V-22 Osprey Tilt-Rotor Aircraft: Background and Issues for Congress

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Summary

The V-22 Osprey is a tilt-rotor aircraft that takes off and lands vertically like a helicopter and flies forward like an airplane. 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 variants for U.S. Special Operations Command, or USSOCOM (funded jointly by the Air Force and USSOCOM); and 48 HV-22s for the Navy.

Through FY2009, a total of 181 V-22s have been procured—155 MV-22s for the Marine Corps, and 26 CV-22s for USSOCOM. These totals include several V-22s that have been procured in recent years through supplemental appropriations bills.

The proposed FY2010 budget requests funding for the procurement of 30 MV-22s and five CV-22s. The budget requests about $2.3 billion in procurement and advance procurement funding for procurement of MV-22s, and about $565 million in procurement and advance procurement funding for procurement of CV-22s.

For FY2010, the V-22 program poses potential a number of potential oversight issues for Congress, including the aircraft's reliability and maintainability.

A June 23, 2009, hearing before the House Oversight and Government Reform Committee reviewed a number of issues concerning the V-22 program, including the aircraft's reliability and maintainability.

FY2010 defense authorization bill: The conference report (H.Rept. 111-288 of October 7, 2009) on the FY2010 defense authorization bill (H.R. 2647) authorizes the Administration's FY2010 request for procurement and advance procurement funding for the procurement of MV-22s and CV-22s.

FY2010 DOD appropriations bill: The House and Senate Appropriations Committees, in their reports (H.Rept. 111-230 of July 24, 2009 and S.Rept. 111-74 of September 10, 2009, respectively) on the FY2010 defense appropriations bill (H.R. 3326), both recommend approving the Administration's FY2010 request for procurement and advance procurement funding for the procurement of MV-22s and CV-22s.

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Introduction

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Background

The V-22 In Brief

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 are rotated 90 degrees forward, so that the rotors function like an airplane's propellers. The Navy states that the V-22 "performs VTOL [vertical takeoff and landing] missions as effectively as a conventional helicopter while also having the long-range cruise abilities of a twin turboprop aircraft."[1]

The MV-22 is designed to transport 24 fully equipped Marines at a cruising speed of 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.

[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.

Figure 1 shows a picture of an MV-22 with its engine nacelles rotated at about a 45-degree angle, or roughly half way between the upward VTOL position and the forward-flight position.

Figure 1. MV-22 Osprey

Source: Military-Today.com: http://www.military-today.com/helicopters/bellboeing_v_22_osprey.jpg.

Intended Missions

The V-22 is a joint-service, multi-mission aircraft. The Navy, which is the lead service for the V-22 program, states that "the Marine Corps version, the MV-22A, 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 will conduct long-range special operations missions."[2] Specific CV-22 missions include "long range, high speed infiltration, exfiltration, and resupply to Special Forces teams in hostile, denied, and politically sensitive areas."[3]

Marine Corps leaders believe that the MV-22 provides significant operational advantages compared to the CH-46, particularly in terms of speed in forward flight. The V-22 has been the Marine Corps' top aviation priority for many years.[4]

[2] 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.

[3] United States Special Operations Command, Fiscal Year (FY) 2009 Budget Estimates, February 2008, Procurement, Defense-Wide, Exhibit P-40 Budget Item Justification Sheet, page 1 of 13 (overall document page 59 of 192).

[4] See, for example, Department of the Navy, *Highlights of the Department of the Navy FY 2010 Budget*, May 2009, p. 5-11.

Key Contractors

The V-22 was developed and is being produced by Bell Helicopter Textron of Fort Worth, TX, and Boeing Helicopters of Philadelphia, PA. The aircraft's engines are produced by Allison Engine Company of Indianapolis, IN, a subsidiary of Rolls-Royce North America. Fuselage assembly is performed in Philadelphia, PA. Drive system rotors and composite assembly is performed in Fort Worth, TX, and final assembly and delivery is performed in Amarillo, TX.

Procurement Quantities

Total Quantities

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 variants for U.S. Special Operations Command, or USSOCOM (funded jointly by the Air Force and USSOCOM); and 48 HV-22s for the Navy.[5]

Through FY2009, a total of 181 V-22s have been procured—155 MV-22s for the Marine Corps and 26 CV-22s for USSOCOM. These totals include several V-22s that have been procured in recent years through supplemental appropriations bills. No HV-22s have yet been procured for the Navy.

Annual Quantities

Table 1 shows annual procurement quantities of MV-22s and CV-22s funded through DOD's regular (aka "base") budget. The table *excludes* the several V-22s that have been procured in recent years through wartime supplemental appropriations bills as replacements for legacy helicopters lost as a result of wartime operations.

[5] Like some other tactical aviation, the total number of V-22 aircraft planned for procurement has decreased over time. In 1989 the Defense Department projected a 663-aircraft program with six prototypes and 657 production aircraft (552 MV-22s, 55 CV-22s, and 50 HV-22s). As projected in 1994, however, the program comprised 523 production aircraft (425 MV-22s, 50 CV-22s, and 48 HV-22s). The Quadrennial Defense Review (QDR), released May 19, 1997, recommended accelerated procurement of 458 production aircraft.

Table 1. Annual V-22 Procurement Quantities

(Excludes V-22s procured through wartime supplemental funding)

FY	MV-22	CV-22	Total
1997	5	0	5
1998	7	0	7
1999	7	0	7
2000	11	0	11
2001	9	0	9
2002	9	0	9
2003	11	0	11
2004	9	2	11
2005	8	3	11
2006	9	2	11
2007	14	2	16
2008	19	5	24
2009	30	6	36
2010 (requested)	*30*	*5*	*35*

Source: Prepared by CRS based on DOD data.

Notes: Figures shown exclude several additional V-22s procured in recent years with wartime supplemental funding.

Multiyear Procurement (MYP) for FY2008-FY2012

V-22s are currently being procured under a $10.4-billion, multiyear procurement (MYP) arrangement covering the period FY2008-FY2012. The MYP contract , which was awarded on March 28, 2008, covers the procurement of 167 aircraft—141 MV-22s and 26 CV-22s. DOD expects the multiyear contract to save $427 million when compared to the use annual contracting.[6]

Cost and Funding

Total Program Cost

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

[6] Christopher J. Castelli, "Navy Awards $10.4 Billion V-22 Multiyear Deal," *Inside Washington Publishers*, March 28, 2008, online at http://www.insidedefense.com.

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.

When translated into constant FY2009 dollars, these figures become about $54.8 billion in total acquisition cost, including about $12.5 billion for research and development and about $42.0 billion for procurement. The PUAC is about $119.5 million, and the APUC is about $92.1 million.

The figures in the preceding two paragraphs are "objective" cost figures, meaning lower costs that DOD hopes to achieve. There are also higher "threshold" cost figures, meaning costs that DOD hopes to not exceed. The threshold cost figures for the program, when translated into constant FY2009 dollars, become about $60.0 billion in total acquisition cost, including about $13.7 billion for research and development and about $46.2 billion for procurement. The PUAC is about $131.5 million, and the APUC is about $101.4 million.[7]

Prior-Year Funding

In then-year dollars, the V-22 program from FY1982 through FY2008 received a total of about $25.7 billion in funding, including about $9.5 billion for research and development, about $15.9 billion for procurement, and about $191 million for MilCon. These figures *exclude* wartime supplemental funding that has been provided in addition to DOD's regular (aka "base") budget. As mentioned earlier, this supplemental funding has, among other things, funded the procurement of several V-22s.

FY2010 Funding Request

The proposed FY2010 budget requests funding for the procurement of 30 MV-22s and five CV-22s. The budget requests about $2.3 billion in procurement and advance procurement funding for procurement of MV-22s, and about $565 million in procurement and advance procurement funding for procurement of CV-22s.

Program History and Milestones

The V-22 program began in the early 1980s.[8] The aircraft experienced a number of development challenges relating to affordability, safety, and program management. Crashes of prototypes occurred in June 1991 (no fatalities) and July 1992 (seven fatalities). Two additional crashes

[7] Source: DOD Acquisition Program Baseline (APB) report for V-22 program, February 29, 2008. Figures translated into constant FY2009 dollars by CRS using DOD's budget authority deflator for procurement excluding pay, fuel, and medical, as presented in Table 5-7 (page 43) of the DOD document *National Defense Budget Estimates for FY 2009.*

[8] The V-22 is based on the XV-15 tilt-rotor prototype which was developed by Bell Helicopter and first flown in 1977. The Department of Defense began the V-22 program first under Army leadership; the Navy and Marine Corps subsequently assumed leadership. The V-22 program was given Milestone 0 approval in December 1981 as the Joint Services Aircraft program, and Milestone I approval in December 1982, at which time the program's acquisition strategy was approved. A preliminary design contract for the aircraft was awarded in April 1983 to a Bell-Boeing industry team, which was the only competitor for the program. The aircraft was designated the V-22 Osprey in January 1985. The program was given Milestone II approval in April 1986, initiating system development and demonstration. A full-scale development (FSD) contract was awarded in May 1986.

occurred in April 2000 (19 fatalities) and December 2000 (4 fatalities). The V-22's development challenges were a topic of considerable oversight and debate during the 1990s.

The acquisition program baseline (APB) for the V-22 has been revised numerous times over the program's history. The V-22 program has undergone restructuring to accommodate recommendations from outside experts and DOD managers.

The George H.W. Bush Administration proposed terminating the V-22 program in 1989 as part of its proposed FY1990 budget, and continued to seek the cancellation of the program through 1992. Congress rejected these proposals and kept the V-22 program alive. The Marine Corps' strong support for the program was a key reason for Congress's decision to keep the program going.

The MV-22 achieved Initial Operational Capability (IOC) in June 2007. The CV-22 achieved IOC in March 2009.[9]

For additional discussion of the history of the V-22 program, see **Appendix B**.

Initial Deployments

The first deployment of MV-22s began in September 2007, with the deployment of 10 MV-22s from VMM-263, a Marine Medium Tiltrotor Squadron, to Al Anbar province in Iraq.[10] During the first three months of deployment, the squadron reportedly had completed more than 2,000 air support requests while logging more than 2,000 combat flight hours and maintaining an average mission-capable rate[11] of 68%.[12] The Marine Corps has lauded the extended range, speed, and payload that the Osprey possesses in comparison to helicopters it is intended to replace as instrumental to the success of time-critical interdiction and medical evacuation missions during the deployment.[13]

[9] In August 1995, the V-22 contract was modified to include the CV-22 as a special operations version of the aircraft. The CV-22 completed CDR in December 1998. CV-22 flight testing began in February 2000 and was completed in October 2007. A production contract for long lead items for the CV-22 was awarded in June 2000. CV-22 Initial Operational Test and Evaluation (IOT&E) began in June 2006.

[10] The first MV-22 prototype flow in helicopter mode in March 1989. The first forward-facing flight occurred in September 1989. The MV-22 completed Critical Design Review (CDR) in December 1994. The first low-rate initial production (LRIP) contract was awarded in June 1996, and the first delivery of an LRIP aircraft occurred in May 1999. Technical evaluation (TECHEVAL) began in July 1999 and was completed in September 1999. Operational evaluation (OPEVAL) began in November 1999 and was completed in July 2000.

In January 2001, an MV-22 squadron commander was relieved of duty after admitting to falsifying maintenance records, and three Marines were found guilty of misconduct in September 2001. In April 2001, a blue ribbon panel formed by Secretary of Defense William Cohen recommended continuing with the V-22 program in restructured form.

Phase II of the MV-22's OPEVAL began in March 2005 and was completed in June 2005. The program was given Milestone III approval, permitting full-rate production, in October 2005.

[11] An aircraft's mission capable rate is the percentage of time an aircraft is available for to fly scheduled sorties.

[12] Gareth Jennings, "USMC Details Osprey Operational Availability Rates in Iraq," *Jane's Defense Weekly*, February 20, 2008, online at http://www.janes.com.

[13] Michael Fabey, "Ospreys Proving Mettle in Counter-IED, Medevac Missions," *Aerospace Daily & Defense Report*, January 31, 2008, p. 4.

In April 2009, it was reported that the Marine Corps anticipates shifting the MV-22 squadron currently deployed in Iraq to Afghanistan sometime in 2009.[14]

The first deployment of CV-22s, which involved four aircraft sent to Mali, occurred in December 2008. The aircraft participated in a multinational exercise. Those involved in the deployment report successfully self-deploying the squadron to a remote and austere location and conducting simulated long-range, air-drop, and extraction missions.[15]

Foreign Military Sales

To date, there have been no sales of the V-22 to foreign military forces. The Marine Corps' deployment of MV-22s to Iraq, however, has reportedly sparked interest in the V-22 among Norway, Israel, and Japan.[16]

GAO Assessments

March 2009 GAO Report

A March 2009 Government Accountability Office (GAO) report on major DOD acquisition programs stated the following in its entry on the V-22 program:

> **Technology Maturity and Design Stability**
>
> The V-22 is being procured in blocks. The program office considers the MV-22 critical technologies to be mature and its design stable. However, MV-22 Block B aircraft, the full-rate production configuration deployed to Iraq, have experienced reliability problems. These aircraft fell short of their mission capability goal (the ability to accomplish any one mission), due in part to component reliability problems with parts such as gearboxes and generators. The aircraft fell well short of its full-mission capability goal (the ability to accomplish all missions), primarily due to a complex and unreliable de-icing system. During the Iraq deployment, the V-22's less than 400 hour engine service life fell short of the 500-600 hours estimated by program management. The program office noted that the contract does not require a specific service life to be met. Also, pending modifications to the program's engine support contract with Rolls Royce could result in increased support costs in the future.
>
> 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 V-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 V-22. This radar and an effective de-icing system are essential for self-deploying the V-22

[14] Dan Taylor, "Marines: V-22 Ospreys Leaving Iraq for Good in Coming Weeks," *Inside the Navy*, April 20, 2009. See also and Zachary M. Peterson, "Conway: Marines, V-22 Osprey Ready to Move to 'Fight' in Afghanistan," *Inside the Navy*, March 16, 2009.

[15] 1st Lt. Lauren Johnson. "CV-22s Complete First Operational Deployment." *Air Force News.* December 3, 2008.

[16] Unattributed, "What's Ahead in Aerospace & Defense: Osprey Export," *Aerospace Daily & Defense Report*, Vol. 226, No. 35, May 19, 2008, p. 1.

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 increases for heavier individual body armor and equipment may affect the V-22's ability to maintain key performance parameters, such as speed, range, and troop carrying capacity.

While the program office reports a stable design, changes can be expected in order to to [sic] integrate planned upgrades. Issues with the aircraft's internal cargo handling capability were identified during Iraq operations and led to significant delays. Program officials state that revised techniques and procedures reduced these delays. External cargo carriage missions were rarely assigned to V-22s in Iraq, as mission tasking during this period required minimal external lift support. In addition, most external loads cannot be carried at speeds that leverage the high-speed capability of the V-22. The program is adding forward firing countermeasures to enhance the aircraft's survivability; modifying the engine air particle separator to prevent engine fires and enhance system reliability; and improving the environmental control system.

The Navy and Marine Corps conducted training for the V-22's shipboard deployment and identified challenges related to this operating environment. Design changes are already being made to some of the ships on which the V-22 will deploy to help ensure effective operations on the flight deck and in the hangar deck during maintenance. The changes will also provide increased space for V-22 spare parts.

Production Maturity

In March 2008, the V-22 program signed a $10.4 billion multiyear production contract with Bell Boeing for the production of 167 aircraft through 2012, even though aircraft continue to be conditionally accepted with deviations and waivers relating to components such as brakes, landing gear, hydraulic hoses, de-icing systems, and radar altimeters. The demand for spare parts for deployed aircraft and the acceleration of CV-22 production could both pose challenges for ramping up V-22 production from 11 in 2005 to 36 in 2009. For example, lessons learned from the initial Iraq deployment stated that the lead time for and lack of availability of MV-22 repair parts led to high cannibalization rates.

Program Office Comments

In commenting on a draft of this assessment, the V-22 program office provided technical comments, which were incorporated where appropriate.[17]

May 2009 GAO Report

A May 2009 Government Accountability Office (GAO) report on the V-22 program stated:

> As of January 2009, the 12 MV-22s (Marine Corps variant of the V-22) 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 farther than the legacy helicopters being replaced. Noted challenges to operational effectiveness raise questions about whether the MV-22 is best suited to accomplish the full repertoire of missions of the helicopters it is intended to replace.

[17] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-09-326SP, March 2009, p. 142.

> Additionally, suitability challenges, such as unreliable component parts and supply chain weaknesses, led to low aircraft availability rates.
>
> MV-22 operational tests and training exercises identified challenges with the system's ability to operate in other environments. Maneuvering limits and challenges in detecting threats may affect air crew ability to execute correct evasive actions. The aircraft's large size and inventory of repair parts created obstacles to shipboard operations. Identified challenges could limit the ability to conduct worldwide operations in some environments and at high altitudes similar to what might be expected in Afghanistan. Efforts are underway to address these deficiencies, but some are inherent in the V-22's design.
>
> V-22 costs have risen sharply above initial projections—1986 estimates (stated in fiscal year 2009 dollars) that the program would build nearly 1000 aircraft in 10 years at $37.7 million each have shifted to fewer than 500 aircraft at $93.4 million each—a procurement unit cost increase of 148 percent. Research, development, testing, and evaluation costs increased over 200 percent. To complete the procurement, the program plans to request approximately $25 billion (in then-year dollars) for aircraft procurement. As for operations and support costs (O&S), the Marine Corps' V-22's cost per flight hour today is over $11,000—more than double the targeted estimate.[18]

Issues For Congress

Aircraft Reliability and Maintainability

One oversight issue for Congress for the V-22 program concerns the reliability and maintainability of in-service V-22s.

May 2009 Navy and Marine Corps Testimony

At a May 19, 2009, hearing on Navy and Marine Corps aviation procurement programs before the Seapower and Expeditionary Forces subcommittee of the House Armed Services Committee, Navy and Marine Corps officials testified that:

> The MV-22B Osprey is now combat-tested and ready for deployment anywhere throughout the world. As our premier medium lift assault support platform, the Osprey brings unprecedented range, speed and survivability to the Warfighter, in a platform that far exceeds the capabilities of the CH-46E it is replacing. The MV-22B has been supporting our Marines in combat continuously since October 2007, with the third successive squadron recently completing a highly successful seven month rotation in support of Operation IRAQI FREEDOM just last month. In Iraq, Osprey squadrons have logged over 9,000 flight hours, carried over 40,000 passengers, and lifted over two million pounds of cargo while flying every mission profile assigned by the Multi-National Force-West Commander.
>
> As we continue to explore the tremendous capabilities of tilt-rotor aircraft and look forward to employing Osprey both aboard ship and in new theaters of operation, we are learning valuable lessons with respect to reliability and maintainability. Like other types of aircraft in the early operational phase of their lifecycles, the MV-22 has experienced lower-than-desired

[18] Government Accountability Office, *Defense Acquisitions[:] Assessments Needed to Address V-22 Aircraft Operational and Cost Concerns to Define Future Investments*, GAO 09-482, May 2009, summary page.

> reliability of some components and therefore higher operations and support costs. With the cooperation and support of our industry partners, we are tackling these issues head on, with aggressive logistics and support plans that will increase the durability and availability of the parts needed to raise reliability and concurrently lower operating costs of this aircraft.[19]

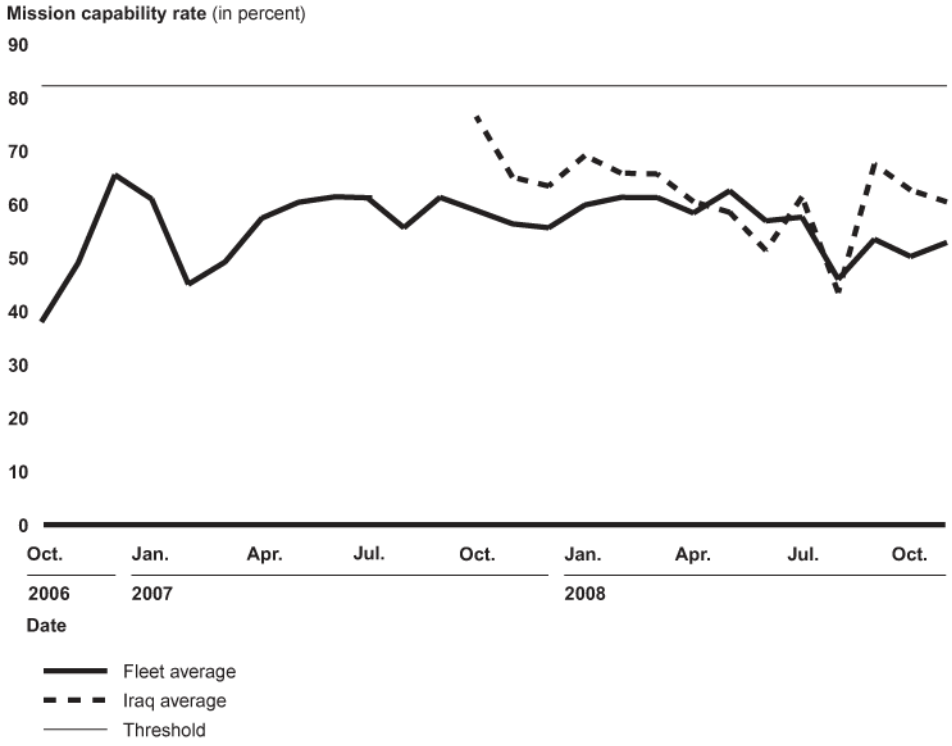
May 2009 GAO Report

The May 2009 GAO report on the V-22 program cited earlier stated the following regarding the aircraft's reliability and maintainability:

> Availability challenges continue to affect the MV-22. In Iraq, the V-22's mission capability (MC) and full mission capability (FMC) rates fell significantly below required levels and significantly below rates achieved by legacy helicopters. The MV-22 has a stated MC threshold (minimum acceptable) requirement of 82 percent and an objective (desired) of 87 percent. In Iraq, the three MV-22 squadrons averaged mission capability rates of about 68, 57, and 61 percent respectively. This experience is not unique to the Iraq deployment, as low MC rates were experienced for all MV-22 squadrons, in and out of Iraq. The program has modified the MC requirement by stating that this threshold should be achieved by the time the fleet completes 60,000 flight hours, which officials expect to occur sometime near the end of 2009. Figure 4 illustrates the MC rates between October 2006 and October 2008.

[19] Statement of Vice Admiral David Architzel, USN, Principal Military Deputy, Research, Development and Acquisition, LTGEN George J. Trautman III, USMC, Deputy Commandant for Aviation, [and] RADM Allen G. Myers, USN, Director of Warfare Integration, before the Seapower and Expeditionary Warfare [sic: Forces] Subcommittee of the House Armed Services Committee [hearing] on [The] Department of the Navy's Aviation Procurement Program, May 19, 2009, pp. 7-8.

Figure 4: MV-22 Mission Capability Rates between October 2006 and October 2008



Source: GAO analysis of U.S. Navy data.

By comparison, the mission capability rates of the Iraq-based CH-46Es and CH-53s averaged 85 percent or greater during the period of October 2007 to June 2008.

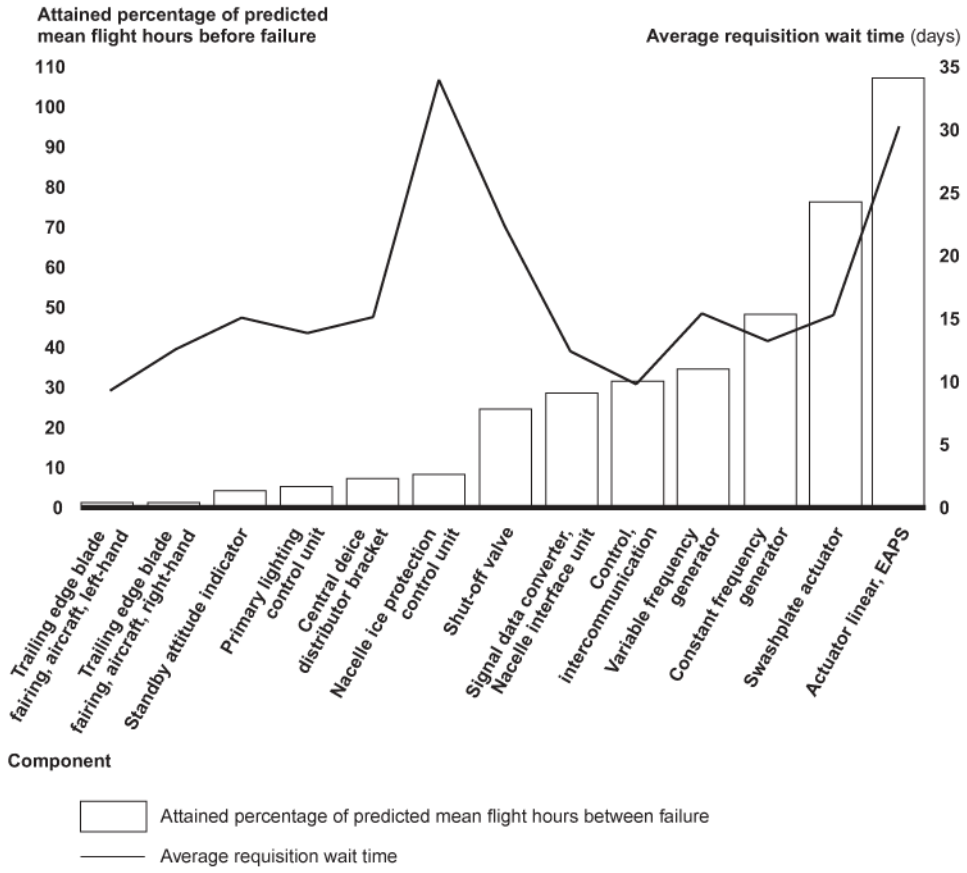
Although FMC is no longer a formal requirement, it continues to be tracked as an indicator of aircraft availability. The Osprey's FMC rate of 6 percent in Iraq from October 2007 to April 2008 was significantly short of the 75 percent minimum requirement established at the program's outset. According to MV-22 officers and maintainers, the low FMC rate realized was due in part to unreliability of V-22 Ice Protection System (IPS) components. Although the faulty IPS had no effect on the MV-22's ability to achieve missions assigned in Iraq, in other areas, where icing conditions are more likely to be experienced—such as Afghanistan—IPS unreliability may threaten mission accomplishment.

Although MV-22 maintenance squadrons stocked three times as many parts in Iraq as the number of deployed MV-22 aircraft called for, they faced reliability and maintainability challenges. Challenges were caused mostly by an immature parts supply chain and a small number of unreliable aircraft parts, some of which have lasted only a fraction of their projected service life.

The MV-22 squadrons in Iraq made over 50 percent more supply-driven maintenance requests than the average Marine aviation squadron in Iraq. A lack of specific repair parts was a problem faced throughout the Iraq deployments despite deploying with an inventory of spare parts to support 36 aircraft, rather than the 12 MV-22 aircraft actually deployed. Despite the preponderance of parts brought to support the MV-22s in Iraq, only about 13 percent of those parts were actually used in the first deployment. In addition, some aircraft components wore out much more quickly in Iraq than expected, which led to shortages. Thirteen MV-22 components

accounted for over half the spare parts that were not available on base in Iraq when requested. Those components lasted, on average, less than 30 percent of their expected life, with six lasting less than 10 percent of their expected life. The shortages caused MV-22 maintainers to cannibalize parts from other MV-22s to keep aircraft flying, and significantly increased maintenance hours. Parts were cannibalized not only from MV-22s in Iraq but also from MV-22s in the United States and from the V-22 production line. The shortages also contributed to the low mission capability rates, as an aircraft in need of maintenance or spare parts may not be considered mission capable. Figure 5 depicts both the percentage of predicted mean flight hours before failure achieved by these 13 parts and their average requisition waiting time during the Iraq deployments.

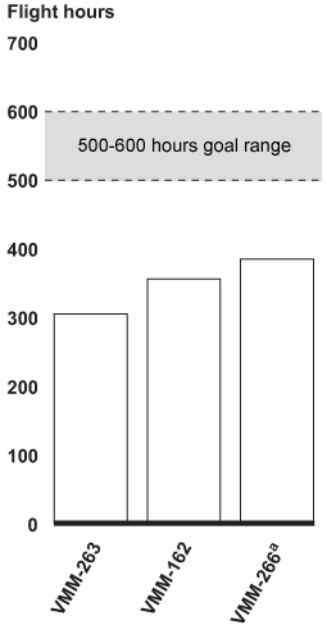
Figure 5: Attained Percentage of Predicted Mean Flight Hours before Failure and Requisition Wait Time for Top 13 Parts Degrading MV-22 Mission Capability



Source: GAO analysis of U.S. Marine Corps data.

The engines on the MV-22s deployed in Iraq also fell short of their estimated "on-wing" service life, lasting less than 400 hours before having to be replaced. The program estimated life is 500-600 hours. The program office noted that there is no contractually documented anticipated engine service life. Figure 6 illustrates the average engine time on wing for the three MV-22 squadrons that have been deployed to Iraq.

Figure 6: Iraq-Deployed MV-22 Squadrons' Average Engine Time on Wing



Source: GAO analysis of U.S. Navy data.
[a]Data for VMM-266 squadron represent only a portion of the ongoing deployment.

> Squadron maintainers explained that the lower engine life span has not affected aircraft availability, as spare engines are readily available and easily replaced. Program officials plan to replace the existing power-by-the-hour engine sustainment contract with Rolls Royce, which expires in December 2009, with a new sustainment contract.17 According to the program office, the new engine sustainment contract is likely to result in higher engine support costs—an issue further discussed later in this report. [20]

Press Articles

A May 2009 defense trade press article based on Marine Corps testimony at an earlier (May 14) hearing before the House Armed Services Committee stated:

> Reliability issues with the V-22 Osprey tiltrotor aircraft remain a top concern for Navy officials, but the Marine Corps' top general said last week that the aircraft's availability is not any worse than any other new aircraft program.
>
> "We have had ... some reliability issues in terms of the availability of the aircraft," Marine Commandant Gen. James Conway told the House Armed Services Committee May 14, "but I would suggest not greater than other new aircraft, especially new aircraft that [operate in] such an austere environment."
>
> In January, Lt. Gen. George Trautman, deputy commandant for aviation, *told Inside the Navy* that V-22 availability is currently below 70 percent, which is "not where I want it to be." He said he would like to see the aircraft top 80 percent readiness.

[20] Government Accountability Office, *Defense Acquisitions[:] Assessments Needed to Address V-22 Aircraft Operational and Cost Concerns to Define Future Investments*, GAO 09-482, May 2009, pp. 14-18.

> However, Conway said the V-22 has been performing well and the Marine Corps was "pleased" with what it was seeing in Iraq, and that availability problems would be worked out in time.
>
> "We're working those issues, and we are very optimistic about the future of this aircraft," he said. [21]

An April 2009 trade press article stated:

> A recent Government Accountability Office report claims that the engines of V-22 Osprey titlrotor aircraft in Iraq are managing a service life of 400 flight hours, but the program manager told *Inside the Navy* last week that, since the report was completed, crews have found a way to add 100 hours to the service life by using pressure washers to remove sand and grit from the motors.
>
> The March 30 report, titled: "Defense Acquisitions: Assessment of Selected Weapons Programs," states that V-22s in Iraq achieved engine service lives that "fell short of the 500-600 hours estimated by program management."
>
> However, Col. Matt Mulhern, the program manager, told *Inside the Navy* in an April 7 phone interview that the program knew going in that the engines would have a shortened service life because of the harsh conditions in theater, and regular washing of the sand and grit from the engines has bumped up the service life closer to 500 hours.
>
> "We knew they were going to have a hard time over there because every engine over there has a hard time," he said. "We instituted some compressor washers and some high-pressure turbine washers, so we bought back about 100 hours just by doing that. We went from about 380 hours on wing to about 480 hours on wing."
>
> He noted that the V-22 fleet as a whole is averaging about 600 hours, and they would be averaging about 1,300 hours if the 12 V-22s in Iraq were removed from the equation....
>
> Addressing the recent brief grounding of the V-22 fleet due to loose bolts discovered in six Ospreys—all but one were stationed in Iraq—Mulhern said he is "comfortable" the program has the problem under control, although the case is not closed until an investigation determines why it happened.
>
> "We've developed an inspection so we can catch this before it's a safety item," he said. "We're going to run engineering investigations on them. That's still ongoing and probably will be for a while, and depending on what we find there, we've got to work out the fix. The fix could be something on the production line on the way we build it, it could be a redesign of some nature, it could be a technique we apply on the flight line or something."
>
> He said it was "hard to say" how long the investigation would take, but the program will have a good idea of the findings in a few weeks after getting all the parts back, which are expected in the next week or so.[22]

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[21] Dan Taylor, "Conway to HASC: V-22 Availability Levels Need Improvement," *Inside the Navy*, May 18, 2009. Bracketed material as in the original.

[22] Dan Taylor, "Mulhern: Program Adds 100 Flight Hours to Osprey Engine Life in Iraq," *Inside the Navy*, April 13, 2009.

An internet site on military and space affairs that calls itself "G2mil," and which states that it is "authored by Carlton Meyer, a former Marine Corps officer" (http://www.g2mil.com/) includes a section (http://www.g2mil.com/ (continued...)

Readiness For Higher Production Rate

Another potential oversight issue for Congress for the V-22 program concerns the program's readiness to increase to higher annual production rates. The March 2009 GAO report cited earlier stated that the V-22 program would face certain challenges in increasing the program's production rate to 36 aircraft in 2009 (see "GAO Assessments"). An April 2009 trade press article stated that Colonel Matt Mulhern, the V-22 program manager, did not agree with this assessment:

> "I'm not sure I agree with that conclusion," he said. "The acceleration that we had of CVs—we added five CVs as part of the [FY-09 supplemental war spending bill]—we have found places in the production line to accommodate those. They shouldn't have a huge impact on the production line."
>
> Regarding the spare parts, the GAO said that "the lead time for and lack of availability of MV-22 repair parts led to high cannibalization rates."
>
> Mulhern agreed there has been "cannibalization" or the removal of parts from an aircraft for use on another that needs them, but said it was to be expected in a young program.
>
> "That's true, we didn't have all the parts we wanted, so in some cases we'd cannibalize," he said. "But it wasn't to the point that we had to stop operating."
>
> He pointed out that 85 percent of the total flight hours have come in the last four years of the program, and "the supply system lags typically about two years," he said.
>
> "The fact that we're flying 700-hour months with 12 airplanes there means we got most of them right," the colonel said. "We didn't get them all right. We recognize we've got some challenges that we've got to work on. That's fairly normal in the life of a program. I think we've been a lot more successful than a lot of people thought we would be."
>
> He said there are "programs in place" to improve component reliability.[23]

Operational Capabilities

Another potential oversight issue for Congress for the V-22 program concerns the degree to which the V-22 has demonstrated certain operational capabilities. The May 2009 GAO report cited earlier states:

> As of January 2009, the 12 MV-22s stationed in Iraq had successfully completed all missions assigned to them in what is considered an established, low-threat theater of operations. The deployments confirmed that the V-22's enhanced speed and range enable personnel and internal cargo to be transported faster and farther than is possible with the legacy helicopters it is replacing. The aircraft also participated in a few AeroScout missions and carried a limited number of external cargo loads. However, questions have arisen as to whether the

(...continued)

scandal.htm) with more than 25 postings dating back to 2001 that are highly critical of the V-22 program. A posting dated June 2009 (http://www.g2mil.com/V-22repairs.htm) contains highly critical comments regarding the maintainability of the V-22 program.

[23] Dan Taylor, "Mulhern: Program Adds 100 Flight Hours to Osprey Engine Life in Iraq," *Inside the Navy*, April 13, 2009. Bracketed material as in the original.

MV-22 is best suited to accomplish the full mission repertoire of the helicopters it is intended to replace. Some challenges in operational effectiveness have been noted....

The Marine Corps considers the MV-22 deployments in Iraq to have been successful, as the three squadrons consistently fulfilled assigned missions. Those missions were mostly general support missions—moving people and cargo—in the low-threat operational environment that existed in Iraq during their deployments. The aircraft's favorable reviews were based largely on its increased speed and range compared with legacy helicopters. According to MV-22 users and troop commanders, its speed and range "cut the battlefield in half," expanding battlefield coverage with decreased asset utilization and enabling it to do two to three times as much as legacy helicopters could in the same flight time. 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....

Commanders and operators have noted that the speed and range of the Osprey offered some significant advantages over the legacy platforms it replaced during missions performed in Iraq, including missions that would have been impossible without it. For example, it enabled more rapid delivery of medical care; missions that had previously required an overnight stay to be completed in a single day; and more rapid travel by U.S. military and Iraqi officials to meetings with Iraqi leaders, thus allowing greater time for those meetings.

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 with a refueling C-130 escort that, according to Marine Corps officers, find suspicious targets and insert Marines as needed to neutralize threats. In 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 Marine equipment requiring external transport is cleared only for transit at speeds under 150 knots calibrated airspeed (kcas), not the higher speeds at which the MV-22 can travel with internal cargo or passengers. According to Iraq-based MV-22 squadron leadership, the CH-53, which is capable of lifting heavier external loads, was more readily available than the MV-22 to carry out those missions and, as such, was generally called on for those missions, allowing the MV-22 to be used more extensively for missions that exploit its own comparative strengths.

The introduction of the MV-22 into Iraq in combination with existing helicopters has led to some reconsideration of the appropriate role of each. Battlefield commanders and aircraft operators in Iraq identified a need to better understand the role the Osprey should play in fulfilling warfighter needs. They indicated, for example, that the MV-22 may not be best suited for the full range of missions requiring medium lift, because the aircraft's speed cannot be exploited over shorter distances or in transporting external cargo. These concerns were also highlighted in a recent preliminary analysis of the MV-22 by the Center for Naval Analysis, which found that the MV-22 may not be the optimal platform for those missions.

The MV-22's Iraq experience also demonstrated some limitations in situational awareness that challenge operational effectiveness. For example, some MV-22 crew chiefs and troop commanders in Iraq told us that they consider a lack of visibility of activity on the ground from the V-22's troop cabin to be a significant disadvantage—a fact previously noted in operational testing. They noted that the V-22 has only two small windows. In contrast, combat Marines in Iraq stated that the larger troop compartment windows of the CH-53 and CH-46 offer improved ability to view the ground, which can enhance operations. In addition, CH-53s and CH-46s are flown at low altitude in raid operations. According to troop commanders this low altitude approach into the landing zones combined with the larger

> windows in CH-53s and CH-46s improves their (the troop commanders) situational awareness from the troop compartments, compared with the situational awareness afforded troop commanders in the MV-22s with its smaller windows and use of high altitude fast descent approach into the landing zone. The V-22 program is in the process of incorporating electronic situational awareness devices in the troop cabin to off-set the restricted visibility. This upgrade may not fully address the situational awareness challenges for the crew chief, who provides visual cues to the pilots to assist when landing. Crew chiefs in Iraq agree that the lack of visibility from the troop cabin is the most serious weakness of the MV-22.[24]

A May 2009 trade press article stated that:

> The V-22 Osprey, which is due to deploy to Afghanistan this fall, remains largely untested in its tactical assault support role, Marines who used the tiltrotor aircraft in Iraq told service officials five months ago, according to internal documents.
>
> The assault support mission calls for moving people and supplies in and around the battlefield. Marine Commandant Gen. James Conway and Lt. Gen. George Trautman, the service's top aviation official, have recently touted the Osprey's assault support capabilities.
>
> "Our third tiltrotor squadron just wrapped up successful combat operations in Iraq while we were still there," Conway told reporters at an April 29 press conference. "The squadrons performed as we expected. They did it without incident or fanfare and through every type of assault support mission required."
>
> In a May 6 teleconference from Iraq, Trautman told bloggers and reporters the V-22 "completed every assigned mission and it did so flying faster, farther, and with safer flight profiles than any other assault support aircraft in the history of military operations."
>
> But Marines who used the V-22 in Iraq have told the Marine Corps Center for Lessons Learned that the Osprey has not yet cut its teeth in the assault support mission. In December, the center interviewed members of the third squadron to use the V-22 in Iraq, VMM-266, at Al Asad airbase in Iraq. Personnel from supporting units were also interviewed. Inside the Pentagon reviewed a summary of the findings, dated this month.
>
> "However, Osprey operators also expressed the view that the tiltrotor capability has not been fully explored or exploited in [Operation Iraqi Freedom] due to the lack of opportunities to participate in assault support missions at the tactical level," the summary states. "The current low level of insurgent activity has contributed to the lack of rigorous testing of the aircraft's assault support role."
>
> "I think that this is nothing more than Marines being Marines and wanting to do everything, but when the situation on the ground has changed so drastically, there is a bit of frustration," said Marine spokesman Maj. Eric Dent. But the service "can readily accept" that kind of frustration, which is tied to peace in Anbar province, he said.
>
> "We don't 'create' missions or tactical opportunities to get a check in a particular box," he said.
>
> A Pentagon official who supports the V-22 described Marine generals' comments about assault support missions as a bit of "spin." There is a difference between doing logistics

[24] Government Accountability Office, *Defense Acquisitions[:] Assessments Needed to Address V-22 Aircraft Operational and Cost Concerns to Define Future Investments*, GAO 09-482, May 2009, pp. 11-14.

missions like transporting howitzer munitions from one location to another and flying 24 Marines into an attack, though both roles are considered assault support, the official said. A true battle test of the V-22 has not happened yet, the official said. But the official concurred that is due to low levels of insurgent activity in Iraq.

In Iraq, the only weapon the V-22 sported was a small-caliber machine gun mounted on its rear ramp. But the Marines plan to give it heavier firepower before it deploys to Afghanistan, where armed insurgents hide in mountains and hills. Troutman said the service is upping the ramp-mounted gun to a 50-caliber while also working with Air Force Special Operations Command and BAE Systems to develop a 360-degree gun to hold off unexpected threats in an objective area. The new fire-suppression weapon would fire tracers to put the enemy's head down, letting the V-22 use its "incredible" speed, power and acceleration to leave threat area, he said.

"As all of you know, assault support airplanes are not offensive platforms," Troutman added. "They take a defensive posture when they encounter a threat." This interim defensive weapon system is going to be "precisely ... what makes sense in the Afghan environment," he said.

The Marines interviewed in December said the V-22 repeatedly demonstrated how its range and speed can "shrink the battlefield," a point Conway underscored in his press conference. "One of my commanders in Iraq compared it [to] being able to turn Texas into a place the size of Rhode Island," Conway said.

Infantrymen also suggested that they needed additional practice deploying on and off the aircraft during periods of brownout caused by the tiltrotor's powerful downwash, according to the summary.

Marines interviewed also called for more avionics technicians in the maintenance department, due to the technical complexity of the V-22 compared with old CH-46 helicopters. On a related note, it was recommended the rotation of deployed aircraft not exceed one year. If this rotation time line is not possible, the maintenance officer advocated establishing a depot-level type maintenance capability in theater.

VMM-263 originally deployed with 10 aircraft. Later, two more aircraft were deployed to bring the squadron up to its full complement of 12. The squadron commander told interviewers that 12 was the right number to accomplish the assigned mission in Iraq.

The squadron generally praised the Desert Talon training exercise, which is set in the Arizona desert and used to prepare for the Iraq deployment.

In addition to touting the V-22's speed and range, the squadron was pleased with the Osprey's ability to maintain communications with controlling agencies at greater ranges than lower flying helicopters. "The ability to maintain line of sight communications facilitated the command and control capabilities of the controlling agency," the summary says. But Marines in the V-22 must use satellite communications due to the aircraft's increased operational range, the squadron told interviewers.

Several squadron leaders also told interviewers that injured Marines could receive quicker medical care if the V-22 were assigned a casualty evacuation mission, in addition to its assigned mission of standby tactical recovery of aircraft and personnel.[25]

[25] Christopher J. Castelli, "Marines Tout V-22, But See It As Untested in Tactical Assault Support," *Inside the* (continued...)

June 23, 2009, Hearing on V-22 Program

A June 23, 2009, hearing before the House Oversight and Government Reform Committee reviewed a number of issues concerning the V-22 program, including those discussed above.[26] Materials from this hearing are presented in **Appendix A**.

(...continued)

Pentagon, May 14, 2009. Bracketed material as in the original.

[26] The hearing was originally scheduled for May 21, 2009, but the hearing was adjourned after a few minutes and laer rescheduled for June 23, 2009. The chairman of the committee, Representative Edolphus Towns, stated the following at the opening of the May 21 hearing:

> Good morning. Thank you all for being here.
>
> We had hoped to conduct today a thorough examination of the Defense Department's V-22 Osprey, an aircraft with a controversial past, a troubled present, and an uncertain future.
>
> However, the Defense Department has evidently decided to stonewall our investigation. On May 5, 2009, I wrote to Secretary of Defense Gates to request information on the Osprey, including copies of two reports on the performance of the Osprey in Iraq, called "Lessons and Observations." I also requested a list of all V-22 Ospreys acquired by the Defense Department, including their current locations and flight status.
>
> However, to this date, the Defense Department has failed to provide this information, despite repeated reminders from the Committee. This is simply unacceptable.
>
> General Trautman, I want you to carry this message back to the Pentagon: We will pursue this investigation even harder than we have so far. We will not be slow-rolled. We will not be ignored.
>
> I intend to conduct a full investigation of the Osprey, not just an investigation of the information that you want me to see. We hope you will provide it voluntarily, but if you do not, we will compel your compliance.
>
> To ensure a thorough investigation and to allow the Defense Department additional time to provide us with these records, we will continue this hearing in two weeks and I am asking the witnesses to return to present their testimony at that time. This hearing is now adjourned, to be resumed in two weeks at the call of the chair.
>
> Thank you.

(Source: Text of opening statement of Representative Edolphus Towns, as posted on the committee's website. http://oversight.house.gov/documents/20090521101314.pdf. The listed witnesses for the hearing were Mr. Mike Sullivan, Director of Acquisition and Sourcing Management, Government Accountability Office; Mr. Dakota L. Wood, Senior Fellow, Center for Strategic and Budgetary Assessments; Lieutenant General George Trautman, Deputy Commandant for Aviation, U.S. Marine Corps; and Lieutenant Col Karsten Heckl, Commander, Marine Medium Tiltrotor Squadron 162 (VMM-162). See also Christopher J. Castelli, "Committee Accuses DOD of Stonewalling on V-22 Documents, Ends Hearing Abruptly," *InsideDefense.com (DefenseAlert – Daily News)*, May 21, 2009; and Geoff Fein, "House Oversight Committee Chair Claims DoD 'Stonewalling' V-22 Investigation," *Defense Daily*, May 22, 2009: 2-3.

On May 22, 2009, it was reported that:

> The Pentagon is denying the House Oversight and Government Reform Committee's accusations that it is stonewalling lawmakers' requests for information about the V-22 Osprey.
>
> "The Department of Defense coordination process is highly complex," Pentagon spokeswoman Cheryl Irwin told InsideDefense.com. "We are diligently working to fulfill this request and will have it to the proper officials in order that the hearing process can continue."
>
> House Oversight Committee Chairman Edolphus Towns (D-NY) yesterday accused the Pentagon of stonewalling his request for V-22 documents and vented his displeasure by abruptly ending a hearing after mere minutes, telling a three-star Marine Corps general to return in two weeks.
>
> Towns said the panel had hoped to conduct a "thorough examination" of the V-22 program, which he said has "a controversial past, a troubled present, and an uncertain future." But the Defense Department has "evidently decided to stonewall our investigation," he complained.
>
> The panel's ranking Republican, Rep. Darrell Issa (CA), also complained about DOD's failure to

(continued...)

Legislative Activity in 2009

FY2010 Funding Request for Procurement of V-22s

The proposed FY2010 budget requests funding for the procurement of 30 MV-22s and five CV-22s.

MV-22s

Procurement funding for MV-22s is in the Aircraft Procurement, Navy (APN) appropriation account, which funds the procurement of Navy and Marine Corps aircraft.

The Navy estimates the procurement cost of the 30 MV-22s requested for FY2010 at $2,359.0 million, or an average of about $78.6 million each. These 30 aircraft have received $143.2 million in prior-year advance procurement funding, leaving another $2,215.8 million requested in the APN account for FY2010 budget to complete their cost. The APN account also requests $84.3 million in advance procurement funding for V-22s that the Navy wants to procure in future fiscal years, bringing the total FY2010 APN funding request for procurement and advance procurement of MV-22s to $2,300.2 million.

(...continued)

> provide the documents, stressing the committee needs such information well in advance of any hearing. In a statement released later, he faulted a "bureaucratic failure of the Office of the Secretary of Defense," not the Marine Corps.
>
> After about three minutes, Towns ended the hearing. He said it would be continued in two weeks to give DOD additional time to provide the records. The witnesses were not invited to speak during the brief hearing nor did they attempt to do so. After the hearing, Lt. Gen. George Trautman, the Marine Corps' top aviation official and one of a handful of witnesses who had been scheduled to testify, declined to speak to reporters.
>
> Later that day, Marine Corps spokesman Maj. Eric Dent told InsideDefense.com the service understands Towns' decision to postpone the hearing. But the Marine Corps was disappointed "that we did not get the opportunity to discuss with the committee the Osprey's remarkable performance in Iraq over the past 19 months," he added. The V-22 program has nothing to hide, according to Dent.
>
> "As we were today, we remain prepared to discuss every aspect of the Osprey program with Congress," he said. "We are fully committed to openness and transparency; in fact, we've been working hand-in-hand with the Government Accountability Office for the past year in its own review of the Osprey program."...
>
> Dent insisted the Marine Corps is making a good-faith effort to address the request.
>
> "We forwarded, at the committee's request, more than 500 pages of maintenance records, after-action reports, and additional information on every MV-22 we have," he said. "Essentially, this was an aircraft-by-aircraft daily record of location and maintenance discrepancies. Collecting this information was a monumental task. Although we cannot speak to why the committee did not receive the information the Marine Corps prepared, we must emphasize that we have a process by which information, including classified material that was asked for by the committee, must be vetted before being released."

(Christopher J. Castelli, "Pentagon Denies Accusations of Stonewalling Congress on V-22," *InsideDefense.com [DefenseAlert – Daily News]*, May 22, 2009.)

CV-22s

Procurement funding for CV-22s is divided between the Aircraft Procurement, Air Force (APAF) appropriation account and the USSOCOM portion of the Procurement, Defense-Wide (PDW) appropriation account.

The Air Force estimates the APAF-funded portion of the procurement cost of the five CV-22s requested for FY2010 at $460.4 million, or an average of about $92.1 million in APAF funding for each. These five aircraft have received $23.1 million in prior-year APAF advance procurement funding, leaving another $437.3 million requested in the APAF account for FY2010 to complete the APAF-funded portion of their cost. The APAF account also requests $13.8 million in advance procurement funding for CV-22s that the Air Force wants to procure in future fiscal years, bringing the total FY2010 APAF funding request for procurement and advance procurement of CV-22s to $451.1 million.

The FY2010 DPW account requests $114.6 million in procurement funding for CV-22s. Adding this $114.6 million to the $451.1 million APAF figure from the previous paragraph would bring the total FY2010 funding request for procurement and advance procurement of CV-22s to $565.7 million. Adding this $114.6 million figure to the $460.4 million figure from the previous paragraph would bring the total estimated procurement cost of the five CV-22s requested for procurement in FY2010 to $575 million, or an average of $115 million each.

FY2010 Defense Authorization Bill (H.R. 2647/S. 1390)

House

The House Armed Services Committee, in its report (H.Rept. 111-166 of June 18, 2009) on H.R. 2647, recommends approving the Administration's FY2010 APN, APAF, and PDW requests for procurement and advance procurement funding for the procurement of MV-22s and CV-22s (pages 57, 94, and 117). In a section on lifecycle operations, maintenance, and supply mission simulation, the report states:

> The committee is concerned about spare parts inventory and supply management by the services. The Government Accountability Office (GAO) has recommended in reports 09-199 and 09-103 that spare parts inventory and supply management should be strengthened, in part, by improving demand forecasting procedures and monitoring effectiveness of providing operational information to item managers. The committee is encouraged by the Army's efforts regarding the UH-60, OH-58, and T-700 engine programs, and the Marine Corps' efforts regarding the light armored vehicle, mine-resistant ambush protected vehicle, MV-22, and H-53 programs to adopt improved spares demand forecasting and lifecycle cost analysis methodologies. (Page 292)

Senate

Division D of S. 1390 as reported by the Senate Armed Services Committee (S.Rept. 111-35 of July 2, 2009) contains the detailed line-item funding tables that in past years have been included in the committee's report on the defense authorization bill. Division D recommends approving the Administration's FY2010 APN, APAF, and PDW requests for procurement and advance

procurement funding for the procurement of MV-22s and CV-22s (pages 613, 630, and 641 of the printed bill).

Conference

The conference report (H.Rept. 111-288 of October 7, 2009) on H.R. 2647 authorizes the Administration's FY2010 request for procurement and advance procurement funding for the procurement of MV-22s and CV-22s (pages 933, 949, and 959).

FY2010 DOD Appropriations Bill (H.R. 3326)

House

The House Appropriations Committee, in its report (H.Rept. 111-230 of July 24, 2009) on H.R. 3326, recommends approving the Administration's FY2010 APN, APAF, and PDW requests for procurement and advance procurement funding for the procurement of MV-22s and CV-22s (pages 148, 184, and 207).

Senate

The Senate Appropriations Committee, in its report (S.Rept. 111-74 of September 10, 2009) on H.R. 3326, recommends approving the Administration's FY2010 APN, APAF, and PDW requests for procurement and advance procurement funding for the procurement of MV-22s and CV-22s (pages 101, 129, and 145).

FY2009 Supplemental Appropriations Act (H.R. 2346/P.L. 111-32)

Request

As part of its proposed FY2009 supplemental appropriations bill (H.R. 2346/S. 1054), the Administration requested $1.83 million in procurement funding and $3.9 million in research and development funding for the V-22 program.

House

The House Appropriation Committee's report (H.Rept. 111-105 of May 12, 2009, pages 19 and 26) on H.R. 2346 recommended rejecting both funding requests.

Senate

The Senate Appropriation Committee's report (S.Rept. 111-20 of May 14, 2009, pages 39 and 48) on S. 1054 recommended approving both funding requests.

Conference

The conference report (H.Rept. 111-151 of June 12, 2009, pages 90 and 99) on H.R. 2346/P.L. 111-32 of June 24, 2009 rejects both funding requests.

Appendix A. June 23, 2009, Hearing on V-22 Program

This appendix presents materials from a June 23, 2009, hearing before the House Oversight and Government Reform Committee that reviewed a number of issues concerning the V-22 program, including the aircraft's reliability and maintainability.

Chairman's Opening Statement

The text of the opening statement of Representative Edolphus Towns is as follows:

> Good morning. Thank you all for being here.
>
> Today's hearing is on the V-22 Osprey, an aircraft that has been in development for about 25 years and has a very controversial past. This hearing, however, looks beyond that checkered past and focuses on current issues raised in a new report by the Government Accountability Office (GAO).
>
> According to GAO, the V-22 has operational problems that raise serious questions as to 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.
>
> GAO found that the V-22 has problems with parts, maintenance, reliability, and availability—and I understand the reliability issue is one in which the Department of Defense concurs. In addition, GAO found that the V-22 may not be operationally effective in combat and questions the ability of the aircraft to operate in both extreme heat and extreme cold.
>
> In short, GAO found that the Osprey has severe operational and suitability problems. And these problems have not come cheap. Since 1983, more than $27 billion has been appropriated for the V-22 program. The cost per aircraft has almost tripled since the Osprey's inception, to some $120 million each. And the cost of the program may rise even higher given expected increases in operation and support costs.
>
> Let me be completely clear: the value of just one American service member is priceless—and if a 120 million dollar aircraft like the V-22 does the best job of protecting our troops and helping them to accomplish their missions, then it should be supported.
>
> But at $120 million per aircraft—the Osprey better work as advertised.
>
> When we first convened this hearing a month ago, I decided, with the support of Ranking Member Issa, to postpone the hearing because the Department of Defense had failed to produce certain key records pertaining to the Osprey. It took them a few weeks to do it, but finally we obtained copies of the after-action reports and other data we had requested.
>
> The additional documents raise even more serious questions about the V-22. The Marine Corps' own reports on the performance of the Osprey in Iraq reveal that the 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.

In the course of our investigation we asked the Defense Department for an inventory of all of their Ospreys and how many of those were ready for combat. The answer was both surprising and appalling.

Since 1988, the Marine Corps has bought 105 Ospreys. Of this number, only 47 are considered "combat deployable." Worse, we asked the Marine Corps how many of these are ready for combat on any given day. On the day the Marine Corps picked, June 3rd of this year, only 22 of these 47 Ospreys were ready for combat. In other words, fewer than half could be used for combat on a good day.

At this point I have strong reservations about the future of this aircraft. I want very much to hear what our witnesses will have to say about these issues.

Thank you.

Marine Corps Testimony

The text of the Marine Corps' statement for the hearing is as follows:

Chairman Towns, Congressman Issa and distinguished Members of the committee, thank you for providing me with this opportunity to appear before you to discuss the Department of the Navy's MV-22B Osprey aircraft program. Your Marine Corps remains engaged every day in support of our ground forces in harm's way. For nearly eight years, we have been at an extraordinarily high operational tempo and we will sustain this pace as long as our nation calls. Your Marines are serving honorably and we remain guided by our tradition and history while we keep an eye on the future. The significant accomplishments of those who serve our Corps are a direct reflection of the tireless efforts and the consistent support of the military by the Congress and this committee. Thank you for your dedication and for your oversight.

The Fiscal Year 2010 President's Budget request includes $2.3 billion in APN for procurement of thirty MV-22Bs and continued development of follow-on block upgrades. Fiscal Year 2010 is the third year of the V-22 multiyear procurement contract. Our strategy supports a continued cost reduction and affordability trend, provides a stable basis for industry, and best supports the needs of the warfighter. The Fiscal Year 2010 appropriations will fully fund Lot 14 and procure long-lead items for Lot 15 under the V-22 multiyear contract.

The Marine Corps Combined-Arms Team

Marine Corps expeditionary operations typically center on what we call the "MAGTF," the Marine Air-Ground Task Force. In 1988, then-Commandant General Al Gray described his vision of the future of expeditionary warfare. Painting a vivid mental picture, General Gray stated that, "if I am a MEU commander off of North Carolina, I want every bad guy from New York to Miami to be nervous." General Gray's vision became reality last week when VMM-263 deployed aboard USS Bataan with the 22nd Marine Expeditionary Unit (or MEU). The leap in technology our former Commandant envisioned is now a reality, and the extraordinary range and speed of future expeditionary operations, once only imagined, are now the norm.

The MV-22B is not a one-for-one replacement for any of our current, aging helicopters. Osprey is not technology for technology's sake. The capability this aircraft represents does not just deliver Marines and equipment faster; it changes the entire calculus of planning and fighting at the tactical and operational level for our joint force and MAGTF commanders. None of us knows what the 2025 battlefield will look like. What we do know is what your

Marine Corps will look like: it will be fast, light, agile, expeditionary and lethal. Further, the Osprey will be a key component of the future of the Corps' contribution to the joint fight.

One of our officers described this capability perfectly, saying, "The Osprey is a great airplane that lands like a helicopter. It's not a helicopter that flies like an airplane." This aircraft shrinks the battlefield, flying higher, faster, farther, and longer than any of our legacy assault support helicopters. Osprey provides the commander with new speed and distance options in maneuvering while in support of Marine ground forces. It takes off and lands like a helicopter, but it transits from objective to objective at medium to high altitudes – above the small arms, man-portable air defense systems (MANPADS) and rocket-propelled grenades (RPGs) that have claimed so many of our conventional helicopters in Iraq. The MV-22B will save lives with its speed and range. It is now combat-tested and ready for deployment throughout the globe.

MV-22 Procurement

In September 2005, the Defense Acquisition Board approved MV-22B Full Rate Production.

Initial Operational Capability was subsequently declared on 1 June 2007. By the end of Fiscal Year 2009, the Marine Corps will have one MV-22B Fleet Replacement Training Squadron, one operational test and evaluation squadron, and six tactical VMM squadrons home based at Marine Corps Air Station New River, North Carolina. Three of these New River squadrons have been combat tested in Iraq, and one is embarked with the 22nd Marine Expeditionary Unit afloat. At our current annual build rate of thirty aircraft, we are creating two Osprey squadrons per year. We have accepted delivery of 91 Ospreys, a quarter of our program objective of 360 aircraft. Our west coast transition will commence with the standup of squadrons at Marine Corps Air Station (MCAS) Miramar, California beginning in Fiscal Year 2010, followed by Okinawa bases in Fiscal Year 2013, then Marine Corps Base Camp Pendleton, California and Marine Forces Reserve by the end of the decade.

As the MV-22 is fielded over time, the capabilities will be increased via a block upgrade acquisition strategy. MV-22 Block A aircraft are now used predominantly in our training squadron. Block B aircraft are being fielded with our operational squadrons and will continue to be delivered via the current multiyear procurement contract. Block C aircraft are operational aircraft with mission enhancements that will be procured beginning in Fiscal Year 2010 and delivered to the fleet in Fiscal Year 2012. In addition, the Marine Corps is teaming with Special Operations Command to field a 7.62mm, all-aspect, crew-served weapon system that will provide an enhanced defensive suppressive fire capability. Pending successful developmental and operational testing, we expect to begin fielding limited numbers of this system later this calendar year.

Combat Operations Summary

A recent Commanding General of Multinational Forces – West in Iraq stated that, "I could dominate Al Anbar Province because I had V-22s, which are an amazing capability. I couldn't do what I did with just helicopters." This statement summarizes the Marine Corps' view of what this aircraft has done in the crucible of combat.

The MV-22B has been supporting our Marines in Iraq continuously since October 2007, with the third successive squadron recently completing a highly successful seven month rotation in support of Operation IRAQI FREEDOM just last month. In Iraq, our Ospreys have penetrated every threat zone, conducting assault support, Command and Control (Senior Leader Transport), Aero Scout, Tactical Recovery of Aircraft and Personnel, and Casualty Evacuation missions. Operating from Al Asad, the MV-22 effectively covered the entire country of Iraq, at twice the speed of conventional helicopters.

Over the past two years we have flown this aircraft hard. In Iraq, we have flown the Osprey at twice the rate we had previously planned and in very demanding, austere conditions and with a newly-fielded aircraft. It is important to note that VMMs 263, 162 and 266 have all deployed to and returned from Iraq and, while there, these squadrons flew the same ten Ospreys that originally arrived in theater in October 2007 along with two more aircraft we added in March 2008.

Therefore, all combat operational data is drawn from the most heavily-used twelve of our 91 aircraft. The dramatic upswing in operational flight hours in harsh environmental combat conditions has uncovered reliability and maintainability issues and these challenges are being addressed aggressively.

We accelerated introduction of the Osprey into the fight a year ahead of our programmed Material Support Date, despite the aviation logistics risks we knew we would incur, as well as the second-order effects we knew we would impose on transitioning the remaining east coast HMM squadrons. However, we simply could not hold back this revolutionary capability from supporting our Marines in combat. The operational performance metrics are impressive: the three VMM squadrons that have 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. The MV-22B completed these lifts almost exclusively by transiting at high altitudes and executing steep descents into all threat zones. To date, while they have been engaged with MANPADS and small arms, we haven't lost any of these aircraft in combat. The Osprey has shown that it can carry an operational load of 24 combat-loaded Marines out to a combat radius of 300 nautical miles at altitudes above the small arms and rocket-propelled grenade threat envelope; this dwarfs the 75 nautical mile radius of a CH-46E loaded with twelve Marines operating right in the heart of the enemy's threat envelope.

Reliability and Maintenance

This aircraft's usage has leapt dramatically since its deployment to Iraq and employment in combat. We began to consider the incredible potential of tilt-rotor technology almost three decades ago, but the V-22 community has flown 85% of its total flight hours since 2004, with 50% of its total program flight hours in the past two years alone. These numbers are high in themselves; they are even more dramatic when one realizes that these hours have been flown in some of the world's harshest environments, in a combat zone, and in response to urgent operational warfighting requirements.

Most new aircraft - especially innovative technological advances like the Osprey - fly their first years at a slow and controlled rate of increasing hours, in a peacetime environment, and under highly controlled operational conditions. Like other types of aircraft in the early operational phase of their lifecycles, the MV-22B has experienced lower-than-desired reliability of some components and therefore higher operations and support costs, but this aircraft has experienced them in an acute fashion due to its early employment overseas. In effect, the operations and maintenance (O&M) costs and reliability issues which we are addressing are compressed: they seem more intense because they are happening in a shorter time, to fewer airplanes, in a more intense environment than is normal with new technology.

With the cooperation and support of our industry partners, we are tackling these issues head on with aggressive logistics and support plans that will increase the durability and availability of the parts needed to raise reliability and concurrently lower operating costs. The reliability and maintainability challenges of the MV-22B are not unique for an aircraft this early in its life cycle. What we now consider to be "legacy" airframes all once went through similar growing pains and a concentration of resources was required to bring improvement. The Naval Aviation Enterprise is responding to MV-22B in the short term by

increasing the use of spares (sparing) and by focusing logistics. In the long term, the enterprise is incentivizing industry and making engineering changes to improve reliability.

Our average mission capable rate for the MV-22B in Iraq was 62%. This readiness rate represents the percentage of time an aircraft is free from downing discrepancies on a 24-hour clock. Assessed in another way, our deployed Ospreys averaged well over 70% aircraft available and "ready for tasking" at the commencement of each Air Tasking Order (ATO) day. This level of reliability is less than the threshold goal of 82% the Marine Corps desires. However, it is important to note that the MV-22B accomplished all assigned tasking in combat (with the exception of occasional and normal maintenance or weather aborts).

The MV-22 Program Manager has had an aggressive reliability Corrective Action Plan (CAP) in place since the fleet introduction of this aircraft. To ensure the CAP was sound, we have requested two separate outside non-advocate reviews. Both reviews reported the program's foundation was strong, but the lack of dedicated funding sources and length of time required to process Class 1 engineering changes was inhibiting the incorporation of corrective actions in a timely manner. To address these issues, the Program Office implemented various initiatives, including incentivized Joint Performance Based Logistics contracts to increase reliability and improve component repair cycles; reduced cycle time to process and implement Class 1 changes to the fleet; and requested Operational Safety Improvement Program funding to address emerging reliability issues.

The Program Office has likewise recently instituted the V-22 Critical Item Logistics Review (CILR) process which will assist in providing a common list of degraders to ensure the optimized focus of the contractors, government integrated product teams, and the type/model/series team members in improving V-22 readiness and operational cost by addressing all of the logistics elements.

The difference between the desired and observed mission capable rates in the MV-22 program is due primarily to the premature failure of selected components. In the initial stages of any new aircraft procurement, spares are purchased to support the failure rates predicted by an engineering analysis rather than on actual historical data. A number of parts on this aircraft have failed sooner than predicted by this original engineering analysis. When errant predictions occur, the impact is a higher than expected demand on spare parts, thereby driving up the burden on the logistics system, increasing costs, and decreasing availability. Some examples of premature failures we have seen in the MV-22 are:

- Swashplate Actuator – Failed at 149 hours actual, versus 195 hours predicted
- Central Deice Distributor Bracket – Failed at 422 hours actual, versus 6,173 hours predicted
- Constant Frequency Generator – Failed at 192 hours actual, versus 404 hours predicted

An adjustment of 1,400 line items to the Operation IRAQI FREEDOM Aviation Consolidated Allowance List (AVCAL) in August of 2008 resulted in a sharp reduction in the number of cannibalizations and customer wait times for parts and improved readiness rates. However, because spares procurement can take years to fully accomplish, we were then just receiving the increased spares quantities we purchased in late 2006.

Several degraders (such as infrared suppressor panels and center bodies and Coanda bleed air tubes and valves) that were originally designated as consumables are now repaired by the depot. The MV-22 depot will be fully operational in Fiscal Year 2011 and we anticipate they will then repair many more components than they do today.

Cost Factors and Mitigation

O&M costs of both deployed and home-based MV-22B squadrons are higher than predicted. Leadership tracks and addresses these conditions through an Executive Supportability Summit comprised of Marine and Air Force aviation advocates, Naval Inventory Control Point representatives, the Naval Air Systems Command, and the Original Equipment Manufacturers. The response by government has been to increase spares and improve maintenance procedures in the short term to keep availability at a manageable level while making engineering changes to components and systems and broadening repair capability at the aviation depots. Industry has responded by investing its own capital to improve production capacity of vendors while designing and implementing improvements to known and predicted degraders. The average year-to-date cost through March 2009 across the fleet, training, and test commands is $11,748 per flight hour, with the fleet-specific average being $9700. This cost is roughly comparable to that of our legacy CH-53E helicopters. Initial model forecasts used engineering predictions based on legacy systems. Adjustments to MV-22 estimates in the future, though, will include actual cost data and demonstrated reliability.

GAO Report

Last week, the Government Accounting Office released a report on the V-22. It is important to note that this report concluded that the Osprey is operationally effective, while mentioning the operational and cost issues that the Marine Corps is addressing. Reliability and availability are parameters which affect operational suitability, not operational effectiveness. This aircraft is effective and suitable: it is the future of Marine Corps assault support, and is one of the foundations on which we are building the MAGTF of the future. However, we are not satisfied with current reliability numbers, and we are working with the V-22 program office and our industry partners to evaluate, address, mitigate and then resolve these issues.

While we agree with, and are addressing, availability and reliability issues, we do not agree with the GAO's recommendation that the Department of Defense conduct a new alternatives analysis. None of the alternatives allow me to fly our Marines as deep into the enemy's battlespace as quickly, nor to offer the takeoff and landing agility of a helicopter while transiting above the threat, thus protecting our embarked Marines, as does the Osprey. None of the options do these things, and that is why we are fully committed to this capability and to further exploiting the immense potential it holds for the future of joint warfighting.

The leadership of the naval service, nearly thirty years ago, made a conscious decision to take a generational leap in technology and give our MAGTF and joint force commanders an unsurpassed asymmetric advantage on the modern battlefield. Osprey technology is no longer new, but it is still unique. Our supply chain and logistics support systems are maturing, catching up to the aircraft, and as they do so we are confident the costs will fall as reliability and aircraft availability rates rise.

Bridge to the Future

We fully expect this aircraft to perform magnificently while supporting our widely dispersed Marines at high altitude and from austere bases throughout Afghanistan. In the irregular warfare environment, the solution to the small arms threat is often to simply fly over it, and in Afghanistan this aircraft will do just that. Analyzing the challenges of our current fight requires us to honor the complexities of engaging an enemy quickly and effectively, bridging the tyranny of distance, and countering the uncertainty of the enemy's lethalities in any clime and place.

The MV-22B has done exactly what we have asked it to do, and more. Its capabilities will form the Marine Corps' bedrock of our doctrine of operational maneuver from the sea. The

commander of Task Force 58 (TF-58), who led the first Marines into combat in Afghanistan in November 2001, pointed out that mission accomplishment from ships based hundreds of miles away from the objective area was actually quite tenuous. TF-58 forces had to leapfrog from ships at sea, across one country and into the center of another, over mountainous terrain and hundreds of miles of empty desert. The Commanding General split his forces into helicopter lifts and vehicle convoys, dependent on the goodwill of host nation governments to move his Marines across international borders.

With Osprey, the operational burden of TF-58 would have been lightened considerably. The range, speed and altitude capabilities of V-22 would have allowed the commander to push the invasion force 400 miles from ship to objective, then maneuver that force quickly throughout the depth of the enemy's battlespace. This agility would have allowed TF-58 to operate at far lower operational risk while at higher tempo. This is the paradigm – light and expeditionary, ready to go anywhere at any time– at which the Marine Corps excels, and this is exactly what the country needs from its Corps. In order to bridge to the future force, we must have a nimble lethality which only a capability such as the Osprey can provide.

SUMMARY

We have interviewed dozens of our combat veteran MV-22B pilots over the past two years. The one consistent theme among them has been that they want to fly this aircraft even harder, higher and faster than we have to date. The Fiscal Year 2010 President's Budget reflects our commitment to the MV-22B Osprey program. We will continue to aggressively pursue efficiencies in the development, testing, procurement and sustainment of this aircraft and its components and weapons systems. Since 2001, the Marine Corps has been fighting shoulder to shoulder alongside our joint and allied partners overseas, supporting an extremely high operational tempo in two theaters while growing our force, introducing new aircraft and systems, and looking beyond the current fight. As we continue to shape naval aviation with your help, we have no doubt about the Osprey's key role at the center of our future warfighting vision.

In closing, Mr. Chairman, I thank you for the opportunity to testify before your committee regarding the Marine Corps' MV-22B Osprey program. I look forward to your questions.[27]

GAO Testimony

The text of the summary page of the GAO statement is as follows:

[27] 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. [The statement carries the date of the originally scheduled May 21, 2009, hearing on the V-22 program.] There was also a one-paragraph statement from a Marine Corps officer who had served as the commanding officer of an MV-22 squadron. The text of the statement is as follows:

> Chairman Towns, Congressman Issa and distinguished Members of the committee, my name is Lieutenant Colonel Karsten Heckl. I was the commanding officer of VMM-162 from 31 August 2006 to 24 October 2008. During that time, I deployed my squadron to Iraq from March 2008 to September 2008. I have been with the program since 1999 and have over 400 hours in the aircraft. I thank you for the opportunity to be here today and I look forward to the opportunity to speak to the committee regarding my operational experience and the operational employment of the MV-22B.

(Statement of LTCOL Karsten Heckl, USMC, Former Commanding Officer of VMM-162, Before the House Committee on Oversight and Government Reform [Hearing] on United States Marine Corps MV-22B Osprey Program, May 21, 2009, 1 p. [The statement carries the date of the originally scheduled May 21, 2009, hearing on the V-22 program.])

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 deliver personnel and internal cargo faster and farther than the legacy helicopters being replaced. However, challenges to operational effectiveness were noted that raise questions about whether the MV-22 is best suited to accomplish the full repertoire of missions of the helicopters it is intended to replace. Additionally, suitability challenges, such as unreliable component parts and supply chain weaknesses, led to low aircraft availability rates.

Additional challenges have been identified with the MV-22's ability to operate in high-threat environments, carry the required number of combat troops and transport external cargo, operate from Navy ships, and conduct missions in more extreme environments throughout the world. While efforts are underway to address these challenges, it is uncertain how successful they will be as some of them arise from the inherent design of the V-22.

The V-22's original program cost estimates have changed significantly. From 1986 through 2007, the program's Research, Development, Test, and Evaluation cost increased over 200 percent—from $4.2 to 12.7 billion—while the cost of procurement increased 24 percent from $34.4 to $42.6 billion. This increase coincided with significant reductions in the number of aircraft being procured—from nearly 1,000 to less than 500—resulting in a 148 percent increase in cost for each V-22. Operations and support costs are expected to rise. An indication is the current cost per flying hour, which is over $11,000—more than double the target estimate for the MV-22.

After more than 20 years in development, the MV-22 experience in Iraq demonstrated that the Osprey can complete missions assigned in low-threat environments. Its speed and range were enhancements. However, challenges may limit its ability to accomplish the full repertoire of missions of the legacy helicopters it is replacing. If so, those tasks will need to be fulfilled by some other alternative. Additionally, the suitability challenges that lower aircraft availability and affect operations and support costs need to be addressed. The V-22 program has already received or requested over $29 billion in development and procurement funds. The estimated funding required to complete development and procure additional V-22s is almost $25 billion (then-year dollars). In addition, the program continues to face a future of high operations and support cost funding needs, currently estimated at $75.4 billion for the life cycle of the program. Before committing to the full costs of completing production and supporting the V-22, the uses, cost, and performance of the V-22 need to be clarified and alternatives should be re-considered.[28]

Testimony of CSBA Analyst

Another witness at the hearing was Dakota Wood of the Center for Strategic and Budgetary Assessments (CSBA). The text of his statement is as follows:

Introduction

Mr. Chairman, Congressman Issa, and distinguished members of the Committee, it is my personal honor to appear before you today to discuss the MV-22 Osprey.

[28] 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.

I have been asked to elaborate on various issues related to the Osprey originally outlined in a paper we at CSBA published this past fall entitled "The US Marine Corps: Fleet Marine Forces for the 21st Century," a monograph in a series of reports written for CSBA's "Strategy for the Long Haul" project.

The point of the larger project, begun nearly two years ago, was to "inform and shape the next administration's defense strategy review"; that is to say, to highlight a range of defense and national security issues to be considered in the 2009 Quadrennial Defense Review by whichever administration was to assume office following the national elections in November, 2008.

This particular monograph on the Marine Corps examined the readiness of the Service to do its part in meeting a set of emerging security challenges we addressed in detail in a separate paper. These challenges include defeating strains of violent Islamist radicalism, hedging against the rise of a hostile or more openly confrontational China or other authoritarian capitalist state, and preparing for a world in which there are more nuclear-armed regional powers. In addition to these specified challenges and their related operating environments, there are also the "meat-and-potatoes" missions typically associated with Marine Corps deployments, such as: non-combatant evacuation operations, humanitarian assistance and disaster-relief missions, various security cooperation initiatives that focus on working with the military forces of other countries, and serving as a general force-in-readiness able to respond to pop-up crises along the world's littorals.

Within the paper, we described the current state of the Marine Corps, discussed what the Corps must be able to do to help meet these emerging challenges successfully, and briefly assessed the Service's program of record and related conceptual, organizational, and operational efforts as they pertain to, or would be impacted by, the aforementioned challenges and operational demands.

With specific reference to the MV-22 Osprey, we questioned the current Marine Corps plan to replace all of its medium-lift helicopters—the CH-46E Sea Knight and the CH-53D Sea Stallion—with the MV-22 and suggested that the Corps revisit this plan to see whether a mixed fleet of MV-22s and a replacement helicopter might be better. During the Osprey's long period of development, some twenty-five years or more, changes in the operational and threat environments, increasing budgetary pressures, and the various implications arising from the Service's own strategic and operational concepts suggest that a mixed medium-lift fleet composed of MV-22s and a new helicopter would provide more options and increased flexibility for the Service at less cost than a fleet composed only of MV-22s.

As already mentioned, the Osprey has been in development for over a quarter of a century at a cost of more than $20 billion. The Corps plans to acquire a total of 345 at a projected total cost of $42 billion, roughly $120 million each. Over the years, the aircraft has been the subject of controversy arising from engineering challenges and related development delays, a few highly publicized crashes, and many funding debates. It has strong supporters and equally passionate 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) and argue that less expensive helicopters can just as effectively support ship-to-shore movements, amphibious landing operations, and various amphibious assault missions without having to coordinate with aircraft of lesser capability—this last point deriving from the fact that standard escort or attack helicopters would not be able to keep pace with the Osprey.

The argument between advocates and critics of the Osprey appears to rest on a fundamental question: does the Marine Corps' commitment to field the MV-22 as its sole medium lift helicopter-like capability help or hinder its ability to perform anticipated missions at an acceptable cost, both in dollars and overall effectiveness in an operational environment? Or should the Corps pursue a much less expensive path that gives it the ability to effectively execute the missions it is most likely to encounter even if this means it would not have the ability to conduct missions at extreme range in as timely a manner? Of course, not having the more advanced capability provided by the MV-22 precludes undertaking missions that would require it.

This leads one to assess the various advantages and disadvantages, or pros and cons, associated with either an MV-22 pure fleet or a mixed fleet of MV-22s and helicopters. From an institutional perspective, the Corps would benefit from the efficiencies of adopting the MV-22 as the sole replacement for its aging fleet of transport helicopters. By eliminating both the CH-46E and CH-53D and fielding the MV-22, supply, maintenance, avionics, and ordnance support will be simplified. Efficiencies would also be obtained in the training and assignment of personnel. Additional efficiencies might be realized in operational employment planning, since operating forces would become accustomed to the specific performance characteristics of the MV-22 rather than having to account for a mixture of platforms. If a mixed fleet approach is adopted, the Service will have to maintain all of the infrastructure and supporting establishment needed to service two platforms vice one, while also retaining the dissimilar communities that operate and maintain the helicopter fleet.

In evaluating such options, however, institutional efficiencies should not be the sole determinant. Resource limitations and overall force effectiveness must be taken into account. The United States has a Marine Corps to accomplish military missions for which it is uniquely suited—i.e. projecting combat power from a seabase to objectives ashore. But the resources made available to the Service to do this, to include equipping its operating forces for such tasks, are not unlimited. Therefore, other factors should also weigh heavily in deciding the type of capabilities to pursue, and the mix (if any) among the various types. Certainly, operational relevance and effectiveness, in addition to resource availability, must be taken into account.

A sound strategy should reflect careful prioritization in the allocation of limited resources. This often demands balancing a variety of capabilities and operational demands such that one can meet the challenges of the most likely threats or operational requirements while hedging against threats or operational requirements that are less likely to occur, but that are of high consequence when they do occur.

As discussed in our monograph, the Corps' current approach to conducting routine operations in the littorals, expanding and enhancing its presence aboard US Navy ships, developing more aggressively its long-term relationships with the military forces of key US allies and partners, and meeting the likely operational demands of an assortment of missions associated with the strategic challenges facing the United States would all be ably served by a helicopter fleet. To be sure, a case can certainly be made that the MV-22's speed and range would enable the Marine Corps to conduct raids, support widely dispersed units, and influence a much larger battle space than is currently possible with a helicopter force, especially in sustained operations ashore.

For operations that cover a very wide expanse of territory, assuming they can be procured in sufficient quantities, an MV-22 fleet would be valuable in supporting the movement, sustainment, and reinforcement of dispersed small units. It should be noted, however, that the advanced capability of the Osprey, its speed and range, would preclude use of escort support from the Marine Corps' helicopter gunship, the AH-1W (soon to be AH-1Z) Cobra.

Accordingly, an MV-22 raid force, or distributed operations force, would need to be supported by conventional fixed-wing, fighter-attack aircraft.

But, again, any assessment of the MV-22 must take cost into account, especially in what is likely to be an increasingly constrained fiscal environment. Just because the MV-22 can fly relatively long distances and at a relatively high rate of speed, it does not automatically follow that the type of missions it can undertake and the mission objectives it can accomplish justify the substantially greater cost of acquiring the capability in the first place.

Moreover, an MV-22-transported raiding force cannot travel with heavy armor or substantial ground mobility systems. Yet, if U.S. operations in Iraq and Afghanistan, or Israeli operations in Southern Lebanon, have taught us anything, it is that today even irregular enemy forces are likely to be equipped with very effective improvised and state-produced weapons. However, a force delivered and supported by MV-22s, operating far from supporting fires, will be limited in its ability to move, shoot, and sustain itself once on the ground.

Furthermore, the proliferation of modern anti-air weapons and more lethal anti-personnel capabilities to irregular forces likely means that even in low-end conflicts MV-22s may be highly vulnerable to enemy action while in flight. When all these factors are taken into consideration, it appears that the mission to be accomplished by an MV-22 transported force would of necessity have to be limited, both in duration and scope. The unanswered question is: does having the ability to conduct such a limited mission set justify its high cost?

A brief comparison of the MV-22 with a modern helicopter (the UH-60 is but one example) finds the Osprey easily outpaces a helicopter in speed and range. But the MV-22 possesses a substantially larger footprint and is therefore more restricted than a helicopter in the number of places it can land, whether ashore or at sea. For example, the rotor spread of an MV-22 is 85 feet, while a CH-46E has a 51-foot spread and a UH-60 one of 53 feet. This characteristic could be troublesome in heavily congested urban environments, complex terrain, or around ships not configured to handle an MV-22. There is anecdotal evidence that MV-22 pilots in Iraq were more sensitive than their helicopter counterparts when it came to aggressively inserting their aircraft into situations where congested terrain was a prominent feature. It is unclear whether this is due to an increased sensitivity on their part to the first-time deployment of the Osprey to a war zone and the impact a crash or combat loss might have on the program, or whether it arose from a genuine safety concern associated with having to operate in urban terrain with an aircraft possessing a 50 percent larger rotor spread than a standard helicopter. But it does indicate there are differences in important performance attributes between MV-22s and helicopters, and not all of them favor the Osprey. The current shipboard deployment of MV-22s with the 22nd Marine Expeditionary Unit, and plans for deploying the Osprey to Afghanistan in the next year, should provide additional insights into such issues.

We should also not forget that even though an Osprey possesses greater range and speed, when it gets to its destination, it must transition to vertical flight and land in or take-off from a landing site just like a helicopter. This means that an MV-22 will encounter the same threats a helicopter would when inserting, extracting, or providing support to forces. Advanced man-portable air defense missiles (MANPADs), rocket-propelled grenades, heavy machines, and/or small arms will remain a feature of the threat environment and will continue to improve in effectiveness irrespective of the MV-22's speed and range advantages. Whether an Osprey is more survivable than a helicopter when under fire remains to be seen. While the loss of any aircraft is regrettable, especially when aircrew and embarked passengers are involved, one cannot discount the fact that the loss of a $100 million dollar aircraft will be more keenly felt than that of a $20 million helicopter.

Though the Marine Corps has routinely packaged the MV-22 as one part of an amphibious force's ability to conduct operations from the sea to objectives deep inland, the very fact that the MV-22 can out-range any other system used by an embarked force, yet cannot enable a small ground force to fight in a highly contested environment, should be cause for careful reflection upon the limitations of the MV-22. It would be very useful to analyze the various missions the Corps has been involved in over the past two decades (while the MV-22 has been in development) and, even more importantly, the types of missions the Corps envisions conducting in the coming years, to include the types of threats that may be encountered, and how they will be overcome. One outcome of such a study might be a revised assessment of the Marine Corps' MV-22 requirement. For example, the Marines may very well determine that MV-22s are best utilized in a paired relationship with their KC-130 Hercules fleet and that Marine Corps units embarked aboard amphibious ships are best supported with helicopters. The Osprey's range and speed would be well-matched by the capabilities of the KC-130 cargo aircraft and the mix of helicopters maintained aboard ship might better match the range of missions most likely to be undertaken by an amphibious force. In those instances where MV-22s are needed, or where operational demands could be forecast with confidence, MV-22s could be sent forward and embarked aboard ship or provide support for extended land operations just as KC-130s are called forward as they are needed today.

Conclusion

In the end, of course, the issue of the MV-22's value must be viewed within the context of the often competing demands of desired operational attributes, the nature of expected operational and threat environments, our experience of how forces are actually employed to achieve their objectives, and the resources available to support the overall force. Achieving such a balance is not easy. It inevitably requires compromises that, when done properly, carefully weigh the costs and benefits of various alternatives. The MV-22 Osprey can certainly enable the Marine Corps to perform a variety of missions far more effectively than has been possible in the past, and to undertake missions it would not otherwise be able to perform. But this capability also comes at a steep price, both financially and in terms of the opportunity costs of absorbing a major slice of the Corps' modernization budget that may starve other badly needed modernization programs.

Mr. Chairman, with these issues serving as points of departure for further discussion, I would be happy to respond to any questions this Committee might have.[29]

Testimony of Former IDA Analyst

Another witness at the hearing was Rex Rivolo, who worked as an analyst at the Institute for Defense Analyses (IDA) until March 2009. The text of his statement is as follows:

From June 1992 to March 2009 I was the principal analyst for the MV-22 and CV-22 at the Institute for Defense Analyses (IDA), a nonprofit organization supporting the Office of Secretary of Defense, Director of Operation Test and Evaluation. In that capacity I have independently analyzed and evaluated extensive flight test and engineering data of the V-22, participated in engineering discussions with US Navy and Bell-Boeing engineers, participated in test planning working group meetings, observed flight testing, and flown as an observer aboard V-22s during routine operational missions and during official flight

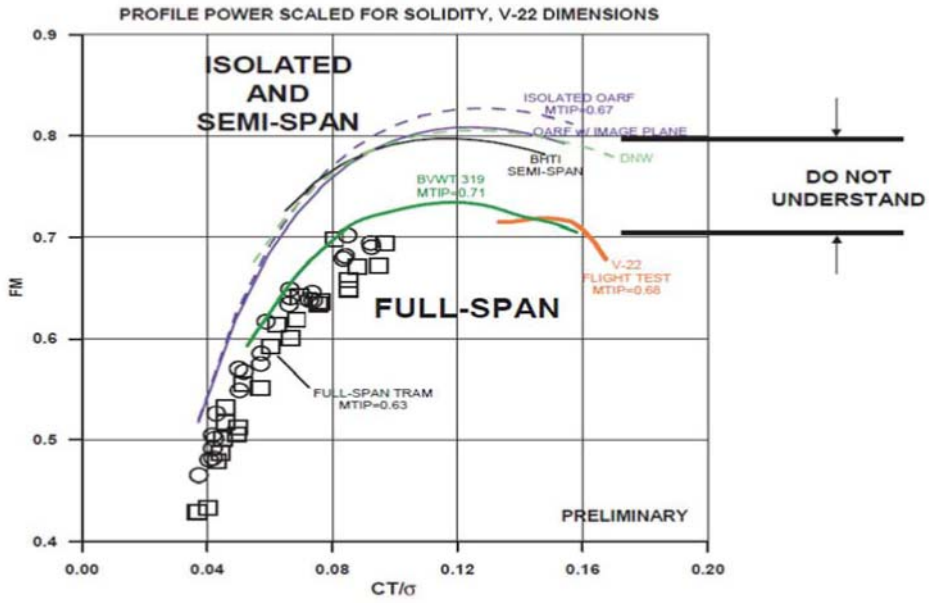
[29] The Future of the MV-22 Osprey, Testimony Before the U.S. House of Representatives Committee on Oversight and Government Reform, [Statement of] Dakota L. Wood, Senior Fellow, Center for Strategic and Budgetary Assessments, May 21, 2009, 5 pp. [The statement carries the date of the originally scheduled May 21, 2009, hearing on the V-22 program.])

evaluation periods. On 13 March 2009 I terminated my employment at IDA and have since severed all relations with the organization. I am here as a private citizen expressing my personal views.

The V-22, conceived as a "transformative technology", three decades ago promised extensive new capabilities for the US Marine Corps and US Air Force special operations war-fighting missions. Today, thirty years later, the aircraft is operational with both the US Marine Corps and the US Air Force, but the promised capabilities have failed to materialize. The aircraft has fallen well short of its design load carrying capability. Additionally, two technical idiosyncrasies make the aircraft problematic in a combat environment. This much awaited, transformative aircraft has, in my opinion, turned out to be a disappointment, falling well short of its design goals. I will address these three critical issues in some detail.

1. Limited Load-Carrying Capacity

The load-carrying issue can be summarized in the chart shown in Figure 1.



The chart was presented at the Tiltrotor Aeromechanics Phenomena Conference held at NASA's Ames Research Center in 2001 following the crash of an MV-22 at Marana, Arizona.

Although the chart is highly technical it serves to illustrate the fundamental shortcoming. The graph is essentially a plot of rotor efficiency (vertical axis) verses rotor thrust (horizontal axis). What the chart shows is that the actual V-22 performance (shown by the orange line) falls well short of the design value (upper curves labeled "ISOLATED AND SEMI-SPAN") especially at the higher power levels. In addition, this difference is apparently not understood by the designers as noted by the "DO NOT UNDERSTAND" notation between the two lines indicating the difference between the expected value and realized value. This difference in rotor efficiency amounts to about 6000 pounds in load-carrying capacity.

This load-carrying shortfall has resulted in many compromises in the aircraft configuration and construction. For example, the requirement to be able to operate in a chemical, biological, and radiological (CBR) environment without the need for aircrews to wear bulky

garments and respirators was compromised because the required overpressure to maintain positive air outflow in the aircraft would require strengthening the fuselage skin panels at the cost of increased weight. A second example is the decision not to replace all drive shaft segments, currently made of fire-susceptible composites, with titanium or steel because the weight increase would prevent meeting the critical mission requirements.

Despite all the compromises, V-22 still fails to meet the requirement for the critical 50 nautical mile, 10000 pound external load mission if all safety-related operational requirements are imposed. These safety requirements include landing with out-of-ground-effect hover power plus a 10% power reserve (margin) and a minimum landing fuel reserve. The practical implications of this shortfall are small as 40 or even 30 nautical miles capability for this mission could easily be compensated for by USMC commanders in the field. However, more compromising implications of the shortfall in the V-22 lifting capacity can be seen in other mission areas.

In mountain operations at high density altitudes, both the MV-22 and CV-22 have little or no capability above 8000 feet, density altitudes that are common and tactically relevant in the Afghanistan Theater of operations. As a practical example, consider a CV-22 conducting non-combatant evacuation operations (NEO) from the US Embassy in Kabul, Afghanistan on a hot summer day. Given the layout and location of the Embassy compound in Kabul, a CV-22 would require out-of-ground-effect hover power for a safe landing into the compound. Operational safety considerations imposed by Air Force regulation will require that an additional 10 percent power be available as a safety margin and further, that the aircrews calculate power available under the assumption that the engines are putting out 95 percent of rated power because of wear and tear.

Under these conditions, a CV-22 taking 24 personnel out of the Embassy compound would have enough fuel to travel about 60 nautical miles before requiring refueling. Alternatives to this are: taking a smaller number of personnel on the evacuation, landing outside of the Embassy compound in a place that allows landing without the safety power margin requirements (e.g., roadway, open field, etc.), or having airborne or ground tankers available for refueling. All of these would significantly increase risk to the mission and make demands on available assets. By contrast, a CH-53E, an aircraft considerably lighter than V-22, under the same conditions could carry the same 24 evacuees over 400 nautical miles or take 35 evacuees to a distance of 250 nautical miles.

I turn now to two idiosyncrasies of the V-22 design that make the aircraft, in my opinion, problematic in a combat environment. The first is the inability of V-22 to safely enter into or recover from an autorotative descent. The second is a controllability and maneuverability issue due to the side-by-side rotor configuration design of V-22, and the implementation of a control system whereby a flight control computer, rather than the pilot, determines how much flight control input should be made. These render the V-22 incapable of the aggressive maneuvers needed for evasion of hostile fire while in conversion or helicopter mode. The only evasive maneuver available to the V-22 is a rapid conversion to airplane mode while maintaining heading. This is clearly problematic if the threat (missiles or bullets) are coming from the front quarter, which is usually the case.

2. Lack of Autorotation Capability

Autorotation is a helicopter's version of gliding. All helicopters have the ability to glide safely to ground following a complete and abrupt interruption of power caused by either engine(s) failure or by the deliberate removal of power to the rotors by pilot action necessitated by failures within the drive system of rotors, or failures within the rotors themselves. The inability of V-22 to safely autorotate has now been acknowledged by the manufacturer and the US Marine Corps, but little significance has been given to the

implication this raises, which is – the V-22 would fail to meet basic airworthiness requirements by the FAA regulation if it were a civilian transport aircraft. Despite this, the US Marine Corps leadership has shown no concerns over this issue and has no problem requiring young men and women to ride as passengers in the V-22 under combat conditions.

Although airworthiness requirements of the FAA do not apply to military aircraft, equivalent requirements have been imposed on all passenger-carrying military aircraft in the past. The V-22 represents the first departure from this policy within the Defense Department. In my opinion, this represents a cynical disregard for soldiers' lives in favor of supporting a blind allegiance to the cause of this aircraft. The adoption of this reprehensible stand by the Marine Corps leadership, as well as by the Defense Department acquisition executives and the Congress, via their passive consent, makes these parties complicit in any future V-22 combat loss where autorotation could have saved lives. I believe this conscious disregard of a substantial and unjustifiable risk qualifies as reckless behavior in the legal sense.

The V-22 proponents who argue that V-22 is capable of making a safe all engine out landing by converting to airplane mode are either fooling themselves or willfully distorting the facts. The V-22 requires 12 seconds to convert from helicopter mode to airplane mode. In this interval, when both engines are inoperable or one engine has failed along with the interconnecting drive shaft, a V-22 will lose about 1600 feet of altitude under ideal conditions (i.e., no pilot errors.) Thus, any complete power failure while in helicopter mode below 1600 feet above the ground will result in a catastrophic loss of the aircraft.

Additionally, the conversion process is so dangerous that the pilot's flight manual for the aircraft instructs (not recommends) pilots not to attempt conversion if the failure occurs while the nacelles are at or above 60 degrees regardless of altitude. Thus, in this case the flight manual, inexplicably, instructs pilots to enter autorotation, irrespective of altitude, knowing full well that the aircraft cannot safely autorotate.

3. Lack of Combat Maneuvering Capability

The V-22 is flown by a flight control computer – not the pilot. The pilot merely asks the computer for a given change of flight path, and the computer obliges by applying the necessary aerodynamic inputs to generate the requested change. Under near-equilibrium flight conditions, i.e., straight and level flight, steady turns, climbs, and descents, etc., the pilot's request and the computer's response are nearly simultaneous and the delivered inputs are exactly those requested by the pilot. However, under non-steady state conditions such as during evasive maneuvering, entry into autorotation, or unusual flight conditions such as vortex ring state, the flight control computer will attempt to protect the aircraft from structural overloads and other dynamical limits such as the flapping of the rotors (rotor disk not perpendicular to spindle shaft) by not producing the commands requested by the pilot's controls positions. This tends to significantly reduce the severity of any hard maneuver commanded by the pilot - the goal of evasive maneuvering.

The fact that the pilot has enough control authority to damage the aircraft during hard maneuvering is the reason why the flight manual places restrictions on how much flight control inputs can be used during evasive maneuvering. That a pilot actually has enough control authority to "break" the aircraft is unique to V-22. Concerns over this issue in V-22 have resulted in a significant decrease in the amount of control authority given to the pilot, making the aircraft less and less maneuverable. Key tests of combat evasive maneuvering scheduled in 2002 remain, to my knowledge, to be completed. Sending V-22 into real combat situations without the completion of these critical tests is, in my opinion, irresponsible.

> Proponents argue that V-22 has been "combat proven" given its operational experience in Iraq. I cannot agree with this position as the mission in Iraq was largely one of "combat circulation", a euphemism for the logistical support of carrying passengers and cargo from one base to next in bus-route fashion. Combat assault, the mission for which V-22 was designed, remains unproven under realistic conditions. A deployment to Afghanistan would certainly serve that purpose but the risks associated with such a mission and the lack of lift capability in the Afghanistan Theater would seem to preclude such a deployment. Indeed, despite the rhetoric heard over the past five years about how V-22 is the ideally suited aircraft for combat operations in Afghanistan, the aircraft has not been deployed into that Theater to date. One could speculate on the reasons for this. I believe the principal reason is that operators and decision makers fully understand the risks involved both operationally and politically.
>
> **Concluding Remark**
>
> I have chosen to discuss what I consider the three major issues concerning operational effectiveness of V-22 in combat operations, as I deem these critical to the future of V-22 as a combat system. I have not discussed readiness and reliability or direct operating costs as I do not have access to recent data. However, I am well-versed in the history of these issues and I was in Iraq during the first deployment of the MV-22 and did manage to glean some information about day-to-day operations. I am prepared to answer any questions members of the Committee may have on these subjects.[30]

Chairman's Closing Statement

The text of Representative Towns' closing statement at the hearing is as follows:

> At the outset of this hearing, I expressed strong reservations about the performance and cost of the V-22 Osprey, but I wanted to hear what our witnesses said today before reaching a conclusion.
>
> What we have heard today convinces me that the dream of a viable high-speed, long-range, tilt-rotor aircraft has not been realized.
>
> Moreover, there is at least some evidence that the aircraft is inherently unsafe.
>
> To sum up, it has problems in hot weather, it has problems in cold weather, it has problems with sand, it has problems with high altitude, and it has restricted maneuverability.
>
> The list of what the Osprey can't do is longer than the list of what it can do.
>
> Not only has the Osprey failed to live up to its initial billing, it has failed expensively.
>
> Our investigation indicates that we've gotten half the aircraft for three times the cost – that's not a recipe for longevity.
>
> I am going to ask the staff to prepare a report on the findings of this investigation, which we will forward to the Appropriations Committee with recommendations for further action. It's time to put the Osprey out of its misery.

[30] Testimony of Arthur Rex Rivolo before the House of Representatives, Committee on Oversight and Government Reform, 23 June 2009, 5 pp.

Appendix B. V-22 Program History

This appendix provides additional discussion of the history of the V-22 program.

May 2009 GAO Report

A May 2009 GAO report provided the following summary of the history of the V-22 program:

> The Osprey program was started in December 1981 to satisfy mission needs for the Army, Navy, and Air Force. Originally spearheaded by the Army, the program was transferred to the Navy in 1982 when the Army withdrew from the program citing affordability issues. The program was approved for full-scale development in 1986, and the first aircraft was flown in 1989. A month after the first flight, the Secretary of Defense stopped requesting funds for the program due to affordability concerns. In December 1989, DOD directed the Navy to terminate all V-22 contracts because, according to DOD, the V-22 was not affordable when compared to helicopter alternatives, and production ceased. Congress disagreed with this decision, however, and continued to fund the project. Following a crash in 1991 and a fatal crash in 1992 that resulted in seven deaths, in October of 1992 the Navy ordered development to continue and awarded a contract to a Bell Helicopter Textron and Boeing Helicopters joint venture (Bell-Boeing) to begin producing production-representative aircraft.
>
> In 1994, the Navy chartered a medium lift replacement COEA, which reaffirmed the decision to proceed with the V-22. It also provided an analytical basis for KPPs to be proposed for the system. This analysis defined the primary mission of a medium-lift replacement aircraft to be the transport of combat troops during sea-based assault operations and during combat operations ashore. Secondary missions included transporting supplies and equipment during assault and other combat operations as well as supporting Marine Expeditionary Unit (MEU) special operation forces, casualty and noncombatant evacuation operations, tactical recovery of aircraft and personnel operations, combat search and rescue operations, and mobile forward area refueling and re-arming operations. These original mission descriptions and aircraft employment were reaffirmed by the Marine Corps in 2003 and again in 2007. The existing medium-lift aircraft fleet needed to be replaced due to inventory shortfalls and reduced aircraft reliability, availability, and maintainability—needs accentuated by the increasing age and limited capabilities of its current fleet of helicopters.
>
> The analysis concluded that the V-22 should be the Marine Corps' choice. The analysis considered a number of helicopter candidates—including the CH-46E and CH-53D—and the V-22 tiltrotor—judging each candidate based on their performance characteristics and expected contribution to tactics and operations. A sensitivity analysis was conducted which measured candidate aircraft against specific performance parameters—including KPPs. The analysis used models to assess research and development, production or procurement, and operations and support cost and concluded that for non-assault missions, such as medical evacuation missions, the V-22 was the most effective option because of its greater speed, increased range, and ability to deploy in one-third the time of the alternative candidates. For assault missions, the analysis concluded the V-22 would build combat power in the form of troops and equipment most quickly, was more survivable, would maximize the arrival of forces and minimize casualties, and would halve helicopter losses. In terms of affordability, the analysis concluded that, holding V-22 and helicopter force sizes equal, the V-22 would be the most effective but at a higher cost. The analysis further noted that while the major factor in favor of the V-22 was its speed, at short distances greater speed offers little advantage.

Subsequently, Low-Rate Initial Production (LRIP) began with five aircraft in 1997, increasing to seven each year in 1998 and 1999. In 2000, the program undertook operational evaluation testing, the results of which led the Navy's operational testers to conclude that the MV-22 was operationally suitable for land-based operations and was operationally effective. Later evaluations resulted in testers concluding that the MV-22 would be operationally suitable on ships as well. Based on the same tests, DOD's independent operational testers concluded that the MV-22 was operationally effective but not operationally suitable, due in part to reliability concerns. Despite the mixed test conclusions, a Program Decision Meeting was scheduled for December 2000 to determine whether the V-22 should progress beyond LRIP production and into full-rate production. Following two fatal crashes that occurred in 2000 and resulted in 23 deaths, the last one occurring just before the full-rate production decision, the V-22 was grounded and, rather than proceeding to full-rate production, the program was directed to continue research and development at a minimum sustaining production rate of 11 aircraft per year.

Before the V-22 resumed flight tests, modifications were made to requirements and design changes were made to the aircraft to correct safety concerns and problems. The aircraft nacelles were redesigned to preclude line chafing; a robust software qualification facility was built; and Vortex Ring State, a dangerous aerodynamic phenomenon that all rotor wing aircraft are subject to and was reported to have contributed to one of the fatal V-22 crashes in 2000, was further investigated. Requirements for landings in helicopter mode in which engine power had failed ("autorotation") and nuclear, chemical and biological weapons protection among others were eliminated, and some KPPs were modified, prior to conducting a second round of operational testing with modified aircraft in June 2005. Testers then recommended that the aircraft be declared operationally effective and suitable for military use. The Defense Acquisition Board approved it for military use as well as full-rate production in September 2005. DOD is procuring the V-22 in blocks. Block A is a training configuration, while later blocks are being procured and fielded as the operational configurations. Tables 1 and 2 provide a summary of the upgrades to be incorporated in each block configuration.[31]

Additional Discussion[32]

Early Development

The first of six MV-22 prototypes was flown in the helicopter mode on March 19, 1989, and as a fixed-wing airplane on September 14, 1989. Prototype aircraft numbers three and four successfully completed the Osprey's first Sea Trials on the USS Wasp (LHD-1) in December 1990.

The fifth prototype crashed on June 11, 1991, on its first flight, because of incorrect wiring in a flight-control system; the fourth prototype crashed on July 20, 1992, while landing at Quantico Marine Corps Air Station, VA, killing seven people and destroying the aircraft. This accident was caused by a fire resulting from hydraulic component failures and design problems in the engine nacelles.[33]

[31] Government Accountability Office, *Defense Acquisitions[:] Assessments Needed to Address V-22 Aircraft Operational and Cost Concerns to Define Future Investments*, GAO 09-482, May 2009, pp. 7-9.

[32] The discussion in this section is retained from earlier versions of this CRS report.

[33] Former Secretary of Defense Cheney tried to terminate the program in 1989-92, but Congress continued to provide funds for development of the V-22. The George H. Bush Administration's FY1990 budget requested no funds for the (continued...)

Flight tests were resumed in August 1993 after changes were incorporated in the prototypes. Flight testing of four full-scale development V-22s began in early 1997 when the first pre-production V-22 was delivered to the Naval Air Warfare Test Center in Patuxent River, MD. The first Engineering and Manufacturing Development (EMD) Flight took place on February 5, 1997. The first of four low-rate initial production (LRIP) aircraft, ordered on April 28, 1997, was delivered on May 27, 1999. Osprey number 10 completed the program's second Sea Trials, this time from the USS Saipan (LHA-2), in January 1999.

Operational evaluation (OPEVAL) testing of the MV-22 began in October 1999 and concluded in August 2000. On October 13, 2000, the Department of the Navy announced that the MV-22 had been judged operationally effective and suitable for land-based operations. On November 15, 2000, the Marine Corps announced that the Osprey had successfully completed sea trials and had been deemed operationally effective and suitable for both land and sea-based operations.

Successfully completing OPEVAL should have cleared the way for full rate production. This decision was to have been made in December 2000, but was postponed indefinitely, because of a mixed report from DOD's director of operational test and evaluation, and two fatal accidents.

On April 8, 2000, another Osprey crashed near Tucson, Arizona, during an exercise simulating a noncombatant evacuation operation. All four crew members and 15 passengers died in the crash. An investigation of the accident found that the pilot was descending in excess of the recommended flight envelope which may have caused the aircraft to experience an environmental condition known as "power settling" or "vortex ring state." According to Lt. Gen. Fred McCorkle, the pilot was descending more than a thousand feet per minute. The recommended descent rate is 800 feet per minute. Following a two-month suspension of flight testing, the Osprey recommenced OPEVAL in June 2000, with pilots flying a slightly tighter flight envelope. A July 27, 2000 report by the Marine Corps Judge Advocate General (JAG) (which had access to all non-privileged information from the safety investigation) confirmed that a combination of "human factors" caused the crash.

> This mishap appears not to be the result of any design, material or maintenance factor specific to tilt ... rotors. Its primary cause, that of an MV-22 entering a Vortex Ring State (Power Settling) and/or blade stall condition is not peculiar to tilt rotors. The contributing factors to the mishap, a steep approach with a high rate of descent and slow airspeed, poor aircrew coordination and diminished situational awareness are also not particular to tilt rotors.[34]

A DOD Inspector General study concluded that the V-22 would not successfully demonstrate 23 major operational effectiveness and suitability requirements prior to the December 2000 OPEVAL Milestone III decision to enter full rate production in June 2001[35]. The Marine Corps agreed with DOD's assessment of the deficiencies, but said that they had been aware of these

(...continued)

program. In submitting that budget to Congress on April 25, 1989, Defense Secretary Cheney told the House Armed Services Committee that he "could not justify spending the amount of money ... proposed ... when we were just getting ready to move into procurement on the V-22 to perform a very narrow mission that I think can be performed ... by using helicopters instead of the V-22."

[34] V-22 JAGMAN Executive Summary, United States Marine Corps, Division of Public Affairs, July 27, 2000, p.1.

[35] *Audit Report: V-22 Osprey Joint Advanced Vertical Aircraft*. Report No. D-2000-174. Office of the Inspector General. Department of Defense. August 15, 2000.

deficiencies before the beginning of OPEVAL. Furthermore, the Marine Corps said that they had an approved plan designed to resolve the deficiencies prior to the Milestone III decision.

On November 17, 2000, DOD's Director of Operational Test and Evaluation issued a mixed report on the Osprey; saying although "operationally effective" the V-22 was not "operationally suitable, primarily because of reliability, maintainability, availability, human factors and interoperability issues." The report recommended that more research should be conducted into the V-22's susceptibility to the vortex ring state blamed for the April 8, 2000 crash.

On December 11, 2000, an MV-22 Osprey crashed near Jacksonville, NC, killing all four Marines on board. This was the fourth Osprey crash since 1991 and the third lethal accident. The aircraft's pilot, Lt. Col. Keith M. Sweeney was the program's most experienced pilot and was in line to command the first squadron of Ospreys. The aircraft's copilot, Maj. Michael Murphy was second only to Sweeney in flying time on the Osprey.[36] The Marine Corps grounded the Osprey fleet pending a mishap board investigation. On April 5, 2001, the Marine Corps reported that the crash was caused by a burst hydraulic line in one of the Osprey's two engine casings, and a software malfunction that caused the aircraft to accelerate and decelerate unpredictably and violently when the pilots tried to compensate for the hydraulic failure.[37] The Marine Corps report called for a redesign of both the hydraulics and software systems involved.[38]

Maintenance and Parts Falsifications

In December 2000, an anonymous letter was mailed to the media by someone claiming to be a mechanic in the Osprey program. The letter claimed that V-22 maintenance records had been falsified for two years, at the explicit direction of the squadron commander. Enclosed in the letter was an audio tape that the letter's author claimed was a surreptitious recording of the squadron commander directing maintenance personnel to lie about the aircraft until the V-22 LRIP decision was made. On January 20, 2001, it was reported that the V-22 squadron commander admitted to falsifying maintenance records. The Marine Corps subsequently relieved him of command and reassigned him to a different position. At a May 1, 2001 hearing, members of the Senate Armed Services Committee expressed their concern that false data might impede DOD's ability to accurately evaluate the V-22 program and identify problem areas and potential improvements. The Department of Defense's Inspector General (IG) conducted an investigation. On September 15, 2001, it was reported that three Marines were found guilty of misconduct and two were reprimanded for their actions.

In June 2005, a U.S. grand jury indicted a company that had supplied titanium tubing for the V-22 program. The indictment charged the company with falsely certifying the quality of the tubes. The V-22 test program was halted for 11 days in 2003 because of faulty tubes. Replacing deficient tubes cost the V-22 program $4 million. Navy officials do not believe that these deficient tubes caused fatal mishaps.[39]

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[36] James Dao, "Marines Ground Osprey Fleet After Crash Kills Four," *New York Times*, December 12, 2000.

[37] An un-redacted version of JAG investigation into the April 2000 V-22 crash indicates that investigators found three "noteworthy" maintenance "areas of concern", including the Osprey's hydraulics system. A Naval Safety Center presentation to the Blue Ribbon Panel brought to light several previously unreported maintenance problems—including hydraulics failures—that caused engine fires or other problems during the Osprey's operational testing.

[38] Mary Pat Flaherty, "Osprey Crash Blamed on Leak, Software," *Washington Post*, April 6, 2001.

[39] Louise Story. "Maker of Tubes for Osprey Aircraft is Indicted." *New York Times*. June 8, 2005. Christopher J. (continued...)

Reviews and Restructuring

On April 19, 2001, a Blue Ribbon panel formed by then-Secretary of Defense William Cohen to review all aspects of the V-22 program, reported its findings and recommendations.[40] These findings and recommendations were also discussed during congressional testimony on May 1, 2001. The panel recommended that the program continue, albeit in a restructured format. The panel concluded that there were numerous problems with the V-22 program—including safety, training and reliability problems—but nothing inherently flawed in basic tilt-rotor technology. Because of numerous safety, training, and reliability problems, the V-22 was not maintainable, or ready for operational use.

The panel recommended cutting production to the "bare minimum" while an array of tests were carried out to fix a long list of problems they identified with hardware, software, and performance. Cutting near-term production was hoped to free up funds to pay for fixes and modifications. Once the changes had been made and the aircraft was ready for operational use, the Panel suggested that V-22 out-year purchases could be made in large lots using multi-year contracts to lower acquisition costs. Program officials estimated that the minimal sustainable production rate is 12 aircraft per year, which would be less than half the Ospreys once planned for FY2002.[41] In P.L. 107-107 Sec.123, Congressional authorizers codified the Blue Ribbon Panel's recommendation to produce V-22s at the minimum sustainable rate until the Secretary of Defense can certify that the Osprey is safe, reliable, maintainable, and operationally effective.

DOD appeared to take managerial and budgetary steps to incorporate the Blue Ribbon Panel's recommendations. For example, DOD's FY2001 supplemental funding request asked for a reduction of $475 million in procurement and an increase of $80 million in R&D funds. The additional R&D funding was to be used to support initial redesign and testing efforts to address deficiencies, logistics, flight test, and flight test support for V-22 aircraft. The reduction in procurement funding reflected the need to reduce production to the minimum rate while the aircraft design changes are being developed and tested.

Secretary of Defense Rumsfeld's FY2002 budget amendment, unveiled June 27, 2001, included a request for the procurement of 12 Ospreys. DOD comptroller Dov Zakheim and Marine Corps Commandant Gen. James Jones both stated that the procurement of 12 aircraft in FY2002 would allow them to sustain the V-22 subcontractor base while simultaneously addressing the Osprey program's needs.[42] V-22s were procured at a rate of 11 per year from FY2002 to FY2006.

Following the Blue Ribbon panel's recommendations, former DOD Undersecretary for Acquisition Edward "Pete" Aldridge assumed acquisition authority for the V-22 program. Undersecretary Aldridge changed the V-22 program's status from an ACAT 1C program—which gives the Department of the Navy the highest required authority for production decisions—to an

(...continued)

Castelli. "Former Supplier of Hydraulic Tubing for V-22 Osprey Faces Indictment." *Inside the Navy*. June 13, 2005.

[40] This panel was chaired by retired Marine General John R. Dailey and included retired Air Force General James B. Davis, Norman Augustine, and MIT professor Eugene Covert.

[41] Adam Hebert, "Minimal Sustainable Rate Will Dramatically Cut Near-Term V-22 Buys," *Inside the* Air Force, April 20, 2001.

[42] DOD News Briefing, Wed. June 27, 2001, 1:30PM and Kerry Gildea, "New V-22 Plan Sustains Lower Tier Contractors, Jones Reports," Defense Daily, May 15, 2001.

ACAT 1D program. Under the latter category, the Defense Acquisition Board (DAB) would decide if and when the program is ready to enter full rate production.[43]

A NASA-led review of the V-22 program, released November 6, 2001, concluded that there were no known aero-mechanical phenomena that would stop the tilt-rotor aircraft's development and deployment. The study focused on several aero-mechanics issues, including Vortex Ring State, power problems, auto-rotation, and hover performance.[44]

In a December 21, 2001 memo to the Secretaries of the Air Force and the Navy, and the Commander, Special Operations Command, Undersecretary of Defense Aldridge gave his authorization for the V-22 to resume flight testing in the April 2002 time frame. Secretary Aldridge expressed support for range, speed, and survivability goals of the V-22. He noted, however that the program still had numerous technical challenges to overcome, and emphasized that the V-22 must demonstrate that "1) it can meet the needs of the warfighter better than any other alternative, 2) it can be made to be reliable, safe, and operationally suitable, and 3) it is worth its costs in contributing to the combat capability of U.S. forces." Secretary Aldridge approved the flight test program under the condition that the production rate be slowed to the minimum sustaining level, that it be comprehensive and rigorous, and that the restructured program is fully funded in accordance with current estimates.[45] Undersecretary Aldridge estimated that the V-22 would require at least two years of flight testing before DOD could conclude that the aircraft is safe, effective, and "worth the cost."[46]

Mechanical adjustments slowed the V-22 test schedule, and the MV-22 took its first test flight on May 29, 2002. The Air Force CV-22 resumed flight tests on September 11, 2002. Flight tests were designed to explore both technical and operational concerns. Technical concerns include flight control software and the reliability and robustness of hydraulic lines. Operational concerns explored included whether the Osprey is too prone to Vortex Ring State to make it a safe or effective aircraft, whether this potential problem is further exacerbated by multiple Osprey's flying in formation, and how well the V-22 handles at sea.[47]

The principal differences between the aircraft that were grounded in 2000 and the aircraft that began testing 17 months later (called "Block A" aircraft) are re-routed hydraulic lines, and an improved caution and warning system.[48] Technical glitches were experienced during tests. Hydraulic failures, for example, continued during the reinstated flight test program, once on August 4, 2003, (due to a mis-installed clamp) and again on September 5, 2003. In June 2004 a V-22 was forced twice to make an emergency landing. During one landing, the aircraft suffered a "Class B" mishap (one causing between $200,000 and $1 million in damage).[49] An investigation

[43] "Navy Loses Osprey Authority," Washington Post, May 22, 2001 and Hunter Keeter, "Aldridge Maneuvers V-22 Acquisition Authority Away from Navy," *Defense Daily*, May 22, 2001 and Linda de France, "V-22 Osprey Production Authority Transferred from Navy to DoD," *Aerospace* Daily, May 22, 2001.

[44] Christopher Castelli, " NASA Review Panel Endorses Resumption of V-22 Flight Tests," InsideDefense.com,. November 14, 2001.

[45] "Text: Aldridge Memo on V-22," *Inside the Navy*, January 7, 2002.

[46] Tony Capaccio, "Textron-Boeing V-22 Needs Two years of Testing, Aldridge Says," *Bloomberg.com,* October 16, 2001.

[47] Thomas Ricks, "V-22 Osprey to Face Make or Break Tests," *Washington Post,* December 25, 2002, p. 14.

[48]Jefferson Morris, "Pilot: Resumption of V-22 Testing To Be Treated Like First Flight," *Aerospace Daily,* April 29, 2002.

[49] Christopher Castelli. "Navy Convenes Mishap Board to Investigate Latest V-22 Incident." *Inside the Navy*. July 5, (continued...)

revealed that the V-22 suffered from widespread problems with an engine component that required replacement every 100 flight hours.[50]

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.[51] Also concurrent with the resumption of V-22 flight testing, DOD began an in-depth study of alternatives to pursue in case the aircraft does not pass muster. Options reportedly include purchasing the S-92, or upgrading CH-53, or EH101 helicopters.[52]

After one calendar year and 466 hours of flight testing, DOD reviewed the Osprey's progress. On May 15, 2003, Thomas Christie, DOD's Director of Operational Test and Evaluation (DOT&E), graded Bell-Boeing's improvements to the Osprey's hydraulics as "reasonable and appropriate" and "effective."[53] Christie also at that time approved of the testing that had been completed and was satisfied with what had been learned about the V-22's susceptibility to Vortex Ring State. On May 20, 2003, the Defense Acquisition Board also reviewed the program and approved of the flight test program's progress.

Marine Corps officials recommended increasing the production rate in FY2006 from the minimum sustainable rate of 11 to 20 aircraft. However, in an August 8, 2003, memorandum, Undersecretary of Defense for Acquisition Michael Wynne announced that this acceleration "presents more risk than I am willing to accept." Instead, Wynne restructured the planned procurement, reducing the FY2006 purchase to 11 aircraft. "For subsequent years' procurement planning, production rates should increase by about 50% per year for a total of 152 aircraft through FY09," according to the August 8th memo. Wynne directed that the savings resulting from the reduced procurement (estimated at $231 million) be invested in improving the V-22's interoperability, by funding the Joint Tactical Radio System, Link 16 and Variable Message Format communication. Wynne also directed that a multi-year procurement (MYP) of the V-22 be accelerated. While some suggest that this restructuring will more quickly deliver high-quality aircraft to the Marines and Special Operations Forces, others fear that slowing procurement will inevitably raise the platform's cost.

In December 2004 the V-22 budget and schedule were restructured again. Program Budget Decision 753 (PBD-753) cut 22 aircraft from the V-22's production schedule and $1.3 billion from the budget between FY2006 and FY2009.

On June 18, 2005, the MV-22 program completed its second round of operational evaluation (OPEVAL) flight. The test program was marked by two emergency landings, a Class B mishap, a

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2004.

[50] Christian Lowe. "V-22 Ospreys Require New Engine Component Every 100 Hours." *Navy Times*. July 16, 2004.

[51] Joseph Neff, "Eased Standards 'Fix' Osprey," *Raleigh News & Observer*, May 19, 2002, p.1.

[52] "Aldridge Makes Progress Check on MV-22 at NAS Patuxent River," *Defense Daily*, February 11, 2003.

[53] Tony Capaccio, "Boeing-Textron B-22 Gets Favorable Review From Pentagon Tester," *Bloomberg.com*, May 19, 2003.

small fire in an engine compartment, and problems with the prop-rotor gear box. However, Navy testers recommended that DOD declare the V-22 operationally suitable, and effective for military use. This recommendation was based, in part, on observations that the MV-22 had complied with the objectives of P.L. 107-107 Sec.123: hydraulic components and flight control software performed satisfactorily, the aircraft was reliable and maintainable, the MV-22 operated effectively when employed with other aircraft, and the aircraft's downwash did not inhibit ground operations.[54]

On September 28, 2005, the V-22 program passed a major milestone when the Defense Acquisition Board approved it for military use and full rate production.[55] The MV-22 continues testing to assess survivability and to develop tactics. The CV-22 is in developmental test and evaluation. The program continues to experience technical and operational challenges, and mishaps. For example, an inadvertent takeoff in March 2006 caused wing and engine damage in excess of $1 million. An engine component has been replaced because its failure in flight has caused seven unexpected flight terminations. In October 2005, a V-22 experienced engine damage during flight due to icing. An engine compressor failure during the V-22's first overseas deployment (July 2006) forced the aircraft to make a precautionary landing before reaching its destination. An engine fire on December 7, 2006, caused more than $1 million to repair, and the Marine Corps grounded all of its V-22s in February 2007 after it was found that a faulty computer chip could cause the aircraft to lose control during flight.

[54] "Letter of Observation in Support of MV-22 Program Compliance with Section 123 of the National Defense Authorization Act for Fiscal Year 2002." Commander, Operational Test and Evaluation Force. Department of the Navy. February 18, 2005.

[55] Andy Pasztor. "Pentagon Clears Full Production for Osprey Aircraft." *Wall Street Journal.* September 29, 2005.

Appendix C. General Arguments Made by Supporters and Opponents of the V-22

This appendix presents general arguments by supporters and opponents of the V-22.

Arguments Made By Supporters

Supporters of the V-22 could argue one or more of the following:

- The V-22 is needed to replace aging military helicopters that are costly to maintain and operate safely and effectively. While there may be new helicopters that could replace and improve on today's military helicopters, none of them would match the Osprey's capabilities.
- When landing on hostile shores in a third-world conflict (typically lacking important infrastructure such as airfields and roads), the V-22 would be critical for the transport of Marines from ship to shore. Senior DOD officials have testified that the V-22 would have, for example, made a significant contribution to the war on terrorism in Afghanistan.
- The Osprey has been rigorously tested and its accident rate is consistent with other aircraft development programs. While some technical problems have been encountered, leading experts have testified that there are no technological barriers to the employment of tilt-rotor technology. Engineering-level modifications have put the Osprey program back on track. The completed OPEVAL demonstrates that the V-22 program has resolved all of the concerns expressed by the Blue Ribbon Panel and by Congress.
- The V-22 also has potential value for civil aviation, law enforcement, and foreign sales by the U.S. aerospace industry.[56] The development of tilt-rotor aircraft for the armed services could have significant spin-off effects for civil aviation and U.S. technology, giving the U.S. aerospace industry a major competitive advantage in the international market.[57]

Arguments Made by Opponents

Opponents of the V-22 could argue one or more of the following:

[56] Sen. Ted Stevens et al., "Continuation of the V-22 Aircraft Program," remarks in the Senate, *Congressional Record*, daily edition, April 19, 1989, pp. S4507-S4509.

[57] The potential civil application of tilt-rotor technology is also considered by some a good reason to pursue the V-22 program. A February 1988 study by the FAA and NASA concluded that tilt-rotors could help relieve airport congestion by diverting commuters and short-distance passengers to vertiports in urban centers. The importance of U.S. production of a tilt-rotor aircraft for civilian purposes was the subject of a hearing on July 17, 1990, by the House Committee on Science, Space, and Technology's Subcommittee on Transportation, Aviation, and Materials. In 1992, Congress enacted legislation (H.R. 6168) directing the Secretary of Transportation to establish a "civil tilt-rotor development advisory committee" to evaluate the feasibility and viability of developing civil tilt-rotor aircraft and infrastructure necessary to incorporate tilt-rotor aircraft into the national transportation system.

- For the kinds of ship-to-shore operations in which the Marines are most likely to be involved in coming years, the V-22's greater speed and range will often not be critical. Consequently, these ship-to-shore operations can be performed adequately by less expensive helicopters. Although the Osprey can lift three times more dead weight than can the CH-46, the Osprey is three times heavier and five times more expensive than the CH-46. The V-22's performance, moreover, should be compared to that of contemporary helicopters such as the EH-101, rather than to the performance of the CH-46, which is a 1970s-era helicopter. When compared to contemporary helicopters, the capabilities of the V-22 are not as impressive.[58]
- Marine assault missions in an opposed landing would coordinating V-22 operations with the operations of aircraft having less speed and range, which in practice will reduce the V-22's advantages in these two areas. The Osprey's hypothetical contribution to the war in Afghanistan is questionable due to the high altitude of that country and the Osprey's inability to improve greatly over helicopter performance in high-altitude operations.
- The Osprey's operational capabilities and operational concepts are open to question. A January 12, 2001, presentation by the Government Accountability Office (GAO) to the V-22 Blue Ribbon Panel, for example, said that the V-22's cabin may not be large enough to carry 24 combat-equipped Marines, and that the severe rotor down wash might impede the ability of troops to exit the aircraft and move into combat positions. Also, to avoid entering Vortex Ring State, Osprey's will have to descend slowly, which will make them vulnerable to ground fire in combat situations.
- Studies suggest that tilt-rotor aircraft are more susceptible than traditional helicopters to airflow instabilities that can cause Vortex Ring State.[59] Our understanding of the kinds of airflow anomalies that have caused mishaps in V-22 flight testing is still very immature.

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[58] See, for example, Everest Riccioni, "Osprey or Albatross?," *Defense News*, January 27, 2004.

[59] Michael Dornheim, "Tiltrotor Wake 'More Complex' Than Classic Vortex Ring State," *Aviation Week & Space Technology*, July 15, 2002.