"HENRI COANDA"
AIR FORCE ACADEMY
ROMANIA

GERMANY

"GENERAL M.R. STEFANIK"
ARMED FORCES ACADEMY
SLOVAK REPUBLIC

INTERNATIONAL CONFERENCE of SCIENTIFIC PAPER
AFASES 2011
Brasov, 26-28 May 2011

V-22 OSPREY: WAGING ITS OWN WAR

Tomáš SCHÓBER,[*] Matúš GREGA,[**] Pavel NEČAS[**]

[*]CGCI (Central ground-controlled interception), Operation Centre Zvolen, Slovak Republic
[**]Armed Forces Academy of General M. R. Štefánik, Liptovský Mikuláš, Slovak Republic

Abstract: *The V-22 Osprey, an aircraft that has been in development for about 25 years and has a very controversial past and uncertain future. It was designed for future irregular warfare environment covering full scale of missions, especially in third-world conflicts with lack of infrastructure. But its operational problems and deployment experience raise serious questions whether the aircraft can accomplish the full range of missions of the helicopter it was intended to replace, or the range of missions provided by other modern helicopters.*

Keywords: *Osprey, tilt-rotor, missions, aircraft restrictions, crash, deployment.*

1. INTRODUCTION

The V-22 Osprey is a tilt-rotor aircraft that takes off and lands vertically like a helicopter and flies forward like an airplane. For taking off and landing, the aircraft's two wingtip-mounted engine nacelles are rotated (i.e., tilted) upward, so that the rotors function like a helicopter's rotor blades. For forward flight, the nacelles can rotate as much as 90 degrees forward, so that the rotors function like an airplane's propellers. It features a cross-coupled drive system so either engine can power the rotors if one engine fails.

There were three planned versions of V-22. MV-22 for the USMC (United States Marine Corps), Air Force variant CV-22 and HV-22 for the Navy.

The MV-22 is designed to transport 24 fully equipped Mariners, or up to 20,000 pounds of internal cargo or 15,000 pounds of external cargo. Its cruising speed is about 250 knots (about 288 mph), exceeding the performance of the Marine Corps CH-46 medium-lift assault helicopters that MV-22s are to replace. The CV-22 has about 90% airframe commonality with the MV-22; the primary differences between the two variants are in their avionics. The CV-22 is designed to carry 18 troops, with auxiliary fuel tanks increasing the aircraft's combat radius to about 500 miles, systems to detect and defeat radar-guided and heat-seeking missiles, enhanced navigation, communications and avionics systems.

The V-22 program began in the early 1980s, based on the XV-15 tilt-rotor prototype developed by Bell Helicopter and first flown in 1977.

The whole program has been revised numerous times over its history and the aircraft has experienced a number of development challenges relating to affordability, safety, and program management. The George H.W. Bush Administration proposed terminating the V-22 program in 1989 as part of its proposed FY1990 budget. The cancellation efforts were

through 1992, but Congress rejected these proposals and kept the V-22 program alive.

Finally, after more than 20 years of development, the MV-22 made its maiden combat flight when deployed to Iraq in October 2007 while CV-22 was declared fully operational in March 2009.

2. INTENDED MISSIONS

The V-22 was projected for vast scale of combat or non-combat missions from peace evacuation operations, humanitarian assistance and disaster-relief mission to assault transport, medevac, aeroscout, tactical recovery of aircraft and personnel, raids conducting and support of widely dipersed units.

The Marine Corps are the lead service in the development of the Osprey. The Marine Corps version, the MV-22, will be an assault transport for troops, equipment and supplies and will be capable of operating from ships or from expeditionary airfields ashore. The Navy's HV-22A will provide combat search and rescue, delivery and retrieval of special warfare teams along with fleet logistic support transport. The Air Force CV-22A is built for conducting long-range special operations missions.[1]

3. COSTS AND FINANCIAL CUTS

Like some other aircraft, the number of V-22s projected for production has reduced over time. First order in 1989 was set on 663 aircraft. Now the Department of Defense (DoD) plans call for procuring a total of 458 V-22s—360 MV-22s for the Marine Corps; 50 CV-22 special operations versions for U.S. Special Operations Command, or USSOCOM (funded jointly by the Air Force and USSOCOM); and 48 HV-22s for the Navy. No HV-22s have yet been procured for the Navy.

V-22s are currently being procured under a $10.4 billion, multiyear procurement (MYP) arrangement covering the period FY2008-FY2012 (Fiscal Year). The MYP contract , which was awarded on March 28, 2008, covers the procurement of 167 aircraft—141 MV-22s and 26 CV-22s [2]. DoD expects the multiyear contract to save $427 million when compared to the use annual contracting. [3]

DoD in February 2008 estimated the total acquisition cost of a 458-aircraft V-22 program at about $53.3 billion in then-year dollars, including about $9.9 billion for research and development, about $43.1 billion for procurement, and $262 million for Military Construction (MilCon). The program was estimated to have a program acquisition unit cost, or PAUC (which is total acquisition cost divided by the number of aircraft), of about $116.3 million and an average procurement unit cost, or APUC (which is procurement cost divided by the number of aircraft), of about $94.5 million. [4]

In addition, operations and support costs are expected to rise. The current cost per flying hour is over 11,000$ - more than double the target estimate for MV-22. [5]

4. CRASHES/LOSSES

Like other types of aircraft during development, testing or the operational phase didn`t avoid several crashes and fatalities. There were five crashes and several notable incidents enregistered till the end of 2010.

1. 11 June, 1991 - An Osprey crashed three minutes into its maiden demonstration flight at a Boeing helicopter flight test center in Wilmington, DE. There were no serious injuries in the crash, which was blamed on gyro wiring problems. Two crew members safely ejected, and the aircraft was badly damaged the accident.
2. 20 July, 1992 - Seven crewmembers lost their lives when a prototype of the V-22 Osprey fell into waters off the Quantico, VA, Marine Corps Air Station. The crash occurred after an engine caught fire as the aircraft was completing a 700-mile non-stop flight from Eglin Air Force Base. mechanical failure was found to have triggered a fire that disabled an engine. The identified design deficiencies were corrected and incorporated in all production aircraft.
3. 08 April, 2000 - An MV-22 crashed during a noncombatant evacuation

evaluation mission. The crash claimed 19 lives -- the deadliest air disaster for the Marines since 22 died in a helicopter crash in 1989. The Osprey was one of four flying from Marine Corps Air Station Yuma, Ariz. It crashed at Marana Airport near Tucson. The mishap aircraft was one of five production aircraft delivered to the Marine Corps for operational use. Officials said that an examination of data did not indicate any mechanical or software failures. In the last seconds of its flight, the mishap aircraft was in a high rate of descent at a relatively low forward airspeed. These characteristics can lead to a condition known as power settling (or vortex ring state) which can result in a loss of lift on the rotor system. Power settling is a phenomenon common to helicopter flight. The primary cause of the crash was the pilot descended too quickly -- 250 percent the acceptable rate.

4. 11 December, 2000 - An MV-22 Osprey crashed in North Carolina during a night training mission. Four Marines were killed when the MV-22 crashed in a remote wooded area about 10 miles outside Jacksonville. The crash was the fourth accident involving the tilt-rotor aircraft since 1991. The Navy and Marine Corps grounded all MV-22 Osprey flights until further notice. The accident investigation concluded that a leak in a chafed hydraulic line, coupled with a software glitch, had caused the crash. The software problem contributed to the aircraft going out of control, rather than compensating for the hydraulic leak. [6]
5. April 8, 2010 - a CV-22 Osprey, crashed approximately 11km west of Qalat city in Zabul province in southern Afghanistan attempting a night landing at a desert landing zone. This was the first loss of CV-22 in combat. Two of the three cockpit crew members — pilot and flight engineer died. The co-pilot who survived, told the invetigators, that he didn't have a clear memory of the flight's last 30 seconds. Also killed were a soldier and a contractor — two of 16 passengers in the cargo compartment. A Taliban spokesmen claimed responsibility for shooting down the Osprey helicopter, however, enemy fire,

brownout or engine failure have been ruled out by the USAF investigation. The true causes of the crash may never be known because no irrefutable evidence exists to substantiate either explanation - the wreckage and black box recorder were destroyed. [7]

5. LIMITS

The Joint Personnel Recovery Agency (JPRA) claimed that the V-22 along with the H-53K are "particularly limited" in their ability to perform vertical extraction of patients and rescuers since they "do not have a hoist or are not practical options for hoisting live personnel due to excessive **downwash**." This feature is critical for rescue aircraft which often cannot land at rescue sites. [8]

V-22 operational tests and training exercises identified challenges in maneuvering limits that affect air crew ability to execute correct evasive actions. Moreover, due the large footprint the Osprey is restricted in the number of places it can land. This can pose serious troubles in urban environment, forested terrain or on shipboard. Identified challenges could limit the ability to conduct worldwide operations.

Worse, safe engine-out landing is a major unresolved issue for the V-22. Emergency landing after the sudden failure of both engines in the Conversion / Vertical Take-Off and Landing modes below 1,600 feet altitude are not likely to be survivable. The V-22 cannot autorotate to a safe landing. [9]

In conjunction with resuming flight testing, the Navy Department modified certain V-22 requirements. For instance, the V-22 is no longer required to land in helicopter mode without power (also known as "autorotation"), protection from nuclear, chemical and biological weapons has been eliminated. The V-22 is no longer required to have an "air combat maneuvering" capability; instead it must demonstrate "defensive maneuvering." Also, the requirement that troops be able to use a rope or rope ladder to exit the cabin at low altitudes has been eliminated. [10]

6. DEPLOYMENT EXPERIENCE

As of January 2009, the 12 MV-22s in Iraq successfully completed all missions assigned in a **low threat theater** of operations—using their enhanced speed and range to engage in general support missions and deliver personnel and internal cargo faster and further than the legacy helicopters being replaced. In addition, the MV-22's ability to fly at higher altitudes in airplane mode enabled it to avoid the threat of small arms fire during its Iraq deployment. This agility allowed the Osprey to operate at far lower operational risk while at higher tempo. Three Marine Corps squadrons that have been deployed to Iraq have flown over 9800 hours while executing more than 6000 sorties, carrying over 45,000 passengers and lifting 2.2 million pounds of cargo without lost a single of these aircraft in combat. The Osprey has shown that it can carry an operational load of 24 combatloaded Marines out to a combat radius of 300 nautical miles at altitudes above the small arms and rocket-propelled grenade threat envelope. [11]

On the other hand, the Marine Corps admit that during the deployment in Iraq, Osprey was restricted to a very limited role due to its vulnerability to hostile fire, its lack of maneuverability and its unreliability in the heat and sand of Iraq.

Experience from deployment shown need for a new upgrade program. Unfortunately, planned upgrades to the aircraft could affect the aircraft's ability to meet its requirements. A limited-coverage, ramp-mounted defensive weapon was installed on aircraft deployed to Iraq. The program plans to incorporate a mission-configurable, belly-mounted defensive weapon system that will provide fuller coverage. For missions requiring the new weapon, however, the interior space needed to integrate the system will reduce the MV-22's troop carrying capability below its key performance parameter of 24 troops, as well as reduce its internal cargo capacity. The program also plans to integrate an all-weather radar into the MV-22. This radar and an effective de-icing system are essential for self-deploying the MV-22 without a radar-capable escort and deploying the V-22 to areas such as Afghanistan, where icing conditions are more

likely to be encountered. However, expected weight increases from these and other upgrades, as well as general weight increase for heavier individual body armor and equipment may affect the MV-22's ability to maintain the key performance parameters, such as speed, range, and troop carrying capacity.

While in Iraq, the MV-22 also conducted a few AeroScout raid and external lift missions. These types of missions were infrequent, but those that were carried out were successfully completed. Such missions, however, were also effectively carried out by existing helicopters. AeroScout missions are made by a combination of medium-lift aircraft and attack helicopters. Participating in these missions, the MV-22 was limited by operating with slower legacy helicopters—thus negating its speed and range advantages. Similarly, external lift missions do not leverage the advantages of the V-22. In fact, most of Marine equipment requiring external transport is cleared only for transit at speeds under 150 knots calibrated airspeed (kcas), which is in the contrary with higher speeds at which the MV-22 can travel with internal cargo or passengers. According to Iraq-based MV-22 squadron leaders, the CH-53 [12], which is capable of lifting heavier external loads, was more readily available than the MV-22 to carry out those missions and therefore was generally called on for those missions, allowing the MV-22 to be used more extensively for missions that exploit its own comparative strengths. [13]

The MV-22's Iraq experience has also demonstrated some limitations in situational awareness that challenge operational effectiveness. Crew chiefs and troops pointed out on lack of visibility outside to the activity on the ground from the V-22's troop cabin as a result of small windows. The combination with brownout [14] caused by the tiltrotor`s powerful downwash was considered to be a significant disadvantage.

Another key upgrades concerning the war experience are adding forward firing countermeasures to enhance the aircraft`s survivability, modifying the engine air particle separator to prevent engine fires and improve system reliability.

7. SELF-DEFENCE

Back in 2007 and prior to the type's first operational deployment, the USMC decided the aircraft needed a self-defence capability to supplement the machine gun fitted to the aircraft's rear ramp. The US Marine Corps operated a ramp-mounted. 50-calibre gun on 10 MV-22 Ospreys deployed to Iraq, but this configuration limited the weapon to firing on only rearward targets. [15] At the time, BAE Systems were developing the Remote Guardian System, a belly-mounted turret fitted with a 7.62mm mini-gun that could fold into the fuselage while on the ground but slide down under the belly of the aircraft during flight.

The gun is operated from inside the aircraft by using a controller. The operator can rotate the gun 360°and acquire targets using a monitor that is fed colour images from a forward-looking infrared sensor. But after using the gun with some success in Afghanistan, recent reports say the marines are ditching the gun system as the drawbacks frequently outweigh its benefits. At 363kg the gun is heavy and this limits the payload the aircraft can lift in Afghanistan's hot and high altitude environment. It can also cause nausea for the crewman operating the system since they must stare at the screen while the aircraft manoeuvres. United States Air Force (USAF) and USMC say they are now looking for a long-term solution. [16] The future system

should be perhaps installed in the nose of the aircraft or in the hell hole.

8. FUTURE OF V-22

Every new design is struggling with problems such as unreliable component parts and supply chain weaknesses, which led to higher operations and support costs and low aircraft availability rates. The V-22 is not an exception. The deployments confirmed that the V-22's enhanced speed and range enable personnel and internal cargo to be transported faster and to extended ranges than is possible by the helicopters it is replacing. On the other hand, lack of autorotation capability makes the aircraft vulnerable especially during final approach to landing. The low-threat missions assigned to Ospreys in Iraq were accomplished at high level. However, questions have risen whether V-22 is the best suited to accomplish the full mission repertoire of the helicopters it is intended to replace, as the current Marine Corps plan is to replace all of its medium-lift helicopters with the MV-22. The question is whether mixed fleet of MV-22s and legacy helicopters would be better. Warfare needs indicate, that the V-22 may not be best suited for the full range of missions requiring medium lift, as the aircraft's speed cannot be exploited over shorter distances or when transporting external cargo. In addition, attack escort helicopters are not be able to keep pace with the Osprey. Over the years, the aircraft has been the subject of controversy for development delays, highly publicized crashes, and many funding debates. Osprey has strong supporters but equally tough critics, both sides claiming that it is either better or worse than conventional helicopter alternatives. Those favoring the program cite its speed, range, and altitude advantages over helicopters, characteristics that make it possible for Marine Corps forces to execute operations from increased distances. Those against the program cite its troubled developmental history and its high cost (relative to helicopters). Moreover less expensive helicopters can just as effectively support ship-to-shore deployments, amphibious landing operations, and various amphibious assault missions.

BIBLIOGRAPHY

1. Castelli, Ch. J.: *Navy Awards $10.4 Billion V-22 Multiyear Deal*, Inside Washington Publishers, March 28, 2008. Available at: *http://www.insidedefense.com.*
2. *Contract modifications have since then increased the multi-year contract total to 174 aircraft.* Available at: http://www.boeing.com/rotorcraft/military/v22/docs/V-22_overview.pdf, October 2010
3. *DOD Acquisition Program Baseline (APB) report for V-22 program*, February 29, 2008.
4. *Flightglobal*, BAE wins CV-22 gun contract, January 17, 2008. Available at: http://www.flightglobal.com/articles/2008/01/17/220905/video-bae-wins-cv-22-gun-contract.html
5. Government Accountability Office, *V-22 Osprey Aircraft[:] Assessments Needed to Address Operational and Cost Concerns to Define Future Investments*, Statement of Michael J. Sullivan, Director Acquisition and Sourcing Management, Testimony Before the Committee on Oversight and Government Reform, House of Representatives, GAO-09-692T, June 23, 2009, summary page.
6. *Government Accountability Office (GAO) report on major DOD acquisition programs*, V-22 entry, March 2009.
7. http://www.globalsecurity.org/military/systems/aircraft/v-22-losses.htm
8. Neff, J.: Eased Standards 'Fix' Osprey, *Raleigh News & Observer*, May 19, 2002, p.1.
9. Osbourne, T.: *Changing the face of assault.* Available at: http://www.boeing.com/ospreynews/2010/issue_01/transform_s30_p2.html
10. *Pentagon`s Joint Personnel Recovery Agency (JPRA) report*, August 2009.
11. Rolfsen, B.: *Generals clash on cause of April Osprey crash*, January 22, 2011 Air Force News. Available at: http://www.airforcetimes.com/news/2011/01/air-force-generals-clash-on-osprey-crash-012211w/.
12. Statement of LTGEN George J. Trautman III, *USMC, Deputy Commandant for Aviation*, Before the House Committee on Oversight and Government Reform [Hearing] on United States Marine Corps MV-22B Osprey Program, May 21, 2009, 10 pp.
13. *The Pentagon Office of Operational Test and Evaluation*, Office of the Director. (September 2005). *V-22 Osprey Program: Report on Operational and Live Fire Test and Evaluation*, 35.
14. U. S. Navy Fact File, *V-22A Osprey tilt rotor aircraft*. Available at: http://www.navy.mil/navydata/fact_display.asp?cid=1200&tid=800&ct=1&page=1.

REFERENCES

[1] *U.S. Navy Fact File, V-22A Osprey tilt rotor aircraft.* Available at: http://www.navy.mil/navydata/fact_display.asp?cid=1200&tid=800&ct=1&page=1.
[2] Contract modifications have since then increased the multi-year contract total to 174 aircraft. Available at: http://www.boeing.com/rotorcraft/military/v22/docs/V-22_overview.pdf, October 2010
[3] Castelli, Ch. J.: *Navy Awards $10.4 Billion V-22 Multiyear Deal*, Inside Washington Publishers, March 28, 2008. Available at: http://www.insidedefense.com.
[4] *DOD Acquisition Program Baseline (APB) report for V-22 program*, February 29, 2008.
[5] Government Accountability Office, *V-22 Osprey Aircraft[:] Assessments Needed to Address Operational and Cost Concerns to Define Future Investments,* Statement of Michael J. Sullivan, Director Acquisition and Sourcing Management, Testimony Before the Committee on Oversight and Government Reform, House of Representatives, GAO-09-692T, June 23, 2009, summary page.
[6] http://www.globalsecurity.org/military/systems/aircraft/v-22-losses.htm
[7] Rolfsen, B.: *Generals clash on caus e of April Osprey crash*, January 22, 2011 Air Force News, Available at: http://www.airforcetimes.com/news/2011/01/air-force-generals-clash-on-osprey-crash-012211w/
[8] *Pentagon`s Joint Personnel Recovery Agency (JPRA) report*, August 2009
[9] The Pentagon, *Office of Operational Test and Evaluation, Office of the Director.* (September 2005). V-22 Osprey Program: Report on Operational and Live Fire Test and Evaluation, 35.
[10] NEFF, J.: Eased Standards 'Fix' Osprey, *Raleigh News & Observer*, May 19, 2002, p.1.
[11] *Statement of LTGEN George J. Trautman III*, USMC, Deputy Commandant for Aviation, Before the House Committee on Oversight and Government Reform [Hearing] on United States Marine Corps MV-22B Osprey Program, May 21, 2009, 10 pp.
[12] CH-53 – heavy-lift transport helicopter.
[13] *Government Accountability Office (GAO) report on major DOD acquisition programs*, V-22 entry, March 2009.
[14] Brownout - reduced flight visibility due to airborne particles, especially from helicopter downwash
[15] *Flightglobal*, BAE wins CV-22 gun contract, January 17, 2008. Available at: http://www.flightglobal.com/articles/2008/01/17/220905/video-bae-wins-cv-22-gun-contract.html
[16] OSBOURNE, T.: *Changing the face of assault.* Available at: http://www.boeing.com/ospreynews/2010/issue_01/transform_s30_p2.html