EXECUTIVE SUMMARY

Faster than the fastest helicopter, able to leap vertically to lift troops and supplies to inaccessible locations behind enemy lines, the *Osprey* epitomizes a transformational super-craft able to swoop, raptor-like, onto an enemy with deadly results. But throughout the V-22's development, 30 people have died—and now this glitch-plagued program that survived one cancellation and numerous design and operating problems is poised to reveal fundamental flaws that may cost even more lives.

The U.S. Air Force wants 50 CV-22s for special operations; the Navy wants 48 for rescue of downed pilots and other missions; the Marine Corps wants 360 MV-22s to replace aging CH-46s and CH-53s to airlift troops and supplies from beyond the horizon directly to inland positions, bypassing vulnerable beachheads.

If deployed in combat, the price could be fatalities inflicted not just by enemy fire, but by flaws that were the result of omitted tests and basic design deficiencies pointed out but never addressed. The question will become, "Who should be held accountable?"

Tipping Point: The Pentagon's September 2005 Report

Following completion of its operational (combat "realistic") testing, the Pentagon concluded in September 2005 that "the MV-22 Block A is operationally suitable" and is "compatible with flight and hangardeck operations." Full production would follow. *Yet evidence within the report itself and in ongoing flight operations shows that in the 17 years since its first flight, the V-22 does not work and faces operational, aerodynamic, and survivability challenges that will prove insurmountable, and lethal, in combat.* Largely following the format of the Pentagon's V-22 evaluation, this analysis examines the *Osprey*'s protracted development, aerodynamic challenges that were not resolved and warnings that have been ignored.

Wars Missed

The *Osprey*'s combat début is set for Iraq in 2007. But the V-22's protracted development has spanned a quarter-century and already caused it to miss deployment to Bosnia in 1995, Afghanistan in 2001, and Iraq in 2003—despite a first flight on March 19, 1989.

A New Technology and Four Crashes

The unique V-22 is an exemplar of multinational endeavors reaching back more than 50 years. But this paradigm shift to an assault transport combining capabilities of both helicopters and aircraft involves a problematic transition from flexible low-twist helicopter rotors to stiffer, high-twist, high rpm, tilt-props. Thus the V-22 enters an unexplored realm fraught with aerodynamic unknowns.

Four crashes ensued—in 1991, 1992, and two in 2000—with 30 fatalities. Three were triggered by below-standard parts, software and/or abysmal assembly line quality control; the fourth was caused by a dangerous aerodynamic phenomenon—vortex ring state (VRS). VRS occurs when a rotor becomes enmeshed in its own downwash and loses lift—with thrust from the remaining rotor often rolling the aircraft into an uncontrollable, inverted dive. Rapid descent vertically or at low forward speed creates conditions ripe for VRS.

Combat deployment in 2007: is the V-22 ready?

VRS and blade stall comprise the most dangerous and complex issues facing the program. VRS can be deadly and is intensified by the blade stall (and loss of lift) triggered during descent when the V-22's extremely high-twist rotorprops cause the smooth laminar flow across the blades' upper surfaces to be replaced by boundary layer separation and turbulent flow. This is the primary reason why the maximum vertical descent speed of 800 feet per minute (fpm)—that's just 9.1 mph—is mandated for this aircraft. It is so slow it will make the V-22 an easy target. This performance limitation is lethal to the aircraft as well as its crew and human cargo. Equally bad, combat pilots trying to insert troops urgently into a "hot" landing zone, where the enemy is shooting, may try to descend more quickly, thus encountering VRS, which will likely roll the aircraft into an inverted dive toward the ground and lose everyone on board in the process. So should a pilot choose to descend at 9.1 mph? If he does, he'll get shot out of the sky. Should the pilot go in fast instead? If he does, a crash is imminent. It's a Catch-22. This design anomaly has not been, and probably cannot be, eliminated.

Now add in faulty flight control software that tries to counter pilot commands, alternately increasing and decreasing power to aircraft rotors. At a March 2006 event, a V-22 inadvertently took off by itself, falling back to the ground and snapping off a wing, demonstrating the frailty of the system.

Add also severe downwash, which knocked over two Marines in one incident and in another caused the pilot to lose visual contact with the water surface so that the aircraft's belly plunged into the waves.

Add the missing defensive gun and personnel hoist, ongoing failures of other parts, and small, poorly placed cabin windows preventing crew chiefs from scanning for threats—and the potential for mishaps and lost lives becomes virtually inescapable.

Consider other survivability-related omissions, such as the failure to test the aircraft against rocket-propelled grenades (RPGs) used so frequently by insurgents in Iraq.

Finally, consider the flight manual instructions to pilots to convert to "airplane mode or autorotation" in case of dual engine failure, even though the DOD report says "the V-22 cannot autorotate to a safe landing."

Altogether, it is an aircraft waiting to increase its casualty list single-handedly if it is ever permitted to go to a combat theater.

Quality control and the *Osprey* money machine

Production facilities of V-22 co-manufacturers Bell-Textron and Boeing achieved prestigious International Standards Organization (ISO) benchmarking certification. Yet during testing preceding the fatal December 2000 crash, the V-22's hydraulic power system suffered 170 failures. Flights were suspended; after they resumed, propeller parts sheared off, and in March 2006, that idling V-22 took off by itself—slamming back to the ground.

Thus, we can quickly see how the *Osprey* might transmute into a Phoenix, an Albatross, or a goose laying golden eggs. It had a rebirth after program cancellation; but weighing in at $70 million a copy, it is a drain on taxpayers. It feeds the military-industrial-congressional feedback loop of campaign donations, production orders, and jobs created in 276 different congressional districts. So many billions of dollars have been spent that the program's momentum precluded shutdown—despite serious ongoing problems.

Testing was inadequate

Specific tests to investigate methods of operating safely within VRS, widely recognized as a potential problem, were cancelled, and because of danger to the rotor system and crew, test aircraft transitioning to helicopter mode "did not employ rapid tight turns" that a helicopter would have used for evasion.

V-22s can supposedly make vertical takeoffs or landings with one engine inoperable, *yet during 17 years of testing, this maneuver has never been attempted.*

Of 29 night mission profiles, only 12 were accomplished.

Intended testing under severe brownout conditions caused by violent V-22 downwash did not occur.

V-22 operating goals not met

The Pentagon considers the MV-22A "operationally effective," yet the range of the improved model will fall 42 percent short with a 10,000-pound external load.

The computerized mission planning system is inadequate.

The V-22 cannot carry an up-armored Humvee (HMMWV).

A time of reckoning

Key Pentagon leaders read in early 2001 how operational test planners had "deleted significant testing that would have provided additional knowledge on V-22 flying qualities and susceptibility to vortex ring state"—testing that might have helped prevent the deaths of 19 Marines in December 2000. Meanwhile, faulty parts and design deficiencies remain and further jeopardize missions and lives.

The V-22 should not be deployed in combat; an alternative, most probably an in-production helicopter, should be selected to replace all V-22s.

Have we learned anything at all after 25 years, $18 billion, and 30 deaths? It seems not. But if we act quickly, we can still save lives.