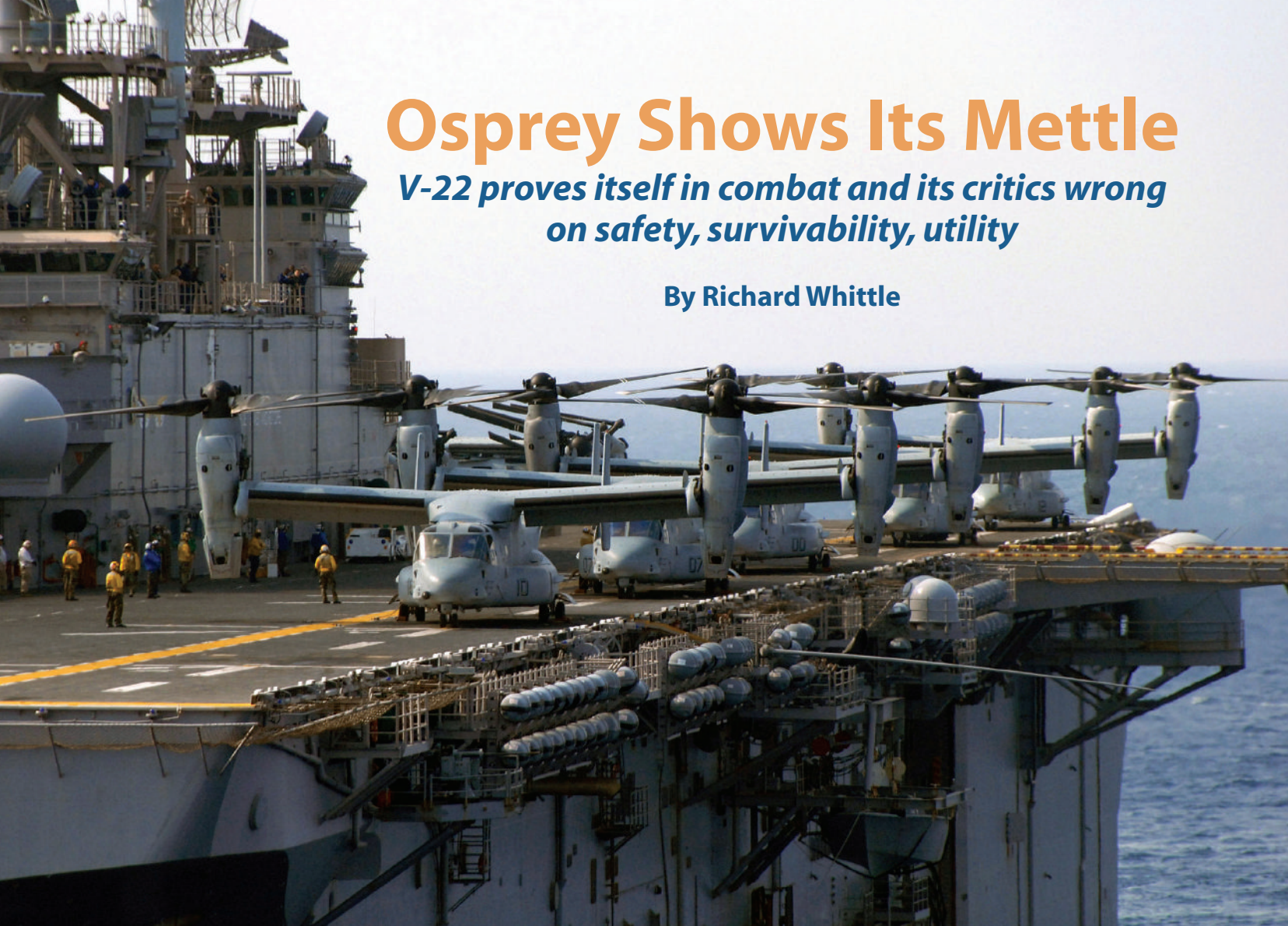


# Osprey Shows Its Mettle

*V-22 proves itself in combat and its critics wrong on safety, survivability, utility*

By Richard Whittle



On October 8, 2007, as the US Marine Corps was putting the V-22 Osprey into service in Iraq, a major step after a quarter century of politically stormy development that had cost \$22 billion and 30 lives lost in crashes, the cover of *Time* magazine depicted the tiltrotor troop transport casting a shadow in the shape of a graveyard cross. Inside the magazine, an article titled “Flying Shame” said the V-22 might “kill a lot of Marines” and do “little of note on the battlefield.” But going on eight years later, *Time* might want to consider publishing a retraction and apology.

The V-22, which tilts two 38 ft (11.6 m) diameter wingtip “proprotors” upward to take off and land like a helicopter, and forward to fly like an airplane, is expensive to buy – \$84 million per copy on average under the most recent contract. It’s also costly to fly and mechanically complex – one reason it suffers from a stubbornly substandard readiness rate. But since the V-22 went

*In October 2007, soon after the MV-22 was declared operational that June, the USS Wasp (LHD-1) transported with VMM-263 to Iraq. (US Navy)*

into service, the world’s first operational tiltrotor has done the opposite of what *Time* and other critics anticipated. The Osprey has proven itself extraordinarily safe, survivable under enemy fire that might bring down most helicopters, and more versatile and useful than even the truest of true believers ever imagined. In short, the Osprey is now putting its critics to shame.

For that reason, its popularity is rapidly rising. The Marines now want to buy two more squadrons of MV-22s than planned, for a fleet of 388 instead of 360. The Air Force Special Operations Command is to take delivery of its 54<sup>th</sup> and final CV-22 in August, but that service is “exploring adding significantly more quantities to do other missions, even potentially for the National Guard,” said Vince Tobin, vice president in charge of the Osprey program for Bell Helicopter Textron Inc., which builds the aircraft with The Boeing Company

in a 50-50 partnership. The Navy – after decades of disinterest – is now on board to buy at least 44 Ospreys of its own, and foreign customers will likely also extend the V-22 production run. Japan has announced it will buy 17 for its military, and while politics has put an Israeli decision to buy six Ospreys on hold, several other countries – South Korea and the United Arab Emirates, to name two – are seriously kicking the tires.

## “We Love This Airplane”

As for the battlefield, at least four Navy SEALs and one Afghan soldier hit by gunfire owe their lives to the Osprey’s speed. In all likelihood, so does an Air Force F-15E Strike Eagle pilot who was rescued by an MV-22 after an aircraft malfunction forced him to bail out over Libya during a strike on dictator Moammar Qaddafi’s air defenses. Incalculable numbers of



An MV-22B with VMM-365 lands in “brown out” conditions in Helmand Province, Afghanistan in July 2010. Dust and sand take their toll on engines, sometimes needing replacement after “just a few hundred hours.” (US Marine Corps)

marines and others, meanwhile, have been carried into and out of combat safely, flying above insurgent small arms fire and potential ambushes, swooping down on objectives from above or from unexpected directions, and arriving with little warning thanks to the Osprey’s minimal forward acoustic signature in airplane mode. The Osprey has also helped save the lives of victims of natural disasters, from tsunamis in the Pacific to the Ebola crisis in West Africa.

“We love this airplane,” said Lt. Gen. Jon Davis, deputy commandant of the Marine Corps for aviation. The Osprey, said AV-8 Harrier jump jet pilot Davis, “has changed the Marine Corps more than anything we’ve put in the air. We’re doing stuff no one ever thought we’d do.”

Just such a mission was conducted last year by 93 marines and sailors from Special Purpose Marine Air Ground Task Force – Crisis Response Africa (SPMAGTF-CR-AF), a unit based in Spain. On October 8, 2014 – seven years to the day after *Time*’s “Flying Shame” article – that detachment boarded four MV-22s and two KC-130J tankers, flew 850 miles with the tankers refueling the Ospreys in flight, landed in the Canary Islands to refuel again and let those aboard stretch their legs, then flew another 975 miles to Dakar, Senegal, arriving about nine hours after their departure from Spain. The detachment spent the night at Dakar, then flew 730 miles the next day to Monrovia, Liberia, where they spent the next 60 days helping that African

nation contain the spread of the Ebola virus.

When President Obama pledged help to Liberia to fight Ebola, said Col. Robert Fulford, SPMAGTF-CR-AF’s commander at the time, MV-22s from his 12-aircraft Marine Medium Tiltrotor Squadron 264 were sent because “no one else could get there rapidly.” The Army assigned UH-60 Black Hawk helicopters from the 101<sup>st</sup> Airborne Division, but they had to be taken apart, sent to Liberia by ship, then put back together. As the Black Hawks were on their way, the marines used their MV-22s to reach areas of Tennessee-sized Liberia inaccessible by road during the rainy season. The four Ospreys flew more than 170 missions, logging 240 hours in the air while carrying more than 1,200 government and relief agency workers and 78,000 lb (35 t) of cargo. They also took VIPs including Liberian President Ellen Johnson Sirleaf, US Ambassador Deborah Malac, and the US Ambassador to the

United Nations, Samantha Powers, to inspect treatment locations throughout the country.

Earlier in his six-month rotation as SPMAGTF-CR-AF commander, Fulford’s MV-22s were put on alert for possible deployment to Iraq to help evacuate Yazidis from Mount Sinjar, where the ethnic Kurds were under siege by extremist Islamic State fighters. Fulford also was ordered at one point to keep four Ospreys and two KC-130J tankers in Sicily at Naval Air Station Sigonella for crisis response eastward, and some of his MV-22s transported 30 marines to Bangui, Central African Republic, to provide security at the reopened US Embassy there.

Deputy Commandant Davis said one reason the Osprey is being used this way is that “we don’t have enough amphibious ships in the United States Navy. Without ships, I’m going to put a Special Purpose MAGTF in Morón, Spain, and another one in Kuwait, where we’re positioned to fly 2,000 miles [3,200 km] east or to Liberia, instead of parking an amphibious ship off the shore.”



The pilot and flight crew of an MV-22B Osprey with VMM-266 Reinforced were honored in January 2013 for the rescue of a downed Air Force F-15E pilot in Libya in 2011. (US Marine Corps)



Liberia President Ellen Johnson Sirleaf (center with striped coat) visited remote Ebola-stricken areas of her country via an MV-22 Osprey in October 2014. (US Army)

## Hours and Safety

No one anticipated such things when the Osprey went to Iraq in 2007. The Marines put the V-22 into service cautiously – “crawl, walk, run” was their mantra – because of the Osprey’s controversial history. In December 2000, after the last of three fatal crashes during the Osprey’s development and the second that year, Pentagon leaders grounded all V-22s and nearly cancelled what until then had been a costly and calamitous project. In the end, however, the Pentagon followed a blue ribbon panel’s recommendations to redesign and retest the Osprey. The Naval Air Systems Command (NAVAIR) corrected wire-chafing problems caused by the V-22’s large rotating nacelles, which house both its engines and proprotors, and rewrote parts of its flight control software. NAVAIR also thoroughly tested the V-22’s vulnerability to vortex ring state, the assessed aerodynamic cause of the Osprey’s worst accident, in which 19 marines were killed.

Those measures clearly paid off. After logging more than 250,000 flight hours through last December 31, including 160,201 operational hours flown by Marine Corps MV-22s and 31,124 by Air Force CV-22s in the war zones of Iraq and Afghanistan, in hostile or treacherous parts of the Middle East and Africa, and in nearly every time zone around the globe, the Osprey turns out to be one of the safest rotorcraft in

Marine Corps history.

“If you look at the first 200,000 [flight] hours, the Class A mishap rate for the V-22 is lower than any other Marine Corps rotary wing platform,” said Marine Col. Daniel Robinson, NAVAIR program manager for the V-22. Class A mishaps include any accident causing loss of aircraft, fatal injury, permanent total disability or, since 2009, more than \$2 million in property damage. Previously the Class A dollar threshold was \$1 million. According to NAVAIR, the Marine Corps version of the Osprey has

suffered five Class A mishaps in the first 200,000 hours it flew after its redesign, the CH-46 Sea Knight helicopter the Osprey replaced suffered 41 over its first 200,000 hours of flight, and other Marine Corps helicopters also logged more than the MV-22 during their comparable period.

Suspicious of how the Marine Corps counts such mishaps, critics dispute those figures, and the conventional wisdom that took hold during the V-22’s dark days – that the Osprey is a death trap and a boondoggle – is still heard. Critics with open eyes and minds, however, have modified their assessments.

“I wouldn’t call it a boondoggle at all,” said Rex Rivolo, one of the Osprey’s severest critics back when the V-22 was on the chopping block. “Being able to go 1,500 miles [2,400 km] to a place without an airport is an enormous military utility, and only this aircraft can give it to you.”

Rivolo, a Vietnam War F-4 Phantom fighter pilot and Ph.D. physicist who also flew Air National Guard search and rescue helicopters with distinction in the 1970s, sees wisdom in the Navy’s decision to buy Ospreys to replace its aging Northrop Grumman C-2A Greyhound fixed-wing turboprop aircraft for carrier on board delivery (COD). Given that the V-22 can land on ships other than carriers, “The COD mission is a great mission for the V-22 –



A member of the US Air Force 8<sup>th</sup> Special Operations Squadron performs operations checks on a .50 caliber (12.7 mm) machine gun at Hurlburt Field, Florida in May 2014. The Marines use a 7.62 mm machine gun on the ramp that is often decried as inadequate by pundits. (US Air Force)

fast transport, vertical lift," Rivolo said. "If it's not a hostile environment, it's a great machine – especially if the distances are long. For that kind of mission, you couldn't ask for a better airplane."

But as the qualification in that last comment hints, Rivolo still contends that the Osprey is unsuited for taking troops into combat. He believes its side-by-side rotor configuration and high disk loading – about 20 lb/ft<sup>2</sup> [98 kg/m<sup>2</sup>] – leave it unable to "yank and bank" to avoid enemy fire when landing in a "hot zone," as helicopters might do and Rivolo deems essential. The Marine Osprey also lacks a standard weapon other than a 7.62 mm machine gun that can be fired off the rear ramp. A plug-and-play .30-caliber belly gun developed for the Osprey proved unpopular with V-22 squadrons because of its bulk and weight.

"If you're going to do combat assault, you have to be able to defeat the threat, and this airplane does not defeat the



An MV-22 Osprey from SPMAGTF-CR-AF flies with a 2180 lb (1 t) pallet at Morón Air Base, Spain in January. (US Marine Corps)

threat," Rivolo said. "In fact, if there's a threat, they just won't go."

Told Rivolo's view, Deputy

Commandant Davis shook his head in disbelief. "That's nuts. That's crazy!" he said. "This aircraft has been shot up more than other helicopters in hot zones and come out. Talk to the marines that are flying it. They're flying this airplane into hot zones. They've been shot at. They've been shot up. They fly out."

Marine and Air Force pilots alike, in fact, have won high honors for flying badly shot-up V-22s out of situations they say surely would have downed a conventional helicopter.

On June 27, 2012, two MV-22s inserting marines into the Shark's Tooth area of Helmand Province, Afghanistan, on a nighttime raid against Taliban insurgents came under heavy fire from medium machine guns and rocket propelled grenades. The pilots, Maj. Michael Hutchings and Capt. David Haake

of Marine Medium Tiltrotor (VMM) Squadron 365, delivered a second wave of marines to reinforce the first, then extracted the entire force though both aircraft were damaged so badly by enemy fire that Hutchings had to swap out his Osprey for another. An Afghan soldier shot in the leg survived as a result, and Hutchings and Haake were awarded the Distinguished Flying Cross. Members of their crews received the Air Medal.

Three Air Force crews, meanwhile, were awarded the National Aeronautics Association's prestigious MacKay Trophy, given for the "most meritorious flight of the year" in military aviation, for a December 21, 2013, CV-22 mission to Bor, South Sudan, to evacuate US citizens from an incipient civil war. The 8th Special Operations Squadron pilots had been told they would be landing in a "permissive environment" but were met by heavy fire. Four Navy SEALs aboard the lead Osprey were badly wounded when at least 119 bullets, including .50-caliber rounds, ripped into the CV-22s. The pilots aborted their landing and instead flew their crippled Ospreys south to Entebbe, Uganda, refueling more than once from two MH-130 Combat Talon tankers during the 500 mile (800 km) flight. All aboard the CV-22s survived. Two of the three aircraft are back in service, and the third is to return to regular operations soon, according to NAVAIR.

"The V-22 has proven itself in combat," said Lt. Gen. Bradley Heithold,



Marines practice fast-roping in Morón, Spain in January, from which four MV-22Bs deployed to Liberia in October 2014 for Ebola epidemic support operations. (US Marine Corps)



MV-22B Ospreys are refueled by a KC-130J off the coast of West Africa in May 2014 enroute to Ghana. (US Marine Corps)

commander of Air Force Special Operations Command. "In fact, it's become the weapon of choice for a lot of our assaulters because it's fast and can get into some places much faster than a helicopter."

Rivolo and other critics insist that few V-22s have flown into "hot zones" where they risked being shot up. Davis said that if Ospreys have been shot up less often than helicopters in Vietnam, it isn't because the Marines won't send the V-22 into harm's way. Instead, he said, as a rule it just isn't necessary. Davis said the Marines usually provide close air support to suppress enemy forces where troops are being landed by Ospreys, whether that means AH-1 Cobra helicopter gunships, AV-8B Harriers, F/A-18 Hornets, or calling on the Air Force to help out with armed MQ-1 Predator or MQ-9 Reaper remotely piloted aircraft. Leithold said his service does the same. "You have to define 'hot,'" he said. "If we're going to take it into a real hot zone, you're going to have air coverage with it, just like the helicopter force."

In any event, said Deputy Commandant Davis, "I'd rather not have to fix holes in my airplanes. But we have had V-22s get shot up in hot zones and they have flown out. Helicopters get shot up in hot zones that stay there, that we blow in place. I've not had to blow a V-22 in place. But we have had helicopters that we can't recover."

So have the other armed services. Since October 1, 2001, more than 420 US military helicopters have been downed by combat or accidents at a cost of more than 630 lives. During the same period,



Two marines conduct post-flight maintenance on a VMM-263 V-22 Osprey on the flight line of Al Asad, Iraq in January 2008. "The demand for this airplane is growing so fast I can't train the maintainers fast enough," says Marine Deputy Commandant Lt Gen Davis. (US Marine Corps)

one CV-22 and one MV-22 mishap have killed a total of six crew or passengers. Four were killed in a CV-22 that flipped nose first onto its back after hitting a gully while rolling across a desert in darkness after the pilot landed short in an April 9, 2010, special operations raid in Afghanistan. Two marine crew chiefs were killed in an MV-22 that crashed in Morocco during an April 11, 2012, training flight, an accident blamed on pilot error.

A CV-22 crash during training at Eglin Air Force Base, Florida, on June 13, 2012, injured five crew members, but no one was killed. Rotor wash from another CV-22 put the mishap aircraft into a roll as it flew near the ground. Two marine crew chiefs have fallen to their deaths from the open back ramps of Ospreys in flight, and another crew chief drowned last October 1 in the Persian Gulf. His Osprey took off from the USS Makin Island but after clearing the ship's deck, settled onto the surface of the water. The pilot kept the MV-22 from going under, but the two crew chiefs, who were wearing body armor, were told to abandon the aircraft and jumped into the water. The victim's flotation system failed and his body armor pulled him under. An investigation yet to be released is expected to conclude that the pilot failed to take the MV-22's Vehicle Management System out of maintenance mode, in which bleed air from the engines is fed into the exhaust

flow to move it away from the fuselage, allowing mechanics to work on it with the engines running. The Osprey had enough power to lift off the deck but not enough to hover out of ground effect.

Since the Osprey's 2002 return to flight, four others have been damaged in Class A mishaps that left no one injured – including two in fires caused by hard landings and one because of a grass fire caused by its engine exhaust with its nacelles in the upright position.

## Readiness Rate Regrets

If NAVAIR and those who fly the Osprey are pleased with its safety record, however, even devoted V-22 advocates agree with Rivolo and other critics that the aircraft's readiness rate is unacceptably low. "I think that's the only disappointment I have in the system," said retired Gen. Robert Magnus, who as a major, helped write the original requirements for the Osprey in 1982 and as assistant commandant of the Marine Corps oversaw its introduction into service 25 years later. "It's fallen way short in terms of its operational reliability and the engineers' choice of the components of the subsystems that make it work."

A Navy Department standard requires that 75% of the aircraft in a squadron be ready to fly, or "Partial Mission Capable," meaning the only parts or systems on an aircraft not fully functioning are unnecessary for safe flight. Calculated as an annual average fleetwide, the Osprey has never met that standard, said Robinson, though NAVAIR, Bell and Boeing, and the services have spent a great deal of time and money trying. Since May 20, 2002, when the Osprey returned to flight after its 17-month grounding, NAVAIR has taken more than 600 actions to correct "individual failure modes" of parts in the V-22's gearboxes and driveshafts, rotor system, flight controls, engines and electrical systems, and has 50 more initiatives underway.

Keeping V-22s ready to fly has been such a stubborn problem for a number of reasons. One is the complexity of its design, which includes not only nacelles that move heavy engines and rotor assemblies, and all the wiring and tubing and fluids that go with them up and down, but also rotor blades that fold and a wing that swivels over the aircraft's back to fit below decks on an amphibious assault ship. Inaccurate estimates of how long parts would last have been another drag on readiness. Engineers simply failed to accurately anticipate the effects of flying the Osprey in sandy, dusty environments that rapidly wear out rotor blades and engines.



An MV-22 of VMM-166 lands on the USS Harry S. Truman (CVN 75) in October 2013. The US Navy now plans to purchase 44 Ospreys. (US Navy)

Until it was redesigned in 2012, for example, one chronic problem was the Engine Air Particle Separator (EAPS), a filter at each engine inlet that often suffered hydraulic leaks that sometimes caused fires and still allows far more dirt than is healthy to pass through. When the Osprey was designed in the 1980s, noted Tobin of Bell Helicopter, the emphasis was on carrying troops in amphibious assaults, not flying in dust and dirt such as that found in Iraq, Afghanistan and inland Africa. As a result of flying in those environments, Tobin said, "We were taking engines off with just a few hundred hours." Still unsatisfied, the program is testing a new and far more effective engine filter that "should be on the airplane in 2017," he said.

Another problem component was the Osprey's proprotor gear box, a flight-critical part that has had to be replaced for \$2.34 million or reworked in a depot for an average cost of \$708,000, according to Marine Corps figures, far more frequently than anticipated. Until recently, this meant proprotor gear boxes were in short supply.

Robinson said EAPS and proprotor gearboxes are no longer on his list of top readiness "degraders." But they have been replaced by swashplate actuators – six per Osprey at \$294,000 each to replace and \$60,000 apiece to rework – and the Osprey's Variable Frequency

Generator, which costs \$168,000 new and \$19,000 to rework in a depot. Both parts are under study, but Robinson said the generator "probably needs redesign."

Such expenses are one reason the V-22's average cost per flight hour is a pricey \$9,156, though that is down from \$11,651 an hour in 2010, a 21% reduction. With the increased demand for Ospreys, however, the average fleet readiness rate has declined.

"We have been very focused on improving readiness for years now and it has been on a steady increase and peaked out at about the 68% point," said Robinson. Ospreys deployed overseas or assigned to HMX-1, the Marine Corps squadron that flies the president, get first call on available parts and generally enjoy higher readiness rates than other units. Even so, Robinson said, the Osprey's operational tempo has risen so sharply that the fleetwide readiness rate "has actually dipped over the past year and it's down to probably about 62% now."

Deputy Commandant Davis said parts supplies and the logistical challenge of getting them to units overseas aren't the only reasons for that decline. "The demand for this airplane is growing so fast I can't train the maintainers fast enough," he said. But demand for the airplane is why the Marines want to increase their total number of Osprey



*MV-22s operating out of Okinawa have been controversial with the local population, but Japan plans to purchase 17 Ospreys. (US Marine Corps)*

squadrons from 16 to 18. "We don't have the money in the budget right now, but we'll find the money in the out years," Davis said. "We need them." The new squadrons, plus four extra aircraft, would raise the total number of V-22s bought for the Marines from 360 to 388.

The Marines also have bigger plans for the Osprey's future. They are adding digital interoperability to the MV-22 so infantry commanders in the back cabin can see intelligence, surveillance and reconnaissance video from other aircraft, manned or unmanned, before they reach their objective. Osprey crews might also be able to control sensors on UAVs or even the drones themselves someday, Davis said, as Army AH-64 Apache helicopter crews are now doing. The Marines are also testing an Osprey whose Forward Looking Infrared Radar pod has been replaced with a sensor ball providing daylight and infrared video cameras, a laser target designator and ranger, an infrared marker and a video data link to transmit what its cameras see. The laser designator could be used to guide forward-firing rockets or missiles the Marines may mount on the Osprey, a concept Bell Boeing tested in November, firing BAE Systems Advanced Precision Kill Weapon System 2.75 inch laser guided rockets and Raytheon Co.'s

Griffin B guided mini-missiles from a side pylon on the nose of a V-22 the companies lease from the military. Davis said the Marines might also opt for the suite of weapons carried by Marine Corps KC-130Js, which use a bolt on/bolt off mission kit that can fire precision weapons including the laser-guided AGM-114 Hellfire missile, the Griffin B, or Northrop's GBU-44 Viper Strike glide bomb. "I think we'll look at the same suite with V-22," Davis said.

To ease the burden on their KC-130J tankers of keeping up with the growing demand for the Osprey, meanwhile, the Marines plan to qualify MV-22 crews to

refuel from Air Force KC-10 tankers. They also plan to use Ospreys equipped with fuel bladders as aerial refueling tankers themselves, especially once the F-35 Joint Strike Fighter becomes operational. Nor is that all. Looking further into the future, the Marines envision a Block D "midlife upgrade" of the current MV-22B to an MV-22C incorporating new technologies that emerge from the Joint Multi-Role (JMR)/Future Vertical Lift (FVL) initiative the Pentagon has underway.

One idea Davis likes a lot, he said, is the possibility of redesigning the Osprey to take its engines out of its rotating nacelles and

make them stationary and horizontal on the wing, as envisioned with Bell Helicopter's entry in the JMR program, the proposed V-280 Valor tiltrotor. Taking the V-22's engines and their flammable fluids out of the moving nacelles could solve a number of the Osprey's problems, he reasons.

But more immediately, Davis said, "I want to get the cost per flight hour down, I want to get the readiness up, I want to make it easier to work on for my marines. I'd say I'm happy, not satisfied."

There's no shame in that.

## About the Author

Richard Whittle covered the Pentagon and other Washington beats for *The Dallas Morning News* for 22 years. He is the author of *The Dream Machine: The Untold History of the Notorious V-22 Osprey* (Simon & Schuster, 2010) and *Predator: The Secret Origins of The Drone Revolution* (Henry Holt and Company, 2014).



...the Osprey is  
now putting  
its critics  
to shame.