Chapter 2
Air Defense Doctrine And Procedures

All services—Army, Navy, and Air Force—are involved in air defense operations. Current doctrine and operational procedures provide for integration of the weapon capabilities of all services.

ARMY AIR DEFENSE OPERATIONS

AUTHORITY

Specific authorization for the Army to engage in air defense operations is derived from the National Security Act of 1947, as amended, and Joint Chiefs of Staff Publication 2, United Action Armed Forces (UNAAF), November 1959. These directives assign the Army primary functions as follows: "To organize, train, and equip Army forces for the conduct of prompt and sustained combat operations on land—specifically, forces to defeat enemy land forces and to seize, occupy, and defend land area." UNAAF assigns the Army the following air defense missions: "To organize, train, and equip Army air defense units, including provision of Army forces as required for defense of the United States against air attack, in accordance with doctrines established by the Joint Chiefs of Staff."

CONCEPT OF AIR DEFENSE OPERATIONS

The broad principles of Army air defense (AAD) doctrine are set forth in FM 44-1, U.S. Army Air Defense Employment. The provisions in FM 44-1 apply to U.S. Army air defense units with a unified command or serving in a combined force. The policies and procedures prescribed by the area air defense (AD) commander will prevail when they conflict with doctrine and procedures described in FM 44-1.

AREA AIR DEFENSE

Doctrine for area air defense is expressed in two basic principles: (1) a coordinated and integrated AD system under a single commander is essential to successful theater operations and (2) the effectiveness of each system is optimized, and no unnecessary restrictions are placed upon its employment.

The unified commander normally appoints the air component commander as the area AD commander and assigns him the mission to integrate the entire AD effort. The area AD commander exercises operational control over all AD forces organic to the area.

In regions where the situation indicates no offensive tactical air operations and the threat is essentially from an enemy air attack, the area AD commander may establish a joint air defense command (ADC). The joint AD commander may be appointed from any service component with the deputy commander appointed from any component other than the commander's. A joint staff will be formed in accordance with the principles of JCS Pub. 2.

FIELD ARMY

A field army commander is responsible for the execution of the land battle in his area. Normally, AD region commanders, designated by area AD commanders, will delegate to field army commanders the authority to control and employ organic AAD units within the field army area. This delegation of authority is for optimum employment of surface-to-air weapons in defense of the forward battle area. Field army and U.S. Air Force electronic coordination and control means will be compatible and connected operationally for optimum combat effectiveness.

NORTH AMERICAN AIR DEFENSE COMMAND

The North American Air Defense Command (NORAD) is a combined command exercising operational control of forces allocated for AD of Canada, Alaska, and the continental United States. Its mission is "To defend the North American Continent against aerospace attack." Headquarters NORAD, located at Colorado Springs, Colorado, prepares operational plans, conducts tactical exercises and readiness tests, and coordinates plans and requirements for new AD weapons. It is the supreme headquarters for directing the air defense of North America in the event of war.

EVOLUTION

NORAD was formed in September 1957 following an agreement between the governments of Canada and the United States which, in effect, was official recognition of the fact that air defense of the two countries is an indivisible task. A high level Canadian-United States committee (Military Cooperation Committee) drew up an emergency plan for the common defense of North America and directed that AD organizations of the two countries prepare detailed emergency AD plans. The first of these was issued in 1950.

Early in 1954, the same committee authorized a combined planning group of representatives from the Royal Canadian Air Force and the U.S. Air Force AD commands. Studies conducted by this group indicated that the best air defense of North America was an integrated defense, with forces of both countries operating under a single command, responsible to both governments. Following the completion of another study 2 years later which had the same conclusions, integration of operational control of the two forces was recommended.

In the meantime, the two countries had gone ahead with the development of a joint radar warning network. Together, they built the Pine Tree line of radars across southern Canada. Canada started constructing the mid-Canada line, and the United States began the distant early warning (DEW) line across the northern rim of the continent. Conditions for operating and manning these lines were mutually agreed upon.

Thus, by 1957, there had been a considerable history of joint planning, coordinating, and sharing, and the need for further integration had been recognized. In August of that year, the United States Secretary of Defense and the Canadian Minister of National Defense announced the two governments had agreed to establish a system of integrated operational control of AD forces for North America and an integrated headquarters. On 12 September 1957, NORAD was established, followed by the signing of an official agreement by both countries on 12 May 1958.

This agreement provided, among other things, that NORAD was to be maintained for a period of 10 years, or such shorter period as agreed upon by both countries. The Commander in Chief, North American Air Defense (CINCNORAD), was to be responsible to the Chief Defence Staff of Canada and the Joint Chiefs of Staff of the United States. During the absence of CINCNORAD, command would pass to the Deputy CINCNORAD. The agreement further stipulated that the appointment of CINCNORAD and his deputy had to be approved by both governments and that both would not be from the same country.

NORAD FORCES

NORAD has no organic fighting elements of its own, but is furnished combat-ready forces including Reserve and National Guard forces by five component commands (fig 6): U.S. Army Air Defense Command (ARADCOM); U.S. Air Force Air Defense Command (USAF ADC); U.S. Naval Forces CONAD (USNAVFORCONAD); Royal Canadian Air Force Air Defence Command (RCAF ADC); and the AD forces of the Alaskan Command. CINCNORAD (fig 7) exercises operational control over all forces attached or otherwise made available by component commanders.

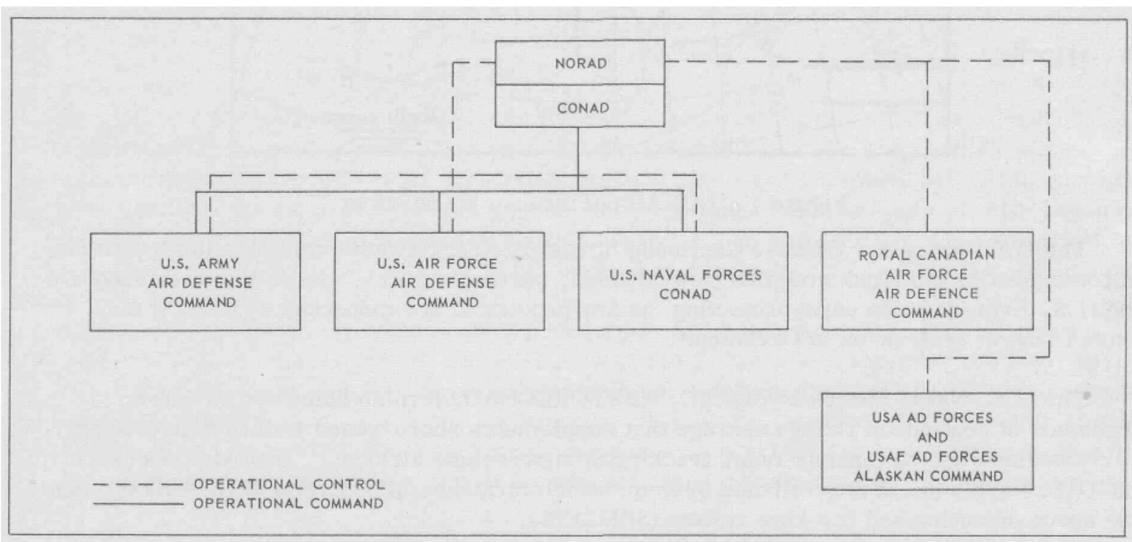

Figure 6. NORAD/CONAD command and control structure.

The Continental Air Defense Command (CONAD) is a unified command under NORAD concerned with purely national AD matters, thus preserving flexibility for unilateral action where strictly United States interests are involved. Accordingly, the mission of CONAD is aerospace defense of Alaska, Greenland, CONUS, and of Mexico, if requested by the Mexican Government. The senior American officer in NORAD is the Commander in Chief, Continental Air Defense (CINCONAD). If CINCNORAD is an American, he also is CINCONAD. If CINCNORAD is a Canadian, then Deputy CINCNORAD is CINCONAD.

Figure 7 . NORAD operational boundaries .

The U.S. Army Air Defense Command furnishes Nike Hercules missiles (high-altitude, surface-to-air) and Hawk missiles (low-altitude, surface-to-air). Under this command are the U.S. Army missile units protecting the key population and industrial centers of the United States, plus bases in Greenland.

The U.S. Naval Forces in NORAD, NAVFORCONAD, furnish ships for off-shore extension of contiguous radar coverage that supplements shore-based radars in providing early warning and continuous radar tracking of approaching aircraft. They also operate the U.S. Navy's Space Surveillance System, which furnishes information to NORAD through the space detection and tracking system (SPADATS).

Most of NORAD's fighter-interceptor squadrons are provided by the U.S. Air Force Air Defense Command (USAF ADC). This component also contributes Bomarc surface-to-air missiles and a large number of radar squadrons and early warning airborne radars. USAF ADC is responsible for the ballistic missile early warning system (BMEWS) and SPACETRACK (a part of SPADATS), providing NORAD important information about ballistic missiles and orbiting space objects. The Air National Guard provides interceptor squadrons and aircraft control and warning squadrons on full-time assignment to NORAD through USAF ADC.

The Royal Canadian Air Force Air Defence Command (RCAF ADC), not a member of CONAD but operating directly under CINCNORAD, provides fighter-interceptor squadrons and two surface-to-air Bomarc missile squadrons. It also contributes heavily to performance of surveillance, detection, and identification functions.

The Alaskan Air Defense Command is a NORAD region responsible directly to CINCNORAD for air defense of the State of Alaska.

OPERATIONAL PROCEDURES

To accomplish its mission, NORAD is guided by these AD principles: hit the enemy as far out as possible; increase the pressure as he continues; complicate his tactical problem by employing a family of weapons to perform low, medium, high, close-in, and distant missions; and realize optimum economy and efficiency of effort through centralized direction and decentralized execution of the air battle.

NORAD must guard against manned bomber attack, ballistic missile attack, and the space threat. It must watch over the North American Continent from treetops to beyond the atmosphere. Currently, the North American Continent is divided into eight regional areas (fig 7) of AD responsibility. Six of these are numbered regions, including some of the southern portions of Canada and all of the continental United States, excluding Alaska. The Northern NORAD Region encompasses the rest of Canada, including highly populated industrial areas of Ontario and Quebec. The Alaskan NORAD Region completes the picture. Each region commander is responsible to CINCNORAD for all aerospace activity within his designated area.

Each of these NORAD regions is further subdivided into areas called sectors, the basic NORAD unit for fighting the air battle. Sectors that cross the international boundary are jointly manned by United States and Canadian personnel. The size of one sector may differ greatly from another, depending generally on the amount of air traffic and number of vital target areas located within sector boundaries.

To accomplish its mission, NORAD must accomplish four basic steps: It detects the the presence of airborne objects, aircraft, or missiles; identifies them as friendly or hostile; intercepts and examines those not identified as friendly; and destroys those identified as hostile, using interceptor aircraft or AD missiles.

NORAD employs three detection systems, each designed to detect one of the three possible threats. The northernmost detection system is the ballistic missile early warning system (BMEWS). The three BMEWS stations (Thule, Greenland; Clear, Alaska (fig 8); and Fylingdales Moor in northern England) are electronic systems providing detection and early warning of attack from enemy intercontinental ballistic missiles (ICBM).

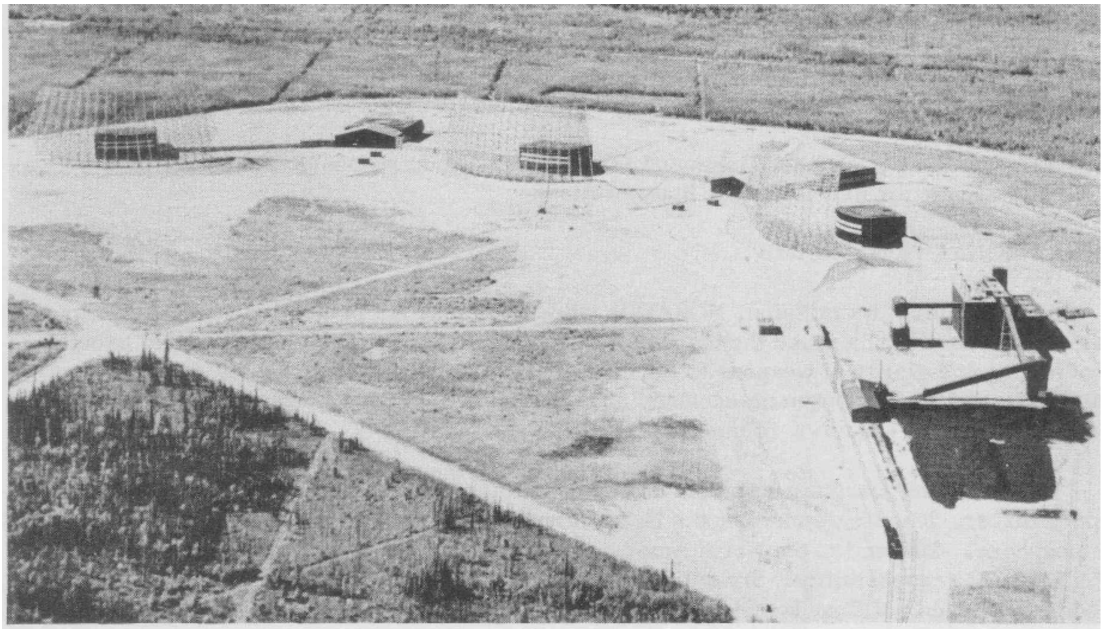

Figure 8. NORAD BMEWS site at Clear, Alaska.

The BMEWS system was made possible by recent scientific developments in the electronics field. The system uses huge radars, approximately the size of a football field, which can detect a missile as far out as 3, 000 miles. The power required for a single station would meet the electrical needs of a small city.

The heart of the BMEWS detection system is a combination transmitter-receiver which transmits an extremely brief burst of energy many times each second in narrow fans of radiofrequency energy at two different degrees of elevation. As a missile passes through these fans, it reflects energy to the station, enabling the coordinates of flight to be recorded. From a set of coordinates, the trajectory can be plotted and the impact point, time, and point of launch calculated. Data processing equipment at the site rapidly computes the data and flashes a warning to NORAD.

A second detection system is the manned bomber surveillance network, composed of three land-based radar networks (fig 9), Navy picket ships, and Air Force and Navy radar planes. The first line of radars begins in the far north with the distant early warning (DEW) line (fig 10). This radar fence, which stretches from the eastern shores of Greenland across the Canadian Arctic and along the Aleutian chain, provides initial warning of attack by manned bombers. Backing up this fence is the mid-Canada radar line across a part of the northern portion of Canada above the well-populated areas. Ground-based radar, called contiguous coverage radar, is extended out to sea off both coasts by Air Force radar planes (fig 11) and Navy picket ships (fig 12). All of these systems are joined together by a communications network terminating in the NORAD Combat Operations Center at Colorado Springs, Colorado.

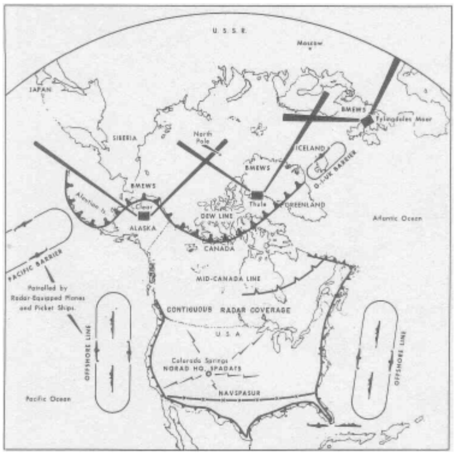

Figure 9. NORAD radar detection system.

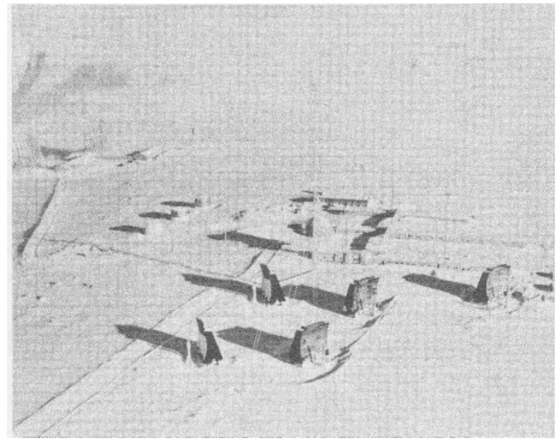

Figure 10. DEW line radar site on Baffin Island.

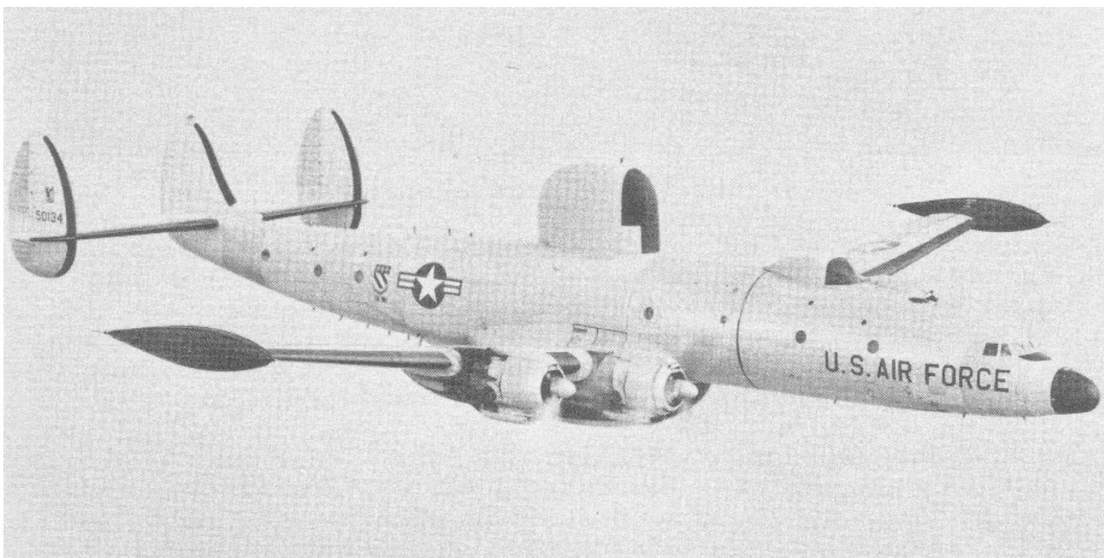

Figure 11. USAF EC-121H Super-Constellation radar plane.

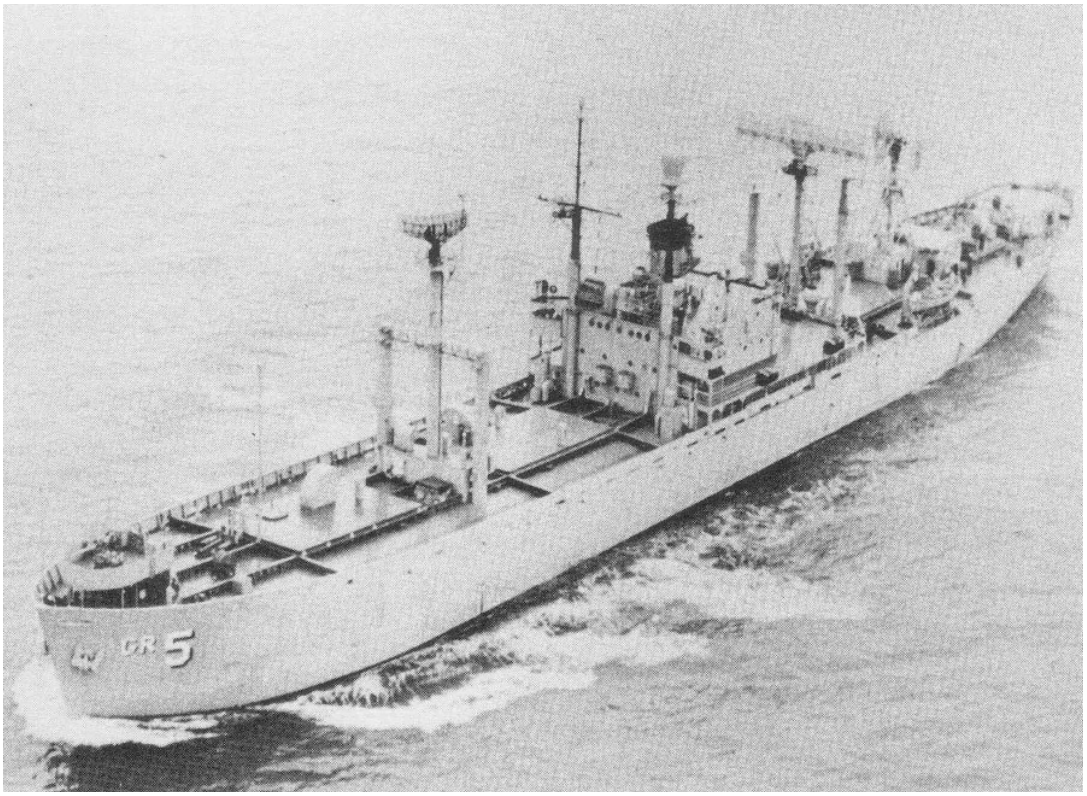

Figure 12. U.S. Navy radar-loaded picket ship.

A third part of the NORAD detection and warning system is the space detection and tracking system (SPADATS) which keeps track of all manmade objects in space and determines entry time and location of new ones. 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. Civilian and government scientific agencies throughout the free world contribute to SPADATS on a cooperative basis.

Primary military members of SPADATS are the USAF SPACETRACK system and U.S. Navy's space surveillance system (NAVSPASUR). SPACETRACK provides tracking information through a series of USAF Air Defense Command-operated radar sensors and BMEWS. NAVSPASUR is composed of three powerful transmitter stations and four receiver stations across the southern United States from California to Georgia. Data from this network are furnished to SPADATS computers through the system's headquarters and operations center at Dahlgren, Virginia. The third type of information comes from the passive optical surveillance system (POSS), composed of Baker-Nunn cameras (fig 13) used by the Air Force Systems Command, Royal Canadian Air Force Air Defence Command, and the Smithsonian Astrophysical Observatories. These telescopic cameras have the ability to probe 100, 000 miles into space to obtain photographs of space objects.

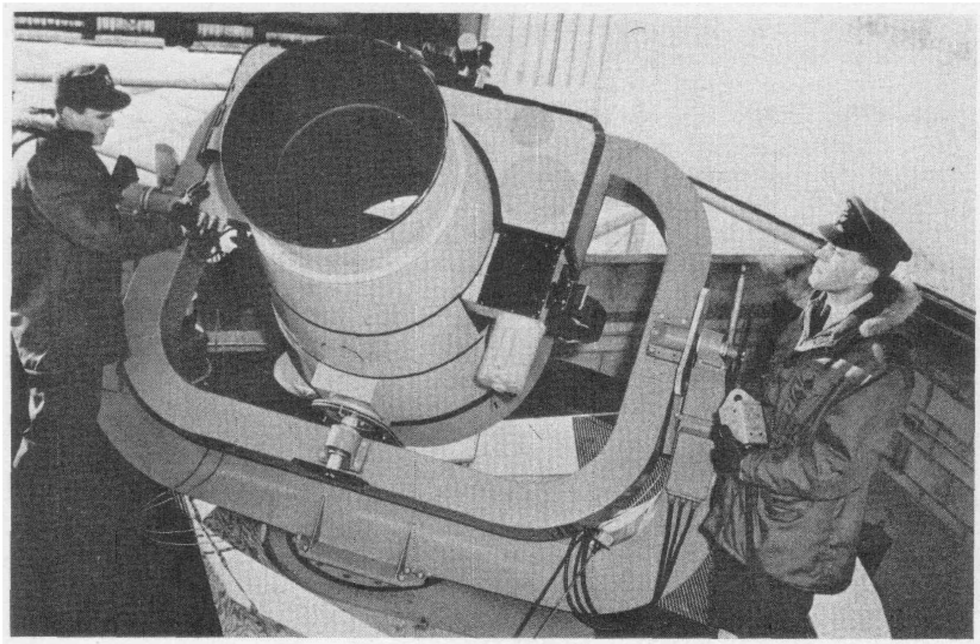

Figure 13. Baker-Nunn camera.

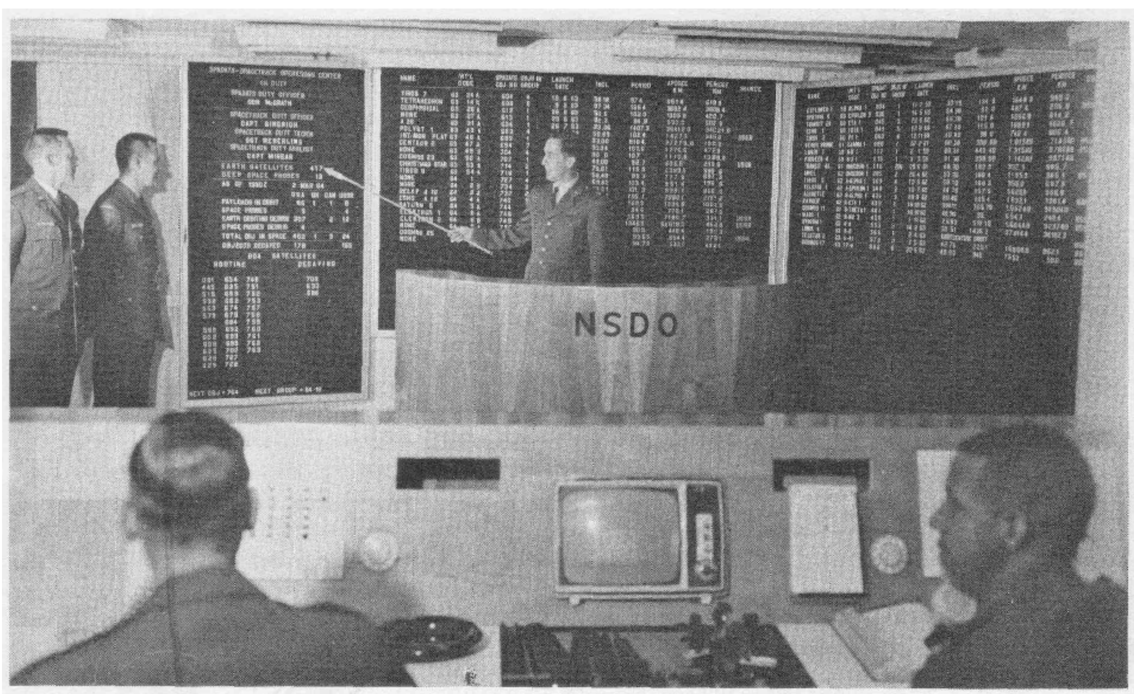

Figure 14. SPADATS Center at NORAD headquarters.

Space tracking information from this widespread system flows into the SPADATS Center (fig 14) at Colorado Springs, Colorado, where giant digital computers digest reams of complex orbital data on space objects.

The wide variety of data received from the numerous sources enables the SPADATS Center to provide complete and timely tracking information on all manmade objects in space. SPADATS also maintains a running catalog on all space traffic which is constantly revised and updated. Thousands of observations are received daily and are used to refine existing orbital characteristics of more than 400 objects. This includes not only payloads, but space junk such as burned-out boosters, wires the size of a lead pencil, and nuts and bolts that go into orbit with every payload launched.

Once the computers have digested all the tracking data and produced their findings, the information is displayed on large status boards in the SPADATS Center. From here it is transmitted to the battle staff area in the adjacent NORAD Combat Operations Center by closed-circuit television.

It is expected that at some future date SPADATS must be equipped to determine the purpose and threat potential of unfriendly space objects, to warn of hostile activity in space, and to provide space traffic control, operational support to antisatellite weapons when and if developed, and support to United States space and weapon activities.

Identification is one of NORAD's most difficult problems, caused chiefly by the large amount of air traffic in the United States and Canada. On the average, there are approximately 600 to 1, 000 overwater incoming flights to the United States and Canada each day, plus an estimated 200, 000 internal flights.

Aircraft penetrating the North American Continent enter air defense identification zones (ADIZ) established around and throughout the continent to assist in identification processing. Any aircraft originating from an oversea area must enter an ADIZ within 20 miles of a predetermined point and within 5 minutes of an estimated time, based on the pilot's flight plan filed at his takeoff point and sent ahead to the Federal Aviation Agency (FAA) in the United States and Department of Transport (DOT) in Canada. This information is relayed to appropriate NORAD sector direction centers (NSDC) and used for correlation when the track is acquired.

If an aircraft enters an ADIZ, but is not within prescribed limits, it is declared an unknown and an interceptor is scrambled to make positive visual identification. The ADIZ system is part of the NORAD identification process known as flight plan correlation.

Under combat conditions, the identification process would be somewhat simplified when provisions of emergency plans, SCATER (security control of air traffic and electromagnetic radiation) and ESCAT (emergency security control of air traffic), are placed in effect. SCATER in the United States and ESCAT in Canada provide for orderly grounding of non-essential aircraft and for establishment of military control over radio navigational aids.

With the large amount of aircraft flights taking place within NORAD airspace in any given 24-hour period, it is a rare day when none of these appear at the NORAD Combat Operations Center as unknown. The average number of unknowns in the system has steadily declined over the years until now the number is less than 10 per day. Of these, it is common to find two or three instances where interceptors are scrambled but recalled before intercept because of further communication checks. The remaining unknowns are intercepted and visually identified by an interceptor crew.

In all, there are more than 40 regular fighter-interceptor squadrons (fig 15) in the NORAD system. In an emergency, these forces would be augmented by available fighter aircraft of the U.S. Navy, U.S. Marine Corps, U.S. Air Forces, Air National Guard, and interceptor training units of the RCAF Air Defence Command. All these forces are highly mobile and constantly practice dispersal and forward base deployment.

Figure 15. USAF ADC fighter-interceptors go into action.

If an unknown is identified as hostile, the aircraft will be destroyed by the most expeditious method available in CINCNORAD's varied arsenal.

NORAD COMBAT OPERATIONS CENTER

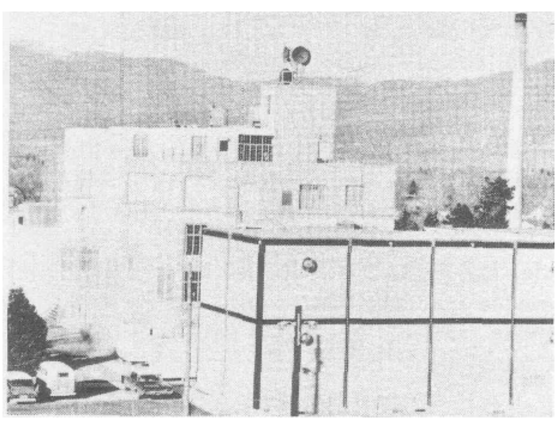

Figure 16. NORAD COG building at Ent AFB.

Nerve center of the North American Air Defense Command is the Combat Operations Center (COG), situated in a two-story concrete blockhouse at Ent Air Force Base, Colorado Springs, Colorado (fig 16). It is from the COG that first warning of an attack on North America would come; and if such an attack should come, the air battle for survival of the United States and Canada would be directed from the COG.

Data are received in the COG from the huge complex of radar stations, interceptor squadrons, missile sites, space tracking and ballistic missile warning units, and NORAD regions and sectors and stored in a large digital computer. Here, too, information is received from other sources, such as the Strategic Air Command, naval forces off both coasts, the Pentagon, and the Department of National Defence in Canada.

This information is electronically displayed by a system known as Iconorama (fig 17). The system permits almost instantaneous observation of the positions of aerospace and seaborne objects thousands of miles away and over any part of the continent covered by radar networks. Iconorama flashes surveillance information on a large, theater-like screen for easy observation.

Figure 17. Iconorama display in NORAD COG.

On this screen is a map of North America, the surrounding oceans, Greenland, Iceland, parts of Siberia, and the Caribbean Islands. Symbols show the location and direction of travel of all aircraft of special interest to NORAD. These may be strategic friendly elements or a commercial or military aircraft that for one reason or another is classed as an unknown until positive identification is made. NORAD is interested in unidentified submarines, friendly aircraft carriers, Soviet fishing trawlers, and air activity over Cuba and Siberia. All this is presented on the main display with special coded symbols that provide a variety of information about the subject.

To the right of the main display is the weapon status board. This is associated with the main display, and information on the board is received, processed, and displayed automatically. The top part of this board, referred to as the "commander's box score, " shows at a glance the number of hostile aircraft in the NORAD system, the number of unknowns, the weapons committed to these tracks, the kills made, and NORAD losses. Below is a listing of worldwide major military commands and their defense readiness conditions. The bottom part of the status board shows the number of weapons available to NORAD on 5-minute alert, including fighter-interceptors and surface-to-air missiles.

To the left of the main display is the BMEWS display. At the top is the threat summary panel providing, under conditions of attack, the number of missiles predicted to impact on North America and the time remaining before the first or next missile. The lower part of the BMEWS display is a map of Europe and Asia as seen looking over the North Pole from North America. On this map the launch areas for incoming ballistic missiles will show as ellipses. Corresponding ellipses appear simultaneously on the main display and show the predicted impact area. These three displays provide up-to-date information to the CINCNORAD and the battle staff at all times.

There are other types and sources of information available on call. The weather forecast office in the COG is manned with trained meteorologists, always on duty and ready to provide the latest weather information either in person or through the closed circuit television network to monitors in front of each member of the battle staff. SPADATS also has its headquarters in the COG and can provide information to the battle staff either by a personal briefing or through the television system.

Currently under construction is a new hardened site for the NORAD COG, located inside Cheyenne Mountain south of Colorado Springs (fig 18). The COG will be housed in steel buildings beneath 1, 000 feet of solid granite. The main part of the COG will be a three-story building (fig 19) constructed within the intersecting chambers. It will include 200, 000 feet of floor space to accommodate *a.* maximum of 700 people. By putting it under the mountain, the vital control center will be virtually safe from thermonuclear attack. The new COG is scheduled to become operational late in 1965.

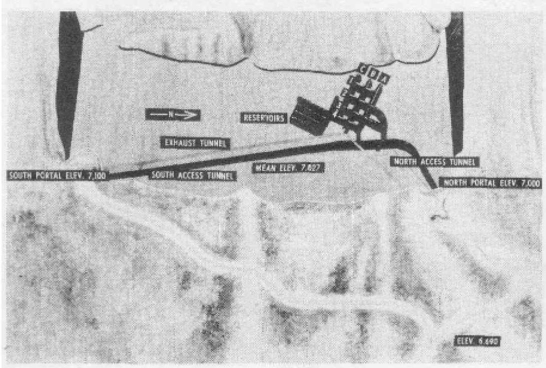

Figure 18. Cut-away mockup of new NORAD underground site.

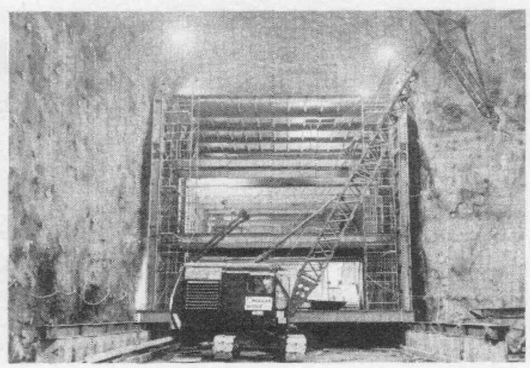

Figure 19 . Underground construction of new NORAD building.

SEMIAUTOMATIC GROUND ENVIRONMENT (SAGE)

Conduct of an area air defense battle requires a great deal of information, dependable communications, and coordination among many organizations. Receiving this information, processing it, and using the necessary instructions in the limited time available proved impossible for unaided human beings, and an electronic air surveillance and weapon control system was devised to do the job. This system, called semiautomatic ground environment (SAGE), receives information, processes it, and communicates instructions to those concerned.

Figure 20 shows the flow of data to and from the SAGE NORAD sector direction center (NSDC SAGE) in the air defense organization. Data are automatically transmitted to the NSDC SAGE from ground-based search radars, airborne long-range inputs (ALRI), and on demand, from height-finder radars. Information on weapon status, weather, airborne early warning, and picket-ship radar tracks are received by telephone, radio, and teletype and are programed into the computer. Similarly, data from the NSDC SAGE are transmitted automatically to direct Bomarc missiles and aircraft equipped with data link receivers to hostile aircraft. Digital data transmission is used to pass hostile track information to Missile Master or BIRDIE fire distribution systems for action by Nike Hercules and Hawk fire units. Selected data are automatically sent to adjacent NSDC's and to the NORAD region combat center (NRCC). Manned interceptors, not equipped with a data link, are directed to the hostile aircraft by voice (UHF radio). Telephone, teletype, and radio are used to pass information to civil defense agencies, SAC, and other headquarters.

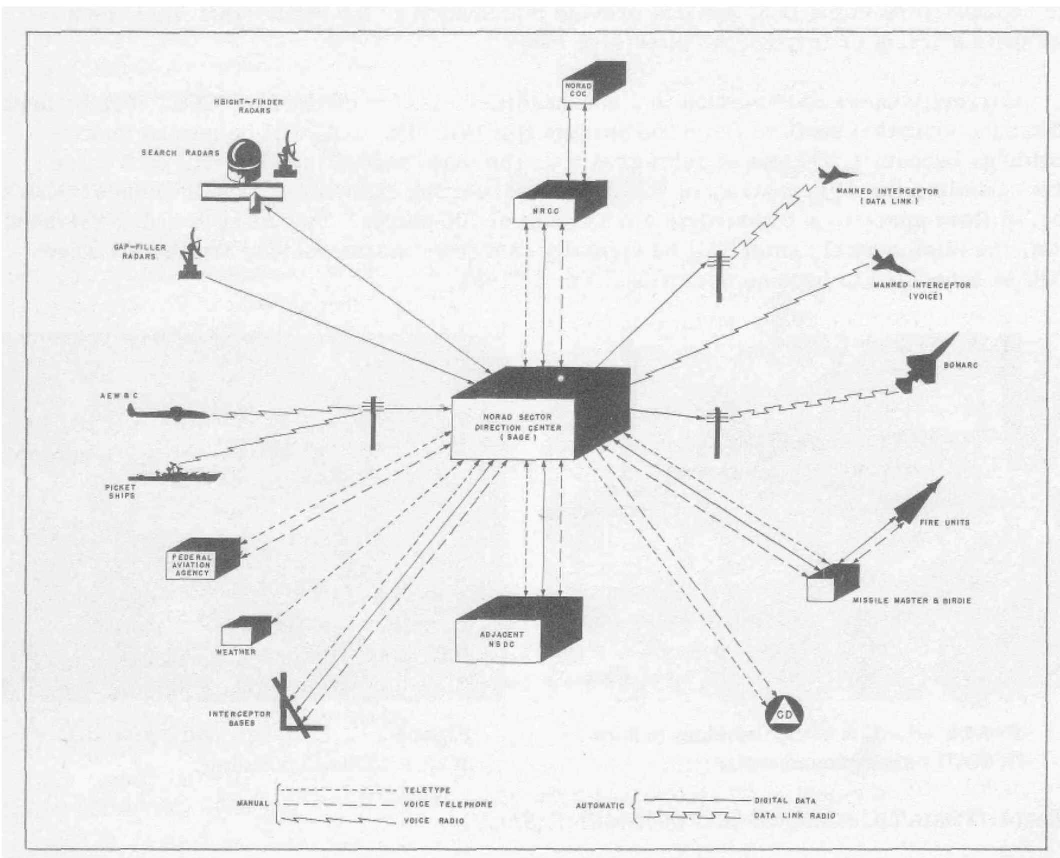

Figure 20. SAGE data flow.

UNITED STATES AEMY AIR DEFENSE COMMAND

The U.S. Army Air Defense Command (ARADCOM) is both a major combat command of the U.S. Army and a component of NORAD. As a member of the two-nation AD organization, ARADCOM is assigned the mission of providing combat-ready Army forces to the Commander in Chief, NORAD, for the air defense of designated strategic and metropolitan target complexes. The mainstay of ARADCOM's weapons inventory is nuclear-capable Nike Hercules surface-to-air missiles, augmented by low-level nonnuclear Hawk missiles, currently deployed in defense of the Homestead-Miami and Key West areas in southern Florida.

HISTORY

The history of the U.S. Army Air Defense Command dates back to 1 July 1950 when it was established as the Army Antiaircraft Command (ARAACOM). However, it was 10 April 1951 before all antiaircraft artillery units located within the continental United States and allocated to its defense were placed under the command jurisdiction of the newly formed ARAACOM.

The Command's early armament consisted of World War II vintage 90-mm and the larger 120-mm guns. Later, the 75-mm Skysweeper, the last of the conventional antiaircraft artillery pieces, was added to the ARAACOM arsenal. The first surface-to-air guided missile to be phased into the Army AD system was the Nike Ajax, which made its operational debut in the Washington-Baltimore defense in May 1954. On 21 March 1957, in recognition of its growing combat-ready surface-to-air guided missile force, ARAACOM was redesignated the U.S. Army Air Defense Command (ARADCOM).

In June 1958, ARADCOM's first Nike Hercules unit attained operational readiness in the Chicago defense. Since that time, all of the Command's missile sites have been converted to the second-generation Nike Hercules for a total of 130 fire units.

ARMY NATIONAL GUARD

The Department of the Army authorized the Army National Guard to convert 32 antiaircraft artillery battalions, then equipped with conventional gun weapons, to Nike Ajax missile battalions in 1957. The 4th Missile Battalion (Nike Ajax), 251st Artillery, California Army National Guard, was the first National Guard surface-to-air guided missile battalion integrated into the active continental United States defense mission. This unit assumed around the clock operations at four battery sites in the Los Angeles area on 14 September 1958. At the completion of the phased training program, the Army National Guard was furnishing 76 batteries in 14 states, defending 15 areas. These were the first U.S. Reserve forces with modern surface-to-air missiles.

In May 1962, the first of the Army National Guard Nike Ajax units were phased out and started retraining to operate and maintain the second-generation Nike Missile, the nuclear-capable Nike Hercules. Four units of the Maryland National Guard were selected for the initial conversion to Nike Hercules and became operational on 11 December 1962.

The last four Nike Ajax sites manned by the National Guard were phased out in May 1964 at Norfolk, Virginia. The final stages of the Nike Hercules conversion program will be completed in April 1965 with 48 Army National Guard batteries, representing 16 states and defending 18 areas, in the on-site program.

Guardsmen assume full operational responsibility for manning the sites around the clock. Full-time personnel man the equipment 24 hours a day, keeping it in constant readiness. This cadre of full-time specialists is capable of initiating effective fire on the enemy without additional personnel. Remaining members of the units are citizens of the community who keep up on their military skills by attending regular drills with their units. If an air attack occurs, they would report immediately to their assigned units.

These Army National Guard units, although an integral part of the AD system when they become operational in wartime, retain their identity as State units under the command of the governor of their respective states in peacetime. ARADCOM has been assigned responsibility for training supervision and support of these units. In event of an emergency requiring use of these units in a combat role, operational command would be exercised by CINCNORAD.

OPERATIONS

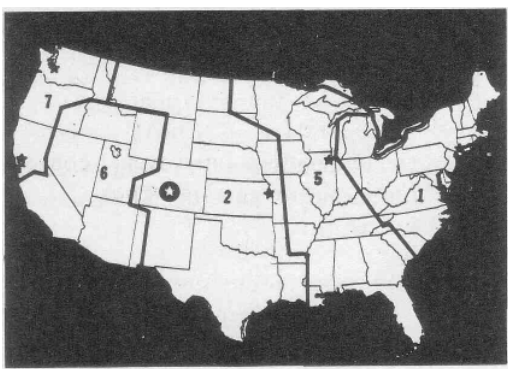

Figure 21. ARADCOM region boundaries and headquarters.

Administrative and training supervision over the widespread defenses are exercised by ARADCOM regions. Figure 21 shows the region boundaries and ARADCOM headquarters located at Colorado Springs, Colorado. Region headquarters and their locations are as follows:

1st Region - Fort Totten, New York[1]
2d Region - Richards-Gebaur AFB, Missouri
5th Region - Fort Sheridan, Illinois
6th Region - Fort Baker, California
7th Region - McChord AFB, Washington

The combat effectiveness of ARADCOM units is determined by use of certain indicators, such as use of target simulators, operational readiness evaluations, tactical effectiveness evaluations, NORAD exercises, short notice annual practices (SNAP), radar bomb scoring (RBS) missions, command maintenance management inspections, and technical proficiency inspections. All indicators must be considered together to determine the effectiveness of units.

THE ARMY AIR DEFENSE COMMAND POST IN NORAD OPERATIONS

The wide dispersion of ARADCOM sites poses a unique problem that requires a specific control and communications system. The heart of this control and communications system is the Army air defense command posts (AADCP). Tactical supervision of Nike Hercules

list Region headquarters will be changed to Stewart AFB, New York, late in 1965.

and Hawk fire units is exercised from AADCP's. An AADCP can use a semiautomatic electronic fire distribution system (FDS), or the AADCP can be manually operated. The FDS used is either Missile Master (AN/FSG-1) or a transportable FDS, BIRDIE (AN/GSG-5 or AN/GSG-6).

AADCP's are linked to NSDC SAGE by digital data, voice, and teletype lines and to their associated fire units by data and voice lines and radio. Normal operation calls for semi-automatic data processing from NSDC SAGE to fire units through the AADCP's, with backup facilities available for emergency and supplemental operations. Missile Master provides for complete semiautomatic operation with fire units when SAGE data are cut off. Facilities are available in all defenses where the Missile Master and BIRDIE systems are installed for manual operations if needed.

AADCP's automatically receive early warning, aircraft identification, and other data from associated NSDC SAGE. These data are collected by the AADCP's; improved, when possible; and transmitted to fire units. In NORAD sectors equipped with SAGE where Army Missile Masters or other FDS's are in operation, NORAD has prescribed four modes for SAGE air defense artillery operations.

Mode I: The primary NSDC SAGE exercises complete control over all air defense forces within its sector.

Mode II: When a primary NSDC SAGE becomes nonoperational for any reason, adjacent NSDC's assume control of the disabled sector by expanding their areas of responsibility.

Mode III: If two adjacent NSDC SAGE become nonoperational, or if other situations develop which preclude or seriously degrade mode I or mode II operation, a NORAD control center (NCC) commander who has been monitoring modes I and II assumes operational control of the AD battle within his assigned areas of responsibility. However, this is not possible in all sectors.

Mode IV: In this mode all AAD units operate autonomously under either the Army air defense commander (AADC) at the AADCP or battery level. The loss of communications between a fire unit and its AADCP or between the AADCP and its NCC necessitates operating in mode IV.

U.S. AIR DEFENSE IN NORTH ATLANTIC TREATY ORGANIZATION

Specified United States AD units in Europe are part of the North Atlantic Treaty Organization (NATO) integrated AD system of Allied Command Europe (ACE), one of the military commands of NATO. The senior military authority in NATO is a military committee composed of a chief of staff or special delegate of each member nation.

The standing group (composed of representatives of the Chiefs of Staff of France, United Kingdom, and the United States) is the executive agency of the military committee.

NATO is divided into three military commands and a regional planning group. The command which concerns AD is ACE, which covers the land area extending from the North Cape of Norway to North Africa and from the Atlantic to the eastern border of Turkey.

Of particular interest in ACE is Allied Forces Central Europe, extending from the southern boundary of Denmark to the northern boundary of Italy. Allied Air Forces Central Europe has responsibility for AD of this area and has divided the area by a line running east-west through the approximate center. The responsibility for AD of the northern portion is assigned to the 2d Allied Tactical Air Force (2 ATAF), while the responsibility for AD of the southern portion is assigned to the 4th Allied Tactical Air Force (4 ATAF).

The commander of 4 ATAF exercises operational control of all U.S. AAD forces assigned. Tactical control of surface-to-air guided missile units in his area of responsibility is exercised by the Allied Sector Operations Center (SOC) commander. The Allied SOC is a unified (U.S. Army-U.S. Air Force) installation, combining facilities of the battle staff, Air Force control and reporting center (CRC), and Army missile control center (MCC). The MCC, tactical headquarters of the AADC, supervises the operation of units through AADCP's of subordinate air defense groups. The battle staff, supervised by the allied SOC director, supervises overall AD operations and coordinates activities between the MCC and CRC. Operational procedures of AAD units in NATO are similar to those of AAD units in the United States.

AIR DEFENSE IN KOREA

In the Pacific area, U.S. AAD units are deployed in Korea, Okinawa, and Hawaii. The Commanding General, U.S. Army Pacific, commands, trains, and administers these units. Operational control of the AD forces is vested in Pacific Air Forces (PACAF).

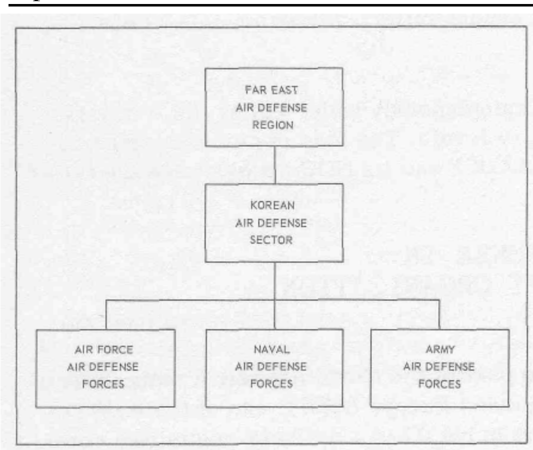

Figure 22. Air defense in Korea.

AAD units in Korea are integrated for operational command into the overall AD system of the Far East Air Defense Region, a sub ordinate command of PACAF. The Commanding General, 5th U.S. Air Force, is the Far East Air Defense Region commander. The region is divided into four specific AD sectors, one of which is South Korea (fig 22). The 314th Air Division is responsible for air defense of the Korean sector and operates a master direction center (MDC) which coordinates air defense activities of all services providing air defense support. The Army air defense command post (AADCP), under operational control of the MDC, exercises operational command over all United States and Allied Army air defenses in South Korea. Operational procedures of AAD units in Korea are similar to those of Army units in the United States.

AIR DEFENSE IN A FIELD ARMY

In modern war, the Army commander at all levels must place emphasis on air defense (AD). Air superiority cannot be assumed in future combat operations and may not always be obtainable. A technically advanced enemy with modern aircraft and missiles can possibly gain air superiority at the time and place of his choosing. The commander's objective is to limit enemy offensive air efforts to a level permitting freedom of action of friendly forces. In accomplishing this task, he must work within the guidance of Doctrine for Air Defense of Oversea Land Areas 0CS Pub. 8). This joint doctrine assigns certain responsibilities to the Army and Air Force since their AD forces will normally comprise those providing AD for the oversea land areas.

JCS Pub. 8 contains basic guidance for oversea air defense. One of the key principles is that "a coordinated and integrated AD system under a single commander is essential to successful area operations." The enemy air threat is considered an entity and is countered by a strategy based upon unity of effort. To achieve unity, the commander of the oversea unified command, subordinate unified command, or joint task force, assigns all responsibility for AD to a single commander—the area AD commander, who is normally the Air Force component commander. He is assisted by representatives from the other service components involved.

The mission of the area AD commander is to insure that a coordinated and integrated AD is achieved. Thus, he must establish broad policies and procedures for the employment of AD means. He also establishes AD regions, the number depending upon geographical and political factors and complexities of the AD problems. In designating regions and appointing region AD commanders, the area AD commander considers other factors such as:

- Contribution of the services.
- Hostile threat.
- Composition, capabilities, and deployment of friendly forces, including capability of the services to augment deployed forces .
- Concept of operations.

The region AD commander may be from any of the component services. In a region where a significant portion of the AD means are provided by another service, a senior officer of that service should be appointed as deputy in AD matters.

The region AD commander has full responsibility for and operational control over all the AD forces within his region. However, he normally delegates authority to field army commander(s) for control and operational employment of organic Army AD means within the field army area.

To accomplish his mission, a field army commander will have a variety of Army AD weapon systems capable of both nuclear and nonnuclear engagements and able to respond immediately to a hostile aerial threat. The primary mission of his Army AD forces is to destroy, nullify, or reduce the effectiveness of attack or surveillance by hostile aircraft and missiles after they are airborne.

A field army commander must include control of the airspace in formulating concepts of operation and organization for combat. Plans must limit the enemy use of the airspace over the combat zone and control the air avenues of approach, one of the major problems confronting Army commanders today. Approximately 1,000 Army aircraft can be expected to be operational within a field army, the majority being small tactical helicopters . Flights of friendly high-speed reconnaissance drones, Air Force tactical aircraft, and multiple launchings of surface-to-surface and surface-to-air missiles complicate the problem. Hence, coordinating the use of the airspace must be included in all future planning for combat in the tridimensional battlefield. The field army commander will be assisted in this planning by his staff and the field army AD commander (normally an AD artillery brigade commander) who also serves as the field army AD officer. The field army AD officer is the principal adviser to the commander on AD matters. The AD officer in planning for and coordinating the air defense will normally:

Recommend to the G3 priorities for AAD.
Recommend the number of AD units required.
Recommend ammunition supply rates for AD units and allocation of warheads.
Formulate the field army airspace utilization plan in conjunction with other services.
Coordinate and integrate AAD matters with higher, lower, and adjacent commands and other services operating in the area.
Coordinate the establishment and functions of an AD intelligence system.
Prepare the field army AD SOP.
Prepare the AD plan.

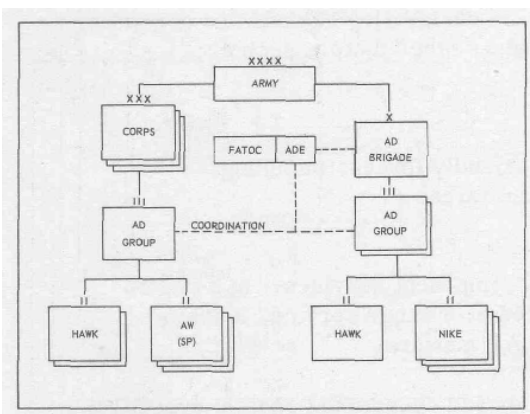

Figure 23. Type field army AD structure.

The AD plan must include the mission, concepts of operation, and organization for combat. Planners must consider that Nike Hercules battalions normally are employed by the ADA brigade to give weighted area coverage to the entire field army. Hawk battalions, employed at Army level or assigned to ADA groups attached to a corps (fig 23), are used to achieve early destruction along low-level routes of approach.

To overcome the inherent limitations of the present air defense for a division, several proposed air defense artillery (ADA) systems are being considered. The Duster (M42, 40-mm) forward area weapon battalions, although limited in effectiveness against high-speed targets, can provide a mobile defense against attack by low-flying aircraft. When allocated to a field army, these battalions would normally be employed with the division to provide forward area air defense.

To insure that AD operations are coordinated with other tactical and tactical support operations, the AD officer supervises operation of the air defense element (ADE) of the field army tactical operations center (FATOC). The ADE, among other tasks, supervises and coordinates the use of nuclear weapons in AD operations, coordinates use of Army airspace, and exercises staff supervision of the application of electronic security measures by AD units.

To meet the requirement for rapid response to hostile air activity, communications are paramount. The Army, realizing this need for faster, more positive fire distribution of surface-to-air missiles in the field army, has developed the AN/MSG-4 (Missile Monitor). This system may be employed for centralized or decentralized control as directed by the AADC.

Coordinated AD effort is a requirement, not only within a field army, but between the field army and tactical air force. To fulfill this responsibility, the AADC normally establishes liaison with the tactical air force. This liaison may be accomplished by collocating the AADCP of various ADA commands with the functional counterpart of the tactical air force or by liaison between these echelons. Figure 24 graphically depicts a typical solution of the liaison requirement. Liaison expedites the flow of early warning and identification information, two vital elements of data for any air defense. Both the control and reporting center (CRC) and the control and reporting post (CRP) can provide early warning information to AAD and the CRC can provide target identification information.

Field army AD is dependent upon complex communications networks and extensive intelligence inputs. Provisions must also be made for operations if communications fail, if intelligence inputs are limited, or if a key command post is destroyed. Such eventualities for completely decentralized control down to fire unit level can be included by use of the battle zone concept.

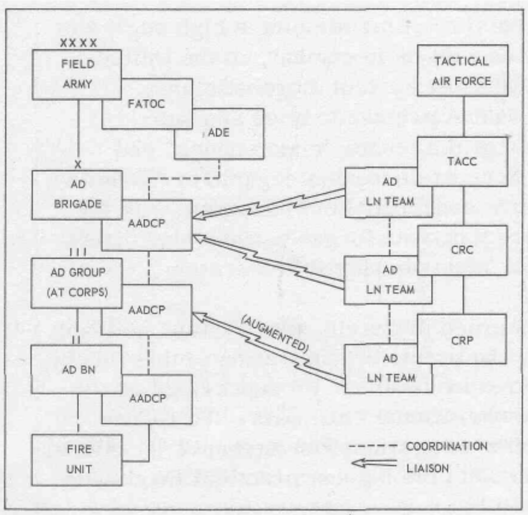

Figure 24. Typical AD liaison.

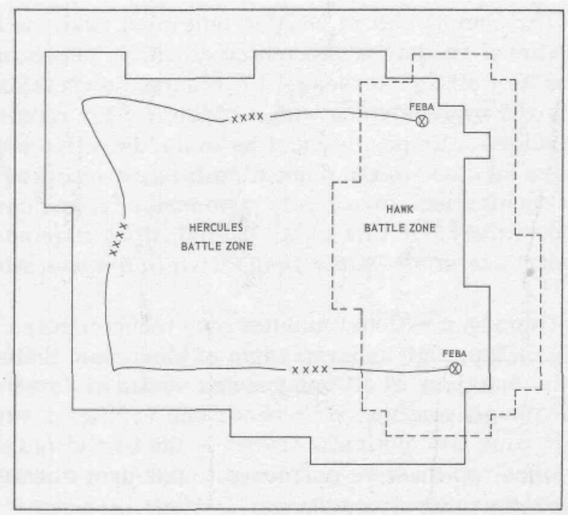

Figure 25. Composite battle zone.

In this concept, Hawk units are deployed well forward, perhaps to within 10 kilometers of the forward edge of the battle area, and in depth to form a zone or umbrella of protection. Aircraft entering this zone and not identified as friendly would be engaged on a weapons-free basis, providing the aircraft met certain criteria as to speed and altitude. For example, the criteria may be to engage aircraft flying below 10, 000 feet altitude and at speeds in excess of 100 knots. This procedure would preclude the possibility of engaging one of our helicopters or other slow-flying Army aircraft.

A Nike Hercules battle zone would also be established. The Nike Hercules zone, however, may consist of a series of three separate battle zones: Alpha, Bravo, and Charlie. In zone Alpha, Nike Hercules would attack all targets, at any altitude, to the edge of the battle zone extending over the composite defense; in zone Bravo, the range would be extended; and finally, in zone Charlie, the range would be extended even further. Again, speed may also be used as a criteria, and the AD commander would designate the Alpha, Bravo, or Charlie zone as the AD battle progressed, dependent upon the means available. The limits of the battle zones may be defined, using either range capabilities or a grid coordinate system.

A composite battle zone employed in a field army is illustrated in figure 25.

AIR DEFENSE MAINTENANCE

The tactical and operational requirements of current and future AD systems demand employment of skilled technicians and adequate test equipment to provide responsive maintenance support to the ADC. Preventive maintenance must be efficiently scheduled and malfunctions rapidly corrected. Maintenance management is the responsibility of every commander and includes motivation, organization, accurate records and reports, and training.

The commander of an ADA unit must have the capability of maintaining a high degree of operational readiness around the clock, in peacetime as well as in combat, in the United States as well as overseas. He requires technicians who are system diagnosticians, supported by repairmen with a capability for repair of defective assemblies and sub-assemblies. Emphasis must be in the direction of performing tests, maintenance, and repairs as close to the point of failure as practical. Support personnel organic to AD units and organizations provide the commander a maintenance capability commensurate with his responsibility. In this light, the principal maintenance functions (organizational and direct support) are immediately responsive to the operational requirements of the system.

The organizational maintenance technician is concerned primarily with system analysis. He has a thorough understanding of electronic theory, the practical application of this theory, and the functions of all components within his area of responsibility. He supervises or performs preventive maintenance and verifies system operational readiness. To reduce repair time and minimize travel on the battlefield, the organizational maintenance technician is trained and must be permitted to perform maintenance to the highest practical level under combat operational conditions.

Timely reports must be made of conditions that adversely affect the maintenance effort. Examples of these conditions are shortages of qualified personnel, equipment, and repair parts; improper scheduling of training; and assignment of missions which impair maintenance of equipment. Commanders must insure that reports concerning maintenance support of their equipment are accurate and reflect the operational readiness of their unit. Analysis of these reports aids determination of total support requirements.

In short, an effective maintenance program is of the utmost importance in ADA units. Air defense commanders must apply techniques of maintenance management which will insure operating equipment to meet operational readiness requirements. The best in AD, in peacetime or war, is dependent on efficient maintenance.

ELECTRONIC WARFARE

The ability to interfere with the enemy's electronically controlled equipment while operating our own without interference is included in an area of military activity known as electronic warfare.

Electronic countermeasures (ECM) are that major subdivision of electronic warfare involving actions taken to prevent or reduce the effectiveness of enemy equipment and tactics that employ or are affected by electromagnetic radiations.

The U.S. Air Force has equipped its aircraft with varying types of intercept receivers, transmitting electronic jammers, and chaff dispensers contingent upon the tactics to be employed. Intelligence reports indicate that potential enemies of the United States have spent vast amounts of money in the development of ECM equipment.

Generally speaking, ECM is introduced into a radar receiver to impair the use of the reflected radar signal. If a jamming signal enters the receiver and prevents the radar operator from seeing the target or causes him to lose the target, the jamming has reduced the effectiveness of the air defense.

Electronic countermeasures may range from relatively simple measures, such as chaff, to complex devices known as "spoofers" whereby false targets are electronically displayed in addition to the actual target echo.

This susceptibility of radar equipment to jamming, both reflective and transmitted, once again forced military planners to the drawing board. This time, the criteria for research was to counter the advantage gained by an attacking force employing ECM. These studies resulted in extensive improvements to radar systems which allow effective operation despite heavy jamming. Since we are countering the use of electronic countermeasures, the term "electronic counter-countermeasures (ECCM)" came into existence.

To counter an ECM attack, many ECCM devices and techniques have evolved. The salient factors concern frequency diversity and frequency change, increased power, increased receiver sensitivity, greater antenna gain, and special ECCM circuits. Some devices employed are special ECCM receivers which allow selection of the best (least jammed) video presentation, parametric amplifiers to reduce receiver noise level, ampli-trons to increase power, coincidence circuits to counter random pulses, and other special ECCM circuits, such as antijam displays, track-on-jamming, and side-lobe blanking circuits. Frequency diversity, involving the use of several radars in different frequency bands, imposes a great problem to any attacking force.

During any future conflict, ECM will be the normal operational environment; therefore, operators must expect ECM, recognize ECM, report ECM, and take appropriate action to counter its effects. Trained operators must use the ECCM devices only as absolutely necessary. The purpose of ECCM operation is to obtain a scope presentation that is free of interference and retains the greatest possible amount of information useful for accomplishing the mission.

To survive in an ECM environment, AD units must have their radar equipment operating at peak efficiency, the latest ECCM equipment, well-trained operators, and skilled maintenance personnel.

IDENTIFICATION, FRIEND OR FOE

Identification presents a major problem to air defense units. To prevent destruction of friendly aircraft, a positive means of identification must be provided. This means must be simple to operate and maintain, economically feasible, and difficult to compromise. Because of the increased capability of AD missile systems and high-performance aircraft, a system was devised whereby identification could be accomplished immediately after detection. Identification, friend or foe (IFF), equipment has been designed and is in use on most AD acquisition radars. IFF refers to an electronic system which operates in conjunction with the radar. The IFF response is displayed with target video, thus enabling an operator to identify friendly aircraft (fig 26). It is possible that, under certain conditions, IFF may be the only means of identification available for all radars. The present IFF system, designated Mark X, is programed to be replaced by a much improved version known as the Mark XII.

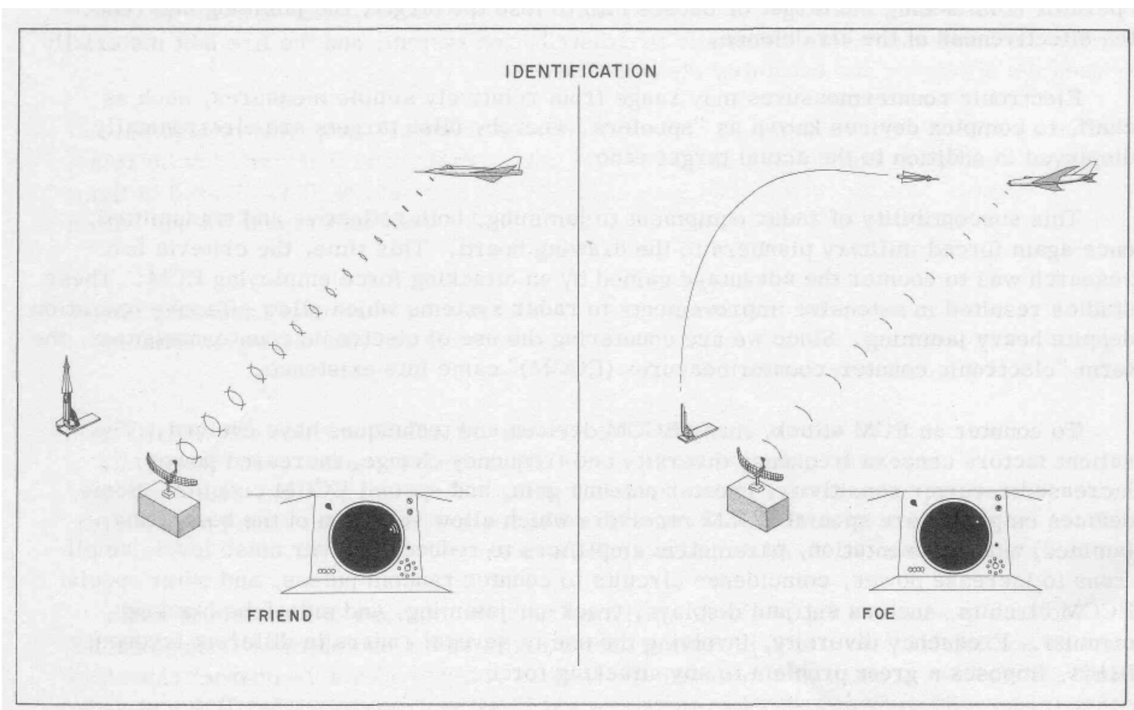

Figure 26. Identification, friend or foe (IFF).

The sequence of operation for Mark X equipment is similar to that of a posted sentry. With the appearance of an unknown person, the sentry interrogates or challenges the person by word or gesture. Upon receiving the challenge, the unknown individual responds with a means of identification. The identification is evaluated by the guard, and he is able to recognize the person as a friend or enemy. Both challenging and recognition are functions of the guard, with the unknown person providing only identification. IFF accomplishes a similar operation by electronic means. The interrogator-responder at the ground station acts as a guard to challenge and recognize. The airborne unit, which is the transponder, is simply an automatic indication unit. The challenge and identification signals are radio-frequency pulses transmitted by the IFF unit which can be coded to afford greater security. Identification is accomplished by the visual display of the IFF reply on the radar screen. This reply is positioned at the same azimuth as the target echo, but usually at a greater range.

To provide a more secure means of identification, a selective identification feature (SIF) is used in conjunction with the Mark X IFF system. The SIF has 160 possible mode and code combinations compared with three in the Mark X IFF system. By use of SIF, compromise by hostile forces is made more difficult.

AIR DEFENSE COMMUNICATIONS

For maximum effectiveness, AAD weapon systems require the command and control made possible by the use of AD communications. A loss or degradation of the vital link between the commander, his electronic fire distribution system, and the fire unit materially reduces the efficiency and capability of air defense.

Within ARADCOM, virtually all communications equipment is supplied by commercial companies, using various combinations of wire, cable, radio, and long-range radio relay. The only organic radios provided AD units in ARADCOM are the AN/TRC-47 used in firing batteries to furnish communication to back up the cable between battery control and launching areas.

Within a field army area, the mobility of AD units and the volume of necessary transmissions require an independent communications system rather than relying on existing commercial or military facilities.

The primary means of communication for AD units in a field army is a VHF/UHF radio relay system. This system is capable of passing digital data (required with the Missile Monitor fire distribution system) or voice information. The Signal Corps, under cellular TOE (11-500 series), furnishes AD units with assigned or attached personnel to establish, operate, and maintain the VHF/UHF radio relay system.

The primary item of Signal Corps equipment used to establish this system is radio terminal set AN/MRC-69 (fig 27). This terminal set is an air or vehicular transportable VHF/UHF FM set mounted in a modified 2l-ton truck. It provides a 24-channel capability with a range of 30 to 50 miles. Nike Hercules and Hawk units are provided TOE radios to back up the primary means of communication and to provide for necessary administrative traffic.

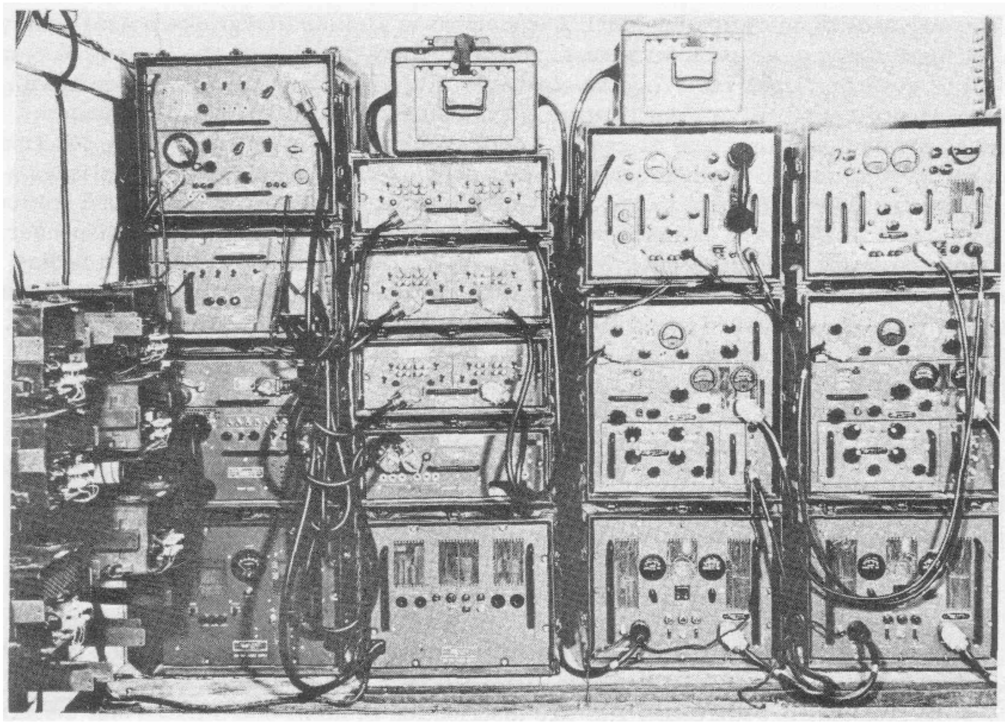

Figure 27. Radio terminal set AN/MRC-69.

Radio receiver set AN/GRR-5 (fig 28) is used at all echelons, primarily for gathering intelligence information. This rugged AM receiver is suitable for use in a fixed field station or in mobile operations. It is compatible with other AM radio sets used and is normally used in intelligence or early warning nets.

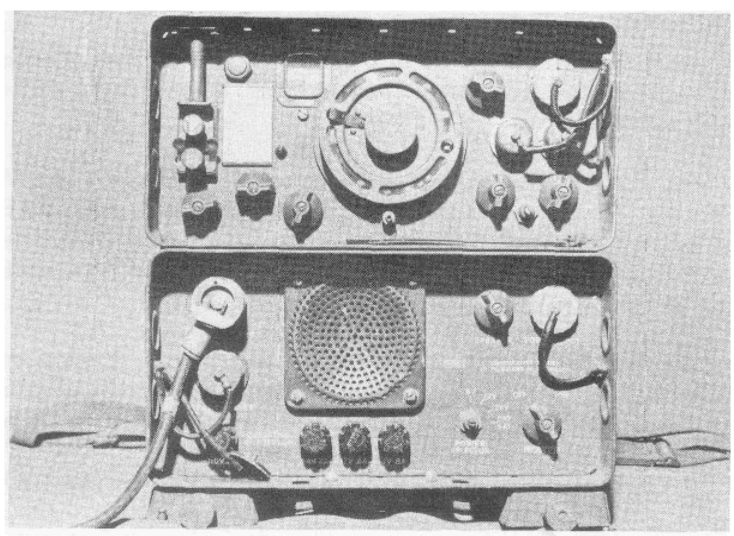

Figure 28. Radio receiver set AN/GRR-5.

The AN/GRC-19 (fig 29) is an AM radio set used in tactical and administrative nets. Designed for mobile use, it can be used for both fixed and portable service and is capable of providing communication over a distance of 50 miles when using the organic whip antenna. Modified antennas will increase the transmission range to 150 to 1, 500 miles. The AN/GRC-46 is a shelter-housed transportable radio teletypewriter set which uses the AN/GRC-19 as its major basic component. The AN/GRC-46 is authorized for ADA battalions primarily to provide communication with higher headquarters.

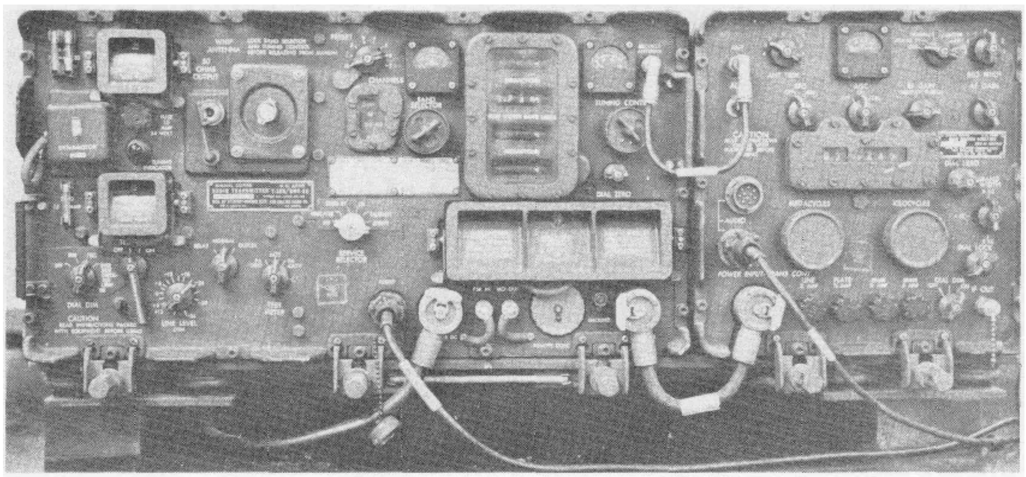

Figure 29. Radio set AN/GRC-19.

For command and logistical control, Nike Hercules and Hawk battalions and batteries are issued AM radio sets that have a range of 10 to 15 miles. Hawk units are issued vehicle-mounted AN/VRC-34 radios while Nike Hercules units are issued ground-mounted AN/GRC-87. These are basically the same radios except for the mounting configuration.

The only FM radios presently issued to AD units are the AN/VRC-9 and AN/VRQ-2, each having a range of 10 to 15 miles. A Hawk battalion is issued one AN/VRC-9 to provide the capability of establishing liaison with a supported unit if such a mission is assigned. The AN/VRQ-2 (fig 30) has a retransmission capability and is issued to Nike Hercules units in the field army area to provide backup communication for the cable link between battery control and launching areas.

It is anticipated that radio terminal sets AN/TRC-84 and AN/TRC-85 will replace the AN/VRQ-2 radios and cable as the primary interarea communications in Nike Hercules batteries. The AN/TRC-84 and AN/TRC-85 have a range of 5 miles and are capable of electronically passing all required data within the Nike Hercules system.

Revised TOE for all air defense echelons, brigade to battery, include up-to-date communications equipment. In voice command nets, the new AN/VRC-12 family of FM radios are to replace AN/VRC-34 and AN/GRC-87 radio sets. The basic receiver-transmitter of the AN/VRC-12 family issued to artillery units is the AN/VRC-46, The AN/VRC-47 (fig 31) is the basic receiver-transmitter with an auxiliary receiver and the AN/VRC-49 consists of two of the basic receiver-transmitters on a single mounting. These small, rugged radio sets possess a range capability of 20 to 30 miles, using a whip antenna.

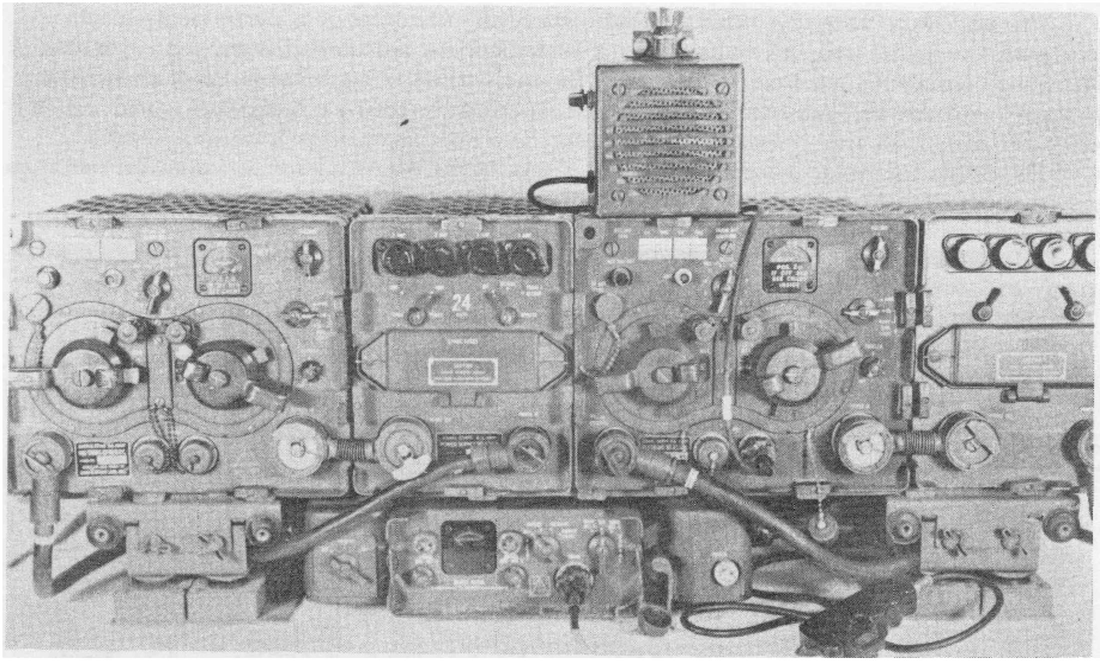

Figure 30. Radio set AN/VRQ-2.

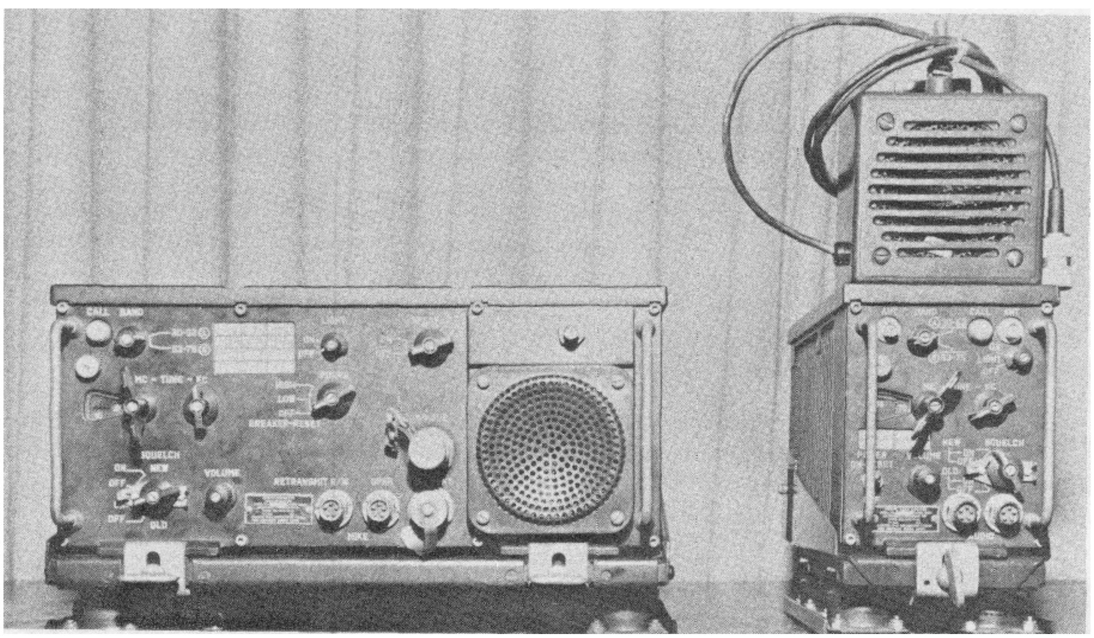

Figure 31. Radio set AN/VRC-47.

Technical advances in weapon systems and advanced concepts of deployment result in ever-increasing demands within the field of communications . Fortunately, improvements in communications equipment design have met this challenge, and the end product is a proposed new series of radios with improved capability as well as reduced size and weight.

The mainstay of these radios is the vehicle-mounted AN/GRC-106, a compact AM single sideband replacement for the AN/GRC-19, with a range of 50 miles. Additional equipment may be added to this basic set to double its range and provide teletype capability. The AN/GRC-106 (fig 32) is presently proposed for all levels of AD units to provide required tactical communications.

The man-packed AN/PRC-25 radio, another of the improved radios, is a forward-area radio set to replace the AN/PRC-8, -9, and -10 radios. This basic set is also to be built as a vehicle-mounted version (AN/VRC-53) (fig 33) or as a convertible man-packed/vehicle-mounted version (AN/GRC-125). The normal range of 3 to 5 miles may be increased to 15 to 20 miles by use of an amplifier.

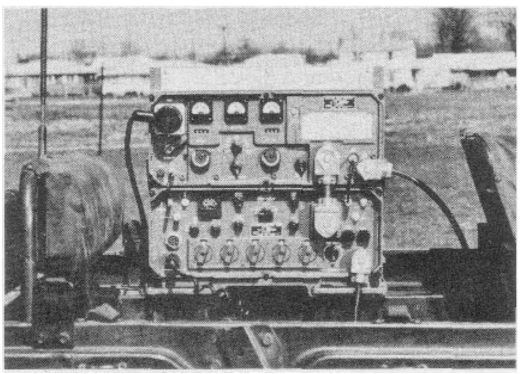

Figure 32. Vehicle-mounted radio set AN/GRC-106.

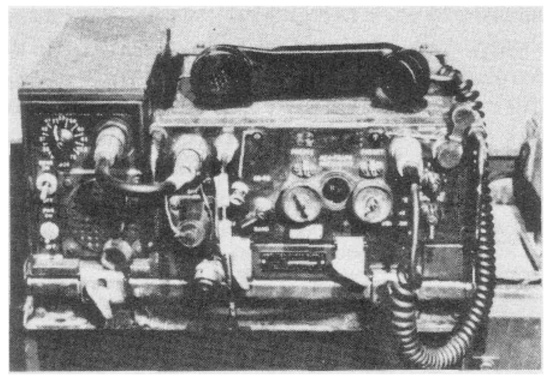

Figure 33. Vehicle-mounted radio set AN/VRC-53.

The challenge presented to AD communications as a result of technical advances in fire distribution systems and modern weapons has been more than adequately satisfied by aggressive research and development within the field of communications equipment. New compact longer-range communications equipment will soon be issued to all echelons of AD to provide an even greater capability to accomplish the latter portion of the artillery axiom—move, shoot, and communicate.