AIRSPACE COORDINATION - WHO NEEDS IT

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ABSTRACT

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The theme is based upon the Army's need to coordinate airspace. Data was gathered using a literature search. The Airspace above the combat zone is used by all services and by all combat branches within the Army. History indicates control of the airspace became a problem during World War I. Between World War I and World War II new concepts for integration of air into the land battle scheme were developed. Korea brought new innovations and produced combat experience in the helicopter for the Army. The Vietnam War produced the concept of Airmobility that further increased airspace control problems. There is no current agreement on joint use of the airspace. Regardless of the outcome of a joint agreement, it is concluded the Army must manage its own resources whether by its own rules or those of another service. Doctrine provides for an Airspace Coordination Element (ACE) that, currently, is not authorized on most TOEs. The ACE, although a workable solution, is restricted by being only a planning and management facility with limited capability. Air Defense Artillery has recommended consolidation of selected equipment with aviation to help solve the airspace problem. The Army should test this proposal, authorize ACE personnel in the major headquarters' TOE, and strive to make the ACE a minute-by-minute operator and problem solver.

PREFACE

This monograph was directed toward the need of the US Army to coordinate the airspace over the combat zone. Although "coordination" is the central theme, it was felt airspace "control" had to be addressed in considerable detail since they both are often used interchangeably by many authors. The history of command and control was the vehicle selected to acquaint the reader with the difference between "control" and "coordination," as seen by the author. Assistance in reconstructing the history of command and control was obtained from senate hearings before the Special Subcommittee on Close Air Support, Preparedness Investigating Subcommittee, Committee on Armed Services during October and November 1971 and from the Phase II Joint Staff Task Force Close Air Support Study convened by the Deputy Secretary of Defense and completed in December 1972.

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INTRODUCTION

Airspace Coordination is not defined in Joint or Army dictionaries. As used in this monograph the following definition is used:

> Airspace coordination is a specialized service required by the commander to assist him in meeting his inherent responsibilities for control of his organic forces and for coordination with other airspace users. The service is designed to minimize mission conflict, promote safety among all airspace users and increase operational effectiveness. The coordination service may apply to specified airspace, specified airspace users, or both. The coordinating mechanism established for the task may or may not be provided command authority.[1]

The control and coordination of the activities of all airspace users over the combat zone is often viewed as a significant and unsolved problem. The 82d Airborne Division sums it up in the following manner in the Forward to the Airspace Coordination SOP for the Division:

> Freedom of movement over the battlefield is as essential to success in combat as freedom of movement on the battlefield. The continued controversy over the responsibility for airspace control-management-coordination has resulted in a distinct absence of firm doctrine of definitive guidance in this area. Following the principle of authority commensurate with responsibility for mission accomplishment, the ground component commander is responsible for coordinating, not controlling, the use of airspace over his area of operation.[2]

The airspace above the combat zone is used by all services and by all combat branches within the Army. It often appears as each feels

that he has exclusive rights to the use of the air in the accomplishment of his mission. It would be difficult to refute that each, at a given time, must have use of a portion of the airspace and a problem is encountered anytime two or more try to use the same space at the same time.

What are the current command and control procedures for use of the airspace, how where they derived, and just how does coordination fit into the scheme of control? A look at history should help to get us started on the answer to these questions.

HISTORY OF COMMAND AND CONTROL[3]

Control of the airspace became a problem during World War I when the US Air Service provided close air support for US Forces in the Meuse-Argonne battle. Between World Wars I and II new concepts for integration of air into the land battle scheme were developed. Initial doctrine for the employment of air forces was established in Training Regulation 440-15, dated 26 January 1926. This regulation stated that the role of aviation was to further the mission of the tactical commander to whom it may be assigned. The ground commander assigned all missions to air units including close air support of the ground troops. During World War II there was a growing awareness of a need for the control of tactical aviation. Three doctrinal publications and a major organizational change established the framework for close air support command and control for the Army and Army Air Forces.

Field Manual (FM) 31-35, published in April 1942, established a rudimentary air ground system with "air support controls" at corps and possibly division level. Air support commander functioned under the ground commander.

Field Manual (FM) 100-15 published in June 1942, emphasized the importance of air superiority, making it equally important with support of the ground forces.

During the North African Campaign (November 1942 - February 1943), assessment of the effectiveness of air support of ground under the doctrine and procedures in FM 31-35 varied. While initially operating in North Africa, air support was dedicated, in accordance with an Army Air Force Plan promulgated by an Army Air Force Commander, to provide separate aerial umbrellas for individual divisions and corps. Although dedicated to individual units for direct support these aerial umbrellas did not operate under the operational control of the individual division and corps commanders. This system, functioning under the overall ground commander, proved unsatisfactory during the battle of Kasserine Pass in February of 1943 primarily because it failed to provide command and control arrangements necessary to mass theater wide air assets required to counter major concentrated enemy threats. Command and control was radically changed while the Kasserine Pass battle was still being fought. The revision and application of the new doctrine brought immediate and decisive results. Air superiority was wrested from the Luftwaff permitting allied bombers to destroy the ships and ports supplying the Germans, and to knock out his airfields. Fighter sweeps mounted to two thousand sorties a day.

Field Manual (FM) 100-20, published in July 1943, recognized this new doctrine. The superior commander in a theater of operations was tasked with the actual conduct of all operations. Land power and air power was stated as coequal and interdependent forces under ground and air force commanders. The priorities for air operations were established as air superiority, interdiction, and close air support.

From the experience gained in the North African campaigns an extensive system for command and control of tactical air in the European theater was developed. The combined headquarters, with the Army Ground and Army Air Force Commander at equal levels, air-ground liaison sections, joint operations centers, the air-tank team, armored column cover, and an improved communications net were introduced. More positive control of tactical air operations was due, in large measure, to the introduction of a Tactical Control Center (TCC), Micro-Wave Early Warning (MEW) Radar, Forward Director Posts (FDP), Close Control Units (CCU), Direction Finding (Fixer) Stations (DFSS), and Lead-in Aircraft.

The close association of the ground and air forces, established at higher headquarters, was assured in corps and divisional headquarters by the provision of air-ground liaison in the form of Tactical Air Party Officers. Ground Liaison Officers (GLO), provided by the Army, were attached to each air headquarters down to group and squadron level. The Tactical Air Party Officer was a qualified pilot attached to an Army combat command headquarters as a liaison officer and transmitted requests for air cooperation to the TAC headquarters. The GLO was

a counterpart of the TAPO. He provided liaison with air headquarters and was responsible for details concerning special request targets.

The invasion of Normandy on 6 June 1944 clearly demonstrated the fine balance of effort by the tactical air forces in attaining their objectives in all three phases of tactical operations.

The advance across France (1 August - 15 September 1944) saw the incorporation of a new use for air power in cooperation with a rapidly advancing Army. Planned missions were impossible because of the rapid advance and closer contact with better communications had to be established between the air and ground. The result was two extremely flexible types of missions. One was armed reconnaissance in which fighter-bombers armed with bombs and guns attacked targets of opportunity ahead of the ground forces. The second type of mission was armored column cover by tactical air. In these operations, four and eight-ship flights orbitted over the lead elements of armored columns, ready to attack on request, to warn the tanks of hidden opposition, and to eliminate delaying actions.

The European campaigns (such as the Normandy invasion and the advance across France) refined the procedures for the air-ground team broadly outlined in FM 100-20. Refinement in control became possible through the introduction of tactical air liaison officers and the introduction of radar for air traffic control and directions. Centralized control of tactical air assets was retained throughout the European campaigns.

In the Southwest Pacific during World War II, the procedures and techniques for delivery of effective close air support of the infantry by the Navy followed concepts developed by the Marine Corps. These innovations included an elaborate organization of ship-based air support control units working with trained Navy air liaison parties attached to infantry units which acted in a capacity similar to artillery forward observers.

After World War II and prior to the Korean War in 1950, the Army Air Forces were reorganized into Strategic Air Command (SAC), Tactical Air Command (TAC), and Air Defense Command (ADC). The National Security Act of 1947[4] established the Air Force as a separate service.

In the intervening years between World War II and the Korean War the elements of the Army-Air Force air ground and control organization for close air support were severely depleted to the extent that only two trained and qualified tactical air control parties were available when the war started. The Army and Air Force were required, during a time of military extremes to reestablish the air-ground team previously developed in World War II.

By July 1951, the Tactical Air Control System in Korea was fully operational. Three innovations of major importance were refined in the command and control of close air support. These were Tactical Air Direction Post (TADP), the addition of the Tactical Aircraft Control Parties (TACP), and the Mosquito airborne controllers. From its beginning in 1950, with two TACPs as its sole elements, a Tactical Air

Control System evolved that controlled more than one thousand five hundred UN combat aircraft in July 1953.

Army aviation came out of Korea with combat experience in a new machine, the helicopter. The helicopter's flight characteristics made it ideally suited for integration into the decentralized concept for the employment of organic Army aviation.

In January 1962 the Air Force assisted the Vietnamese Air Force (VNAF) by establishing a Tactical Air Control System (TACS). Two parallel systems were formed: one to accommodate USAF/VNAF tactical air support of the Vietnamese Army (ARVN) operations and one for support of American and free world forces.

In April 1962, the Army began looking at new concepts in the organizational structure of Army combat units. These concepts ultimately led to the development of the attack helicopter. A new look was taken at land warfare mobility that was completely different from traditional viewpoints and past policies. This resulted in the Army developing several new types of units: an air assault division, an air transport brigade, an air cavalry combat brigade, a corps aviation brigade and various other modified units. The large increase in the number of Army aircraft over the combat zone was a significant factor in the airspace control problem.

In April 1965 the Chief of Staff, Army and Chief of Staff, Air Force concurred in a "Concept for Improved Joint Air-Ground Coordination" which provided for Air Force Tactical Air Control Parties collocated with Army command elements down to battalion level; apportionment of

resources to close air support on a daily basis by the joint commander with provisions for allocation, suballocation, or reallocation of close air support sorties through the ground force chain of command.

In August 1965 the 1st Cavalry Division (Airmobile) deployed to Vietnam, thus providing a divisional size unit with a command and control capability over specifically tailored organic armed helicopter units.

An Airborne Battlefield Command and Control Center (ABCCC) began operations in September 1965 and provided on-scene control of tactical air resources for close air support operations.

COMMAND AND CONTROL PROBLEMS

The look at history has demonstrated airspace command and control growth from World War I to the Vietnam War. Our forces have always sought and managed to obtain air superiority and it has been over twenty years since an American Army has been faced with a sophisticated air attack. Only a few commanders remain who have suffered that experience. Yet, in future conflicts our combat troops are not likely to enjoy the immunity from air attack experience in Korea and Vietnam. The presence of hostile aircraft over our field armies greatly complicates the identification and airspace management problem. If we cannot adequately coordinate the efforts of fire support, air defense artillery, and aviation of all services, the ground commander will be greatly hampered in mission accomplishment.

In May 1965, the Joint Chiefs of Staff (JCS) agreed to a broad concept for control of the airspace over the combat zone.[6] The Air Force was requested to develop, in coordination with the other services, the necessary joint doctrine. The Air Force submitted draft manuals for service comment in 1965 and each subsequent year. These documents have not resolved basic divergencies and have not been agreed upon by the other services. One of the recent draft manuals[7] submitted by the Air Force acknowledges the basic principle of maximum freedom of operations /desired by the Army/ and recognizes a possible requirement for block airspace under control of the land force commander, but it does not provide specific doctrine. Centralized control of all airspace by the air component commander is implied in the manual.

Although there is no joint agreement, all services apparently recognize that there will be a single airspace control authority and that authority will normally be that of the Air Force component commander. This point has not been a point of contention.

There are a number of overall concepts for airspace management. The impact of these concepts is often in the area of "who's the boss," and have little impact on specific coordination procedures for accomplishment of the Army's portion of the overall airspace coordination task. For example, if an Air Force control element has full airspace control authority in certain airspace, this has little effect on the procedures the Army will follow. It just limits coordinating the use of the airspace to Army users and requires a coordination element be

provided at the Army-Air Force interface. That is, the Army must manage its own resources whether by its own rules or those of another service. Therefore, the Army must still operate with the same people and perform essentially the same function as if the Army had full airspace control authority over the battlezone.

PRESENT DAY USERS OF AIRSPACE

A closer and more detailed look at the present day users of airspace over the forward combat zone and present control and coordination methods should help to further identify the coordination problems.

Field artillery and mortars: Field artillery and mortar units maintain a system of fire direction centers (FDC) for internal fire control. The field artillery system is rapidly converting to automation of many functions. Field artillery units provide the fire support coordination centers (FSCC) and fire support elements (FSE) at the various levels; these facilities are currently "manual" with potential for future automation of many field artillery functions. Mortar units are directly controlled by the maneuver unit commanders and are expected to continue to operate in the manual mode. The primary function of the FSE and FSCC is to provide command coordination

of supporting fires on surface targets.

Army aviation: A system of flight operations centers (FOC), flight coordination centers (FCC), approach/departure control facilities, airfield control towers, and navigation aids are provided throughout

the combat zone for the control and coordination of Army aviation. The FOC/FCC provides air traffic regulation services to enroute aircraft. Approach/departures control provides air traffic service to aircraft arriving, departing, or overflying its area of responsibility. The airfield control towers are part of the terminal traffic control (TTC) system and issue landing and takeoff clearances, control aircraft within the airport traffic area, and relay clearances and advisories to aircraft within the airport traffic control area.[10]

Air Force: The Air Force's radar supported control and reporting centers/air traffic regulation centers (CRC/ATRC), control and reporting posts (CRP), and forward air control posts (FACP) provide air surveillance and control of Air Force aircraft. The CRC/ATRC is the control focal point, with the other elements being forward extensions thereof. This system directs Air Force air defense intercepts and also controls Air Force offensive missions until the aircraft are handed off to other systems or to forward air controllers. The Air Force also provides direct air support centers (DASC), tactical air control parties (TACP), and forward air controllers (FAC) to assist the Army in requesting and coordinating USAF tactical air support and to control such support as necessary. They work closely with the S2/S3 Air or tactical air support element (TASE) in the Army command posts/ tactical operations centers.[11]

Army Air Defense: Army air defense operations are controlled by Army Air Defense Command Posts (AADCP). The AADCP controlling the Hawk and Nike Hercules weapon systems are supported by local radars and semi-automatic control and coordination systems. The divisional ADA battalions

(Chaparral/Vulcan) AADCPs are "manual" and feature full decentralization of engagement control of the Chaparral and Vulcan air defense artillery weapons. Control authority for Redeye and other organic weapons capable of engaging aircraft rests with the using unit, subject to compliance with established joint procedures and unit SOP.[12]

The Army definition of centralized control is: "Under the centralized method of control an air defense commander may require that fire units only conduct engagements upon receipt of specific orders or permission from a designated higher air defense echelon."[13] In this mode of operation, target assignments are made from the higher echelon of command and fire units are permitted to engage only those targets so designated.

The Army definition of decentralized control is: "Under this method of control, engagement decisions are made at the ADA squad level (fire unit) based on the rules of engagement and subject to any temporary engagement restriction imposed by higher echelons."[14] In this mode of operations fire units engage targets that are detected by their own organic means without requesting permission from higher defense echelons. This concept provides for maximum defense reaction and permits the maximum number of targets to be engaged. Coordination between air defense weapons is at a minimum, however. What coordination does exist is achieved by proper defense design, assignment of primary sectors of fire and mutual exchange of information.

AIRSPACE COORDINATION ELEMENT

It becomes easy to see that coordination by the army of its own assets is no small task. Current doctrine provides for an Airspace Coordination Element (ACE) at division, corps, and field army level to serve as the commander's focal point for airspace coordination. The ACE is manned by personnel from organic and attached/supporting ADA and Army aviation units.[15] However, only the Chaparral/Vulcan battalions TOE provides organic resources for this purpose. The Chief of the element may be provided by either ADA or Army aviation. Normally, he is the senior individual present in the ACE.

It should be understood that the ACE does not coordinate the minute-by-minute on-going operations within the combat zone airspace. This is accomplished by the airspace users in accordance with established SOP, plans, orders, and coordinating instructions from the ACE. The ACE integrates information on airspace usage and recommends priorities for use of the airspace to the commander. Currently, the ACE is a planning and management facility with limited information handling capabilities. There is a tentative doctrinal requirement for establishment of a full-time brigade airspace coordinating element (BACE) at each brigade (regiment) command post.[16] The brigade airspace coordinating element, if formed, extends the airspace capability forward by coordinating and regulating brigade airspace utilization in accordance with commander's priorities. The BACE would have a minute-by-minute operations capability.

ACE coordination of use of the airspace includes virtually all airspace activity other than "random" traffic. As an example the ACE:[17] (1) In conjunction with the fire support element (FSE) and the tactical support element (TASE), determines how airspace requirements can best be met and submits recommendations to the commander. (2) Regulates Army air traffic by promulgating information on prohibited or restricted areas and other restrictions imposed on air traffic by the commander, higher headquarters, the theater air defense commander and airspace control authority, or through agreement with other services. Based on these restrictions, the ACE disseminates aviation control guidance (e.g. corridors, altitudes, areas in which all flights must be cleared). (3) Assist the commander in supervising Army air defense operations. This function is performed by the air defense section of the ACE which: (a) Maintains continuous estimates of the air defense situation, and represents the air defense officer in recommending changes in the allocation and employment of Army air defense means. (b) Assists the commander in regulating air defense weapons fires and preventing undue interference with other operations by regulating the air defense weapons control status (weapons hold, weapons tight, or weapons free). Weapons control status changes may be initiated by higher Army headquarters or the area air defense command, or may be recommended by the ACE. (4) Receives and disseminates airspace control information. Information flow is typically as follows: (a) Information regarding the number of air

defense weapons operational and their deployment is sent from the AADCP. Redeye information is received from units having Redeye weapons. (b) Information regarding the number of Army aircraft available and their deployment is disseminated from the aviation unit. (c) Field artillery information (field artillery fire plans, firing battery locations, and restricted or free fire areas as approved) is provided the ACE by the FSE. (d) Other-service air support is disseminated from the tactical air support element (TASE) to the ACE. The TASE provides preplanned and immediate close air support information as missions are requested and performs airspace coordination with the ACE as part of the coordinate/approval process. (e) Information on aircraft flights by organic/attached or supporting aircraft is transmitted from the aviation unit when the flight plan is filed. (f) Air movement information regarding friendly air activity is disseminated to airspace users. (g) Air defense intelligence, obtained through air defense channels, is furnished to other elements of the TOC. (h) Information is provided to organic, attached, and supporting aviation units on airspace utilization concerning them (e.g., location of field artillery firing batteries, Army air traffic regulation plan, location of the FSCL).

NEW INNOVATIONS

The current ACE organization is a workable solution however the problem of coordinating airspace over the combat zone increases with the intensity of use of the airspace. As the Army's air defense

artillery, and aviation share the airspace over the battlezone with the Air Force and other services' aircraft, the airspace will continuously become more congested. New innovations are needed to assist the ACE in its vital role. In view of forecast tight budgets in the years ahead for the military, hopefully they will be economical innovations. In this regard the Army air defense artillery has recently proposed the use of some of their equipment for air traffic regulation (ATR).[18] A very brief summary of their proposal is as follows:

> The Army wants improved air defense artillery and air traffic regulations subsystems. ADA needs are already recognized in that the Forward Area Alert Radar (FAAR) and AN/TSQ-73[19] are approved and funded items. The need for a modern ATR subsystem is stated in an Army requirement document entitled "Automated Air Traffic Management System (ATMS)" now being staffed. It is hoped ATMS will make it to the users in the early 1980s. Therefore the FAAR/TSQ-73 will beat ATMS into the field.
>
> The ADA system of radars /those currently in the field and FAAR - which is in the field or in the process of being placed in the field/ can see into most of the field army airspace, even down to the low altitudes in the forward area. They see everything - hostile aircraft, friendly aircraft that are kind enough to identify themselves, and friendly aircraft that are not being so cooperative. So, why not employ the FAAR and TSQ-73 to do a large part of the ATR task. Specifically, why not let these systems, with the necessary modifications, handle the "enroute" and "approach/departure control" portions of the future ATR task? ADA equipment, combined with Army Aviation's improved approach and control tower facilities, should give the Army an improved ATR capability early and at less cost.

CONCLUSIONS AND RECOMMENDATIONS

The ADA recommendation, at least on the surface, appears to be cost effective and a great boost for airspace coordination. If two of the largest users of airspace over the combat zone are intergrated into one control system, and going one step further, the ACE has a data link to this system, the coordination task is both more effective and easier.

The recommendation is currently being evaluated by the United States Army Combat Development Command and early indications show the proposal may be worthy of serious consideration and testing.[20]

Regardless of the outcome of Joint agreements on control of the airspace, the Army should make airspace coordination the responsibility of a single manager at all levels of command from brigade to field army. ACE personnel should be authorized in headquarters TOE/MTOE and be independent of the requirement for ADA or aviation units.

Consideration and study should be given the airspace coordination problems with a thought of making the ACE not only a planner for airspace use but also a minute-by-minute operator/problem solver for the combat ground commander. In this respect, sufficient equipment should be authorized the ACE to allow firm channels of communication with the aircraft, AADCPs in the vicinity, adjacent or higher headquarters ACE, and to all airspace users. If the ADA recommendation for equipment consolidation with Army aviation is approved, the above will have already been partially accomplished.

The Army, as well as all users of airspace over the battle zone, need the best airspace coordination possible - the sooner, the better.

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FOOTNOTES

1. This definition is also used by the US Department of the Army, Headquarters, US Army Combat Developments Command, Training Text 44-10-1, p. 2-1 (hereafter referred to as Tng Text 44-10-1).

2. US Department of the Army, Headquarters, 82d Airborne Division, Airspace Coordination SOP, p i (foreword).

3. The history of command and control was extracted in abbreviated form from the Phase II Joint Staff Task Force Close Air Support Study, US Department of Defense, pp. 1-17 and US Congress, Senate, Committee on Armed Services, Preparedness Investigating Subcommittee, Special Subcommittee on Close Air Support, Hearings, pp. 10-19.

4. US Laws, Statutes, etc., Public Law 253.

5. US Joint Chiefs of Staff, Publication 2, p. 28 (par 20408), FOR OFFICIAL USE ONLY.

6. US Joint Chiefs of Staff, Decision Paper 2308/299-2, FOR OFFICIAL USE ONLY.

7. US Air Force, Draft Manual, Doctrine and Procedures for Airspace Control in the Combat Area, par 100-309.

8. Tng Text 44-10-1, pp. 2-2, 2-3.

9. US Department of the Army, Draft Field Manual 44-10 (Test), p. 2-10 (hereafter referred to as FM 44-10).

10. Ibid., p. 2-8.

11. Ibid., p. 2-9.

12. Ibid., p. 2-11.

13. US Department of the Army, Field Manual 44-1, p. 10-6.

14. US Department of the Army, Field Manual 44-3, p. 5-4.

15. FM 44-10, p. 2-11.

16. Ibid., p. 2-12.

17. Ibid., pp. 3-17 to 3-24.

18. Major James Rudy and Mr. J.B. Fries, "Air Defense Artillery Equipment for Air Traffic Regulation," Air Defense Trends, October 1972, pp. 19-23.

19. The AN/TSQ-73 missile minder system is a very high-speed, largely automatic, microminiaturized system that coordinates the action of surface-to-air missile units against hostile targets.

20. US Army Combat Developments Command, Draft, Phase I, Evaluation of the Air Defense Center Proposal for Airspace Control. ACN 20213. Fort Leavenworth, Kansas: November 1972.

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5. Hicks, Joseph T., LTC. "Airspace Coordination - A Flaw in Army Operations," Air Defense Trends, March 1972, pp. 31-33.

6. "Integrated Battlefield Control System," Air Defense Trends, March 1972, p. 21.

7. "Proposal Air Defense Artillery Systems," US Army Air Defense Digest, 1 June 1972, pp. 107-110.

8. Rudy, James, Major, and Fries, J.B. "Air Defense Artillery Equipment for Air Traffic Regulation." Air Defense Trends, October 1972, pp. 19-23.

9. US Congress. Senate. Committee on Armed Services. Preparedness Investigating Subcommittee. Special Subcommittee on Close Air Support.Hearings, 92d Cong., 1st Sess. Washington: US Government Printing Office, 1972.

10. US Congress. Senate. Committee on Armed Services. Preparedness Investigating Committee. Special Subcommittee on Close Air Support. Report, 92d Cong., 1st Sess. Washington: US Government Printing Office, 1972.

11. US Air Force. Doctrine and Procedures for Airspace Control in the Combat Area. Draft Manual. Washington: March 1971.

12. US Army Combat Development Command. Evaluation of the Air Defense Center Team Proposed for Airspace Control: Phase I Report. Draft. Fort Leavenworth, Kansas: November 1972.

13. US Department of Defense. Joint Staff Task Force Close Air Support Study Phase II. Washington: Nd.

14. US Department of the Army. Field Manual 1-100: Army Aviation Utilization. Washington: October 1971.

15. US Department of the Army. Field Manual 44-1: US Army Air Defense Artillery Employment. Washington: February 1970.

16. US Department of the Army. Field Manual 44-3: Air Defense Artillery Employment, Chaparral/Vulcan. Washington: 1968.

17. US Department of the Army. Field Manual 44-10: Army Airspace Control Doctrine. Draft. Washington: June 1972.

18. US Department of the Army, Headquarters, US Army Combat Developments Command. Training Text 44-10-1: Army Airspace Coordination Techniques. Fort Belvoir, Virginia: November 1971.

19. US Department of the Army, Headquarters, 82d Airborne Division. Airspace Coordination SOP, 1 December 1971, p i (Foreword).

20. US Joint Chiefs of Staff. Decision Paper 2308/299-2 (U). Washington: 17 May 1965. FOR OFFICIAL USE ONLY.

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