

GAO

Report to the Chairman, Committee on
Armed Services, House of
Representatives

September 1989

CLOSE AIR SUPPORT

Comparison of Air Force and Marine Corps Requirements and Aircraft



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**National Security and
International Affairs Division**

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The Honorable Les Aspin
Chairman, Committee on
Armed Services
House of Representatives

Dear Mr. Chairman:

This report, which was prepared at your request, compares the Army's and the Marine Corps' close air support mission requirements, discusses how mission requirements are used to determine aircraft operational requirements, presents the views of the Air Force and the Marine Corps on how their aircraft meet mission requirements, and compares procedures for requesting and executing close air support missions during combat.

As arranged with your Office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time we will send copies to the Secretaries of Defense, the Air Force, the Navy, and the Army; the Director, Office of Management and Budget; and other interested parties.

GAO staff members who made major contributions to the report are listed in appendix II.

Sincerely yours,

A handwritten signature in black ink that reads 'Harry R. Finley'.

Harry R. Finley
Director, Air Force Issues

Executive Summary

Purpose

The Air Force is responsible for providing close air support to the Army and uses the A-10 as its primary close air support aircraft. However, the Air Force wants to replace the A-10 with the A-16, a variant of the F-16. The Marine Corps is generally expected to provide its own close air support and uses the AV-8B as its primary close air support aircraft. The House Committee on Armed Services has questioned the Air Force and the Marine Corps on their close air support missions and on the capabilities of their aircraft for those missions.

The Chairman, House Committee on Armed Services, requested that GAO compare the Army's and the Marine Corps' close air support mission requirements, determine how mission requirements are used to determine aircraft operational requirements, obtain the views of the Air Force and the Marine Corps on how their aircraft meet mission requirements, and compare procedures for requesting and executing close air support missions during combat.

Background

Close air support missions provide aerial firepower against enemy forces in close proximity to friendly forces. The Army and the Marine Corps will require this support in different environments. The Army will operate in large geographical theaters with the Air Force supporting the Army from fixed bases. The Marine Corps plans to perform primarily expeditionary operations anywhere in the world and support its ground forces generally from ships or temporary sites.

The Air Force wants to replace its 1970s vintage A-10 aircraft with the A-16. However, the Office of the Secretary of Defense and the Air Force have not agreed on the best alternative for the Air Force's future close air support aircraft. The Congress was concerned that the Air Force had not fully evaluated alternatives to the A-16, so it directed the Secretary of Defense to conduct an independent assessment of Army and Air Force studies of aircraft alternatives for the close air support missions. Moreover, the Congress directed the Director, Operational Test and Evaluation, to develop an operational test plan for a competitive fly-off of alternative aircraft. Because these requirements were imposed on the Department of Defense, GAO did not assess alternative aircraft being considered for the close air support missions.

The Marine Corps fielded the AV-8A in the 1970s and later fielded the AV-8B. It chose the AV-8B, upgraded for night attack, to perform close air support through the 1990s.

Results in Brief

Although the operational environments for the Army and the Marine Corps are expected to differ, they have similar mission requirements for their close air support aircraft: the aircraft must be responsive and available, survivable, flexible, and capable of destroying varied targets. The Air Force and the Marine Corps have processes for ensuring that mission requirements are incorporated in aircraft operational requirements. Although both services followed their processes, the Air Force did not base its funding request for the A-16 on validated operational requirements, as required by Air Force regulations. However, the Air Force validated the requirements on May 10, 1989.

The Air Force and the Marine Corps believe that their aircraft, the A-16 and AV-8B, respectively, have or will have the capabilities and characteristics to perform close air support missions effectively. The Air Force and the Marine Corps described several similar aircraft capabilities and characteristics and cited factors other than the ability of the aircraft to meet the close air support mission requirements as being important to their choice of aircraft. These factors include the Air Force's desire to have a follow-on close air support aircraft in the early 1990s and the Marine Corps' requirement for an aircraft that can operate off a ship and close to the battle.

Principal Findings

Mission Requirements Are Similar

Although the Army and the Marine Corps operate in different environments, their requirements for the close air support mission are similar. The Air Force plans to support the Army in established theaters and from fixed bases of operation. The Marine Corps plans to support its expeditionary operations from a ship or dispersed temporary sites. The Army and the Marine Corps require close air support aircraft to be responsive and available, which includes the capabilities to generate a high number of sorties (complete flights), communicate with ground forces, and operate day or night and in under-the-weather conditions (operate in adverse weather to get to the target area but descend below the weather to see the target). They also require their close air support aircraft to be capable of destroying an array of targets in close proximity to friendly forces and flexible enough to operate and survive anywhere on the battlefield of the 1990s.

Air Force and Marine Corps Followed Processes for Considering Mission Requirements

The Air Force and the Marine Corps have similar processes for identifying, analyzing, documenting, and validating aircraft operational requirements to meet mission needs. The processes ensure that user commands and headquarters staff have an opportunity to validate that operational requirements are consistent with mission requirements and cannot be met by existing programs. Both services followed their processes for their aircraft.

The Air Force evaluated aircraft options for the close air support missions because it was concerned that current aircraft could not perform the missions, given the projected Soviet air defense threat of the 1990s. The Air Force chose the A-16 after identifying aircraft operational requirements in response to mission needs and evaluating information from industry on aircraft design alternatives. Contrary to Air Force regulations, the Air Force proposed the A-16 for funding before having validated operational requirements. However, the Air Force validated operational requirements in May 1989.

The Marine Corps acquired the AV-8A in 1971 to meet the need for an aircraft with short takeoff and landing capability to operate close to the battlefield. According to the Marine Corps, the AV-8B with night capability will meet its long-standing need for an aircraft that can perform close air support at night and in under-the-weather conditions.

Aircraft Capabilities Are Similar

The Air Force and the Marine Corps consider their aircraft capable of performing effective close air support missions. They described similar essential aircraft capabilities and characteristics for effective mission performance. For example, both services' aircraft have similar (1) speeds, maneuverability, and size, important for aircraft survivability, (2) abilities to carry and deliver a variety of weapons accurately, important for destroying varied targets, and (3) day, night, and under-the-weather capabilities, important for availability and responsiveness. Notable differences in the aircraft are that the A-16 is projected to have some hardened surfaces to reduce vulnerability, whereas the AV-8B will not be hardened, and the AV-8B's vertical takeoff and short landing capability will allow it to operate from ships and austere sites, whereas the A-16 will require more established air bases.

Other Factors Influencing Aircraft Choice

Factors other than the capability to perform close air support have influenced the Air Force's and Marine Corps' choice of aircraft. The Air Force also considers availability and affordability important to its

choice of aircraft. According to the Air Force, the A-16 can be available in the early 1990s without the cost of a new aircraft development. The Air Force also states it could use existing F-16 logistics and training infrastructures to reduce costs. The Marine Corps considers the AV-8B's compatibility with amphibious operations and the reliability and maintainability of the aircraft important to its choice. For example, the AV-8B can be transported by and initially operated from a ship, move quickly to shore operations, and support a dispersed and mobile forces concept.

Close Air Support Request and Execution Procedures Are Similar

The Army and the Marine Corps have similar procedures for requesting and approving close air support. For example, the ground forces commanders in both services control the request and approval of close air support missions. Also, the Air Force and the Marine Corps have similar procedures for executing close air support. Both depend on similar communication and coordination procedures to execute close air support missions.

Recommendations

GAO's report describes similarities and differences in the Army's and the Marine Corps' close air support mission requirements and the Air Force's and the Marine Corps' aircraft. It contains no recommendations.

Agency Comments

The Department of Defense concurred with GAO's findings, as shown in appendix I.

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Abbreviations

CAS close air support
GAO General Accounting Office

Introduction

Close air support (CAS) missions provide aerial firepower against enemy forces in close proximity to friendly ground forces. CAS missions are requested and approved by the ground forces commanders. The Air Force and the Marine Corps are responsible for providing CAS to friendly forces involved in ground operations. Both services plan to perform the CAS missions in different operating environments.

The Air Force's and the Marine Corps' preferred aircraft for the CAS mission are the A-16 (a variant of the F-16), and the AV-8B, respectively. Both services also plan to use these aircraft for other missions.

Close Air Support and the Services' Responsibilities

The Army's basic war fighting doctrine describes the requirements for CAS. The doctrine requires that tactical air forces be capable of supporting the Army by attacking enemy ground forces in contact with friendly forces. Air Force doctrine specifically establishes the CAS mission to provide this support. The Marine Corps' doctrine for fire support also addresses the requirements for CAS. CAS is considered one of several fire support resources available to the Marine Corps' ground forces. Marine Corps aviation doctrine establishes CAS as a mission for supporting ground forces.

CAS missions are requested by a ground force commander when the commander requires additional fire power to accomplish the operation. The ground forces select which targets will be attacked during CAS missions.

The Army and the Marine Corps plan to use CAS in considerably different operating environments because of their different responsibilities. The Army is responsible for U.S. ground operations in geographical theaters around the world. The Air Force is responsible for supporting the Army and other friendly ground forces in these theaters. Currently, the Air Force plans to support the Army from bases in the following five major theaters: European (includes central Europe), the Pacific (includes Korea), Central (includes Southwest Asia and the Middle East), Southern (includes Latin and South America), and the Atlantic.

The Marine Corps is responsible for providing expeditionary task forces that can be sent anywhere in the world. The task forces consist of command, ground, aviation, and support elements. The organization and size of these forces depend on their specific mission.

The Marine Corps aviation element provides CAS to its ground element. Its aircraft would operate initially from ships, if necessary, and would

move to air strips on shore as soon as defensible areas have been established.

Air Force's and Marine Corps' Choice of Aircraft

The Air Force and the Marine Corps have chosen different aircraft to perform CAS missions in the 1990s. The Air Force is seeking to replace its primary CAS aircraft, the A-10, with the A-16 (see fig. 1.1). The Marine Corps wants its AV-8B, upgraded for night attack, to perform CAS (see fig. 1.2).

The A-10 was developed in the early 1970s specifically for the CAS mission. The Air Force questions the A-10's survivability in high-threat environments such as central Europe. Therefore, in December 1986 the Air Force recommended to the Office of the Secretary of Defense that the A-10 be replaced by the A-16 starting as early as 1993. Air Force officials said the A-16's estimated unit flyaway cost¹ could range from \$12 million to \$19 million in 1988 dollars, depending on the configuration of the aircraft. We reported on the status of the A-10's replacement in September 1988.²

The Office of the Secretary of Defense did not concur with the Air Force's recommendation, preferring that alternatives be studied further. Between 1984 and 1989, several major studies have been conducted on CAS aircraft alternatives; however, the Department of Defense has not agreed on an acceptable alternative.

The Marine Corps obtained the AV-8A in the early 1970s for the CAS role. They have since replaced all AV-8As with the more capable AV-8Bs. In September 1989 the Marine Corps expects to obtain its first upgraded version of the AV-8B for night attack at an estimated recurring unit flyaway cost of about \$15 million in 1988 dollars. Both the existing AV-8B and the AV-8B night attack aircraft are expected to perform CAS for the Marine Corps through the 1990s.

¹Unit flyaway costs include engineering, tooling, labor, material, quality control, propulsion, avionics, armament, and engineering change order costs. It does not include costs for such things as research and development, training, and spare parts.

²Close Air Support: Status of the Air Force's Efforts to Replace the A-10 Aircraft (GAO/NSIAD-88-211, Sep. 2, 1988).

Figure 1.1: Proposed A-16 Aircraft

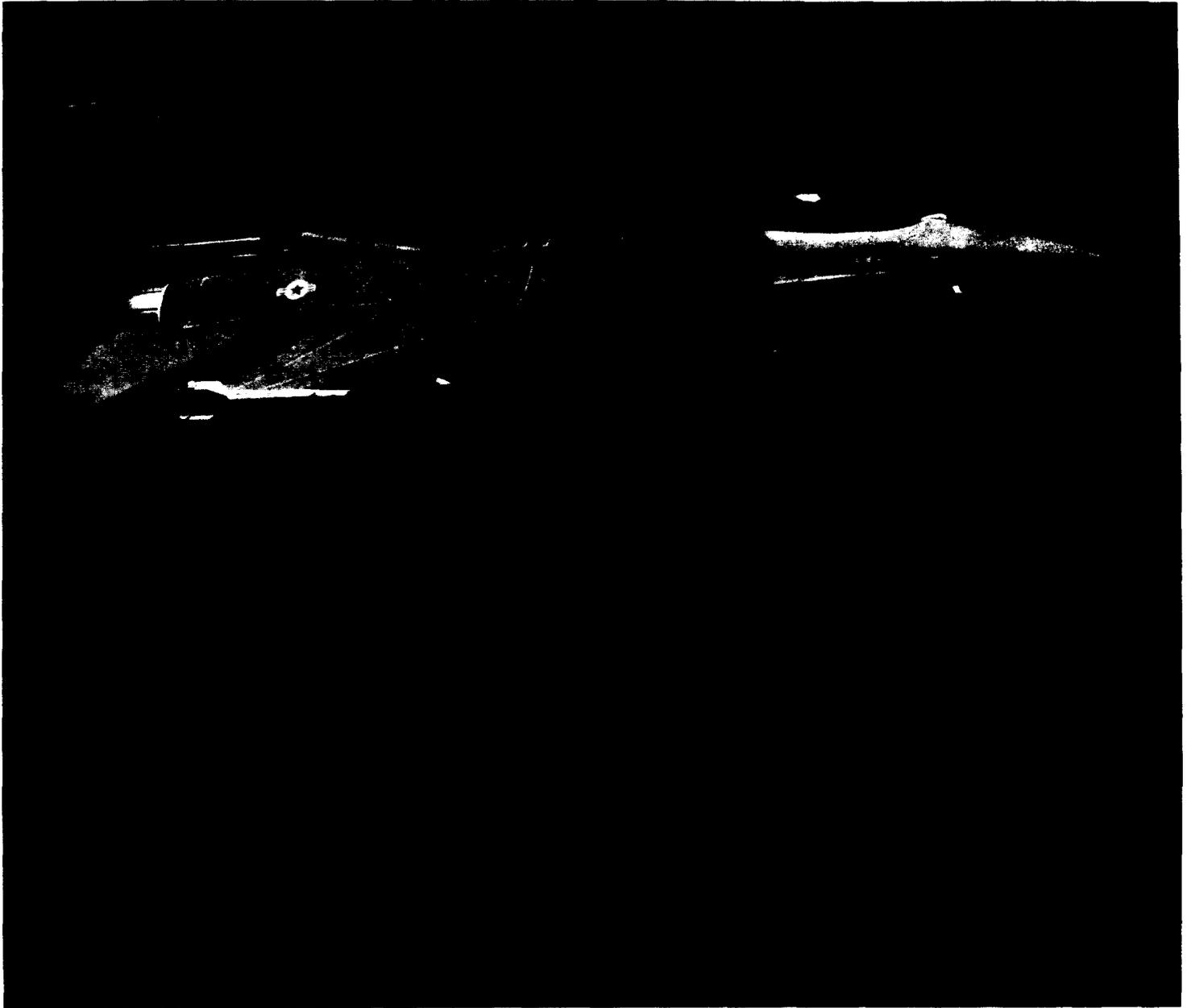
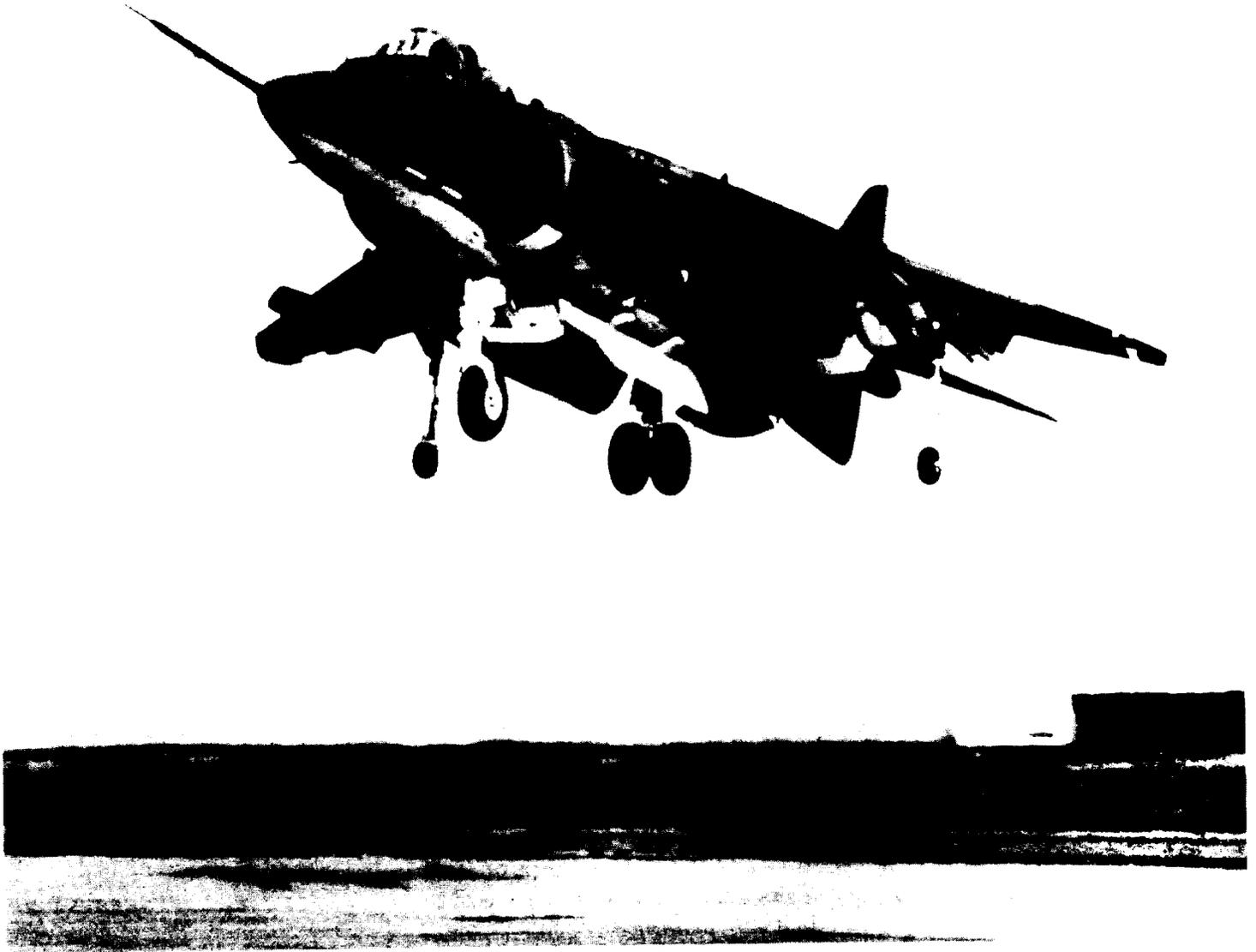


Figure 1.2: AV-8B Aircraft



Congressional Interest and Concern

The Congress has expressed interest in the CAS mission and the services' roles in that mission. It has also expressed concerns about the Air Force's studies of alternative aircraft for that mission. In March 1988 hearings, the House Committee on Armed Services questioned the Air Force and the Marine Corps on their CAS missions and on the capabilities of their aircraft for that mission. In its report on the National Defense Authorization Act for Fiscal Year 1989, the House Committee on Armed Services strongly recommended that the AV-8B, along with other existing aircraft, be considered as candidates for the Air Force's follow-on CAS aircraft.

The National Defense Authorization Act for Fiscal Years 1988 and 1989 (P.L. 100-180) required the Secretary of Defense to develop a master plan clarifying the services' roles in CAS by October 1988. According to an Office of the Secretary of Defense official, this requirement was replaced by the more extensive requirement in the Defense Authorization Amendments and Base Closure and Realignment Act (P.L. 100-526), which requires (1) the Secretary of Defense to assess the feasibility of transferring, no later than fiscal year 1992, the CAS mission from the Air Force to the Army, (2) the Secretary of Defense to conduct an independent assessment of Army and Air Force studies and analyses of CAS aircraft alternatives, and (3) the Director, Defense Operational Test and Evaluation, to develop an operational test plan for a competitive fly-off of alternative aircraft for the CAS mission.

The Secretary is to submit a final report on these matters to the Senate and House Committees on Armed Services and on Appropriations not later than December 31, 1989.

Objectives, Scope, and Methodology

In March 1988 the Chairman, House Committee on Armed Services, requested that we compare the Army's and the Marine Corps' CAS mission requirements; determine how mission requirements are used to determine aircraft operational requirements; obtain the views of the Air Force and the Marine Corps on how their aircraft meet CAS requirements; and compare the services' request and execution procedures for their CAS missions.

We reviewed the Army's and the Marine Corps' CAS requirements, procedures for requesting and approving CAS, and environments in which the CAS missions will be performed. We reviewed the Air Force's and the Marine Corps' processes for ensuring that mission requirements are included in aircraft requirements. Additionally, we obtained the Air

Force's and the Marine Corps' analyses of aircraft capabilities and characteristics to meet the CAS mission requirements. We did not validate the services' analyses, so we cannot agree or disagree with their positions.

To accomplish our objectives, we interviewed and obtained data from officials at the following locations:

- Headquarters, United States Air Force, Washington D.C., for information on CAS aircraft, mission requirement studies, and operational procedures in various theaters;
- Tactical Air Command, Langley Air Force Base, Hampton, Virginia, for mission and aircraft requirements, CAS operational procedures and environments, and analysis of A-16 capabilities and characteristics;
- Headquarters, United States Army, Washington, D.C., for information on CAS requirements and the process by which these requirements were developed;
- Training and Doctrine Command, Fort Monroe, Virginia, for information on the battlefield of the 1990s and the Army's CAS requirements;
- Headquarters, United States Marine Corps, Washington D.C., for information concerning CAS requirements, the aircraft requirements process, and AV-8B upgrade capabilities;
- Marine Corps Warfighting Center, Quantico Marine Corps Base, Quantico, Virginia, for CAS mission requirements, operational procedures and environments, and analysis of AV-8B capabilities and characteristics;
- Marine Aviation and Weapons Tactics Squadron One, Marine Corps Air Station, Yuma, Arizona, for information on pilot training for performing the CAS missions; and
- Twentynine Palms Marine Corps Base, Twentynine Palms, California, to observe the Combined Arms Exercise where ground and aviation forces worked together while requesting, approving, and executing CAS missions.

We conducted our work from August 1988 through July 1989 in accordance with generally accepted government auditing standards. The Department of Defense concurred with our findings.

Close Air Support Mission and Aircraft Requirements

Even though the Army and the Marine Corps expect to use CAS in different conflict environments, their CAS mission requirements are similar. These requirements are stated as general aircraft characteristics.

The Air Force and the Marine Corps have processes for ensuring that mission requirements are incorporated in aircraft operational requirements. Although both services followed their processes for their CAS aircraft, the Air Force's request for funds was not based on validated operational requirements.

Operating Environments

The Army is responsible for ground operations in five theaters worldwide that vary considerably in size. The Air Force is responsible for providing air support to the Army, generally from established bases³ in these theaters. The Air Force may be required to concentrate efforts at decisive points or respond to numerous dispersed conflicts throughout the theaters.

To fulfill its worldwide expeditionary responsibility, the Marine Corps plans to deploy aboard ships as a landing force to the area of operation. Once they reach the operations area, their geographical area of responsibility, which is generally smaller than the Army's, would normally range from 30 to 150 miles in width and depth. During the initial phases of the operation, the Marine Corps plans to operate its CAS aircraft from ships until they can be moved ashore. Once ashore, the aircraft would operate from established airfields, if available, and/or from several austere sites about 30 miles from the main battle area. The austere sites could be temporary grass landing strips or existing hard surface roads.

Aircraft Requirements for Effective Close Air Support

To be effective, the Army and the Marine Corps require CAS aircraft to be responsive and available to the ground force's request for CAS during daylight, night, or under-the-weather conditions;⁴ survivable; flexible; and capable of destroying varied targets.

³We reported on the defense and survivability of air bases in Europe in a classified report, NATO Air Defenses: DOD's Master Plan Does Not Adequately Address Critical Issues (GAO/C-NSIAD-88-16, June 10, 1988).

⁴Under the weather generally means that the pilot has to operate in adverse weather to get to the target area but will be able to descend below the weather to acquire the target visually.

Responsive and Available

According to Army and Marine Corps officials, CAS aircraft must respond to a request when needed. Both services consider the capability of the aircraft to generate a high number of sorties⁵ essential to responsiveness. The potential for around-the-clock ground operations and the desire to mass air power at decisive points on the battlefield will generate the need for high sortie rates.

Marine Corps officials consider an aircraft responsive if it responds within 20 minutes of the request. The Army has not specified a required amount of time to be responsive.

Army and Marine Corps doctrines indicate that CAS will be required day, night, and under the weather. Therefore they want their CAS aircraft to be able to support them at all times and in all types of conditions.

Survivable

The Army and the Marine Corps want the CAS aircraft to be survivable in the increasing threat environments of the 1990s. Survivability is the capability of an aircraft to avoid and/or withstand a human-made hostile environment while executing its assigned mission. Both the Air Force and the Marine Corps consider aircraft speed and maneuverability and the suppression of enemy air defenses critical to aircraft survivability in the CAS environment. Aircraft speed and maneuverability contribute to threat avoidance by minimizing aircraft exposure time to enemy air defenses. The suppression of enemy air defenses involves locating hostile anti-aircraft weapons and destroying or neutralizing them before they can attack CAS aircraft.

Flexible

The Army and the Marine Corps want the CAS aircraft to have the flexibility to perform CAS and other missions. Both services will require air support beyond the area where troops are engaged with enemy forces. Army officials stated that the ability to kill targets beyond the CAS area will increase in importance to the ground forces commander. Thus, a flexible CAS aircraft could readily respond to these targets. Air attacks on these targets will require the aircraft to cross dangerous portions of the battlefield, with or without the support of other threat suppressing aircraft. Additionally, the Marine Corps wants its CAS aircraft to be able to attack airborne threats such as enemy aircraft. According to Marine Corps officials, this will provide self-defense capabilities and air defense in the absence of other aircraft. Although the Army's CAS requirements

⁵A sortie is considered one complete flight—takeoff to landing—by an aircraft.

do not include the need to attack airborne targets, the A-16 will have air-to-air capabilities.

Capable of Destroying Varied Targets

The Army and the Marine Corps want the CAS aircraft to be capable of delivering an array of munitions accurately and against varied targets. According to their doctrines, CAS can significantly enhance ground operations by providing the capability to deliver massive firepower at decisive points. Both the Army and the Marine Corps require CAS aircraft to carry and deliver an array of weapons capable of destroying targets such as armored vehicles, artillery, and personnel. The aircraft must be able to deliver ordnance accurately on the target. According to Air Force and Marine Corps officials, this requires good visibility from the aircraft and the ability to communicate and coordinate with ground forces to obtain accurate target locations. Once targets are identified, the ability of the aircraft to deliver munitions accurately (1) minimizes its time in the target area and the possibility of attacking friendly forces and (2) maximizes its effectiveness against enemy targets.

Process to Meet Mission Needs

Both the Air Force and the Marine Corps have established processes for identifying, documenting, and validating aircraft operational requirements to meet mission needs. Once needs are identified, proposed aircraft operational requirements to meet those needs should be documented and sent to various user and staff organizations within each service for review and validation. Once requirements are validated, the aircraft program for meeting these requirements can be identified and compete for funds with other service programs.

According to Air Force regulations and Marine Corps officials, proposed aircraft operational requirements are developed to meet mission needs. The requirements can originate at any level in the services but are often initiated by individuals or activities within user commands. Once the requirements are identified, they are documented and distributed to the primary user commands, headquarters commands, and headquarters staff for comment and concurrence. The command and headquarters staffs validate that the operational requirements are consistent with mission requirements and cannot be met by existing resources or programs. Solutions to operational requirements could include aircraft modifications, and/or a new aircraft program.

In 1984 the Air Force initiated a series of evaluations of aircraft options to improve air support to ground operations. The evaluations were initiated because the Air Force was concerned about the adequacy of its aircraft to perform air-to-ground missions given the projected Soviet air defense threat of the 1990s. Subsequently, the Air Force and the Army jointly developed CAS mission needs for the 1990s. In April 1985 the Air Force issued a request for information to industry to obtain design alternatives for an aircraft that could perform the missions and could be available for production beginning in the late 1980s. In June 1985 the Air Force identified operational requirements for a follow-on CAS aircraft in response to mission needs. Four contractors responded to the request for information, including General Dynamics with an F-16 derivative. In December 1986 the Air Force recommended to the Office of the Secretary of Defense that it fund the A-16 as the aircraft to provide CAS to the Army. The Office of the Secretary of Defense rejected the request because it was concerned that the Air Force had not considered all the viable aircraft alternatives.

Air Force regulations state that operational requirements must be validated before a program can compete for funding. Operational requirements for the A-16 were not validated until May 10, 1989. Therefore, the Air Force did not have validated requirements to support its early funding request.

According to Marine Corps officials, the Marine Corps did not have specific operational requirements for the AV-8A when it was acquired in 1971, although the Marine Corps had identified a need for an aircraft with short takeoff and landing capability to operate close to the battlefield. Also, according to the officials, the Marine Corps had a long-standing need for an aircraft that can perform CAS at night and in under-the-weather conditions. The operational requirement for the night attack AV-8B was developed in 1983 and validated in September 1984. Initial funding for the aircraft was requested in December 1984.

Capabilities of Air Force and Marine Corps Close Air Support Aircraft

According to the Air Force and the Marine Corps, the A-16 and the AV-8B, respectively, possess or will possess the capabilities and characteristics to perform CAS missions effectively. The Marine Corps expects future upgrades to the AV-8B will further enhance its effectiveness. Both services described many similar capabilities and characteristics as being essential for effective CAS. However, both services consider factors other than the ability of their aircraft to meet the CAS mission requirements as being important in their choice of aircraft.

Air Force Views of Proposed A-16 Capabilities and Characteristics

The Air Force considers the capabilities and characteristics projected for the A-16 to be essential for effective CAS in the high-threat environment of the 1990s. According to Air Force officials, the A-16 will be responsive and available to the Army's request for CAS in day, night, and under-the-weather conditions. Additionally, the A-16 will be able to operate over the entire battlefield with the capability to engage and destroy enemy targets and remain survivable, even in a high-threat environment.

According to the Air Force, the A-16 was selected for the CAS mission because of its projected CAS capabilities and other equally important factors. Since the A-16 does not exist, the Air Force projected the A-16's capabilities from F-16 performance data and the estimated performance of equipment planned for the aircraft. These projected capabilities are described below.

Responsive and Available

According to the Air Force, the A-16 will be responsive because of its ability, like the F-16's, to sustain high sortie rates in a wartime environment. For example, the Air Force cited the F-16's performance in a 1988 exercise in which the F-16 substantially met wartime requirements over a 26-day period. The Air Force also believes that the A-16 will be responsive because it will have the capability to communicate with ground forces via multifrequency voice radio and identify targets accurately through its automatic target handoff system and laser spot detector, which are interoperable with Army systems. The automatic target handoff system electronically transfers target information from a forward observer to the aircraft. The laser spot detector identifies energy reflected from a target that has been illuminated by a forward observer.

According to the Air Force, the A-16 will have several systems that individually or collectively aid its availability for CAS missions at night and under the weather. According to Air Force officials, the A-16's air to

ground radar system will have a moving target indicator that will be the primary target detection system for under-the-weather CAS. The A-16 is also expected to have a forward looking infrared system, which, according to Air Force officials, will help detect targets at night and in the battlefield's smoke and haze. The officials also said that these systems, operating with the automatic target handoff system, will make the A-16 an effective around the clock CAS aircraft. For example, the automatic target handoff system would provide target location information, the radar would find the target, and the forward looking infrared system would provide initial target recognition through infrared imagery. To assist further in providing night and under-the-weather CAS, the A-16 will have a digital terrain system, which is a computerized navigation system to provide automatic low-altitude terrain avoidance and very accurate navigation.

Survivable

The A-16's survivability will depend on its ability to avoid the threat or survive damage sustained from a hit. According to the Air Force, the A-16's speed, maneuverability, and small size will enhance its ability to avoid detection and engagement by the threat. Although the threat will influence the A-16's speed, Air Force officials said a typical speed using low-altitude tactics in a high threat target area, will be about 480 knots approaching the target area and 540 knots leaving the area. The A-16's maneuverability would allow it to evade threats by turning quickly while maintaining its speed. The A-16, like the F-16, will be smaller than other Air Force CAS aircraft such as the A-10 and A-7.

According to the Air Force, the A-16's proposed integrated suite of electronic warfare systems will enhance its ability to avoid detection by the threat. Air Force officials expect the A-16 to have an advance radar warning receiver that will identify the threat type, status, and location. The receiver will also be integrated with the airborne self-protection jammer and decoy dispenser system. The airborne self-protection jammer will receive radar signals from enemy weapons and jam them with noise and return radar signals. The decoy system will dispense flares and chaff to distract infrared and radar guided weapons, respectively.

According to Air Force officials, the A-16 will be designed to survive some damage from enemy weapons. The production model A-16 will be hardened in key vulnerable areas such as around the cockpit, critical avionics, and beneath the engine bay to protect against enemy fire up to 23-millimeter artillery. The A-16 is expected to have redundant critical systems like hydraulics systems and fuel pumps. Also, in the event a

flight control surface is damaged, the A-16's computerized flight control system will be capable of switching to an alternate flight control surface to perform the function of the damaged surface. According to Air Force officials, the computerized flight control system will be protected and shielded by less critical avionics.

Flexible

According to Army and Air Force officials, there is a need to have CAS aircraft that can readily attack targets beyond the front line of troops. Air attacks against these targets must be closely integrated and may be inseparable from CAS efforts, according to Air Force doctrine. Air attacks on these targets will require transiting enemy air defenses that are dense and lethal, with or without the support of other threat suppression.

According to the Air Force, the A-16 will be flexible enough to operate across the entire battlefield. It will have the speed to support Army operations beyond the front line of troops, either with or without the support of other aircraft to suppress enemy air defenses. The Air Force believes that the digital terrain system and accurate navigation systems will give the A-16 the needed flexibility for operations beyond the front line of troops. Additionally, the A-16, as previously discussed, is expected to have an integrated suite of electronic warfare systems to help it avoid detection and engagement by enemy air defenses in and around the battle area.

Capable of Destroying Varied Targets

The A-16 will be capable of destroying multiple and diverse targets, according to Air Force officials. It will be capable of carrying a wide variety of existing munitions such as bombs and guided missiles. It will also be capable of carrying future munitions such as the hypervelocity missile. According to Air Force officials, the A-16 will have a 20-millimeter internal cannon and the capability to carry the 30-millimeter external cannon. Also, to help deliver munitions accurately, the A-16 will have a heads-up display capable of providing navigation and weapons delivery information.

Marine Corps Views of AV-8B Capabilities and Characteristics

The AV-8B possesses the capabilities and characteristics needed to perform effective CAS, according to the Marine Corps. These capabilities and characteristics, along with other factors, enhance the AV-8B's role in an expeditionary environment and influenced the Marine Corps' decision to choose this aircraft for CAS missions. According to the Marine Corps, the

AV-8B possesses the attributes necessary to be responsive and available to requests for CAS in day, night, and under-the-weather operations. It is also survivable and flexible enough to operate in and around the battle area, using a wide array of weapons capable of destroying a variety of targets. A description of these capabilities and characteristics follows.

Responsive and Available

Marine Corps officials believe the new AV-8B's ability to operate close to the battle area; fly at high speeds; operate day, night, or in under-the-weather conditions; communicate with other aircraft and ground forces; and detect laser designated targets make it responsive and available to the ground forces. Short takeoff and vertical landing capability enhances the AV-8B's responsiveness by allowing it to operate close to the target area. According to the Marine Corps, this closeness substantially increases the number of sorties the AV-8B can fly, as evidenced by the AV-8B's demonstrated ability in exercises to generate twice as many sorties from a forward operating location than from more distant main bases. The Marine Corps plans to have forward locations approximately 30 miles from the main battle, which would allow the AV-8B to get to the target area in about 5 minutes.

Marine Corps officials believe the AV-8B will have attributes necessary to provide CAS during day, night, and under-the-weather operations. All new AV-8Bs will have night attack systems consisting primarily of a navigation forward looking infrared radar, night vision goggles, and a color digital moving map. Marine Corps officials expect the first upgraded night attack aircraft in September 1989. According to the Marine Corps, the radar will amplify targets and the helmet mounted night vision goggles, which require some ambient light, will allow the pilot to see terrain features on the battlefield during night operations. Moreover, the increased pilot work load of night CAS will be better managed with the digital color moving map. According to the Marine Corps, the digital color moving map will enhance overall pilot situational awareness and assist in distinguishing friendly from enemy forces. This map is more easily read at night than traditional maps. Also, Marine Corps officials believe the AV-8B's proposed multi-mode radar will enhance the pilot's ability to acquire ground targets.

The AV-8B's night attack system will also enhance its under-the-weather capability, according to the Marine Corps. Additionally, future AV-8Bs will be upgraded with radar beacon forward air controller systems, which will allow even better under-the-weather target location by recognizing electronic beacons used by ground forces to mark targets.

According to the Marine Corps, the AV-8B has the capability to communicate with other aircraft as well as ground forces. The Marine Corps plans to acquire digital data link systems that will allow data communications by means of electronic transmissions. Mission data will be transmitted in short bursts to the AV-8B's computer which displays the information for the pilot and integrates it with weapon systems. The AV-8B is equipped with a laser spot detector to identify energy reflected from a target illuminated by a forward observer working with the ground forces.

Survivable

According to the Marine Corps, the AV-8B's ability to avoid the threat and withstand a hit makes it survivable. Also, the AV-8B will be able to avoid the enemy threat through its speed, maneuverability, and small size. According to the Marine Corps, the AV-8B would typically approach the target at about 420 knots and leave the target area at about 520 knots. It is considered very maneuverable, being able to turn quickly and maintain its speed. The AV-8B is also difficult to locate visually since it is a relatively small aircraft. According to Marine Corps officials, it is smaller than the F-4, F-14, and the F-15 but is approximately the same size as the F-16 and F/A-18.

Marine Corps officials said the AV-8B's electronic systems will make it difficult for the aircraft to be detected and engaged by enemy air defenses. Its radar warning system will identify radar signals from enemy air defense units and provide the pilot threat status and general location information. The Marine Corps plans to have a self-protection radar jamming system on the AV-8B that will counter threat radar with noise or return radar signals. The AV-8B's flare and chaff dispensing capability also enhances its threat avoidance by distracting certain anti-aircraft weapons, such as heat- and radar-guided missiles. For example, flares dispensed from the aircraft could cause a heat-seeking missile to track the flares rather than the aircraft.

According to the Marine Corps, the AV-8B is undergoing internal modifications to reduce its vulnerability after being hit. These modifications include foam in the wing tanks to reduce the possibility of explosion and fire extinguishers throughout the aircraft to protect the engine bays, fuselage tanks, and hydraulic lines from fires.

Flexible

According to the Marine Corps, the AV-8B can provide support to ground forces throughout the battlefield to include CAS and support

beyond the area where ground forces are engaged with the enemy. Also, the AV-8B has air-to-air capabilities that the Marine Corps would use when primary air-to-air aircraft are not available.

Capable of Destroying Varied Targets

According to the Marine Corps, the AV-8B has the capability to deliver a variety of munitions. The aircraft can carry various weapons such as bombs, missiles, and a 25-millimeter cannon to engage a variety of targets, including tanks, artillery, and personnel. Marine Corps officials believe the AV-8B's angle rate bombing system, which will automatically calculate when bombs should be released, will provide the accuracy needed for the AV-8B to put bombs on target on the first pass. Additionally, the AV-8B's heads-up display will provide navigation and weapons delivery information.

Other Factors Influencing the Air Force's and the Marine Corps' Choice of Aircraft

Factors other than CAS capabilities and characteristics were important to the Air Force and the Marine Corps when they were deciding on what aircraft they wanted for CAS missions. The Air Force said these factors were production availability and affordability and the Marine Corps said these factors were basing flexibility and reliability.

The A-16 could be available for operations in the early 1990s, according to the Air Force, thus meeting its need for an early replacement of the A-10. Air Force officials state that the A-16 can be produced on the existing F-16 production lines without the high cost and long lead time associated with the development of a new aircraft.

The Air Force also considers the A-16 affordable because of its estimated cost and the existing F-16 logistics and training infrastructures. Air Force officials said the A-16's estimated flyaway cost could range from \$12 million to \$19 million in 1988 dollars, depending on the configuration of the aircraft. According to Air Force officials, much of the F-16's logistical support infrastructure will also support the A-16. For example, spare parts inventories and test equipment are in place worldwide for the F-16 and are expected to be substantially common with those of the A-16.

According to Air Force officials, much of the training on the A-16 will be available for pilots and support personnel through existing F-16 schools. According to the officials, A-16 pilots would receive initial training on the F-16 and then CAS specific training through the pilots' assigned units.

The AV-8B's basing flexibility and reliability were key factors in the Marine Corps' choice of the aircraft. Because of its short takeoff and vertical landing capability, the Marine Corps can base the AV-8B at austere sites ashore, such as roads and grass strips. According to the Marine Corps, the AV-8B has proven to be a reliable aircraft that is able to operate with minimum support and downtime for repairs. Logistical support for the AV-8B and fully operational training programs for pilots and support personnel already exist in the Marine Corps.

Similarities and Differences in Aircraft Capabilities and Characteristics for Close Air Support

Even though the A-16 and AV-8B have some fundamental differences, they are to have similar capabilities and characteristics, such as speed, maneuverability, and threat avoidance, for performing CAS.

According to Air Force and Marine Corps officials, the A-16 and AV-8B, respectively, (1) would approach the target in the range of 420 to 480 knots and leave the target area in excess of 500 knots, (2) are considered very maneuverable and relatively small, (3) are expected to have or eventually be upgraded to have similar threat avoidance systems, such as radar warning and self-protection radar jamming systems and chaff and flare decoy systems, and (4) have features to reduce or suppress fires resulting from hits. However, the production A-16 is projected to have some hardened surfaces to reduce its vulnerability to lethal hits, whereas Marine Corps officials said the AV-8B will not be hardened.

According to the Air Force and the Marine Corps, the A-16 and the AV-8B respectively, will have multifrequency radios for voice communications with ground forces and heads-up displays to assist in navigation and target acquisition. The AV-8B is also projected to have color digital moving maps to assist the pilot in managing the cockpit work load during low-visibility CAS. Both aircraft are also expected to have systems such as forward looking infrared systems, multi-mode radars, and laser spot detectors to assist in target location and identification. Both aircraft are also expected to have additional systems to increase their ability to locate CAS targets: the automatic target handoff system on the A-16 and radar beacon forward air controller on the AV-8B. According to the Air Force and the Marine Corps, the A-16 and AV-8B, respectively, can carry and accurately deliver a variety of weapons designed to engage and destroy a range of CAS targets as well as air-to-air and interdiction targets.

Additionally, the AV-8B has the capability to be transported by and operate from a ship. Its short takeoff and vertical landing capability

Chapter 3
Capabilities of Air Force and Marine Corps
Close Air Support Aircraft

allows it to move ashore quickly in an amphibious operation and operate from austere locations to support the Marine Corps' dispersed mode of operation. Conversely, the A-16, like the F-16, is built to operate from fixed air bases.

Requests For and Execution of Close Air Support Missions

The Army and the Marine Corps have similar procedures for requesting and approving CAS. All CAS missions are requested and approved or disapproved by ground force commanders. In addition, the Air Force and Marine Corps have similar communications and coordination procedures during mission execution.

Request and Approval of Close Air Support Missions

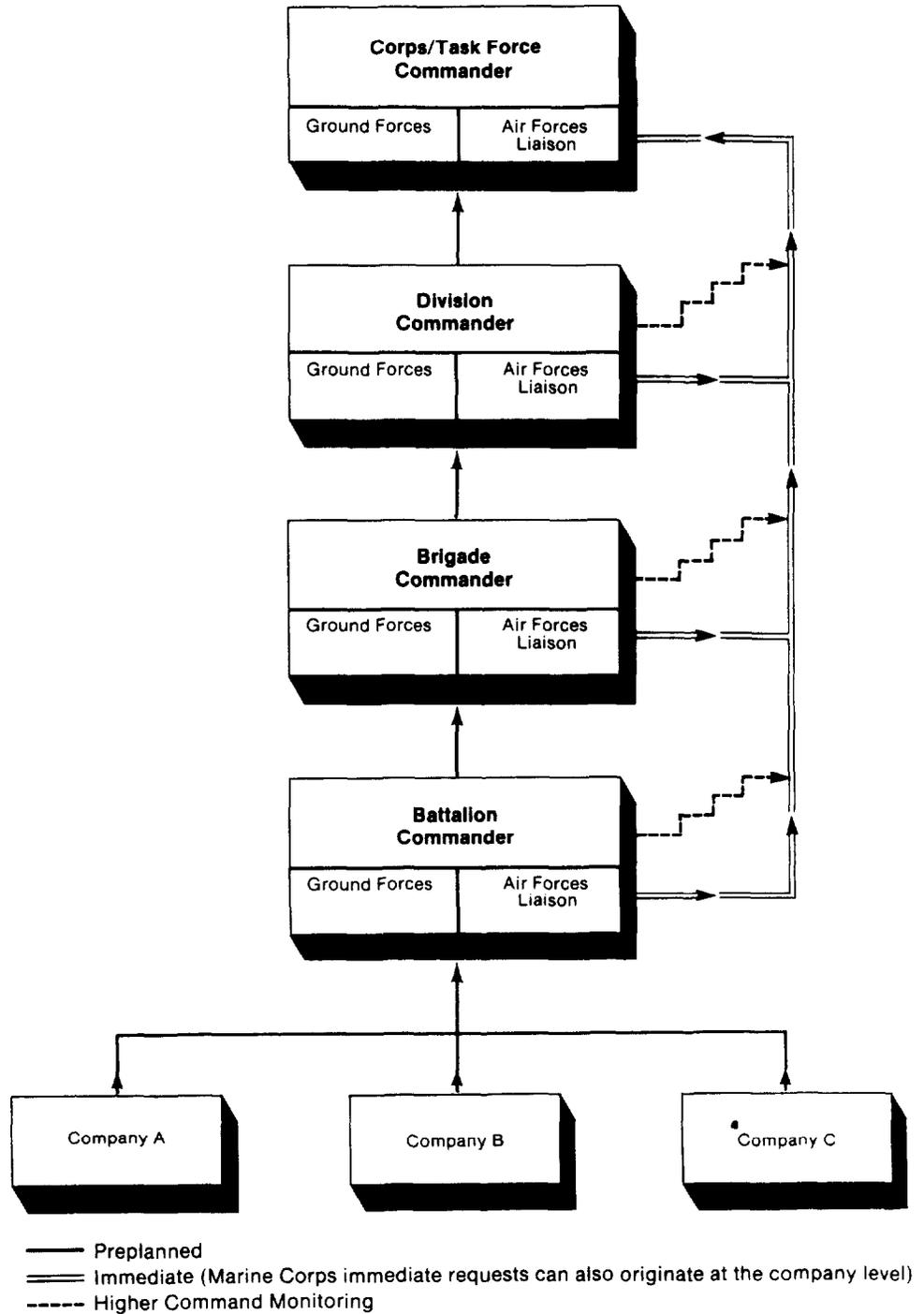
Requests for CAS can originate anywhere in the ground forces' chain of command, including the company level. Each higher-level ground force command reviews and approves these requests, which can be preplanned or immediate. The highest ground force unit commander involved, generally the Army Corps Commander or Marine Corps Task Force Commander, gives final approval.

Commands must submit preplanned requests enough in advance to allow detailed mission planning and coordination. Usually, the requests must be submitted about 12 to 24 hours before the day the ground forces need the support. The requests flow from the requesting unit through each of its higher commands, with each command making a decision on whether it has the appropriate weapons to engage the target or whether it must request assistance from higher commands. At each command level, the ground force commander, with assistance from air force representatives, recommends targets for CAS.

Once preplanned CAS missions are approved, they are included in air tasking orders, which the air forces use to plan and schedule missions for a specified period of time, usually 24 hours. After CAS targets are included in air tasking orders, only the ground forces commander or the commander's representative can cancel, change, or disapprove the targets. However, the air forces component commander may decide not to fly CAS missions because of weather conditions, troop safety, and aircraft safety considerations.

Immediate requests for air support do not provide sufficient time for advanced mission planning and coordination. These requests are generated by the ground force unit needing the support and communicated to the unit's aviation representative. The requests are then transmitted by radio directly to the air forces component responsible for coordinating CAS missions. Higher-level commands monitor these radio transmissions and communicate their disapproval to the requesting unit. Silence of higher commands constitutes approval of the request. Figure 4.1 shows the typical request and approval process for preplanned and immediate CAS missions.

Figure 4.1: Request and Approval
 Process for Preplanned and Immediate
 Close Air Support Missions



Coordination During Mission Execution

According to Air Force regulations and Marine Corps guidance, two important factors to successful CAS mission execution are communications and coordination between the aircraft and ground forces. The Air Force and the Marine Corps communicate and coordinate with ground forces during CAS mission execution in basically the same manner and for the same purposes. Communications and coordination may take place throughout CAS mission execution to convey target description and location information. Additionally, coordination with ground force operations must take place to allow the safe movement of friendly aircraft in the area.

Although target information can be communicated to the pilot any time before engaging the target, this information is generally conveyed at designated points either before aircraft launch or on the way to the target area. For example, detailed target location and description information is generally provided before the aircraft is launched for preplanned missions. For immediate missions, however, this information may not be available before launch and would have to be provided while the aircraft is on the way to the target area. For both mission types, coordination with ground forces and other fire support takes place to ensure that artillery fire will not endanger aircraft in its range and that friendly forces are not mistaken for enemy forces.

Once the aircraft approaches the target area, the pilot contacts the forward air controller, an air force liaison to the ground forces, who passes on final target location and identification information. The forward air controller also gives the pilot clearance to release bombs on targets once the pilot can clearly identify friendly from enemy forces and has acquired the target.

Comments From the Director of Defense Research and Engineering



DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

29 AUG 1989

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "CLOSE AIR SUPPORT: Comparison of Air Force and Marine Corps Requirements and Aircraft," dated July 21, 1989 (GAO Code 392426/OSD Case 8066).

The DoD has reviewed the report, concurs with its contents, and has no further comment. The Department appreciates the opportunity to review the draft report.

Sincerely,

A handwritten signature in cursive script, appearing to read "Robert C. Duncan".

Robert C. Duncan

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