AU/ACSC/033/1999-04

AIR COMMAND AND STAFF COLLEGE

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THE CV-22 "OSPREY" AND THE IMPACT ON AIR FORCE COMBAT SEARCH AND RESCUE

by

Tom P. Currie Jr., Major, USAF

A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

Advisor: Major Steven Purtle

Maxwell Air Force Base, Alabama

April 1999

Disclaimer

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Preface

This research project addresses tiltrotor technology and the US Military. Specifically, this report outlines the advantages and doctrinal enhancements possible if the Air Force purchases the CV-22 for the Combat Search and Rescue mission. I chose this topic to begin the dialogue that is essential in developing new doctrinal ideas. The Air Force at large and the rescue community in particular must develop new ideas that take into account and exploit the unique capabilities and characteristics of the CV-22 as a rescue platform.

I would like to thank Major Steven Purtle for his guidance and assistance through this process, and Carl Bauer of Boeing Helicopters for his expert technical assistance. Finally, I would like to thank Major Tim Healy (Det 1 418th FLTS), Major Dan Altobelli (SAF/AQQU), and Major Alvin Drew (ACC/DR) for providing up to date information and ideas on the current developments in this emerging area.

Abstract

Tiltrotor technology successfully combines the best attributes of a helicopter with those of an airplane. These unique characteristics are resident in the first production, tiltrotor aircraft, the V-22. The "Osprey" will dramatically expand the capabilities of the US Military. The US Marine Corps in purchasing the MV-22 will greatly enhance its operational and tactical maneuver capabilities. With the CV-22, US Special Operations Command will add new and much needed capability to extract SOF personnel and American citizens from behind enemy lines. The CV-22 can also be useful to the Air Force in performing Combat Search and Rescue (CSAR). This paper explores this area and answers the following question: *How will theCV-22's unique qualities advance the state of the art of Air Force CSAR?* Conducting the CSAR mission with the CV-22 will eradicate current mission deficiencies and enhance execution through advances in Combat Search and Rescue Task Force and command and control doctrine. In addition to evolving current doctrine to enhance CSAR, the CV-22 will lead to new CSAR capabilities and doctrine. Finally, the CV-22 will enhance two Air Force core competencies: global attack and rapid global mobility.

I gathered information for this paper from many sources including Bell and Boeing Helicopters, SAF/AQQU, ACC/DR, HQ AFSOC, 418th Flight Test Squadron and recent studies. Additionally, my experiences and knowledge gained as a developmental test pilot on the V-22 program was a basis of much of the data.

Chapter 1

Introduction

> *During the twentieth century…none of the most important devices that have transformed war—from the airplane through the tank, the jet engine, radar, the helicopter, the atom bomb, and so on all the way down to the electronic computer—owed its origins to a doctrinal requirement laid down by people in uniform*
>
> —Van Creveld

The 1997 US National Military Strategy (NMS) paints a picture of the strategic environment "characterized by rising regional powers, asymmetric challenges including weapons of mass destruction (WMD), transnational dangers, and the likelihood of wild cards that cannot be specifically predicted."[1] To mollify these dangers the NMS sets forth a three pronged integrated military strategy embodied by the terms shape, respond, and prepare now.[2] The Military's ability to successfully execute this strategy and meet the wide range of global challenges is dependent on its strategic agility and flexibility.[3] Therefore, in preparing the Armed Forces for a future in this environment, the weapon systems purchased and the technologies developed must enhance the overall agility and flexibility of the war fighter. An emerging aircraft technology that has the potential to succeed in this environment is the tiltrotor. Tiltrotor technology combines the best attributes of a helicopter and an airplane into one aircraft and provides the warfighter with an agile, flexible tool for the twenty-first century.

Figure 1. MV-22 in Airplane Mode

Tiltrotor Technology and the Military

Beginning with research in the 1940s and demonstration aircraft in the 1950s, the US military and defense industries have endeavored to combine the hover capability and medium lift capacity of a helicopter with the higher airspeed characteristics of a conventional airplane. However, due to technological limitations, this dream never reached maturity until the 1990s. Advances in materials, engine technology, flight controls, and structures in the last half of this century led to the first production tiltrotor, the V-22 "Osprey." This revolutionary aircraft successfully melds the capabilities of a medium lift helicopter with the speed of today's turboprop aircraft providing a flexible tool for today's combat forces. After an introductory flight in the "Osprey," General Ryan, when asked what he thought of the V-22, accurately synopsized the aircraft with a one-word critique—"versatility."

The US Marine Corps is currently testing and buying the V-22—designated the MV-22—to conduct combat assault and combat service support missions. The Marine "Osprey" fleet is scheduled to reach initial operational capability (IOC) in 2001. With the MV-22, the Marine Corps will enhance both its operational and tactical maneuver capabilities resulting in increased combat effectiveness. United States Special Operations Command (USSOCOM) is also a participant in the program. USSOCOM and Air Force Special Operations Command (AFSOC) as the operators of the aircraft are committed to buying 50 CV-22s, a modified version of the MV-22. The CV-22's scheduled IOC is 2005. With the CV-22, USSOCOM will have, for the first time, the capability to execute the deep exfiltration mission. The revolutionary and unique capabilities of this aircraft will significantly enhance the combat capabilities of both USSOCOM and the Marine Corps.

In addition to its application in these two mission areas, the agility and flexibility of the CV-22 can enhance the ability of the Air Force to conduct Combat Search and Rescue (CSAR) missions. Proper integration of this technology into the CSAR mission area can correct current deficiencies, boost operational capabilities, and strengthen Air Force core competencies. However, for the integration to be a success we must understand the unique capabilities and strengths of this aircraft. Additionally, we must develop appropriate doctrine to exploit this technology. Employed properly, this revolutionary aircraft will greatly enhance CSAR operations within the Air Force.

Research Question

The purpose of this paper is to examine the doctrinal issues that arise and the advantages gained if the Air Force uses the CV-22 to conduct Combat Search and Rescue. This paper will focus on and answer the following question: *How will the CV-22's unique qualities advance the state of the art of Air Force CSAR?*

This paper will answer this question by first defining, describing and presenting the history of tiltrotor technology. Next, the paper will present the current state of the art in tiltrotor technology, the V-22. With that background, the paper will discuss MV-22 integration into the Marine Corps and CV-22 integration into USSOCOM. These discussions will focus on the doctrinal and mission enhancements possible using this new technology. Finally, the will present the CSAR mission in the light of the CV-22. The presentation will highlight current deficiencies and doctrine with discussion on enhancements and advancements possible with this new more capable platform, and will explore the benefits to two Air Force core competencies: global attack and rapid global mobility.

The CV-22 has the capability to drastically change and enhance the capabilities of the CSAR force. However, for this to occur the aircraft must be viewed as a new and unique tool, a revolution in capability, and not simply a replacement for an aging CSAR helicopter. We must advance doctrine to accommodate the capabilities inherent in the CV-22 "Osprey."

Notes

[1] *National Military Strategy of the United States of America,* September 1997, 30.
[2] Ibid, 1.
[3] Ibid, 30.

Chapter 2

Tiltrotor Technology

I believe the tiltrotor aircraft is the most significant aviation development, actually since the Wright Brothers.

—Senator Barry Goldwater

Since their invention as a practical tool in 1936, the helicopter has made a significant contribution to aviation due to its unique ability to takeoff and land in small, unprepared areas.[1] However, the relatively slow maximum forward speed of the helicopter when compared to turboprop or jet aircraft is a significant disadvantage. Characteristic cruise speed is 120 to 140 kt for today's helicopters while fixed wing aircraft typically cruise at 250 kt and higher. Since the 1940's engineers have tried to combine this fixed wing speed advantage with the helicopter's unmatched ability to takeoff and land vertically. One avenue of research to accomplish this objective has been in the area tiltrotors.

Basic Operations

Tiltrotors are unique aircraft that can takeoff, hover, and land like a helicopter in addition to flying fast and efficiently like a turboprop. When the engines are vertical, a tiltrotor operates like a helicopter—the proprotors provide both lift and aircraft control. Rotating the engines and proprotors forward causes aircraft speed to increase. The proprotors still provide lift and control; however, the wings and conventional airplane control surfaces become increasingly more efficient and are also used for lift and control as the speed increases. Once the engines are horizontal, the tiltrotor operates as a conventional turboprop aircraft; the wings provide lift, proprotors provide thrust, and conventional airplane aerodynamic control surfaces are used for control. Conversion is the term given to this process. Reconversion is just the opposite: rotating the nacelles aft from the horizontal to transition from airplane to helicopter mode. In addition to operating in helicopter and airplane modes, a tiltrotor can fly with the nacelles at any intermediate position. When flying in these intermediate positions the aircraft is said to be in conversion mode.

Research Vehicles

Bell Helicopter engineers first explored the tiltrotor concept in the 1940s and early 1950s. The XV-3, the first tiltrotor research vehicle, proved their ideas in flight. The XV-3's first flight occurred in August 1955 followed by the first successful conversion in December 1958. In all, the XV-3 conducted 250 test flights including 110 conversions and reconversions to explore and investigate this new technology, and show feasibility.[2] Although this research program was a success, in that it showed the feasibility of the concept, tiltrotor technology still suffered from major technological limitations in the areas of flight controls, propulsion, and structures.[3] Combined, this limitations prohibited development of a successful production tiltrotor aircraft at that time.

With advances in flight control, propulsion, and structure technology the US Army and NASA in the 1970s contracted with Bell Helicopter to build a second tiltrotor demonstrator. Two 13,000 pound SV-15s were built under this contract. These aircraft conducted their first flights in May 1978 and April 1979, and the first conversion to airplane mode occurred in July 1979. Following this initial conversion, test pilots slowly expanded the flight envelope to 300 kt and 21,000 ft. The success of this test program led directly to the Joint Services Advanced Vertical Lift Aircraft (JVX) program designed to produce a Vertical Takeoff and Landing (VTOL), medium-lift transport aircraft for all four Military Services.[4]

Bell Helicopter Textron and Boeing Helicopters joined forces to pursue the JVX program and produced the MV-22 “Osprey” with first flight in March 1989. Over the years, as a result of continuous testing and constant refinements, the second version of the “Osprey” has entered Low Rate Initial Production (LRIP). If the aircraft successfully completes its Operational Evaluation (OPEVAL) scheduled for the last half of 1999 and the first half of 2000, the MV-22 program is anticipating a full rate production decision in the summer of 2000.[5]

The MV-22

Today’s MV-22 is a technological advanced, versatile, and militarily capable platform that will revolutionize military operations in the coming century. “From its inception, the V-22 has been developed to meet a Joint Services Operational Requirement (JSOR) for an aircraft with multiple mission capabilities. The foremost of these missions includes assault support, special operations, and combat rescue.”[6] The requirements of these missions demand both the speed and range of a turboprop and the vertical takeoff and landing capability of a helicopter.[7] Numerous enabling technologies and specialized military mission equipment, capabilities, and designs combine to give the MV-22 the necessary performance and capabilities to accomplish these diverse and demanding missions.

Enabling Technologies

The technologies that enable the MV-22 to be successful are both extensive and leading edge. The most consequential of these technologies include digitally controlled turboshaft engines, composite construction, fly-by-wire flight control system, and an integrated avionics suite.[8]

Advancements in jet engines and propulsion control have reduced pilot workload and are a fundamental enabling technology in the Osprey. The MV-22 is powered by two 6200 SHP class Rolls Royce/Allison T406-AD-400 turboshaft engines. Each engine output shaft drives a 38-foot diameter, three-bladed proprotor. Should one engine fail, the remaining, operating engine will drive both proprotors allowing continued flight and a safe roll-on landing. Dual redundant full-authority digital engine control (FADEC) computers govern the engines. A major function of the FADEC is to monitor and maintain all engine limits. This self-limiting feature frees the pilot of this added task giving him “care free” flying throughout the flight envelope. The engine/FADEC integration is an essential technology and a fundamental reason for the MV-22’s success.[9]

Another enabling technology within the MV-22 is composite materials. The “Osprey’s” structure consists of an optimal use of composite materials and metals. The composite laminates provide a corrosion resistant, ballistic tolerant material with a higher strength-to-weight ratio when compared to metals. By weight, the MV-22 is 26% composite material.[10] The extensive use of composites has resulted in an aircraft which is 22% lighter than a comparable all metal design.[11] In addition to lowering weight, composite materials also enhance safety. Composite materials are “more resistant to fatigue failure, and damage to composite parts typically results in a slow degradation rather than the catastrophic failure typically found in metal parts.”[12] Composite materials have enhanced the MV-22 by providing a strong, safe aircraft at reduced weight.

In addition to composite technology, the full authority, triply redundant, digital, fly-by-wire flight control system is also a fundamental enabling technology for the "Osprey." Important advantages of the fly-by-wire flight control system are:[13]

1. Reduced system weight (711-lb)
2. Increased reliability
3. Enhanced fault detection/isolation
4. Increased damage tolerance through redundancy and physical separation
5. Enhanced safety through integration of active structural loads limiting

Three flight control computers (FCCs) form the hub of the system. The primary flight control system (PFCS) contains the control laws that provide the basic functions for flight throughout the V-22's envelope and full integration with the FADEC system. Laid on top of the PFCS is an automatic flight control system (AFCS) which provides stability and control augmentation for enhanced handling qualities.[14] The current optimized flight control system has resulted in acceptable pilot workload for all pilot tasks from maintaining a precise hover to flying fingertip formation. The digital, fly-by-wire flight control system greatly enhances the "Osprey's" capabilities.

The final enabling technology within the MV-22 is the integrated avionics system (IAS). The IAS links all aircraft systems and provides capabilities for communication, precise navigation, aircraft system control/monitoring, data processing, and sensor control.[15] At the hub of the IAS are dual redundant mission computers (MCs) that serve to process and control the systems. The flightcrew monitors and makes inputs into the IAS through four multi-function displays (MFDs), two cockpit display units (CDUs), and the engine instrument crew alerting system (EICAS) all located within easy reach of the pilot and copilot. Engineers designed the crew to aircraft interface to reduce pilot workload while maximizing situational awareness and mission flexibility. Taken as a system the IAS gives the flightcrew the capability to fly the aircraft, control their environment, and execute the mission with maximum effectiveness; the IAS is a key MV-22 technology.

Military Equipment, Capabilities, and Design

Combined with these enabling technologies are a host of military specific equipment, subsystems, and capabilities that make the MV-22 a mission capable, survivable platform. Military equipment includes an environmental control system (ECS) that permits operations in an NBC environment, onboard oxygen generating system, forward looking infrared radar (FLIR), cargo handling system, and an electronic warfare (EW) system. Other features that enhance military effectiveness and flexibility are shipboard compatibility, night vision goggle (NVG) compatibility, helicopter in-flight refueling (HIFR) capability, and aerial refueling capability. In addition to aerial refueling the V-22 may also be equipped with removable long-range fuel tanks giving the V-22 the ability to self-deploy anywhere in the world without requiring strategic air or sea lift. These military system enhancements and military specific systems take a capable basic aircraft and make it a militarily viable weapon system. Appendix A contains more details on these systems.

Within these military systems and imbedded throughout the aircraft design are military enhancing characteristics that significantly increase safety and mission effectiveness. The most prominent design characteristic is the emphasis on vulnerability reduction through redundancy, separation and ballistic tolerance. Most major subsystems are triply redundant. In addition to redundancy, designers separated the systems throughout the airframe to reduce the possibility of a single hit degrading capability. Where separation or redundancy was not possible designers reduced vulnerability through ballistic hardening.[16]

Figure 2. MV-22 in Conversion Mode

CV-22

AFSOC is purchasing the first variant in the "Osprey" family, the CV-22. The CV-22 is a MV-22 with system enhancements and additional equipment. The enhancements to existing aircraft systems and the additional equipment create new and strengthen existing capabilities. Systems upgraded include communication, fuel, and EW. The communications system was upgraded to include 4 radios, survivor locator (SL), and a Multimission Advanced Tactical Terminal (MATT), which receives near real-time battlefield and survivor information via satellite. The SL operates in conjunction with the combat survivor evader locator (CSEL) radio and integrates with the MATT and digital map to display survivor location. Engineers upgraded the fuel system with additional wing tanks giving the CV-22 an unrefueled combat radius of 500 nautical miles when performing the USSOCOM specified mission. The upgraded EW system now incorporates the newly developed Suite of Integrated Radio Frequency Countermeasures (SIRFC) which combines a powerful RF jammer with sensitive, passive warning receivers.[17] Although testing is yet to be conducted, the CV-22 EW system is designed to protect the aircraft in a medium threat environment.

In addition to these enhanced MV-22 systems, the CV-22 also incorporates a new and critical mission system, the terrain following/terrain avoidance (TF/TA) system. A Multi-Mode Radar (MMR), designated the APQ-174D, forms the nucleus of the TF/TA system and enables the CV-22 to fly at 300 feet above the ground in adverse weather without visual reference to the ground. Future development will lower this altitude to 100 feet. The TF/TA envelope encompasses most of the aircraft envelope extending from the "Osprey's" maximum forward speed down to 5 kt. Additionally, the TF/TA system includes a self-contained approach capability that uses flight director symbology that the pilot follows to take the CV-22 from a cruise flight condition to a 50 ft hover over a predetermined point defined by GPS coordinates. The TF/TA system will give the Special Operations Force (SOF) the capability to infiltrate denied territory at low level and in adverse weather thereby reducing exposure to the enemy. Taken as a whole these upgraded, redesigned and new aircraft systems greatly enhance the basic capabilities of the MV-22 and make it a capable SOF platform. Appendix A contains more detailed system specifications.

Performance

The systems, military capabilities, and enabling technologies combine to make the CV-22 and MV-22 an aircraft that successfully combines the capabilities and advantages of both a helicopter and an airplane. Table 1 shows important performance capabilities of the "Osprey."

Figure 3 shows the V-22 flight envelope in comparison to representative helicopter and airplane envelopes.

Table 1. Key V-22 Performance Capabilities

Maximum Airspeed	345 kt
Level Flight Cruise Airspeed	230 kt
Maximum Gross Weight	60,500-lb
Maximum Load Factor	3.9g
Out of Ground Effect Hover	47,709-lb (3900 ft/82°F)
Self-deployment Range	2100 nm (CV-22)
Mission Radius	500 nm(CV-22)
Service Ceiling	25,000 ft
Cargo Capacity–Internal	20,000-lb
Cargo Capacity-External	12,000-lb

Source: Dunford (p107)/ Schwartzenburg (p3,12)

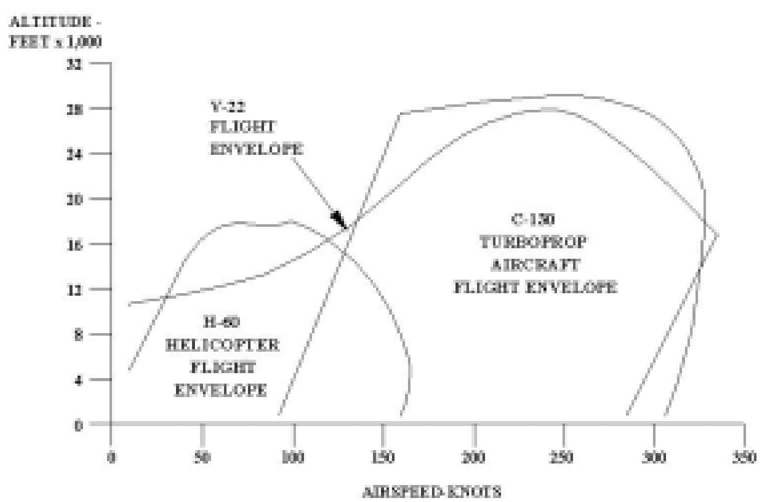

Figure 3. V-22 Flight Envelope

Notes

[1] *1999 World Book Encyclopedia – Deluxe Addition*, 1999ed., s.v. "helicopters."

[2] Bell Helicopter Textron, Inc. and Boeing—Philadelphia, *V-22…The Future is Here* (1997), 4.

[3] Carl Bauer, Associate Technical Fellow, Boeing Helicopters—Philadelphia, interviewed by author, 19 January 1999.

[4] Bell Helicopter Textron, Inc. and Boeing—Philadelphia, 4.

[5] V-22 Program Office, *EMD (MV) Flight Test: Year End 1997 Revised LRE Schedule*, 9 December 1997.

[6] Bell Helicopter Textron, Inc. and Boeing—Philadelphia, *Rescue V—22: Concept Submittal for the Rescue Technical Planning Integrated Product Team Call for Concepts*, 1998, 7.

[7] Phil J. Dunford, Thomas L. Macdonald, and LtCol John Rudzis, "V-22 'Osprey' Engineering—Manufacturing Development (EMD) Flight Test: Challenges and Successes," *Forty Second Symposium Proceedings*, September 1998, 106.

[8] Jim Mitchell, Technical Fellow, Boeing Helicopters—Philadelphia, interviewed by author, 19 January 1999.

[9] Ibid.

[10] Bell Helicopter Textron, Inc. and Boeing—Philadelphia, 20.

[11] Captain Johnny K. Johnston, USAFR, "Osprey Development: Creating an Advanced Technology Industrial Base for the 21st Century," *V-22 Resource Manual*, revision 3, 4.

[12] Ibid, 4.

[13] Bauer.

[14] Bell Helicopter Textron, Inc., and The Boeing Company, Defense and Space Group, Helicopters Division, *V-22 Product Information Executive Summary* (1996), 15.

[15] Bell Helicopter Textron, Inc. and Boeing—Philadelphia, 24.

[16] Bell Helicopter Textron, Inc. and Boeing—Philadelphia, 12.

[17] Frank Colucci, "They Think, Therefore They Jam," *Vertiflite* 44, no. 4 (Fall/Winter 1998), 24.

Chapter 3

The MV-22 and the United States Marine Corps

> *The V-22 is on the cutting edge of aviation technology and represents an important first step in modernizing Marine Corps aviation for the battlefields of the 21st Century.*
>
> —Lt Gen Dake, USMC Deputy Chief of Staff for Aviation

Recognizing the unique abilities of a tiltrotor aircraft, the Marines have long been a powerful advocate for the MV-22 to perform both the amphibious combat assault and combat service support missions. The "Osprey" is the Marine Corps' highest acquisition priority and is essential to implement their new doctrine of Operational Maneuver from the Sea (OMFTS).[1] OMFTS articulates the vision for dealing with real world challenges in the next century by moving the focus of operations from the open ocean to maneuver in the littoral areas.[2] Marine Corps' doctrine emphasizes warfighting based on rapid, flexible, and opportunistic maneuver as a way to win in the uncertain, chaotic, and fluid environments of today's battlefields.[3]

> Maneuver warfare is a warfighting philosophy that seeks to shatter the enemy's cohesion through a variety of rapid, focused, and unexpected actions, which create a turbulent, and rapidly deteriorating situation with which the enemy cannot cope.[4]

Embedded in this concept of maneuver is the need for speed to seize the initiative, keep the enemy off balance and increase friction.[5] The MV-22 provides the Marine Air Ground Task Force (MAGTF) with the required operational and tactical mobility to execute this maneuver warfare called for in OMFTS.[6] The V-22 greatly enhances this concept of maneuver warfare in the Marine Corps due to its significantly increased range and speed as compared to the existing CH-46E and CH-53E medium and heavy lift helicopter fleet. The agility and flexibility of the MV-22 will enhance existing doctrine and improve both operational and tactical maneuver within the Marine Corps.

Operational Maneuver

Within the concept of operational maneuver the Marine Corps seeks "to gain an advantage over the enemy bearing directly on the outcome of the campaign or in the theater as a whole."[7] The MV-22 enhances operational maneuver by bringing two dynamic capabilities to the battlefield: self-deployment and increased speed and range.

The global self-deployment capability of the MV-22 enables the Marine Corps to project combat power rapidly anywhere in the world and directly to the battlefield. After a six-hour reconfiguration, the MV-22 can deploy worldwide in less than two days. For example, a deployment to the Southwest Asia theatre will take 26 hours when deploying from the East Coast of the United States.[8] When compared to today's deployments, a MV-22 fleet can arrive on scene at a world crisis 11 to 21 days earlier than a helicopter squadron deploying by sea.[9] The natural fallout of self-deployment capability is the significantly reduced requirement for strategic support. "When compared to a strategic air deployment (of a typical helicopter squadron), a self-deploying "Osprey" squadron saves four to six C-5 sorties."[10] The self-deployment capability and the ensuing reduced deployment footprint gives the Marine Corps and the theater commander increased maritime force closure. MV-22 self-deployment enhances Marine Corps operational maneuver.

In addition to self-deployment, the MV-22's speed and range enhances Marine Corps operational maneuver. The "Osprey's" speed and range significantly increases operational reach and timeliness of forward-deployed Marine Expeditionary Units (MEUs).[11] The "Osprey" will provide a new and more capable set of options to future operational planners.[12] Operation Eastern Exit is a perfect example highlighting the benefits and increased capabilities of the MV-22. Operation Eastern Exit was a Noncombatant Evacuation Operation (NEO) of the U.S. Embassy in Mogadishu, Somalia by a Navy/Marine Task Force in 1990. In conducting this mission, the *USS Trenton* detached from their Amphibious Ready Group (ARG) operating in the Persian Gulf and steamed towards Somalia. After traveling 1600 miles and still 460 miles from the embassy, two CH-53E helicopters launched to evacuate the embassy because of the rapidly deteriorating situation.[13] After aerial refueling twice at night, the helicopters arrived at the Embassy just as hostile forces were scaling the walls.[14] The mission was a success; however, further delay would have been disastrous. Overall, the mission lapse time was 87 hours and required risky daytime flying for the helicopter crews. Accomplishing this same mission with the MV-22 would have required approximately 7 hours to accomplish—more than a tenfold reduction in time—and could have been completed entirely under the cover of darkness.[15] This mission illustrates the greatly enhanced operational maneuver brought to the fight by the MV-22 due to both its speed and range.

Tactical Maneuver

In addition to an enhanced operational maneuver capability, the speed and range capabilities of the MV-22 will also strengthen tactical maneuver within the MAGTF. The "Osprey's" range expands the littoral maneuver space, and its speed increases operational tempo.

With the MV-22's range, commanders will be able to launch their vertical assault forces from over-the-horizon. This range advantage enables the ships to remain farther out at sea and keep them away from land-based threats and the mines normally associated with the littorals.

Additionally, the "Osprey's" range exposes more of the enemy's coastline to a possible assault. This increased area of influence spreads the enemy's defenses giving the Marines decreased resistance and maximizing the element of surprise. Finally, the increased range also gives commanders flexibility to select the most favorable landing zones (LZs). "If there were 5 potential LZs for the helicopter, there are likely to be 25 available LZs for the MV-22."[16] The increased range of the MV-22 greatly enhances the Marine Corps' ability to conduct the tactical maneuver within amphibious assault operations.

In addition to the MV-22's range, its speed also enhances tactical maneuver. The speed of the MV-22 allows the operational commanders to conduct and complete major assault operations under the cover of darkness. Additionally, the faster assault times will also increase the operations tempo by allowing for more sequential evolutions.[17] Finally, once on the battlefield, the Osprey's speed will give the commander the ability to move troops quickly to key areas in minimum time. This increased tempo will greatly benefit future operations and increase the probability of combat success.[18]

Taken together the speed and range of the MV-22 are combat multipliers that will enhance tactical maneuver. LtGen Dake stated that the MV-22 "allows Marines to strike deeper and quicker; it provides Navy ships adequate standoff distance in response to shore-to-ship missiles, underwater mines, and other developing threats, and also delays detection of the striking force."[19] The MV-22 also enhances operational maneuver giving combat commanders the flexibility and agility to accomplish a wide range of theatre missions.

Notes

[1] LtGen Terrence R. Dake, "Status of Marine Aviation," *Marine Corps Gazette*, May 1998, 18.

[2] MajGen John E. Rhodes, "The V-22 Procurement Rate Problem," *Marine Corps Gazette*, September 1996, 61.

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[3] Marine Corps Doctrine Publication (MCDP) 1, *Warfighting*, 20 June 1997, 72.
[4] Ibid, 73.
[5] Ibid, 74.
[6] Dake, 18.
[7] Marine Corps Doctrine Publication (MCDP) 1-2, *Campaigning*, 1 August 1997, 78.
[8] Bell Helicopter Textron, Inc. and Boeing—Philadelphia, *Rescue V—22: Concept Submittal for the Rescue Technical Planning Integrated Product Team Call for Concepts*, 1998, 17.
[9] Rhodes, 63.
[10] Ibid, 63.
[11] Maj Timothy G. Hanifen, "V-22 'Osprey': There is No Alternative," *Marine Corps Gazette*, May 1995, 35.
[12] LtCol James D Hildreth, "War with the "Osprey": Technology and the Limits of Vision in Warfare," Research Report (Newport, RI: Naval War College, 17 June 1994), 20.
[13] Rhodes, 62.
[14] Bell Helicopter Textron Congressional Affairs Office and Boeing Congressional Affairs, *V-22 Resource Manual, Rev 3,* 2-15.
[15] Rhodes, 62.
[16] LtGen Keith A. Smith and RAdm William Smedberg, "COEAs, Scenarios, and the V-22," *Marine Corps Gazette*, May 1994, 54.
[17] Hanifen, 35.
[18] Loren Thompson, "Marine Corps Tilts into the Future," *Sea Power*, November 1997, 46.
[19] Dake, 18.

Chapter 4

The CV-22 and US Special Operations Command

> *We are excited about this airplane. We are basing our future capability to infiltrate and exfiltrate for US Special Operations Command on the CV-22. We have a requirement to be able to infiltrate and exfiltrate in one period of darkness—from night to early morning—and the CV-22 gives us the speed and range necessary.*
>
> —Maj Gen James Hobson, Commander, AFSOC

Just as the Marine Corps will profit from the unique capabilities of the MV-22, USSOCOM also stands to benefit from this emerging technology. The CV-22 will give them new capabilities with which to conduct their missions and erase many long-standing Special Operations Forces (SOF) deficiencies.

USSOCOM Mission

USSOCOM is organized, trained, and equipped to perform nine primary missions: direct action, special reconnaissance, foreign internal defense, unconventional warfare, combating terrorism, psychological operations, civil affairs, counterproliferation of weapons of mass destruction, and information operations.[1] Accomplishing these missions often requires deep (beyond 400 nautical miles) penetrations into hostile or denied territory by SOF aircraft.[2] Additionally, the missions are most often clandestine; enemy knowledge of the mission is often enough reason to abort or cancel an operation. This demand for secrecy has forced SOF crews to conduct their missions at night and at low level. Furthermore, SOF combat crews require robust electronic warfare capability to penetrate denied airspace and defeat enemy air defenses. Finally, due to the often time critical nature of the missions, weather cannot be a limiting factor for mission accomplishment. SOF aircraft must be capable of operating in adverse weather conditions. In summary, a SOF platform must be capable of deep, clandestine penetrations of denied territory in adverse weather. The CV-22 with its long range, extensive EW suite, and TF/TA system combined with its unique tiltrotor attributes has the capabilities to enhance USSOCOM's ability to conduct their primary missions.

SOF Deficiencies

With the CV-22, USSOCOM will be able to perform their primary missions better. The nine missions listed above often involve long infiltration and exfiltrations (infil/exfil) of denied airspace. A primary operational SOF mission profile is to extract SOF personnel and American citizens from deep behind enemy lines. Currently, successful accomplishment of this mission is unlikely due to three deficiencies with the current aircraft inventory:[3]

- Inability to execute a significant number of major regional contingency (MRC) and national missions without incurring additional support requirements and an increased operational signature (e.g., numerous in-flight refueling sorties) due to limited unrefueled ranges and combat radii.
- Inability to complete MRC and national missions clandestinely within one period of darkness due to limited airspeed capability.
- Limited growth for self-protection avionics systems due to space/weight constraints.

These shortfalls result in USSOCOM having a diminished probability of successfully accomplishing this mission along with an increased risk to SOF personnel.[4] "The extraction of SOF and other personnel from behind enemy lines or contested airspace is US Commander in Chief Special Operation Command's priority one SOF capability shortfall, and the CV-22 is being acquired to meet his shortfall."[5] The capabilities of this aircraft successfully correct the three deficiencies inherent in the current USSOCOM aircraft inventory. The "Osprey's" 500 nm, unrefueled combat radius will reduce the chances of mission compromise by reducing the need for aerial refueling. The CV-22's 230 kt cruise speed will enable combat crews to accomplish the mission within one period of darkness. Finally, the upgraded EW suite will provide sufficient self-protection during these long missions. Taken as a whole this aircraft erases several shortfalls with the current aircraft inventory and enhances USSOCOM's ability to execute the long-range infil/exfil mission.

The CV-22's unique capabilities are new to USSOCOM. These qualities erase current deficiencies and give this combative command a higher probability of successful mission accomplishment.

Notes

[1] Joint Publication (JP) 3-05, *Doctrine for Joint Special Operations*, 17 April 1998, viii.
[2] *AFSOC CV-22 Command Management Action Plan (CMAP)*, 15 August 1998, 10.
[3] Ibid, 3.
[4] Ibid, 3.
[5] Ibid, 10.

Chapter 5

The CV-22 and Combat Search and Rescue

Asking what good is the CV-22 is like asking what good is a newborn baby. It can do almost anything you can imagine, and I have a big imagination. I see a big role. It will have a major role in SOF, in short-range airlift, and in combat rescue, and it will have a major role in low-intensity conflicts of all sorts. It will be an amazing airplane.

General Duane H. Cassidy

In addition to furthering the capabilities of USSOCOM to conduct a critical mission and increasing the operational and tactical maneuver capacity for the Marine Corps, the unique character of the V-22 will also greatly enhance CSAR within the Air Force. The current CSAR capability and equipment within the Air Force is deficient; the CV-22 can correct these deficiencies and advance the state of the art. The "Osprey" will also further two core competencies of the Air Force, global attack and global rapid mobility.

Air Force CSAR – Current State of the Art

Definition

CSAR is "a specific task performed by rescue forces to effect the recovery of distressed personnel during major theater war or military operations other than war (MOOTW)."[1] Although the Air Force, organizes, trains, and equips forces to conduct CSAR operations throughout the range of military operations, the Air Force's emphasis in this mission area is the recovery of downed crewmembers (DCMs). DCMs are the most likely Air Force personnel to require rescue.[2] "CSAR is an integral part of US combat operations."[3] Successful accomplishment of CSAR enhances combat capability by sustaining morale, denying a source of intelligence to the enemy, and returning key personnel to fight another day.[4] Meeting this objective requires CSAR forces capable of locating, communicating with, recovering, and medically treating survivors in adverse weather and non-permissive threat environments over land and water.[5]

Equipment and Deficiencies

Presently, the Air Force is equipped to conduct CSAR using HH-60G helicopters as the primary recovery platform. The helicopters in this rescue fleet are aging and have limited capability. Air Combat Command (ACC) considers the capability limitations to be top ranked deficiencies. Deficiencies include threat susceptibility, poor tactical adverse-weather penetration, limited combat radius, insufficient situational awareness, restricted payload space, and less than adequate mission reaction time.[6]

Need

Because of these deficiencies, ACC presented a Mission Need Statement (MNS) to the Joint Requirement Oversight Council (JROC) outlining the deficiencies and requesting validation of the need. ACC's top priority in the CSAR mission area is to fix these deficiencies.[7] One of the non-developmental, materiel alternatives presented by ACC to correct the shortfalls was the CV-22.[8] From a capabilities viewpoint and when compared to other materiel alternatives, both modernization of existing equipment and off-the-shelf procurement, the CV-22 is the most promising solution. Because of the much higher speed of the tiltrotor, the CV-22 is more responsive and as a result superior to all other non-developmental alternatives.[9]

CV-22 CSAR – Advancing the State of the Art

Using the CV-22 as a recovery platform will advance the state of the art in CSAR by correcting the current deficiencies and consequently increase responsiveness. The CV-22 is a survivable aircraft that can operate in adverse weather at long ranges while giving the rescue crew superior situational awareness. Payload capacity is not a limiting factor with the "Osprey," and the speed of the aircraft significantly reduces mission reaction time. The CV-22 will also drive significant changes in current CSAR doctrine and give CSAR forces new ways to accomplish their mission—new doctrine for future CSAR.

Correcting Deficiencies

The "Osprey" addresses and corrects each the deficiencies present in the HH-60G rescue fleet.

Threat Susceptibility/Survivability. The CV-22 is survivable. The design incorporates maximum use of redundancy along with separation and hardening of critical systems when redundancy is not possible. Additionally, the electronic warfare suite, which includes a jammer, further reduces threat susceptibility. The aircraft also protects the crew and passengers while operating in an NBC environment. Finally, the increased enroute airspeed, almost twice that of helicopters, reduces exposure time and increases survivability. Combined, these factors will drastically reduce aircraft losses due to enemy threats. Models of the "Osprey" in a combat environment predict loss rates of one-third to one-half that of the HH-60G.[10] These models, however, require many assumptions that are germane to the outcome. Upcoming developmental and operational flight tests will verify or disprove these assumptions and determine actual threat susceptibility.

A major factor that gives the CV-22 its increased survivability is airspeed. At twice the speed of helicopter, threat systems have half the time to acquire, track, and engage the CV-22. However, this advantage is not present when the "Osprey" reconverts to helicopter mode and operates in and around the rescue site or landing zone. In this environment, the CV-22 is a large, slow target that must rely on its other vulnerability reducing characteristics mentioned earlier to survive. Furthermore, from a qualitative evaluation, the CV-22 is less maneuverable than a typical helicopter in the slow airspeed regime. Repositioning and hovering in the zone to affect a pickup may take 15 to 30 seconds longer than performing a similar maneuver in a helicopter. This is increased exposure time during a vulnerable phase of the mission. The "Osprey" offsets this disadvantage either partially or fully with its quicker acceleration out of the zone.[11] Preliminary performance data shows that the CV-22 can accelerate from a hover to 200 kt in less than 40 seconds.[12]

Adverse Weather. The CV-22's TF/TA system enables rescue crews to conduct CSAR operations in adverse weather conditions. This capability will keep time to rescue at minimum by reducing weather delays. The CV-22 is more responsive due to its adverse weather capability.

Combat Radius. "During DESERT STORM there were 38 downed Coalition aircraft and many downed crew members. Several downed crew members ejected over or near heavily fortified Iraqi positions, deep inside Iraq, making rescue attempts impossible due to distances involved and the enemy situation."[13] A standard rescue configured HH-60G has a 230 nm combat radius (unrefueled).[14] The CV-22 on the other hand can pick up four DCMs at 600 nm without tanker support.[15] This increased capability gives military planners the luxury to expand their area of operations while retaining responsive CSAR capability.

Situational Awareness. The IAS of the CV-22 greatly enhances situational awareness for the CSAR crew. With the real-time battlefield and survivor information integrated with the digital map and the complete suite of communications capability (clear and secure) the rescue crew has everything at their disposal to plan and execute the CSAR mission. This onboard mission planning capability will reduce mission reaction time by giving the crew the capability to plan enroute with the latest battlefield information.

Payload Space. The CV-22 can carry 24 troops. This large cabin space gives the "Osprey" the ability to conduct multiple rescue missions without aborting due to cabin space considerations. Current doctrine does not consider this possibility since the HH-60G can only recover two or three DCMs before the cabin is full.[16] Therefore, current doctrine assumes rescue crews will perform only one rescue before returning to base. The larger cabin will also provide more room for additional rescue and/or medical equipment.

Mission Reaction Time. Getting to a survivor in minimum time is an essential aspect affecting a successful rescue operation. Historical data reveals that probability of rescue decreases exponentially with time.[17] Although the specific relationship between rescue probability and time is dependent on environment and threat, the general relationship is consistent throughout CSAR history. Rescue crews often talk about the "golden hour" which refers to the first hour of a survival situation. If a rescue platform can get overhead within the first hour, the chances for success are greatly increased.[18] Reaction time, time to rescue, is a function of three items: notification/mission planning time, enroute time, and delay time due to aircraft availability/weather. A survivable rescue vehicle that minimizes reaction time will provide a greater possibility of mission success.[19] The inherent capabilities of a tiltrotor with its greater speed, range, and radius combined with its onboard mission planning and adverse weather penetration capabilities will significantly reduce reaction time. The CV-22 is more responsive.

Summation. Taken as a whole the CV-22 is significantly more effective than the H-60 in conducting CSAR. ANSER INC. reached this conclusion after conducting an extensive analytical study that compared the HH-60G to the CV-22 conducting the CSAR mission in an Operation Desert Storm environment. Because the evaluation was limited to one scenario, the results are not definitive; however, the trends are valid. Specifically, ANSER found that the "Osprey" achieved approximately three times the number of saves per downed rescue crewmember. Furthermore, they found that the more qualitatively demanding the rescue environment, the greater the advantage of the CV-22. A third conclusion reached by the study was that the "Osprey" provided greater operational flexibility in CSAR planning. Finally, the study concluded that the CV-22 eliminates CSAR dependence on aerial refueling in the given scenario.[20] With a 600 nm combat radius, the CV-22 eliminates the need for aerial refueling. Overall, the "Osprey's" capabilities combine making it a capable, responsive rescue platform that is a leap forward from the current technology in use.

Advancing Current Doctrine

In addition to fixing current deficiencies, the "Osprey" can also enhance CSAR doctrine at the operational level. Operational doctrine for the conduct of CSAR is contained in Joint Publication 3-50.21, *Joint Tactics, Techniques, and Procedures (JTTP) for Combat Search and Rescue*, and Air Force Doctrine Document (AFDD) 2-1.6, *Combat Search and Rescue*. The doctrine is a product of current capabilities and limitations. However, with tiltrotor technology, the Air Force must advance doctrine to take advantage of the new capabilities. Two areas where the new capabilities of and technologies in the CV-22 will lead to doctrinal changes are in the Combat Search and Rescue Task Force (CSARTF) and in command and control of rescue forces.

Combat Search and Rescue Task Force (CSARTF). The CSARTF is simply a group of aircraft placed together to perform a combat rescue mission. JP 3-50.21 states: "Multiple assets and forces committed to a single CSAR operation are referred to as a CSARTF."[21] The size and makeup of the force will vary with the situation but will always consist of recovery vehicles plus supporting aircraft. The supporting aircraft may include fighter escort, tankers, and/or command and control based on the situation and mission. In total, the task force can be as large as 20 aircraft working together to affect one rescue.[22]

Recovery Vehicles. An essential part of the CSARTF is the recovery vehicles, the aircraft charged with the actual pickup of the DCM. AFDD 2-1.6 states: "typically, a primary and a secondary recovery vehicle are flown to the objective area to make the pickup. The formation provides a backup mission aircraft and offers mutual support should the primary recovery vehicle encounter problems."[23] Characteristics of the CV-22 may drive a change in this doctrine. If the CV-22 is as survivable and reliable as predicted, a second aircraft may no longer be necessary. Although a controversial idea, if this doctrinal change is adopted, the Air Force will see cascading benefits in reduced force structure requirements. However, if rescue crews still desire a second aircraft, the CSARTF can use the "Osprey's" speed to their benefit. The secondary aircraft can loiter well away from the objective area or at altitude (CV-22 service ceiling is 25,000 ft) and away from enemy threats and dash to the scene if needed. Additionally, a backup aircraft at altitude could serve as a communication relay or command ship for the mission. Either of these doctrinal changes will decrease friendly forces exposed to the enemy thereby reducing losses of rescue assets.

Rescue Escort (RESCORT). Another important member of the CSARTF is RESCORT. Current doctrine calls for RESCORT aircraft to accompany recovery aircraft on CSAR missions to provide "navigation assistance, armed escort, and assist in locating and authenticating isolated personnel."[24] Typical RESCORT aircraft are A-10s and F-16s. The RESCORT flight lead is most often designated the on scene commander.[25] In the past, this service was required because the RESCORT aircraft had more capabilities in navigation and communication than the recovery vehicles. However, with the CV-22 the tables are now turned. The CV-22, with its integrated navigation suite combined with real-time battlefield and survivor information, now has the complete picture of the combat environment. Additionally, with a crew of three and a robust communications suite, the rescue "Osprey" has the manpower and equipment to deal with a dynamic battlefield environment. The Air Force must rethink the purpose and mission of RESCORT based on the new and improved capabilities of the recovery vehicle. The crew of the CV-22 may be the right choice to serve as the on scene commander and take over many of the responsibilities formerly performed by RESCORT aircraft.

Fixed-Wing Rescue Assets. A third type of aircraft often used within the CSARTF are fixed-wing assets. Currently the Air Force uses HC-130s in this role. AFDD 2-1.6 states:

> Fixed-wing tanker-capable rescue assets are a key element of CSAR operations and play a critical role in extending the operational range of air refuelable helicopters. Optimally, fixed-wing rescue assets should be capable of air dropping personnel and equipment to isolated personnel should recovery efforts be protracted.[26]

The ANSER study showed that the CV-22 significantly reduces or eliminates CSARTF dependence on fixed-wing rescue assets. With the CV-22 in the inventory, the HC-130s no longer possess unique capabilities from the recovery aircraft except for aerial refueling. However, with the extended range of the CV-22, the CSARTF will rarely require that capability. In the Southwest Asia scenario, ANSER found that the 35 rescue MC-130s required for an HH-

60G rescue fleet were not required for a CV-22 rescue fleet.[27] Therefore, planners can eliminate fixed-wing assets from most rescue missions serving to both reduce complexity and expose fewer rescue personnel and assets to the enemy threat.

Command and Control. The CSARTF is the force that affects the rescue; however, the command and control for the effort within the Air Force resides with the RCC that works hand in hand with the Joint Search and Rescue Center.[28] AFDD2-1.6 refers to the RCC as the "hub of rescue activities."[29] Currently two duties of the RCC are to initiate CSAR planning and maintain real time intelligence on systems posing threats to CSAR activities.[30] Upon notification of an Air Force rescue situation, the RCC assumes CSAR mission coordinator responsibilities, performs initial mission planning, and coordinates the appropriate CSAR forces and assets. This coordination cycle is extensive and requires extensive time often measured in hours not minutes.[31] However, with the enroute planning capability and real-time battlefield information available on the "Osprey," the CV-22 gives the rescue crew the capability to fulfill roles currently conducted by the RCC. If the RCC allows the rescue crews to conduct initial planning, the rescue crew could launch quicker and arrive at the rescue site in less time. The mission planning capabilities of the CV-22 can result in reduced elapsed time to rescue. Command and control of CSAR forces must evolve to exploit the new capabilities and the agility inherent in the "Osprey."

Creating New Doctrine

In addition to evolving current doctrine to enhance CSAR, the CV-22 will lead to new CSAR capabilities and doctrine. Three possible areas for advances are attack force packaging, organic refueling, and inter-meteorological conditions (IMC) CSAR.

Strike Force Packaging. With the higher speed and altitude capabilities of the CV-22, planners could assign these rescue assets to strike packages. The CV-22 could fly a loose escort within the strike package, loiter within theatre at altitude, and wait for a rescue situation to develop. From its position on the "perch," the CV-22 could then dive at 300 knots and arrive over the survivor in minimum time to affect the rescue.[32] During the rescue, other aircraft in the strike package could change missions and serve as RESCORT protecting the CV-22 during the pickup phase and escorting it out of danger. With this concept, each strike package will contain its own organic rescue capability. A variation on this same idea is to have CV-22s flying a rescue cap much like fighter caps that are flown in today's operations. Planners could position and support the rescue cap so that the CV-22 crew could perform rescue operations at a moment's notice.

Organic Refueling. In addition to the concept of strike force packaging, the CV-22 can also provide new opportunities if used as an organic tanker. Bell and Boeing Helicopter have proposed to equip the "Osprey" with an aerial refueling kit. Equipping the CV-22 with this kit would give the CSARTF organic refueling capability of up to 14,000-lb at a 200 nm radius or 10,000-lb at 400 nm.[33] As a refueling platform, the aircraft could add range to the recovery aircraft, extend on station time for a loitering rescue aircraft, or refuel after survivor recovery. Refueling after recovery will allow the rescue aircraft to conduct the rescue with minimum fuel giving it an increased hover capability and safety margin. These functions are possible with the current fleet of tankers; however, the CV-22 brings an added benefit. A tanker equipped "Osprey" could also serve as the secondary recovery platform. Serving as an organic tanker, recovery aircraft, and command ship points to the flexibility and agility that the CV-22 brings to the CSAR mission.

IMC CSAR. Finally, the CV-22, with its TF/TA system, gives rescue forces the added capability of performing rescue operations in the weather. The MMR in the CV-22 gives the "Osprey" the ability to fly in almost any weather conditions. Planners must develop doctrine for RESCORT during missions where the CV-22 is flying in the weather. In these conditions, the clouds will prevent traditional escort procedures. However, the weather will also keep the enemy from acquiring the CV-22 visually. Therefore, appropriate RESCORT for this situation will be radar defeating aircraft flying in a loose formation with the rescue aircraft.[34]

CV-22 CSAR—Air Force Core Competencies

In addition to enhancing and changing CSAR doctrine, the CV-22 can also enhance two Air Force core competencies: global attack and rapid global mobility. Although core competencies are not doctrine, they are enablers of doctrine. Core competencies are "at the heart of the Service's contribution to our nation's total military capabilities."[35]

Global Attack. The Air Force has the ability with its fleet of armed bombers and strike aircraft supported by a large tanker fleet to strike targets anywhere in the world at any time. This core capability speaks to the ability of performing strike missions on a global scale from a peacetime basing posture. With global attack, crews carry out strike missions from a world setting as opposed to a theatre lay down. A good example of this capability was "El Dorado Canyon." In this mission, F-111s launched from England, flew nonstop to attack Libya, and then recovered to their home base in England. In the Expeditionary Air Force (EAF) concept, bombers will launch from stateside locations, fly to the target, drop their ordinance, and return to their home base. The CV-22 has the capability to support these types of missions. With its 600 nm unrefueled rescue radius, the "Osprey" can deploy to ships or locations close to the target but sufficiently removed in order to not compromise mission secrecy and perform quick reaction

CSAR missions. In addition to providing CSAR coverage at the target, CV-22s could provide enroute rescue capability throughout the route of flight; one CV-22 could cover 1200 nm of the route. The “Osprey” is an enabler of Global Attack within the Air Force.

Rapid Global Mobility. In addition to enhancing global attack, the CV-22 will also strengthen rapid global mobility. “Rapid global mobility refers to the timely movement, positioning, and sustainment of military forces and capabilities through air and space, across the range of military operations.”[36] The self-deployment capability of the CV-22 provides the timely movement referred to in this definition as well as the sustainment of military forces by being in place early in a contingency to support the earliest strike missions in theatre. The self-deployment capability also releases strategic airlift assets for use by other units. Deploying a 24 aircraft HH-60G rescue force to a theatre of operations requires 6 C-5 sorties and 24 C-141 sorties. However, the same rescue coverage can be had with 11 self-deployable CV-22s that require only 9 C-141 sorties for transport of personnel and supplies.[37] Being on station ready to support operations while freeing strategic airlift assets for other jobs enhances the Air Force’s core capability of rapid global mobility.

Summary

From enhancing core competencies to creating new and furthering current doctrine, the CV-22 will greatly benefit Air Force CSAR. The “Osprey’s” increased range and speed combined with significant onboard capabilities gives this unique aircraft the responsiveness that is critical for CSAR operations. The “Osprey” will correct existing CSAR deficiencies and reduce or eliminate tanker force requirements. Proper integration of the CV-22 into the CSAR mission will drastically reduce time to rescue and increase rescue efficiency. The CV-22 is an excellent match for the CSAR mission, and the Air Force would greatly benefit from the combination.

Notes

[1] Air Force Doctrine Document (AFDD) 2-1.6, *Combat Search and Rescue*, 30 September 1998, 1.

[2] Ibid, 1.

[3] Ibid, 60.

[4] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, 60.

[5] Gen Richard E. Hawley, Mission Need Statement, CAF 315-97 for HH-60G Combat Search and Rescue (CSAR) Aircraft Replacement (ACAT Level I), 5 October 1998, 1.

[6] Maj Alvin Drew, HQ ACC/DR, JROC Review Brief, 11 December 1998.

[7] Hawley, 2.

[8] Drew.

[9] Ibid.

[10] ANSER Inc., "An Analysis of V-22 and H-60 Effectiveness for the Combat Search and Rescue Mission," prepared for Defence Evaluation and Research Agency (DERA) (Farnbourough UK), September 1997, 48.

[11] Major Tim Healy, Commander, Detachment 1, 418 Flight Test Squadron, Patuxent River NAS, interviewed by author, 5 Feb 1999.

[12] Bell Helicopter Textron, Inc. and Boeing—Philadelphia, *Rescue V—22: Concept Submittal for the Rescue Technical Planning Integrated Product Team Call for Concepts*, 1998, 57.

[13] Joint Publication (JP) 3-50.21, *Joint Tactics, Techniques, and Procedures for Combat Search and Rescue*, 23 March 1998, I-3.

[14] Bell Helicopter Textron, 49.

[15] Ibid, 50.

[16] Healy.

[17] ANSER Inc., 3.

[18] Healey.

[19] Drew.

[20] ANSER Inc., 55.

[21] Joint Publication (JP) 3-50.21, II-12.

[22] Healey.

[23] Air Force Doctrine Document (AFDD) 2-1.6, 14.

[24] Ibid, 15.

[25] Ibid, 13

[26] Ibid, 14.

[27] ANSER Inc., 54.

[28] Ibid, 18.

[29] Ibid, 9.

[30] Ibid, 9.

[31] Healey.

[32] Healey.

[33] Bell Helicopter Textron, 19.

[34] Healey.

[35] Air Force Doctrine Document (AFDD) 1, 27.

[36] Ibid, 33.

Notes

[37] ANSER Inc., 58.

Chapter 6

Conclusion

Today's post Cold War environment has changed dramatically, and the US military must now counter a variety of threats.

> The US must prepare to face a wider range of threats, emerging unpredictably, employing varying combinations of technology, and challenging us at varying levels of intensity.[1]

To counter this new and often asymmetric threat, the Air Force is shifting to an expeditionary approach in order to respond around the world. The focus is now on Global Engagement through flexible response.[2] The cornerstone of the EAF is rapid deployment of appropriately structured forces to counter real-world threats in support of the combative CINCs. Part of that force will include the ability to conduct CSAR.[3]

The radical shift of technology in and the capabilities of the CV-22 support this new approach to warfare. The flexibility of self-deployment combined with the agility to conduct CSAR missions deep behind enemy lines in adverse weather gives the Combative CINCs the necessary tool to accomplish the mission. The CV-22 corrects the current deficiencies of CSAR and advances the state of the art in this mission area. Integration of the CV-22 into the CSAR mission will eradicate current mission deficiencies in threat susceptibility, adverse weather penetration, combat radius, situational awareness, payload space, and mission reaction time. Additionally the CV-22 will change and enhance the execution of CSAR through advances in both CSARTF and command and control doctrine. The CV-22 will also give the Air Force new and better ways to perform the mission. Finally, the CV-22 will enhance two Air Force core competencies: global attack and rapid global mobility. Supporting these core competencies of the Air Force will in turn lead to supporting and furthering the aims of Joint Vision 2010 by enhancing dominant maneuver, focused logistics, and full-dimensional logistics. The CV-22 is the aircraft that can make CSAR a viable function for the Air Force.

This paper was the first step in the necessary process of developing CSAR doctrine for the CV-22. Future studies in this area need to focus, in depth, on specific doctrinal changes and enhancements that will result if the Air Force uses the CV-22 as the next rescue platform. Tactical employment, operational doctrine, and force structure changes are three areas that need further study. With a radical shift in technology such as is present in the CV-22 it is not sufficient to do what we have always done. Doctrine must evolve to exploit the new capabilities and use the technology to make our forces more effective on the battlefield. If the CV-22 attains IOC as a CSAR platform, the doctrine needs to be in place to support and exploit the unique and greater capabilities of the aircraft. The 422nd Test and Evaluation Squadron at Nellis AFB has the rescue expertise to conduct this research and should take the lead in this area. To gain the aircraft expertise, the CSAR School should work in concert with the 418th Flight Test Squadron at Edwards AFB, the Air Force Operational Test and Evaluation Center (AFOTEC), and the 18th Test Squadron at Hurlburt AFB. These three organizations are currently conducting both the developmental and operational testing for the CV-22, and can provide a wealth of current and accurate information.

Notes

[1] Joint Vision 2010, 11.

[2] General Michael E. Ryan, "Expeditionary Aerospace Force, A Better Use of Aerospace Power for the 21st Century," 1998.

[3] Ryan.

Appendix A

V-22 "Osprey" Facts[1,2,3]

Aircraft Characteristics

Note: Items in *italics* are CV-22 specific numbers.

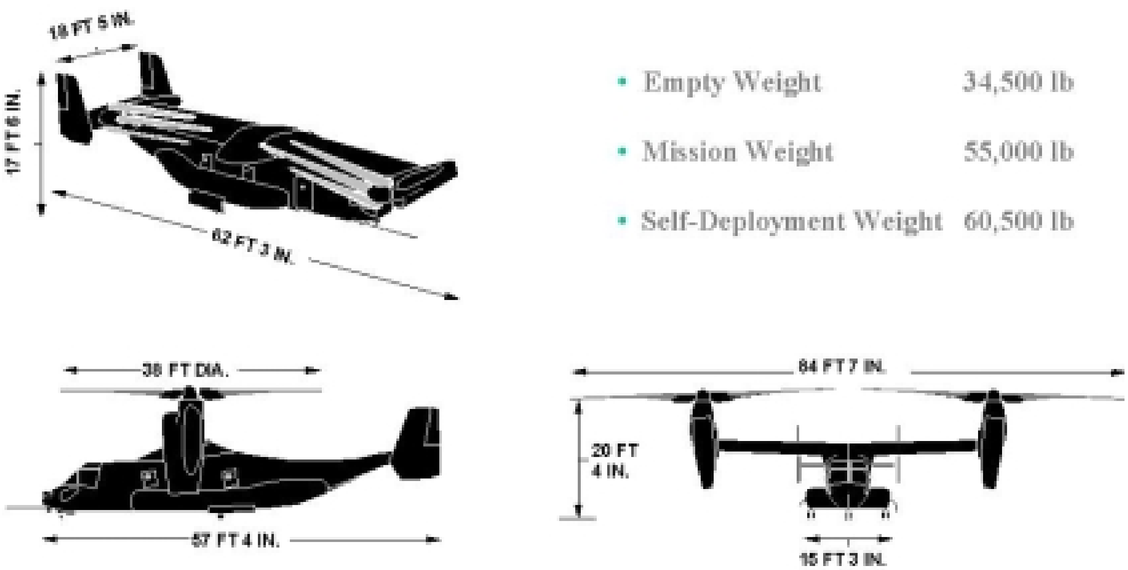

Figure 4. V-22 Size and Weight

Aircrew

- Pilot and copilot
- Flight Engineer (1 or 2 based on mission)

Speed

- 230 kt cruise
- 270 kt dash
- 345 kt/.6 Mach (max flight test)

Range/Radius

- *500 nm mission radius (without cabin tanks)*
- *2100 nm self-deployment range without refueling (cabin tanks)*

Payload

- 24 troop seats (16G crashworthy)
- 32 troops floor loaded
- 12 liters
- 2000-lb winch and pulley system and roller rails
- 20,000-lb internal load
- 463L (2) half pallets at 5,000-lb each
- External load - 10,000-lb single hook/12,000-lb dual hook

Rescue Hoist

- Hydraulically powered integrated hoist, boom, and sheave head assembly
- Installed at the forward cabin bulkhead adjacent to the cabin door
- Normally stowed inside the cabin and manually rotated to position the boom and sheave head outside the cabin for hoist operations
- Capable of lifting 600-lb at variable cable speeds of 25 to 250 ft/sec
- In addition to rescue hoist, capable of alternate insertion/ extraction using fast rope, special insertion and extraction (SPIE) rig, or rappelling ropes

Airframe

- Constructed by weight from carbon graphite epoxy composite laminates(43.7%), fiberglass (3.4%), metals (46.1%), and other materials (6.8%)
- Composites provide a 22% weight savings over traditional metals, infinite fatigue life, and will not corrode over time

Engine System

- Powered by 2 Allison T406-AD-400 turboshaft engines
- Produce over 6200 shp each at 100% Np
- 14 stage axial compressor, two-stage gas generator, two-stage power turbine
- APU T-62T-46-2 required for preflight, engine start and blade fold wing stow

Fuel System

- Automatic, crashworthy system comprising five subsystems: management/ gauging, fuel storage, distribution, fuel transfer and cross transfer
- 2 Engine feed tanks (600-lb each), *two wing auxiliary tanks (2000-lb each)*, left and right forward sponson tanks (3250-lb each), right aft sponson tank (2150-lb), 3 cabin ferry auxiliary tanks (4200-lb total)
- MV-22 total fuel: 9850-lb
- *CV-22 total fuel: 13,850-lb*
- All tanks fully nitrogen inerted and self-sealing

Drive System/Proprotor System

- Comprised of 5 gearboxes: 2 tiltaxis gearboxes, 2 proprotor gearboxes, 1midwing gearbox
- Composite driveshafts run from each proprotor along the back of the wing
- Drive system power transfer ensures continuous operation of both proprotors in the event of single engine failure
- 3 bladed, 38 feet diameter proprotor assembly is a semi-rigid, underslung, teetering, rotor system

Hydraulic System

- 3 independent 5000 psi systems
- No. 1 and No. 2 systems are dedicated flight control systems
- No. 3 system used for flight controls or utility systems
- Loss of one system will not degrade system operation and failure of a second system will not result in a hazardous loss of control responses

Blade Fold Wing Stow

- Provides full shipboard compatibility
- First aircraft with a wing that can be rotated parallel to the fuselage to create a rectangle necessary for operation and storage aboard ships
- Electrically controlled an hydraulically actuated to rotate the wing assembly and fold the blades in approximately 90 seconds

Flight Control System

- Fly-by-wire design
- Triply Redundant
  - 3 digital flight control computers
  - 3 independent channels
  - Redundant actuator assignments
- Hydraulic Actuators
  - 6 swashplate actuators
  - 8 flaperon actuators (4 each side)
  - 2 rudder acutators (1 each side)
  - 3 elevator actuators
  - 2 conversion actuators (1 each side)

Electrical System

- AC system provides 115/200 vac, 3 phase, 400 hz power from 4 oil cooled generators
- DC system provides 28 vdc through 3 regulator converters
- System consists of 2 constant frequency generators, 2 variable frequency generators, and a single 24 vdc lead acid battery

Environmental Control System

- Provides cockpit heating and cooling
- Provides dry filtered air and cabin overpressurization (pressure differential between the aircraft and environment) enabling the V-22 to operate within a nuclear, biological, and chemical (NBC) environment

Cockpit Management System

- Glass cockpit
- No dedicated gauges for instrument readout
- Four Multi-Function Color Displays (MFD)
- Two Control Display Units (CDU) with keyboards
- One Engine Instrument Crew Alerting System (EICAS)

Avionics Systems

- *AN/APQ-174D Multi-Mode Radar (MMR)*
  - *Terrain Following/Terrain Avoidance (TF/TA) radar*
  - *Weather avoidance*
  - *Ground mapping*
  - *Low power/low velocity operation*

- *Air to ground ranging*
- *AN/ALQ-211 Suite of Integrated RF Countermeasures SIRFC*
  - *Provides real time situational awareness to aircrews and battlefield commanders*
  - *Fuses on and off board sensor threat data*
  - *RF jamming and warning capability will reduce RF expendable requirements*
- *AN/ALE-47 Chaff/Flare Dispenser Set*
  - *Automatic and manual dispensing*
  - *Five dispensers*
- *Multi-Mission Advanced Tactical Terminal (MATT)*
  - *Radio Terminal for UHF Satellite Communications*
  - *Provides received threat data directly to CV-22 avionics for improved mission replanning and threat avoidance*
- *Survivor Locator (SL)*
  - *Operates in conjunction with Combat Survivor/Evader Locator (CSEL) radio*
  - *Integrated with MATT and digital map (displays location)*
- Integrated Navigation Suite
  - Global Positioning System (GPS)
  - Triply redundant inertial navigation system (INS)
- *Enhanced Digital Map*
  - *Integrated with MATT*
  - *Shows aircraft present position on real time color moving map display*
- AN/AAQ-16B/D FLIR System
  - Receives infrared energy and converts to video
  - Assists aircrew in piloting and navigation
  - Video presented on any of the MFDs
  - Fully integrated into the IAS
  - Enhances pilot situational awareness during night and low visibility operations
- Radar Altimeter
- *Four DCS 2000 Radios*
  - *Provides VHF FM/AM, UHF, SATCOM, crypto, secure voice*
  - *Simultaneous transmit/receive on 4 bands*
- AVR-2A Laser Warning Receiver
  - *Space weight and power provisions only*
  - *Integrated with SIRFC*

Notes

[1] Bell Helicopter Textron, Inc. and Boeing—Philadelphia, *V-22…The Future is Here* (1997), 11-27.

[2] CDR Dave Schwartzenburg, *MV Test Progress—CV Impact*, 3 November 98.

[3] HQ AFSOC/XP, *CV-22 Osprey Facts.*

Glossary

ACC	Air Combat Command
AFCS	Automatic Flight Control System
AFDD	Air Force Doctrine Document
AFSOC	Air Force Special Operations Command
ARG	Amphibious Ready Group
CDU	Cockpit Display Unit
CSAR	Combat Search and Rescue
CSARTF	Combat Search and Rescue Task Force
CSEL	Combat Survivor/Evader Locator
CV-22	Air Force version of the V-22 “Osprey”
DCM	Downed Crewmember
EAF	Expeditionary Air Force
ECS	Environmental Control System
EICAS	Engine Instrument Crew Alerting System
EW	Electrical Warfare
FADEC	Full-Authority Digital Engine Control
FCC	Flight Control Computer
FLIR	Forward Looking Infrared Radar
GPS	Global Positioning System
HIFR	Helicopter In Flight Refueling
IAS	Integrated Avionics System
INS	Inertial Navigation System
IMC	Instrument Meteorological Conditions
IOC	Initial Operational Capability
JROC	Joint Requirement Oversight Council
JSOR	Joint Services Operational Requirement
JTTP	Joint Tactics, Techniques, and Procedures
JVX	Joint Services Advanced Vertical Lift Aircraft
kt	Nautical Miles per Hour

LRIP	Low Rate Initial Production
LZ	Landing Zone
MAGTF	Marine Air Ground Task Force
MATT	Multimission Advanced Tactical Terminal
MC	Mission Computer
MEU	Marine Expeditionary Unit
MFD	Multi-Function Display
MNS	Mission Need Statement
MMR	Multi-Mode Radar
MOOTW	Military Operations Other Than War
MRC	Major Regional Contingency
MV-22	Marine version of the V-22 “Osprey”
NBC	Nuclear, Biological, and Chemical
NEO	Noncombatant Evacuation Operation
nm	Nautical Miles
NMS	National Military Strategy
NVG	Night Vision Goggle
OMFTS	Operational Maneuver from the Sea
OPEVAL	Operational Evaluation
PFCS	Primary Flight Control System
RESCORT	Rescue Escort
RCC	Rescue Coordination Center
SAR	Search and Rescue
SIRFC	Suite of Integrated Radio Frequency Countermeasures
SL	Survivor Locator
SOF	Special Operations Force
TF/TA	Terrain Following/Terrain Avoidance
USSOCOM	United States Special Operations Command
VTOL	Vertical Takeoff and Landing
WMD	Weapons of Mass Destruction

Combat Survivor Evader Locator: Survival radio capable of user identification, location, and both voice and secure data communication. Aircraft equipped with the Survivor Locator will receive information from the CSEL radio and know the exact location and identification of the survivor or evader.

Composite Materials: A structural material such as plastic in which manufacturers imbed fibrous materials such as silicon carbide.

Doctrine: Fundamental principles that guide the employment of forces.

Environmental Control System: Aircraft system for maintaining temperature, pressure, and humidity within the cockpit and cabin of an aircraft.

Fly-By-Wire: Flight control system in which flight control computers calculate and command flight control surface positions. Flight control computers send electrical commands to hydraulic actuators at the control surfaces that move appropriately to place the surface at the commanded position.

Forward Looking Infrared Radar: Sensor that operates in the infrared spectrum displaying a picture of the environment based on differences in heat.

Helicopter In Flight Refueling: Aerial refueling while in a hover above a ship using a long hose.

Initial Operational Capability: Date when a weapon system is operational and ready for employment by combatant commanders.

Landing Zone: Unimproved area used for landing and takeoff by vertical landing and takeoff aircraft.

Loads Limiting: Part of the flight control system that limits pilot flight control authority in order to keep the aircraft below its structural limits.

Night Vision Goggle: Optical device that magnifies ambient light enabling the operator to see objects during low illumination conditions (i.e. at night).

Operational Evaluation (OPEVAL): Extensive evaluation conducted by the military. Successful completion of an OPEVAL results in the purchase of the item tested by the government.

Terrain Following/Terrain Avoidance Flight: Low level flight that uses on board sensors (usually radar) to sense the ground and command the pilot to maintain the desired altitude above the ground.

Tiltrotor: An aircraft that can both hover much like a helicopter and fly like a turboprop by rotating its proprotors from the vertical to the horizontal.

Turboshaft: Jet engine whose power turbine drives a power shaft that is connected to a transmission that drives a propeller or rotor.

Turboprop: Propeller aircraft where the jet engine drives the propeller.

Proprotor: Large rotor on a tiltrotor that acts like a propeller in airplane mode and a rotor when in helicopter mode.

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