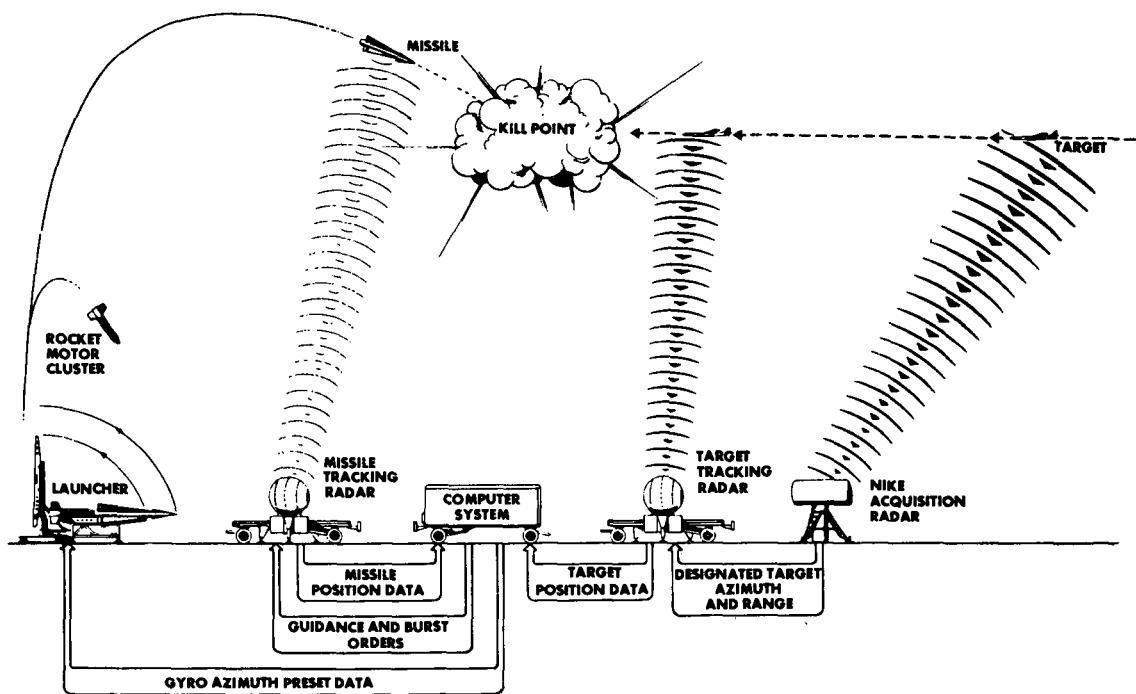
a. *Nike Hercules System.* To understand how Nike Hercules works, only certain major items of equipment need be considered — a computer, three radars, and the missile (fig. 1). The acquisition radar detects a target that is then designated to the target tracking radar. The target tracking radar acquires the target from the acquisition radar; tracks it; and measures slant range, azimuth, and elevation angle to the target. Once this latter condition (target tracked) is achieved, the target tracking radar continuously sends this target information to the computer. The missile tracking radar automatically acquires the transmitted beacon signal from a designated missile and sends missile present position data to the computer. Thus, the electronic computer knows the location of the target and missile at any instant of time. The computer uses the data from the target and missile tracking radars to compute a predicted kill point. The computer will permit the system to be fired *only* after the kill point is within maximum effective range of the system. Before fire, the azimuth of the predicted kill point is sent as gyro azimuth preset data to the selected missile in the launcher. After fire, guidance commands are determined by the computer and transmitted through the missile tracking radar to guide the missile to the kill point. When the missile reaches the proper point in space, a burst command is initiated by the computer and sent through the missile tracking radar to detonate the missile warhead.

b. *Nike Hercules Capabilities.* The Nike Hercules system has demonstrated effectiveness against targets traveling at speeds in excess of 1,800 knots (3,400 kmph), at ranges exceeding 75 nautical miles (139 kilometers), and at altitudes greater than 100,000 feet (30,500 meters). The two-stage, supersonic Nike Hercules missile may be armed with either a nuclear or high explosive warhead. The missile-rocket motor cluster combination weighs in excess of 10,000 pounds.

- (1) *Nike Hercules reaction times.* See paragraph 4k, FM 44-1A.
- (2) *Nike Hercules surface-to-surface mission.* See FM 44-95.

c. *Improved Nike Hercules System.* Most Nike Hercules systems have been modified to improve system capability against smaller, faster, higher-flying targets in a sophisticated electronic countermeasures (ECM) environment. This modified system is designated the Improved Nike Hercules system. Improvements have been made in the basic target tracking radar, the presentation system of the acquisition and target tracking radars, and tactical controls. A target ranging radar has also been added. The target ranging radar functions as a supplemental radar to the target tracking radar and provides target range information when required in an ECM environment. The target ranging radar incorporates many circuits designed to counter the ECM threat anticipated over the next several years.

d. *Improved Nike Hercules System with HIPAR or Alternate Battery Acquisition Radar.* An additional radar, the high power acquisition radar (HIPAR) or the alternate battery acquisition radar, may be issued for use with the Improved Nike Hercules system to increase

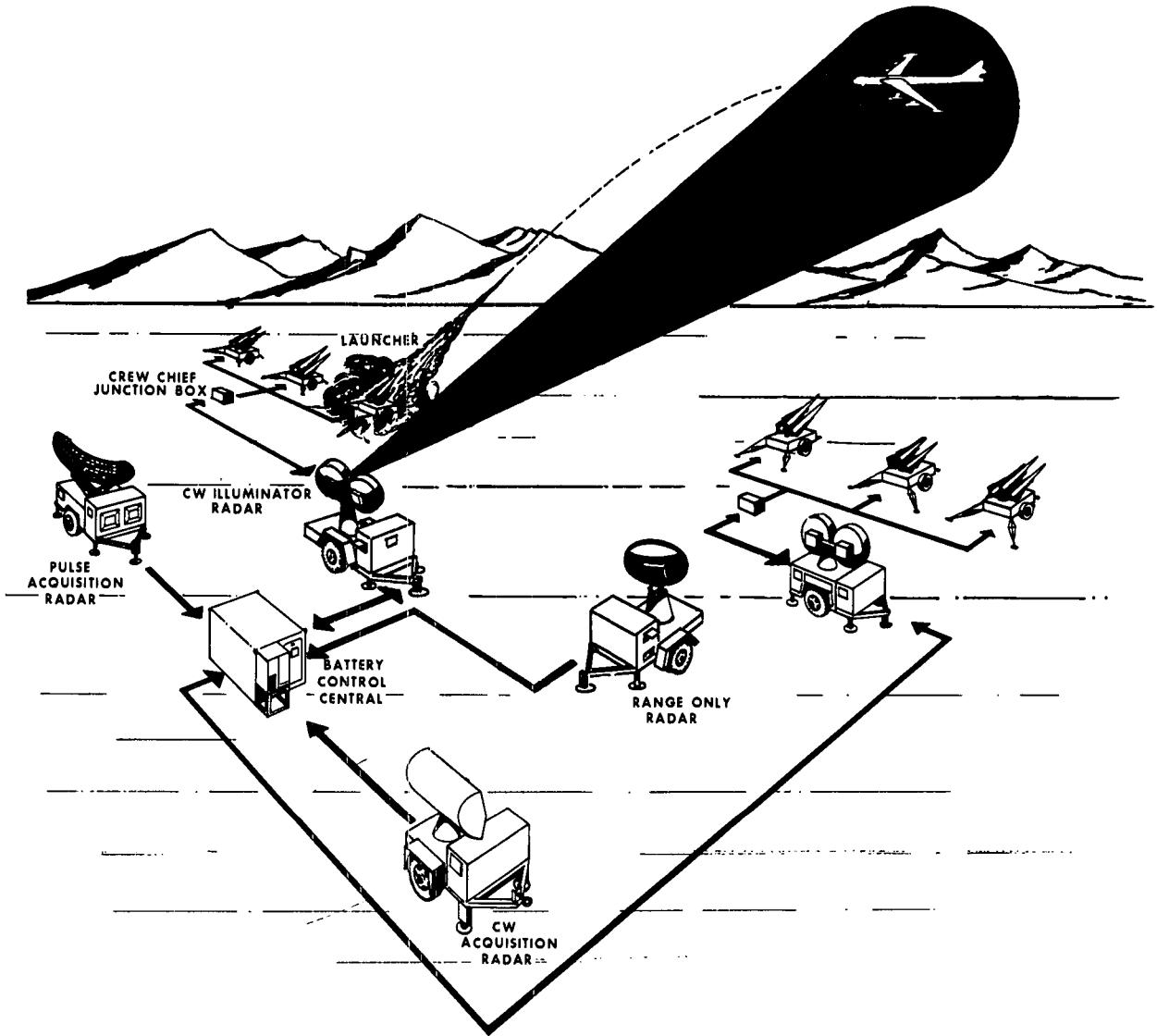


*Figure 1. How Nike Hercules works.*

target detection range. Either of these radars is capable of detecting small targets in an intense ECM environment. Due to their beam patterns, the radars provide continuous altitude coverage from the radar horizon to an altitude greater than can be attained by air-breathing aircraft of the present and foreseeable future. The acquisition radar of the Improved Nike Hercules system, which operates in a different frequency band from HIPAR or the alternate battery acquisition radar, is retained to provide greater flexibility in an ECM environment.

### 13. Hawk Weapon System

a. The Hawk system is designed to cope with low and medium altitude targets. An aircraft may attack at a low altitude to escape radar detection and penetrate a defense by taking advantage of the degradation to pulse-type radars caused by ground clutter. Hawk's continuous-wave radars and semiactive homing guidance are not seriously degraded by ground clutter. The Hawk is a mobile and flexible system having a high rate of fire. System effective



*Figure 2. How Hawk works.*

range and altitude are in excess of 14 nautical miles (26 kilometers) and 38,000 feet (11,600 meters), respectively. The missile is 16.5 feet (5 meters) long and weighs 1,295 pounds. It has a solid propellant missile motor and is armed with a high explosive warhead. All the equipment is either vehicular or trailer-mounted, giving excellent ground mobility. Most Hawk missile battery TOE equipment is air transportable by fixed-wing transport aircraft (C-119, C-123, C-124, C-130, C-133, and C-141) or transport helicopters (sling loads for CH-37 and CH-47).

b. The equipment in a Hawk battery includes a battery control central, a pulse acquisition radar for medium altitude coverage, a continuous-wave acquisition radar for low altitude coverage, two continuous-wave illuminator radars or high power illuminator radars for tracking targets, a range-only radar to provide range information in an ECM environment, six launchers, two crew chief junction boxes, and seven trailer-mounted generators (fig. 2).

c. A target is detected initially with one or both of the acquisition radars. Following target acquisition, an illuminator radar tracks the tar-

get and provides a reference signal to the missile. After launching, the missile homes-in on the target by continuous comparison of the transmitted energy of the illuminator radar with the reflected energy from the target. Using this information to make continuous adjustments in its course, the Hawk missile flies the most direct route to the kill point.

d. The system is highly flexible, both in its means of attack and its method of employment. The Hawk battery, having two independent firing sections, can fire at two different targets simultaneously. Although primarily designed to meet the low-altitude threat, it also provides excellent defense against higher altitude targets. When the situation dictates, a portion of the battery, called the *assault fire unit*, can be deployed rapidly to meet a specific threat. The basic assault fire unit consists of an assault fire command console (not shown in fig. 2), a continuous-wave illuminator radar or a high power illuminator radar, a loader-transporter, two generators, a launcher, a pallet with missiles, a crew chief junction box, and necessary cabling. The assault fire command console is the control center for the Hawk assault fire unit. The basic assault fire unit can be augmented with the continuous-wave acquisition radar, two additional launchers, and pallets with missiles to form the *augmented assault fire unit*.

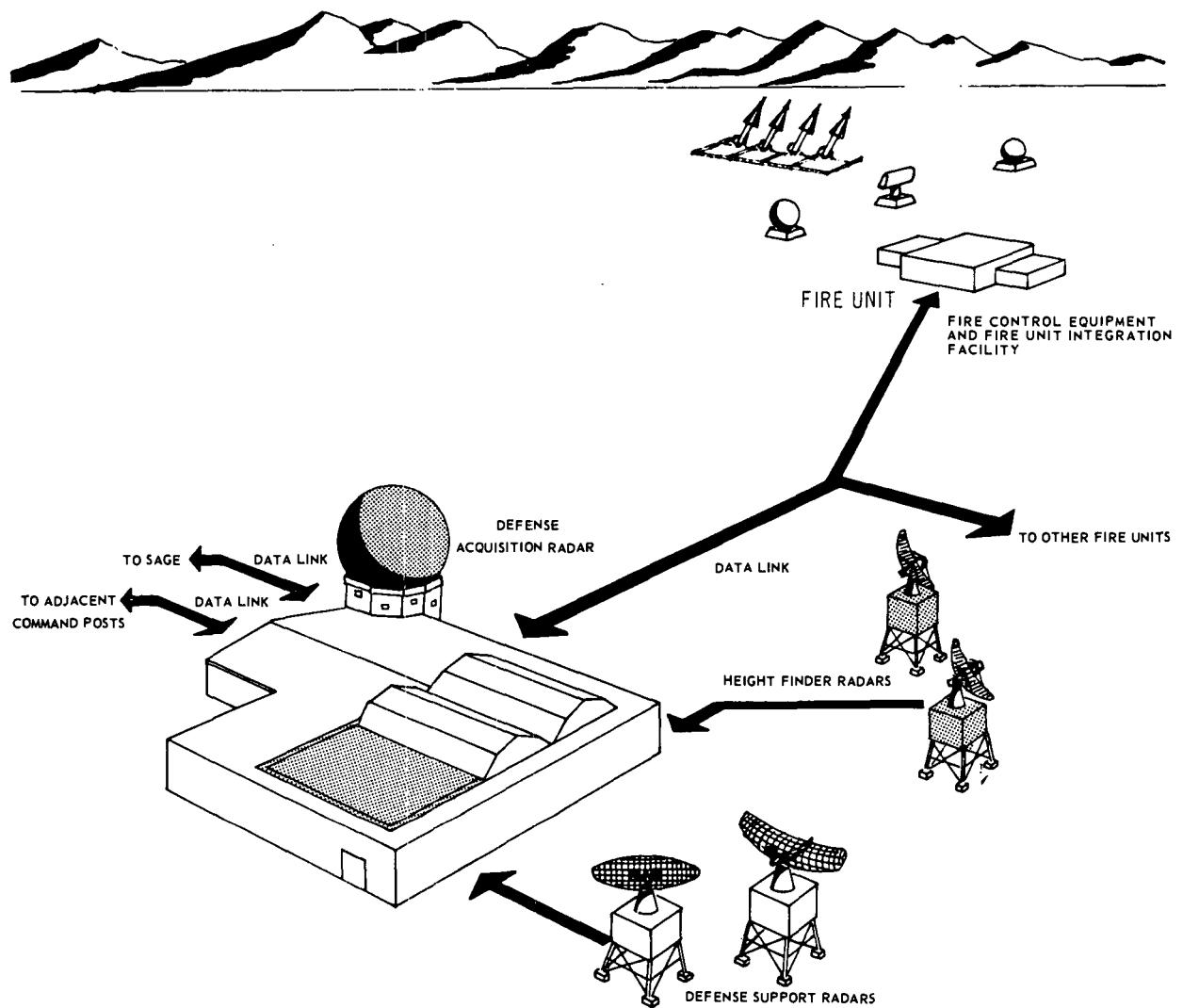
## 14. Fire Distribution Systems

a. Fire distribution systems can be used to exploit the capabilities of AD weapon systems by assisting in the distribution of their fires. They can also be used by the AD commander to exercise centralized control over associated fire units and to provide warning, identification, and other information to the fire units to assist them in performance of their mission. The Army now has three fire distribution systems: the Missile Master (AN/FSG-1), and the BIRDIE (AN/GSG-5(V) or AN/GSG-6) for use in CONUS Nike Hercules defenses, and the Missile Monitor (AN/MSG-4), which is normally employed by the AD groups with a field army and may be used whenever a mobile fire distribution system is required or wherever Hawk is deployed. The AN/FSG-1 Missile Master system will soon be replaced by an improved fire distribution system, the AN/

TSQ-51. These fire distribution systems collect information on airborne objects provided by radar or other sources, present the information on electronic displays at the Army air defense command post (AADCP), and distribute this data and weapon control information to the fire units. At the same time, information on the activities of all fire units of the defense is exchanged between units. Thus, each fire unit commander receives all available reference data to enable him to effectively select, attack, and destroy hostile targets.

b. The Missile Master fire distribution system (fig. 3) serves the AADCP established at defense level (brigade or group), and enables the Army AD commander to supervise defense operations. The Missile Master includes operating consoles, status displays, defense acquisition and height-finding radars, communications, and automatic data link equipment. Battery terminal equipment (designated as the fire unit integration facility in the Missile Master system) at each fire unit integrates the fire unit with the AADCP. The Missile Master may receive automatic data link input from SAGE (para. 44), and can accommodate up to 24 Nike Hercules AD missile batteries. In the near future, fire distribution systems AN/TSQ-51 will replace the remaining Missile Master systems deployed in CONUS. The AN/TSQ-51 system provides technically improved fire distribution facilities at a reduced cost and with lessened personnel requirements when compared with Missile Master. The system is designed on the modular concept, allowing the addition or deletion of major functions so requirements of various defense complexes can be met economically.

c. The BIRDIE AN/GSG-5(V) fire distribution system (fig. 4) serves the AADCP established at defense level (brigade, group, or battalion), and enables the Army AD commander to supervise defense operations. The BIRDIE situation display consoles may be shelter-mounted or emplaced in a permanent structure. There are four different configurations of the BIRDIE AN/GSG-5(V) system. The particular configuration used is determined by the requirements of the defense area and is identified by the number of consoles employed. Each console is capable of coordinating up to four



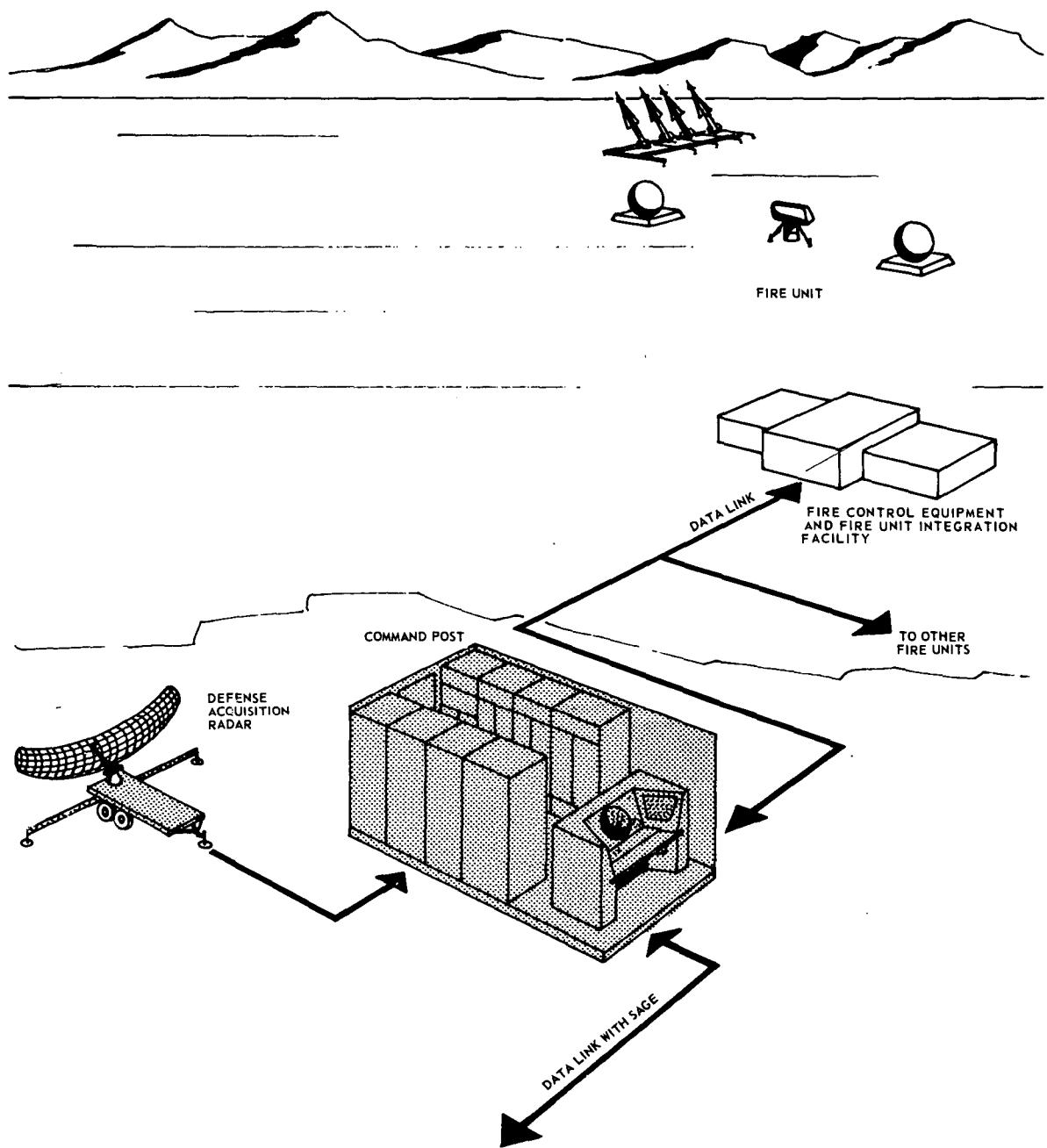
*Figure 3. Missile Master fire distribution system.*

missile fire units. A maximum of four consoles may be used. A defense acquisition radar supplies radar information to the system. Battery terminal equipment (designated as the fire unit integration facility in the BIRDIE system) at each fire unit integrates the fire units with the AADCP. The system is capable of receiving semiautomatic ground environment (SAGE) automatic data link input.

d. The BIRDIE FDS AN/GSG-6 is similar in function to the AN/GSG-5(V) (fig. 4). It consists of one console, and automatic data link and communications equipment to accommodate two AD missile batteries.

e. The Missile Monitor fire distribution system (fig. 5) uses standard military vehicles to make the system completely mobile for use by Army AD units overseas. It is composed of a group-level operations central AN/MSQ-28B or AN/MSQ-56 (operations central modified to be compatible with the U.S. Air Force 412L air weapon control system), and up to eight battalion-level AN/MSQ-18 or AN/TSQ-38 (air transportable version) fire distribution systems.

- (1) The operations central AN/MSQ-28B or AN/MSQ-56 normally will be located at the AADCP of the AD group. The group-level operations central is

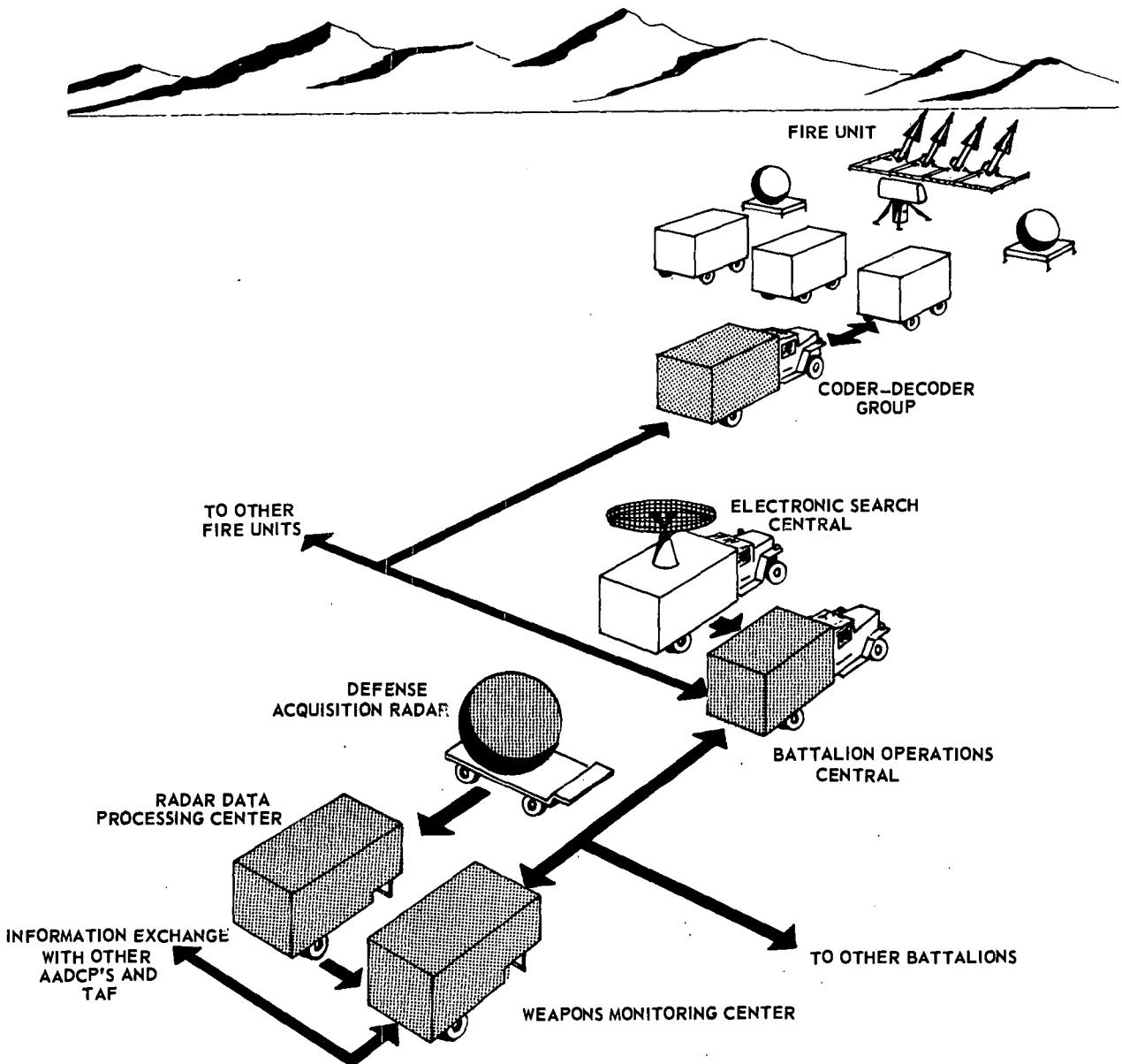


*Figure 4. BIRDIE fire distribution system.*

composed of the radar data processing center, a defense acquisition radar, and the weapons monitoring center. The weapons monitoring center is the tactical center of the Missile Monitor system.

- (2) The AN/MSQ-18 or AN/TSQ-38 may operate independently or as a part of

Missile Monitor. The AN/MSQ-18 or AN/TSQ-38 system consists of a battalion-level operations central, and a battery terminal equipment (designated as the coder-decoder group in the Missile Monitor system) for each associated missile battery. The coder-decoder group is similar in function to



*Figure 5. Missile Monitor fire distribution system.*

the fire unit integration facility used in CONUS fire distribution systems. The battalion radar section's electronic search central AN/GSS-1 or AN/GSS-7 provides local radar data at battalion level.

- (3) Missile Monitor systems are not compatible with the Air Force's SAGE system (para. 44). This has significance only in the case of ARSTRIKE

AD units when they are based in CONUS.

f. Radar tracking stations, used in conjunction with a radar netting unit, may provide additional radar data for use by Army AD missile units. The radar tracking station (fig. 6) obtains data from a surveillance radar with which it is collocated, and semiautomatically tracks and automatically disseminates digital aircraft track data to the field army fire distribution

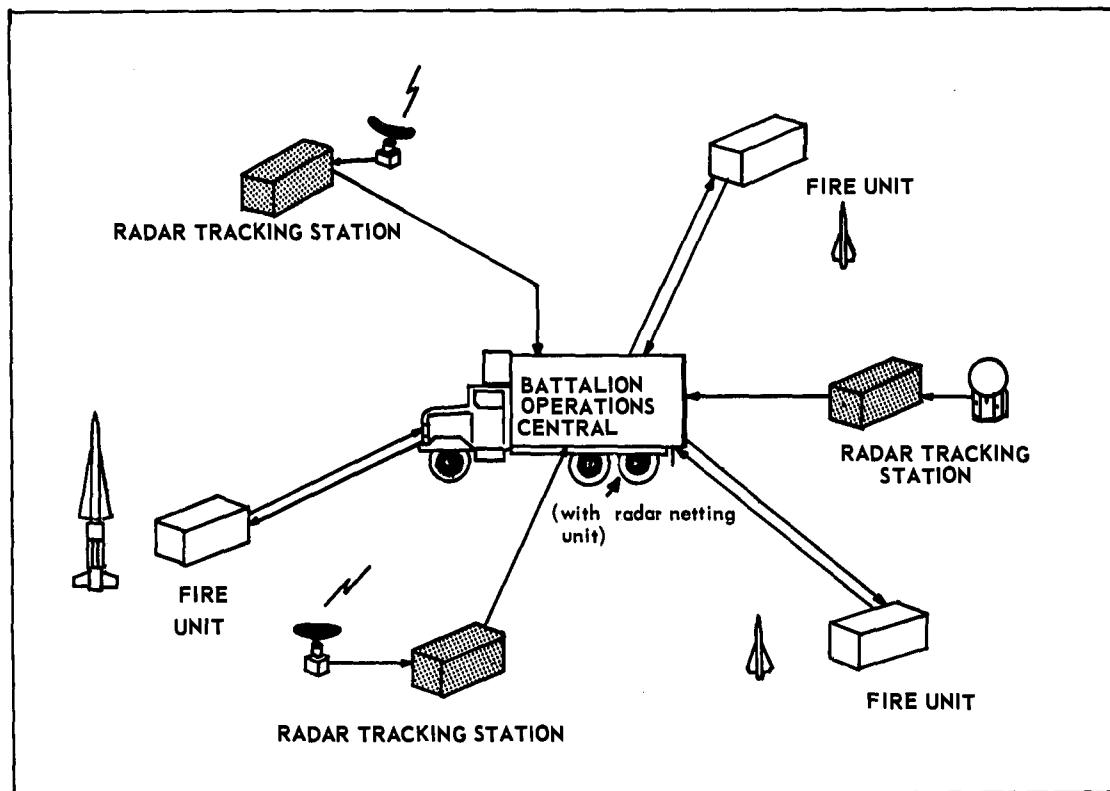


Figure 6. Radar tracking stations and radar netting unit.

systems. The radar tracking station equipment is compatible with most U.S. Army acquisition radars and certain U.S. Air Force radars although, in some cases, it is necessary to provide connectors and line terminals peculiar to the radar concerned. Radar tracking stations associated with military and civilian surveillance and gap filler radars can provide additional early warning information to air defense units, and serve to remove blind spots in a defense's radar coverage.

*g.* The radar netting unit (fig. 6), when added to the battalion operations central AN/MSQ-18 or AN/TSQ-38, enables the operations central to receive track data from one to four radar tracking stations, and allows synchronized insertion of this data in the battery data link channels so that information from the radar tracking stations is available to both the battalion operations central and the fire unit operators. In addition, the radar netting unit transfers the track data from each radar tracking station to the others in the net, and permits

each radar tracking station to receive fire unit track and engagement data. When the radar netting unit has been added, the battalion operations central may receive track data from the radar tracking station or from the group operations central, but not from both simultaneously.

## 15. Automatic Weapon Systems

*a. M42, Self-Propelled, Twin 40-mm Forward Area Weapon (Duster).* The Duster, in addition to providing forward (division) area air defense, can also provide ground support. A number of Army National Guard Duster units are currently operational.

*b. Caliber .50 Machinegun.* Ground and vehicular-mounted caliber .50 M2 heavy barrel machineguns may be authorized by TOE or Tables of Allowances for use in forward area air defense roles.

*c. Appendixes.* Appendix I lists references for the caliber .50 and 40-mm AD automatic weap-

ons, and appendix III contains information concerning their employment.

## **16. Future Weapon Systems**

*a. General.* Future air defense weapon systems include Nike-X, SAM-D (Surface-to-Air Missile Development, formerly AADS-70), Chaparral, Mauler, and Redeye.

*b. Nike-X* is being developed to provide an effective CONUS-based defense against ballistic missiles. A number of components and techniques developed in the Nike Zeus program, to include the Nike Zeus missile itself, will be carried over into the Nike-X system. New components will include a multifunction array radar, a missile site radar, and a high-acceleration missile called Sprint, to provide improvements in target-handling capability, quick reaction, and decoy discrimination. The Nike-X mission is far more complex than that of intercepting a single ballistic missile. Rather, the Nike-X task is to cope with ballistic missile saturation attacks,

and ballistic missile penetration aids such as sophisticated decoys, ballistic missile tank fragmentation, electronic countermeasures, nose cones with extremely small radar cross sections, multiple warheads, and nuclear blackout of defensive radars.

*c. SAM-D* is to be an AD system capable of defending the field army against the tactical ballistic missile threat. This weapon could also be employed in CONUS. It will replace or supplement current missile systems.

*d. The Chaparral and Mauler* forward area weapon systems are being developed to provide air defense for the divisions. Chaparral and Mauler will be light, self-propelled air defense missile systems that are air-transportable.

*e. The Redeye* weapon system is a portable, shoulder-fired, AD missile system. It will provide forward combat elements with a means of self-protection against low flying aircraft. See paragraph 7, FM 44-1A for Redeye weapon characteristics.

## CHAPTER 4

### ARMY AIR DEFENSE ORGANIZATION

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#### **17. General**

a. The organization of AD brigade and group headquarters and AD battalions and batteries is contained in the 44-series Tables of Organization and Equipment listed in DA Pam 310-3. The composition, in terms of units, of AD echelons above battery is flexible and is determined by the requirements of a specific situation.

b. The organization and functions of the AD staff are flexible and may be varied by the commander within the composition provided by TOE. The duties of AD staff officers conform to the principles and procedures outlined in FM 101-5. Staff personnel specializing in the technical aspects of air defense radar and missile equipment are provided at each AD echelon.

c. Organization of AD missile units provides only a limited ground defense capability. The AD unit can provide internal security only. Normally, it is deployed in close proximity to, and depends on, other forces for protection against ground attack. It may, when reinforced by additional personnel, defend itself against extensive ground attack.

d. The TOE of AD units are austere with regard to personnel and equipment authorized for the maintenance and supply support normally required. Thus, it may not be adequate for combat operations in all types of climates and tactical situations. As a result, special arrangements for the logistical support of these units must be made in order to provide required personnel, equipment, communication, and stockage of repair parts for the mission and geographical area in which the unit is employed. These capabilities should be incorporated into the fire unit to the degree specified in the maintenance concept (para 9d(2)) in order to be readily and continually available.

#### **18. Air Defense Battalion**

a. The battalion is normally the basic administrative unit in air defense. It consists of a headquarters and headquarters battery and two to four firing batteries.

b. Some AD battalions are organized under special TOE's designed to meet particular requirements more economically.

- (1) The headquarters and headquarters battery may be reduced to a small command group for supervision of training. Most of the administrative functions of the battalion are then assumed by an augmented group or battalion group headquarters.
- (2) More than one type of firing battery may be assigned to an AD battalion. The battalion headquarters and headquarters battery is augmented if additional personnel are required to provide adequate supervision and assistance to the firing batteries.

#### **19. Air Defense Battalion Group**

When an AD group headquarters is not available or is not considered necessary, one or more AD battalions may be attached to another battalion to form a battalion group. Battalion groups are formed to achieve unity of effort and direction by providing one overall control headquarters for an integrated air defense of a designated area separate from other AD forces. The battalion group headquarters has the same functions as an AD group headquarters (para 20), but will require augmentation to have the same capabilities as an AD group headquarters. The senior battalion commander is designated the battalion group commander.

## **20. Air Defense Group**

The AD group consists of a group headquarters and headquarters battery and units as may be attached. The group commander will exercise command over two or more AD battalions. To enable it to relieve attached battalions of administrative functions, the group headquarters may be augmented with a part of the attached battalions' administrative personnel and equipment.

## **21. Air Defense Brigade**

The AD brigade consists of a brigade headquarters and headquarters battery and AD groups, battalions, and other units as may be assigned or attached. A brigade headquarters will normally be required when the number of Army air defense units in a single defense or units responsive to a single commander is be-

yond the capabilities of a single AD group. A brigade will usually include two or more groups. The brigade commander will exercise command over all units assigned or attached to the brigade.

## **22. Air Defense Commands**

The brigade headquarters and headquarters battery is the highest AD command and control headquarters provided by TOE. When a higher AD echelon is required, the headquarters element is provided by a table of distribution organization designed to meet the particular requirements and air defense units are assigned or attached as required. Examples of these special organizations include the U.S. Army Air Defense Command, Theater Army Air Defense Commands, and the various Regional Air Defense Commands.

## CHAPTER 5

### AIR DEFENSE EMPLOYMENT CONSIDERATIONS

#### 23. General

Adequacy in active air defense is obtained by the deployment in depth of a family of complementary weapon systems. This deployment must be quantitatively and qualitatively balanced against the probable enemy threat.

#### 24. Defended Areas

a. Areas to be protected are specified by the Commander-in-Chief, North American Air Defense Command in CONUS, and by the unified or Army commander in the theater of operations. The commander specifying the area to be protected may also specify the desired degree of protection for each area in terms of engagement effectiveness (EE). Defenses fall into two categories: vital area (VA) defense and area defense.

- (1) In a vital area defense, the AD mission is to provide a specified degree of defense for a designated target area such as a city, military installation, or industrial complex. At present, all Army air defenses in the United States are of the vital area type.
- (2) In an area defense, the AD mission is to provide a specified degree of defense for an entire area such as a field army area in a theater of operations. An area defense may include certain critical installations defended as vital areas.

b. Where the concentration of targets of appropriate value does not warrant defending large land areas against air and missile attack, the requirements for air defense are met by defending only the critical targets or vital areas; e.g., military installations, metropolitan

areas, industrial complexes, harbor facilities, and logistic depots. Air defense means will often be insufficient to defend all high value targets, therefore, the force commander will state the critical areas and priorities for their defense. Four factors will be considered in determining defense priorities:

- (1) *Criticality.* Comparative importance to the accomplishment of the force commander's mission.
- (2) *Vulnerability.* Resistance against damage by air attack; i.e., the "hardness" or "softness" of a defended area or target.
- (3) *Recuperability.* The time, material, and effort required to return a critical area to normal capacity or operation following destruction or damage.
- (4) *Enemy capabilities.* Enemy resources and his tactical and technical ability to execute a destructive attack.

#### 25. Defense Design

a. The defense is designed to maximize available air defense capabilities against the expected threat, with the objective of denying the enemy the use of low-cost attack options. The weapons, speed, altitude, and delivery or attack technique composing the threat must be determined or estimated. The defense is then designed so as to provide a balanced effectiveness against those combinations of weapon and technique that are known to be available to the enemy in meaningful quantity and are evaluated as likely to be employed by him.

b. Defense design must consider the deployment guidelines for each AD weapon system as outlined in paragraphs 26 through 29.

## **26. Nike Hercules Deployment Guidelines**

*a. Vital Area Defense.* The primary guideline for deployment of Nike Hercules units in a vital area (VA) defense is that the defense must be balanced; i.e., the defense must be able to deliver approximately equal firepower in all directions. Balance is obtained by placing the fire units at approximately equal distances from each other near the estimated bomb release line (para 4b, app II) or around the perimeter of the vital area if the threat employs air-to-surface missiles or the lay-down bombing technique. Mutual support between systems is desired; it is assured by separating fire units by no more than 0.8<sup>1</sup> effective missile range.

*b. Area Defense.* The primary guideline for deployment of Nike Hercules units in an area defense is that weighted area coverage must be achieved. Weighted coverage is obtained by distributing the fire units throughout the entire defended area to provide the heaviest density of firepower toward exposed boundaries and around priority areas, but without sacrificing overlapping coverage within the area. Mutual support should be maintained by separating fire units by no more than 0.8<sup>1</sup> effective missile range. However, if fewer fire units are allocated to the defense, separations up to 1.6<sup>1</sup> times the effective missile range may be tolerated and still provide full coverage, provided all fire units remain operational. Nike Hercules units normally are employed no closer to the forward edge of the battle area (FEBA) than 30 kilometers in order to remain out of range of conventional enemy artillery.

## **27. Hawk Deployment Guidelines**

Regardless of defense type, Hawk units should be deployed to accomplish early destruction of low-flying targets. Some units should be positioned behind those deployed forward to add depth to the defense and provide flexibility and continuity of fire. Mutual support between Hawk units should be maintained by separating fire units by no more than 0.8 effective missile range.<sup>2</sup> Normally, Hawk units are not employed closer to the FEBA than 10 kilometers in order

to remain out of range of most conventional artillery and ground observers.

## **28. Automatic Weapon Deployment Guidelines**

AD automatic weapon defenses are designed to impose maximum attrition rates upon attacking aircraft. Weapons are sited so that the maximum number of targets can be engaged, continuous fire can be delivered, the most likely routes of approach are covered, and both AD and surface missions can be carried out.

## **29. Redeye Deployment Guidelines**

Redeye weapons are deployed to provide local air defense for small units operating in the forward combat area. Redeye positions are selected to provide for maximum observation and unobstructed fields of fire, commensurate with associated considerations of probable routes of low altitude air attack and ground security requirements.

## **30. Composite Defense**

A composite defense is composed of two or more AD weapon types. In a composite defense, the placement of the longest range system is planned first, based on its deployment guidelines. Then, the other systems are deployed according to their guidelines, with emphasis on filling gaps in the coverage of the longer-range system. Mutual support distance is measured between like systems only.

## **31. Integrated Defenses**

An integrated defense is the defense of two or more vital areas close enough for the defense to be combined. Defense integration is generally desirable when some fire units of one vital area provide mutual support to fire units of the other area. An integrated defense will either use fewer fire units or increase the firepower of an existing defense. Fire units in an integrated defense, as in simple defenses, are deployed to achieve defense balance.

## **32. Detailed Defense Design Procedures**

*a. Sections I through VI, appendix II provide detailed procedures for planning, designing, and evaluating Nike Hercules and Hawk defenses. The evaluation procedures in appendix II pro-*

<sup>1</sup> Effective missile range varies with system and target characteristics (see para 4b, FM 44-1A).

<sup>2</sup> Effective missile range varies with system and target characteristics (see para 3b, FM 44-1A).

vide only a means of hasty evaluation. When the situation permits, missile defense design should be influenced and evaluated by computer war gaming wherein many possible threat variations are played against the possible defense design.

*b.* Section VII, appendix II presents Redeye employment considerations.

*c.* Appendix III presents details regarding automatic weapons defense design and employment.

### **33. Unit Self-Defense Considerations**

*a.* The capability of the AD units to influence the outcome of the air battle makes these units high priority targets for enemy attack. It can be expected that the enemy will focus his efforts on locating AD sites, making a determined effort to neutralize them. Close attention must be given to local security. Local security includes those measures taken by a command to defend itself from attack, espionage, observation, sabotage, harassment, or surprise.

*b.* In planning the security of an AD position area, consideration must be given to every

means the enemy can be expected to employ in his attack. These means may include counter-battery fires, guerrilla action, infiltration, special ground and airborne striking forces, and airstrikes employing saturation tactics.

*c.* Although AD units have a limited capability for repelling enemy ground attacks, tables of organization and equipment do not authorize the missile unit sufficient personnel and equipment to adequately defend itself against extensive ground attack. To adequately defend itself against extensive attacks the unit must be augmented by additional security forces. The size and composition of the augmentation force will be based on the nature of the threat and on available resources. When additional security forces are made available, they are integrated into the unit defense plan so as to minimize readjustments in the event that their attachment is terminated. When augmentation forces are not available, efforts must be made to position the AD units near other units and to integrate their local defenses with those of the adjacent units. Active and passive measures for self-protection of AD units are contained in appendix IV.

## PART TWO

### AIR DEFENSE, UNITED STATES

#### CHAPTER 6<sup>1</sup>

##### DOCTRINE AND ORGANIZATION

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##### Section I. BASIC DOCTRINE FOR AIR DEFENSE OF THE UNITED STATES

###### 34. The Role of Air Defense

The AD forces defending the United States—

- a. Lend credibility to the U.S. deterrent posture.
- b. If deterrence fails, contribute to the destruction of enemy forces which pose a threat to the United States—

- (1) Enhancing U.S. military counteraction against the enemy through warning and active protection of installations and forces required for retaliatory purposes.
- (2) Destroying enemy offensive forces.
- (3) Insuring U.S. survival as a nation by limiting the damage inflicted on the basic elements of our national strength.

###### 35. Functions of the Air Defense System

a. To discharge its role in furtherance of national objectives, the system for air defense of the United States performs the following basic functions:

- (1) *Detection* of potential threats.
- (2) *Identification* of unknown objects.
- (3) *Interception* of enemy forces.
- (4) *Destruction* of the hostile threat.

b. AD forces are equipped, trained, and employed to carry out these functions by striking the enemy as soon as possible, as far from the target area as is feasible, and subjecting him to pressures of increasing intensity and diversity as he approaches the target area, keeping him under attack so long as he constitutes a threat.

###### 36. Characteristics of the Air Defense System

a. *General.* Air defense of the United States is achieved by equipping, deploying, training, and employing available forces to provide tactical warning and defense in depth against enemy attack through aerospace. Accordingly, AD forces reflect those characteristics best suited to perform these tasks as determined by evaluation of enemy air offensive capabilities. These characteristics are—

- (1) *Readiness* to respond with minimum warning.
- (2) *Reliability* to function without system failure.
- (3) *Flexibility* to meet varied and changing situations.
- (4) *Survivability* to continue functioning during enemy attack.
- (5) *Kill-Effectiveness* to destroy or neutralize hostile objects in aerospace.

<sup>1</sup>This chapter is based on JCS Pub 9 "Doctrine for Unified Defense of the United States Against Air Attack."

- (6) *Tactical autonomy* to permit autonomous operations when the appropriate authority directs or when required by other circumstances.
- b. *Readiness.* Readiness assures timely reaction to aerospace attack. Readiness is the ability of AD forces to react to attack in a timely manner despite enemy efforts to achieve surprise. To this end, detection and warning systems perform continuing surveillance. Weapon systems maintain a readiness posture which permits optimum response to operational needs with minimum advance warning. Command/control systems process and display current situation data on a continuing basis for timely evaluation and decision.
- c. *Reliability.* Reliability precludes mission failure due to system malfunction. This characteristic reflects the capability of AD forces to perform their operational tasks without interruption by reason of component systems failure. The close interdependence of basic elements such as sensors, weapons, communications, and control facilities makes it essential that each element function properly at the required time and place. Design engineering, equipment multiplexing, operational and logistics management technique, redundancy of communications and control, and proper training of operating and maintenance personnel are measures which insure reliability in AD systems.
- d. *Flexibility.* Flexibility permits concentration of forces at the proper time and place. Flexibility is the ability of AD forces to counter a variety of threats under highly diverse environmental conditions. It permits the concentration of forces at crucial locations and rapid restoration of capability to degraded areas. It provides the potential for quickly adapting to changes in enemy capabilities, objectives, tactics, and penetration techniques. Flexibility of air defense forces is achieved by fully exploiting the qualities of speed, range, mobility, endurance, automatism, and diversification. Where feasible, maximum use is made of the inherent multipurpose capabilities of a particular weapon system. A weapons mix is employed, as necessary, to permit advantages of one type weapon to offset limitations of another and to insure defense in depth.
- e. *Survivability.* Survivability entails continued operations in face of enemy attack. Survivability reflects AD ability to operate effectively during enemy attack and retain a residual capability sufficient for continued defense. Facilities may be subjected to chemical, biological, and radiological contamination as well as physical damage. AD forces employ passive measures, in conjunction with active defense, to enhance their survivability and insure continuity of essential functions.
- f. *Kill Effectiveness.* Kill effectiveness assures optimum destruction. Kill effectiveness is a measure of the ability of the AD system to destroy or neutralize enemy air offensive forces in aerospace before they can accomplish their objectives. It is achieved by deploying AD systems of a quality and quantity best calculated to counter estimated enemy capabilities and by maintaining these systems in a high state of readiness. The effects of mass destruction weapons impose the need for essentially a 100 percent kill potential against the most likely and dangerous threats. Therefore, air defense systems must be designed, deployed, and employed to minimize limitations and optimize effectiveness.
- g. *Tactical Autonomy.* Tactical autonomy retains mission accomplishment capability. This characteristic reflects the capability of elements of the AD family of weapons to contribute to the air defense posture by independent operation. Autonomous operations occur when an AD weapon system, through loss of communications, can no longer receive operational instructions and other operational information or intelligence from a North American Air Defense/Continental Air Defense Command (NO-RAD/CONAD) commander or defense element. In such an environment, the autonomous capability may be the significant contributor to the AD mission.

## **37. Principles of Air Defense Organization**

- a. Control of AD forces is vested in undivided authority. Forces made available for air defense of the United States comprise many diverse elements performing a variety of tasks to accomplish a common mission. To permit the AD system to function as a cohesive force op-

erational control is centralized at the highest level. Centralized control is exercised at the highest operational echelon that can effectively assess the situation and direct the employment of forces. Authority for execution of AD functions is decentralized to subordinate echelons of the AD system in accordance with the policies and procedures established by the authority exercising centralized control. The exercise of command and the staff representation at all levels must be in consonance with the provisions of Unified Actions Armed Forces (JCS Pub. 2).

b. The organization should complement operational needs. The organization of AD forces is responsive to operational requirements. Changes in system capabilities and employment concepts are reflected, as necessary, in the organizational

structure to insure the most effective use of available forces.

c. The AD organization should enhance interaction with other agencies. There is considerable interaction of AD functions with those of other military organizations and governmental agencies. For example, air defensive and offensive forces operate with singleness of purpose. Also, air defense and air traffic control operations are mutually supporting. Therefore, each system is planned and developed in relation to the other. AD forces are organized in a manner to enhance close coordination of the planning and operational activities of these agencies. This close coordination is best attained by collocation of component headquarters at all comparable levels; collocation should be accomplished whenever feasible.

## Section II. ORGANIZATION

### 38. General

a. Unified Action Armed Forces, JCS Pub 2, assigns to the Army the following air defense functions: to organize, train, and equip Army AD units, including the provision of Army forces as required for the defense of the United States against air attack, in accordance with doctrines established by the Joint Chiefs of Staff. The combined command established to defend the continental United States, Canada, and Alaska against aerospace attack is the North American Air Defense Command. The unified command established to perform AD missions of a national nature is the Continental Air Defense Command. The command established to carry out the Army portion of the AD mission (less defense of Alaska) is the United States Army Air Defense Command. The Army portion of the Alaskan air defense mission is carried out by AD forces of U.S. Army, Alaska.<sup>2</sup>

b. Army AD units operating with ARSTRIKE forces, although not actually included in the CONUS AD organization described in this manual, are tied in with the CONUS AD organization when these field army-type units are based in the United States. The degree to which AR-

STRIKE AD units can tie into the CONUS AD organization is limited because of the incompatibility of the Missile Monitor fire distribution system used by these units with the SAGE system (para 44).

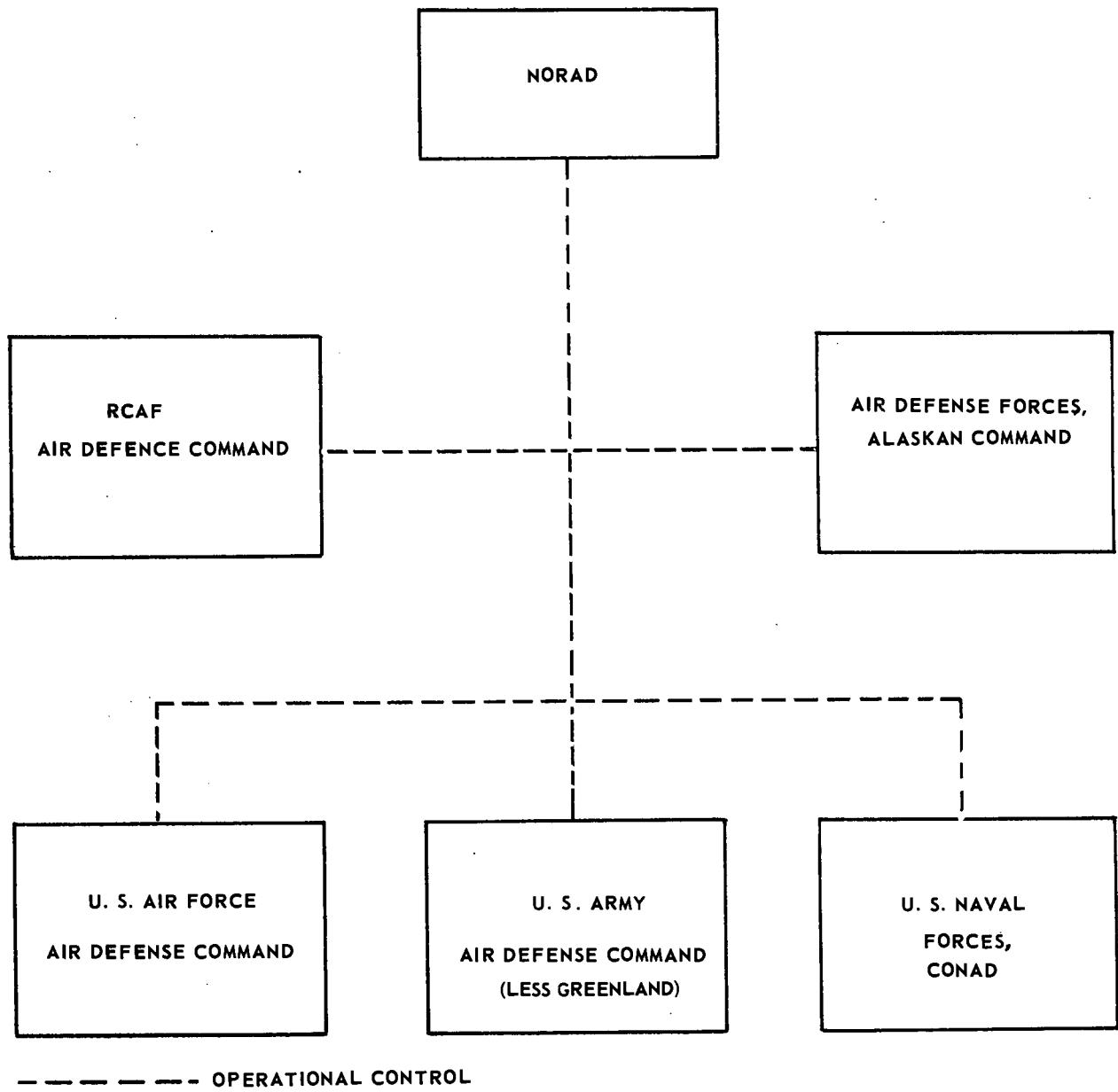
### 39. North American Air Defense Command (NORAD)

(fig. 7)

a. North American Air Defense Command is a combined command responsible to the United States Joint Chiefs of Staff and the Chief Defense Staff (Canadian) for aerospace defense of the continental United States, Canada, and Alaska. The Commander-in-Chief NORAD (CINCNORAD) exercises *operational control*<sup>3</sup> over all United States and Canadian Forces assigned, attached, or otherwise made available for aerospace defense. These component forces include— The U.S. Army Air Defense Command (ARADCOM); the U.S. Air Force Air Defense Command; U.S. Naval Forces CONAD; the Royal Canadian Air Force Air Defense Command; and air defense forces of the Alaskan Command. Each component force provides com-

<sup>2</sup> Although air defense of Hawaii is not a NORAD-CONAD-ARADCOM function, the general principles outlined in this chapter apply to all forces engaged in air defense of the United States.

<sup>3</sup> The degree of authority denoted by the term "operational control" in a combined sense will depend upon the provisions of the binational or multinational agreements establishing the basis for the combined command. This is particularly true in the field of logistics.



*Figure 7. NORAD structure.*

bat ready AD units to CINCNORAD for operational control; however, each of the component force commanders retains command (less operational control) of his respective force.

b. By agreement between Canada and the United States CINCNORAD and his deputy will not be of the same nationality. Staff positions are filled without regard to service affiliation.

c. NORAD prepares operational plans, conducts tactical exercises and readiness tests, and

coordinates plans and requirements for new air defense weapons. Most important, it plans for the direction of the air defense battle for North America in the event of war.

## **40. Continental Air Defense Command (CONAD) (fig. 8)**

a. CONAD is a unified command directly under the United States Joint Chiefs of Staff for

AD matters. CINCCONAD is the senior U.S. officer in Headquarters, NORAD. The senior U.S. officer at each echelon of the NORAD organization is the CONAD commander at that echelon. CONAD is essentially NORAD, less Canadian personnel and equipment. CONAD gives the U.S. the capability of unilateral air defense action if, for example, the U.S. should go to war and Canada were to remain neutral. CONAD also performs all AD missions of a purely national nature.

b. CINCCONAD acts as a U.S. Commander only and exercises operational command over all U.S. AD forces in NORAD without duplicating the operational control responsibilities of CINC NORAD.

c. CONAD provides air defense of Greenland under agreement with the Danish government.

d. CONAD may provide air defense of Mexico if requested.

#### **41. United States Army Air Defense Command (ARADCOM)**

a. The senior U.S. Army AD headquarters in the NORAD structure is ARADCOM which commands (less operational control exercised by NORAD) the U.S. Army AD units in CONUS and Greenland.

b. ARADCOM Hawk and Nike Hercules units defend major industrial and population centers of the United States as well as selected Strategic Air Command bases. ARADCOM sites are manned by active Army and Army National Guard personnel.

#### **42. Alaskan and Hawaiian Air Defense Forces**

a. Army AD forces in Alaska are under the command (less operational control exercised by

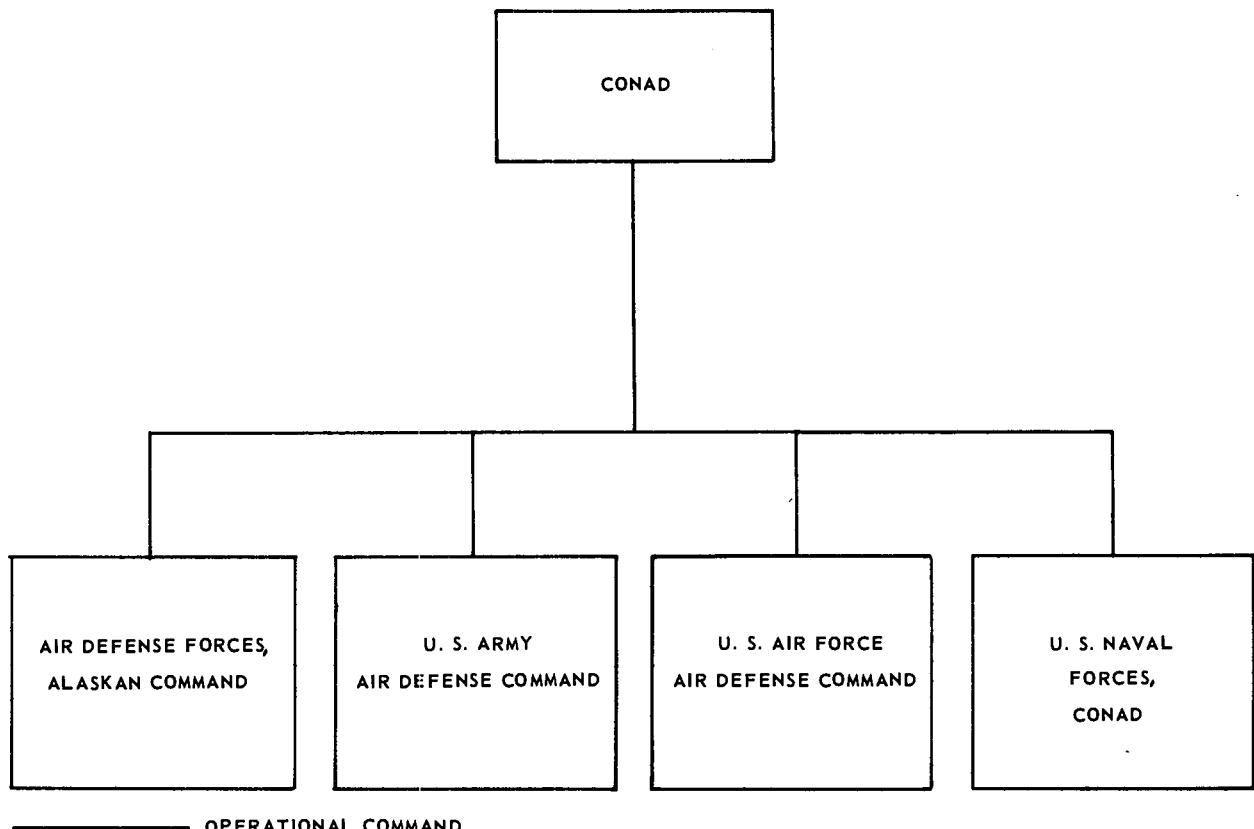


Figure 8. CONAD structure.

NORAD) of U.S. Army, Alaska (USARAL). Nike Hercules sites in Alaska are manned by USARAL personnel.

b. Since the USARAL AD forces have the same relation to a NORAD region as do ARADCOM units, and since both USARAL and ARADCOM AD units are subject to NORAD control and procedures, the remainder of this part of

the manual, though it discusses only ARADCOM facilities and operations, also applies to USARAL AD forces.

c. Army AD forces in Hawaii are under the command of U.S. Army Hawaii (USARHAW). Nike Hercules sites in Hawaii are manned by Army National Guard personnel. See footnote, paragraph 38a.

## CHAPTER 7

### AIR DEFENSE OPERATIONS

#### Section I. COMMAND AND CONTROL FACILITIES

##### 43. NORAD-ARADCOM Command and Control Facilities

(fig. 9)

a. CINCNORAD's command post is the combat operations center (COC).

b. NORAD and ARADCOM are both divided into geographic regions. Generally, the ARADCOM region headquarters are not collocated with NORAD region headquarters. The NORAD region commander exercises operational control over all air defense means in his region from the NORAD region combat center (NRCC).

c. NORAD regions are divided into geographic sectors; a sector is the basic NORAD unit for fighting the air battle. Operational control of a sector is exercised by the sector commander from the NORAD sector direction center (NSDC). The direction center may be a SAGE (semiautomatic ground environment) direction center (para 44), or may be manually operated. Control of BOMARC interceptor missiles is accomplished at the SAGE direction center level. Control of manned interceptors also is accomplished at this level during SAGE operation; however, control may be accomplished at lower levels by NORAD control centers or ground control interception stations (*d* and *f* below) during manual operations.

d. NORAD control centers (NCC) are established subordinate to either a NORAD region or a sector. The NORAD control center commander exercises *operational control* over all AD forces within a designated area during Mode III operations (para 45).

e. AADCP's are established for each Army air defense and may control an Army vital area

defense of brigade, group, battalion, or two-battery size. *For command (less operational control) purposes*, the Army AD commander at the AADCP is subordinate to the appropriate ARADCOM region or unit commander. *For operational control purposes*, the AADCP is under the NORAD region, sector, or control center commander, depending upon the equipment, organization, and operating mode within the particular NORAD region. The Army AD commander at the AADCP exercises command to include operational control, of assigned or attached Army AD forces. This commander exercises direct operational control of individual fire units in the defense in response to control instructions received from the appropriate NORAD commander. Commanders of ADA brigades, groups, or battalions who are not assigned a mission as a defense commander exercise command (less operational control) of assigned or attached Army AD units and assist the higher ARADCOM echelons in carrying out their missions.

f. NORAD ground control interception stations (not shown in fig. 9) are established subordinate to the NCC to assist in control of Air Force manned interceptors during operations without SAGE. If the NCC should become non-operational, a ground control interception station can take over its functions, less operational control of Army AD means. The ground control interception station in this case coordinates target engagements with the AADCP or fire units.

g. Figure 9 shows the relation between control facilities when SAGE is employed. This assumes that the AD means of both the Army and the Air Force contribute to the defense for which an NCC is responsible. The actual organization

within a region is influenced by — the size of each region and each sector; whether sectors are SAGE-equipped; whether forces of more than one component defend a given area; and whether the AADCP is manual or semiautomatic (equipped with Missile Master or BIRDIE). Further, the lines of control will change automatically if combat losses and equipment failure occur.

#### 44. Semiautomatic Ground Environment (SAGE)

a. The SAGE system is a USAF electronic air surveillance and weapon control system designed to facilitate the conduct of the air battle within a NORAD sector. All sectors but two are SAGE-equipped; the two that are not SAGE-equipped operate manually.

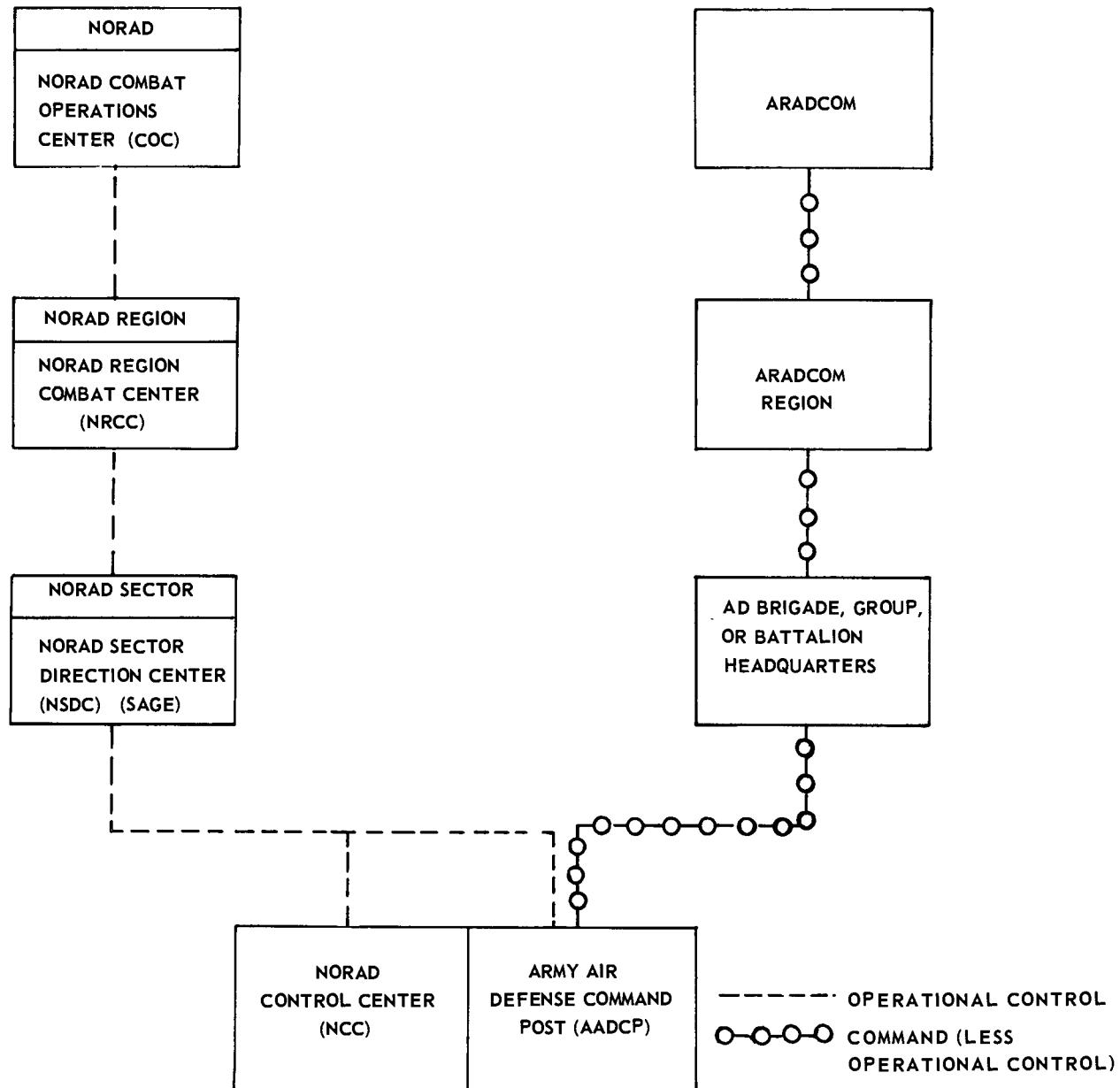
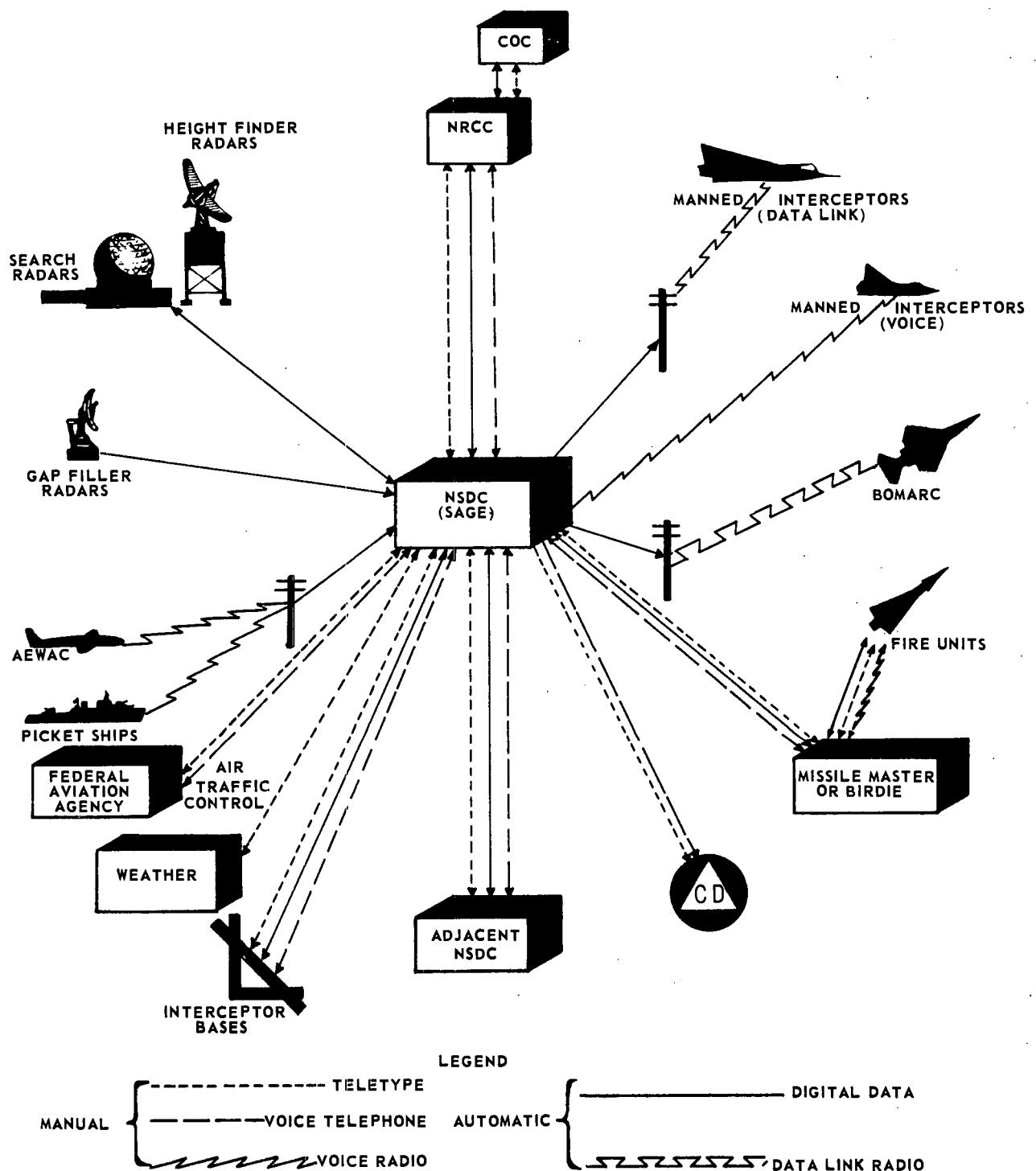


Figure 9. NORAD-ARADCOM command and control facilities.



*Figure 10. SAGE data flow.*

b. The flow of SAGE data in the AD organization is portrayed in figure 10. The SAGE computer receives data automatically and continuously from search and gap filler radars and,

on demand, from height-finding radars. Air movement information, weapon status, weather reports, airborne early warning, and picket-ship radar tracks are received by telephone, radio,

and teletype; and these data are manually programmed into the computer. Data from the direction center are transmitted automatically to scramble manned interceptors, and to direct unmanned interceptors (BOMARC missiles) and those manned interceptors equipped with data link receivers to the hostile aircraft. Digital data transmission is used to pass hostile track information to AADCP's equipped with fire distribution systems. Selected data are automatically sent to adjacent direction centers and to the NRCC. Manned interceptors not equipped with

a data link are directed to the hostile aircraft by voice over radio. Telephone, teletype, and radio are used to pass information to AADCP's, civil defense agencies, SAC, and other headquarters.

c. The Army AD brigade TOE, and the group TOE augmentation, provides the personnel for an air defense direction center section at NSDC, SAGE. The principal function of this Army element is to coordinate and monitor the track and fire unit information flow between the NSDC and AADCP.

## Section II. CONTROL PROCEDURES

### 45. Weapon Control

a. *Guidelines.* The NORAD concept of weapon control is based on the following guidelines:

- (1) The role of area defense weapons, such as manned interceptors, is to inflict maximum attrition and bring the attackers under increasing pressure as they approach the vital target area.
- (2) The Army AD weapons, such as Nike Hercules, provide a final line of defense around vital target areas. Their role is to deny penetration by surviving attackers.
- (3) Although simultaneous engagement of a hostile track by manned interceptors and nuclear-armed AD missiles is permitted, the necessity for such action should be eliminated by progressive engagement of a hostile track with all suitable weapon systems.

b. *Weapon Control.* The following operating modes are prescribed by NORAD for operations in a NORAD sector.

- (1) *SAGE operational (Modes I and II).* Mode I is the normal mode of operation, wherein the primary SAGE sector controls all air defense means within that sector. Mode II is used when the primary SAGE sector becomes non-operational and adjacent sectors take over the primary sector's area of responsibility. The primary SAGE direction center (Mode I) or an adjacent SAGE direction center (Mode II) is

responsible for the conduct of the Air battle within the assigned sector boundaries.

- (2) *Manual operations (Mode III).* Mode III is used in a SAGE sector when SAGE Modes I and II are nonoperational. This mode is normal for a non-SAGE sector. The NCC commander exercises operational control over all assigned or attached weapons in this mode.
- (3) *Autonomous operation (Mode IV).* This mode is used if all communications are lost between the AADCP and all NORAD control facilities, or when directed by the NORAD region or sector commander. This mode is also used by the individual fire unit if it loses communications with the AADCP. In this mode, Army AD commanders assume full responsibility for conduct of the air battle.

c. *Weapon Control Statuses.* The following weapon control statuses are prescribed by the Army AD commander and apply only to Army AD weapons systems.

- (1) *Decentralized control.* This is the preferred control status. In this status, the AADCP furnishes target information to the fire units and monitors their actions to insure effective fire distribution and to prevent engagement of friendly aircraft. This is done electronically through use of Missile Master or

BIRDIE fire distribution equipment, or is done by voice in the case of the manual AADCP. The fire unit selects targets for engagement and warheads to be employed, in accordance with established rules for target selection and engagement and weapon control case.

- (2) *Centralized control.* In this status, the AADCP would make direct target-to-fire unit assignments, electronically or by voice.

## 46. Other Control Measures

Other control information received or initiated by the AADCP and supplied to the fire units include air defense warning, defense readiness conditions, states of alert, special control instructions, and weapon control cases.

a. *Air Defense Warning* is an appraisal of the probability of attack received by the AADCP. It is expressed as —

**AIR DEFENSE WARNING RED:** Attack by hostile aircraft or missiles is imminent or in progress.

**AIR DEFENSE WARNING YELLOW:** Attack by hostile aircraft or missiles is probable.

**AIR DEFENSE WARNING WHITE:** Attack by hostile aircraft or missiles is not considered immediately probable or imminent.

b. *Defense Readiness Conditions (DEFCON)* are the means used by CINCNORAD or other specified authority to maintain the defenses at a state of preparedness compatible with the real or apparent imminence of attack.

c. *States of Alert* are the means used by the Army AD commander at the AADCP to prescribe the required readiness of fire units in the defense. The state of alert is initiated in response to the defense readiness conditions

(DEFCON) announced by the NORAD commander, and specifies the time within which the fire unit must be able to assume battle stations. Examples of states of alert are 3-hour, 30-minute, 15-minute, and 5-minute. The state of alert will be further defined in local unit tactical SOP.

d. *Special Control Instructions.* The following terms will be used to issue instructions for specific airborne objects —

**HOLD FIRE:** Do not open fire; stop firing.

Missiles in flight will be destroyed. Fire units will cease tracking the target. (Hold fire normally is used to protect friendly aircraft).

**CEASE FIRE:** Refrain from firing on an airborne object. Missiles in flight are permitted to continue to intercept. Fire units will continue to track the target. (The cease fire command is used to permit a friendly interceptor time to complete his run on a hostile track and clear the area prior to a surface-to-air missile engagement.)

**CEASE ENGAGEMENT:** Disengage the specified track and prepare to engage another. Missiles in flight will be permitted to continue to intercept. (Cease engagement is used to divert a fire unit to a target of higher priority.)

e. *Weapon Control Case* is used to control the employment of nuclear warheads, and is prescribed by classified NORAD/ARADCOM directives. Weapon control cases are defined in paragraph 6b, FM 44-1A.

f. *Minimum Normal Burst Altitudes (MNBA)* specify the minimum heights of nuclear burst above terrain which will result in acceptable effects on the surface. Paragraph 99b through f present a further discussion regarding minimum normal burst altitudes. MNBA's are computed in advance and published in the tactical SOP.

**Section III. DETECTION AND IDENTIFICATION****47. General**

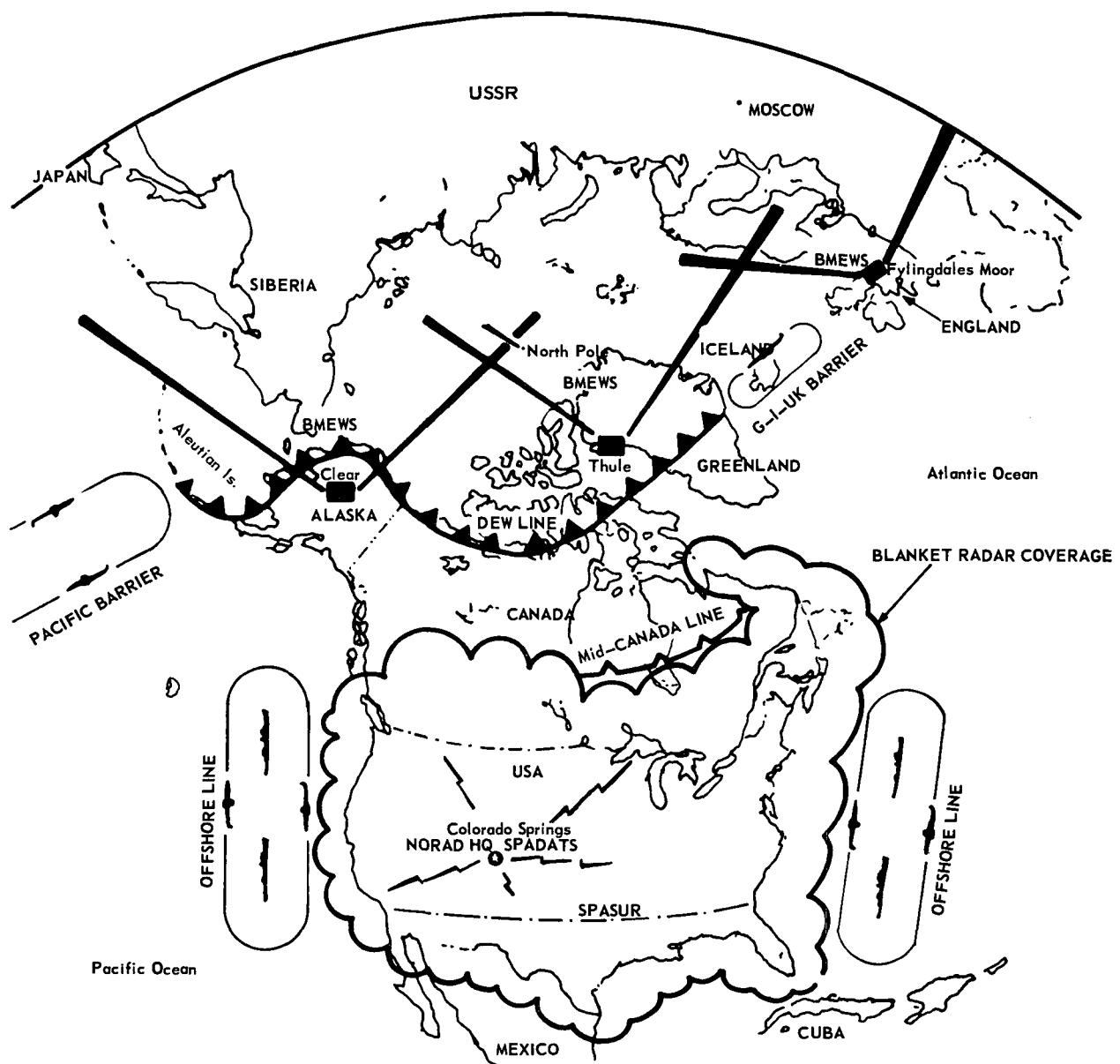
The function of an AD intelligence system is to provide adequate, timely, reliable, and continuous AD intelligence — the backbone of an AD system. The NORAD AD intelligence system consists of U.S. Air Force and Royal Canadian Air Force aircraft detection facilities, NORAD aerospace facilities, U.S. Air Force and U.S.

Navy surveillance facilities, U.S. Army acquisition facilities, U.S. Army signal intelligence (SIGINT) facilities, and identification means associated with all of the above.

**48. NORAD Aircraft Detection Facilities**

(fig. 11)

An aircraft detection network — one part of the AD intelligence system — provides for early



*Figure 11. NORAD aircraft detection and aerospace facilities.*

detection of hostile aircraft and timely warning of their approach.

a. Initial detection of possible airborne attack may be received from U.S. Army Security Agency SIGINT facilities located throughout the world. The positive detection phase against an aircraft threat begins with the Distant Early Warning (DEW) line. This radar fence stretches across the Canadian Arctic, to Alaska. The DEW line is operated jointly by the U.S. Air Force and Canada under the operational control of CINCNORAD. The Pacific extension of the DEW line is called the Pacific barrier and is under the operational control of CINCPAC who reports directly to the NORAD COC. The Atlantic extension is called the Greenland-Iceland-United Kingdom barrier and is under the operational control of CINCLANT who reports directly to the NORAD COC.

b. Behind the DEW line, some 1,000 kilometers south, lies a second detection system, the Mid-Canada line. It was built and is manned by Canada.

c. In addition to these lines is the contiguous coverage radar system which is a network of land-based radars within CONUS, Alaska, Greenland, and Iceland.

## 49. NORAD Aerospace Facilities

(fig. 11).

To fulfill its mission of defense against attack by ballistic missiles and space vehicles, NORAD employs —

a. *The Space Detection and Tracking System (SPADATS)*. Through a global system of radar, radio, and optical sensors, SPADATS brings under NORAD operational control all space detection and tracking resources available to the military. The primary military members of SPADATS are the U.S. Air Force SPACE-TRACK system and the U.S. Navy SPASUR system. SPADATS also receives information from a passive optical surveillance system operated by the U.S. Air Force, the Royal Canadian Air Force, and the Smithsonian Astrophysical Observatories.

b. *The Ballistic Missile Early Warning System (BMEWS)*. The purpose of BMEWS is to warn against ballistic missiles attacking North America over the north polar region. Missile

origin and predicted point and time of impact can be computed by the BMEWS equipment and a warning flashed to NORAD.

c. *The Space Surveillance System (SPASUR)*. SPASUR is a U.S. Navy satellite detection system that, through electronic and radar devices that cover certain regions of space, can discover, identify, and predict the orbit of any satellite that may penetrate it.

d. *SPACETRACK*. SPACETRACK provides tracking through a series of U.S. Air Force-operated radar sensors and BMEWS (b above).

## 50. NORAD SAGE Surveillance Facilities

a. U.S. Air Force, Royal Canadian Air Force, and Federal Aviation Agency long-range radars are located throughout NORAD to provide radar information directly to the semiautomatic ground environment (SAGE) direction centers. The radar sites use data processing and transmitting equipment to accept radar returns, process target information, and transmit digital data to the SAGE direction center where they are automatically entered into the direction center computer.

b. U.S. Air Force and Royal Canadian Air Force gap filler radar sites, also using data processing and transmitting equipment, supplement the coverage of the long-range radar by providing similar data to the SAGE direction center.

c. The above facilities, with the exception of some Federal Aviation Agency radars, are part of the contiguous radar coverage (para 48c).

## 51. Army Acquisition Facilities

The primary function of the acquisition radars organic to Army AD units is local target detection. These radars may perform the additional function of providing information to the overall AD intelligence system.

## 52. Identification Means

a. Friend-or-foe identification is one of NORAD's most difficult problems, due to the large amount of air traffic in the United States and Canada. The various means used to aid in the identification process are discussed below. Use of these means is prescribed in classified NORAD and ARADCOM directives.

b. Air defense identification zones (ADIZ) are established to aid in identification and recog-

nition. The zones are located around the North American continent. Any aircraft penetrating an ADIZ must do so within an established distance of a predetermined point, and within certain time limits. The ADIZ system is the part of the NORAD identification process of flight plan correlation. United States and Canadian civil aviation control facilities provide flight plan information to the NORAD agencies (NSDC, NCC) having responsibility for identification. At these NORAD facilities, tracks are evaluated and flight plan correlation is performed.

c. Safe passages may be established by designated NORAD commanders. Army AD is then informed of these safe passages.

d. Another aid to identification available to Army AD elements is the identification friend or foe system, with the selective identification feature (Mark X IFF/SIF). This equipment electronically interrogates aircraft in the defended

area and indicates all "friendly" aircraft responding with a properly-coded reply. The degree to which engagement decisions may be based on IFF information is determined by the AD situation and is prescribed in classified NORAD/ARADCOM directives.

e. Interceptor aircraft may be vectored by ground radar control to a rendezvous point in order to effect visual recognition of unknown aircraft.

f. After the outbreak of hostilities, the identification process would be simplified when the emergency plan SCATER is in effect. SCATER (Security Control of Air Traffic and Electronic Radiations) provides for the orderly grounding of nonessential aircraft, and for military control of radio navigational aids. EBS (Emergency Broadcasting System) is another emergency plan and provides facilities through which civil defense and other information would be broadcast in time of national emergency.

## Section IV. COMMUNICATIONS

### 53. Communications

a. General. Operation of Army AD units as part of an integrated defense requires reliable, high speed communication. The responsibility for providing the required tactical communication is shared by the various component forces in NORAD. Considerable use is made of commercial facilities. NORAD entrance into the commercial automatic voice network (AUTOVON) and automatic digital network (AUTODIN) systems has added capability to the already sophisticated and multi-routed communications systems available for air defense.

b. AADCP-NORAD Communications. Communication between the AADCP and higher NORAD echelons is by voice, teletype and, in the case of communications between SAGE and Army fire distribution systems, by automatic digital data link. Backup circuits are provided. The U.S. Army is responsible for providing, operating, and maintaining the Army-used en-

trance, termination, and supporting equipment for these communications.

c. AADCP-AADCP Communications. The U.S. Army is responsible for providing, operating, and maintaining communications between the AADCP and adjacent and alternate AADCP's.

d. AADCP-Fire Unit Communications. The Army AD commander is responsible for providing, operating, and maintaining communications between the AADCP and fire units. Fire distribution system circuits should be backed up with manual circuits. AD communications facilities required within the missile battalions are covered in detail in FM 44-95 and FM 44-96.

e. Cross-Service Agreements. The responsibilities outlined above may vary depending upon special support agreements at specific sites where one service is host and the other is tenant. In such cases, the tenant service is responsible for providing information as to its future requirements in accordance with programming practices of the host service.

## PART THREE

### AIR DEFENSE, THEATER OF OPERATIONS

#### CHAPTER 8

##### AREA (THEATER) AIR DEFENSE

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##### Section I. DOCTRINE, ORGANIZATION, AND FUNCTIONS<sup>1</sup>

###### 54. General

a. The President of the United States, through the Secretary of Defense and the Joint Chiefs of Staff (JCS), may establish a specified or unified command in a strategic area and prescribe the mission of the command in an approved plan of operations. This strategic area is referred to for joint usage as an area of operations and for Army usage as a theater of operations. A specified command normally is composed of forces from but one service. A unified command contains component forces from more than one service. A combined command includes assigned forces from more than one nation. The provisions contained in this manual pertain to a U.S. unified command; however, principles of employment for Army AD apply to other types of commands and task forces.

b. Consistent with the provisions of UNAAF, JCS Pub 2, and the organizational form prescribed by the establishing authority, commanders of unified commands organize their forces so as best to accomplish their assigned missions. The organizational forms selected may, of necessity, vary among the oversea unified commands and, as a consequence, the organizational arrangements for accomplishing the air defense functions within the various unified commands may also vary.

c. The command and organizational arrangements described in this chapter apply to commanders of unified commands overseas to whom responsibility for certain normal continuing operations within a specific geographic land area is assigned. In other oversea unified commands, wherein the geography is not solely a land area or wherein arrangements must be made for limited operations within the command areas, the command and organizational arrangements prescribed may be appropriately modified. Such modified arrangements do not preclude the establishment and maintenance of local superiority (including air) by naval forces in an area of naval operations, the seizure and defense of advanced naval bases, and the conduct of such land and air operations as may be essential to the prosecution of a naval campaign.

###### 55. Application

The doctrine and principles prescribed herein apply to each of the services when engaged in planning for and conducting AD operations from oversea land areas. The Army and Air Force are assigned certain responsibilities in this regard (see para 20205 and 20405, UNAAF, JCS Pub 2), and their AD forces normally will be comprised of those providing air defense from oversea land areas. With respect to AD operations associated with oversea land areas, the Navy and/or Marine Corps, as appropriate, have responsibility for —

<sup>1</sup> Paragraphs 54 through 61 of this section are based on JCS Pub 8 "Doctrine for Air Defense from Oversea Land Areas."

a. Providing sea-based air defense and sea-based means for coordinating control for defense against air attack, when required, and for maintaining liaison with appropriate AD commanders ashore in order to provide for measures to prevent mutual interference.

b. Providing, upon request, augmentation for air defense ashore after giving primary consideration to the conduct of their basic mission. In such instance, the AD support will be accomplished within the rules and procedures and air weapons control systems established for the area of operations. Relationships during joint amphibious operations will be in accordance with the principles set forth in UNAAF as amplified by the Joint Chiefs of Staff or the commanders of unified commands. See FM 31-11 for details of Army participation in joint amphibious operations.

c. Providing air defense of their own forces at sea and air defense of the landing force throughout the conduct of amphibious operations, employing organic means and such special AD augmentation forces as may be requested and assigned for such operations.

## 56. Fundamental Considerations

Such fundamental considerations underlie the doctrines expressed in this manual. They are —

a. The destructive power that is inherent in a single hostile nuclear weapon-equipped aircraft or missile.

b. The extremely short time available for air defensive activities as a result of the speed of flight and efficiency of modern offensive aircraft and missiles.

c. The variety and complexity of the weapon systems constituting the air threat (aircraft, missiles, and foreseeably, spacecraft).

d. The variety, number, and complexity of defensive and offensive weapon systems available and being employed by all services.

e. The basically reactive nature of air defense to the enemy's choice of strategy.

f. The need to establish optimum control and coordination measures to prevent or minimize mutual interference.

g. The need to support the ground scheme of maneuver.

## 57. Basic Principles

a. A coordinated and integrated air defense system under a single commander is essential to successful area operations.

b. AD forces must be organized, equipped, trained, and, when possible, positioned and alerted prior to hostilities. An air defense cannot be adequately improvised. Constant surveillance must be maintained to insure timely response of AD forces and concurrent warning to the offensive forces of the command.

c. The enemy air threat must be considered as an entity and countered by a strategy based upon unity of effort. The hostile threat and targets to be defended are the points of departure for all AD planning and the basis on which air defense requirements must be computed.

d. AD rules and procedures for areas of operations will be promulgated and the AD forces exercised during peacetime, when feasible, so that the transition to war conditions may take place without confusion or delay. Joint AD exercises will be accomplished whenever two or more services are involved in air defense in accordance with subparagraph 20205C, 20305C, and 20405H, UNAAF JCS Pub. 2.

e. Commanders at all echelons have the responsibility to take whatever action is required to protect their forces and equipment against enemy air attack. Normally, such action will be governed by rules and procedures established by the AD commander. Emergency action deemed necessary, if contrary to the established rules, should be carefully weighed for its effect on the operations and safety of other friendly forces, and, if taken, reported to the appropriate commander at the earliest practicable time.

## 58. Requirements of Air Defense Organization

The specific command, control, and organizational arrangements within which the AD function is accomplished must provide for —

a. Centralized direction and maximum decentralized authority to engage hostile aircraft, guided missiles and other air vehicles compatible with identification capability.

b. Compatible Army, Navy/Marine, and Air Force electronic coordination and control means, operationally connected, whenever AD forces of

these services are operating within the same area.

c. Coordination of effort and unity of action, to include close coordination with sea-based and adjacent air defense commanders.

d. Rapid reaction.

e. Warning to friendly military forces and civil authority, as appropriate.

f. Minimum mutual interference among operating forces and with all services' primary functions.

g. Safeguards to preclude inadvertent implementation of air defense wartime operations during peacetime.

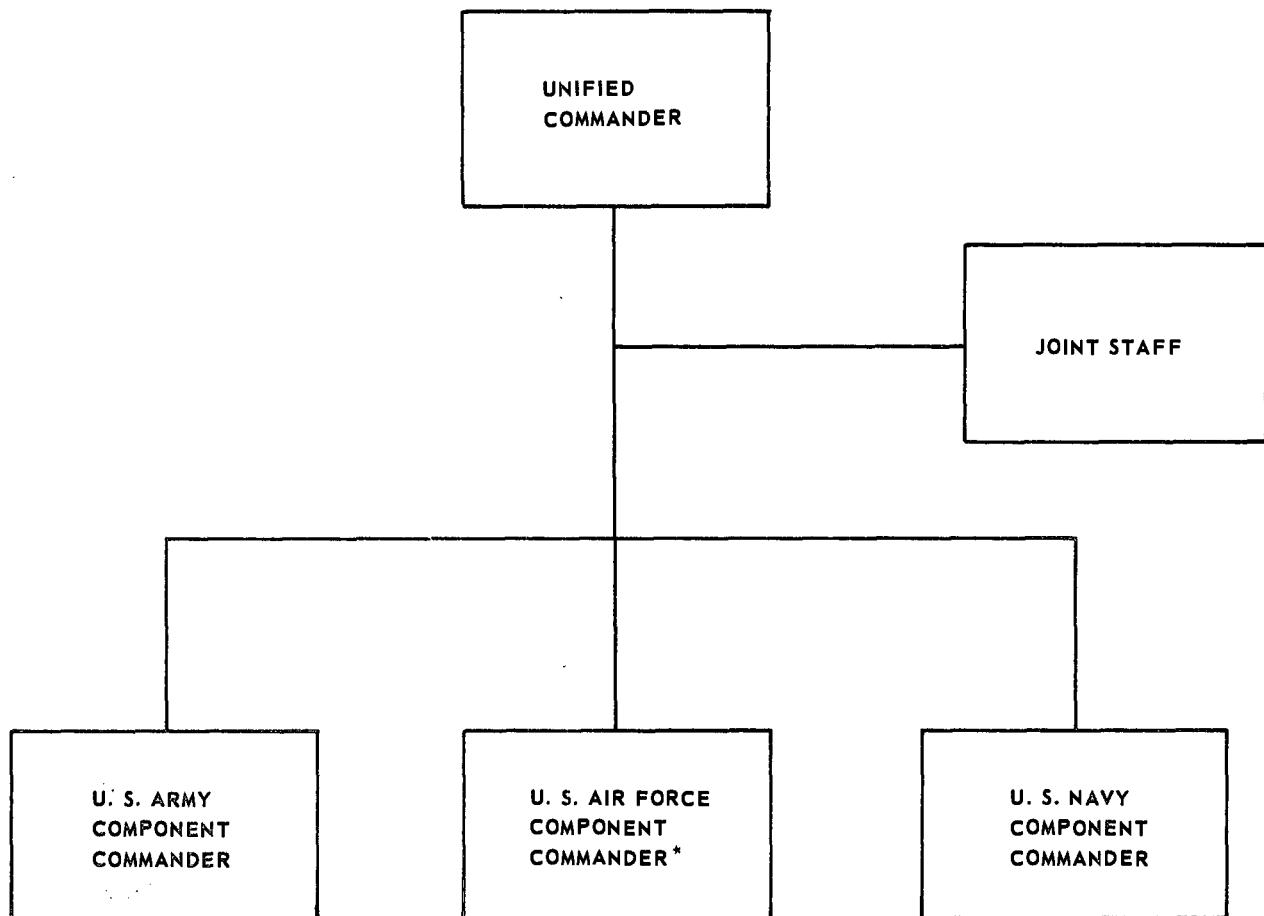
h. Coordination of AD operations with exterior friendly air offensive forces operating within or through the area of operations.

i. Continued effective air defense if command, control, and communications systems should be degraded due to enemy action.

## 59. Unified Commander

a. The unified commander is the theater of operations commander. The composition of forces assigned depends upon the mission, objectives, and projected type of operations. Figure 12 shows a typical theater organization.

b. The Unified commander has overall respon-



\* THE AIR COMPONENT COMMANDER WILL NORMALLY BE APPOINTED THE AREA AIR DEFENSE COMMANDER.

### OPERATIONAL COMMAND

Figure 12. Theater of operations command organization.

sibility for air defense of the theater of operations. He —

- (1) Establishes the theater air defense priorities, based on the recommendations of the component commanders.
- (2) Allocates the AD means to the component commanders.
- (3) Designates a single commander for theater air defense.

## 60. Area Air Defense Commander

a. Within an oversea unified command, subordinate unified command, or joint task force, the commander will assign overall responsibility for air defense to a single commander. Normally, this will be the Air Force component commander (fig. 12). Representation from the other service components involved will be provided, as appropriate, to the area air defense commander's headquarters.

b. The mission of the area air defense commander will be to coordinate and integrate the entire air defense effort within the unified command. Subject to the authority of the commander of the unified command, he will establish broad policies and procedures for the employment of air defense means and the coordination of such means with the operations of other elements within the area. The air defense commander must insure, through his organization and application of appropriate procedures, that optimum effectiveness is realized from each of the various air defense weapon systems and that no unnecessary restrictions are placed upon their employment.

c. Where a significant portion of the means for air defense from land areas is contributed by a service other than that of the area air defense commander, a senior officer should be appointed from that service to serve as deputy in air defense matters to the area air defense commander.

## 61. Regional Air Defense Commanders

The area AD commander will establish air defense regions.<sup>2</sup> The number of such regions may vary, depending upon geographical and political factors and the complexities of the AD problem.

<sup>2</sup> This wording, based on JCS Pub 8, is not interpreted as requiring a mandatory subdivision where the area is relatively small.

a. The area AD commander will appoint the regional AD commanders and designate their areas of responsibility, taking into consideration such factors as —

- (1) Contribution of the services.
- (2) Geography of the area.
- (3) The hostile threat.
- (4) Composition, capabilities, and deployment of friendly forces; including capability of the services to augment deployed forces.

- (5) Concept of operations.

b. In a region where a significant portion of the regional AD means consist of AD weapon systems of another service, a senior officer of that service should be appointed to serve as deputy in air defense matters to the regional AD commander. Service staff representation will be assigned, as appropriate, to the regional AD activities.

c. The regional AD commander will be fully responsible for and will have full authority in the air defense of his region. *He will, however, normally delegate authority to field army commander(s) for control and operational employment of organic<sup>3</sup> Army air defense means within the field army area.*

d. In other land regions where the situation indicates that there will be no likelihood in war of extensive tactical air offensive operations for attaining air superiority, or conducting interdiction or close air support, and the threat is essentially that of enemy air attack, the area AD commander may establish a Joint Air Defense Command (JADC). The organizational form selected will depend primarily on the air defense means available. When a Joint Air Defense Command is established —

- (1) The commander may come from any component, depending on the organization and operational situation within the region and the air defense means available.
- (2) A deputy commander will be appointed from a service other than that of the commander.

<sup>3</sup> The term "organic" is quoted from JCS Pub 8. Since the field army currently has no "organic" air defense means, the term is taken to mean the Army air defense means assigned, attached, or otherwise made available to a field army.

- (3) A joint staff, with appropriate representation from the service components involved, will be formed in accordance with the principles set forth in JCS Pub 2 (UNAAF).

## 62. U.S. Army Component Commander

a. The mission of the theater army forces assigned to a theater of operations is to plan and execute sustained land combat operations, either independently or in conjunction with other service components.

b. A typical theater army organization (fig. 13) consists of —

- (1) Theater army headquarters (TAHQ).
- (2) Commands organized for performance of major logistical and administrative functions, such as the theater army logistical command (TALOG) and the Theater Army Civil Affairs Command (TACAC).
- (3) Field armies which may be under the control of army groups when the size of the force warrants.

- (4) In some cases, air defense forces not attached or assigned to field armies/army groups.

c. The Army component commander is responsible to the unified commander for the employment of the Army air defense forces as part of the theater AD system. Specific responsibilities include —

- (1) Furnishing the unified commander with theater army air defense requirements in priority.
- (2) Allocation, organization, and employment of Army air defense means in accordance with the unified commander's operational plans and established AD priorities.
- (3) Prescribing, under established Army doctrine, unit training, operating, logistical, and administrative procedures which will achieve maximum combat effectiveness of personnel and materiel.
- (4) Planning, coordination, and conduct of staging additional Army air defense forces into the theater of operations.

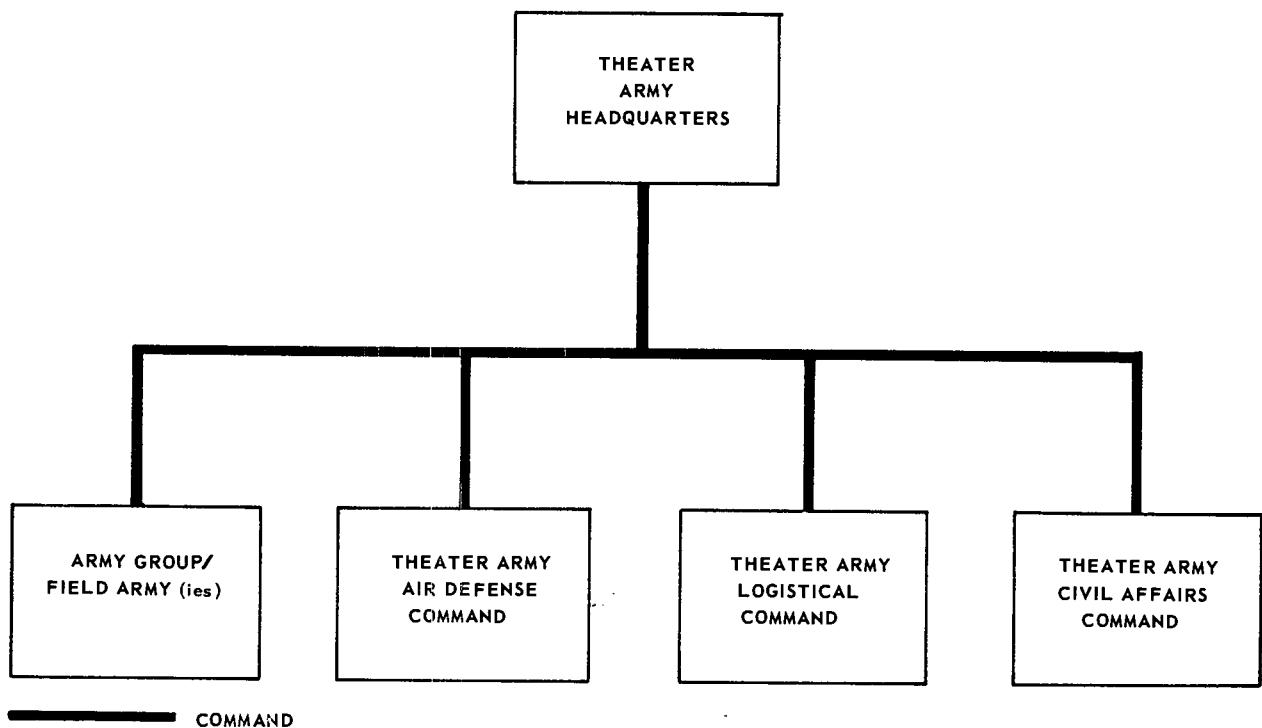


Figure 13. Theater army organization.

d. Under some circumstances, the staff functions peculiar to the execution of the responsibilities in c above, may be accomplished by an appropriate air defense section of the TAHQ staff or by the staff of the senior Army AD organization in the COMMZ. However, when warranted by the size of the air defense forces and the nature of the tasks involved, the Army component commander may establish a Theater Army Air Defense Command.

### **63. Theater Army Air Defense Command (TAADC)**

a. The organization of the TAADC will vary according to the theater and the operational environment within which it will function. It provides the Army component commander with a means of exercising command (less operational command exercised by other designated commanders) of theater army air defense forces not assigned or attached to field armies/army groups, and to carry out his responsibility for integration of the Army AD capability into overall Army and theater planning.

b. Specific functions of the TAADC include—

- (1) Command (less operational command exercised by other designated commanders) of all theater Army AD units not assigned or attached to field armies/army groups, and coordination of their activities as part of the AD system established by the area AD commander.
- (2) Development of unit training, operating, administrative, and logistical procedures, and coordination of combat service support for all theater army AD forces to insure their maximum combat effectiveness.
- (3) Recommendation to the Army component commander of allocations of available AD means based on his established operational requirements and AD priorities.
- (4) Allocation of Army AD units and nuclear warheads for defense of areas and installations in the COMMZ for which the Army is responsible, based on established AD priorities. Operational command of these units and warheads

is assumed by the appropriate regional air defense commander or regional joint air defense commander.

- (5) Allocation of Army AD units and nuclear warheads to the army groups/field armies based upon established AD priorities.
- (6) Establishment of procedures for the exchange of AD intelligence with other agencies and services to complement the intelligence network established by the area air defense commander. Maximum use is made of U.S. Army Security Agency signal intelligence (SIGINT) facilities.
- (7) Establishment of liaison with higher, allied, or other service AD headquarters.
- (8) Provision of Army AD representation on various theater staffs and in the operations section thereof.
- (9) Staging of Army air defense units received as theater reinforcements.

### **64. Field Army Commander**

a. The field army commander normally is responsible for control and operational employment of allocated AD means, subject to the rules and procedures imposed by the area and regional air defense commanders.

b. Detailed procedures regarding field AD operations are contained in chapter 9. These procedures also are generally applicable to Army AD headquarters and combat units operating in COMMZ with the understanding that COMMZ AD units are under the operational command of regional AD commanders and are commanded (less operational command) by the theater Army AD commander.

### **65. Summary: Theater AD Command and Control**

(fig. 14)

a. The unified commander specifies the organization for theater air defense, based on the principle that a coordinated and integrated air defense system under a single commander is essential to successful theater operations. Normally, the commander of theater air defense is the air component commander. All theater AD means are responsive to this commander.

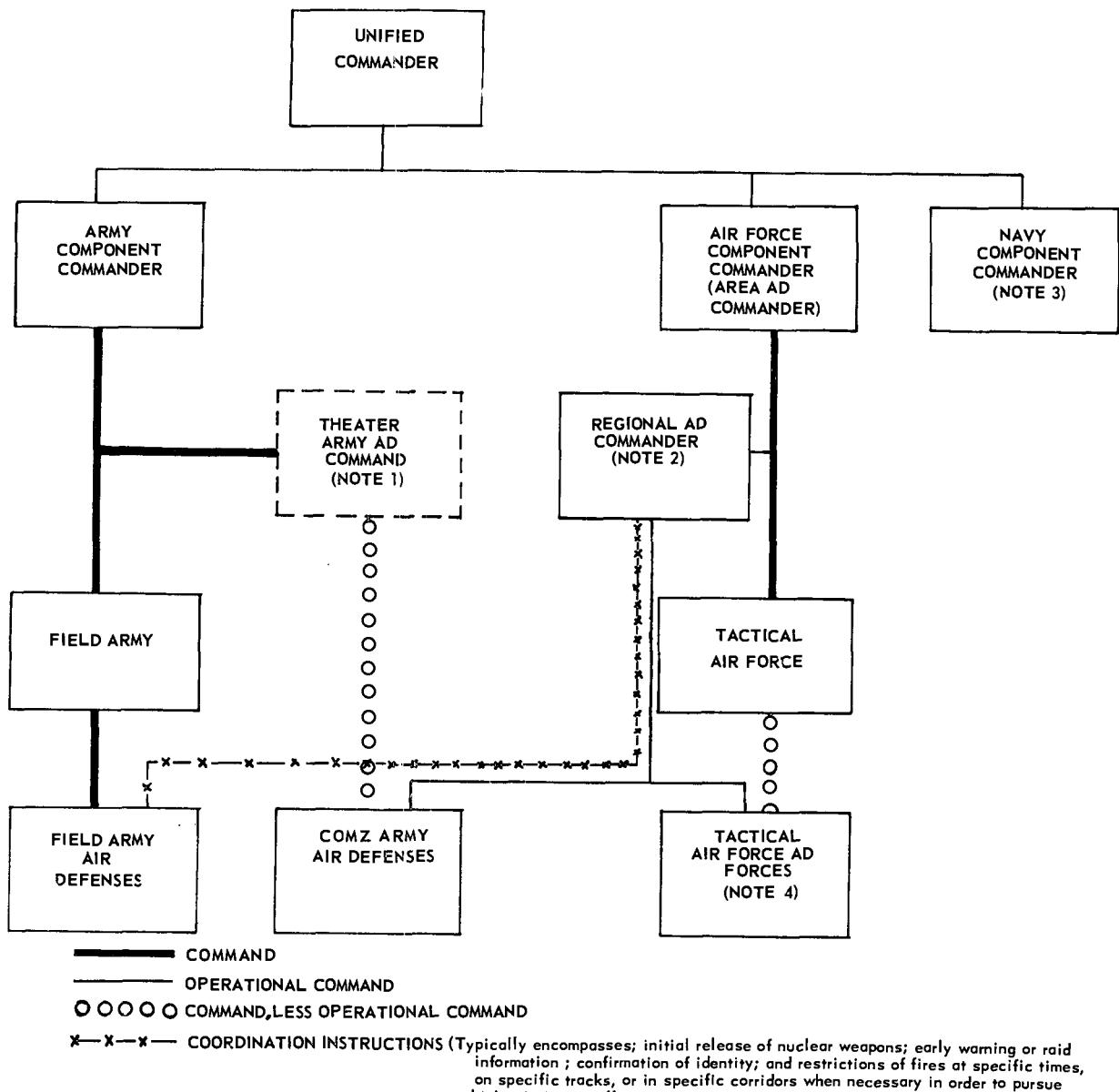


Figure 14. Theater AD command and control.

b. The component commanders organize their AD means to fulfill their air defense responsibilities. The Army component commander may

establish a Theater Army Air Defense Command. This command exercises command, less operational command, of all theater army AD

units not assigned or attached to army groups/field armies. It does not command Army AD units assigned or attached to Army groups/field armies.

c. Army AD units assigned to the field armies normally are under the field army commanders

for control and operational employment; however, the electronic coordination and control means of these units will be compatible and collocated or operationally connected with Air Force electronic coordination and control means for optimum combat effectiveness (para 66-68).

## Section II. COORDINATION AND CONTROL FACILITIES

### 66. General

The mission of the area AD commander is to coordinate and integrate the entire AD effort within the theater into a single AD system. To assist in accomplishing this mission, all field army and Air Force electronic coordination and control means will be compatible and collocated or operationally connected.

### 67. Typical Army-Air Force AD Coordination System

a. The organization of Army and Air Force forces assigned to a theater will vary, depending upon the size and geography of the area of operations, assigned missions, forces available, and the desires of the component commanders. Figure 15 depicts a portion of the air defense facilities and coordination links in a type theater.

b. Army air defense operations are coordinated with other Army and Air Force tactical and tactical support operations by the air defense elements (ADE) located in the supported force tactical operations centers (TOC). Details are presented in paragraphs 83 through 88.

c. Army AD operations are conducted by AD commanders operating from Army air defense command posts (AADCP). AADCP operations are discussed in paragraphs 89 through 98. As necessary, the AADCP coordinates its tactical operations with collocated and/or operationally connected Army flight operations centers (FOC) and U.S. Air Force facilities, thereby insuring the safety of friendly aircraft from friendly air defense fires. The following subparagraphs describe the U.S. Air Force facilities.

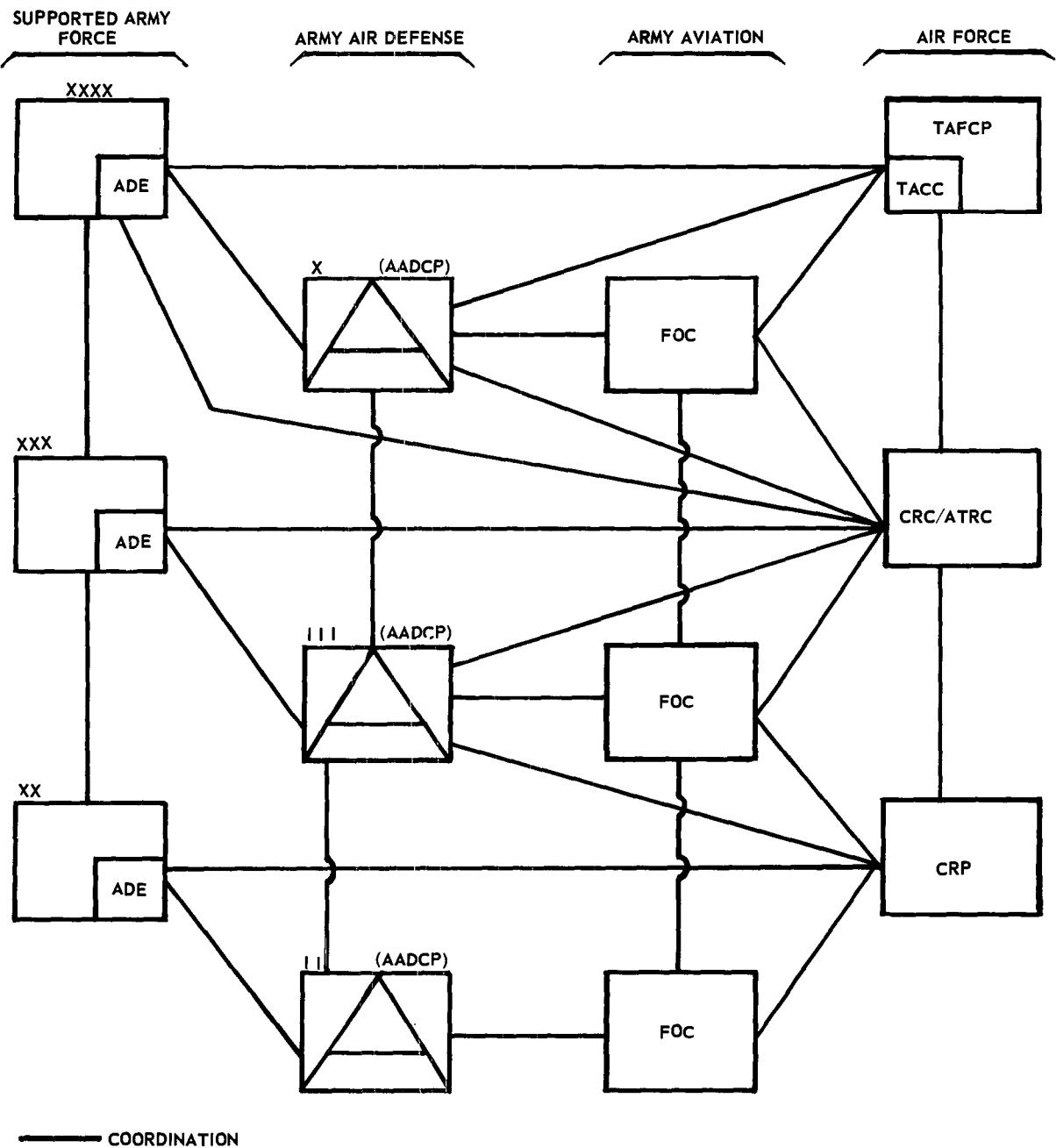
d. The tactical air control center (TACC) is the operations center of the Air Force commander's command post. The TACC plans and coordinates the employment of offensive and defensive tactical air effort and air control functions in the

theater of operations. Through the TACC facilities, the Air Force commander effects centralized direction of the Air Force effort and coordinated planning. The TACC maintains a visual presentation of the overall air situation on an AD plotting board. The AD plotting board is supplemented with status boards which continuously reflect AD tactical action; fighter, reconnaissance, and airlift mission progress; conditions of alert; and other data pertinent to current air operations. The TACC also directs the detailed apportionment of available air effort to the various tasks to be performed.

e. The subordinate control and reporting centers (CRC) provide radar surveillance within a designated area, and have the capability of vectoring fighter-interceptor aircraft in both offensive and defensive operations and furnishing early warning and identification to Army surface-to-air missile units. The CRC is connected to the Army fire distribution system operating in the area by automatic data links or manual communications. To facilitate the required coordination, the CRC, the AADCP, and the FOC (para 97) may be collocated when the tactical situation permits.

f. CRC capabilities are extended forward by subordinate control and reporting posts (CRP). These installations are capable of vectoring fighter-interceptor aircraft and furnishing radar surveillance information to Army surface-to-air missile units. The CRP normally has no responsibility to identify aircraft except for those they are currently vectoring, unless designated as an alternate CRC.

g. Army AD augmentation elements will be provided for operation in the Air Force facilities involved with air defense at each level, in order to facilitate coordination of Army and Air Force air defense efforts. The size and composition of the Army augmentation elements pro-



**NOTES:**

1. The number and location of AADCP's, CRC's, FOC's, FCC's in a field army area and the coordination links between them will vary widely depending on force mission, composition, and deployment.
2. Facilities with equivalent areas of responsibility should be collocated whenever possible.

*Figure 15. Typical theater air traffic control/air defense coordination system.*

vided may vary with the situation; however, there must be sufficient personnel for sustained operations. See TC 44-7 for details regarding operations of Army elements in Air Force facilities.

*h.* Figure 15 also applies for COMMZ Army AD units, with the understanding that these units are commanded by the theater Army AD commander, subject to operational command exercised by regional AD commanders.

*i.* The effectiveness of this coordination system is dependent upon the survival in battle of complex communications and intelligence networks; therefore, provisions must be made for continuance of Army AD operations should the coordination system be degraded.

#### **68. Electronic Coordination and Control Facilities**

*a.* The Army Missile Monitor fire distribution system (para 14, 93, 94) will be used in some

theaters of operation, and may operate in the same areas as the Air Force air weapon control system 412L. When operating in the same area, the systems should be operationally connected.

*b.* The 412L system performs the essential functions of air surveillance, maintenance of aircraft movement and identification information, and weapon control for air defense against air-breathing threats and for offensive strike and reconnaissance missions. Varying numbers of 412L systems may be netted together to provide coordinated air control for a large geographical area (fig. 16).

*c.* CRC Army augmentation element personnel will function in the 412L system facilities performing the duties of coordination and missile controllers. In those areas not equipped with 412L digital data facilities, CRC Army augmentation elements will net with appropriate AADCP's to furnish the necessary coordination and control links.

### **Section III. COMMUNICATIONS**

#### **69. Communications**

*a.* The theater commander, through his communications-electronics officer (J-6), plans, directs and coordinates the provision of communications to the air defense forces in the theater. Communications required by AD units of any of the services may be provided through facilities operated by that service or by another service, depending on such factors as unit locations, availability or facilities, and requirements of other users.

*b.* Army-operated communications facilities available for the support of AD forces are provided by the theater army communication system. This system extends from the theater rear boundary into the field army areas where it interconnects with the field army area communica-

tions system. The theater army communications system provides the extension facilities required by the Theater Army Air Defense Command. The theater army communications system is under the operational command of the theater army signal officer. Details are presented in FM 11-20.

*c.* The headquarters of the Theater Army Air Defense Command (TAADC) will require internal communications among staff sections, and external communications to theater army headquarters, the area AD commander, subordinate units, and AD agencies of other services. The internal communications are provided by the signal operations company, medium headquarters. External communications are provided as outlined in *a* and *b* above.

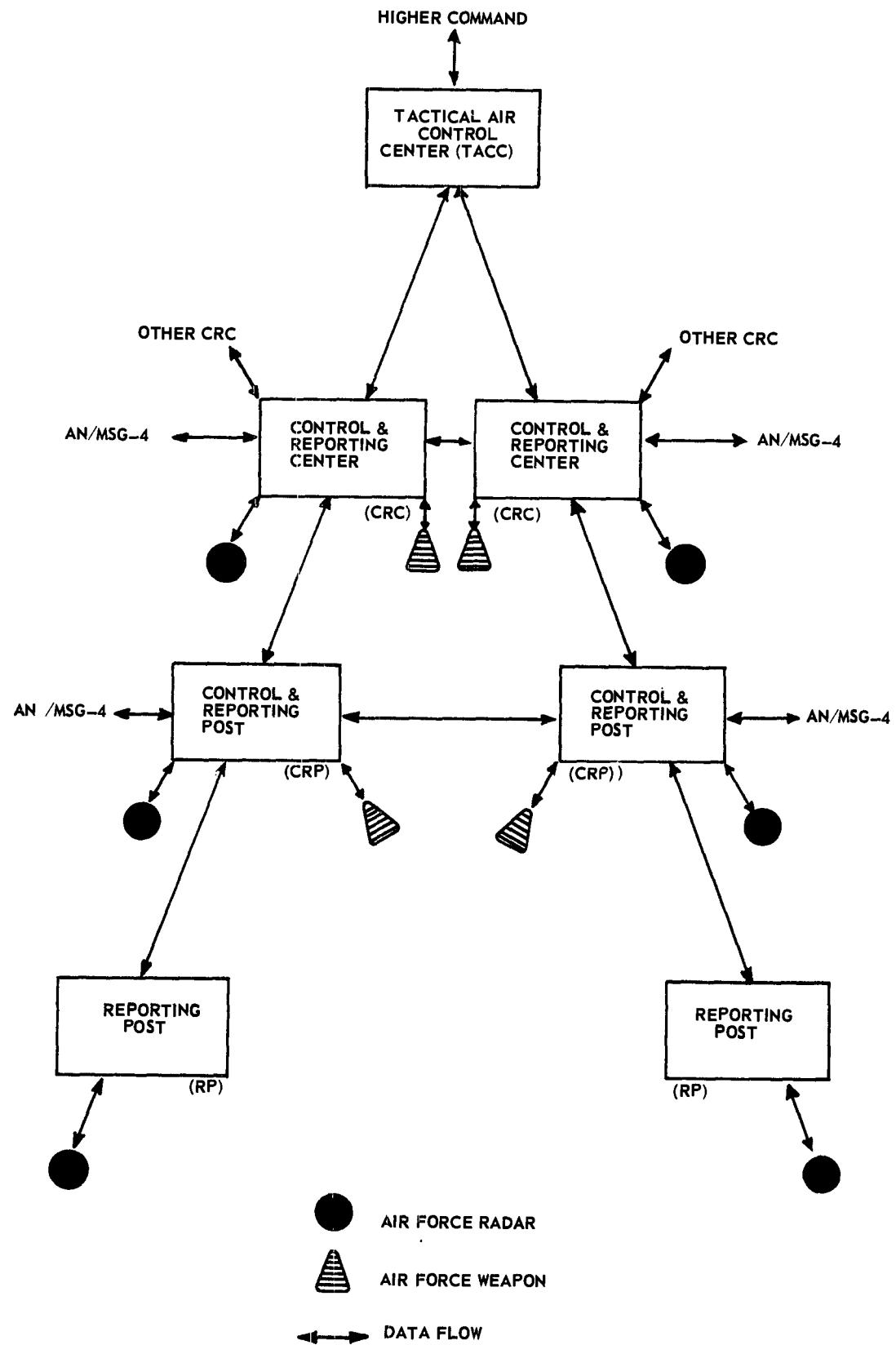


Figure 16. 412L air weapon control system organization.

## CHAPTER 9

### FIELD ARMY AIR DEFENSE

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#### Section I. GENERAL

##### 70. Air Defense Responsibility

The field army commander has a specified responsibility for military operations in the field army area (which includes enemy-held territory to a depth designated by higher headquarters). Normally, he will be provided with means commensurate with his responsibility including weapons and forces to defend against air attack. The field army commander will normally be delegated authority for control and operational employment of the organic<sup>1</sup> Army AD means within the field army area.

##### 71. Air Defense Commander's Responsibilities

- a. The senior commander of Army AD units

supporting a field army, corps, or division normally serves in a dual capacity; i.e., he is a commander of supporting AD units, and he is also designated a special staff officer on the supported commander's staff.

b. The AD commander's command and staff functions are presented separately in this manual for clarity. It should be noted that, when operating in support of a corps or field army, many of the AD commander's coordination functions are performed by AD representation provided by AD brigade and group TOE and operating in the supported commander's tactical operations center. Special augmentations of AD personnel are required at division level to accomplish these functions.

#### Section II. AIR DEFENSE OFFICER STAFF FUNCTIONS

##### 72. Army Group Air Defense Officer

The senior member of the army group AD staff section, or the senior AD commander if AD forces are retained at army group level, is the army group air defense officer. The army group air defense officer, assisted by assigned AD personnel —

- a. Advises the commander and staff on all AD matters.
- b. Determines the number and types of AD units required by the forces of the command including special equipment requirements.
- c. Recommends the allocation of AD units to subordinate commanders. AD allocations are not normally retained at army group level.

d. Determines AD ammunition requirements and recommends allocations.

e. Coordinates the active defense of the army group with higher, lower, and adjacent commands to insure its maximum effectiveness consistent with the mission.

f. Coordinates with appropriate agencies of the Army and with other services on matters pertaining to the control, regulation, and utilization of the airspace over the supported force.

g. Provides for coordination and exchange of AD intelligence between the field armies, the area and regional AD commanders, and TAADC, and publishes AD information and intelligence.

<sup>1</sup> See footnote in paragraph 61c.

### **73. Field Army Air Defense Officer**

The senior commander of Army AD units supporting a field army (normally an ADA brigade commander) also serves as the field army AD officer. The field army AD officer is considered a member of the field army special staff and is the principal adviser to the field army commander on AD matters. His staff functions include the planning and coordinating activities described in paragraphs 74 and 75.

### **74. Planning Activities**

The field army AD officer, assisted by assigned AD personnel —

*a.* Determines AD unit requirements, considering recommended AD priorities and the objective of limiting the effectiveness of the estimated air threat to a level permitting freedom of action to friendly forces. The AD unit requirements recommended by the AD officer are reviewed by the G3 in relation to other troop requirements, and are incorporated in the troop list recommended to the field army commander.

*b.* Recommends the allocation of available air defense means and nuclear AD warheads to be made to subordinate commands, and the command relationship between the subordinate commands and supporting air defense units. Paragraph 79 describes a typical field army AD allocation and command relationship.

*c.* Determines the required ammunition supply rates for AD units, and recommends allocation of the available supply rate to subordinate commands and AD units retained under control of the field army commander.

*d.* Formulates the overall field army plan for coordination of airspace utilization. This should not be confused with the airspace utilization plan for current operations prepared at the ADE (para 86*h*). The plan is based on joint concepts and plans for airspace utilization, rules for engagement, and the joint concept for integration of the air traffic control systems of the services. The field army G2/G3 furnishes guidance regarding airspace priorities, the Army aviation section furnishes overall Army aviation airspace requirements, and liaison officers of the other services provide general advice as required. The plan is coordinated with the G2/G3, Army aviation section, and other affected staff sections,

and is then disseminated to provide broad guidance for the field army forces.

*e.* Coordinates and integrates Army AD matters with higher, lower, and adjacent commands and other services operating in the area. In addition to coordination among elements connected with air defense, coordination must be accomplished with other elements of the Army that employ electronic emitters or receivers. Such equipments include communication transmitters, navigational aids for aircraft, control systems for surveillance drones, U.S. Army Security Agency facilities, electronic warfare emitters, and ground surveillance radars. The G3 must establish priorities among these rival elements for occupation of terrain and for periods of operation to preclude interference. Based on G3 priorities, AD units should be so located as to be able to operate at all times without interfering with higher priority elements.

*f.* Coordinates the establishment and functioning of an air defense intelligence system within the field army.

*g.* Prepares the field army AD SOP. In conformity with the theaterwide rules for engagement prescribed in general terms by the unified commander through the area and regional AD commanders, the AD officer recommends detailed field army rules for engagement to G3. Through coordination with G2, target identification procedures are integrated, in strict consonance with the theater identification criteria, into the AD SOP and are coordinated with other Army and other service agencies using the airspace over the field army. G3 provides guidance for the conditions under which AD nuclear weapons may be used. This guidance is prescribed in detail in the AD SOP to include responsibilities, controls, and specific considerations for nuclear employment by the AD unit. Appropriate portions of the AD SOP are coordinated with FASCOM to provide compatibility with the rear security and damage control plans. Passive counterguerrilla procedures, and procedures for reporting enemy guerrilla action, are prescribed. Required AD intelligence, radar reporting, and electronic security (ELSEC) procedures are prescribed. The conditions of AD warning, states of alert, weapon control instructions, and other control and limiting measures are included. The AD SOP is reviewed and published by G3 as an

annex to the field army SOP. See appendix V for a suggested form for the AD annex to a field army SOP.

*h.* Prepares the field army AD plan, based on established priorities, allocations, SOP, and defense requirements. The plan is coordinated with field army staff and other Army agencies and other services operating in or over the field army area, and is submitted through G3 for the field army commander's approval. The plan includes AD intelligence, mission, concept of operations, priorities, allocations, organization for combat, coordinating measures and necessary administrative instructions. The AD plan is published in an annex to the field army operation order. See appendix IV, FM 101-5 for a suggested form for the air defense annex to a field army operation order.

*i.* Prepares other necessary plans, policies, and directives pertaining to AD activities and coordination of the use of the airspace over the field army area.

## 75. Coordinating Activities

The field army AD officer's function of coordinating AD operations with other operations of

the supported force is carried out in the field army tactical operations center (FATOC). Details are presented in paragraphs 83 through 88.

## 76. Corps Air Defense Officer

The senior commander of Army AD units supporting a corps (normally an ADA group commander) also serves as the corps AD officer, and is considered a member of the corps special staff. His duties and responsibilities are similar to those of the field army AD staff officer except that corps-level AD is not authorized direct coordination with elements of the other services on matters regarding AD policy and procedure. This coordination is achieved through the field army AD officer. Direct coordination is authorized in the case of an *independent* corps.

## 77. Division Air Defense Officer

The division AD officer is a designated member of the division staff for air defense. He may be provided by augmentation or may be the senior commander of AD forces attached to the division. His duties are similar to those of the corps air defense officer.

## Section III. ORGANIZATION AND DEPLOYMENT FOR COMBAT

### 78. General

The field army AD officer recommends the initial organization for air defense. Based on his recommendations, the AD units allocated to the field army are assigned or attached to the field army, corps, and possibly division echelons to accomplish the AD mission, to obtain maximum effectiveness of AD weapons, and to integrate the AD means at each echelon into the overall field army AD system. The organization of field army AD is influenced by —

- a.* The present situation.
- b.* Operations plans.
- c.* The enemy threat.
- d.* AD priorities.
- e.* The defense area.
- f.* The field army AD plan.
- g.* The principles of tactical AD employment.
- h.* AD weapons capabilities.

- i.* The number of AD units available.
- j.* AD position requirements.

### 79. Organization

*a.* A proposed allocation of AD units to a type field army (fig. 17) consists of six Nike Hercules battalions, eight Hawk battalions, nine forward area weapon battalions, five group headquarters, and one brigade headquarters.

*b.* The six Nike Hercules battalions and two of the Hawk battalions, organized into two groups, are normally retained at field army level under the control of the ADA brigade commander. These units provide field army area defense.

*c.* The remaining Hawk battalions may be divided into three groups; one group may be assigned or attached to each corps. Each ADA group commander is directly responsive to the air defense needs of the corps to which his group

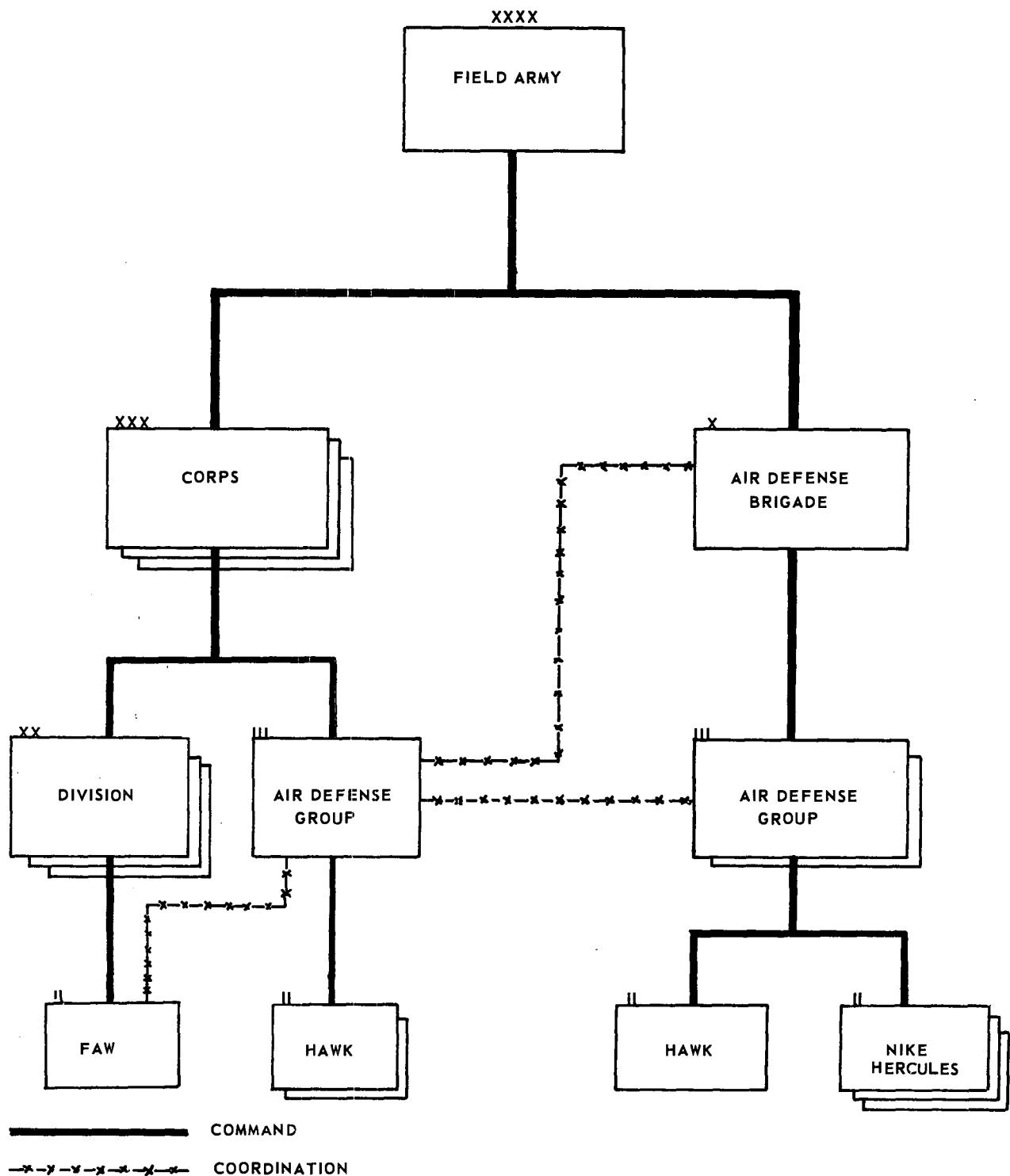


Figure 17. Air defense organization, type field army.

is assigned or attached. The field army AD officer integrates the corps AD requirements into the overall field army plan.

*d.* The forward area AD battalions are attached to the divisions as required. Further organization within the division is the prerogative of the division commander. Although the AD battalion may be employed directly under division control or may be further attached to division artillery, direct division control is to be preferred from the air defense viewpoint. Coordination of the operation of divisional AD units with each other and with other AD forces of the corps is included in division and corps plans.

*e.* Not indicated on figure 17 is any AD capability which may be organic to the maneuver elements; e.g., caliber .50 machineguns and Redeye. These are not considered a part of the integrated AD system.

#### **80. Nike Hercules Deployment**

*a.* Nike Hercules battalions allocated to field army provide medium and high altitude air defense. In addition, the Nike Hercules missile units have a surface-to-surface capability. Nike Hercules battalions are normally assigned to ADA groups under the control of the ADA brigade commander.

*b.* Nike Hercules batteries are positioned throughout the field army area to provide weighted area coverage. The deployment guidelines for Nike Hercules defenses are described in chapter 5.

*c.* Planning procedures for Nike Hercules defense design are contained in appendix II.

#### **81. Hawk Deployment**

*a.* Hawk battalions allocated to the field army provide medium- and low-altitude air defense. Enemy aircraft will attempt to penetrate the field army defense by choosing a method of attack that will be exposed to the least amount of AD missile fire. The low-altitude method of

attack makes radar detection difficult because of terrain masking, ground clutter, and masking by the curvature of the earth. Hawk units will be employed throughout the entire army area of operations based upon priorities for low altitude defense established by the field army commander.

*b.* Deployment guidelines for Hawk defenses are described in chapter 5.

*c.* Planning procedures for Hawk defense design are contained in appendix II.

#### **82. Forward Area AD Weapon Deployment**

*a.* Forward (division) area air defense is deployed to protect the maneuver elements against enemy aircraft operating at low altitudes and to prevent them from interfering with the mission of the unit. AD measures will be both passive and active.

*b.* The active air defense mission is accomplished by engaging all aircraft identified as enemy or which have demonstrated hostile intent. As much attrition as possible is effected on aircraft endeavoring to penetrate to the rear at very low altitudes. The forward area AD mission is also accomplished when deployment of forward area weapons causes attacking aircraft to operate at higher altitudes within reach of other long range AD missile systems.

*c.* Forward area weapon battalions, if allocated to the field army, may be deployed to defend infantry, armored, and mechanized brigades, artillery units, march columns, assembly areas and other critical points.

*d.* Caliber .50 heavy barrel M2 machineguns, as authorized by TOE or table of allowances, are deployed in the division forward area to protect divisional units against hostile air activity.

*e.* Deployment guidelines and planning procedures for AD automatic weapon system defense design are contained in appendix III. Redeye defense considerations are included in section VII, appendix II.

## Section IV. OPERATIONS

### 83. General

a. Air defense operations are *coordinated* with other current tactical and tactical support operations by air defense elements in the field army, corps, and division tactical operations centers. Air defense brigades and groups are provided personnel and equipment by TOE and TOE augmentation for an air defense element (ADE) to coordinate AD operations in the tactical operations centers at army and corps. Present communications equipment authorized for the ADE may be insufficient to establish required coordination links, in which case additional equipment must be provided. No personnel or equipment is presently provided by TOE or TOE augmentation to accomplish AD tactical operations center functions at the division. Air defense element functions in the tactical operations centers are discussed in paragraphs 84 through 88.

b. Air defense operations are *conducted* by AD commanders, operating from Army air defense command posts (AADCP). AADCP operations are discussed in paragraphs 89 through 98.

c. Special considerations for use of the AD nuclear and surface-to-surface capabilities are presented in paragraphs 99 and 100.

### 84. Field Army Tactical Operations Center (FATOC)

(fig. 18)

The FATOC is established by the field army commander to assist in the tactical operation aspects of his exercise of command. The FATOC is manned by representatives of the general and special staff sections concerned with tactical operations and tactical support. These representatives assist the field army commander by providing information on current tactical operations and the tactical support available, making recommendations for command decisions, accomplishing coordination of combat and combat support operations, and taking action and issuing implementing instructions on operational matters within the scope of policy and command guidance.

### 85. Air Defense Element (ADE), FATOC

a. *General.* The field army AD officer, or a designated representative, exercises general supervision of the operation of an air defense element at the FATOC. The ADE performs the primary functions of coordinating Army AD operations with other tactical and tactical support operations, and coordinating the utilization of the airspace over the field army. A detailed SOP, based on current Army doctrine and guidance for the conduct of operations in the tactical operations center, must be developed for the ADE. Comprehensive training of ADE personnel in their duties, functions, and procedures is required. Frequent participation in field training and command post exercises is needed to test personnel, procedures, and equipment.

b. *Chief ADE.* The chief of the ADE advises other elements of the FATOC on capabilities and employment of AD and insures coordination of current Army AD operations with other current tactical operations. He keeps other interested FATOC elements informed of the status of AD means to include availability of AD surface-to-surface capabilities.

c. *ADE Authority.* The chiefs of the individual FATOC elements, as well as the officer in charge of the FATOC, are normally delegated authority to make decisions within the scope of policy and command guidance. The degree of authority delegated is determined by the commander and will vary with circumstances and experience.

### 86. ADE Functions

The ADE is responsible for coordinating current AD operations with other tactical and tactical support operations. The ADE —

a. Recommends changes to field army AD priorities, unit allocations, and ammunition allocations as changes in the situations dictate.

b. Recommends modification of the AD SOP, AD plan, and other policies and directives in accordance with the requirements of the current situation.

c. Coordinates the surface-to-surface fires of AD units with other fire support means and

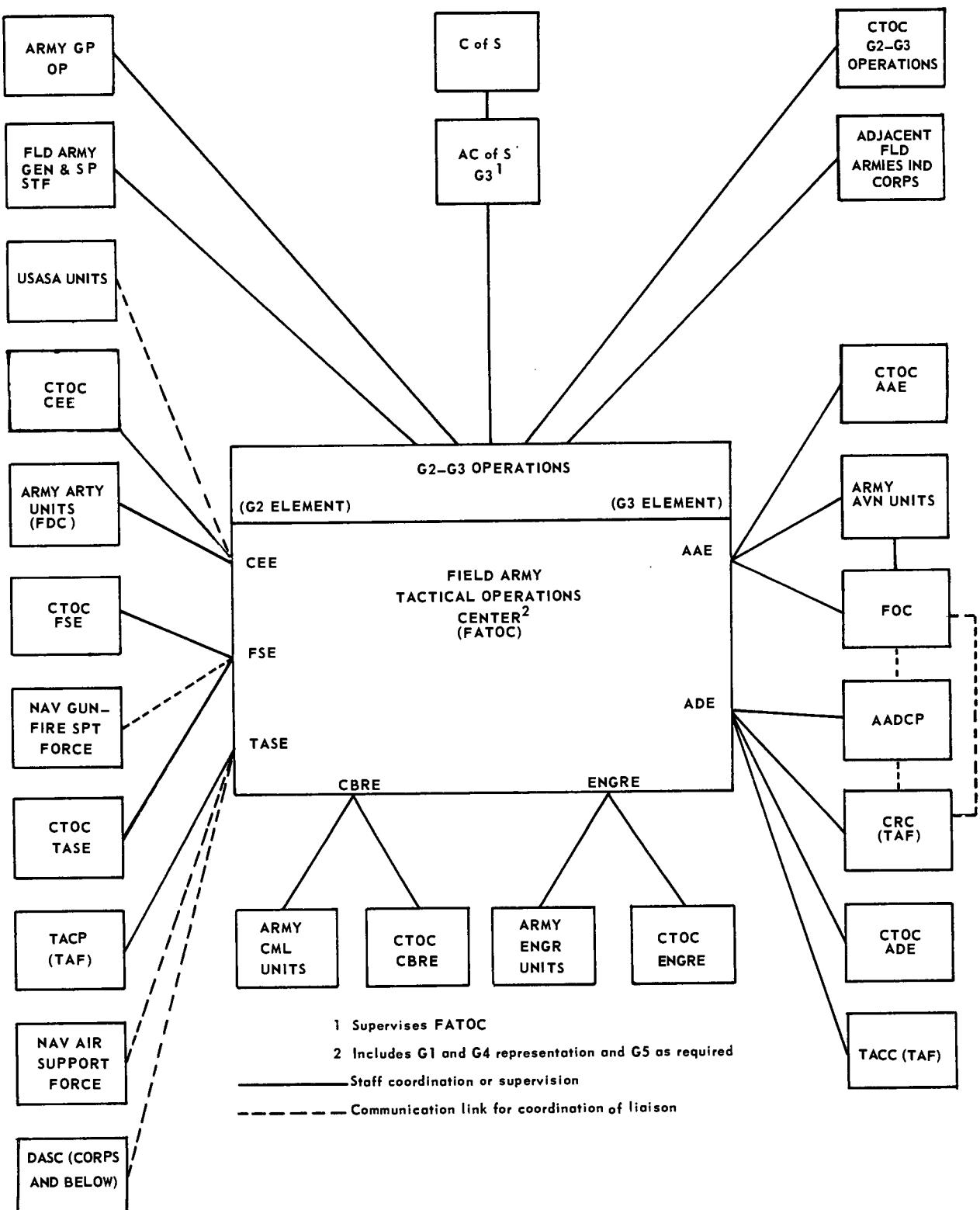


Figure 18. Field army tactical operations center (FATOC).

other combat elements. (See para 100 for details.)

*d.* Coordinates Army AD operations with other services in the army area.

*e.* Monitors other tactical and tactical support operations to minimize interference with the effectiveness of the AD system.

*f.* Issues supplementary instructions to Army AD units, as required by the situation, in compliance with established policies and procedures.

*g.* Coordinates the use of nuclear weapons in air defense operations.

(1) Revises minimum heights of nuclear weapon burst in light of the current tactical situation and in consonance with established rules for engagement and theater directives.

(2) In coordination with the Army aviation element (AAE), tactical air support element (TASE), and fire support element (FSE), recommends nuclear-safe areas for aircraft outside corridors, as appropriate, and in consonance with established rules for engagement.

(3) Advises the FSE and the G3 element on the use of AD means for nuclear attack of surface targets. (Further details on use of nuclear AD weapons are presented in para 99 and 100 and para 6, FM 44-1A.)

*h.* Prepares the airspace utilization plan for current operations in coordination with the AAE, TASE, and FSE. This plan will become the airspace utilization annex (see app V for sample) to the current operations order and will be based upon the overall field army plan for coordination of airspace utilization (para 74d). The minute-to-minute coordination required is normally decentralized to the appropriate AADCP, Army flight operations centers (FOC), Air Force control and reporting centers (CRC), and Navy tactical air control centers (TACC).

*i.* Exercises supervision of the application of electronic security (ELSEC) measures by AD units.

*j.* Compiles statistical data and operational reports on AD operations as a basis for planning.

*k.* See FM 101-5, TC 44-8, and TC 101-2 for details regarding ADE operations.

## **87. Independent Corps or Independent Division Tactical Operations Centers**

*a.* The staff responsibilities and functions of the ADE of an independent corps tactical operations center (ICTOC) or independent division tactical operations center are essentially the same as those described for the ADE of a FATOCC. Modification of certain procedures is required because the TOC of an independent corps or division is closer to the conduct of operations; therefore, theater or task force coordinating procedures may vary. Coordination between the independent corps or independent division and other services is authorized.

*b.* Functions, such as coordination of the utilization of the airspace, performed by the ADE at corps and army must be accomplished in the DTOC regardless of whether or not AD units are attached to the division.

## **88. Corps or Division Tactical Operations Centers (CTOC and DTOC)**

*a.* The staff responsibilities and functions of the CTOC and DTOC elements are essentially the same as those described for the FATOCC. Coordination by a TOC with other services to establish policy and joint operating procedures is normally not accomplished below field army, independent corps, or independent division level. However, recommendations on AD coordination with other services are forwarded by the CTOC or DTOC — after command approval — to the TOC of the next higher echelon.

*b.* Paragraph 87b applies.

## **89. AADCP, ADA Brigade**

*a.* The brigade AADCP is the tactical headquarters of the ADA brigade commander. The brigade AADCP collects and evaluates information and disseminates AD intelligence to field army AD units. The brigade commander exercises command and coordination of field army AD units through the AADCP's. The brigade is not normally involved in the minute-to-minute conduct of the air battle.

*b.* The ADA brigade commander will designate a group AADCP as an alternate brigade AADCP. The alternate brigade AADCP will assume the functions of the brigade AADCP if the brigade AADCP goes out of action.

c. Detailed capabilities, characteristics, and operations of the various types of AADCP and fire distribution system equipment are contained in FM 44-8.

## 90. AADCP, ADA Group

The group AADCP is the tactical headquarters of the ADA group commander. The group normally has organic electronic fire distribution equipment, such as the Missile Monitor system, which is electronically connected to the assigned battalion's fire distribution equipment and where possible, to the nearest CRC or other control center having electronic equipment. This equipment may be used by the group commander to exercise fire distribution, supervise fire unit operations, and exchange information with brigade, adjacent AADCP's, FOC's, and Air Force control facilities.

## 91. Air Defense Coordination

a. Close coordination is maintained between AD forces or elements of the services to insure unity of action and to exchange information with respect to capabilities, intelligence, operating procedures and other information concerning AD activities.

b. The AD brigade has one organic tactical air control center section which provides an Army augmentation element at the Air Force tactical air control center (TACC). However, when authorized by Department of the Army or the Army component commander, the brigade will be augmented with as many sections as necessary to provide Army elements at the Air Force control and reporting center (CRC).

c. The AD group has no organic TACC or CRC sections. However, when authorized by Department of the Army or the Army component commander, the group will be augmented with as many sections as necessary to provide Army elements at the Air Force control and reporting center (CRC) or control and reporting post (CRP).

## 92. Air Defense Operations Officer Functions

An AD operations officer assigned to the Army element at the TACC, CRC, or CRP performs the following functions —

a. Advises the TACC, CRC, or CRP director on Army AD matters and the employment of Army AD.

b. Supervises operation and training of the Army element personnel.

c. Takes part in planning conferences.

d. Informs the TACC, CRC, or CRP of the current status and coverage of Army AD weapons and radars.

e. Advises the Army AD commander of current and planned friendly air activities and of the evaluation of the enemy air threat.

f. Informs the Army AD commander of the current status of other elements of the air defense system.

g. Insures that timely air surveillance information and intelligence is passed to the AADCP.

h. Insures that track information and intelligence is received from the AADCP and passed on to appropriate agencies within the TACC, CRC, or CRP.

i. Requests identification of all plots originating in the AADCP and not displayed in the Air Force facilities.

## 93. Weapon Control Statuses

a. The AD commander determines the weapon control status best suited to the particular defense situation. It is orally put into effect and does not require system changes. AD unit procedures for each control status are established in detail in the AD SOP's.

b. In the *decentralized* control status, the fire unit commander selects and engages targets in accordance with AD SOP's and the use of reference data furnished by Army and Air Force sources. The group or battalion provides the most accurate information available and monitors fire unit actions, overriding fire unit target selections whenever deemed necessary. This control status provides for maximum reaction when the raid size approaches the maximum handling capability of the defense.

c. In the *centralized* control status, target assignments are made directly from group or battalion. Fire units are only permitted to engage designated targets. The defense effort is conducted by the AD commander through fire distribution and supervision of fire unit opera-

tions. This control status would be efficient when few aircraft are attacking the defense.

*d.* A combination of the control statuses may be desired for the defense, or sectors of the defense may be designated for operation under different control statuses.

## 94. Missile Monitor Methods of Operation

*a.* The Missile Monitor fire distribution system (para 14) is capable of operating in six different switch-selected methods. Three of the methods are for use during tactical operations and are described below. The other three methods, used during emergency operations or during installations after a displacement has occurred, are described in FM 44-13.

*b.* The *normal* method of operation provides 2-way automatic data link (ADL) between all units in the system. The AD group can send selected reference data and commands to, and receive tracking data from, all fire units. The battalion enters local radar data into the system and monitors the action.

*c.* The *sector* method of operation provides 2-way ADL between the AD group and selected battalions of the defense and limited ADL with the other battalions. In this method, the AD commander retains supervision of the selected battalions. The other battalions receive reference data from the group, but the battalion commander supervises operations of his own fire units.

*d.* The *independent* method of operation provides ADL between an AD battalion and its fire units, but does not provide ADL to the AD group or other battalions. The battalion is the highest echelon in this system. In this method, means may be established for the battalion to receive data from TAF and exchange data with adjacent AADCP's.

## 95. Coordination of Use of the Airspace

*a. Responsibility.* Within a theater of operations, the control and coordination of airspace, together with air defense, will be assigned to a single agency by the unified commander. Normally, this agency will be the air component command of the unified command.

*b. Airspace Users.* The major users of the airspace over the field army are the air components of the other services, Army aviation, Army ar-

tillery, and Army air defense. All require maximum freedom of operations in order to accomplish their missions.

*c. Mission Interrelation.* Since performance of the force mission requires the use of aircraft and requires Army AD to destroy aircraft, and both activities are to be accomplished in the same airspace, aviation and Army air defense operations must be coordinated to —

- (1) Insure that enemy aircraft are engaged.
- (2) Insure that friendly aircraft are not engaged.

*d. Identification.* The mission interrelation defines the major function which is of common interest to both the aviation and Army air defense systems — *identification*. As stated in the foreword to this manual, when a secure and reliable electronic means of assuring rapid aircraft identification is available, the coordination required to fulfill this function is readily and simply accomplished. In the current time period, coordination for identification purposes must be accomplished as follows:

- (1) Coordinated planning of major air operations (para 83-88).
- (2) Adherence to identification criteria in the prescribed rules for engagement, which may be restrictive to one or both of the systems. Rules for engagement are covered in paragraph 96.
- (3) Exchange of information on specific flights not covered by (1) and (2) above. Information exchange facilities and procedures are covered in paragraphs 67 and 97.

## 96. Rules for Engagement

*a. General.* Rules for engagement govern air defense fires at air targets. Such rules are normally prescribed by a unified, joint, or task force commander, and are incorporated into the standing operating procedures of all affected units. The air defense rules for engagement must be flexible enough to adjust to changes in the offensive-defensive relationship. Any rules established must accommodate considerations of national policy and immediate political considerations germane to the area of operations.

## b. Sample Rules for Engagement.

- (1) After the announcement of a state of air defense emergency, all aircraft will be engaged which are determined to be hostile by any one or combination of the following means:
  - (a) Identified by responsible authority and track-told to the fire unit.
  - (b) Identified by lack of proper IFF response.
  - (c) Operating in a restricted area (established by codes). This rule would be especially useful when a heavy threat exists or there is a saturation of facilities.
  - (d) Employing ECM unless mission has been prearranged.
  - (e) Operating at prohibited speeds, altitudes, or directions.
  - (f) Committing hostile acts, as defined in theater policy.
  - (g) Visually identified as hostile, as defined in theater policy.

*Note.* Rules (f) and (g) are the only rules considered appropriate for visually directed forward area air defense systems.

- (2) Friendly aircraft will not be engaged. Friendly identity may be established by any one or combination of the following means:
  - (a) Passed as friendly track(s) to the fire unit by responsible authority.
  - (b) Returning a friendly IFF response.
  - (c) Operating in a designated "safe" area (established by codes). Such areas should be employed only when necessary to protect a friendly air operation. This condition may be established when there is a light threat and all tracks can be continuously monitored.
  - (d) Operating below a specified ground speed within a designated area or altitude zone.
  - (e) Executing prescribed emergency patterns.
  - (f) Visually identified as friendly.

- (3) When conflicting identity is established, precedence for action should depend upon criticality of the defended area and be as established in SOP.

## 97. Army Information Exchange Facilities

a. Exchange of information between Army AD and Air Force air defense/air traffic control facilities is described in paragraph 67.

b. Information regarding Army aviation flights is received from Army flight operation centers (FOC) and Army flight coordination centers (FCC) located throughout the field army area (fig. 15). Areas of responsibility of these facilities will normally coincide with those of the AADCP's.

c. Total dependence for identification should not be placed upon this method of minute-to-minute exchange of information. Considering the technical limitations of the information systems, and the direct relationship of combat confusion and battle losses with the degree of exchange of information, such dependence will tend to result in failure in combat. Therefore, the minute-to-minute information exchange method of obtaining identification should be reserved to handle the "special cases" and for emergencies.

## 98. Air Attack Warning

a. Units in an area of operations maintain radio receivers in an area warning net for receipt of broadcast air attack warning and other urgent operational information.

b. SOP should direct AADCP's to enter the area warning net as required to broadcast urgent air attack warnings to combat units and headquarters in the area. This procedure will insure timely warning when forward air defense units are the first to detect an air attack.

## 99. Use of AD Nuclear Weapons

### a. Employment Decision.

- (1) The decision to initiate employment of nuclear weapons will be made at the predesignated governmental level.
- (2) Once the decision is made, the allocation of nuclear weapons to a commander carries with it the authority to use them in combat, after certain predesignated conditions are met. All nuclear

rounds in the theater of operations are normally allocated to the unified commander who further allocates them to the component commanders.

- (3) Nuclear weapons may be employed in the theater of operations when the unified commander announces that their use is authorized. Once nuclear warfare has commenced, the authority to employ nuclear weapons is decentralized. The ADA missile battery must then be given the authority to use its nuclear weapons, *subject to rigid conditions specified in SOP's based on theater policies*. The rapid reaction required of an ADA missile battery defending the field army against nuclear attack does not permit involved coordination procedures.

b. *Minimum Normal Burst Altitude*. Minimum normal burst altitudes for each type of AD nuclear weapon must be established. The commander who commands both AD forces and maneuver or logistical units evaluates the damage that may occur from a friendly air defense burst and compares it with the risk posed by the enemy threat. Based on this evaluation, he determines the risk (*c* below) he is willing to accept. For each risk level, there is an associated minimum normal burst altitude (MNBA) below which the weapon is not normally employed. The MNBA is defined as a minimum height of burst *above terrain* which will result in acceptable effects on the surface. MNBA's have been precomputed for each risk and warhead, are shown in FM 101-31-2, and should be included in AD SOP's. An appropriate MNBA is pre-selected by the commander who has knowledge of both the air threat and the ground situation. MNBA selection is based on the unified commander's policies and guidance. To minimize the restrictions imposed upon air defense, the MNBA providing either moderate or emergency risk (nuclear) is most commonly employed in the theater of operations.

c. *Risk Altitudes*. The negligible, moderate, and emergency risk (nuclear) altitudes are defined and discussed in FM 101-31-1.

d. *Employment of Nuclear Weapons Below the MNBA*. The restrictions on AD imposed by the MNBA cause formation of a "safe corridor"

at low altitudes. Failure to engage hostile aircraft or missiles in this corridor permits enemy entry into defended areas. Detailed procedures must be established to preclude such entry.

- (1) Nonnuclear warheads may be employed below the MNBA.
- (2) Nuclear weapons can be employed below the MNBA when the engagement takes place over enemy-held territory or unpopulated (para 6d, FM 44-1A) areas. Engagement below the MNBA over enemy-held terrain, but close to friendly troops, requires that AD units observe troop safety distances (FM 101-31-2) for unwarned exposed personnel. AD unit commanders must keep informed of the areas where employment below the MNBA is permitted.
- (3) The commander who commands both AD forces and maneuver or logistical units may decide that destruction of hostile aircraft or missiles is so great a tactical necessity that he is willing to risk casualties among his own troops. In such circumstances, he authorizes employment of the nuclear AD weapons below the MNBA. Rules for nuclear weapon employment below the MNBA are prescribed by the unified commander or his designated representative. Authorized violation of the MNBA must be rigidly controlled.

e. *Air Defense Nuclear Effects on Friendly Aviation*. Prior to or at the moment of firing a nuclear warhead, AD fire units inform the AADCP of the predicted location of the nuclear burst. The AADCP will broadcast nuclear burst warnings as specified in SOP. Most pilots will be warned in sufficient time to minimize the danger of flash-blindness. However, the warning will not usually be received in time to allow pilots flying low performance aircraft in the vicinity of the predicted burst to reach safety. The risks involved are accepted when the air threat justifies use of nuclear AD weapons.

f. *Planning and Coordination*.

- (1) Early in the planning stages for the air defense of a particular area, a detailed terrain analysis of the area is conducted. This analysis includes the

location of critical military installations and a general survey of the troop and population density. This information, coupled with the commander's guidance, permits the application of the risk altitudes to the engagement area of the AD units.

- (2) Details of nuclear weapons planning and employment are presented in FM 101-31-1 and FM 101-31-2.

g. See paragraph 6, FM 44-1A, for classified nuclear weapon employment doctrine.

## **100. Coordination of AD Surface-to-Surface Capabilities**

The nuclear surface-to-surface fire support missions by AD units are planned and coordinated by the fire support element (FSE) with the ADE. Weapons allocated for field army air defense are not employed in the surface role without specific authorization of the commander making the allocation. If any nuclear AD weapons are allocated to the field army specifically for use in the surface role, field army SOP should permit their expenditure in the air defense role when deemed necessary by the field army air defense officer.

a. *Supervision and Coordination of Surface-to-Surface Fire Support Operations.* The chief of the FSE supervises the preparation of the fire support annex to the operations order and reviews the component fire plans (artillery, air, naval gunfire, and the nuclear portions of each if prepared separately) to insure that all surface-to-surface and air-to-surface fires are integrated. He also coordinates with ADE on use of the airspace, with CBR element (CBRE) on

the CBR plan, with engineer element (ENGRE) on the barrier plan, and with ADE for fires to be used to attack surface targets. He then submits the fire support plan to the G3 element for the integration of fire with maneuver.

b. *Recommendation of the Allocation and Re-allocation of Nuclear Weapons to be Delivered by Army Surface-to-Surface Means.* Based on the commander's concept of the operation, missions assigned to subordinate commands, and the command relationship established between the subordinate commands and the surface-to-surface fire support units, the chief of the FSE prepares a recommended allocation or reallocation of nuclear weapons. This recommendation is coordinated with the chief of the G2 element (known or potential targets in the zone of the command receiving the allocation), chief of the G3 air group (weapons to be delivered by tactical air), chief of ADE (Army air defense means to be used in a surface-to-surface role), chief of the ENGRE use of atomic demolition munitions (ADM), and the G4 representation in the FATO (feasibility of distributing the weapons to support the allocation or reallocation).

c. *Recommendation of Targets To Be Attacked With Nuclear Weapons.* Based upon target intelligence received from the G2 element, the FSE evaluates targets continuously as they develop. The FSE recommends to the G3 element those targets that should be attacked with nuclear weapons. These recommendations are coordinated with the G3 air group (targets to be attacked by tactical air), ADE (tentative air-space authorization), ENGRE (when use of ADM is recommended), and the CBRE (when significant fallout may result).

## **Section V. DISPLACEMENT OF AIR DEFENSE UNITS**

### **101. General**

a. The field army commander and subordinate commanders will maneuver their assigned or attached AD units as necessary to support their operations. The region and area AD commanders must be kept informed of major displacements of Army AD missile units.

b. The air defense officer at field army or corps level normally designates the approximate loca-

tions of the AD units, using the principles outlined in chapter 5. Initial selection of positions may be based on map, aerial, or ground reconnaissance.

### **102. Movement of Units**

a. A frequently desirable technique for AD unit displacement is leap-frogging, wherein batteries of a battalion are moved one or two at a time. This technique minimizes vehicle and

road space requirements and maintains maximum AD support during the move.

b. The long-range capability of Nike Hercules missile units tends to reduce the requirement for frequent moves. Normally, one battery in each battalion is moved at a time. Engineer support should be made available to assist the unit in preparing the new position.

c. Hawk units can move rapidly by motor or air transport. Their method of displacement should be governed by the following considerations:

- (1) Required levels of defense in the old and the new areas.
- (2) Limitations on the low altitude capabilities of enemy aviation due to darkness and weather.
- (3) The ability of a Hawk battery to provide limited air defense with one firing section while moving the other.

d. The ADA missile battalion accomplishes route and position reconnaissance, position selection, and occupation of position as described in FM 44-95 and FM 44-96.

## Section VI. COMMUNICATIONS

### 103. General

In the field army, the connecting facilities between AD units will be provided by organic communications equipment, area communications systems, and by special communications support requested from the field army commander. These systems will provide the high-quality automatic data link network and voice communications connections needed for an efficient AD system. Emergency backup for all tactical communications should be provided by alternate routes.

ments for communication support must therefore be submitted to the field army commander in whose area the AD unit is operating. Army signal support units with the communications equipment and personnel to maintain and operate this equipment should then be made available to meet the AD requirement.

b. Several factors must be considered in determining the communications requirements to be submitted to the field army commander.

- (1) *Number of units in the defense.* Necessary radio relay terminal equipment must be provided at each fire unit, and additional radio relay terminal equipment must be provided at each higher echelon in the defense.
- (2) *Tactical employment.* The distance and type of terrain between units may require the use of radio relay repeater stations.
- (3) *Future deployment.* The number of radio relay terminal and radio relay repeater stations necessary for communication in one area may not be sufficient for operations in a new area in which AD units may have to be deployed.
- (4) *Anticipated combat losses.*
- (5) *Types of data passed between elements of the defense.* The communications equipment provided by the signal support unit must be capable of providing automatic data link, voice, and tele-type communications.

### 104. Responsibility

a. The Army AD commander is responsible for the establishment of an effective communications system to be used by each element of his command in carrying out its assigned mission. The signal or communication officer of each unit is responsible to the commander for the proper installation, operation, and maintenance of the communication equipment used by that unit and will advise the commander on matters pertaining to its employment.

b. All requests for additional communications support will be coordinated with the field army commander or his designated representative, normally the field army signal officer.

### 105. Planning

a. Current AD unit TOE's do not provide the communication equipment required to completely support tactical operations when using AN/MSG-4 Missile Monitor equipment. Require-

## 106. Employment

- a. To meet the communications requirements for air defense operations when using AN/MSG-4 Missile Monitor equipment, a VHF/UHF radio relay system is established using attached or augmented signal support units.
- b. The minimum communication links that must be provided by this system between a battalion and its fire units include one automatic data link and three voice channels —
  - (1) *Command.*
  - (2) *Operations.*
  - (3) *Intelligence/radar reporting.* This is operated full duplex on one channel providing facilities for transmission of intelligence from higher to lower echelon and radar reporting from lower to higher echelon.

*Note.* These channels must use sole-user channels capable of providing full duplex operation. Additional links, such as administrative/maintenance may be provided as the commander directs. Additional communication support requirements on a common user basis are normally coordinated through the nearest army signal center; additional communications support on a sole-user basis depends on equipments available from augmentation resources, or on channels that may be obtainable through the field army area communications system.
- c. For liaison and coordination, the AD units should utilize common user channels available through the field army area communications system.
- d. In a static situation, control of radio relay stations (a above) should be at brigade or group level. As the situation becomes fluid, the control of relay stations should be at battalion level.
- e. Any additional communications means available, such as commercial circuits, land lines, and area communication systems, should be considered for alternate communications.

## 107. Backup Communications

- a. Should the VHF/UHF radio relay system or the Missile Monitor equipment fail, backup communications must be available for manual AADCP operation. Backup communications are established using TOE radio equipment.
- b. The following nets are recommended for use with organic communication equipment:
  - (1) *The command net* is used for command supervision and control, and limited administration and logistical information if a command and administrative net is not available.
  - (2) *The Air Force early warning broadcast net* is used for receipt of early warning and identification from Air Force sources.
  - (3) *The Air Force liaison net* is used for exchange of information between the AADCP and an Air Force installation.
  - (4) *Other liaison nets* are used for exchange of information between the AADCP and other units such as adjacent AADCP's, FOC's, FCC's, Navy, armor, and infantry units.
  - (5) *The radar reporting net* is used for transmission of radar plots from defense acquisition radars directly to the AADCP.
  - (6) *The intelligence broadcast net* is used for transmission of plot-tell and warning information from the AADCP to fire units. Information transmitted includes the location and identity of airborne objects, emergency warning, and similar information. Acknowledgements by receiving units are made over the radar reporting net.
  - (7) *The operations net* is used for voice transmission of tactical information relative to air battle operations such as after action reports, rounds expended, engagement results, weapon status, states of alert, and action status.
  - (8) *The admin RATT net* provides a command and administrative hard-copy facility between higher headquarters and battalion.
- c. Further details regarding use of organic AD communications equipment are presented in FM 44-2, FM 44-95, and FM 44-96.

## CHAPTER 10

### AIR DEFENSE IN SPECIAL OPERATIONS

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#### 108. General

a. Special operations are those in which the terrain, weather, or nature of the operations, or a combination of these influences, creates the need for special techniques, tactics, or equipment.

b. The deployment guidelines for the employment of AD forces involved in special operations are, in general, the same as for any normal operation; however, the tactics and techniques by which the principles are applied may be modified. The problems and differences that arise in special operations are concerned mainly with training, movement, and logistics.

c. In joint task force contingency operations the capabilities of both air and ground forces must be closely coordinated and must satisfy the requirement for centralized direction, decentralized execution, and common doctrine. Joint employment of Army and Air Force AD forces is in accordance with the doctrinal and organizational principles set forth in paragraphs 54 through 61 and JCS Pub 8. When an ADA group or brigade is employed with tactical air force elements in joint task force operations, sufficient ADA personnel are authorized to prepare and coordinate all necessary AD plans and orders and to provide Army augmentation elements at Air Force control agencies. Procedures and duties of Army element personnel are discussed in paragraphs 91 and 92.

d. In small joint task force operations of corps or division size, an ADA battalion and a tactical air force element may be employed to provide air defense. The tactical air force element will normally establish a TACC and the ADA battalion an AADCP. In this type of operation the ADA battalion staff must be aug-

mented with sufficient ADA personnel to accomplish the necessary coordination and liaison with ground forces at the tactical operations center and to provide an Army augmentation element for operation with the tactical air force. Additional communications equipment may also be required to establish the necessary command, control, and liaison nets.

e. Details on special operations are contained in FM 57-10 and in field manuals of the 31-series listed in appendix I. Some additional special considerations and differences in planning, command, control, and weapon allocation during certain special and contingency operations are discussed in the following paragraphs.

#### 109. Amphibious Operations

a. The attainment of air superiority is a requirement for the successful conduct of large scale amphibious operations.

b. During the early stages of the landing, the required air defense will be provided predominantly by shipborne surface-to-air guided missiles, guns, and fighter aircraft. All AD operations will be controlled by the Navy. Control and coordination of AD fires will be set forth in the Navy antiair warfare plan.

c. During the early phases of the landing, control of AD fire units ashore will be by naval control facilities afloat until adequate AD control facilities are established ashore. When Army AD fire units are involved, special arrangements and augmentations must be made to allow control by naval control facilities afloat. When the landing force is established ashore with adequate communications and control facilities, the landing force commander assumes control of tactical land operations, shore party activities, and tactical support activities, to include air de-

fense. This transfer of AD control must be carefully coordinated to insure maximum effectiveness of air defense during the transfer. Upon completion of the amphibious operation, Army AD units will conduct operations as outlined in chapter 9.

## 110. Airborne Operations

a. An airborne operation involves the movement and delivery in an objective area, by air-drop or airlanding, of combat forces and their logistic support for execution of a tactical or strategic mission. Airborne operations may be conducted entirely by parachute, or the combat forces may be airlanded or airmobile. Large scale operations of this type require attainment of air superiority en route and over the marshaling and objective areas.

b. Marshaling areas and departure airfields are defended by theater air defense forces. If Army AD means must be displaced to provide this defense, they should be among the first units to arrive in the marshaling areas.

c. En route air defense is provided by the Air Force and by the fires of any Army AD means available along the route. Air movement plans are coordinated with the appropriate AD commander when air movements are to take place within range of friendly air defense artillery.

d. In major operations, protection of airborne troops landed in the objective area is provided by attached ADA units and by the Air Force. Air defense artillery must be airlanded in the objective area as soon as suitable sites have been seized. Planning factors for air loading of Army AD equipment are contained in FM 101-10.

e. Integration of ADA operations and Air Force interceptor operations in defense of troops landed in the objective area is accomplished basically as described in chapters 8 and 9 and as directed by the unified commander through the area AD commander. During the early phases of operations in the objective area, integration of Army and Air Force air defense efforts will be made more difficult since only limited air traffic regulations and identification facilities will be available.

f. The nature and size of the area to be defended, the threat, and the AD weapons avail-

able will dictate the type of defense to be established. A small area to be defended will be treated as a vital area defense while a larger area could be treated as an area defense.

g. When small-scale airborne operations are conducted without attached air defense artillery, air defense is provided by the Air Force and by organic machineguns and small arms.

## 111. Desert Operations

A larger than normal number of AD fire units may be required to support the field army engaged in desert operations, since the lack of natural cover and concealment makes the army especially vulnerable to air attack.

## 112. Jungle Operations

Effective passive AD is possible for many units engaged in jungle operations, thereby reducing the number of AD units required. The effects of the terrain on active AD operations will usually require autonomous operation by small and highly mobile AD fire units.

## 113. Contingency Operations

a. In joint task force operations, the primary active AD means normally available to the commander will be ADA missiles and tactical fighter aircraft. Hawk units may be employed as part of a joint task force to provide low and medium altitude air defense in contingency operations. When a corps or smaller size task force is employed in an area where no friendly air defense exists, Hawk units may be employed together with Air Force aircraft to provide air defense. When no Nike Hercules units are present the aircraft will provide long range and high altitude coverage in conjunction with the low and medium altitude fires of the Hawk units.

b. The defensive capabilities of both air and ground forces must be closely coordinated and must satisfy the requirement for centralized direction, decentralized execution, and common doctrine. The AADCP and the CRC should normally be collocated and will always be operationally connected.

c. In joint task force operations, Hawk is a highly useful vital area defense weapon, either in the forward area or in defense of important facilities such as airfields, command posts, and

logistic installations. Hawk vital area defenses offset the interceptor aircrafts' frequent inability to prevent vital area penetration by fast, low-level, enemy aircraft. Rapid and frequent Hawk displacement enhances their tactical utilization but complicates the problem of coordination of fire and mutual support; therefore, any integrated control system must be flexible.

*d.* When sufficient Hawk units are included in the task force, weighted air defense coverage will normally be provided for the entire area of operations. Hawk units should be positioned so that coverage is weighted toward low altitude routes of approach and in favor of those areas containing key forces and installations. In this type of deployment, defense in depth and overlapping fires of adjacent units must be maintained.

*e.* If the number of Hawk units available to the task force is insufficient to provide adequate low and medium altitude air defense for the entire area of operations, priorities for Hawk vital area air defense must be established by the joint task force commander. For a discus-

sion of the establishment of air defense priorities see paragraph 24.

*f.* When low and medium altitude routes of approach into a Hawk defended area are available to enemy aircraft from all directions, Hawk units must be positioned to provide all-around air defense coverage. This coverage should be weighted in favor of the routes most likely to be used by the enemy.

*g.* ADA missile effectiveness will be enhanced if units are provided in adequate numbers, early warning from the Air Force tactical air control system is available, plans and SOP are explicit, and engagement control is decentralized to fire unit level.

*h.* In contingency operations involving strong hostile insurgency or enemy guerrilla operations, local security becomes a major consideration in the deployment of Hawk units. Local security of air defense artillery units is discussed in appendix IV.

*i.* Joint task force AD command and organization are basically as described in chapters 8 and 9.

## APPENDIX I

### REFERENCES

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Department of the Army pamphlets of the 310-series should be consulted for latest changes or revision of references given in this appendix and for new publications relating to material covered in this manual.

- |              |  |
|--------------|--|
| AR 320-5     | Dictionary of United States Army Terms.  |
| AR 320-50    | Authorized Abbreviations and Brevity Codes.                                    |
| FM 1-100     | Army Aviation.   |
| FM 11-20     | Signal Operations, Theater of Operations.                                      |
| FM 11-21     | Tactical Signal Communication Systems, Army, Corps, and Division.              |
| FM 21-30     | Military Symbols.  |
| FM 23-65     | Browning Machine Gun Caliber .50 HB, M2.                                       |
| FM 30-5      | Combat Intelligence.   |
| FM 30-30     | Aircraft Recognition Manual.   |
| FM 31-11     | Doctrine for Amphibious Operations.  |
| FM 31-12     | Army Forces in Amphibious Operations (The Army Landing Force).                 |
| FM 31-15     | Operations Against Irregular Forces.   |
| FM 31-25     | Desert Operations.   |
| FM 31-30     | Jungle Operations.   |
| FM 31-60     | River Crossing Operations.   |
| FM 31-70     | Basic Cold Weather Manual.   |
| FM 31-71     | Northern Operations.   |
| FM 31-72     | Mountain Operations.   |
| (S) FM 44-1A | U.S. Army Air Defense Employment (U).  |
| FM 44-2      | Light Antiaircraft Artillery (Automatic Weapons).                              |
| FM 44-7      | Electronic Search Central AN/GSS-1 and Radar Set AN/TPS-1D, 1G, and AN/FPS-36. |
| FM 44-8      | Army Air Defense Command Posts.  |
| FM 44-10     | U.S. Army Air Defense Fire Distribution System, AN/FSG-1 (Missile Master).     |
| (C) FM 44-18 | U.S. Army Air Defense Fire Direction System, AN/MSG-4 (Missile Monitor) (U).   |

(C) FM 44-14	U.S. Army Air Defense Fire Direction Systems, AN/GSG-5(V) and AN/GSG-6 (U).
(CM) FM 44-95	Air Defense Artillery Missile Battalion, NIKE HERCULES (U).
FM 44-96	Air Defense Artillery Missile Unit, HAWK (Battalion and Battery).
(S) FM 44-96A	Air Defense Artillery Missile Unit, HAWK (Battalion and Battery) (U).
FM 57-10	Army Forces in Joint Airborne Operations.
FM 57-35	Airmobile Operations.
FM 100-5	Field Service Regulations-Operations.
FM 101-5	Staff Officers' Field Manual; Staff Organization and Procedure.
FM 101-10 (Part II)	Staff Officers' Field Manual; Organizational, Technical and Logistical Data.
FM 101-31-1	Staff Officers' Field Manual; Nuclear Weapons Employment.
(SRD) FM 101-31-2	Staff Officers' Field Manual; Nuclear Weapons Employment (U).
DA Form 11-47	4/3 Earth Curvature.
DA Pam 310-series	Military Publications Indexes.
TC 44-7	Field Army Air Defense Liaison with Air Force Tactical Air Control System.
TC 44-8	Air Defense Element, Tactical Operations Center.
TC 44-12	Air Defense Artillery Radar Clutter and Coverage Diagrams.
TC 101-2	Tactical Operations Centers.
TM 11-673	Generation and Transmission of Microwave Energy.
JCS Pub 1	Dictionary of United States Military Terms for Joint Usage.
JCS Pub 2	Unified Action Armed Forces (UNAAF).
JCS Pub 8	Doctrine for Air Defense from Oversea Land Areas.
JCS Pub 9	Doctrine for the Unified Defense of the United States from Air Attack.

## APPENDIX II

### ESTABLISHMENT OF MISSILE DEFENSES

#### Section I. INTRODUCTION

##### 1. General

a. Sections I through VI of this appendix pertain to Nike Hercules and Hawk defense design. Section VII presents considerations for employment of the Redeye weapon system.

b. Air defense employment is essentially a problem of deploying fire units and coordinating their fires so that each defense established will maximize the capabilities of the weapon systems against the assumed threat, and still provide adequate defense against variations of the threat.

c. Air defense forces deployed in defense of the United States must insure, as their primary objective, the survival of the U.S. as a nation by limiting the damage inflicted on the basic elements of our national strength. When deployed in defense of oversea land areas, air defense forces must have the objective of limiting the effectiveness of enemy offensive air efforts to a level permitting freedom of action to friendly forces of all types. The task of the AD planner may involve determining the number of AD units to provide a specific degree of protection of an industrial, metropolitan, or military area of strategic or tactical importance; or it may

require planning the best deployment of a fixed number of AD units for any of these areas.

d. Defense design should be influenced and evaluated by computer wargaming, to take advantage of the large number of threat and defense variations which can be accommodated when using this technique. If time or computer availability does not permit wargaming, the hasty design procedures described in this appendix may be used.

##### 2. Sequence

The following sequence provides a logical approach to the problem of establishing a missile defense.

###### a. Planning Phase.

- (1) Define the area to be protected.
- (2) Determine the characteristics of the threat.
- (3) Determine the characteristics of the available defense weapons.

b. Design Phase. Make trial deployments to achieve the optimum defense.

c. Evaluation Phase. Evaluate defense capabilities and advise the commander thereof.

#### Section II. THE PLANNING PHASE

##### 3. Defining Area to be Protected

a. *General.* Areas to be protected are specified by CINCNORAD in CONUS, and by the unified or Army commander in the theater of operations. The commander specifying the areas to be protected may also specify the desired degree

of protection for each area. Given in terms of engagement effectiveness, the specified degree of protection expresses as a percentage the average kill capability of the defense against an assumed raid size ( $n_a$ ). The value  $n_a$  can be computed by the method in paragraph 9c, this appendix.

*b. Defenses.* Defenses fall into two categories —

- (1) *Vital area defense.* Vital area defense is the defense of a limited area or installation, such as a city, military installation, or industrial complex. At present, all Army air defenses in the United States are of this type.
- (2) *Area defense.* Area defense is the defense of a large area such as a field army in a theater of operations. This type defense is normally established for the field army, although certain critical installations within the area may be defended as vital areas.

*c. Defining the Defended Area.* The planner defines the defended area on a map or overlay.

- (1) For a vital area defense, the defended area is defined by the contour of the city or installation to be protected, increased by the radius of effect of the most likely nuclear weapon the enemy may use. These contours have been predetermined for CONUS vital areas and include the commander's specifications as to maximum acceptable damage.
- (2) For an area defense, the defended area is defined by the area's boundaries; e.g., the field army boundaries define the defended area.

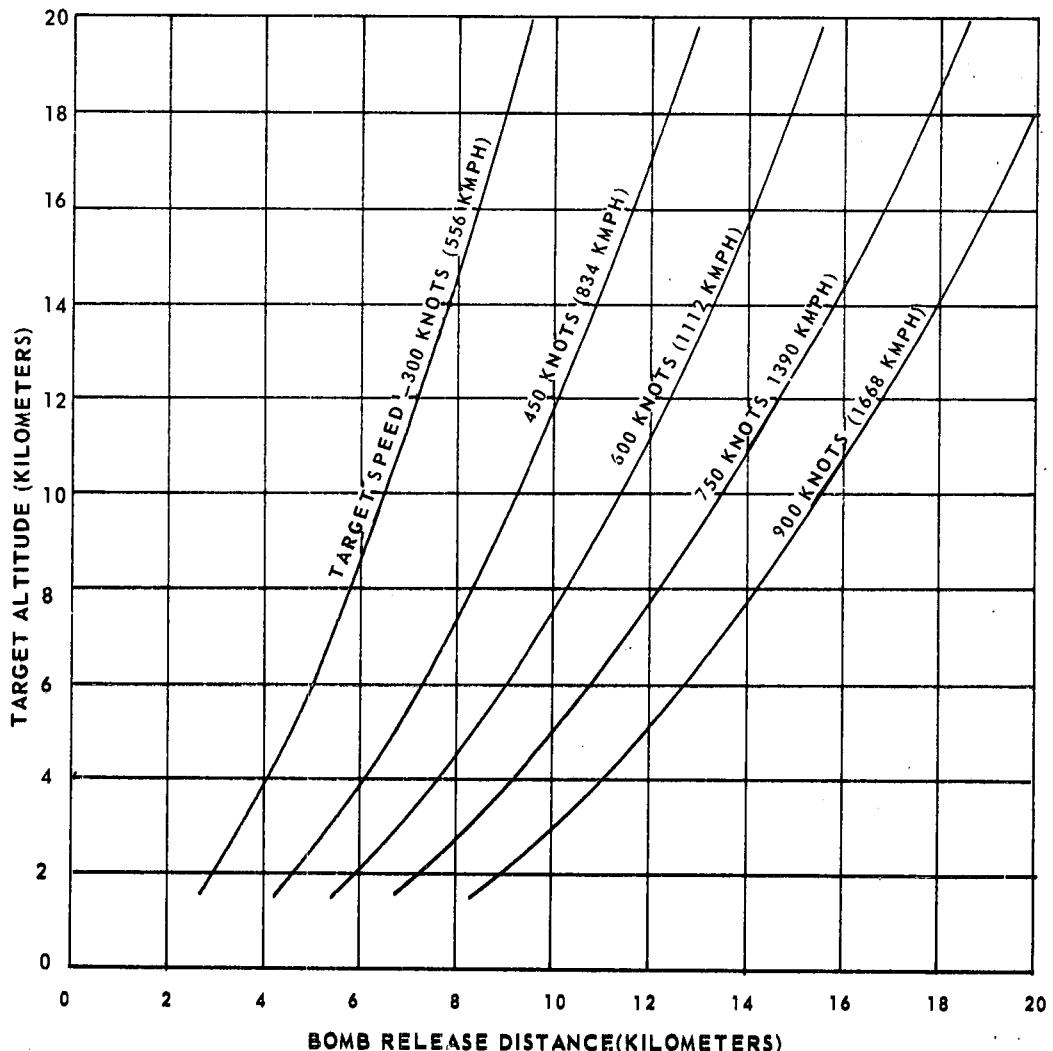


Figure 19. Gravity bomb release distance graph.

#### 4. Threat Characteristics and the Bomb Release Line

*a. The Threat.* The defense planner must make a thorough study of enemy capabilities. The most likely attack speed, altitude, weapons, numbers, and delivery or attack technique must be determined or estimated. The enemy's attack techniques may include conventional high-altitude bombing, use of air-to-surface missiles, low-altitude laydown bombing, or the LABS (low altitude bombing system). The most likely enemy attack capabilities and techniques are the guide in designing and evaluating the defense. The defense is designed so as to provide a balanced effectiveness against those combinations of weapons and techniques that are known to be available to the enemy in meaningful quantity and are evaluated as likely to be employed by him.

*b. The Bomb Release Line — Vital Area Defense.* A bomb release line (BRL), if any, is inscribed around the vital area. This line will be used during the evaluating phase, when "points of evaluation" will be needed.

- (1) If the expected threat is the manned bomber using conventional gravity bombing techniques, the horizontal distance a bomb will fall for certain target speeds and altitudes can be determined from a gravity bomb release distance graph (fig. 19). This distance is measured outward from the edge of the vital area in order to inscribe the BRL.
- (2) For the manned aircraft using the low altitude bombing system (LABS), the BRL can be determined from the assumed altitude, angle, and speed of the enemy aircraft at bomb release, and a mathematical computation of the ballistic trajectory of an object released under these conditions. Lacking estimates upon which to base computations, use of a BRL 20,000 yards (18,300 meters) outside the perimeter of the vital area is recommended.
- (3) For air-to-surface missiles or manned aircraft using the lay-down technique, no BRL is inscribed. In these cases, the perimeter of the vital area will provide the points needed for evaluation.

(4) The point of evaluation is the critical line which must not be reached by the threat.

*c. The Bomb Release Line — Area Defense.* No BRL, as such, is inscribed around the defended area. The area boundaries will provide the needed points for evaluation.

#### 5. Defense Weapons

*a. Allocation.* Although the planner's normal mission is to make the best use of a fixed allocation, there may be situations wherein the planner is to recommend an initial allocation of Nike Hercules fire units for defense of a vital area. For this case, an *initial* planning figure can be determined by the following procedure.

(1) Using figure 20, determine the number of attempted missile launches required to provide the desired probability of killing one target. Nike Hercules system effectiveness (SE) figures are obtained from paragraph 4e, FM 44-1A.

(2) Solve the following formula to determine the firepower required at the BRL or other point of evaluation:

$$M_t = m n_a \text{ wherein:}$$

$M_t$  = Total number of attempted missile launches required to achieve the specified engagement effectiveness.

$m$  = Number of attempted missile launches per target required to achieve the specified engagement effectiveness.

$n_a$  = Assumed number of simultaneously attacking targets.

(3) Determine a planning radius by measuring from the center of the vital area to the farthest point of evaluation. This point may be on the BRL or on the edge of the vital area (para 4b, this appendix).

(4) Use the planning nomograph (fig. 13, FM 44-1A) to determine tentative number of fire units required.

(a) Enter column 1 with the planning radius.

(b) Enter column 3 with the maximum effective range of the target

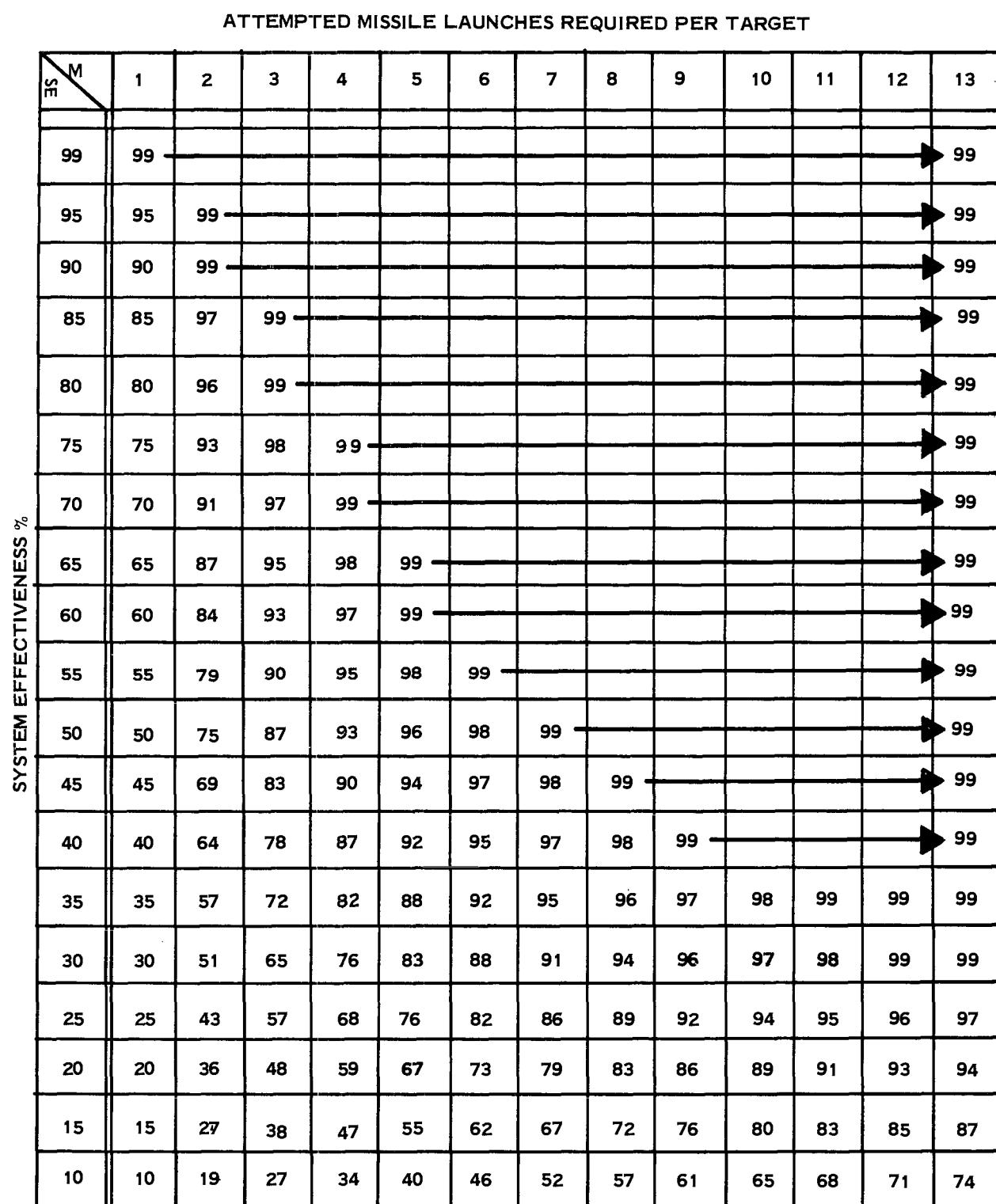


Figure 20. Engagement effectiveness expressed as a percentage.

tracking radar, considering assumed target size, and the effects of earth curvature if the threat technique is low-altitude attack.

Table III, FM 44-1A, provides the information necessary to determine effective target tracking range as a function of target size.

- (c) Inscribe an index mark on column 2 by connecting the points indicated on columns 1 and 3.
- (d) Enter column 4 with the previously computed quantity  $M_t$ .
- (e) Connect the column 2 index mark and the column 4 point marked. An extension of this connecting line determines the column 6 index mark.
- (f) Connect the column 6 index mark with a point in column 5 corresponding to assumed speed of the threat. An extension of this connecting line determines the point on column 7, fire units required.
- (5) The nomograph may also be used to determine the theoretical capabilities of an existing vital area defense; e.g., given the number of fire units available and the threat characteristics, the  $M_t$  capability for a defense can be determined.

*b. Defense Characteristics.*

- (1) *System effectiveness (SE).* See glossary for definition. Specific SE figures are contained in paragraphs 3g and 4e, FM 44-1A.
- (2) *Engagement effectiveness (EE).* See glossary for definition. Specific EE figures for a given SE and number of attempted missile launches may be obtained from figure 20.
- (3) *Operational assumptions.* Certain operational characteristics of the system being employed; e.g., maximum range, rate of fire, reaction time, and dead zones, will affect the defense and must be considered by the defense planner and accounted for when evaluating the defense.

*c. Deployment Guidelines.* Deployment guidelines for air defense differ depending on the weapon system and type defense (vital or area defense).

(1) *Nike Hercules (vital area).*

(a) *Balance.* A balanced defense is one which can deliver an approximately equal amount of firepower along all directions of attack at the point of evaluation.

(b) *Position requirements.* The position selected must meet tactical, technical, and electronic security requirements.

1. *Tactical requirements.* Certain tactical requirements such as combat operations plans, road space requirements, available terrain, proximity to the forward edge of the battle area (FEBA), and mutual support must be considered. Mutual support is the ability of one fire unit to deliver effective fire into the dead zone of an identical adjacent fire unit. Mutual support strengthens the defense by providing overlapping fires, and allows a unit to go out of action leaving a gap in the overall defense. Mutual support is achieved by positioning identical units no farther apart than eight-tenths of effective missile range. If eight-tenths range separation is exceeded, mutual support cannot be achieved. A degree of effective overlapping fires will be retained until separation exceeds 1.6 effective range. At this time, weaknesses may appear in the defense coverage.

2. *Technical requirements.* These requirements, which include equipment line-of-sight, cable lengths, and minimum antenna depression angles, must be satisfied to insure proper system operations.

3. *Electronic security requirements.* When feasible, AD radars should be sited to take advantage of terrain masking which would prevent enemy signal intelligence devices from sampling and analyzing radar electromagnetic emissions. Frequency assignments to AD units must also be taken into consideration.

(2) *Nike Hercules (area defense).*

(a) *Weighted area coverage.* A primary consideration for deployment of Nike Hercules in an area type defense is weighted area coverage. Fire units are deployed to provide proper coverage throughout the

area being defended, weighted towards exposed boundaries and priority areas.

- (b) *Position requirements.* (See (1) (b) above.)

(3) *Hawk.*

(a) The Hawk missile system is deployed forward along low-altitude routes of approach to achieve early destruction of low-flying targets.

(b) Defense in depth: Some fire units should be positioned to the rear of those deployed forward to add depth to the defense and provide a degree of flexibility and continuity of fire.

- (c) *Position requirements:* (See (1) (b) above).

### Section III. THE DESIGNING PHASE

#### 6. Trial Deployments

a. *General.* Defense design involves the trial deployment of fire units consistent with the deployment guidelines. Although the final deployment may vary somewhat from the planner's recommended deployment, his recommendations serve to focus fire unit efforts during reconnaissance, selection, and occupation of position.

b. *Vital Area Defense.* To counter mass attacks from a single direction, and at the same time maintain effective fire against multiple directions of attack, the best deployment pattern would probably be one in which some units are deployed at greater distances from the center of the vital area than other units. However, this probably would require too many units. The following trial deployment is recommended:

(1) *Composite defense.*

(a) Place Nike Hercules fire units approximately equidistant apart, and far enough from the center of the vital area to deliver maximum firepower at the points of evaluation. If the vital area has an irregular or unusual configuration, the distance between units may have to be varied in order to maintain balance at the points of evaluation.

(b) Place Hawk fire units along low altitude routes of approach, according to the priority established for each.

- (2) *Hawk defense.* Place Hawk fire units in the most advantageous positions to provide adequate coverage of low altitude routes of approach and as much balance as possible.

c. *Area Defense.* In an area defense, the AD mission is to provide coverage of the airspace over the entire defended area. Trial deployment criteria for Nike Hercules and Hawk are as follows:

- (1) Deployment of Nike Hercules units is made to provide weighted area coverage. The coverage is weighted toward exposed boundaries and, in some cases, toward priority areas. Mutual support should not be sacrificed. Normally, Nike Hercules units are employed no closer to the FEBA than 30 kilometers (out of range of conventional enemy artillery).

- (2) Hawk fire units are deployed along low-altitude routes of approach. These routes are determined by considering gaps and weaknesses in the Nike de-

fense, and natural low-altitude approaches. Hawk units are then deployed well forward along these routes to exploit system range, although normally no nearer the FEBA than 10 kilometers (out of range of most conventional artillery and ground observers). As with the Nike Hercules units, Hawk units should provide mutual support.

*d. Terrain Difficulties.* A map and ground reconnaissance of the tentative positions will invariably encounter terrain difficulties. The two major categories of terrain difficulty are emplacement and masking. Either difficulty will cause changes in the basic defense design.

## **7. Emplacement Difficulty**

*a.* An emplacement difficulty is encountered when a fire unit cannot be placed in the area initially selected because of land cost, nonavailability, nonaccessibility, local security requirements, or other considerations.

*b.* Those units that would normally be plotted in the unusable area are moved to the nearest usable area. Because it has been necessary to move a unit away from the optimum position, other units may have to be moved to regain balance and maximum capability. The evaluation phase will show whether additional moves are necessary.

*c.* Emplacement of Nike Hercules units may be complicated by the desire to provide rocket motor cluster impact areas (para 4*j* FM 44-1A). Such areas should be provided if possible, but not at the expense of defense effectiveness.

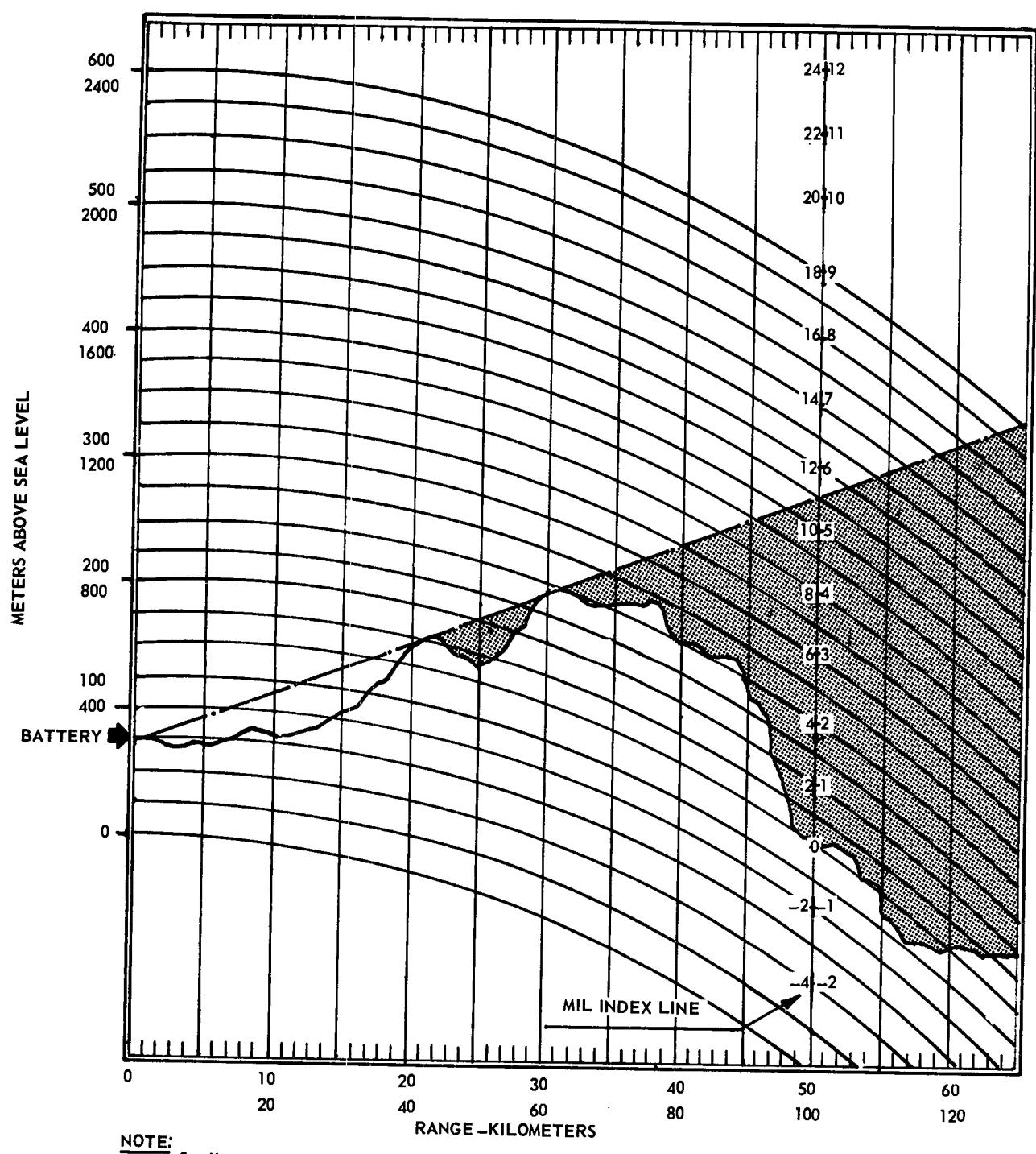
## **8. Masking Difficulty**

*a.* A masking difficulty is an obstacle which limits required radar-to-target line-of-sight. Use of the procedure outlined in *b* below to determine the effect of the masking difficulty is recom-

mended. Detailed procedures for determination of radar coverage are included in TC 44-12.

*b.* An evaluation of the terrain around the position under consideration should be made with a 4/3 earth curvature chart constructed in accordance with chapter 2, TM 11-673 or by using DA Form 11-47. Terrain evaluation should be performed for each 200 mils azimuth, measured from the intended battery position. The 4/3 earth curvature method modifies the normal curvature of the earth to compensate for the propagation characteristics of rf energy. Figure 21 illustrates the method of showing radar coverage along a selected azimuth on a 4/3 earth curvature chart. The figure shows a battery located 75 meters above sea level. Through analysis of map contour lines, the terrain along the selected azimuth has also been plotted on the 4/3 chart. The battery's line-of-sight is indicated by the dashed line. The mask angle shown is the graphic mask angle, which should approximate the optical mask angle which is normally measured after the battery is emplaced. The battery has no coverage in the shaded area due to terrain mask. Maximum detection range can be determined for any assumed threat altitude. For example, the unit shown in fig. 21 can first detect a target flying at 300 meters above sea level at the range of 37 kilometers along the selected azimuth. It is possible that close-in masks, which are not indicated in the maps used for the analysis, will show up when the battery is emplaced, necessitating position adjustments. Ground reconnaissance, when feasible, will determine the presence of close-in masks in the tentative positions.

*c.* Masking difficulties are countered using the same technique as for countering emplacement difficulties. For Nike Hercules units, masking problems sometimes can be alleviated by minor adjustment of the relative location of the battery control and launching areas.



**NOTE:**

Small numbers on vertical axis correspond to small numbers on horizontal axis.

Large numbers on vertical axis correspond to large numbers on horizontal axis.

Figure 21. 4/8 earth curvature chart.

## Section IV. THE EVALUATING PHASE

### 9. Vital Area Defense

*a. Initial Firepower Determination.* The initial choice of positions is now evaluated for its military worth. For Nike Hercules defenses, draw at least 16 radial direction-of-attack lines equal angles apart through the center of the vital area. For hawk defenses, draw route-of-approach lines toward the vital area along each low-altitude route-of-approach. Using burst locators (details on construction and use are provided in section VI), record the total number of missile launches ( $M_t$ ) that the defense's fire units can attempt against a target approaching from one direction-of-attack (route-of-approach), before the target reaches the BRL or other point of evaluation. Repeat for each direction-of-attack (route-of-approach) line, recording an  $M_t$  for each line.

*b. Defense Balance.* For Nike Hercules defenses, check the balance to see if the defense has approximately the same strength along each direction of attack. In sectors where strength is relatively low, move fire units either closer to that direction-of-attack line or outward toward the approaching target. In sectors where strength is relatively high, move fire units away from that direction of attack. When fire units are repositioned, it is generally necessary to reanalyze the defense. A guide for determining balance is that no direction of attack should have a deviation of more than plus-or-minus 10 percent of the average number of attempted missile launches.

*c. Effectiveness Formula.* The  $M_t$  values indicate the maximum number of missiles that a defense can attempt to deliver against a target before it reaches the BRL or other point of evaluation. These values were used for determining defense balance. The next step is to determine the maximum raid size against which the defense has the specified engagement effectiveness, using the effectiveness formula —

$$n_c = \frac{M_t}{m}, \text{ wherein :}$$

$n_c$  = The maximum raid size against which the defense has the specified engagement effectiveness, expressed as a whole number (all fractions are dropped).

$M_t$  = The number of missiles a defense can attempt to deliver along a given direction of attack (route of approach) before the target reaches the BRL or other point of evaluation.<sup>1</sup>

$m$  = Number of attempted missile launches required to obtain the specified probability of killing one target (para 5a(1), this appendix).

The quantity  $n_c$  must be greater at all points around the defense than the single raid size capability credited to the enemy in the initial threat estimate. If defense balance has been achieved and  $n_c$  is not greater at all points, the commander must either acquire additional AD fire units or accept the decreased defense capability. The quantity  $n_c$  may also be used as a figure of merit to determine relative defense weighting.

### 10. Area Defense

*a. Evaluation of a Nike Hercules area defense* is made at area boundaries. Direction-of-attack lines are constructed approximately 15 kilometers apart perpendicular to the FEBA and to all exposed flanks. A field army is normally provided air defense on the flanks by adjacent field armies and to the rear by other theater AD elements. An isolated field army would require evaluation all around its boundaries. The computed values  $M_t$  and  $n_c$  are used to check for overall defense adequacy and relative weighting toward exposed boundaries and priority areas.

*b. The Hawk air defense of the area is evaluated* along all expected low-altitude routes of approach toward the FEBA and other exposed portions of the field army boundary. The value  $n_c$  is used to check the defense capability of Hawk fire units defending a route of approach. Outlining the first burst contour on the map or overlay will provide a graphic hasty check as to the defense ability to accomplish early destruction of low-flying targets.

### 11. Validity of Analysis

*a. Multiple Attacks.* If the enemy is assumed to have the capability for multiple raids from more than one direction, fire distribution must be

<sup>1</sup> The slight difference in definition of the term  $M_t$ , as compared to its definition in paragraph 5a(2), this appendix is intentional.

considered when analyzing the defense. Only those fire units which have been assigned to one direction of attack and fall under the burst locator for that direction of attack should be given credit for firing upon the threat. Fire units assigned to other directions of attack are assumed to be engaging their portion of the multiple raid, and cannot be considered as contribut-

ing to defense in the direction of attack being considered.

*b. Attack Variations.* Major variations in threat speed, altitude, and size will make invalid the absolute values of any numerical data produced by the evaluation; e.g., total firepower ( $M_t$ ). The conclusions regarding relative balance and weighting will remain valid however.

## Section V. COMPOSITE AND INTEGRATED DEFENSES

### 12. Composite Defense

*a. A composite defense is composed of two or more AD weapon system types. The composite defense is normal in the field army.*

*b. In a composite defense the placement pattern of the longest-range system is designed first, according to its deployment guidelines. Then other systems are employed to complement, particularly at low altitude, the coverage afforded by the longer-range system. First burst contours drawn for both Nike Hercules and Hawk will provide a hasty check to determine if Hawk satisfactorily complements Hercules.*

*c. Mutual support is measured only between like systems.*

*d. Each weapon system is evaluated independently. Their individual capabilities are totalled to reflect composite capability.*

number of fire units required, or fire units that can be redeployed to other defenses without degrading the integrated defense, is determined by a trial procedure. As a guide, initially reduce the total number of fire units allocated to the separate vital areas by 25 percent. Increase or decrease fire units until the minimum number of fire units have been used to establish a common defense as strong as, or stronger than, the individual defenses.

*c. Design.* To obtain balance with an integrated defense, it is necessary to deploy fire units around the sides and the opposite ends of the vital areas except that fire units normally are not deployed between the vital areas. Unless the area between is unusually wide, fire units from both vital areas can fire over it, thereby causing this area to be the strongest within the defense.

*d. Evaluation.* The direction-of-attack lines drawn to evaluate an integrated defense are constructed by first defining the vital areas and then drawing a line that connects the centers of the vital areas. Next, draw a line perpendicular to this center line through the center of each vital area. Now draw in an appropriate number of direction-of-attack lines on the outside half of each vital area (not more than 400 mils apart). Direction-of-attack lines are not normally drawn between the vital areas. If such lines are drawn, any common direction-of-attack lines that intersect may be checked for adequacy, but they will not be used in computing figures for balance. When using a burst locator to evaluate an integrated defense the fire units that do not fall under the burst locator, but which have contributed to the defense because the target has flown through the field of fire of these fire units, must be considered.

### 13. Integrated Defense

*a. General.* An integrated defense is the defense of two or more vital areas located close enough together so that the defenses can be combined. Consideration normally should be given to integrating the defenses whenever some of the fire units deployed in their optimum position around the different vital areas are capable of engaging the same target. Integration is rarely complete; i.e., all of the fire units of one vital area will rarely be mutually supporting with each other or with all the fire units of the other vital area.

*b. Characteristics.* An integrated defense will either use fewer fire units or increase the firepower of an existing defense. Some of the weapons deployed around one vital area will contribute firepower to the other if integrated. The

## Section VI. ANALYZING DEVICES

### 14. The Burst Locator

a. The burst locator (figs. 22 and 31) is a graphic portrayal of the summation of bursts as the target approaches and recedes from the range of a fire unit. The burst locator should be used for a hasty analysis only. Computer analysis should be used when time permits. The curved contour lines on the burst locator connect initial points of an equal number of missiles. The spaces between contour lines represent the horizontal distance that the target travels during crew and system reaction time and missile time of flight.

The numbered value of each contour line represents the number of missile launches that a fire unit is capable of attempting against a target by the time the target arrives at the point of evaluation.

b. The outer contour of the burst locator represents the maximum effective horizontal range of the missile. The center represents the position of the threat. The actual shape of the burst locator outer contour may vary considerably from the examples shown in figs. 22 and 31, depending upon threat characteristics.

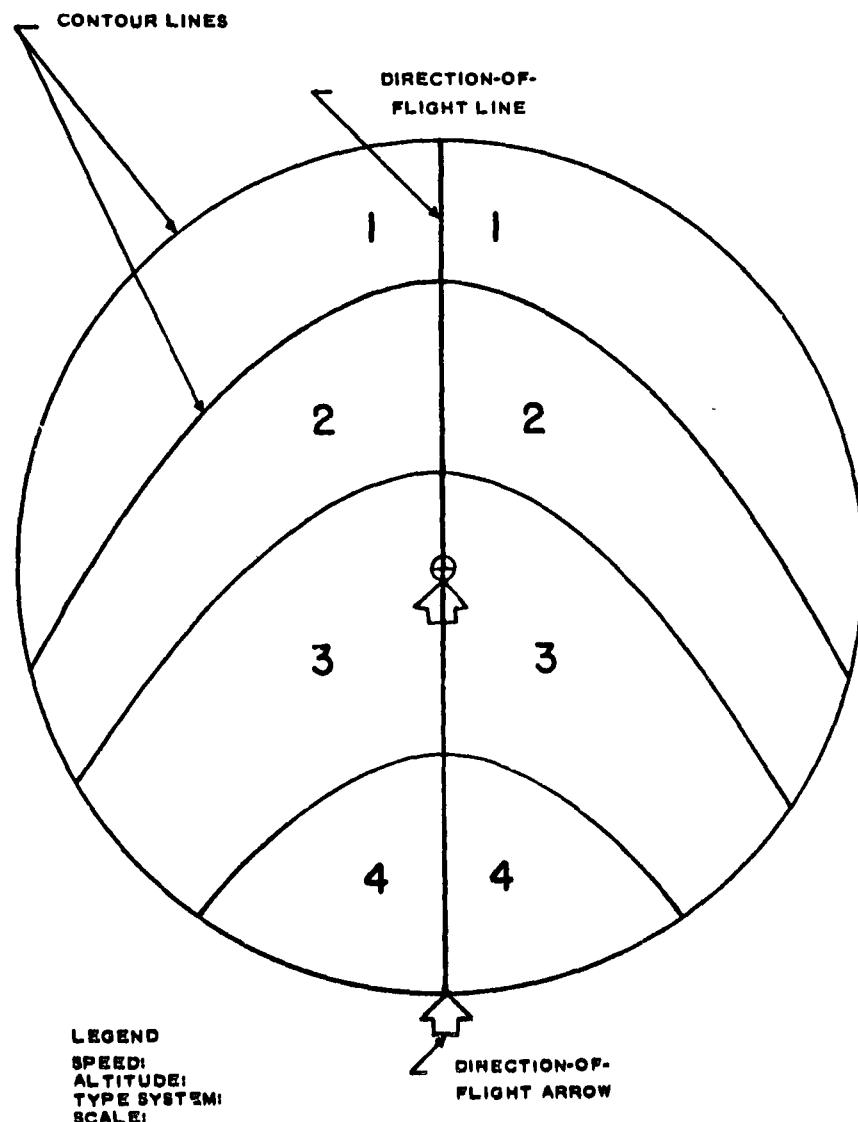


Figure 22. Type of Nike Hercules burst locator.

c. The burst locator is placed with its center on a point of evaluation; e.g., the intersection of a direction of attack line and the BRL; and with its direction-of-flight arrow point *inward* along the direction of attack line. The battery positions falling under the burst locator are then evaluated.

d. It is assumed that all target courses are parallel to the direction-of-flight line indicated. The analyzer is read to give the unit the missile value of the area in which it falls. *Do not* interpolate between contours. A fire unit outside the forward of the outer contour line is indicated as zero since this unit is not yet within range. Conversely, a fire unit to the rear and outside the limits of the burst locator has been within range, therefore it is given a value by extending a line parallel to the direction-of-flight line from the fire unit location to the circumference of the analyzer and reading the missile value at that point. This is known as tail effect.

e. It will be necessary to prepare a burst locator for the specific conditions to be encountered. Knowing a specific condition of attack for a particular area, a target flight scale and a missile trajectory scale are first constructed. The two scales are then used to construct the burst locator. In some cases, one burst locator can be used to analyze an entire defense. However, if a portion of a defense is exposed to excessive masking, analysis of that portion of the defense is accomplished by using the flight and trajectory scales.

## 15. Target Flight Scale

a. In the construction of the target flight scale, the distance that a target will travel in a given period of time based upon a particular map scale and target speed is graphically represented as illustrated in fig. 23. The target flight scale must have at least as many seconds of time represented as the maximum time of flight of the missile being considered.

b. The divisions to the right of zero are derived the same as the divisions to the left. There must be at least as many seconds represented to the right of zero as the maximum system dead time (response and reaction time) (para. 3d, e, 4c, and d, FM 44-1A).

c. The scale is valid for any target altitude.

## 16. Missile Trajectory Scale

a. The missile trajectory scale (fig. 24) is constructed by extracting the time of flight (seconds) from the time-along-trajectory graph (para 3i and 4h FM 44-1A) for the particular intercept altitude and weapon system. Unlike the target flight scale, the missile trajectory scale must be reconstructed whenever variations in intercept altitude are expected to occur. Map scale range in kilometers is constructed as horizontal range, and the time-along-trajectory is projected to correspond to the given range on the missile trajectory scale. Construction technique is as follows (the technique used in constructing the sample scale shown in fig. 24 is explained):

- (1) Mark the "horizontal range (scale)," in increments of two kilometers, as appropriate for the map which will be used for defense design and analysis. The scale length must equal maximum possible missile ground range. See fig. 11 or 14, FM 44-1A for indications of actual maximum missile ground ranges.
- (2) Determine the probable altitude at which the threat will be intercepted. The missile trajectory scale will be usable only for that threat altitude (10,000 meters in fig. 24).
- (3) Using the appropriate missile time along trajectory graph (fig. 11 or 14, FM 44-1A) determine missile time of flight to a kill point occurring at 10,000 meters altitude and; e.g., 20 kilometers ground range. Mark the "time along

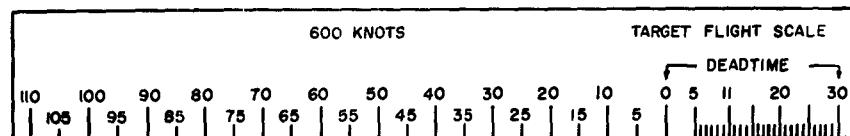


Figure 23. Target flight scale.

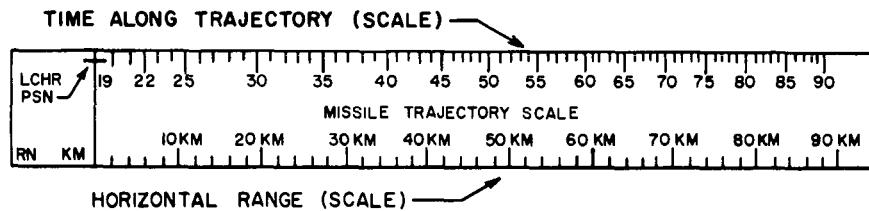


Figure 24. Missile trajectory scale (10,000-meter intercept altitude).

trajectory (scale)" with the appropriate number of seconds above the 20 kilometers "horizontal range (scale)" tick mark. (For example, fig. 24 shows that missile time along trajectory to an intercept occurring at 20 kilometers ground range and 10,000 meters altitude is 30 seconds.) Repeat as necessary to complete the scale.

b. On the missile trajectory scale, the launcher position or zero time is shown at the left. Appreciable horizontal movement does not immediately occur for the Nike Hercules scales since the missile is initially moving vertically. Note that the distance the missile travels in a given period of time varies because the missile speed does not remain constant. The number of seconds represented must be equal to the maximum time of flight of the missile being considered.

### 17. Matching Times on the Scales

The principal use of special analyzing devices is to match the time of flight of the target with a corresponding time of travel of the missile.

*Example:* A missile is launched from position A, (fig. 25) at the time that an aircraft is at position B; place the missile trajectory scale with the launcher position at A and the 0 on the target flight scale at B. The missile will meet the

target where the two times correspond (they will meet after the target and missile have each traveled for 60 seconds as shown in fig. 25).

### 18. Construction of the Nike Hercules Burst Locator

a. This paragraph considers the case wherein the defense suffers no reduction in maximum effective missile range because of limitations imposed by the characteristics of the threat. This case, although not a normal one, is chosen for convenience in presenting the fundamentals of burst locator construction. Paragraph 19 considers the common construction variations which may be required.

b. Draw a series of parallel lines to represent the direction of attack. An arbitrary point is selected to represent the center of the fire unit launching area. Around this point describe a circle whose radius is equal to the maximum effective horizontal range of the missile system (para 4b, 44-1A). This circle represents the initial burst contour.

c. The target flight and missile trajectory scales are used to construct the position of the remaining burst contours (fig. 27). The launcher position (0) on the missile trajectory scale is oriented at the center of the burst locator. The target flight scale remains parallel to the direc-

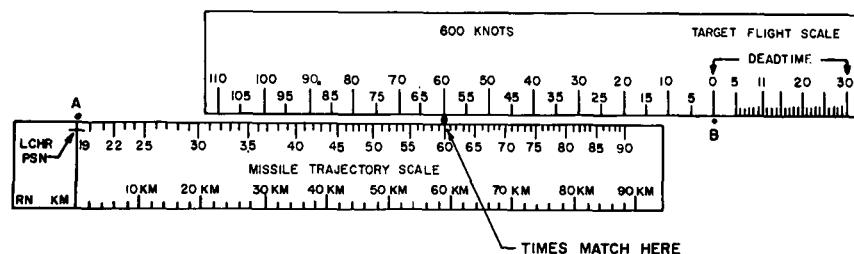


Figure 25. Matching times with flight and trajectory scales.

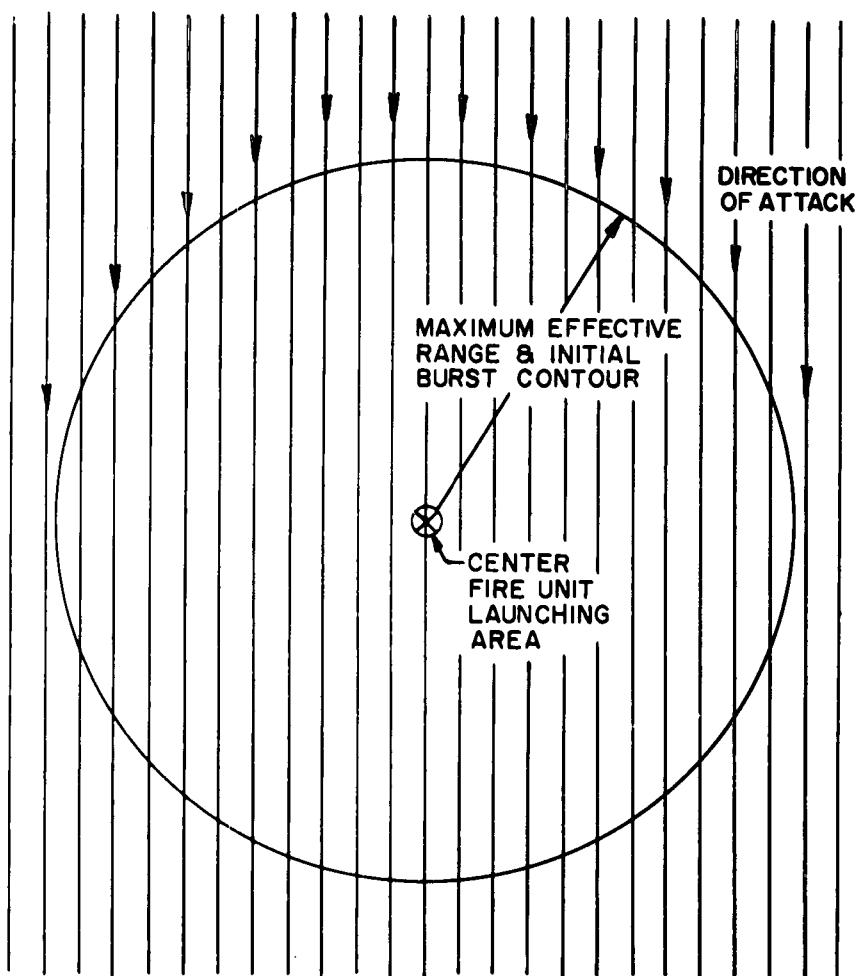


Figure 26. Nike Hercules burst locator (initial).

tion-of-attack lines with the 0 mark inside the initial burst contour by the amount of reaction time (6 seconds in fig. 27; actual figures are included in para 4d, FM 44-1A). The initial burst occurs at point A, as previously determined. The target will move to point B before the same battery is able to launch its second missile. The target moves in further during missile time of flight and the second burst will occur where flight scale times match at point C.

d. To locate the remainder of the second burst contour, the target flight scale is oriented on each direction-of-attack line with the reaction time at the initial burst contour. The missile trajectory scale is then rotated until times are matched and marked as a second burst contour point. A contour is drawn connecting the second burst contour points, thus completing the second burst

contour. This procedure is continued throughout the construction of the various contour lines of the burst locator (fig. 28). If a time match cannot be achieved, the target flight scale is placed with the reaction time set off on the first burst contour. The target flight scale is kept parallel to the direction-of-attack line. The scale is then moved away from the center of the burst locator, keeping the specified reaction time on the target flight scale on the contour line until the time corresponding to the maximum time of flight of the missile touches the periphery of the circle. This point will be the end of the second burst contour line.

e. To complete the burst locator, the areas must be given an appropriate missile value. This is accomplished by assigning to the area between the first contour line (maximum effective mis-

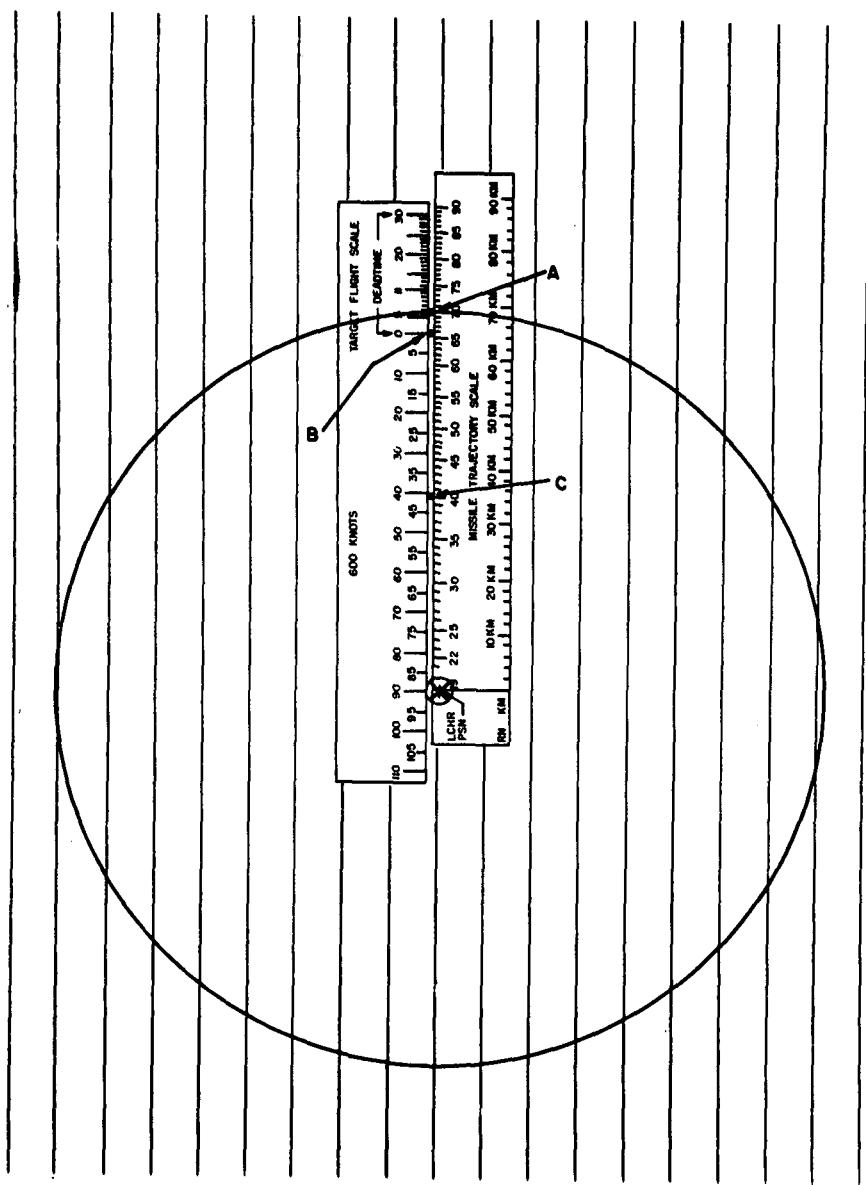


Figure 27. Burst locator with target flight and missile trajectory scales.

sile range circle) and the second contour line a value of 1. Each of the following areas is assigned an accumulative higher value, i.e., 2, 3, and 4 (fig. 22).

#### **19. Nike Hercules Burst Locator Construction Variations**

There are two variations that must be considered when constructing a Nike Hercules burst locator.

a. The location of the initial burst contour will often be at less than maximum theoretical

range because of range limitations imposed on the system radars, or because of high target speeds. The degradation of effective radar range could be the result of earth curvature masking when low-altitude targets are to be engaged, or could result if the threat consists of small (low radar cross section) targets such as air-to-surface missiles. When this occurs, first burst cannot occur at maximum system effective horizontal range and the procedure outlined in (1) through (6) below must be followed, after reading paragraph 4c, FM 44-1A.

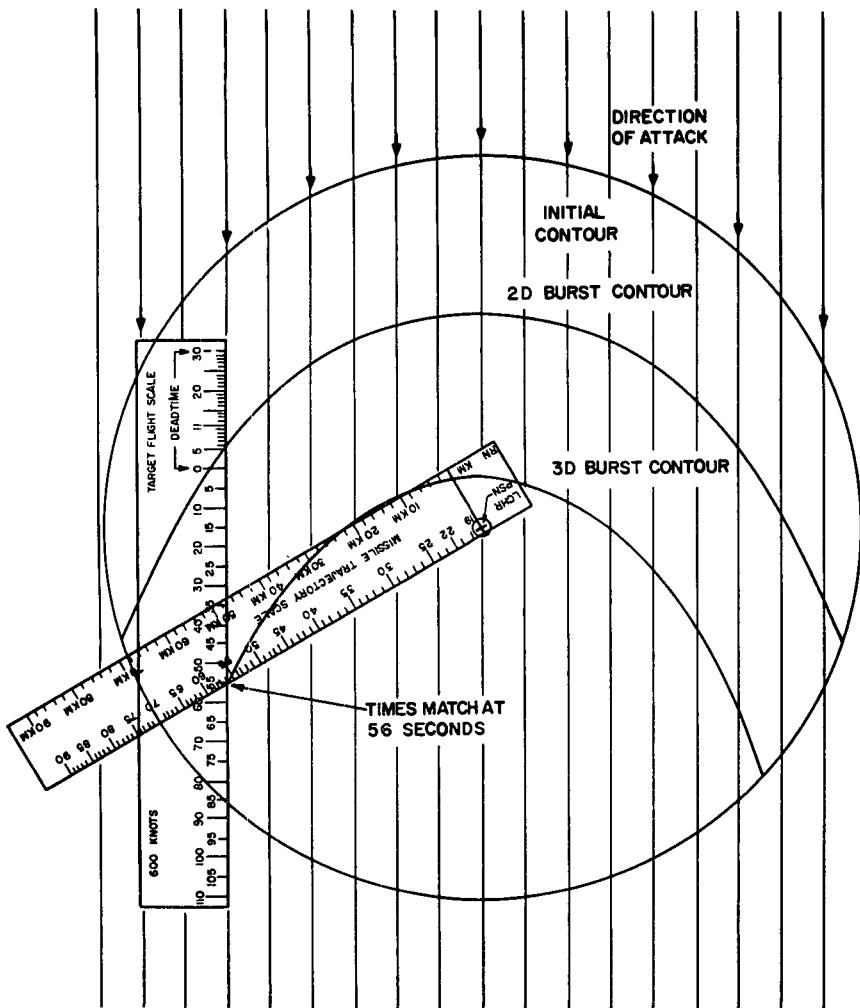


Figure 28. Completing burst contours.

- (1) Assume the Nike fire unit cannot detect a target until it comes within a range of 120,000 meters and cannot track it until it comes within 110,000 meters. This limitation may be common to all batteries in the defense as would be the case if the threat consists of small radar cross section targets which degrade performance of all defense radars (thereby requiring modification of the burst locator); or, this limitation may be peculiar to batteries near particular direction-of-attack lines as would be the case if only a portion of the defense has masking difficulties. A burst locator is not modified for a particular direction of attack.
- (2) Inscribe a circle with radius equal to maximum tracking range, as shown in fig. 29. This circle will suffice for the lower portion of the burst locator, but should be drawn in lightly in the upper portion of the burst locator.
- (3) Determine from paragraph 4c, FM 44-1A, whether acquisition and tracking range separation is adequate for the target speed being considered. If separation is adequate, complete the dotted portion of the burst locator circumference as shown in fig. 29 and select the lower system response time (para 4c, FM 44-1A) for use. If separation is not adequate, the dotted upper portion

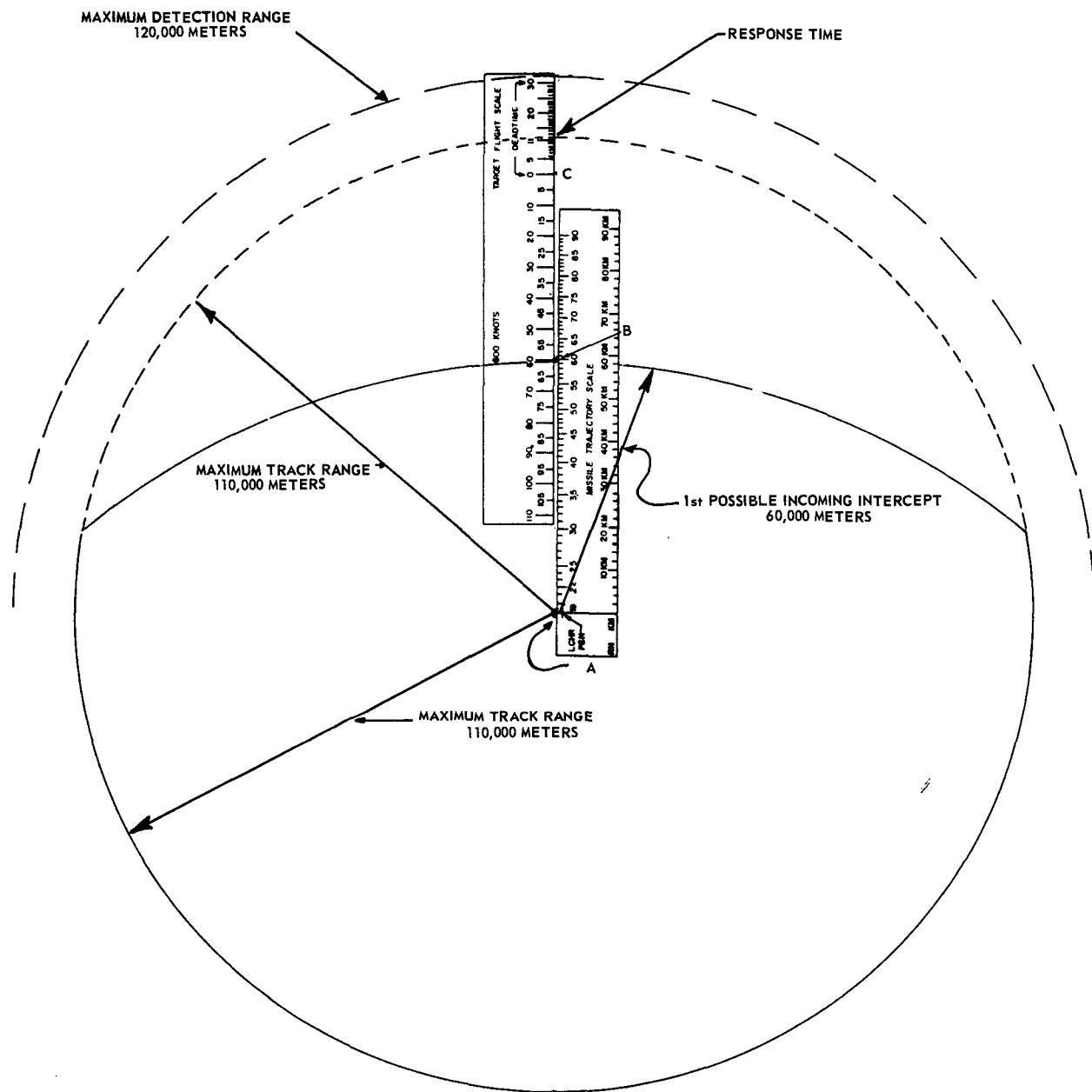


Figure 29. Initial burst contour range less than system maximum effective range.

of fig. 29 would have to be moved outward to effective detection range (assumed 120,000 meters in this case) and the higher system response time would have to be used. Figure 29 assumes acquisition and tracking radar separation is adequate for the target speed being considered: i.e., the lower response time, measured from the effective tracking range area, is used.

- (4) With the target flight scale placed as shown in fig. 29, an incoming target will be at point C, assuming a 12-second response time, when the first missile is launched from point A. The first burst will occur at point B (60,000 meters), the point where the missile flight time measured from A matches the target flight time measured from C. Point B then represents the first plotted point of the initial burst contour.

- (5) If acquisition and tracking range separation had not been adequate, target flight would have been measured from the detection range point and the longer response time would have been used.
- (6) To locate the remainder of the initial burst contour, the target flight scale is oriented on a direction-of-attack line with the response time at the maximum detection or tracking range, as appropriate (the maximum tracking range arc would be used in fig. 29). Target and missile flight times are then matched as done previously, and the point of match is marked as the initial burst point. This procedure is continued throughout the construction of the various contour lines of the burst locator. Note that only the bottom portion of the burst locator is circular.

b. The Nike Hercules system has a dead zone caused by limitations on the missile's ability to maneuver. This dead zone is shown in fig. 14, FM 44-1A. If the threat is low enough to fly through this dead zone it must be considered in constructing the burst locator.

- (1) Inscribe the dead zone around the center point of the burst locator. Follow usual construction procedure as outlined above. If the burst contour should fall inside the dead zone, the contour line must be altered to skirt around the rear of the dead zone (fig. 30). If the battery control officer ever observes that the predicted kill point will fall inside the dead zone, he will delay firing until the missile is capable of achieving an intercept. This delay causes the contour to fall behind the dead zone.
- (2) Subsequent contours are measured from the preceding burst contour, causing a dip in all succeeding contour lines (fig. 30).

## 20. Hawk Burst Locator

a. The Hawk burst locator (fig. 31) is a Hawk effectiveness template (fig. 32) contoured to reflect specific missile capability of the defense against the specified threat. The outer contour represents maximum effective missile range.

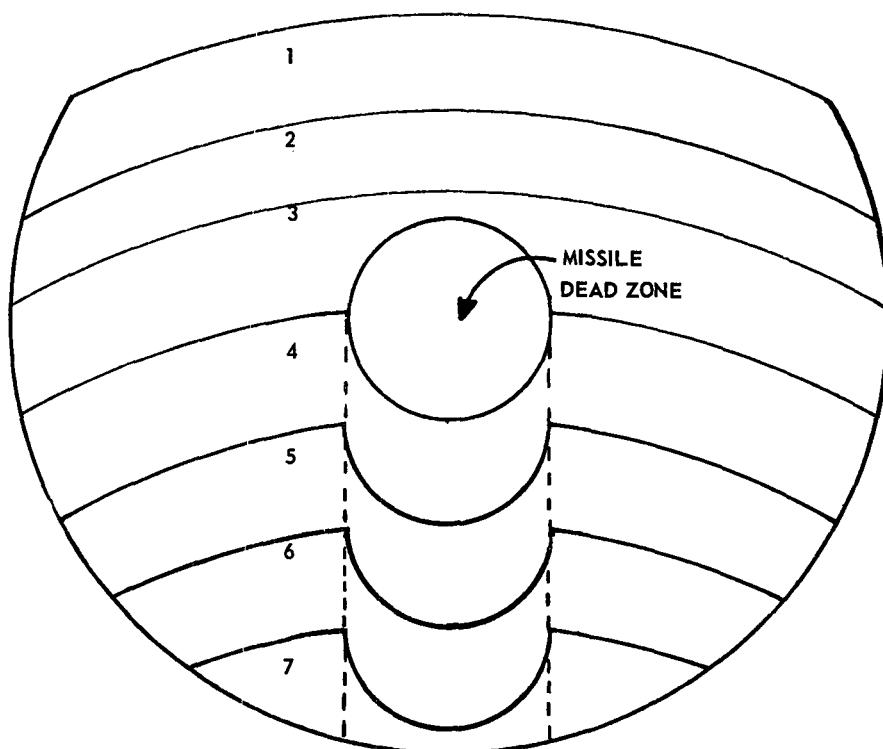


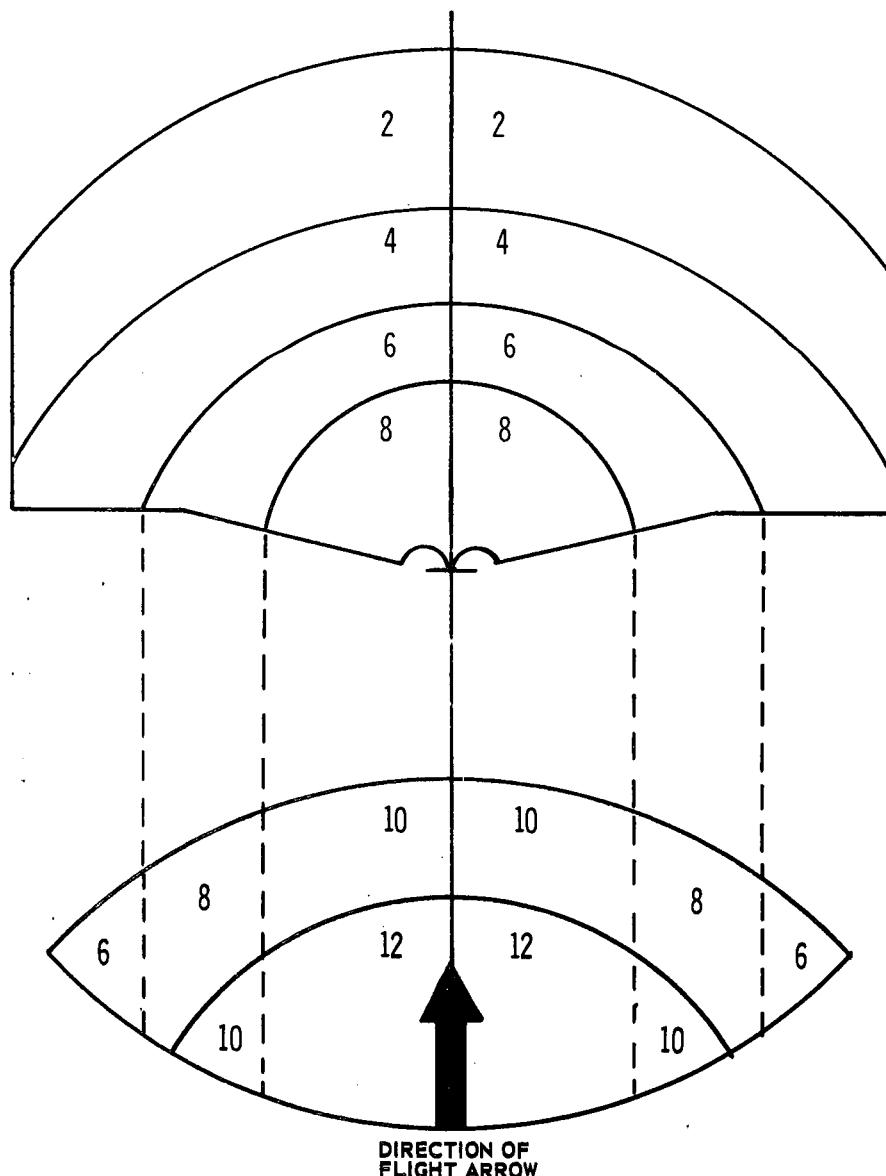
Figure 30. Nike Hercules burst locator with missile dead zone.

The burst locator is used on a defense overlay or map to give a direct reading of missile capability by the time a threat arrives at a particular point.

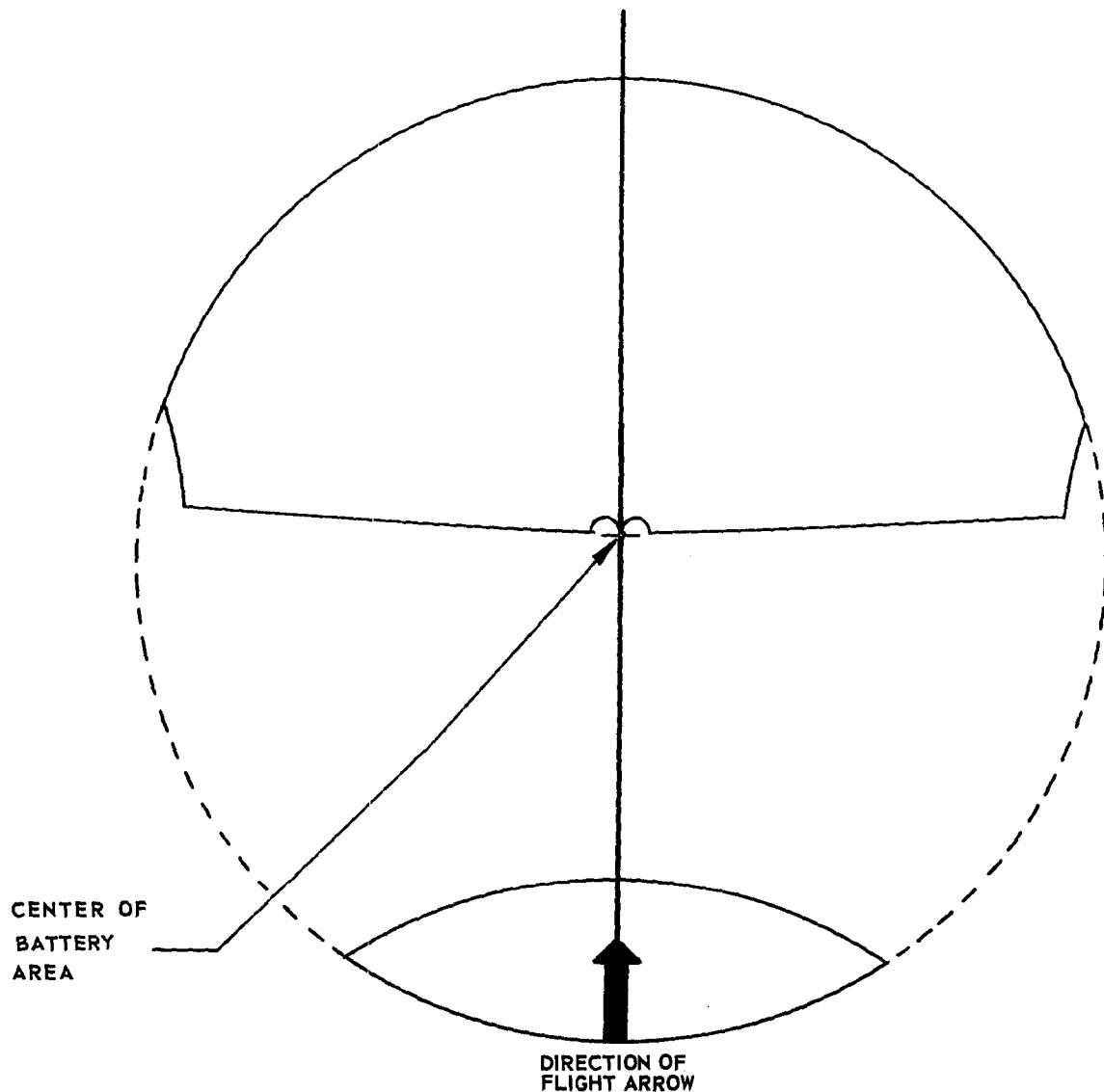
b. The effectiveness template defines the effective area and dead zone of the Hawk unit. Hawk effectiveness templates are presented in figures 1 through 10, FM 44-1A. The direction of flight line and arrow must be added to the templates as shown in figure 32. The effectiveness template does not show successive intercepts against the target; this must be determined using target flight and missile trajectory scales.

c. In preparation for the construction of a Hawk burst locator, a target flight scale and missile trajectory scale must be constructed, using the pertinent data for the weapon system (para 3, FM 44-1A) and defense attack assumptions. The target flight and missile trajectory scales are constructed as described in paragraphs 15 and 16.

d. If terrain masking is not a limiting factor, the forward edge of the selected effectiveness template defines the first burst contour and the burst locator is constructed by contouring the effectiveness template (fig. 33).

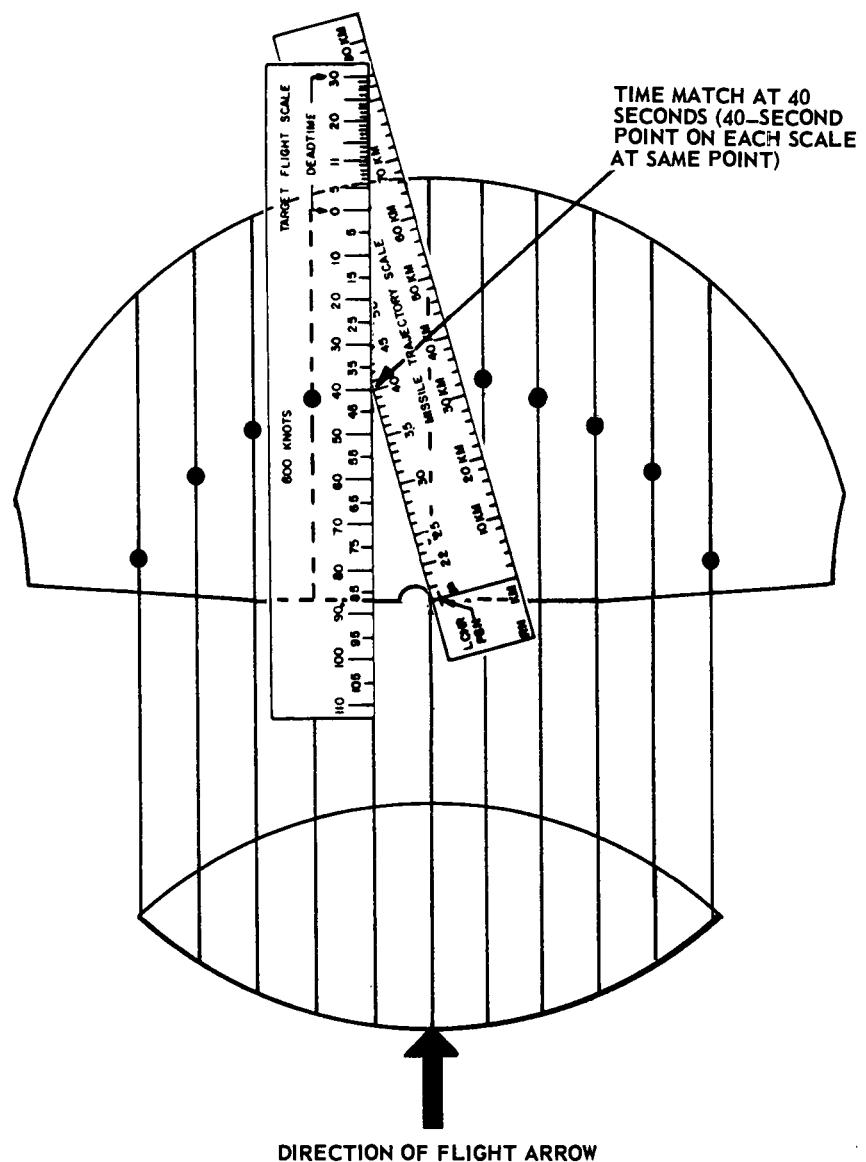


*Figure 31. Type of Hawk burst locator.*



*Figure 32. Hawk effectiveness template (with direction of flight line and arrow added).*

- (1) On the effectiveness template, draw a number of parallel lines to represent routes of approach. The lines are drawn parallel to the direction of flight lines which is the centerline as shown in figure 32.
- (2) The outer contour of the effectiveness template represents the first pair of bursts. The target flight scale is oriented parallel to a route of approach line with the scale moved in from the outer contour of the specified dead (reaction) time to determine zero time for the target. Place the zero or launch position of the missile trajectory scale at the center which represents the launcher position. Match time and mark this point. Do this along each route of approach line, then connect these points with a smooth line. Label this line as the second burst contour (with a value of four). Subsequent contours are determined in a like manner.
- (3) In figure 33, the dots show points where time matched but have not been connected with a smooth line to form



*Figure 33. Construction of Hawk burst locator.*

the second burst contour. In this illustration, a sample reaction time of 6 seconds was used.

e. Using the standard Hawk burst locator—

- (1) Determine and draw in the low-altitude routes of approach toward the center of a defended vital area, or toward the FEBA and exposed flanks in an area defense.
- (2) Plot the BRL or other line of evaluation. The point of evaluation depicts

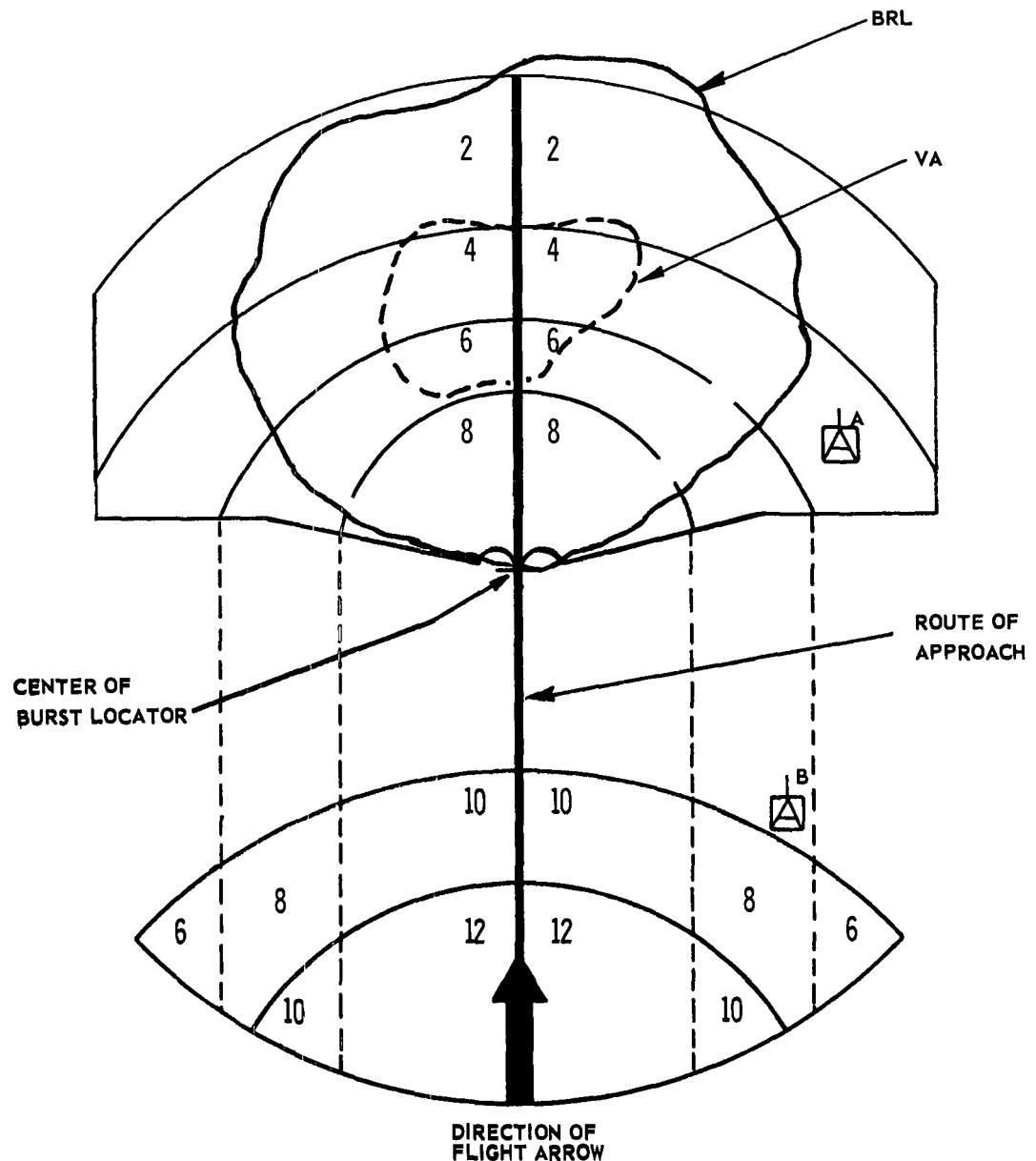
the point that must not be reached by the threat if the air defense mission is to be accomplished. For manned aircraft using the gravity drop or LABS technique, this point is where the route of approach intercepts the BRL. When use of air-to-surface missiles or the lay-down technique is assumed, there is no bomb release line. The point of evaluation is where the routes of approach intersect with the edge of the vital area. In an area defense, the field

army boundaries are the line of evaluation. The manned aircraft attacking a vital area will be used for further illustration.

- (3) Place the burst locator over the route of approach (fig. 34) with the midpoint at the BRL, the direction of flight arrow pointed inward towards the center of the vital area, and the direction of flight line superimposed over the route of approach. Read the

total missile value for each fire unit falling under the burst locator; e.g., fire unit A receives a value of 4.

- (4) Record the individual fire unit readings on the recording form and total to determine defense capability.
- (5) All target courses are coincident with, or parallel to, the direction of flight line. Do not interpolate between contours. If a fire unit falls in a dead zone between the forward and rear effective



*Figure 34. Hawk burst locator oriented over route of approach.*

zones, give this unit credit for the number of missile launches it would have been able to attempt as it left the forward effective zone and went into the dead zone.

**Example:** Fire unit B plots in the dead zone as shown in figure 34. Following between the dotted lines back to the forward effectiveness zone, read a value of "6." Therefore, fire unit B would be credited with a missile value of six.

f. If first burst from a certain Hawk battery cannot occur at the forward edge of the selected template because of terrain masking, the capabilities of the battery must be analyzed separately. For example, in figure 35, assume that a target can reach point B before a missile can be launched from point A, considering degraded radar range and an assumed response time of 13 seconds.

(1) The missile trajectory scale is oriented with the launcher position at A, and the target flight scale is placed parallel to the route of approach with the appropriate response time (e.g., 13 seconds in fig. 35) at the point of detection. Time matches (point C) when both objects have traveled towards each other for 65 seconds; this point

becomes the location of the first burst. Each time match must occur on or inside of the effective area outlined by the effectiveness template. If time matches in the dead zone (point D), the burst would be moved in the direction of target flight, parallel to the direction of flight line, until the rear effective area was encountered (point E). As soon as the rear effective area was reached, the burst point would be plotted.

- (2) Total bursts along the particular route of approach line for this particular battery are obtained by using the above method only. The capabilities of the unaffected batteries are analyzed by using standard techniques (e above).
- (3) Use of this technique is not necessary if radar ranges are only degraded slightly, in which case the standard techniques may be usable. If the plot of the first burst falls forward of the forward edge of the template, it is obvious no significant system degradation has been suffered, and the battery does not require use of the special analysis technique.

## Section VII. REDEYE DEFENSE CONSIDERATIONS

### 21. General

a. The Redeye is a 29 pound, infrared homing optically aimed air defense weapon that can be carried and operated by one man.

b. The Redeye weapon system can provide units with a self-defense capability against hostile, low performance, low flying aircraft within range and engagement capability. The Redeye weapon system is not a component of an integrated and coordinated air defense deployment. Normally the following rules for engagement apply:

- (1) Attack aircraft identified as hostile.
- (2) Attack aircraft committing a hostile act.

c. The definition of a hostile act and the criteria for identification of aircraft will be published by the area air defense commander and

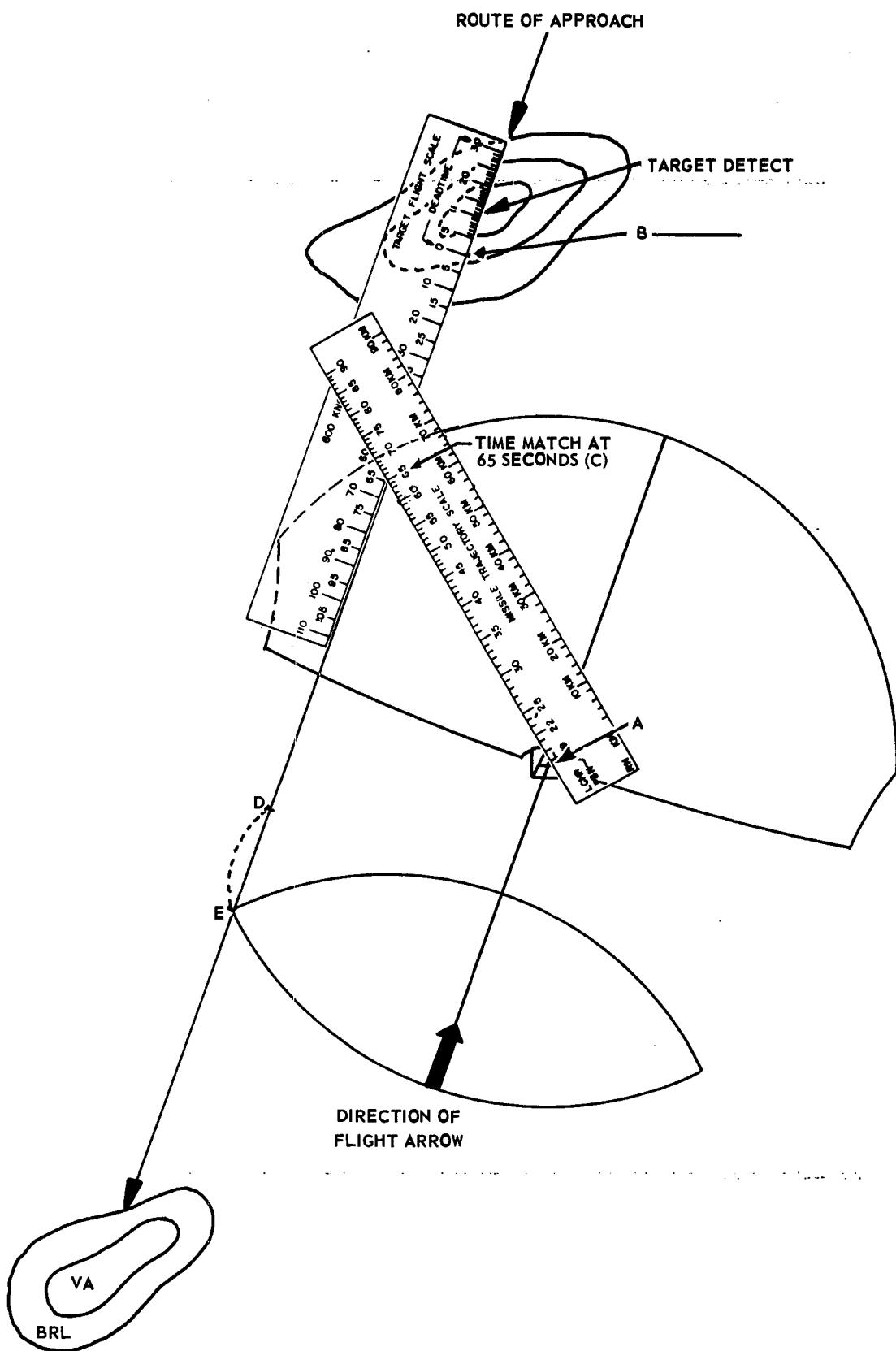
will be incorporated in the unit standing operating procedure. For detailed coverage of aircraft identification, see FM 30-30. For other items that should be covered in the SOP, see paragraph 22g, this appendix.

d. Unless otherwise directed, hostile aircraft within the capability of the weapon should be engaged. To avoid the disclosure of positions, commanders may direct that aircraft not be engaged in some special situations.

e. When permitted by theater rules, commanders in certain situations may direct that the Redeye team engage all aircraft not identified as friendly.

### 22. Employment

a. *Redeye Mission.* The Redeye mission is to provide local air defense of small combat and combat support units.



*Figure 35. Use of effectiveness template with trajectory and flight scales.*

*b. Organization.* Redeye is employed by two-man teams allocated on the basis of one per combat and selected combat support company/battery/troop. Redeye is assigned to an air defense section in designated battalions and to designated separate companies/batteries/troops. Redeye teams are normally attached to or placed in support of company size units during operations. Redeye may be employed on a "dual duty" basis in certain cases.

*c. Defense of the Unit in Position.* Redeye teams depend upon visual means for the detection and identification of targets. The positions selected must provide for maximum observation and unobstructed fields of fire commensurate with associated consideration of likely avenues of approach, the desire to engage the enemy before he can strike the defended unit, and local ground security. At least one gunner continuously performs surveillance of the surrounding airspace, alternating with the other gunner as required. The gunners may be separated short distances where observation is otherwise limited. During periods of intense activity, both may act as gunners thereby doubling the rate of fire or covering additional avenues of approach. Surveillance is maintained in all directions with emphasis on the expected or most likely direction of attack. Units should prepare detailed SOP's for air defense based on Army and theater guidance. These SOP's should incorporate provisions for early warning compatible with the unit mission and communications capability. Provision should be made for augmenting Redeye fires with those organic, non-air defense weapons, primarily automatic weapons, capable of delivering large volumes of direct fire.

*d. Defense of the Unit During Movement.*

- (1) In a company column, the company commander should place one team member near the front of the column and one near the rear, each with a portion of the available missiles. Appropriate primary and secondary zones of responsibility should be assigned. All-around observation should be assured, some missiles should be unpacked and ready, and gunners should be ready to dismount quickly.
- (2) During movements in which more than one team is involved; e.g., a battalion

or brigade move, teams should be placed throughout the column with emphasis on the front and rear. Disposition of the teams within the column is made by the column commander. Route coverage may be improved by directing certain teams to occupy critical points along the route; however, road conditions or column speed may preclude leapfrogging.

- (3) The wheeled vehicle provided the Redeye team possesses the required mobility in the majority of situations. In certain cases, the requirement for mobility may be such that temporarily dropping the trailer and carrying a reduced load of missiles in the truck itself is justified. When tracked vehicle transportation is mandatory in certain situations, the transportation must be obtained on a priority or share-the-ride basis.

*e. Control.* The Redeye gunner (primary duty) is normally permitted to engage all targets positively identified as hostile or committing hostile acts within the criteria set forth in guidance by higher headquarters. The gunner normally attacks the targets on his own initiative since time and space limitations do not permit the gunner to request permission to fire on any particular target. Unit commanders may impose further restrictions on Redeye fires to prevent compromising the unit location, but under no circumstances will the unit commander allow freedom to fire beyond that established by higher authority. The gunner has no authority to deviate from the established action status, rules for engagement, identification criteria, and rules for target selection. *Dual duty gunners are only permitted to fire at aircraft actually firing upon the unit.*

*f. Firing Doctrine.* The engagement of a low performance aircraft is accomplished by one gunner firing a single weapon, assessing the results, and firing additional weapons as required. Several high performance aircraft may be simultaneously engaged by both gunners, each firing until the aircraft are destroyed or beyond engagement range.

*g. Unit SOP.* The unit SOP for Redeye operators should include the following, as a minimum:

- (1) Mission.
- (2) Command.
- (3) States of alert — manning requirements.
- (4) Action status and rules for engagement, to include —
  - (a) Precise definition of terms.
  - (b) Identification criteria and authority to declare an aircraft hostile.
  - (c) Personnel with authority to authorize deviation.
  - (d) Statement that self-defense is never denied.
- (5) Rules for target selection.
- (6) Firing doctrine.
- (7) Fire coordination between team members.
- (8) Communications.
  - (a) Nets and frequency allocations.
  - (b) Discipline and security.
  - (c) Alternate communications.
- (9) Reporting requirements.
  - (a) Warning: air, ground, and CBR.
  - (b) Operational status.
  - (c) Position and displacement.
  - (d) After action.
- (10) Ground security.
- (11) Passive air defense procedures.
- (12) Standard vehicle loading and movement plan, to include measures to increase mobility.
- (13) Logistics.
  - (a) Resupply procedures.
  - (b) Reports.
  - (c) Maintenance.
- (14) Emergency destruction plan.
- (15) Site selection and alternate site selection.
- (16) Safety procedures.

### **23. Materiel**

The Redeye team (primary duty) is equipped with the following items:

*a. Transportation.* The team is transported in a wheeled vehicle.

*b. Armament.* The team is armed with the prescribed basic load of Redeye missiles. The basic load may be split between the gunners in certain situations. Each gunner has a 5.56mm or 7.62mm rifle.

*c. Communications.* Required communication equipment is provided to support team operations, and to permit receipt of orders from the unit commander and transmission of the alert to the commander and other elements upon the detection of hostile aircraft.

*d. Orientation and Surveillance.* Maps, a compass, and a binocular are provided to assist the team in self-location, orientation, and surveillance of the airspace.

*e. Decontamination.* A decontamination apparatus is carried in the vehicle to permit decontamination following a CBR attack.

## APPENDIX III

### ESTABLISHMENT OF AIR DEFENSE AUTOMATIC WEAPON DEFENSES

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#### Section I. GENERAL

##### 1. Scope

This appendix covers the design of defenses using the 40-mm (Duster) ADA automatic weapon and the caliber .50 machinegun. Details on equipment characteristics, gunnery, and operations are provided in FM 44-2 and FM 23-65.

##### 2. Defense Design Factors

a. The mission of ADA automatic weapon defenses is to impose maximum attrition rates upon the attacking enemy.

b. ADA automatic weapon defenses are designed against aircraft delivering conventional weapons.

c. Defense design should produce a balanced defense equally effective in all directions, unless a forced route of approach exists.

d. Weapons should be sited so that the maximum number of targets can be engaged, continuous fire can be delivered, the most likely routes of approach are covered, and both air defense and surface missions can be carried out.

#### Section II. DEFENSE DESIGN, DUSTER FORWARD AREA WEAPON

##### 3. General

The Duster (M42, self-propelled, twin 40-mm) is the forward area weapon used in the ADA automatic weapons battalion (SP). One or more battalions may be attached to a division, corps, or field army and deployed to defend infantry, armored, and mechanized brigades, nuclear delivery means, march columns, assembly areas, and other critical points.

##### 4. Allocations and Deployment Guidelines

a. *Planning Factors Table.* Duster allocations are estimated from the planning factors table (table I), except in the case of march column and assembly area defense. The table provides a minimum defense.

b. *Allotment of Weapons.* Weapons are always allotted in increments of two. The minimum allocation is four, which will insure that at least two and usually three weapons will be capable of simultaneously attacking any target.

c. *Duster Defense of Maneuver Brigade.* The perimeter of the vital area, for purposes of entering table I for an allocation, is defined as the brigade frontage multiplied by two. Fire units should be located well forward, and in occupied areas to gain some measure of protection against ground attack. For design purposes (para. 5, this appendix), the overall defense is considered as a noncircular vital area with the existing safe lanes as probable routes of approach. Safe lanes may be caused by the terrain, by gaps in radar coverage, and by habitual observance of minimum normal burst altitudes (MNBA) by nuclear-armed AD missile systems. The defense may be integrated with adjacent Duster defenses depending on the distance between units.

d. *Duster Defense of Nuclear Delivery Means.* The minimum allocation of Duster fire units for defense of nuclear delivery means is six, based on a minimum perimeter of 4,000 meters. If the actual perimeter is larger, the planning factors

*Table I. Planning Factors Table  
40-mm (M42) Fire Units*

Perimeter of VA in meters	Number of fire units required	Perimeter of VA in meters	Number of fire units required
0- 2,750	4	21,601-22,700	36
2,751- 5,500	6	22,701-23,800	38
5,501- 7,300	8	23,801-24,900	40
7,301- 8,400	10	24,901-26,000	42
8,401- 9,500	12	26,001-27,000	44
9,501-10,600	14	27,001-28,100	46
10,601-11,700	16	28,101-29,200	48
11,701-12,800	18	29,201-30,300	50
12,801-13,900	20	30,301-31,400	52
13,901-15,000	22	31,401-32,500	54
15,001-16,100	24	32,501-33,600	56
16,101-17,200	26	33,601-34,700	58
17,201-18,300	28	34,701-35,800	60
18,301-19,400	30	35,801-36,900	62
19,401-20,500	32	36,901-38,000	64
20,501-21,600	34		

*Notes.*

1. Mutual support distance: 100-1,100 meters.
2. Weapons are to be distributed in depth with some located as much as 200 meters outside the VA.
3. For larger VA's, two weapons should be allocated for each increase of 1,100 meters, or fraction thereof, in the distance around the VA.
4. For a stronger defense, additional weapons may be used and the distance between fire units decreased.
5. A 100-meter displacement is permitted for minor terrain difficulties.
6. The shape of the defense should conform generally to the shape of the VA.
7. The minimum number of weapons for a defense is four fire units. Additional weapons will be allocated in increments of two.
8. Use conversion tables in appendix VI to convert meters to yards if necessary.

table is used to determine the allocation. The defense will normally be designed (para 5) as a vital area having critical points; i.e., the weapons, storage areas, and troop areas. The Duster fire units move with the nuclear artillery. Adjacent Duster defenses are not integrated.

e. *Duster Defense of March Columns.* Duster allocation is based on march column road space, rather than the planning factors table. One fire unit is placed in the first 100 meters of the column, the second is 550 meters behind the first, and the third is 550 meters behind the second. The rear of the column receives the same consideration. The remaining weapons should be dispersed throughout the column at 1,100 meter intervals. In the absence of detailed information, 12 fire units may be allocated for defense of a

brigade march column, unless multiple routes of march are used. Fire units must also be placed at critical points along the march route; e.g., bridges, defiles, and passes. Usually four fire units can protect a critical point, but more will be needed if the perimeter exceeds 2,750 meters. These units are kept in place only as long as the points remain critical to the march column.

f. *Duster Defense of Assembly Areas.* Since the assembly will usually be in connection with a road march, fire units will normally have already been allocated for the march column. These weapons will also be used to provide air defense in the assembly area. If additional fire units are required, they should be made available at the assembly area prior to the arrival of the other units. The defense is designed as a VA with vital points (para 5, this appendix).

g. *Duster Defense of Other Vital Areas.* The planning factors table is used to determine fire unit allocations. An exception is the long, narrow vital area. Defense design is accomplished as described in paragraph 5, this appendix.

*h. Special Employment Considerations.*

- (1) Duster fire units may be required within the danger area of a nuclear kill area to cover safe lanes. Close coordination with the supported unit will be required.
- (2) Duster fire units may be required to fire surface missions when the requirement for ground support exceeds the requirement for air defense, and during time of poor visibility when the air defense mission cannot be accomplished. This decision is made by the supported commander. Duster units should move into the perimeter of the supported unit and tie in with its ground defense plans.
- (3) Where possible, assistance in ammunition resupply should be obtained from the supported unit, as the rate of fire of the 40-mm guns can deplete the entire basic load in a few minutes.

*i. Employment of Other Organic Elements.*

- (1) The battalion's AN/GSS-1 electronic search central should be located 9 to 27 kilometers behind the FEBA and positioned to take advantage of its 300-

kilometer maximum range. Site selection details are provided in FM 44-7.

- (2) The visual observer teams should be employed to fill gaps in radar coverage. They should be placed on the general outpost line not over 5 kilometers apart. The observation points can then provide about 30 seconds warning to forward fire units.

## 5. Duster Defense Design

a. The Duster defense design is based on a low altitude or dive attack by a 520-knot maneuvering aircraft approaching from any direction.

b. The Duster defense design considers —

- (1) Maximum effective range — 1,650 meters.
- (2) Rate of fire — 240 rounds per minute.
- (3) Maximum mutual support distance — 1,100 meters.
- (4) Minimum mutual support distance — 100 meters.

c. The configuration of the defense is determined by the characteristics of the vital area and the number of fire units allocated.

d. A Duster defense must attain balance, unless a forced route of approach exists.

e. A suggested method for designing the defense of various types of vital areas is described in the following paragraphs. An alternate to using the suggested procedure is to hand-tailor

the defense by allocating weapons according to the planning factors table and considering mutual support distances.

## 6. Initial Position Template

(fig. 36)

To assist in designing the Duster defense, an initial position template is used. The template is constructed on an appropriate overlay by placing weapons 1,100 meters apart in columns with each column 900 meters apart, then offsetting every other column 550 meters. The result is a dispersed pattern with no weapon more than 1,100 meters from any adjacent weapon, thereby providing mutual support for each fire unit from at least two other fire units.

## 7. Use of Template

a. Place the template on the map and adjust it so that most of the fire units allocated are in or near the VA. Move those weapons outside the vital area in toward the center of the VA until they are within 200 meters of the edge. Relocate enough weapons in the defense to avoid a design with continuous straight lines or diagonals of fire units. Relocation may come about naturally because of minor terrain difficulties. When moving because of minor terrain difficulties or to break up the straight line patterns, do not move weapons more than 100 meters in any direction. In the completed design, some weapons may be slightly more than 200 meters from the edge of the VA.

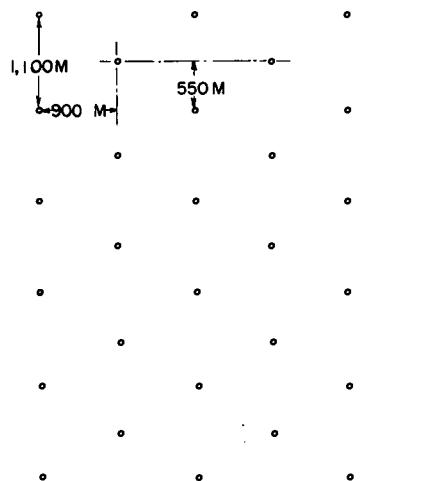


Figure 36. Initial position template.

b. Figure 37 illustrates the design of a simple defense using the initial position template. The same basic system is applicable to defenses involving special considerations.

## 8. Special Considerations

a. *Vital Points Within Vital Areas.* Within a VA to be defended with Duster, certain points will probably be more important than others; e.g., nuclear weapon and guided missile storage areas. In such cases, design the defense with fire units emplaced close to the vital points; i.e., adjust the template initially to favor the vital points. Any fire units that must be moved because of minor terrain difficulties should be moved toward the more important points.

b. *Noncircular Vital Area.* When designing the defense of a noncircular VA, the defense generally should follow the shape of the VA. After defining the VA on a suitable map, determine its perimeter. Consideration should be given to minimizing the perimeter distance; i.e., since the perimeter of a VA with an indentation gives a false picture of the total area to be defended, measure the shortest distance around the VA. Using this distance, find the number of fire units required, using the planning factors table. Next, place the template on the map and adjust it to provide the best balanced defense with the fire units allocated, placing some fire units inside and some outside the VA. Finally, as with the simple defense, bring the fire units within 200 meters of the VA and reposition enough to break up the straight line pattern.

c. *Long Narrow Vital Area.* In some cases, a

long narrow VA can be defended with fewer fire units than required by the planning factors table; for example, a VA 5,000 meters long and 400 meters wide with a total perimeter of 10,800 meters. The table calls for 16 fire units. However, use of the template indicates that this VA can be defended with only 10 fire units. This defense is the only type of VA that should be allocated fire units by using the template. The long narrow VA is shown in figures 38 and 39.

d. *Integrated Defenses.* Defenses may be integrated when the near edges of the VA's are within 1,300 meters of each other. In this case, the defense is designed as a single defense by establishing a common perimeter of the two or more VA's. When designing, consider each VA as a vital point within the overall VA. Defenses of nuclear delivery means are not integrated.

e. *Terrain Difficulty.* Major terrain difficulty requires special consideration. Design the defense, using the template, disregarding the major terrain difficulty. Move those fire units that are in the terrain difficulty and space them equidistant along its edge, considering the other fire units in the defense. In this way, a balanced defense is maintained by increasing the volume of fire, thus compensating for the decrease in firing time. If other fire units must be moved because of minor terrain difficulties or to break up the straight line pattern, they should be moved toward the major terrain difficulty.

f. *Probable and Forced Routes of Approach.*

- (1) The probable route of approach is one that the enemy is likely to use but does

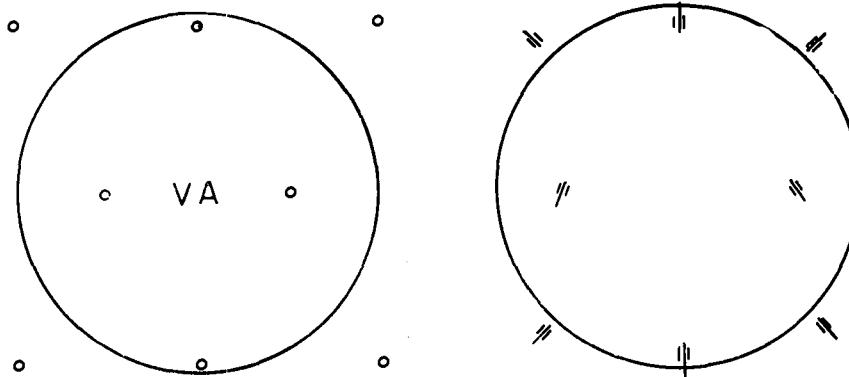
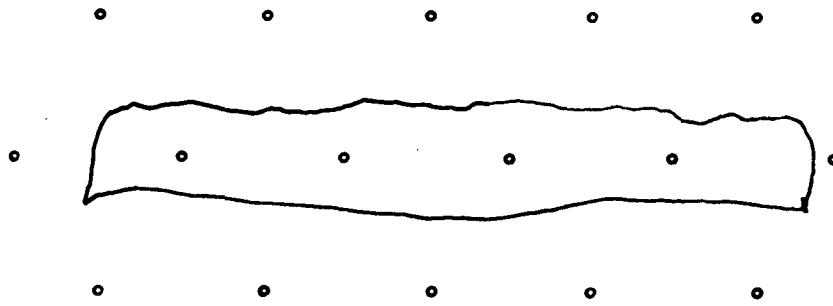
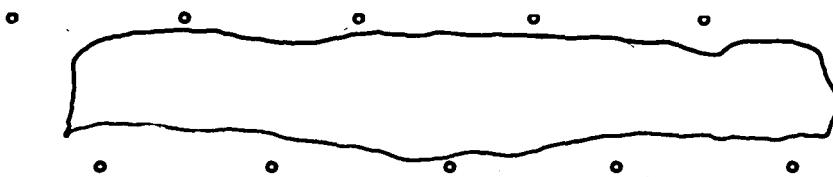


Figure 37. Simple defense.



*Figure 38. Allocation by planning factors table and initial positioning with template (16 fire units).*



*Figure 39. Allocation and initial positioning using the template only (10 fire units).*

not necessarily have to use. Probable routes of approach are defined by landmarks and terrain variations such as highways, rivers and valleys. To design a defense involving a probable route of approach, the template is used in the normal manner except that it is initially positioned to locate as many fire units as possible near the probable route. Balance is not disregarded when designing this type of defense. After positioning the template, any fire units

that are to be moved up to 100 meters may be moved to favor the probable route.

- (2) An example of a forced route of approach would be targets that cannot be destroyed from overhead. They must be destroyed by low-level attack. Usually a single route of approach exists. Balance is disregarded when designing the defense for a forced route of approach and the defense is hand tailored to fit the situation (fig. 40).

### Section III. DEFENSE CONSIDERATIONS, CALIBER .50 MACHINEGUN

#### 9. General

a. Caliber .50 machineguns can provide units with a limited self-defense capability against hostile low-flying aircraft. These weapons are employed as part of the unit's local defense with a dual mission of ground and air defense. The machineguns are not components of an integrated and coordinated AD system. Normally, the following rules for engagement apply:

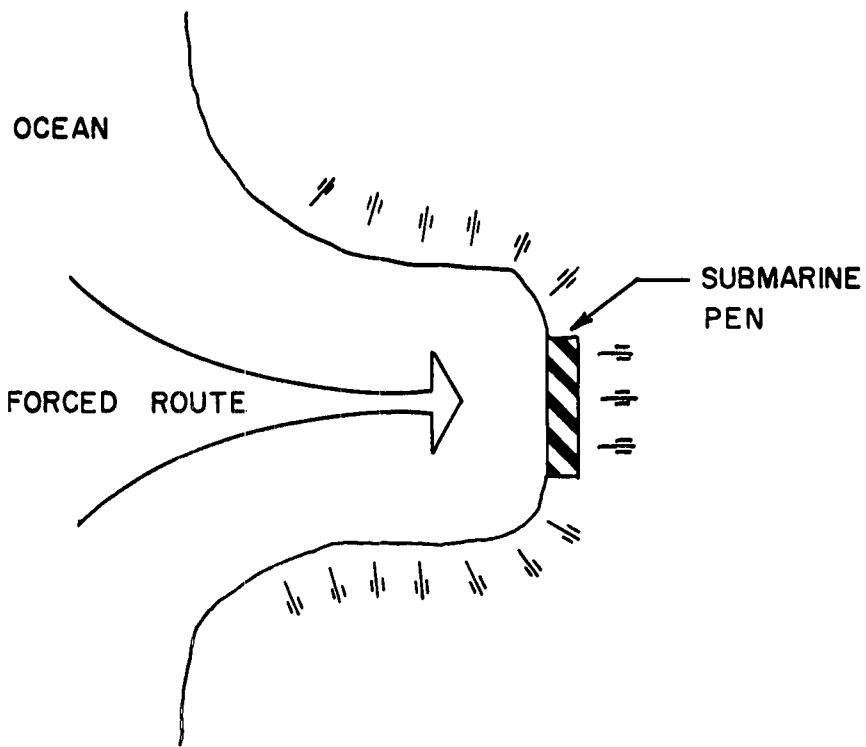
- (1) Attack aircraft identified as hostile.
- (2) Attack aircraft committing a hostile act.

b. The definition of a hostile act and the criteria for identification of aircraft will be pub-

lished by the area air defense commander. For detailed coverage of aircraft identification, see FM 30-30.

c. Unless otherwise directed, hostile aircraft within range of weapon (730 meters maximum effective range) should be engaged. Surveillance, reconnaissance, and liaison aircraft; troop carriers; helicopters; and drones are typical targets.

d. FM 23-65 furnishes details pertaining to gunnery, maintenance, and weapon operating procedure. Tracer observation techniques for aerial gunnery are discussed in chapter 10, FM 44-2.



*Figure 40. Forced route of approach.*

## 10. Employment

a. *Defense Design.* Employment of machine-guns for AD is guided by the basic automatic weapon design factors listed in paragraph 2, this appendix.

b. *Local Defense.* Machineguns used for local defense depend upon visual means for target selection and engagement control. The positions selected for the weapon must provide for maximum observation and unobstructed sectors of fire. Units furnished caliber .50 weapons in sufficient numbers should position them within mutual support distance of 90 to 360 meters. Each weapon is assigned a primary and secondary sector of fire. When a weapon is manned by a crew, a crewmember will maintain constant vigilance in the primary sector of fire, regardless of the sector in which the weapon is actually engaged. Units should prepare detailed SOP's for AD based on Army and theater guidance. These SOP's should incorporate provisions for early warning compatible with unit mission and communications capability. Where possible, unit machinegun positions should be coordinated with

adjacent unit defenses to insure adequate coverage at unit boundaries.

c. *March Column Defense.* When mission, time, terrain, and weapon allocation permit, machineguns should be positioned at critical points along the route of march, in advance and in addition to interspersing them within the convoy itself. Locations such as bridges, defiles, and passes, where an air attack could halt the entire column, should be considered critical points. To achieve the most effective defense, weapons should be located on or as close to the critical point as possible while maintaining balance, observation, unobstructed sectors of fire, and mutual support distances. In column movement, machineguns should be sent ahead to critical locations with column security elements. This prepositioning by passing or leapfrogging to critical positions may be accomplished by using Army air or ground vehicles. When occupation of critical positions is impractical, all weapons will be interspersed in the march column with emphasis on the lead and rear elements and application of mutual support requirements (fig. 41).

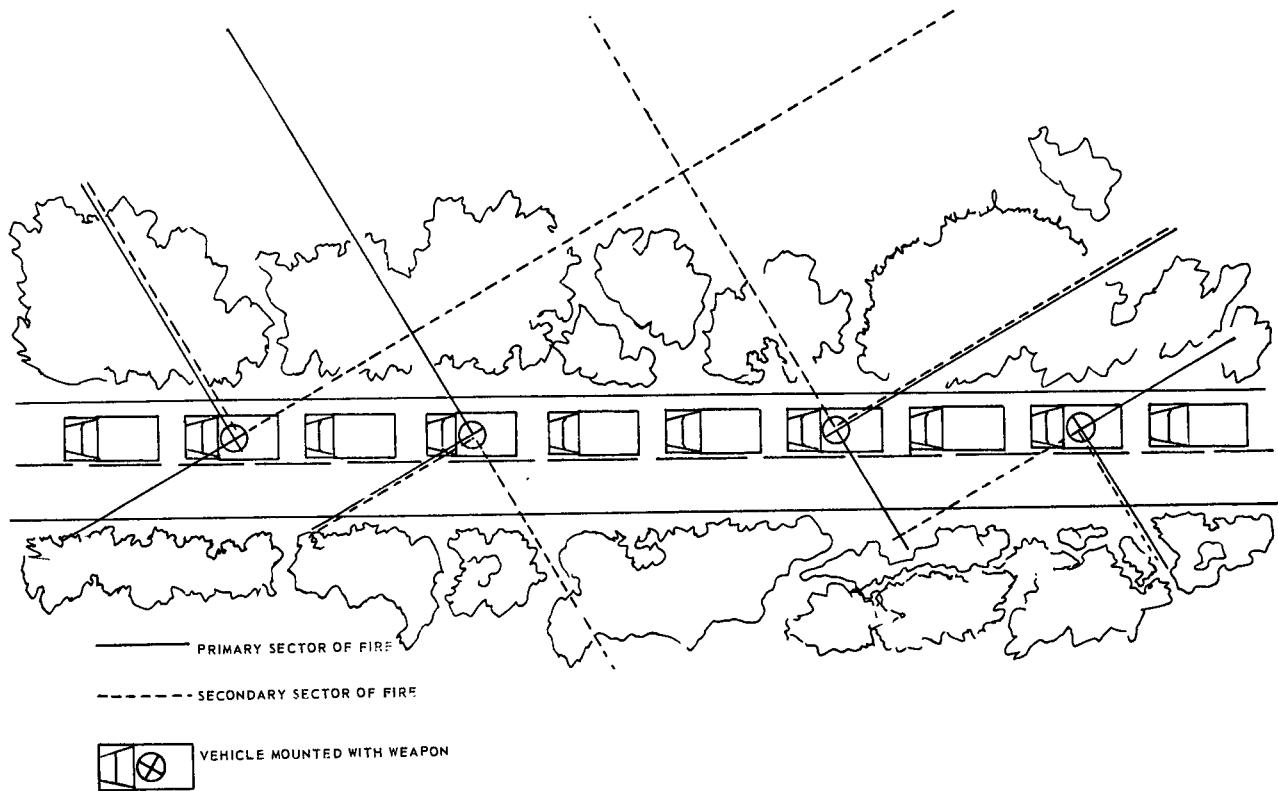


Figure 41. March column with four caliber .50 machineguns.

## 11. Allocation

a. The Browning machinegun, caliber .50 HB, M2 is provided to forward area units by TOE and/or on table of allowance basis. Issue is determined by tactical considerations, extent of air parity, and the type of unit (armor, artillery, engineer, infantry) concerned.

b. Applicable mounts for the machinegun include —

- (1) Antiaircraft mount M63.
- (2) Truck mount M36.
- (3) Pedestal truck mount M31C.
- (4) Pedestal truck mount M24A2.

(5) Cupola and external turret mount, main battle tank and light gun tank.

(6) External mount, armored personnel carriers (until replaced by M26 cupola).

(7) Cupola mount (M26) modified.

c. The M63 mount is portable and can be employed either on the ground or bolted to a vehicle platform that has been reinforced. Unless modified, the other mounts listed are suitable for vehicular use only. The M26 mount was designed for the personnel carrier, M114. In a modified version, it may be appropriate for use on the personnel carrier, M118.

## APPENDIX IV

### LOCAL SECURITY

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#### **1. General**

Local security must include all available active and passive measures consistent with the enemy threat. The commander must insure that adequate protection from enemy air attack and surveillance as well as ground attack and surveillance is established.

#### **2. Passive Defense**

*a. General.* Passive defense includes all defensive measures other than the employment of weapons. The passive defense plan is made before moving into a position and is implemented, and improved upon, while the unit remains in the position. In planning defense measures careful consideration is given to cover, concealment, dispersion, deception, warning signals, CBR defense, and electronic security.

*b. Cover.* Maximum use is made of whatever natural cover is available in the position area. Emplacement and structures for the protection of personnel and equipment are constructed as soon as possible and the position is continually improved. Because of the limited organic engineer capabilities of air defense units, engineer support should be provided the units whenever possible. For details of construction of emplacements, shelters, and obstacles see FM 5-15.

*c. Concealment.* Air defense equipment other than radar antennas lends itself to natural and artificial camouflage. For details of concealment methods, see FM 5-20. Radar antennas may be camouflaged at the discretion of responsible commanders when not in operation. However, when in operation, radars must be free of camouflage and must have clear line-of-sight to achieve their maximum capabilities. Launcher emplacements must likewise be free of overhead obstructions during firing.

*d. Dispersion.* The technical and safety requirements of air defense missile systems normally provide for dispersion within the battery. Additional dispersion must be accomplished by proper location of the battery command post, assembly and service area, motor park, bivouac area, and administration facilities. Dispersion must be balanced against the need for local ground defense.

*e. Deception.* When authorized by higher headquarters, dummy positions may be constructed to deceive the enemy. To achieve realism dummy positions should be provided some personnel activity. A transmitter should be moved into the dummy position and operated at random scheduled intervals. Dummy sites must be so located that the real installations will not be damaged if the dummy positions are taken under attack.

*f. Warning Signals.* Unit SOP must prescribe specific warning signals for ground, air, airborne, and CBR attacks. The signals must be clearly understood by all personnel. Likewise all personnel must be made aware of the actions to be taken in each instance. Periodic rehearsals and drills must be conducted to insure that the signals used are understood and that the methods of dissemination are adequate to provide unit personnel sufficient warning time to take action. Devices such as trip flares may be used to provide warning against infiltration by ground attackers. Locations of such devices must be reported to the next higher headquarters and all unit personnel must know their location.

*g. CBR Defense.* All troops must be able to take defensive measures in case of CBR attack. Radiac teams must be organized and trained. See FM 31-40, FM 21-41, and FM 21-48 for procedures and training methods for CBR defense.

*h. Electronic Security.* Radar emissions must be restricted to those essential to the accomplishment of the mission. Radio discipline to include radio silence when appropriate must be strictly enforced. Dummy loads and careful positioning of antennas must be used during maintenance when practical.

*i. Other Passive Measures.* The use of challenges, countersigns, and blackout discipline must be considered when the situation warrants.

### **3. Active Defense**

*a. Active defense* is the deployment of forces against actual or anticipated threats. All available weapons are sited so as to achieve maximum effectiveness against air and ground attacks. In addition to the primary missile system armament, weapons organic to the air defense units include caliber .50 machineguns, 7.62-mm machineguns, 3.5-mm rocket launchers and individual weapons.

*b. Aircraft attacking missile sites* are engaged as soon as detected and kept under an increasing volume of fire. Enemy aircraft that may succeed in penetrating the missile barrier are aggressively taken under fire according to SOP, with all available machineguns and individual weapons as soon as they come within range. Considerations for the employment of the caliber .50 machinegun in the air defense role are presented in appendix III. Individual weapons may be used against fast low-flying attacking aircraft in a technique known as a "pattern of fire" in which each individual fires his weapon in the path of the aircraft making no attempt to track the aircraft. Against very slow flying aircraft and helicopters, more effective fire can be achieved by placing well-aimed shots on or ahead of the target. The decision as to which technique to use is left to the individual's or units' discretion. It is recommended that individual weapons only be used against aircraft actually attacking the units position. Even though the electronic means available will normally provide advance warning of incoming hostile aircraft, adherence to the prescribed rules for engagement must be stressed in unit and individual training.

*c. When available and required, missile units may be augmented by additional air defense weapons such as M42, self-propelled, twin 40-mm (Duster) units for increased protection. In*

such instances the missile sites become the vital area for the Duster and its employment and defense design is as presented in appendix III.

### **4. Local Security Against Ground Attack**

*a. General.* Local security is provided by the effective use of personnel and materiel available to a unit. It includes all the measures necessary for protection against local attack. Local security plans and procedures must be closely coordinated with supported and adjacent units and conform with the area security plan and area damage control plan.

*b. Selection of Position.* In selecting the air defense site, the following factors are considered in attaining local security—

- (1) Fields of fire.
- (2) Routes of approach to and from the position to include low altitude routes of air approach.
- (3) Observation.
- (4) Tactical advantage of the ground.
- (5) Camouflage.
- (6) Cover.

*c. Organization of Position.* The defended area should be kept as small as possible consistent with the need for dispersion. Machineguns and rifles are sited to form bands of interlocking fire around the perimeter to prevent enemy penetration.

*d. Materiel.* Weapons and equipment normally contained within an air defense weapon unit will be used for local security as follows:

- (1) *Machineguns.* Machineguns are the primary ground defense weapons. They are sited for interlocking, grazing fire through unobstructed fire lanes. Machineguns are fired in short bursts to prevent overheating. Alternate machinegun positions should be prepared.
- (2) *Hand grenades.* Hand grenades are of great value for both their killing and psychological effects. An added value is that they do not reveal the friendly positions to the enemy.
- (3) *Mines and boobytraps.* Mines and boobytraps, in addition to being effective in inflicting casualties and demoralizing the enemy, also serve as warning

devices. Mines must be laid far enough outside the defended area to avoid injuring friendly personnel. The laying of mines must be as authorized by higher headquarters.

- (4) *Barbed wire.* Barbed wire delays the enemy and provides a warning to the defended area. Wire should be strung from 50 to 100 meters from the equipment. Noise-making devices may be attached to the wire. Details on wire obstacle construction are contained in FM 5-15.
- (5) *Individual arms.* Wire and other obstacles are covered by small arms fired from foxhole positions. Riflemen should be placed where they can provide protection for crew served weapons with flanking and crossfire.
- (6) *Rocket launchers.* Rocket launchers are located to cover probable avenues of approach for armor and mechanized vehicles.

e. *Standing Operating Procedures.* SOP's for local security are necessary for all units. It must be thoroughly understood by every individual. It will include as a minimum —

- (1) A plan for maintaining security during displacement and for establishing and executing immediate local security upon occupation of position.
- (2) A system of marking restricted areas, including mined and boobytrapped areas.
- (3) The procedure for submitting mine and boobytrap reports.
- (4) Alert signals.
- (5) The organization of a mobile reserve to reinforce threatened sectors or to counterattack penetrations.
- (6) A system of challenges, passwords, and replies.
- (7) An alert plan for manning defensive positions.
- (8) The establishment of ground observation and listening posts.
- (9) A plan for defense against CBR attacks.
- (10) Priorities for opening fire on various types of targets.
- (11) Guidance regarding authority to aban-

don the primary mission when necessary to accomplish self-defense.

f. *The Local Security Plan.* The local security plan must be simple and flexible. It must make provision for establishing —

- (1) An all-around perimeter defense.
- (2) Sites for weapons.
- (3) Sectors of fire for all weapons.
- (4) Guards and listening posts.
- (5) Guard details and orders.
- (6) Personnel alert stations.
- (7) Procedures in the event of perimeter penetration.
- (8) Restricted areas.
- (9) Blackout discipline.
- (10) Methods of communication.
- (11) Priorities.

## 5. Special Considerations

a. *Movement.* Air defense units supporting field army operations will normally displace the ground scheme of maneuver (para. 101 and 102). Air defense units are most vulnerable to air and ground attacks while on the move. If possible, movements should be made under conditions of reduced visibility. The possibility of moving by infiltration must be considered. Air guards are placed and remain alert in each vehicle. Machineguns are employed as discussed in appendix III. Individual weapons are used in the manner discussed in paragraph 3b, this appendix.

b. *Emergency Destruction of Equipment.* Plans must be made for emergency destruction of equipment to prevent its capture by the enemy. The priorities for destruction are pre-established. Actual destruction is accomplished as a matter of last resort —

- (1) When authorized by higher headquarters if it can be contacted.
- (2) On order of the senior commander present when communications with higher headquarters have failed.
- (3) Destruction is authorized only when —
  - (a) Capture is imminent.
  - (b) The equipment cannot be evacuated.
- (4) Disposition of nuclear components is discussed in FM 44-95.

*c. Counterguerrilla Operations.* All considerations discussed in the previous paragraphs are applicable when air defense units are placed in support of forces operating in areas where a guerrilla environment exists. Due to the increased ground threat, the need for providing augmentation security forces to the air defense missile units becomes paramount. The augmentation forces, in this case, are normally employed in static security posts (FM 31-16) tied in by roving patrols to secure the area around the

site. Scouting and patrolling are conducted at a considerable distance from the battery's location to guard against the possibility of the enemy attacking the position with indirect fires by light artillery and mortars. Locations that the enemy could use as observation posts to adjust the indirect fires are kept under continuous surveillance. The area security measures established by the augmentation forces do not relieve the air defense units of the responsibility of utilizing all organic resources for self-defense.

## APPENDIX V

### SAMPLE FORMATS AND REPORTS

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1. SUGGESTED FORMAT FOR AD ANNEX TO A FIELD ARMY STANDING OPERATING PROCEDURE.

(Classification)

Issuing headquarters

Location

Date of Issue

ANNEX B (\_\_\_\_\_ Army AD SOP) to SOP, \_\_\_\_\_ Army

#### Section I. GENERAL

1. Reference: SOP \_\_\_\_\_ Army.
2. Applicability: AD with \_\_\_\_\_ Army and Corps.
3. Purpose: This SOP standardizes normal procedures; it applies unless otherwise rescinded or superseded.
4. Unit Procedure: Submits issue SOP to conform.
5. Definitions (when required):

#### Section II. PERSONNEL AND ADMINISTRATION

(Extracts from \_\_\_\_\_ Army SOP relative to replacements, decorations, awards, leaves, promotions, reports, and morale activities may be listed.)

#### Section III. INTELLIGENCE

6. Condition of Air Defense Warning.
7. Reports.
  - a. After Action. Sufficient data to provide a basis for subsequent determination of combat effectiveness.
  - b. Periodic Intelligence Report, see para 3 below.
  - c. Tactical Nuclear Weapon (extracted from \_\_\_\_\_ Army SOP for emphasis).
    - (1) By fastest possible means, report information indicating enemy capability of tactical employment of nuclear weapons.
    - (2) Report radiation activity detected, using iso-intensity chart.

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- d. Accidents/Incidents Involving Aircraft/Missiles. Accidents/Incidents involving aircraft/missile of Army AD forces stationed in a NATO country will be reported to the air force of that nation for investigation. Wreckage should be undisturbed and safety zones established, as necessary. (STANAG 3581 — Investigation of Aircraft/Missile Accidents/Incidents).
- 8. Air Defense Effectiveness Capabilities.
  - a. ADA in Division Zone of Operations.
    - (1) Report to ADA group attached to corps the location of all fire units.
    - (2) Follow initial report with an overlay of effectiveness capabilities indicating minimum and maximum slant range and altitude limits of each fire unit, and areas in which units cannot fire.
  - b. ADA in Corps Zone of Operations.
    - (1) Report immediately through channels the location of all fire units and AADCP.
    - (2) Follow initial report with overlays of effectiveness capabilities of all fire units, and safe burst altitudes.
  - c. ADA in Army Zone of Operations. Report all information as required in a and b above. All coverage data will be furnished to the appropriate U.S. Air Force control facilities.
- 9. Location of Defended Units. Report through channels all changes in location of defended units in the defended areas, and all changes in air corridors.
- 10. Safe Burst Altitudes.
  - a. Unit SOP's will reflect the commander's decision.
  - b. All missile fire units capable of firing nuclear warheads will have a current overlay depicting the safe altitudes in their zones of effectiveness.
- 11. Displacement. Except in case of tactical necessity, no unit under operational control of ADA group and brigade will displace without prior clearance and coordination with army headquarters.
- 12. AD Aviation.
  - a. Airfield: Aircraft will be stationed at airfields assigned by unit commander, or at the nearest army aviation airfield.
  - b. Operation: Regardless of where the aircraft are stationed, unit commander will retain control of aircraft.
  - c. Communication: SOI, SSI applies.
- 13. Rules for Engagement. Unit SOP's will reflect unified commander's decision.

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14. Condition of Air Defense Warning. The theater (area) AD commander is responsible for determining the condition of the air defense warning. Warning will be announced to all AADCP's.
15. AD States of Alert. Define the degree of readiness required for each state of alert.
16. Surface-to-Surface Fires. Air defense units with a surface-to-surface capability must be capable of switching rapidly between AD missions and surface missions.

#### Section V. LOGISTICS

17. General. Conform to para\_\_\_\_\_, Logistics SOP; Army.
18. Ammunition. ADA group inform subordinate units of available supply rate.
19. Evacuation. Units directed to nearest clearance station.
20. Services. Subordinate units inform ADA group of service request.
21. Maintenance. Conform to para\_\_\_\_\_, Logistics SOP; Army.
22. Reports.
  - a. Report ammunition in excess of basic load every 24 hours.
  - b. Equipment shortage report.
  - c. Unit equipment status report every 24 hours.

#### Section VI. COMMAND

23. Command Posts. Battalions and fire units report movement and location to ADA group. ADA group report to ADA brigade.
24. Communication.
  - a. General. Conform to Army SOI and SSI. All communication officers extract information as necessary and as authorized.
  - b. Radio Nets. Organic radio nets as described in FM 44-series.
  - c. Wire System.
    - (1) Area communication system provides facilities to ADA battery, battalion, group, and brigade except forward area weapons.
    - (2) Forward area weapons will install wire circuits to nearest area communications center when practicable.
    - (3) See SOI and SSI for circuit requirements and priorities.
  - d. Security. Evidence of wiretapping, wirecutting, jamming, and loss of SOI or SSI will be reported immediately.

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(Signature)

Authentication

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(Classification)

2. SAMPLE FIELD ARMY AIRSPACE UTILIZATION PLAN

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(Classification)

Copy No. 2  
Tenth Army  
Paris  
17 0900 Jan  
R 108

Annex \_\_\_\_\_ (Airspace Utilization) to OPORD 4.

Reference: Map, EUROPE, 1:250,000\_\_\_\_\_

Map, USAF Navigation\_\_\_\_\_

1. Situation.

- a. Enemy forces. Op ORD 4.
- b. Friendly forces. Op ORD 4.
- c. Attachments and detachments — none.

2. Mission.

To insure proper and efficient coordination and timely access to the airspace over the combat area by all users with minimal interference.

3. Execution.

a. Concept of airspace utilization:

- (1) Aircraft of all services must be free to conduct combat operations without restraint except those required for command, control, coordination of effort within and among the participating services, and safety.
- (2) The VFR/IFR coordination altitude is established at 7000 feet MSL. Army aircraft will be free to operate VFR below this altitude with no restrictions other than those imposed by the following paragraphs.
- (3) Surface-to-surface and air defense weapons must be free to fire in all airspace subject only to normal fire support coordination measures, restraints imposed by readiness conditions, and rules for engagement.
- (4) For aviation, air defense, and surface-to-surface artillery to fulfill their missions in the same airspace, all must accept some restrictions and risks. The restrictions and risks imposed on each will reflect the commander's priorities for operations.

b. Airspace priorities:

- (1) Upon receipt of the appropriate Zulu code, Army air defense has total priority in the designated areas and all friendly air traffic will clear the airspace immediately.
  - (a) Zulu Alpha — Clear entire combat zone airspace.
  - (b) Zulu Bravo — Clear I Corps airspace.

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- (c) Zulu Charlie — Clear II Corps airspace.
- (d) Zulu Delta — Clear III Corps airspace.

Code Blue Sky (All Clear) will be broadcast every 30 seconds for ten minutes.

- (2) I Corps area priority to west-bound traffic on air routes/corridors A32 and T2.
- (3) II Corps area priority to east-bound traffic on air routes/corridors T1, T4, D21 and D22.
- (4) III Corps area priority to west-bound traffic on air routes/corridors B30 and T3.
- (5) U.S. Air Force tactical fighter bombers have priority on Objectives Alpha, Bravo, and Charlie, from 180500 to 180550 Jan.
- (6) Army airmobile and aerial fire support aircraft have priority from 180551 until completion of the airmobile operation on Objectives A, B, and C.
- (7) Restricted (hot) areas: As indicated on overlay, TAB A hereto. Aircraft will not enter these areas without complying with restrictive measures in effect.
- (8) Prohibited (exclusion) area: As indicated on overlay, TAB B hereto. Aircraft will not enter or overfly this area at any time.

c. Concept of air support:

- (1) Army Aviation: See Annex \_\_\_\_, Army Aviation, to Operations Order 4.
- (2) U.S. Air Force: See Appendix \_\_\_\_, Air Fire, to Annex \_\_\_\_ to Operations Order 4.

d. Air traffic regulation organization: FOC locations and areas of responsibility — FCC locations and areas of responsibility. See annex \_\_\_\_, Army Aviation, to Operations Order 4.

e. Coordination instructions:

- (1) All Army aircraft moving forward in the division area with the exception of surveillance aircraft will remain below 600 feet until 180550 January.
- (2) ATCL #2 effective 180550 Jan.
- (3) Air warnings will be disseminated by all air traffic regulation elements, the AADCP, and the warning broadcast net.
- (4) High performance aircraft will not penetrate a lower safety layer of 200 feet absolute altitude except for take off and landings, unless under positive control of a forward air controller.
- (5) All flights above the IFR-VFR coordinating altitude are subject to control by the CRC of the 9th Air Force.

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- (6) Air corridor B is restricted between altitudes of 1500 and 7000 feet from 180645 Jan until 180900 hrs Jan for the use of troop life aircraft.
  - (7) Flights operating in the brigade areas of the 4th and 5th divisions are restricted to brigade aircraft and aircraft in the direct support of the brigade.
  - (8) Air routes/corridors B1 and E1 are restricted to aircraft performing the ALOC mission from 150600 Jan to 162400 Jan.
  - (9) Aircraft flying along air routes/corridors are under direct control of the appropriate air traffic regulation organization from the time of its departure until termination. The following coordination is effected for these controlled flights.
    - (a) Below the coordinating altitude: Flight plan data passed to air traffic control facilities.
    - (b) Above the coordinating altitude:
      - 1. Flight plan data passed to the 9th AF CRC.
      - 2. Flight plan data passed to the AADCP.
      - 3. All Army ATR units concerned are notified.
  - (10) Air corridors A and B are designated recovery corridors.
- f. Air Defense Rules for Engagement: See Air Defense Annex —, and Air Defense SOP, Hq, 9th AF.
- g. Identification and Emergency re-entry procedures: See Air Defense Annex —, and Air Defense SOP, Hq, 9th AF.
4. Administration and Logistics.  
Admin Order 4.
5. Command and Signal.  
a. Signal:
  - (1) Annex H to Operations Order 4.
  - (2) Call words and frequency: Tenth Army SOI.
  - (3) Ninth AF call words and frequency: Tenth Army SOI.
  - (4) Navigation facility frequency en route: air navigation charts dated 210001 Feb 64.
- b. Command:
  - (1) Annex C operation overlay to Operations Order 4.
  - (2) Location of FOC, FCC (See Overlay Tab A).
  - (3) Location of AADCP (See Air Defense Plan).

Acknowledge

Tab A. Air Route Overlay

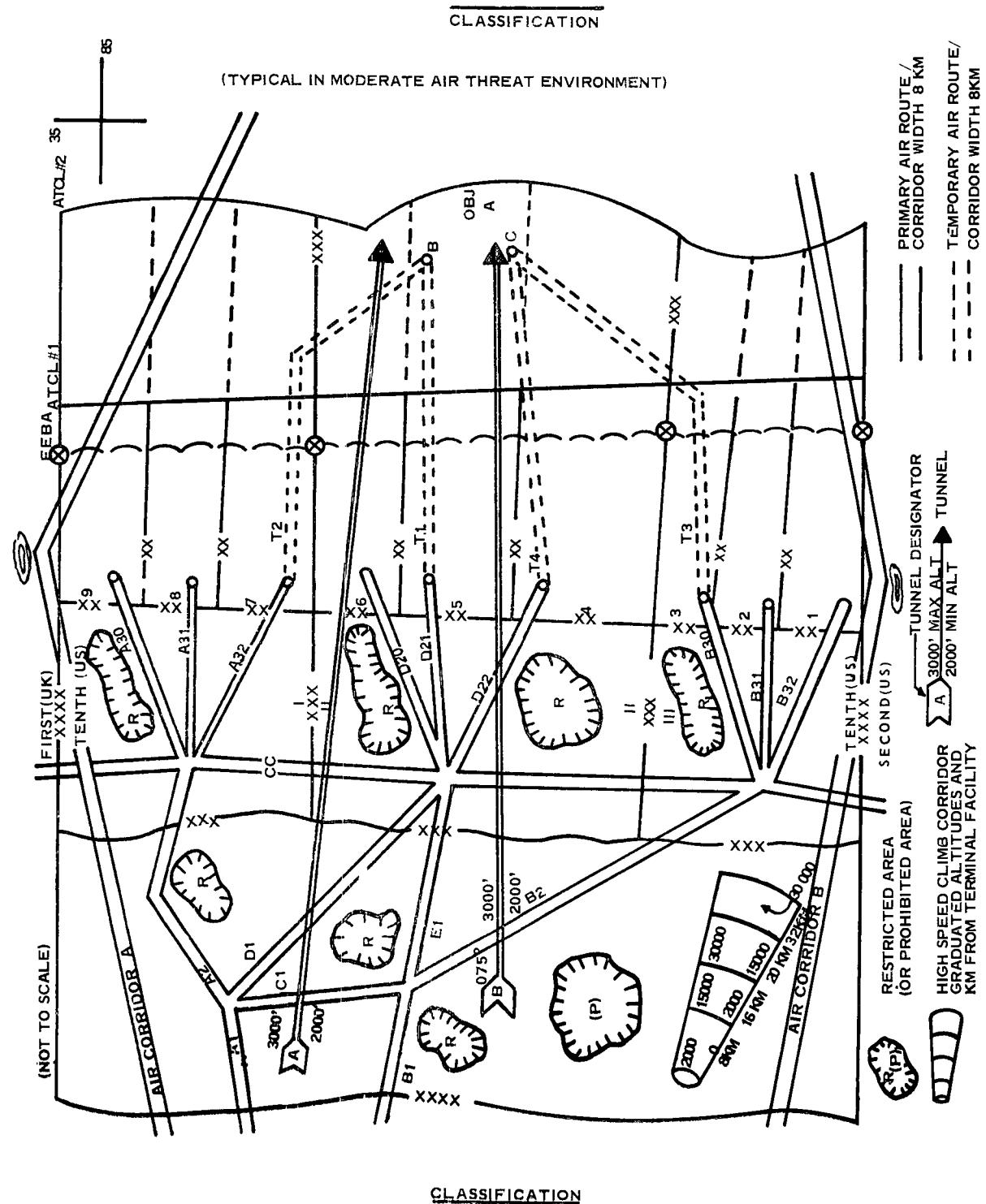
Distribution: B

OFFICIAL

/s/G3

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(Classification)



*Figure 42. Tab A — Air route overlay.*

**3. FORM FOR OTHER AD DOCUMENTS**

Appendices IV and V, FM 101-5, provide general guidance for the preparation of the following AD documents:

- a. Operation Order and Operation Plan.
- b. Air Defense Plan Annex to Operation Order.
- c. Air Defense Periodic Intelligence Report.

## APPENDIX VI

### CONVERSION TABLES

*Table II. Conversion Table — Linear Measurements*

Multiply Number of → To Obtain ↓ By ↓	Centi-meters	Meters	Kilo-meters	Inches	Feet	Yards	Nautical Miles	Statute Miles
Centimeters		$10^2$	$10^5$	2.540	30.48	91.44	$1.853 \times 10^5$	$1.609 \times 10^5$
Meters	0.01		$10^2$	$2.540 \times 10^{-2}$	0.3048	0.9144	1853	1609
Kilometers	$\times 10^{-5}$	0.001		$2.540 \times 10^{-5}$	$3.048 \times 10^{-4}$	$9.144 \times 10^{-4}$	1.853	1.609
Inches	0.3937	39.37	$3.937 \times 10^4$		12	36	$7.296 \times 10^4$	$6.336 \times 10^4$
Feet	$3.281 \times 10^{-2}$	3.281	3281	$8.333 \times 10^{-2}$		3	6080.27	5280
Yards	$1.094 \times 10^{-2}$	1.094	1094	$2.778 \times 10^{-2}$	0.3333		2027	1760
Nautical miles	$5.396 \times 10^{-6}$	$5.396 \times 10^{-4}$	0.5396	$1.3703 \times 10^{-5}$	$1.645 \times 10^{-4}$	$4.934 \times 10^{-4}$		0.8684
Statute miles	$6.214 \times 10^{-6}$	$6.214 \times 10^{-4}$	0.6214	$1.578 \times 10^{-5}$	$1.894 \times 10^{-4}$	$5.682 \times 10^{-4}$	1.1516	

*Table III. Conversion Table — Linear Velocity Measurements*

Multiply Number of → To Obtain ↓ By ↓	Meters per second	Feet per second	Yards per second	Miles per second	Miles per minute	Miles per hour	Kilo-meters per hour	Knots
Meters per second		0.3048	0.9144	1609	26.82	0.4470	0.2778	0.5148
Feet per second	3.281		3	5280	88	1.467	0.9113	1.689
Yards per second	1.094	0.3333		1760	29.33	0.4889	0.3039	0.5631
Miles per second	$6.214 \times 10^{-4}$	$1.894 \times 10^{-2}$	$5.682 \times 10^{-4}$		$1.667 \times 10^{-2}$	$2.2778 \times 10^{-4}$	$1.726 \times 10^{-4}$	$3.199 \times 10^{-4}$
Miles per minute	$3.728 \times 10^{-2}$	$1.136 \times 10^{-2}$	$3.409 \times 10^{-2}$	60		$1.667 \times 10^{-2}$	$1.036 \times 10^{-2}$	$1.919 \times 10^{-2}$
Miles per hour	2.237	0.6818	2.045	3600	60		0.6214	1.152
Kilometers per hour	3.6	1.097	3.291	5793	96.54	1.609		1.853
Knots	1.943	0.5921	1.776	3126	52.10	0.8684	0.5396	

## GLOSSARY

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Standard definitions are contained in AR 320-5 and JCS Pub 1.

*Autonomous operation* — As used in air defense, the mode of operation assumed by a unit after it has lost all communications with higher echelons. The unit commander assumes full responsibility for control of weapons and engagement of hostile targets.

*Centralized control* — As used in air defense, the control mode wherein a higher echelon makes direct target-to-fire unit assignments.

*Decentralized control* — As used in air defense, the control mode wherein a higher echelon monitors fire unit actions, making direct target-to-fire unit assignments only when necessary to insure proper fire distribution or to prevent engagement of friendly aircraft.

*Engagement Effectiveness (EE)* — The average kill capability of the defense, expressed as a percentage, against a particular raid size. The AD commander specifies the degree of protection for each area in terms of engagement effectiveness. Values of EE may be obtained from figure 20.

*Hawk ripple* — A method of fire in which the target is engaged by the Hawk firing section firing a series of missiles at a predetermined interval between launches.

*Hawk salvo* — A method of fire in which the target is engaged by both firing sections of a Hawk battery firing missiles simultaneously at predetermined intervals between launches within each section.

*Lay-down bombing* — A very low level bombing technique wherein delay-fuzed bombs are used to allow the attacker to escape the effects of his own bomb.

*Low Altitude Bombing System (LABS)* — A low level bombing technique wherein the attacker approaches the target at a very low altitude, makes a definite pull up at a given point, releases the bomb at a predetermined point during the pull up, and tosses the bomb into the target area.

*Radar cross section* — The area of a hypothetical target which returns as much energy to the radar as would the actual target. The radar cross-section of an actual target depends on many factors and can only be found empirically. Typical radar cross sections: Bomber, 10 to 30 square meters; fighter, 2 to 10 square meters; air-to-surface missile, 0.4 to 1 square meter.

*Reaction time* — The time delay, in burst locator construction, between detonation of one missile (or the last missile of a Hawk salvo) and lift

off of the succeeding missile (or first missile of a succeeding Hawk salvo) fired by the same unit at the same target.

*Response time* — The time delay, in burst locator construction, between the time the target enters detection range and lift off of the first defending missile.

*System effectiveness (SE)* — The probability, expressed as a percentage, that a fire unit will acquire a single target within system design capability, deliver a single round that will burst within system design accuracy, and achieve the desired degree of target destruction. The numerical value for SE is based on empirical data and includes system reliability, crew performance, maintenance proficiency, and environmental factors. System effectiveness values given in FM 44-1A are average figures including most, but not all, of the above named factors and may be varied for a particular defense at the discretion of the air defense commander.

*Vital area (VA)* — Key area which warrants protection by air defense artillery.

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For explanation of abbreviations used, see AR 320-50.

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