MQ-9 Reaper Armed Unmanned Aircraft System (UAS)

Executive Summary

- The Air Force fielded the Block 5 Remotely Piloted Aircraft (RPA) and Block 30 Ground Control System (GCS) in May 2017 and began conducting combat Block 5 RPA/ Block 30 GCS combat operations in June 2017. Results of the FY16 Air Force Operational Test and Evaluation Center (AFOTEC) FOT&E of the MQ-9 Block 5 RPA and Block 30 GCS demonstrated that the system was not operationally capable of conducting wide area searches to hunt fixed or moving targets with the Lynx Synthetic Aperture Radar (SAR) system. Furthermore, FOT&E results showed that the MQ-9 Unmanned Aircraft System (UAS) was not operationally effective in the hunter mission role. FOT&E results also established that the Block 5 RPA and Block 30 GCS were not operationally suitable, and the Block 5 RPA was subject to overheating problems in operationally relevant environments.
- In May 2017, the Air Force 53rd Wing began a Force Development Evaluation (FDE) of the MQ-9 system to test software and hardware changes intended to correct some of the deficiencies from the FY16 FOT&E. The FDE is ongoing, and to date has demonstrated that the Air Force addressed the overheating problems observed during the FY16 FOT&E, but did not resolve the radar system deficiencies encountered during the test. Additional preliminary observations indicate the following:
  - An improved aircraft Generator Control Unit (GCU) and expansion of the Payload Control Computer (PCC) thermal operating limits have alleviated Block 5 RPA overheating problems encountered in FY16 FOT&E.
  - Block 30 GCS radar control human-machine interface (HMI) improvements enabled aircrews to perform simple SAR tasks such as spot image and moving target indicator (MTI) radar scan operations; however, the Lynx SAR continues to be difficult to configure in the GCS, remains unreliable, and has not demonstrated the ability to perform operationally relevant wide-area search functions.
- The Air Force continues planning to upgrade the MQ-9 GCS to the Block 50 configuration beginning in FY21. Block 50 GCS development and fielding is a major acquisition effort projected to cost approximately $1 Billion. The Air Force intends for the Block 50 GCS to incorporate an ergonomically optimized cockpit, new HMI, multi-level security, improved cautions and warnings interface, and separated flight and payload systems. The Air Force has not completed a new Test and Evaluation Master Plan (TEMP) to support the Block 50 GCS test and evaluation activities.

System

- The MQ-9 Reaper UAS is a remotely piloted and armed aircraft system that uses optical, infrared, and radar sensors to locate, identify, target, and attack ground targets.

  - The MQ-9 RPA is a medium-sized aircraft that has an operating ceiling up to 50,000 feet, an internal sensor payload of 800 pounds, an external payload of 3,000 pounds, and an endurance of approximately 14 hours.
  - Aircraft sensors include the Multi-spectral Targeting System (MTS)-B electro-optical and infrared targeting sensor and the Lynx SAR system.
  - The GCS commands the MQ-9 RPA for launch, recovery, and mission control of sensors and weapons. RPA launch and recovery operations use C-band line-of-sight datalinks, and RPA mission control uses Ku-band satellite links.
- MQ-9 RPAs carry AGM-114 HELLFIRE II anti-armor precision laser-guided missiles, GBU-38 Joint Direct Attack Munition (JDAM) 500-pound bombs, and GBU-12 500-pound, laser-guided bombs.
- The Air Force is using an evolutionary acquisition approach for meeting Increment One Capability Production Document requirements, with Block 1 and Block 5 RPAs and Block 15 and Block 30 GCSs.
- The Air Force is currently fielding the Block 5 RPA and the Block 30 GCS.
- The Air Force designed the Block 5 RPA to incorporate improved main landing gear, an upgraded electrical system with more power, an additional ARC-210 radio, encrypted datalinks, a redesigned avionics bay and digital electronic engine control system, the BRU-71 bomb rack, high-definition video, and upgraded software to allow the two-person aircrew to operate all onboard sensors and systems.
- The Air Force designed the Block 30 GCS to incorporate upgraded flight control displays and avionics, secure digital datalinks, Integrated Sensor Control System, Continuous Look Attack Management for Predator, Control of Lynx and Analysis Workstation software, and high-definition multifunction displays.

Mission
- Combatant Commanders use units equipped with the MQ-9 to conduct armed reconnaissance and pre-planned strikes. When provided wide-area search cues from off-board sources, units equipped with MQ-9s can execute cued searches to find, fix, track, target, engage, and assess critical emerging targets (both moving and stationary).
- MQ-9 units can also conduct aerial intelligence gathering, reconnaissance, surveillance, and target acquisition for other airborne platforms.

Major Contractor
General Atomics Aeronautical Systems Inc. – San Diego, California

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Activity
- The Air Force conducted MQ-9 testing in accordance with the DOT&E-approved TEMP.
- The Air Force fielded the Block 5 RPA and Block 30 GCS on May 15, 2017, and began conducting Block 5 RPA/Block 30 GCS combat operations in June 2017.
- The Air Force will complete delivery of the MQ-9 program of record fleet under low-rate initial production.
- In May 2017, the Air Force 53rd Wing began an FDE of the MQ-9 UAS at Creech Air Force Base, Nevada, to assess Operational Flight Program (OFP) software version 904.6.4 and hardware changes intended to correct deficiencies and address some of the FY16 FOT&E shortfalls. As of the end of FY17, the FDE is ongoing. Key hardware and software changes incorporated the following:
  - Improved GCU. The GCU controls the engine operating speed at which the generator will begin supplying electrical power to the RPA. The Air Force redesigned the GCU to enable RPA GCU electrical power during ground operations at lower power settings to conserve aircraft battery life prior to take-off.
  - Increased PCC temperature limits. During the FY16 FOT&E, the PCC often reached its yellow caution temperature limit before take-off, contributing to ground aborts. The Air Force reevaluated the yellow caution temperature limit and determined that it could be raised from 85 degrees Celsius to 96 degrees Celsius with no deleterious effects to the PCC.
  - Improved Lynx SAR GCS HMI. The Air Force developed a simpler interface to partially replace the complicated SAR HMI flown during the FY16 FOT&E. The new interface reduces the modes available to spot images and MTIs and uses graphical cues to indicate the spot resolutions, MTI target sizes, and speeds available. The previous legacy system interface is still available for executing other complex SAR modes.
  - MTS-B hardware and software changes. MTS-B hardware now includes both the legacy AN/DAS-1 and new AN/DAS-4 hardware. The AN/DAS-4, which the Air Force intends to field in FY18, is an upgraded version of the entire MTS B system that incorporates additional high-definition video modes, target location accuracy enhancements, automatic boresight alignment, and a laser designator tracker. New MTS-B software, compatible with both hardware versions, includes split screen modes to enable simultaneous viewing of targets in different modes.
  - Video-Oriented Transceiver for Exchange of Information (VORTEX). VORTEX provides encrypted MTS B video and metadata to MQ-9-supported ground units equipped with Remotely Operated Video Enhanced Receiver (ROVER) hardware kits.
- The Air Force continues planning to upgrade the GCSs to the Block 50 configuration starting in FY21. The Block 50 GCS development and fielding is a major acquisition effort projected to cost approximately $1 Billion. The Block 50 GCS is expected to incorporate an ergonomically optimized cockpit, new HMI, multi-level security, improved cautions and warnings interface, and separated flight and payload systems.
- General Atomics delivered the last of 195 Block 1 RPAs to the Air Force in 2015, and then transitioned the production line to Block 5 RPAs. As of July 2017, General Atomics had delivered 52 of 155 planned Block 5 RPAs. Total Air Force MQ-9 deliveries as of July 2017 include 247 of 350 planned MQ-9s (Block 1 and Block 5 combined). General Atomics plans to deliver the final Block 5 RPA in FY21.

Assessment
- Results of the FY16 AFOTEC FOT&E of the MQ-9 Block 5 RPA and Block 30 GCS demonstrated that the system was not operationally capable of conducting wide-area searches to hunt fixed or moving targets with the Lynx SAR system. Furthermore, FOT&E results showed that the MQ-9 UAS was not operationally effective in the hunter mission role. FOT&E results also established that the Block 5 RPA and Block 30 GCS were not operationally suitable, and the Block 5 RPA was subject to overheating problems in operationally relevant environments.
- The 2017 FDE is ongoing, and to date has demonstrated that the Air Force addressed the overheating problems observed during the FY16 FOT&E, but did not resolve the radar system deficiencies encountered during the test. Additional preliminary observations indicate the following:

- An improved aircraft GCU and expansion of the PCC thermal operating limits have alleviated Block 5 RPA overheating problems encountered in the FY16 FOT&E.
- The improved GCU appears to be functioning correctly. Battery depletion problems on the ground encountered during testing in the FY16 FOT&E have not been observed in the FY17 FDE, and pilots have not had to monitor battery status as closely as the FOT&E testers had to resulting in lower pilot workloads during ground operations.
- The PCC temperature limit increase allows more time for ground operations without encountering overheating, which contributed to reduced pilot workload.
- Block 30 GCS radar control HMI improvements enabled aircrews to perform simple SAR tasks such as spot image and MTI radar scan operations; however, the Lynx SAR continues to be difficult to configure in the GCS, remains unreliable, and has not demonstrated the ability to perform operationally relevant wide-area search functions.
- The new MTS-B AN/DAS-4 sensor and software appear to provide useful capabilities that function as designed. The split screen mode aided target location. Automatic boresight alignment capability eliminated the requirement to have a local target board and associated infrastructure to perform airborne manual boresights for the video camera and laser designator.
- Combat Search and Rescue scenarios demonstrated that the MQ-9 aircrews could establish radio communications with a downed pilot, secure the area around the downed pilot from enemy forces by taking SAR spot images, and monitor the area with SAR MTI.
- The MQ-9 transmitted unencrypted and encrypted MTS-B video and metadata to ground units equipped with ROVER; however, transmission reliability from VORTEX to ROVER was not consistently reliable.
- Unencrypted and encrypted radio communications were demonstrated; however, communication on some frequencies was poor. HAVEQUICK radio communication does not work well.
- The MQ-9 UAS maintenance construct requires Air Force personnel to maintain both the RPA and GCS. Air Force maintainers cannot consistently maintain the Block 30 GCS without assistance from contractor personnel.

- The Air Force currently plans to complete the MQ-9 Increment One system with the Block 50 GCS and a future system OFP. The AFOTEC IOT&E of the Block 50 GCS and future capabilities is scheduled to occur in FY22 or later. A new TEMP is required to document the test strategy and resources necessary to evaluate the Block 50 GCS; incorporation of new program of record content; and testing of Lynx SAR wide-area search capabilities that could not be performed during the FY16 FOT&E.

Recommendations

- Status of Previous Recommendations. The Air Force made some progress toward, but did not fully satisfy the FY16 recommendations to correct shortfalls identified during the FY16 FOT&E.
- FY17 Recommendations. The Air Force should:
  1. Correct the shortfalls identified in the FY16 FOT&E and FY17 FDE, including problems with the SAR, and confirm preliminary findings that hot weather thermal management shortfalls have been successfully mitigated.
  2. Conduct sufficient testing during Block 50 IOT&E to determine the ability of the MQ-9 system to execute an all-weather operational hunter mission role using the SAR.
  3. Develop and submit a new TEMP for DOT&E approval, documenting the incorporation of new program of record content (e.g., the Block 50 GCS) and the test and evaluation strategy and resources required to mature and test these capabilities and systems.