

GAO

Report to the Honorable
Patrick Kennedy, House of
Representatives

November 1998

SPECIAL OPERATIONS FORCES

C-130 Upgrade Plan Could Help Fix Electronic Warfare Deficiencies





**United States
General Accounting Office
Washington, D.C. 20548**

**National Security and
International Affairs Division**

B-278786

November 13, 1998

The Honorable Patrick Kennedy
House of Representatives

Dear Mr. Kennedy:

In response to your concern that threats to the U.S. Special Operations Command's (USSOCOM) aircraft are increasing, while funds available for electronic warfare are decreasing, we are reviewing USSOCOM's acquisition strategy for aircraft electronic warfare systems. This report focuses on fixed-wing C-130 aircraft operated by USSOCOM's Air Force component, the Air Force Special Operations Command (AFSOC). As you requested, we determined (1) the soundness of AFSOC's electronic warfare acquisition strategy and (2) the extent to which AFSOC is correcting deficiencies and maximizing commonality in its electronic warfare systems. We also identified a funding source that could help AFSOC further implement its electronic warfare acquisition strategy. We will address USSOCOM's rotary-wing aircraft in a separate report.

Background

The nation's special operations forces provide the National Command Authorities a highly trained, rapidly deployable joint force capable of conducting special operations anywhere in the world.¹ In November 1986, Congress enacted section 1311 of Public Law 99-661, which directed the President to establish USSOCOM, a unified combatant command to ensure that special operations forces were combat ready and prepared to conduct specified missions. USSOCOM's component commands include AFSOC, the Army Special Operations Command, the Naval Special Warfare Command, and the Joint Special Operations Command. AFSOC, located at Hurlburt Field, Florida, deploys and supports special operations forces worldwide.

To ensure that special operations were adequately funded, Congress further provided in section 1311 of Public Law 99-661 that the Department of Defense create for the special operations forces a major force program (MFP) category for the Future Years Defense Plan of the Department of Defense. Known as MFP-11, this is the vehicle to request funding for the development and acquisition of special operations-peculiar equipment, materials, supplies, and services. The services remain responsible under

¹Special Operations are operations conducted to achieve military, political, economic, or psychological objectives by nonconventional military means in hostile, denied, or politically sensitive areas.

10 U.S.C. section 165 for providing those items that are not special operations-peculiar.

Since Operation Desert Storm, AFSOC's threat environment has become more complex and potentially more lethal. More sophisticated threat systems, both naval and land-based, have been fielded, and the systems are proliferating to more and more countries. Even nations without complex integrated air defense systems have demonstrated the capability to inflict casualties on technologically superior opponents. According to threat documents, worldwide proliferation of relatively inexpensive, heat-seeking missiles is dramatically increasing the risk associated with providing airlift support in remote, poorly developed countries. Increased passive detection system use is also expected throughout lesser developed countries. Passive detection allows the enemy to detect incoming aircraft without alerting the crew that they have been detected, thereby jeopardizing operations. Finally, commercially available, second-generation night vision devices, when linked with warfighter portable air defense systems (e.g., shoulder-fired missiles), provide these countries with a night air defense capability. This night air defense capability is significant because AFSOC aircrews have historically relied on darkness to avoid detection.

AFSOC aircraft carry a wide variety of electronic warfare systems to deal with enemy threat systems. Some of AFSOC's systems are common with systems used by the regular Air Force, while others are unique to special operations. Memoranda of Agreement (MOA) between USSOCOM and the military services lay out specifically the areas of support the services agree to undertake in support of the special forces. An MOA, dated September 16, 1989, and one of its accompanying annexes, dated February 22, 1990, entered into between the Air Force and USSOCOM list those items and services the Air Force agrees to fund in support of AFSOC's special operations mission. This list includes modifications common to both AFSOC and regular Air Force aircraft, and electronics and telecommunications that are in common usage. Part of AFSOC's electronic warfare equipment for fixed-wing aircraft is acquired with USSOCOM MFP-11 funds as special operations-peculiar items because the Air Force historically has employed very little electronic warfare equipment on its C-130s.

Results in Brief

AFSOC's electronic warfare acquisition strategy is sound because it is based on eliminating operational and supportability deficiencies confirmed by an Air Force study, test reports, and maintenance records. This evidence indicates that AFSOC's current electronic warfare systems are unable to defeat many current threat systems and have supportability problems. AFSOC's acquisition strategy is to procure a mix of new systems and upgrades for older ones while maximizing commonality within its fleet of C-130s.

Amidst budget constraints, USSOCOM is funding only portions of AFSOC's acquisition strategy due to other higher budget priorities, thereby hampering AFSOC's efforts to correct deficiencies and maximize commonality in electronic warfare systems. For example, although USSOCOM is funding an AFSOC effort to make C-130 aircraft less susceptible to passive detection, enhance aircrews' situational awareness, and increase commonality, it has rejected other requests to fund effectiveness and commonality improvements to systems dealing with radar- and infrared-guided missiles. As a result, in the foreseeable future, deficiencies will continue, and AFSOC will have to operate and maintain older and upgraded electronic warfare systems concurrently.

An opportunity exists, however, to help AFSOC implement its electronic warfare acquisition strategy. Since AFSOC's acquisition strategy was adopted, the Air Force has decided to begin a \$4.3 billion C-130 modernization program (C-130X program) for all C-130s. Some of the planned elements of this modernization are common with some of the elements of AFSOC's acquisition strategy that was to be funded by USSOCOM's MFP-11 funds. If, as required by the MOA, the Air Force C-130 avionics modernization program funds these common elements, USSOCOM could redirect significant portions of its MFP-11 funding currently budgeted for AFSOC C-130 passive detection and situational awareness deficiencies to other unfunded portions of AFSOC's electronic warfare acquisition strategy.

AFSOC Has a Sound Acquisition Strategy

AFSOC's acquisition strategy for electronic warfare equipment is contained within AFSOC's Technology Roadmap. The Technology Roadmap identifies and ranks operational deficiencies and links the deficiencies to material solutions. The Roadmap flows out of AFSOC's mission area plans for mobility, precision engagement/strike, forward presence and engagement, and information operations. For C-130s, the Roadmap indicates that AFSOC has serious electronic warfare operational deficiencies in several areas and identifies solutions for each of these operational deficiencies. These

solutions include introducing a mix of new systems and making upgrades to older systems (See app. II for descriptions of AFSOC's C-130 aircraft.) AFSOC's acquisition strategy is sound because it is based on eliminating operational and supportability deficiencies confirmed by an Air Force study, test reports, and maintenance records.

According to AFSOC officials responsible for electronic warfare acquisition, AFSOC's C-130s are most vulnerable to three types of threat systems: (1) infrared missiles, (2) passive detectors, and (3) radar-guided missiles.² These deficiencies have become more critical since Operation Desert Storm in 1991 as more sophisticated threats have been developed and spread to more areas of the world.

An ongoing Air Force Chief of Staff directed study, the Electronic Warfare Operational Shortfalls Study, confirms what AFSOC officials maintain. This study found that there are many electronic warfare-related operational deficiencies within the overall Air Force, including the C-130 community. The study identified deficiencies with missile warning system missile launch indications and warning times, infrared expendables and jamming effectiveness, signature reduction, passive detection, situational awareness, and electronic warfare support equipment. Classified test reports and threat documentation corroborate the study's findings. According to Air Force officials, electronic warfare deficiencies within Air Force components, including AFSOC, are so extensive that the solutions necessary to correct all of them are not affordable within the framework of Air Force fiscal year 2000-2005 projected budgets.

AFSOC's aging electronic warfare systems are also failing more often and requiring more staff hours to support. According to AFSOC's Technology Roadmap and maintenance records, all AFSOC electronic warfare systems have some supportability problems. AFSOC maintenance personnel told us that they are working more hours to repair the systems, and maintenance records show that system failures are becoming more frequent. The ALQ-172(v)1 high band radar jammer in particular is problematic, requiring more staff hours for maintenance than any other AFSOC electronic warfare system. The staff hours charged for maintaining the ALQ-172(v)1 represent 34 percent of the total time charged to maintaining all electronic warfare systems from 1995 through 1997.

²Infrared missiles detect aircraft from the heat aircraft emit. Passive detectors detect aircraft by intercepting electronic signals emitted by onboard systems, such as radar or radios. Radar-guided missiles actively emit electronic signals and receive reflections that reveal an aircraft's position.

Budget-Driven Funding Decisions Are Undercutting AFSOC's Efforts to Correct Deficiencies and Maximize Commonality

AFSOC has made several efforts to correct deficiencies and maximize commonality in electronic warfare systems. USSOCOM is funding the Common Avionics Architecture for Penetration (CAAP) program, which is designed to make AFSOC's C-130 aircraft less susceptible to passive detection, enhance the aircrews' situational awareness, lower support costs, and improve commonality. AFSOC has sought to begin several other efforts in the past several years, as well, but USSOCOM has rejected these requests. In addition to addressing deficiencies identified in the Technology Roadmap, AFSOC is trying to improve commonality among its electronic warfare systems by eliminating some of those systems from its inventory. For example, it is replacing the ALR-56M radar warning receiver on its AC-130U Gunships with the ALR-69 radar warning receiver already on the rest of its C-130s. AFSOC also planned to replace ALQ-131 radar jamming pods on its AC-130H Gunships with a future upgraded ALQ-172(v)3 radar jammer for its AC-130s and MC-130Hs. Achieving commonality avoids duplicating costs for system development, lowers unit production costs through larger quantity buys, and simplifies logistical support.

According to USSOCOM officials, in selecting what to fund they had to determine which programs would maximize capability, including sustainability, while conserving resources. The USSOCOM officials said that these decisions were difficult because although some systems offer tremendous improvements in capabilities, they require significant commitment of resources. For instance, USSOCOM did not have sufficient resources to fund both the CAAP program and the ALQ-172(v)3 upgrade program to improve commonality and capability against radar-guided missiles. Additionally, AFSOC had planned to replace its ALE-40 flare and chaff dispensers with the newer programmable ALE-47 to improve protection against infrared-guided missiles. But, because of budget constraints, AFSOC will have to keep the ALE-40 on two of its C-130 model aircraft while the other models are upgraded to the ALE-47 configuration.

Furthermore, in prioritizing resources for fiscal year 2000-2005, USSOCOM is accepting increased operational and sustainment risks for systems it does not anticipate being key in 2010 or beyond. Under this approach, USSOCOM is dividing AFSOC's C-130s into so-called legacy and bridge aircraft. The older legacy aircraft will receive flight safety modifications but not all electronic warfare upgrades; newer bridge aircraft will receive both. As a result, the legacy aircraft will become less common over time with the newer bridge aircraft, even as they become more vulnerable to threats and more difficult to maintain. Because, according to AFSOC officials, the legacy

aircraft are planned to remain in service for 12 more years, for the foreseeable future, AFSOC will have to operate and maintain more types of electronic warfare systems.

Opportunity Exists to Help Implement AFSOC's Acquisition Strategy

Since AFSOC's electronic warfare acquisition strategy was adopted, the Air Force has decided to fund a \$4.3-billion Air Force-wide C-130 modernization program of all C-130s, including the special operations fleet. This avionics modernization program shares many common elements with the USSOCOM CAAP program. CAAP includes \$247 million of MFP-11 funds for upgrades/systems to address AFSOC's C-130 aircraft situational awareness and passive detection problems. Consistent with the provisions of title 10, the MOA requires that the Air Force, rather than USSOCOM, fund common items. Therefore, the overlap between the two programs creates an opportunity for USSOCOM to direct its MFP-11 funding from CAAP to other solutions identified in AFSOC's Technology Roadmap instead of paying for items that will be common to all Air Force C-130s.

The Air Force is funding its avionics modernization program to lower C-130 ownership costs by increasing the commonality and survivability of the C-130 fleet. Because USSOCOM designed CAAP independently of and earlier than the Air Force modernization program, CAAP provides funding for a number of items that are now planned to be included in the Air Force program. These include (1) an open systems architecture, (2) upgraded displays and display generators, (3) a computer processor to integrate electronic warfare systems, (4) a digital map system, and (5) a replacement radar.

USSOCOM and AFSOC officials note that these C-130 modernization program items have the potential to satisfy CAAP requirements with only minor modifications. For example, AFSOC's estimates indicate that the cost to develop and procure a new low-power navigation radar with a terrain following/terrain avoidance feature as part of CAAP would be approximately \$133 million. However, if the navigation radar selected for the avionics modernization program incorporates or has a growth path that will allow for the addition of a low-power terrain following/terrain avoidance feature to satisfy CAAP requirements, USSOCOM could avoid the significant development and procurement costs of the common items. According to Air Force, USSOCOM and AFSOC officials, coordinating these two programs would maximize C-130 commonality and could result in additional MFP-11 funding being available to meet other AFSOC electronic warfare deficiencies.

Consistent with the provisions of title 10, and as provided for in the MOA between the Air Force and USSOCOM, the Air Force has included the AFSOC C-130 fleet in its draft planning documents to upgrade the C-130 avionics. However, while the MOA requires the Air Force to pay for common improvements incorporated into AFSOC's C-130, the Air Force may not pay for special operations-peculiar requirements as part of the common upgrade. Nevertheless, the Air Force is not otherwise precluded from selecting systems that can satisfy both the Air Force's and AFSOC's requirements or which could be easily and/or inexpensively upgraded by AFSOC to meet special operations-peculiar requirements.

Conclusion

AFSOC has a sound electronic warfare acquisition strategy based on a need to eliminate operational and supportability deficiencies while maximizing commonality within its C-130 fleet. Because of budget constraints, however, USSOCOM funding decisions are undercutting AFSOC's efforts to implement its Technology Roadmap. An opportunity now exists, however, to help free up some MFP-11 funds to permit AFSOC to continue implementing its electronic warfare strategy as outlined in the Technology Roadmap.

Recommendation

We recommend that the Secretary of Defense direct the Secretary of the Air Force in procuring common items for its C-130 avionics modernization, to select items that, where feasible, address USSOCOM's CAAP requirements or could be modified by USSOCOM to meet those requirements. We further recommend that the Secretary of Defense direct USSOCOM to use any resulting MFP-11 funds budgeted for but not spent on CAAP to address other electronic warfare deficiencies or to expand the CAAP program to other special operations forces aircraft.

Agency Comments

In comments on a draft of this report, the Department of Defense (DOD) partially concurred with both recommendations. With regard to our first recommendation, DOD stated that Air Force and USSOCOM requirements require harmonization in order to take advantage of commonality and economies of scale. DOD agreed to require the Air Force and USSOCOM to document their common requirements. While this action is a step in the right direction, Office of the Secretary of Defense-level direction may be necessary to ensure that appropriate common items for USSOCOM are procured by the Air Force. As for our second recommendation, DOD officials stated that any MFP-11 funds originally budgeted for CAAP but

saved through commonality should be used to address documented electronic warfare deficiencies or to deploy CAAP on other special operations forces aircraft. We agree with DOD that savings to the CAAP program by using common items should be used to address electronic warfare deficiencies or for expansion of the CAAP program to other special operations forces aircraft. We have reworded our recommendation to reflect that agreement. DOD's comments are reprinted in appendix I.

Scope and Methodology

To assess the basis for AFSOC's strategy for acquiring and upgrading electronic warfare equipment and determine the extent to which it would address deficiencies and maximize commonality, we analyzed AFSOC acquisition plans and studies and reviewed classified test reports and threat documentation. We also discussed AFSOC's current electronic warfare systems and aircraft and AFSOC's planned electronic warfare upgrades and system acquisition with officials at USSOCOM, MacDill Air Force Base, Florida; AFSOC, Hurlburt Field, Florida; and Air Force Headquarters, Washington, D.C. Additionally, we discussed AFSOC electronic warfare system supportability with officials responsible for the systems at USSOCOM; AFSOC; and Warner Robins Air Logistics Center, Georgia, and reviewed logistics records for pertinent systems. We accepted logistics records provided by AFSOC as accurate without further validation.

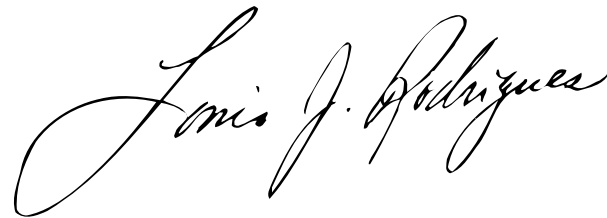
To identify alternative sources of funding to implement AFSOC's strategy, we examined legislation establishing and affecting USSOCOM and memoranda of agreement between USSOCOM and the Air Force regarding research, development, acquisition, and sustainment programs. We discussed relevant memoranda of agreement with USSOCOM, AFSOC, and Air Force officials. Furthermore, we reviewed planning documents and discussed the planned Air Force C-130 avionics modernization program with Air Force officials at Air Force Headquarters and the Air Mobility Command, Scott Air Force Base, Illinois.

We conducted our work from October 1997 through July 1998 in accordance with generally accepted government auditing standards.

We will send copies of this report to interested congressional committees; the Secretaries of Defense and the Air Force; the Assistant Secretary of Defense, Office of Special Operations and Low-Intensity Conflict; the Commander, U.S. Special Operations Command; the Director, Office of Management and Budget; and other interested parties.

Please contact me at (202) 512-4841 if you or your staff have any questions. Major contributors to this assignment were Tana Davis, Charles Ward, and John Warren.

Sincerely yours,

A handwritten signature in black ink that reads "Louis J. Rodrigues". The signature is written in a cursive style with a large, looping initial "L".

Louis J. Rodrigues
Director, Defense Acquisitions Issues

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Abbreviations

AFSOC	Air Force Special Operations Command
CAAP	Common Avionics Architecture for Penetration
DOD	Department of Defense
MFP	major force program
MOA	memoranda of agreement
USSOCOM	U.S. Special Operations Command

Comments From the Department of Defense



ACQUISITION AND
TECHNOLOGY

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12 NOV 1998

Mr. Louis J. Rodrigues
Director, Defense Acquisition Issues
National Security and International
Affairs Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Rodrigues:

This is the Department of Defense (DOD) response to the General Accounting Office (GAO) draft report, "SPECIAL OPERATIONS FORCES: C-130 Upgrade Plan Could Help Fix Electronic Warfare Deficiencies," dated September 29, 1998 (GAO Code 707302/OSD Case 1699). The DOD partially concurs with the draft report's two recommendations. The DOD will require the Air Force and CINCSOC to document savings from common requirements. The DOD will also require CINCSOC to show how Common Avionics Architecture for Penetration program (CAAP) budgeted funds saved through commonality will be used to resolve documented electronic warfare deficiencies or for CAAP requirements for other SOF aircraft not presently funded for CAAP.

The DOD appreciates the opportunity to comment on the draft report.

Sincerely,

George R. Schneider
Director
Strategic and Tactical Systems

Enclosure



Appendix I
Comments From the Department of Defense

GAO DRAFT REPORT – DATED SEPTEMBER 29, 1998
(GAO CODE 707302) OSD CASE 1699

“SPECIAL OPERATIONS FORCES: C-130 UPGRADE PLAN COULD HELP
FIX ELECTRONIC WARFARE DEFICIENCIES”

DOD COMMENTS ON THE GAO RECOMMENDATIONS

Now on p. 7.

RECOMMENDATION 1: The GAO recommended that the Secretary of Defense direct the Secretary of the Air Force, in procuring common items for its C-130 avionics modernization, to select items that, where feasible, address AFSOC’s Common Avionics Architecture for Penetration program (CAAP) requirements or could be modified by AFSOC to meet those requirements. (page 11/GAO Draft Report)

DOD RESPONSE: Partially concur. The Air Force and CINCSOC requirements require harmonization to take advantage of commonality and economies of scale where feasible. Common C-130 requirements are an Air Force responsibility and would allow CINCSOC to utilize saved MFP-11 funds for resolving existing special-operations-peculiar electronic warfare deficiencies. The DOD will require the Air Force and CINCSOC to document common requirements between the Air Force C-130 avionics modernization program and CINCSOC’s CAAP for his C-130s.

Now on p. 7.

RECOMMENDATION 2: The GAO also recommended that the Secretary of Defense direct USSOCOM to use any resulting MFP-11 funds budgeted for, but not spent on, CAAP to address other C-130 electronic warfare deficiencies. (page 11/GAO Draft Report)

DOD RESPONSE: Partially concur. Any MFP-11 funding originally budgeted for the CAAP should be used to address documented CINCSOC/AFSOC electronic warfare deficiencies or for CAAP on other SOF aircraft not currently funded for CAAP. The DOD will also require CINCSOC to show how CAAP budgeted funds saved through commonality will be used to resolve documented electronic warfare deficiencies or for additional SOF unfunded CAAP requirements.

AFSOC C-130 Aircraft

The Air Force Special Operations Command (AFSOC) uses specially modified and equipped variants of the C-130 Hercules aircraft to conduct and support special operations missions worldwide. Following are descriptions of the C-130 models.

AC-130H Spectre Gunship

Command: AFSOC

Quantity: 8

Mission: The AC-130H is a gunship with primary missions of close-air support, air interdiction, and armed reconnaissance. Additional missions include perimeter and point defense, escort, landing, drop and extraction zone support, forward air control, limited command and control, and combat search and rescue.

Special equipment/features: These heavily armed aircraft incorporate side-firing weapons integrated with sophisticated sensor, navigation, and fire control systems to provide precision firepower or area saturation during extended periods, at night, and in adverse weather. The sensor suite consists of a low-light level television sensor and an infrared sensor. Radar and electronic sensors also give the gunship a method of positively identifying friendly ground forces and deliver ordnance effectively during adverse weather conditions. Navigational devices include an inertial navigation system and global positioning system.

AC-130U Spectre Gunship

Command: AFSOC

Quantity: 12

Mission: The AC-130U's primary missions are nighttime, close-air support for special operations and conventional ground forces; air interdiction; armed reconnaissance; air base, perimeter, and point defense; land, water, and heliborne troop escort; drop, landing, and extraction zone support; forward air control; limited airborne command and control; and combat search and rescue support.

Special equipment/features: The AC-130U has one 25-millimeter Gatling gun, one 40-millimeter cannon, and one 105-millimeter cannon for armament and is the newest addition to AFSOC's fleet. This heavily armed aircraft incorporates side-firing weapons integrated with sophisticated

sensor, navigation, and fire control systems to provide firepower or area saturation at night and in adverse weather. The sensor suite consists of an all light level television system and an infrared detection set. A multi-mode strike radar provides extreme long-range target detection and identification. The fire control system offers a dual target attack capability, whereby two targets up to 1 kilometer apart can be simultaneously engaged by two different sensors, using two different guns. Navigational devices include the inertial navigation system and global positioning system. The aircraft is pressurized, enabling it to fly at higher altitudes and allowing for greater range than the AC-130H. The AC-130U is also refuelable. Defensive systems include a countermeasures dispensing system that releases chaff and flares to counter radar-guided and infrared-guided anti-aircraft missiles. Also infrared heat shields mounted underneath the engines disperse and hide engine heat sources from infrared-guided anti-aircraft missiles.

EC-130E Commando Solo

Command: Air National Guard

Quantity: 5

Mission: EC-130E Commando Solo, the Air Force's only airborne radio and television broadcast mission, is assigned to the 193rd Special Operations Wing, the only Air National Guard unit assigned to AFSOC. Commando Solo conducts psychological operations and civil affairs broadcasts. The EC-130E flies during either day or night scenarios and is air refuelable. Commando Solo provides an airborne broadcast platform for virtually any contingency, including state or national disasters or other emergencies. Secondary missions include command and control communications countermeasures and limited intelligence gathering.

Special equipment/features: Highly specialized modifications include enhanced navigation systems, self-protection equipment, and the capability to broadcast color television on a multitude of worldwide standards.

MC-130E Combat Talon I and MC-130H Combat Talon II

Commands: AFSOC, Air Force Reserve, and Air Education and Training Command

Quantity: 14 Combat Talon Is, 24 Combat Talon IIs

Mission: The mission of the Combat Talon I/II is to provide global, day, night, and adverse weather capability to airdrop and airland personnel and equipment in support of U.S. and allied special operations forces. The MC-130E also has a deep penetrating helicopter refueling role during special operations missions.

Special equipment/features: These aircraft are equipped with in-flight refueling equipment, terrain-following/terrain-avoidance radar, an inertial and global positioning satellite navigation system, and a high-speed aerial delivery system. The special navigation and aerial delivery systems are used to locate small drop zones and deliver people or equipment with greater accuracy and at higher speeds than possible with a standard C-130. The aircraft is able to penetrate hostile airspace at low altitudes and crews are specially trained in night and adverse weather operations.

MC-130P Combat Shadow

Commands: Air Force Special Operations Command, Air Education and Training Command, and Air Force Reserve

Quantity: 28

Mission: The MC-130P Combat Shadow flies clandestine or low visibility, low-level missions into politically sensitive or hostile territory to provide air refueling for special operations helicopters. The MC-130P primarily flies its single- or multi-ship missions at night to reduce detection and intercept by airborne threats. Secondary mission capabilities include airdrop of small special operations teams, small bundles, and rubber raiding craft; night-vision goggle takeoffs and landings; and tactical airborne radar approaches.

Special equipment/features: When modifications are complete in fiscal year 1999, all MC-130P aircraft will feature improved navigation, communications, threat detection, and countermeasures systems. When fully modified, the Combat Shadow will have a fully integrated inertial navigation and global positioning system, and night-vision goggle-compatible interior and exterior lighting. It will also have a forward-looking infrared radar, missile and radar warning receivers, chaff and flare dispensers, and night-vision goggle-compatible heads-up display. In addition, it will have satellite and data burst communications, as well as in-flight refueling capability. The Combat Shadow can fly in the day against a reduced threat; however, crews normally fly night, low-level, air refueling and formation operations using night-vision goggles.

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