CHAPTER IV

IADS: DOCTRINE, ORGANIZATION, AND METHODS OF CONTROL AND INTEGRATION

Introduction

Vast improvements in Soviet offensive tactical air capability and the new Soviet offensive doctrine require a reassessment of the United States tactical air defenses. The United States, unlike many other countries, still maintains a distinct service separation in its armed forces between air-to-air defenders and surface-to-air defenders. The former are in the Air Force, while the latter are a branch of the Army. The combining of these two separate defensive forces into an integrated air defense system (IADS) is a complex process. Thus the assessment of United States tactical air defense is a difficult task.

To assess the effectiveness of the IADS in countering the threat, the individual capabilities of each service's defensive system must be examined. More importantly, however, the process by which the two services integrate their defensive weapons into the IADS as a whole is of even greater significance. This integration process lies at the cornerstone of the IADS effectiveness question. Individual weapon performance and service defensive interoperability are dependent on how well this integration process works.

Unfortunately, the large and separate service elements that constitute the IADS make the integration processes complex and confusing. Historical service parochialism and individual weapon development have prevented smooth integration. These and other problems have also contributed to doctrinal differences and procedural arguments between the two services. In addition, IADS organizations have grown cumbersome and overly centralized. The two services are beginning to solve many integration problems, but implementing the solutions is difficult and slow.

The United States IADS is explained in this chapter and in Chapter V with emphasis on integration processes and associated problems. Doctrine is discussed here from the viewpoints of both the Air Force and the Army to illustrate how each service perceives the defensive air battle and the role of integrated air defense (IAD). The development of the complex IADS organization and methods of employment is a direct result of historical doctrinal disputes and controversial agreements between the services. These organizations and means of employment are defined in detail to demonstrate conceptual operation of the system. Actual equipment, weapons, and training are discussed in the next chapter for the purpose of determining if conceptual system design meets operational requirements.

Doctrine

Current joint doctrine for integration of air defense weapons was developed in the late 1950s and early 1960s following the Key West

and Newport conferences in which the Department of Defense classified service roles and missions. One of the functions resulting from the early conferences was that the Air Force would develop "doctrines, procedures, and equipment for air defense from land areas."[1] As a result of Department of Defense Directive 5100.1 (31 December 1958) and further guidance in Publication 2 by the Joint Chiefs of Staff in November 1959, the Army and Air Force Chiefs of Staff reached a controversial agreement. This so-called Decker/LeMay agreement was the basis for Publication 8 by the Joint Chiefs of Staff in May 1964, Doctrine for Air Defense From Overseas Land Areas.[2]

Publication 8, which has not been amended or changed since 1964, remains the cornerstone document upon which IAD doctrine is based. The organization for joint air defense operations is doctrinally established in this publication to provide for "centralized direction and maximum decentralized authority to engage hostile aircraft."[3] The centralized commander would normally be an Air Force commander. While this is generally accepted in today's Army manuals, the Army opposed it at the

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[1]Department of Defense, Functions of the Department of Defense and Its Major Components, DOD Dir 5100.1 (31 December 1958), p. 12.

[2]"Air Defense and Air Superiority," Draft Annex _____ (n.p., n.d.), entire source. (USACGSC Library Doc. N-18090.3. This unpublished draft of an 80-page staff study lists numerous Army arguments against the Decker/LeMay agreements and the proposed Publication 8 by the Joint Chiefs of Staff.)

[3]Department of Defense, Joint Chiefs of Staff, Doctrine for Air Defense From Overseas Land Areas, JCS Pub 8 (May 1964), p. 9.

time.[4] Publication 8 discusses the integration of air defense weapons only briefly, and that is in Paragraph 305, "Effectiveness of Various Air Defense Weapon Systems," which reads:

> 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.[5]

Air Force Doctrine

Since the Air Force is given primary responsibility for the formulation of air defense doctrine, an examination of its doctrine regarding the IADS has considerable merit. Unfortunately, no single Air Force doctrinal manual is specifically devoted to tactical air defense. The Air Force interpretation of IAD can be examined only by combining bits and pieces from a number of Air Force 1- and 2-series manuals. The most important Air Force manuals that deal with IAD doctrine are:

1. Basic Doctrine, AFM 1-1, 15 January 1975.
2. Tactical Air Operations--Counterair, Close Air Support, and Air Interdiction, AFM 2-1, 2 May 1969.
3. Tactical Air Force Operations--Tactical Air Control System (TACS), AFM 2-7, 25 June 1973.
4. Tactical Air Operations--Airspace Control in the Combat

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[4]"Air Defense and Air Superiority," p. 3.

[5]Department of Defense, Joint Chiefs of Staff, p. 12.

Area, AFM 2-12, April 1973.

5. US Air Force/US Army Airspace Management in an Area of Operation, AFM 2-14, 1 November 1976.

Although the dates on most of these manuals are relatively recent, doctrine concerning air defense, sometimes referred to in the Air Force as defensive counterair, has remained basically unchanged since World War II. The Air Force has consistently accorded top priority to offensive counterair, deep penetration, and interdiction missions. Offensive air operations dominated tactical air forces throughout the Korean and Vietnam wars. This offensive strategy has been reflected not only in Air Force doctrinal evolution[6] but also in aircraft development. Air Force fighter aircraft design characteristics stress long range, air-to-air refueling capability to extend range further, sophisticated self-contained navigation equipment and penetration aids, and the ability to carry large weapon loads. Even the F-15, the first Air Force fighter to be used exclusively for air-to-air combat since the F-106, was originally designed as a multipurpose fighter.

The wisdom of this historically offensive oriented tactical air doctrine is being questioned by various elements of America's military society and civilian institutions. For example, a recent news article cited a 1977 Brookings Institute study that urges a reorganization and

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[6]Charles J. Brown and Johnnie R. Reeder, "The Development of Counterair Doctrine" (Research Report No. 5858, Air War College, April 1976), entire report. (DDC Doc. AD B011161.)

upgrading of America's tactical air defense posture in Europe.[7] Two recent war college studies further highlight the fact that the Air Force has been remiss in defensive counterair doctrinal development. The following excerpt summarizes the concern:

> The possibility that the USAF [U.S. Air Force] might have to operate from airfields which enemy air power actually attacks is glossed over in USAF basic and operational doctrines. . . . There seems to be some irrational expectation that all wars will be fought from sanctuaried airfields. . . .
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> . . . USAF doctrine should officially acknowledge the possibility of fighting a defensive air campaign, since that is a possible situation faced in Europe. . . .[8]

The author of the second study questioned the validity of a North Atlantic Treaty Organization (NATO) offensive air strategy. He convincingly concluded that it would be impossible to gain air superiority or to conduct an effective interdiction campaign in a short, intensive European conflict.[9]

Despite these and other warnings, the preference for offensive operations over defensive counterair continues to permeate current Air Force doctrine. Basic Doctrine, a 1977 draft update of AFM 1-1, states

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[7]Bernard Weinraub, "Air Attack 'Threat' to NATO: West Vulnerable to Soviet Strike, Brookings Finds," Kansas City Times, 30 January 1978, p. 8A.

[8]Claude C. Blanch, "Air Superiority Today and Tomorrow" (Report No. 5847, Air War College, April 1976), pp. 21-22. (DDC Doc. AD B011430L.)

[9]Ray G. Thompson, "An Alternative NATO Air Strategy of Defensive Operations" (student paper, U.S. Army War College, 16 March 1972), pp. 44-48.

that offensive counterair operations "are the most effective means for achieving air superiority and are essential to gaining air supremacy."[10] AFM 2-1 parallels this thinking by stating:

> . . . [U]ntil air supremacy is gained, the emphasis should be on offensive counter air operations. Air defense, while vital to the total counter air program, is a relatively inefficient means of destroying enemy air potential and, by its very nature reacts only when the enemy exercises initiative action. Offensive pressure must be maintained so that the enemy is forced to withhold a significant portion of his air potential for defense of his own area.[11]

While stressing the importance of offensive operations, AFM 2-1 only briefly discusses defensive counterair operations. It reemphasizes the fact that the Air Force has the overall responsibility for integrating the theater air defenses by stating:

> It is essential that a single Air Force commander be assigned overall responsibility for gaining and maintaining air supremacy. Friendly forces assist to the degree that their organic capabilities and efforts can contribute to the success of the counter air task. The AFCC [Air Force Component Commander] is normally designated Area Air Defense Commander and Area Airspace Control Authority. As Area Air Defense Commander his mission is to coordinate and integrate the entire air defense effort within the joint force command. . . .[12]

The manual further establishes that the AFCC has the responsibility to "insure that optimum effectiveness is realized from each of the various air defense weapon systems" and to establish "air defense procedures and rules of engagement."[13]

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[10]Department of the Air Force, United States Air Force Basic Doctrine, AFM 1-1 (DRAFT) (20 May 1977), p. 21.

[11]Department of the Air Force, Tactical Air Operations--Counterair, Close Air Support, and Air Interdiction, AFM 2-1 (2 May 1969), p. 5-3 (hereinafter cited as DAF, AFM 2-1).

[12]Ibid., p. 5-2. [13]Ibid., pp. 5-2 & 5-4.

Reflecting the designation of the AFCC as the Theater Air Defense Commander, Air Force doctrinal manuals continually stress the need for centralized control of air defense weapons. AFM 2-1 explains it this way:

> . . . Effective air defense requires centralized control of air defense weapons within an area of operations. Control agencies and communications-electronics facilities must provide the means for integrating air defense actions with all other air operations. Adequate early warning and defense in depth should be provided to allow engagement by multiple weapon systems. Identification criteria, weapon assignment procedures, and rules of engagement must be uniform and the activities of strike and support aircraft must be coordinated with air and surface-to-air defense activities.[14]

Although the remaining 2-series manuals briefly discuss air defense, their main thrust is an explanation of the intricate command and control relationships throughout the air defense and airspace management organization. These manuals are based on the premise that "air defense and airspace control are interrelated and inseparable. Thus a coordinated and integrated air defense and space control system under a single authority is essential."[15] This appears to be the basic rationale for the overemphasis on centralized control throughout the IADS organization.

Surprisingly, not one of the manuals under consideration here discusses the basic issue of how an IADS is to operate. Such items as

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[14]DAF, AFM 2-1, p. 5-3.

[15]Department of the Air Force/Department of the Army, US Air Force/US Army Airspace Management in an Area of Operation, AFM 2-14/ FM 100-42 (1 November 1976), p. 1-1.

IAD procedures, rules of engagement, airspace and geographical control zones, target allocation, and assignment decisionmaking are not even discussed. In summary, Air Force doctrine manuals are historical copies of past offensively oriented manuscripts and they lack the necessary recognition of a changing balance of power. On the other hand and as shown next, the Army has attempted to update its air defense manuals based on the new threat.

Army Doctrine

In 1976 the Army published the first of its new "how to fight" doctrine manuals, FM 100-5. Since then, branches within the Army have published new "how to fight" manuals that include a new series of air defense artillery (ADA) employment manuals. The manuals that concern IADS doctrine are:

1. Operations, FM 100-5, 1 July 1976.

2. U.S. Army Air Defense Artillery Employment, FM 44-1, 26 March 1976.

3. U.S. Army Air Defense Artillery Employment: Chaparral/Vulcan, FM 44-3, 30 September 1977.

4. U.S. Army Air Defense Artillery Employment: Redeye, FM 44-23, 30 September 1977.

5. U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90, 30 November 1977.

FM 100-5, the fundamental Army doctrinal manual for operations, lays the foundation for the Army's reliance on the "active defense" and

states that the "first battle of our next war could be its last battle."[16] The Army is basing its doctrine on fighting outnumbered and especting to win a short, intense defensive first battle with the enemy. Throughout FM 100-5 and as taught in the U.S. Army Command and General Staff College, defensive action in a short, intense war will be the primary method of operation for the Army. This defensive Army strategy somewhat clashes with the offensively oriented Air Force doctrine discussed earlier.

Even though the Air Force has been given overall responsibility for integrating air defense, the Army ADA employment manuals address more of the basic IAD doctrinal issues than do the Air Force manuals. Although the Army's general treatment of IAD doctrine is very thorough, some major misconceptions relating to interceptor integration are quite disturbing. To begin, FM 44-1 lists the four basic ADA employment principles. These are weapon mass, weapon mix, mobility, and integration. In describing integration doctrine, the Army manual explains that "air defense artillery weapons must be integrated into the force commander's scheme of maneuver and also into the battle for air superiority."[17] How this integration takes place is further explained by listing the family of weapons and how the weapons are to be used. For

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[16]Department of the Army, Operations, FM 100-5 (1 July 1976), p. 1-1.

[17]Department of the Army, U.S. Army Air Defense Artillery Employment, FM 44-1 (26 March 1976), p. 5-3 (hereinafter cited as DA, FM 44-1).

instance, short-range air defense (SHORAD) weapons are normally employed in maneuver elements. Low-to-medium altitude air defense (LOMAD) weapons are deployed throughout the division and in the rear areas.

> . . . Manned fighter aircraft complete the family. They seek to strike enemy aircraft on the ground or to engage enemy aircraft well-forward of the FEBA [forward edge of the battle area] to effect maximum attrition and break up concentrated attack formations before they reach elements of the Army in the field protected by ADA.[18]

References to the large offensive counterair battle the Air Force plans to fight are seen in the preceding excerpt on fighter employment. Even in the new FM 44-1, the Army's concept of Air Force participation in the air defense battle is that the interceptors be assigned a mission "well-forward" of the FEBA. Unfortunately, "well-forward" of the FEBA is probably the most dangerous and ineffective place for interceptors to be assigned. Not only is the enemy's own ADA most effective in this area, but lack of friendly ground-controlled intercept (GCI) stations, excessive fuel loads, external pod carriage of electronic countermeasures (ECM), and difficult navigation become compounding problems in this region.

Another doctrinal area of concern with FM 44-1 is its explanation of the role of Air Force interceptors in the medium-to-high altitude regime (see Fig. 8). As stated in the manual: "The long-range Nike Hercules system, in conjunction with Air Force interceptors and the Hawk missile system, is employed against the medium- and high-altitude

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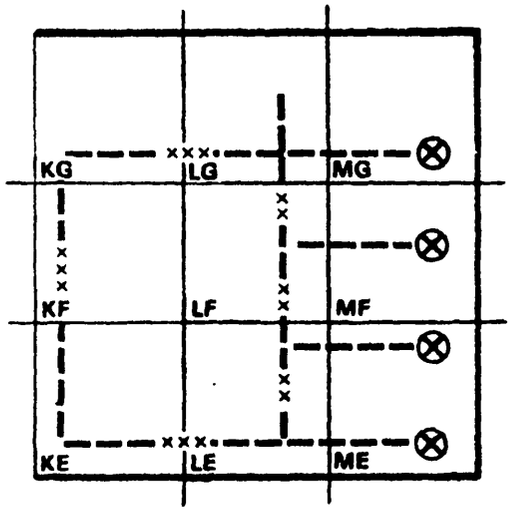
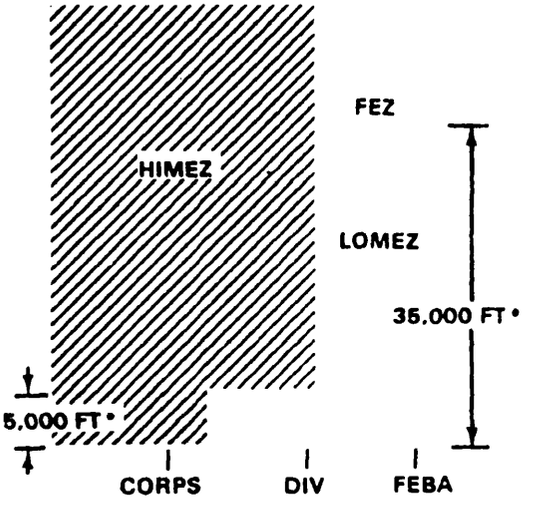
[18]DA, FM 44-1, p. 2-5.

- **Fighter aircraft engagement zone (FEZ).**
- **High-missile engagement zone (HIMEZ).**
- **Low-missile engagement zone (LOMEZ).**



GEOREF



*ALTITUDES SHOWN ARE EXAMPLES ONLY.

Weapons engagement zones are defined by horizontal boundaries through the use of the geographic reference (GEOREF) system and by altitude limits.

In this case, the LOMEZ would have been established based on a message, such as:

"LOMEZ established GEOREF squares MG, MF, & ME, 0-35,000 feet MSL; GEOREF squares KG, KF, KE, LG, LF & LE 0-5,000 feet MSL." (Horizontal limits may also be defined by partial GEOREF squares and/or by geographic coordinates.)

SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. 5-13.

Fig. 8. Air Defense Weapons Engagement Zones (Vertical View)

air threat."[19] In a European scenario, the effect of medium altitude employment, coupled with the "well-forward" strategy, places the manned interceptor in the worst possible location for intercepting the primary enemy air threat, which will be low altitude aircraft. Enemy ADA is of even further concern. Overlaying the engagement zone figure of FM 44-1 with the enemy ADA figure from FM 100-5 graphically displays the problem for the interceptor pilot (see Fig. 9).

Despite these major misconceptions concerning interceptor employment, the Army's remaining explanation of IAD employment doctrine is very informative. Momentarily disregarding the location of the engagement zones, Figures 8 and 9 show that the integrated air defense doctrine of the United States as articulated by the Army is similar to the Arab and Soviet "zonal control" (see pages 29-30 and 40-41). Further evidence of this is found in FM 44-1, where it is explained that segregation of air defense weapons is insured through airspace and geographical separation. Weapons engagement zones, restricted areas, and safe corridors are used to solve the fratricide problem. Simultaneous engagement by Hawk and interceptors is considered only under special circumstances and highly controlled conditions.[20]

The FM 44-1 discussion of "Hawk belts" and forward missile intercept zones along the borders in Europe hint at the common usage of this zonal control doctrine.[21] This is in fact the case as a 1976 study

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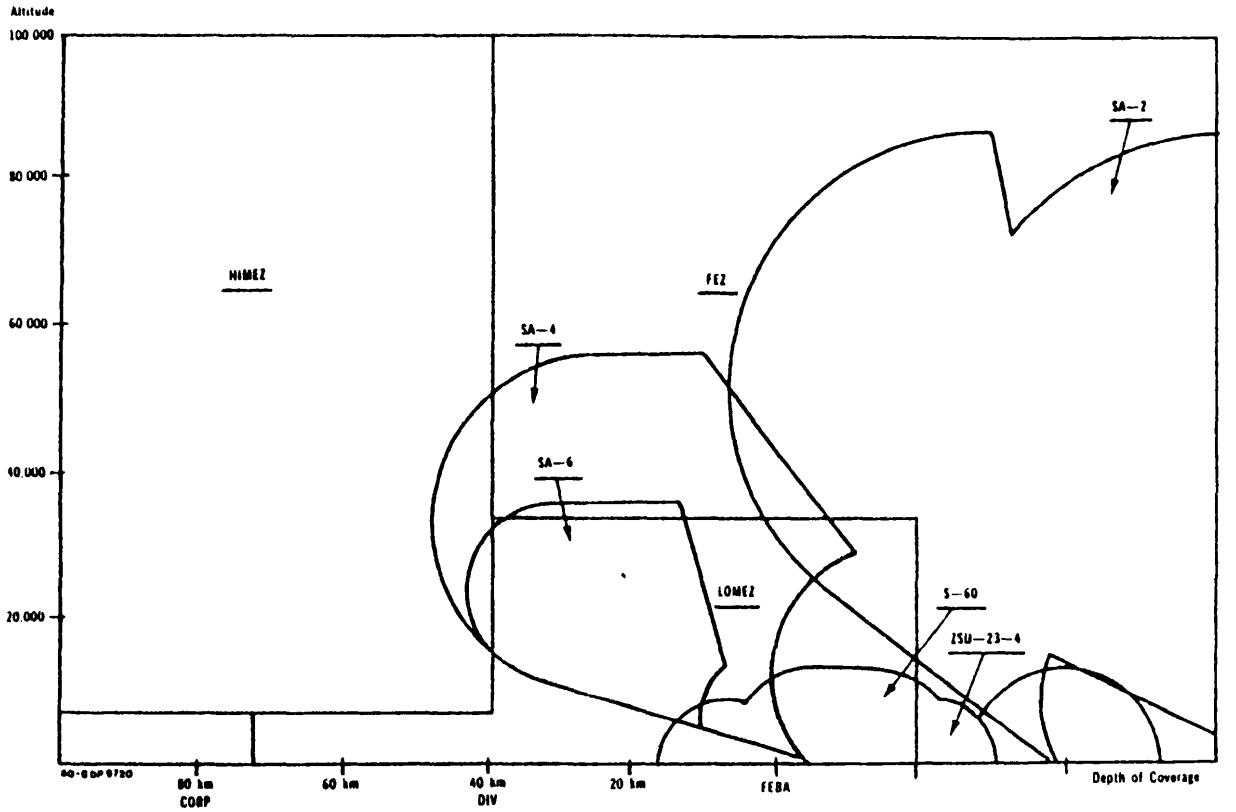
[19] DA, FM 44-1, p. 5-5.

[20] DA, FM 44-1, pp. 6-2 & 6-3.

[21] DA, FM 44-1, p. 3-7.



SOURCES: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. 5-13; Department of the Army, Operations, FM 100-5 (1 July 1976), p. 8-3; and Department of the Army, U.S. Army Air Defense Artillery Employment, FM 44-1 (25 March 1976), p. 6-3.

Fig. 9. Weapons Engagement Zone Problem for Interceptor Pilots

of NATO tactical air forces explains European IAD doctrine. According to the study:

> In 2ATAF [Allied Tactical Air Forces], fighters conduct a zonal defense in the rear of the Hawk Belt, which lies 80 to 120 kilometers from the Demarcation Line (DL). . . . Since preplanned effective Combat Air Patrol (CAP) positions are behind the Hawk/Nike engagement zones considerable enemy penetration of the forward area will occur before enemy aircraft are engaged by friendly defensive fighters and friendly air superiority will be non-existent in the forward areas.
>
> In 4ATAF fighters defend as far forward as possible to assist the army and to protect key land and air facilities. This levies a requirement to gain and maintain air superiority further forward, consequently, 4ATAF air defense/CAP positions are closer to the DL than similar positioning in the 2ATAF area. The 4ATAF Hawk sites are also situated much closer to the DL and employ a mobile concept, moving to alternate sites during buildup/hostilities. . . .[22]

While the Army ADA doctrine manuals contain major misconceptions in interceptor employment, their general explanation of IAD doctrine and procedures is excellent. Unlike the Air Force manuals, the Army manuals discuss the major considerations of IAD control--weapons engagement zones, geographical control, and other employment problems. Unfortunately, this unilateral state of doctrinal development exists despite directives by the Department of Defense and publications by the Joint Chiefs of Staff that give IAD doctrine responsibility to the Air Force. It appears that the Army, rather than ignoring the problem, has prudently initiated some effort toward developing operational IAD doctrine and the Air Force is reluctant or institutionally opposed to doing so.

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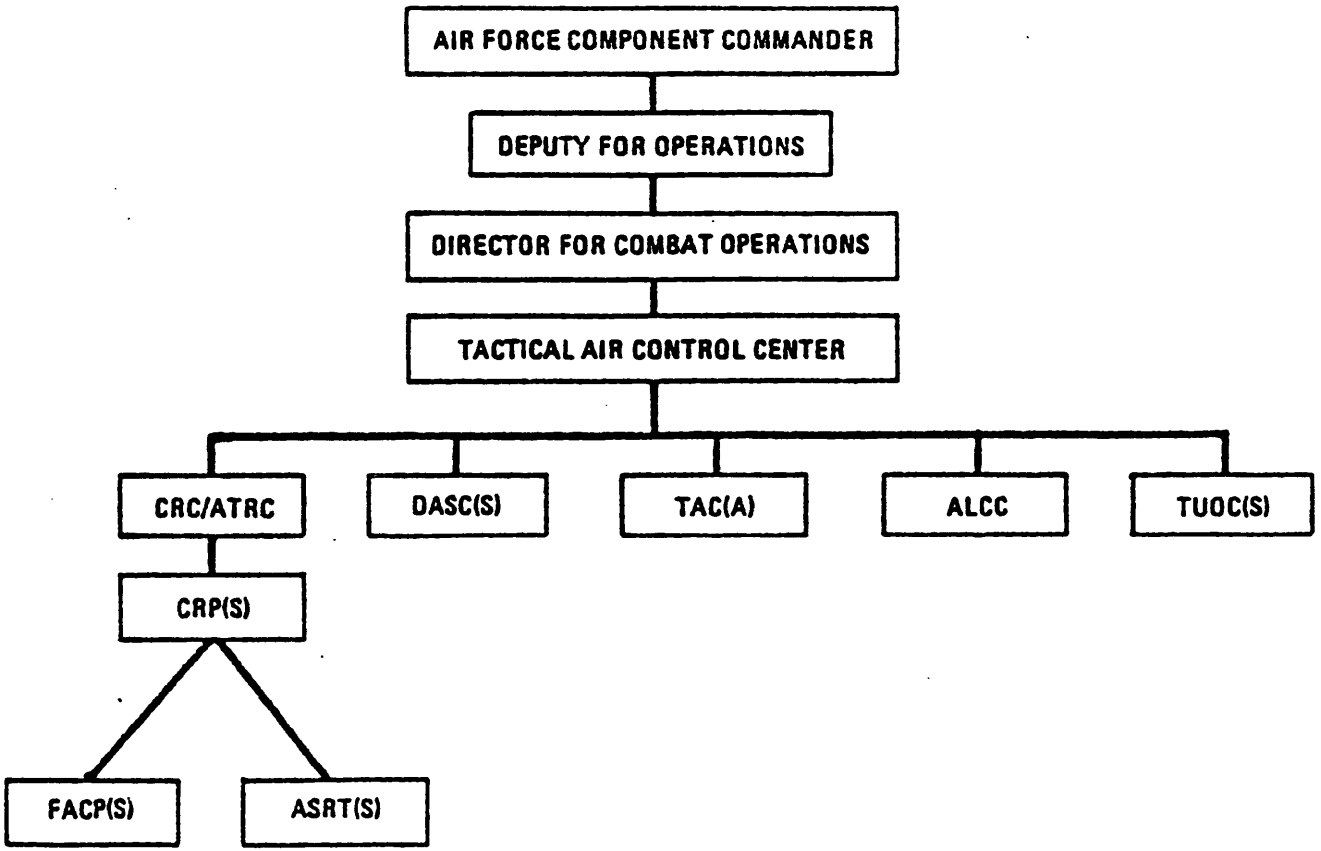
[22]Steven L. Canby, "Tactical Airpower in Europe: Airing the European View (U)," Report No. TSC-PD-471-1 (Santa Monica, Calif.: Technology Service Corporation, 19 July 1976), pp. 39-40.

Organization and Lines of Control and Communication

Since the Air Force and Army maintain separate but complementary air defense weapon systems, constructing a simple command, control, and communication (C^3) IADS organization chart is difficult. Often the case is that the IADS command, control, and communication lines do not overlap. Terms such as "command less operational control" are common throughout the organization. As a result and in an attempt to simplify the explanation of how the system works, this writer has concentrated on a description of the important functional weapons control and communication lines throughout the IAD organization. This description focuses on the positions that are responsible for developing and passing the IAD battle plan, weapons rules of engagement, and target assignments. Also explained are the lines of control and communication whereby target information, weapon integration, and firing decisions are passed.

As a brief overview, the tactical air defense organization is based on the doctrinal principle of centralized management and control and decentralized execution. The AFCC, acting as the Area Air Defense Commander, controls all air defense forces through an organization called the Tactical Air Control System (TACS) (see Fig. 10). Through the tactical air control center (TACC), the AFCC permits decentralized control of essential air missions to subordinate TACS elements. The planning for the integration of air defense resources is accomplished in the TACC; however, the actual control of the air defense battle is delegated to the control and reporting centers and posts (CRCs/CRPs).



ADAPTED FROM: U.S. Army Command and General Staff College, U.S. Air Force Basic Data, RB 110-1 (July 1977), p. 5-2.

Fig. 10. Typical Tactical Air Control System (TACS)

At the CRCs, Army ADA weapons are integrated into the system through data link and communication lines to the Army Air Defense Command Posts (AADCPs) (see Fig. 11). An AADCP may be at various echelons depending upon the scale of operations, but it would normally be either at brigade or group level or at Hawk battalion level. The lines of control are then decentralized down to individual Hawk batteries and Chaparral/Vulcan (C/V) battalion AADCPs. Further lines of control and communication exist between the C/V AADCPs and the C/V squad leader and Redeye teams.

Through this extensive system the AFCC exercises centralized operational control of all theater air defense weapons. He does this by implementing rules of engagement and standard operating procedures. This organization looks simple; however, many subtle and some not so subtle problems are associated with it. The lines of control and communication are too centralized and cumbersome to respond to the kind of intense low altitude air battles that were fought in the 1973 Middle East War. Many of the important positions required for IAD planning and control are never exercised. The effectiveness of SHORAD weapons is reduced due to lengthy lines of communication and lack of integration with the Air Force and Hawk early warning radars. These and other problems throughout the IADS organization are expanded upon in the following discussion of the IADS organization from the AFCC down to the Redeye team leader.

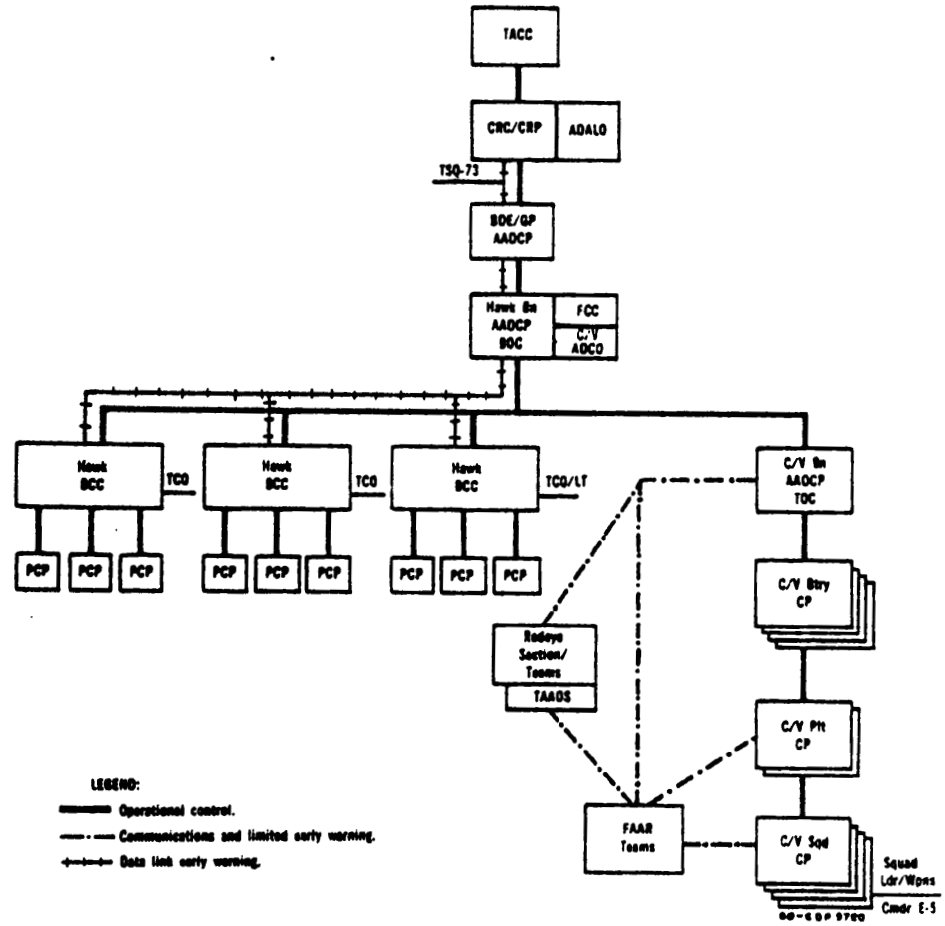


Fig. 11. IADS Lines of Control and Communication

Air Force Component Commander

The centralized management concept requires the AFCC to maintain positive control over all Air Force and Army air defense weapons. He does so by recommending an overall air defense battle plan to the Joint Forces Commander (usually an Army commander). In the battle plan, the AFCC recommends the apportionment of tactical air resources to be devoted to air defense and the rules of engagement for air defense weapons. The apportionment recommendation alone is an important decision. A recent study of a European scenario explained that a simple 10% change in the apportionment of tactical air forces could lead to a 50% increase in the ground area lost by NATO forces.[23]

Although the number of fighters apportioned to the air defense forces is important, an even more important factor that affects the outcome of the air defense battle could be the rules of engagement by which execution of the battle is decentralized to subordinate elements in the TACS. Terms such as "centralized control" and "decentralized execution," "command less operational control," and "operational control of weapons" are common throughout the IADS organization. These terms make the actual weapons engagement control lines confusing to the operators.[24] This confusion factor forces the AFCC to invoke rather strict

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[23]E. Dews and others, "Tactical Airpower in a Mid-Seventies NATO Defensive Contingency (NATO ALPHA) (U)" (Santa Monica, Calif.: RAND Corp., October 1974), p. xii. (DDC Doc. AD1000156L.)

[24]Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. 5-20 (hereinafter cited as DA, FM 44-90).

and universal rules of engagement and weapons control status on all air defense weapons, thereby grossly inhibiting their effectiveness.

Tactical Air Control Center

The air defense battle plan the AFCC proposes to the Joint Force Commander is formulated by the AFCC staff in the TACC. According to TACR 55-45, the individual who is actually responsible for developing the daily apportionment recommendation that the AFCC briefs to the Joint Force Commander is the chief of the Fighter Planning Branch in the Current Plans Division of the TACC.[25]

Also according to TACR 55-45, however, the key individual in the TACC for the development of the IAD plan is the TACS Planning Officer. The regulation states that this individual, who also works in the Current Plans Division and is the chief of the Airspace Management Branch, has the responsibility to:

> Plan for the employment and integration of area air defense weapons systems, including AWACS [airborne warning and control system] and Other Service air defense weapons systems.
>
> Develop policies and procedures for air defense operations. Coordinate and promulgate rules of engagement, and employment directives.
>
> Advise the Chief, Fighter Planning Branch on the recommended employment of fighter aircraft in the defensive counter air role.
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> . . . . . .

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[25]Department of the Air Force, Air Force Component Headquarters and Tactical Air Control Center Operations, TACR 55-45 (7 February 1975), p. 6-3 (hereinafter cited as DAF, TACR 55-45).

Prepare briefing of proposed air control procedures and air defense employment plans as required.[26]

In a search for IAD planning considerations, it appears that simply contacting a TACC TACS Planning Officer would yield great insights. In an attempt to do just that, however, it was discovered that the TACS Planning Officer exists only on paper in the Tactical Air Command (TAC). At the two garrison TACCs in the TAC (9th Air Force, Shaw Air Force Base, and 12th Air Force, Bergstrom Air Force Base), only about 10 of approximately 50 positions are permanently filled. The TACS Planning Officer is not one of the garrison positions. In actual deployment, this position would be manned by an Air Force major, senior weapons controller (Air Force Specialty Code (AFSC) 1716/1744). Upon arrival at the TACC as the TACS Planning Officer, he would presumably begin the IAD planning. In most cases, however, the IAD planning would have occurred prior to the major's arrival, because IAD procedures, rules of engagement, weapons control status, and weapons engagement zones appear in contingency or exercise operation plans and/or in supporting operation orders (OPlans/OpOrds). These plans are formulated by planning officers in the Readiness Command and in numbered air forces.

Although the regulation calls for the TACC planning division to build the IADS battle plan, in practice the real IADS planners are the officers who develop the contingency or exercise OPlans/OpOrds. For example, the development of the IADS plans for joint exercises such as

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[26]DAF, TACR 55-45, pp. 6-11 & 6-12.

Brave Shield and Bold Eagle are accomplished at the Plans Divisions of the 9th and 12th Air Forces. Joint meetings are held with representatives from the TACC, CRC, Army ADA, and fighter wings in attendance. Through these conferences, the plans officers develop and publish the IADS procedures in exercise OPlans/OpOrds. Thus, the TACC/TACS Planning Officer, who is rarely activated for exercises, has little to contribute to IADS planning.[27] As a result, he would be ill-prepared to manage the complex IADS as directed by the regulation.

Control and Reporting Center

The rest of the IADS organization is relatively simple to reconstruct, but it contains ambiguities that are similar to those found in the TACC. The overall responsibility for conducting the air defense battle is delegated to the CRC (see Fig. 12). In the CRC the battle commander (BC) retains ultimate responsibility for IAD employment. The BC is normally the senior ranking Air Force controller (AFSC 1716/1744) in the CRC. He coordinates and establishes operating procedures with the Army Air Defense Artillery Liaison Officer (ADALO), the Weapons Assignment Officer (WAO), and the Senior Director (SD) in the CRC for allocation of targets to ADA and fighter forces. The ADALO and WAO further coordinate with their respective weapons systems for final firing orders. Like the TACC/TACS Planning Officer, the CRC/BC position

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[27]Telephone conversations with TAC Plans, 9th and 12th Air Forces TACC, 17-19 January 1978.

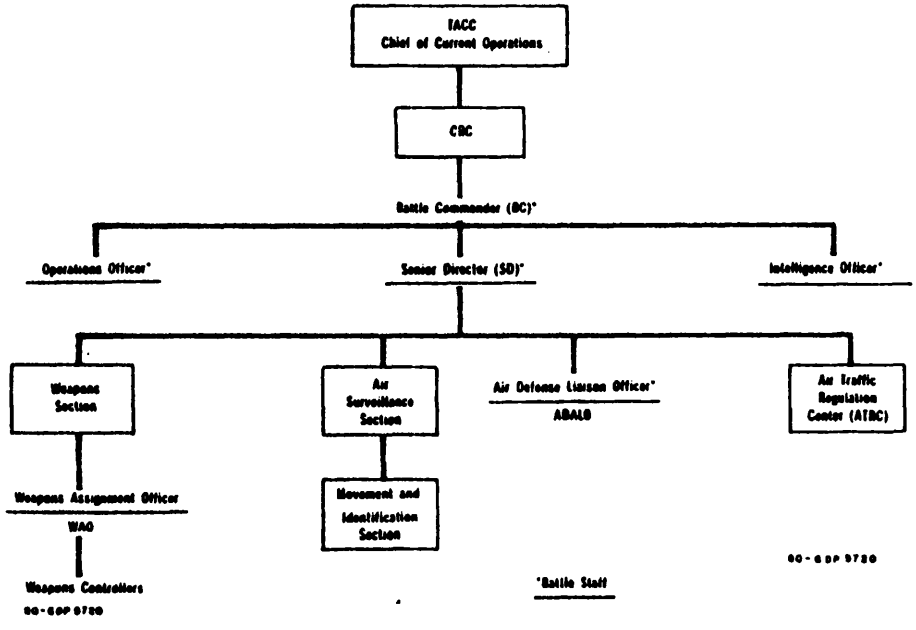

Fig. 12. Control and Reporting Center Chain of Responsibility for Air Defense Operations.

is not manned in-garrison. Normally, the CRC Operations Officer or the CRC Senior Director assumes CRC/BC duties in-garrison.[28]

Army Air Defense Artillery

For Air Force/Army air defense integration, the ADALO is the key individual in the CRC. He coordinates and monitors CRC/AADCP functions and relays IAD procedural changes down the Army ADA chain of control (see Fig. 11, page 74). For the Hawk units, data link and/or manual communication lines are used to exchange early warning information and to designate target assignment. These lines of control terminate in the Hawk battery control central (BCC), where the Tactical Control Officer (TCO), normally a lieutenant, executes the final firing order.

For the SHORAD units, lines of communication from the CRC/ADALO are used only to pass changes to IAD procedures, such as rules of engagement or weapons control status. Air Force early warning information and data link are not normally associated with SHORAD employment. The ADALO relays changes to IAD procedures through the brigade/group or Hawk AADCP where a Chaparral/Vulcan Air Defense Coordination Officer (ADCO) is positioned. The ADCO may also be located in the CRC/CRP when coordination with a Hawk battalion is not possible.[29] The IAD

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[28]Department of the Air Force, Tactical Air Control System (TACS): Surveillance and Control of Tactical Air Operations, TACR 55-44 (20 March 1975), pp. 7-9.

[29]Department of the Army, U.S. Army Air Defense Artillery Employment: Chaparral/Vulcan, FM 44-3 (30 September 1977), pp. 5-6 & 5-7.

procedural changes are relayed in turn by the ADCO to the C/V AADCP and by the C/V AADCP to the individual C/V squad leader/weapons commander (usually an E5 or lower), who then executes the final firing order.[30] Redeye teams also receive these procedural changes through the C/V AADCP channels of control. These SHORAD lines of control and communication rely strictly on voice communication via FM radio nets that are limited by line of sight, short range, and enemy jamming doctrine. Until about 1973, SHORAD units were equipped with the ANGRC-5 (AM receiver only), which provided a credible early warning integration. These receivers, however, were deactivated in 1973, and, as of this time, no suitable replacement has been found.[31] As Air Force early warning and target acquisition are not included in the SHORAD lines of communication, these units use an Army organic forward area alerting radar (FAAR)/target alert data display set (TADDS) system for this function (see Chapter V, pages 109-112).

In summary, the control and communication lines throughout the entire IADS organization are complex and lengthy. For rapid target acquisition and subsequent engagement, this highly centralized organization is slow in responding. Important IAD positions of responsibility in the TACC and CRC are not normally manned, which means that

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[30]Gordon M. Gershon, "Tactical Air Defense Evaluation Study (TAD-E), Subtask 6--Analysis of SHORAD Weapon Systems: Command and Control Alternatives (U)" (Menlo Park, Calif.: Stanford Research Institute, May 1974), p. 12. (DDC Doc. AD 530688L.)

[31]Personal interview with an Army SHORAD officer, 24 April 1978.

operational training is questionable. In addition, because the SHORAD units are not incorporated into the Air Force/Hawk early warning and target assignment nets, strict SHORAD rules of engagement and weapons control procedures are employed which restrict their effectiveness.

Methods of Control and Integration

The method by which the AFCC insures safe integration of all air defense weapons is through the establishment of air defense rules and procedures. These rules and procedures allow for centralized control of weapons and decentralized execution of the air battle. One of the underlying purposes of these control methods, however, is to limit the fratricide problem. All of the control rules and procedures limit the use of air defense weapons in some way. Yet, because the weapons use the same airspace and the problem of identification of friendly aircraft is not solved at this point in time, strict engagement rules and procedures are required.

The methods of control and integration can be placed into three broad categories that may be referred to as positive means, procedural means, and airspace/geographical means. Included in these broad categories are the rules of engagements and air defense directives that delineate the circumstances by which a weapon may fire at an aircraft.

Positive Means

The engagement decision or target assignment for interceptor aircraft and Hawk units is normally retained in the CRC/CRP. Weapons

control remains highly centralized within the CRC/CRP, and individual target assignments by weapon are normal procedure. According to FM 44-90, however, the engagement decision may be decentralized to Hawk units under special circumstances. The manual states:

> The inability of higher echelons to detect aircraft attacking at low altitudes will, in itself, normally be cause for the delegation of authority for engagement of these targets to Hawk battalion, battery, and/or platoon level during wartime.[32]

This presupposed delegation of engagement authority is not considered a normal mode of operation, yet it serves to illustrate the Army's reluctance to accept centralized control of its resources.

Procedural Means

Procedural means for controlling weapon fires is accomplished by using strict "hostile identification criteria." The rules of engagement contained in the OPlan/OpOrd will include the criteria by which hostile aircraft are identified. These criteria apply to all air defense units. Hostile targets may be identified by either electronic or visual means. In the case of low-to-medium-altitude air defense (LOMAD) weapons (Hawk/interceptor), identification normally is by electronic means. This includes basing hostile declaration on identification, friend or foe (radar) (IFF) response; target speed, heading, and location as determined by radar; and/or ECM emissions. Even these weapons, however, are restricted from firing unless visual confirmation is received. SHORAD

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[32]DA, FM 44-90, p. 5-10.

hostile criteria are normally visual, for example, "aircraft attacking friendly troops or a defended asset" and "aircraft having the markings and/or configuration of an aircraft belonging to an enemy force."[33]

As SHORAD weapons are the most decentralized of all the air defense weapons in the system, their engagements are even further restricted through a procedure called "weapons control status." The weapons control categories are Weapons Free: fire at any aircraft not positively identified friendly, Weapons Tight: fire only at positively identified hostile aircraft according to hostile criteria, and Weapons Hold: do not fire except in self-defense.[34]

Normally, SHORAD units are restricted to weapons tight status. Also, because of the long and relatively insecure lines of control between the CRC and SHORAD units, all SHORAD weapons in an area of operation operate under the same weapons control status.[35] This highly centralized and restrictive procedure is a disturbing and controversial subject to many ADA officers. Due to the requirement for enemy visual identification in a weapons tight status and given the target speeds versus the small engagement envelopes of SHORAD systems, effective utilization of the SHORAD weapons in this restrictive environment is questionable. A more effective system would be to selectively place

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[33]DA, FM 44-1, p. 6-1.

[34]DA, FM 44-1, p. 6-2.

[35]Department of the Air Force, Director of Operational Plans, Ninth Air Force (TAC), "AFFOR/OPP-AIR/EXORD 702" (Shaw Air Force Base, S. C., 12 August 1977), p. C-17-B-1.

SHORAD units in weapons free status based on location, time, and other decentralized control procedures. This problem of integrating the manually operated SHORAD weapons into the highly centralized electronic IAD structure is a continuing concern for the Army.[36]

Another procedural means of weapons control is the usage of "firing commands" as published in the rules of engagement. Higher echelons use these firing commands to further control weapons engagements when they are decentralized. Typical firing command orders are Hold Fire: destroy missile in-flight, cease tracking, do not fire; Cease Fire: allow launched missile to impact, do not fire but continue to track; and Cease Engagement: allow missile to impact, cease tracking, engage new target.[37]

Airspace/Geographical Means

The major integration method that prevents ground weapons from shooting down friendly aircraft is the employment of airspace and geographical control zones. The airspace restriction problems (see pages 65-70) were raised in discussing the doctrinal issues concerning the "weapons engagement zones." Similar altitude and zonal restrictions to friendly fighter operations exist in the formation of safe passage corridors, restricted and hostile fire areas.

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[36]Alex Dumbrique, "The Need for Adequate Division Air Defense Command and Control," Air Defense Magazine, October-December 1976, pp. 18-21.

[37]DA, FM 44-90, p. 5-12.

Safe passage corridors exist for friendly aircraft returning from enemy territory. These corridors are based on arrival time, altitude, and heading.[38] These criteria are difficult to coordinate in a large scale exercise, and positive radar control is most often required. Thus, returning aircraft are forced to fly at higher altitudes than tactically necessary so they can be identified as friendly.

FM 44-90 (Hawk employment) lists examples of safe passage corridors as 8,000 to 10,000 feet and 16,000 to 18,600 feet, with aircraft speed at 350 knots.[39] These examples of altitude and airspeed restrictions for fighter operations are grossly unrealistic. Aircraft survival while crossing the FEBA requires that pilots be allowed to operate as low and as fast as possible. Procedures calling for aircraft climbs for identification purposes when approaching the FEBA are unrealistic and are often intentionally violated by interdiction pilots.[40] Restricted and hostile fire areas impose similar operational restrictions on friendly aircraft while denying vast geographical areas to interceptors. This is done to allow "Hawk and other ADA units maximum freedom of action in an area where the enemy has air superiority."[41]

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[38] DA, FM 44-90, p. 5-14.

[39] DA, FM 44-90, p. 5-14.

[40] For an excellent discussion of this problem in the European IADS, see: Department of the Air Force/CINCUSAFE/DO&I, Salty Control (U) (June 1976), pp. 1-82.

[41] DA, FM 44-90, p. 5-15.

Conclusions

The United States IAD employment concept is similar to the concept Egypt used in the 1973 war and the Soviets' "zonal" control. Under current IADS doctrine, weapons engagement zones separate aircraft and ground air defense systems. Simultaneous weapons engagements rarely occur.

Even though the Air Force is given overall responsibility for IAD doctrinal development, the Army ADA doctrine manuals are more current and contain the most complete explanation of the IAD structure and procedures. Air Force doctrine manuals, although recently updated, do not address IAD doctrine vis-à-vis changing balances of power, U.S. Army defensive doctrine, or short and intense warfare. Although the new Army ADA manuals are far superior to the Air Force manuals, some outdated concepts do exist in Army IAD doctrine concerning employment of interceptors and passage of friendly interdiction aircraft.

Organization of the IADS is based on the doctrine of centralized control and decentralized execution and is extremely complex and occasionally dysfunctional. The doctrinal concept of "decentralized authority" for engagement is a misnomer. The entire IADS organization is highly centralized, with uniform rules of engagement, standard operating procedures, and CRC engagement control. Many of the important IAD planning positions are unmanned except in wartime. This makes realistic training, conceptual experimentation, and employment evaluation difficult to impossible.

Methods of control and integration of the IADS are designed to allow the AFCC and the CRC to maintain operational control of all air defense weapons. These control methods are simultaneously restrictive to both Air Force and Army air defense weapons. Weapons engagement zones, "Hawk Belts," and safe passage corridors are currently used to solve the fratricide problem. These control methods require a very sophisticated centralized organization to maintain command of the defensive battle.

This air defense system and its integration process are extremely complex. It is difficult to comprehend how it operates at best in peacetime. Given wartime problems of equipment outages, enemy jamming, and battlefield confusion, the credibility of the IADS is questionable.

CHAPTER V

IADS: EQUIPMENT, WEAPONS, AND TRAINING

> If we are going to train like we're going to fight, and we are, this means working closely with the Army.[1]
>
> General Robert J. Dixon, Commander
> Tactical Air Command, USAF

Introduction

The doctrine, organization, and methods of control and integration for the integrated air defense system (IADS) were presented in Chapter IV to demonstrate its conceptual operation. Equipment, weapons, and training procedures for the IADS are examined in this chapter to determine whether present capabilities match conceptual design. One of the primary concepts for integration of air defense weapons was found to be the principle of centralized command and control. One reason for centralization is the inherent limitation of air defense weapon operators to separate friendly and enemy targets. The centralized control agencies have been given this responsibility, and the design of IADS equipment and weapons reflects this centralization principle.

Current equipment and weapons used in this integration process are presented in this chapter. Only the major components are discussed

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[1] "Dual Challenges Confront TAC," Aviation Week & Space Technology, 6 February 1978, p. 50.

etc., are shown, with emphasis on integration capabilities and limitations.

Tactical Air Control Center

The first major IADS command and control item is the TACC Operations Central AN/TSQ-92 (see Figs. 13, 14, and 15). This unit provides the Air Force Component Commander a facility for control of the entire air effort. The major limitation of the AN/TSQ-92 is that all management information must be manually processed on plotting boards within the unit. A recent article explained that "with the existing system, the time required to update and display the air situation can require 10 min. or longer."[2] This is one reason the air defense battle is delegated to the CRC. Another limitation is that the AN/TSQ-92 is relatively insecure to enemy air attack when it is deployed, and consequently it must be placed well to the rear for self-protection. The system is portable and modular in design, which allows it to support an operation that has 3 to 24 tactical fighter squadrons.[3]

Control and Reporting Center/
Control and Reporting Post

The next major piece of equipment in the IADS organization is the CRC/CRP Operation Centers AN/TSQ-91 (see Figs. 16 and 17). Like the

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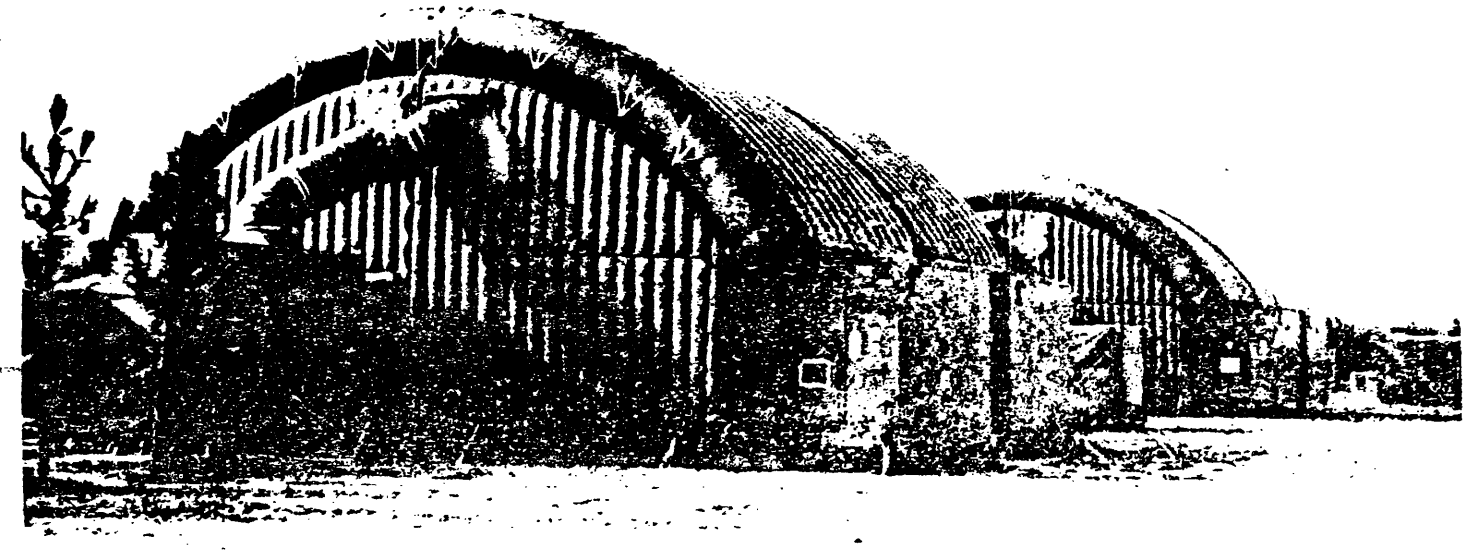
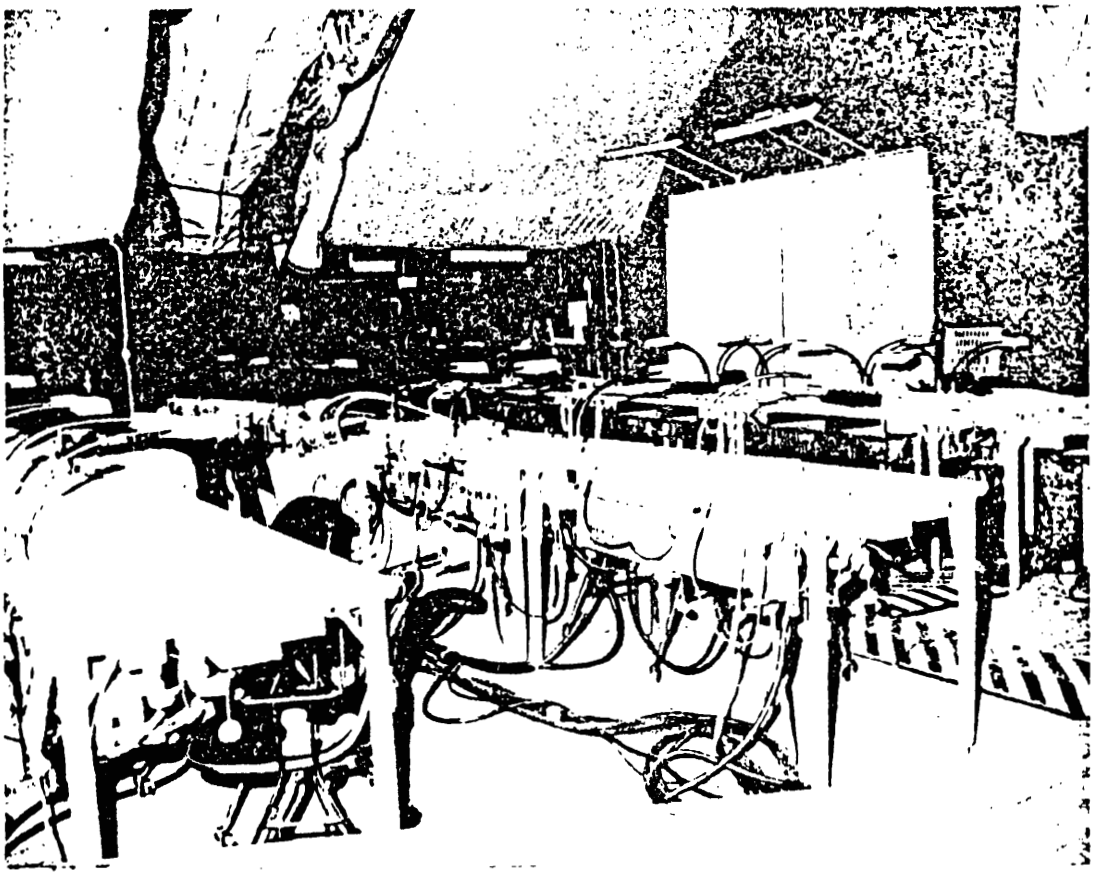
[2]"Battle Assessment Techniques Pressed," Aviation Week & Space Technology, 6 February 1978, p. 243.

[3]Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), pp. 4-43 through 4-49 (hereinafter cited as DAF, TAC, TACP 55-43).



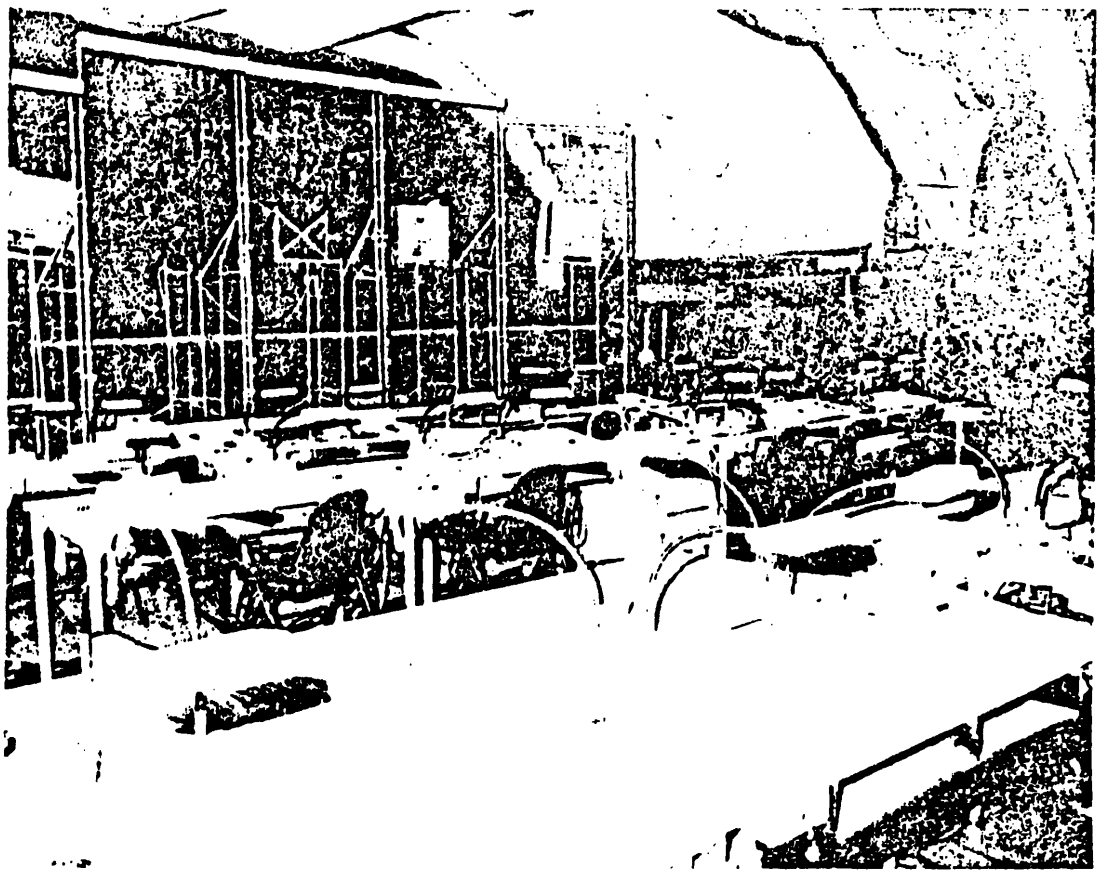
SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-47.

Fig. 13. TACC Operations Central AN/TSQ-92



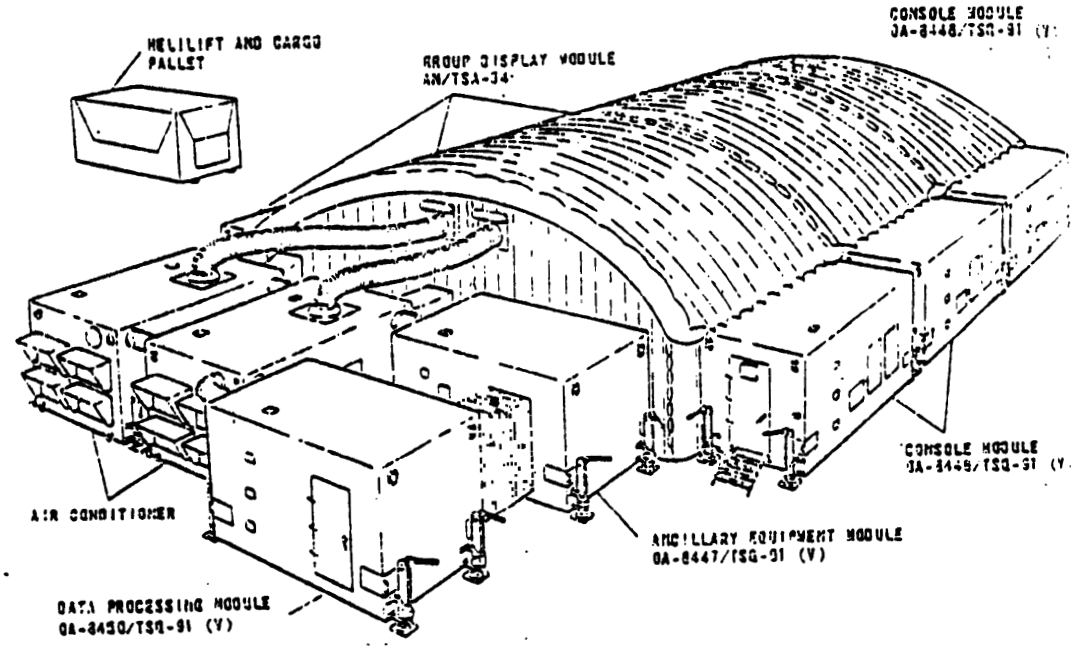
SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-48.

Fig. 14. Interior View of AN/TSQ-92



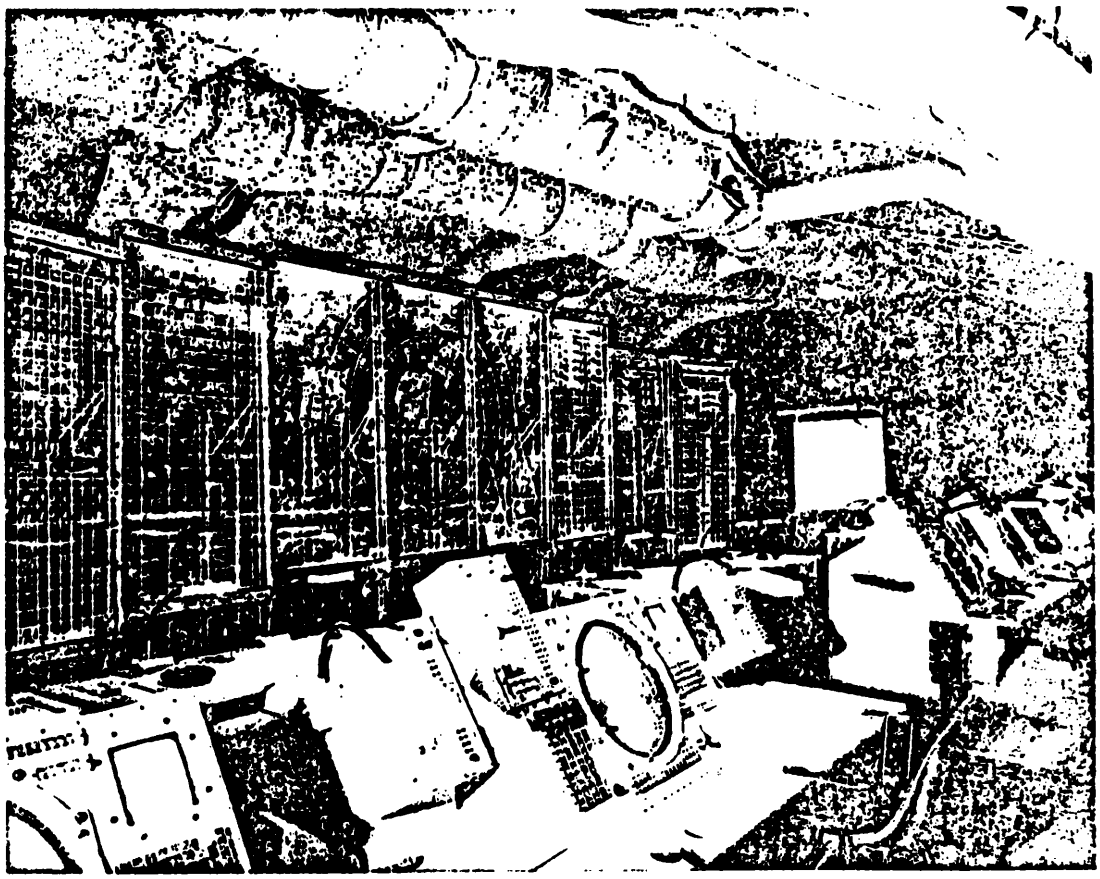
SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-49.

Fig. 15. Interior View of AN/TSQ-92



SOURCE: Department of the Air Force, Tactical Air Control System (TACS): Surveillance and Control of Tactical Air Operations, TACR 55-44 (20 March 1975), p. 48.

Fig. 16. CRC/CRP Operations Central AN/TSQ-91 (V)



SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-35.

Fig. 17. Interior View of AN/TSQ-91

TACC, the AN/TSQ-91 is mobile and modular in design for variable deployment configurations. Its major feature is a data processing module that contains the HM-4118 Computer. With this module, the CRC has the capability to operate both manually and in computer-assisted operations. In the computer-assisted mode, the HM-4118 "processes surveillance, computes weapons data and generates console displays."[4] Like the TACC, the CRC presents a rather large static target to enemy action. For this reason, CRCs are deployed in rear areas and are linked to a network of forward air control posts (FACPs) that function as low altitude radar gap fillers. The FACPs consist of an AN/TSQ-61 Operations Central, which is a two-scoped van connected to either a TPS-44 or a TPS-43 radar (see Fig. 18). The FACPs are far more mobile than the CRCs/CRPs. Communication between the FACP, CRP, and CRC is provided through two-way voice, digital data, and teletype nets.[5]

Air Force Early Warning Ground Radar

The primary radar currently employed by the Tactical Air Control System (TACS) is the AN/TPS-43 E Radar Set (see Fig. 19). It is a mobile ground radar designed for simultaneous long range search and height finding. It has the capability to interface with the CRC, the CRP, and the FACP operation centers. Its range capability is listed as

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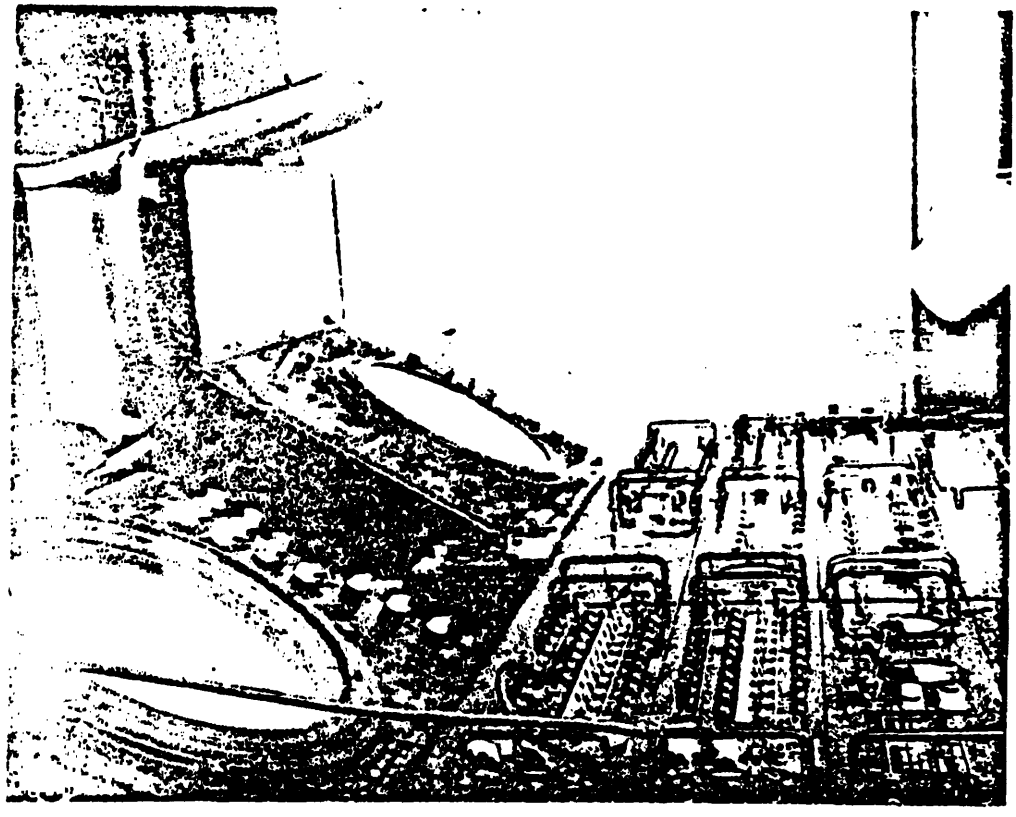
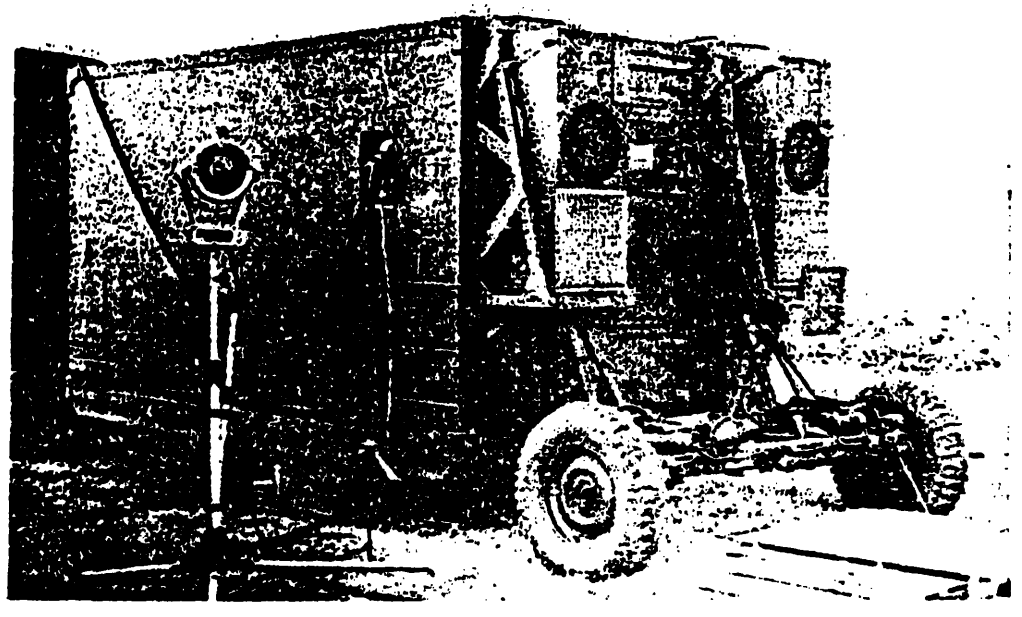
[4]DAF, TAC, TACP 55-43, p. 4-30.

[5]DAF, TAC, TACP 55-43, pp. 4-26 through 4-28.

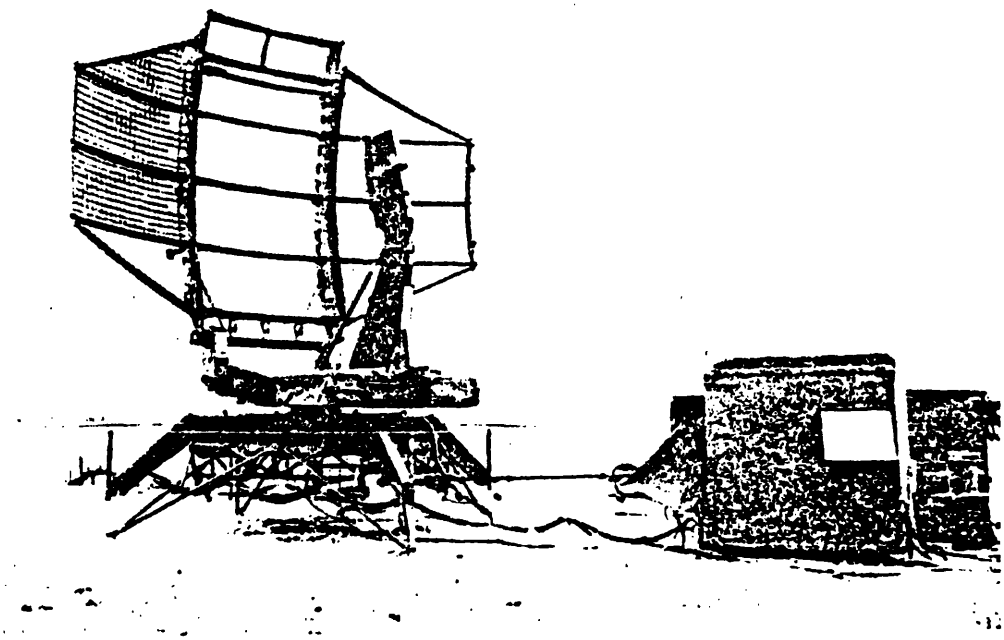




SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), pp. 4-26 & 4-28.

Fig. 18. FACP Operations Central AN/TSQ-61

200 nautical miles with a height finding capacity of 75,000 feet. Minimum altitude coverage is classified, but, due to ground clutter and line of sight limitations, the effective low altitude (below 1,000 feet) is limited.[6] A recent modification includes a moving target indicator function on the radar that reduces most of the ground clutter problem.[7]



SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-3.

Fig. 19. AN/TPS-43E Radar Set

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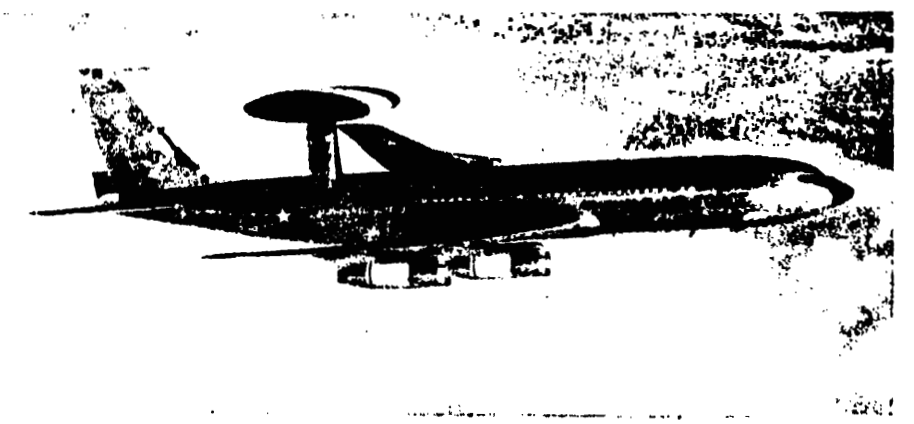
[6]DAF, TAC, TACP 55-43, p. 4-3.

[7]Department of the Air Force, 727th Tactical Control Squadron (TAC), "After Action Report of Detachment 1, 727 Tactical Control Sq for Red Flag 78 1-2 (U)," Prepared by James E. S. Burns (Bergstrom Air Force Base, Tex., 10 January 1978), p. B-1 (hereinafter cited as DAF, 727th Tac Con Sq (TAC)).

Airborne Warning and Control System

The airborne warning and control system (AWACS) (see Fig. 20) program is now in the initial training phase prior to operational deployment. The AWACS offers the IADS a capability for low altitude target detection never before possible.

> . . . As an air defense system, it will detect, identify and track low-flying enemy aircraft and guide friendly interceptors against the intruders. From an altitude of 30,000 ft, the E-3A [AWACS] can detect low flying aircraft out to the radar horizon at a range of 245 mi.[8]



SOURCE: "A Major Command Tactical Air Command," Air Force Magazine, May 1977, p. 82.

Fig. 20. E-3A Airborne Warning and Control System

As the AWACS has not yet been operationally deployed, how it will integrate into the IADS picture remains to be demonstrated. Whether the AWACS will operate as simply a long-range radar platform or will replace the CRCs in air battle management has not been definitely

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[8]Benjamin M. Elson, "TAC Readies for Deployment of E-3A," Aviation Week & Space Technology, 6 February 1978, p. 106.

determined. Certainly the AWACS has capabilities far beyond the radar early warning role normally associated with its mission. These employment issues, together with various software and hardware modifications, are yet to be resolved.

Army Air Defense Command Post

The next facility in the organizational chain of control is the Army Air Defense Command Post. This is the headquarters to which the Air Defense Artillery Liaison Officer (ADALO) must communicate to integrate Army/Air Force weapons. In the past, all coordination between the CRC and the AADCP was via voice communication and manual plotting. This was time-consuming and ineffective. With the recent operational deployment of the AN/TSQ-73 Missile Minder (see Fig. 21), the Army now has the capability for complete two-way automatic data link between the CRC and the AADCP. This capability allows the Army to pass near-real-time early warning information to the CRC from Hawk radars and also to receive Air Force target information from the TPS-43s or AWACS. With or without the AN/TSQ-73, the configuration of the AADCP must remain mobile and flexible to meet requirements of the air defense situation. Any suitable shelter (building, tent, or vehicle) may be used (see Fig. 22).[9]

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[9]Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), pp. B-2 & B-3 (hereinafter cited as DA, FM 44-90); and Department of the Army, U.S. Army Air Defense School, Air Defense Artillery Reference Handbook (1977), pp. 5-3 & 5-4 (hereinafter cited as DA, USAADS).

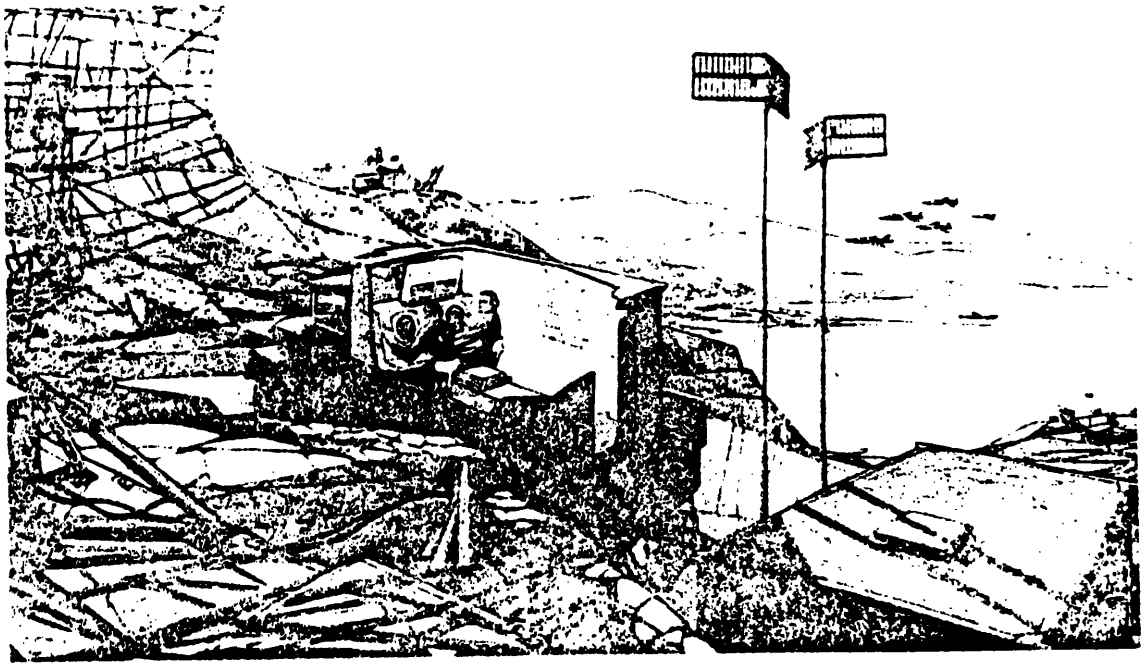

Fig. 21. Missile Minder (AN/TSQ-73)

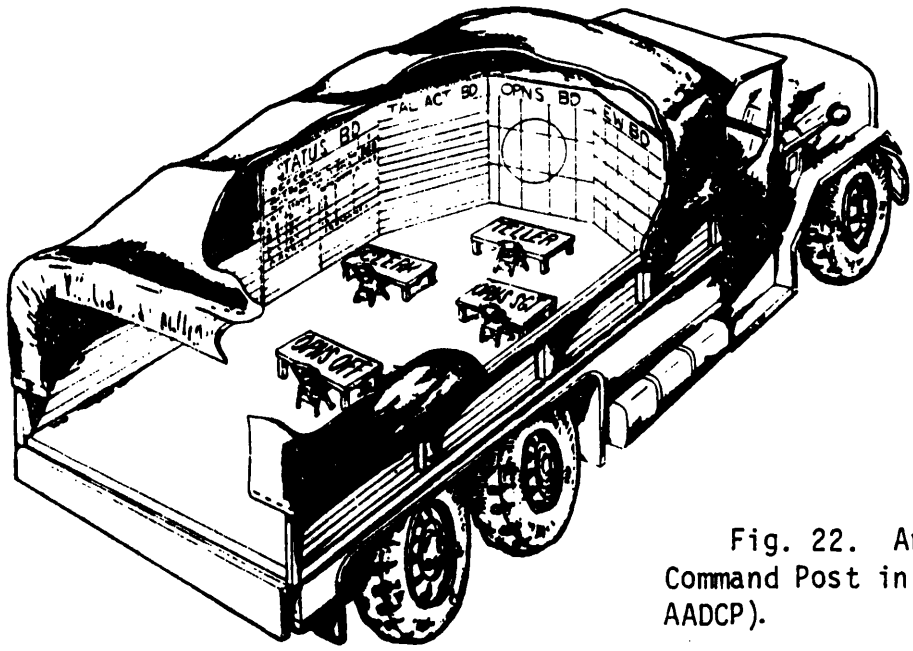

Fig. 22. Army Air Defense Command Post in Truck (Manual AADCP).

SOURCE: Department of the Army, U.S. Army Air Defense School, Air Defense Artillery Reference Handbook (1977), p. 5-3 (Fig. 21) & p. 16-16 (Fig. 22).

Army Hawk Equipment

For Hawk employment, the CRC/ADALO passes target assignments through the AADCP to the Hawk air defense battalion operations center (BOC). The BOC normally consists of three basic components: the AN/TSQ-73, a backup manual fire control element, and an operations and intelligence element. The fire control element, located in an expandable van, is responsible for the conduct of the air battle for the Hawk battalion (see Fig. 23).[10] As seen in Figure 23 and as described in Chapter IV (page 80), the Chaparral/Vulcan (C/V) Air Defense coordination officer (ADCO) is located in this van. His main purpose is to keep the C/V AADCP advised of the current weapons status and procedural changes, but he can also pass target information to the C/V AADCP from early warning and tactical action boards in the BOC (see Fig. 24). This target information, however, is plotted manually in World Geographic Reference System (GEOREF) grid coordinates that must be converted to universal transverse mercator grid coordinates, the coordinates short-range air defense (SHORAD) units use. By the time high speed tracks could be passed from these boards to the C/V AADCP and received by the C/V fire units, the information would probably be too dated to be useful.

Another limitation of the BOC for effective integration between Army and Air Force components is the lack of UHF capability in the BOC.

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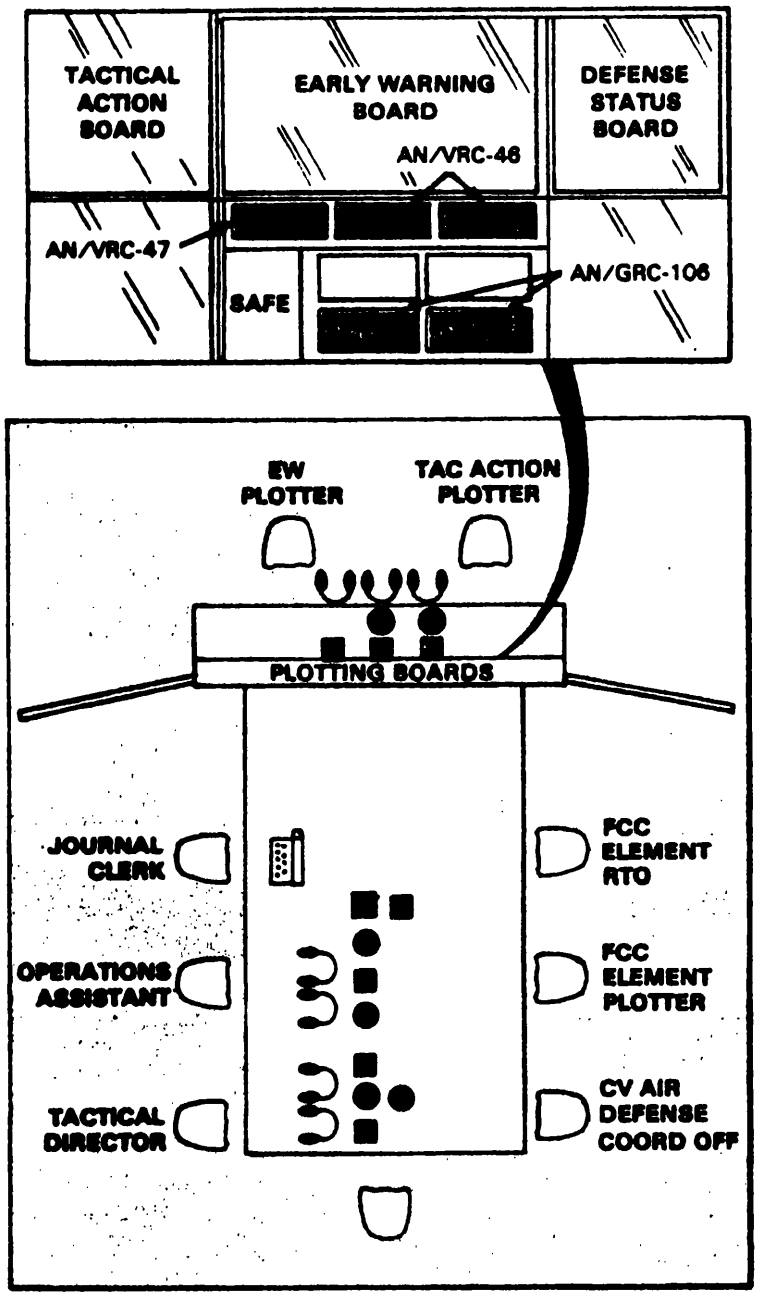
[10]DA, FM 44-90, pp. B-1 through B-11.



SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. B-4.

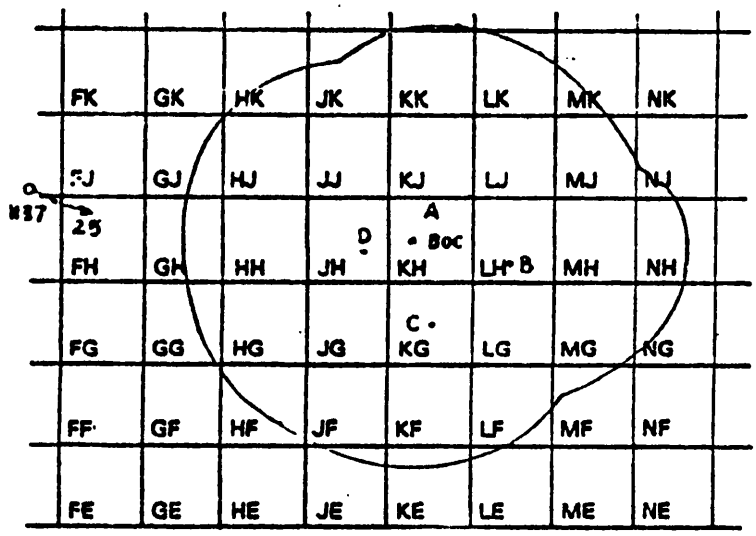
Fig. 23. Hawk Battalion Operations Center

DEFCON	D	POP-UP		ECM		
ADA WARNING		METHOD OF CONTROL			WAD	
RED	X	BATTALION			F	
YELLOW						
WHITE						

STATUS OF UNITS

UNIT	SITE	ALERT STATUS						REMARKS	MSL CT
		0S	5 MIN	20 MIN	30 MIN	1 HOUR	O/A		
A (-)	21	X							9
A (DFP)	21A						X		9
B (-)	22	X							16
B (DFP)	22A	X							12
C (-)	23	X							10
C (DFP)	23A	X							14
D (-)	24						X		10
D (DFP)	24A	X							16

DEFENSE STATUS BOARD



EARLY WARNING BOARD

TRK #	A/C	ALT	SPD	SITE	ACQ	L/O	MA	RESULTS	REMARKS
M01	3	60	50	23	18	20	23	KILL	
H36	1	5	40	22A	19	22	24		
H37	2	50	90	21	25	27	29		

TACTICAL ACTION BOARD

SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. B-5.

Fig. 24. Battalion Operations Center Early Warning and Tactical Boards.