MV-22 Osprey

Executive Summary

- The Navy conducted the first phase of Operational Test IIIK (OT-IIIK) FOT&E from March to August 2015 and a second phase of OT-IIIK from February to May 2016.
- The second phase evaluated modifications to the Defensive Weapon System (DWS) and Ramp Mounted Weapon System (RMWS) that were made after the first phase of testing.
- Modifications implemented between the first and second phase did not improve the reliability of the DWS and RMWS.
- The DWS is now compatible with the Mission Computer Obsolescence Initiative (MCOI) aircraft.

System

- The MV-22 is the Marine Corps variant of the V-22 Osprey. It is a tiltrotor aircraft capable of conventional wing-borne flight and vertical take-off and landing. The Marine Corps is replacing the now-retired CH-46 and CH-53D helicopters with the MV-22.
- The MV-22 can carry 24 combat-equipped Marines and operate from ship or shore. It can carry an external load up to 10,000 pounds over 50 nautical miles and can self-deploy 2,363 nautical miles with a single aerial refueling.
- Recent system upgrades include the following:
  - MCOI. The MCOI computer hardware initiative is designed to improve the performance of the existing Advanced Mission Computer architecture by adding greater processing speed and more data storage while maintaining the same functionality as the original computer.
  - Blue Force Tracker 2 (BFT-2). The updated BFT-2 GPS-enabled system receives information on friendly, neutral, and hostile forces, as well as sends and receives text and image messages via a federated cockpit display.
  - DWS. GAU-17 DWS improvements add a sensor-only mode that allows the gunner to use the electro-optical sensor when the gun turret is not being used. The turreted, remotely operated, all-quadrant, 7.62 mm DWS is designed for fire suppression against ground troops and soft targets.
  - RMWS. The GAU-21 .50 caliber RMWS replaced the GAU-18 RMWS.

Mission

- Squadrons equipped with MV-22s provide medium-lift assault support in the following operations:
  - Ship-to-Objective Maneuver
  - Sustained operations ashore
  - Tactical recovery of aircraft and personnel
  - Self-deployment
  - Amphibious evacuation

Major Contractors

Bell-Boeing Joint Venture:

- Bell Helicopter – Amarillo, Texas
- The Boeing Company – Ridley Township, Pennsylvania

Activity

- Testing activity focused on the four recent upgrades to the MV-22. The first phase of OT-IIIK was conducted from March to August 2015. The Navy conducted a second phase of OT-IIIK FOT&E from February to May 2016, which evaluated modifications designed to address deficiencies in the DWS and to the RMWS that were discovered in the first phrase of testing. Testing was done in accordance with the DOT&E-approved test plan.
- Marine Corps pilots conducted testing at locations with conditions representative of those encountered in fleet operations. These locations included Marine Corps Base Camp Lejeune, North Carolina; at or near Kirtland AFB, New Mexico; and at or near Marine Corps Air Station Yuma, Arizona. They used three production-representative Advanced Mission Computer aircraft and a production-representative MCOI aircraft. The Advanced Mission Computer configuration is the original, pre-MCOI configuration.
- The Navy's Commander, Operational Test and Evaluation Force, with assistance from Marine Operational Test and Evaluation Squadron 22, conducted cybersecurity testing of

the MV-22 aircraft, mission planning system, and maintenance systems from May 4 – 8, 2015, at Marine Corps Air Station New River, North Carolina. The cybersecurity evaluation was based upon an Adversarial Assessment that included a test of the ability of the unit to protect against cyber-attacks, detect and respond to a cyber-attack, and restore to normal operations in the event of a successful cyber-attack. At the current time, the Navy does not have the capability to do cybersecurity testing on Military Standard (MIL-STD)-1552 data buses, so those were not evaluated.

Assessment

- The upgrades did not enhance the operational effectiveness, suitability, or survivability of the MV-22-equipped unit and MV-22 units remain effective, suitable, and survivable.
- Crews employing MV-22 aircraft equipped with updated mission computers (commonly referred to as "MCOI-equipped") discovered two deficiencies that would hinder the ability of a MCOI-equipped unit to perform its mission:
  1. Pilots reported that numbers and text on the cockpit displays in the MCOI aircraft were not as sharp as those in legacy aircraft despite the new displays' higher resolution.
  2. The MCOI hover display mode did not transition into and out of hover mode without extra pilot actions.
- MCOI aircraft demonstrated compatibility with the DWS in Phase 2, which was not the case in Phase 1.
- The BFT-2 delivery of digital messages is improved over BFT-1. BFT-2 pilot workload remains high for use in a busy cockpit. The BFT 2 transfer of digital images did not work.
- Inherent deficiencies in the design of the DWS continue to limit the unit's ability to provide suppressive fire against threat targets. The Phase 2 modifications to the DWS design had no measureable effect on the aircrew's capability to provide suppressive fire with the DWS.
- The field of fire of the RMWS has expanded and the gun provides suppressive fire to the rear when it fires, but the RMWS cannot be counted on to fire when needed.
- Modifications to the DWS and RMWS did not improve the effectiveness or reliability of the weapon systems.
- After conclusion of the 2016 test period, fuselage damage to several test aircraft was discovered in an area not usually inspected during normal postflight procedures. This damage was discovered in the vicinity of where the DWS ejects shell casings.
- During testing, the OT-IIIK MV-22 aircraft met reliability requirements but did not meet maintainability and availability thresholds. Demonstrated reliability, maintainability, and availability performance is consistent with that of the MV-22 fleet.
- Cybersecurity vulnerabilities were discovered during testing; the details of which are classified.
- The Air Force Special Operations Command observed repeated problems with the CV-22 Icing Protection System (IPS) during testing of the Tactical Software Suite this year, as stated in the CV-22 Annual Report. As the MV-22 has the same system, there could be similar problems on its system.

Recommendations

- Status of Previous Recommendations. The Navy has not completed actions to address the following FY15 recommendations:
  - Address failure modes and supply issues that limit aircraft availability.
  - Use Marine Air-Ground Task Forces to employ tactics, techniques, and procedures to compensate for limitations in the DWS.
  - Improve BFT-2 message latency.
  - Investigate and improve RMWS reliability.
  - Address cyber vulnerabilities of the MV-22 and its supporting systems.
- FY16 Recommendations. The Navy should:
  1. Continue to execute a viable reliability growth program for the MV-22 fleet, and address failure modes that degrade aircraft availability.
  2. Address the MCOI shortcomings and focus on improving the clarity of cockpit displays and modifying the hover page function so that it always returns to the previously selected page.
  3. Investigate and remedy the cause of BFT-2 image messaging failures.
  4. Continue to investigate and remedy the causes of reliability failures in the DWS and RMWS.
  5. Inspect the MV-22 fleet for possible fuselage damage caused by the DWS. If damage is discovered, the cause should be investigated and prevention/remediation actions should be taken.
  6. Address cybersecurity vulnerabilities of the MV-22 and supporting systems.
     a. Develop the capability to conduct cybersecurity testing of MIL-STD-1553 data buses.
     b. Investigate whether modifications to aircraft restore procedures are needed after a cyber-attack.
  7. Investigate MV-22 IPS performance fleet-wide. If MV-22 IPS problems are discovered, the Navy should initiate improvement actions to correct repeated IPS failures.