MQ-8 Fire Scout

Executive Summary

- The Commander, Operational Test and Evaluation Force (COTF) and Air Test and Evaluation Squadron ONE (VX-1) conducted the land-based Quick Reaction Assessment (QRA) from May through June 2015 in response to a request by the Director, Battlespace Awareness, Operational Navy N2/N6F2, for an assessment of the operational capabilities and limitations of the radar-equipped MQ-8B Fire Scout to support maritime and littoral operations.
  - DOT&E assessed MQ-8B performance in a March 2016 memorandum to the Navy.
  - While this QRA demonstrated the potential of the radar-capable MQ-8B, this land-based-only QRA may have presented an overly optimistic assessment of this capability. The Navy intends for the radar-equipped MQ-8B to launch from a host vessel capable of supporting helicopter flight operations (such as the Littoral Combat Ship (LCS)) in support of intelligence and surface warfare (SUW) operations. This concept of operations was not demonstrated during the QRA.
- VX-1 conducted the MQ-8C operational assessment (OA) at Naval Air Station Point Mugu, California, in November 2015 to support the upcoming Milestone C decision. This testing focused on air vehicle endurance, mission coverage, performance of the MQ-8C electro-optical/infrared (EO/IR) sensor in a littoral environment, reliability of the system, and operator workloads.
  - DOT&E assessed MQ-8C performance in a June 2016 memorandum to the Navy.
  - The MQ-8C OA presents a partial assessment of MQ-8C performance. This land-based MQ-8C OA presents an overly optimistic assessment of the capability since the Navy did not complete shipboard testing under operational conditions.
- The Navy awarded a contract for 10 additional MQ-8C helicopters in September 2015 bringing the total number to 29. The Navy plans to complete their buy of the remaining 11 aircraft in FY17 prior to IOT&E.
- The Navy is planning to conduct the Milestone C decision for the restructured program in 2QFY17.

MQ-8B

MQ-8C

System

- The MQ-8B and follow-on MQ-8C are helicopter-based tactical unmanned aerial systems that support intelligence, surveillance, and reconnaissance (ISR), SUW, and mine countermeasures (MCM) payloads.
- The Navy plans to replace the MQ-8B airframe (Schweizer 333) with the MQ-8C airframe (Bell 407), which has better endurance and payload capacity. MQ-8B vehicles are deployed on ships in the fleet and will be phased out via attrition. The MQ-8C concept of operations is primarily in support of LCS missions but it can also be employed off other suitably equipped aviation capable ships.
- The MQ-8C airframe is equipped with the AN/AAQ-22D Bright Star II, a multi-sensor imaging system with EO/IR cameras and laser designation/range finding.
- The Navy plans to incrementally integrate different mission payloads into the MQ-8C airframe:
  - The Endurance Baseline Increment integrates the AN/AAQ-22D Bright Star II, Automated Identification System (AIS), Tactical ISR (TAC-ISR) Remote Broadcast omni-directional datalink, and an ultra-high frequency/very high frequency (clear or secure) voice communications package.
  - The SUW Increment integrates maritime search radar as well as Inverse Synthetic Aperture Radar and Synthetic

Aperture Radar imagery capability and the Advanced Precision Kill Weapons System (APKWS).
  - The MCM Increment is the final increment that integrates the Coastal Battlefield Reconnaissance and Analysis system and a Data Mission Payload.
- LCS components supporting the MQ-8 airframes are permanently installed on the host platform and consist of one Mission Control System (MCS), one Data Link Suite, and two Unmanned Air Vehicle Common Automatic Recovery Systems. System interoperability is achieved using the Tactical Control System (TCS) software embedded in the MCS and the host platform's command, control, communications, computers, collaboration, and intelligence architecture.

Mission
Commanders employ naval units equipped with MQ-8 airframes to provide ISR, target acquisition capability, communications relay capability, and/or APKWS in support of LCS SUW and MCM operations.

Major Contractor
Northrop Grumman – San Diego, California

Activity
- The Navy requested that USD(AT&L) certify the restructure of the Vertical Take-off and Landing Unmanned Aerial Vehicle (VTUAV) program on June 16, 2014, due to a Nunn-McCurdy breach. The Acquisition Decision Memorandum (ADM) for the restructured VTUAV program rescinded Milestone C approval for the VTUAV program granted in 2007, renamed the program as MQ-8 Fire Scout System, and designated the restructured program as an Acquisition Category (ACAT) ID Program of Record.
- Further Acquisition Category delegation to ACAT IC via the ADM occurred in June 2015. The Navy awarded a contract for 10 additional MQ-8C helicopters in September 2015 bringing the total number to 29. The Navy plans to complete their buy of the remaining 11 aircraft in FY17 prior to IOT&E. The Navy is planning to conduct the Milestone C decision for the restructured program in 2QFY17.
- COTF and VX-1 conducted the land-based QRA in response to a request by the Director, Battlespace Awareness, Operational Navy N2/N6F2, for an assessment of the operational capabilities and limitations of the radar-equipped MQ-8B to support maritime and littoral operations. The operational test events were conducted near the Naval Air Station Patuxent River over a 34-day period from May through June 2015.
- VX-1 conducted an MQ-8C OA at Naval Air Station Point Mugu, California, in November 2015 to support the upcoming Milestone C decision. This testing focused on air vehicle endurance, mission coverage, performance of the MQ-8C EO/IR sensor in a littoral environment, reliability of the system, and operator workloads.
- COTF and VX-1 conducted all operational testing in accordance with the DOT&E-approved test plans.

Assessment
- The MQ-8B QRA presented a partial assessment of radar-capable MQ-8B performance. While this QRA demonstrated the potential of the radar-capable MQ-8B, DOT&E is concerned that the land-based-only QRA presented an overly optimistic assessment of this capability. The Navy intends for the radar-equipped MQ-8B Fire Scout to launch from a host vessel capable of supporting helicopter flight operations (such as the LCS) in support of intelligence and SUW operations. This concept of operations was not demonstrated during the QRA.
- DOT&E assessed the MQ-8B performance based on QRA testing in a March 23, 2016, memorandum to the Navy, which highlighted the following results from the QRA:
  - Target location error (TLE) for radar tracks generated by MQ-8B varied from flight-to-flight. The distance to target, air vehicle speed, and whether or not the target was in the center or off-center of the radar's 180-degree search area had significant effects on TLE.
  - High flight-to-flight variability in TLE suggests that radar performance may change substantially depending on flight-specific factors that were uncontrolled in the test design, such as sea state and weather.
  - The radar-equipped MQ-8B complements the EO/IR payload capability by providing a long-range search and an all-weather target classification capability.
  - The MQ-8B radar demonstrated low detection rates for intended targets. Once potential targets were located with the radar, the MQ-8B crew demonstrated the ability to slew its EO/IR camera to the targets; determine whether these potential targets were threatening or benign; and pass information on these targets to a friendly MH-60R helicopter crew.
  - The MQ-8B demonstrated an inconsistent capability to detect target boats.
  - The MQ-8B demonstrated that the capability to employ its communications relay payload to communicate with other platforms was not consistent. During the coordinated straits transit scenario, the MH-60R and the range boats crews participating in the exercise were not able to communicate with the white cell using MQ-8B communications relay on a consistent basis.
  - During 26.3 hours of testing, testers did not observe any operational mission failures (OMFs) attributable to the AN/ZPY-4(V)1 radar.
  - MQ-8B accrued 32.3 flight hours during this QRA, experiencing two OMFs. MQ-8B suffered one OMF due to an inability to maintain a consistent Tactical Common Data Link connection, a condition known as lost link.

  - Aviation vehicle operators (AVOs) and mission payload operators (MPOs) indicated that workload was generally low to moderate.
  - The Radar Command and Control Station (RCCS) is a standalone laptop computer capable of displaying information from the radar including tracks generated by the Radar Subsystem (RSS), association of these tracks with AIS tracks, and information linking these tracks to known nautical features such as buoys. The MPO controls the radar via the RCCS from within the ground control station. There is no interface between the RSS and the standard MQ-8B mission payload controls.
  - Operator performance demonstrated over the course of the QRA revealed gaps in training. For example, half way through the test, one MPO found that he could move the search arc of the radar when operating in short-range mode much more efficiently than the approach he had been using previously. This reduced his workload when operating the air vehicle in short-range mode.
  - The Navy did not conduct cybersecurity testing during this QRA.
- The MQ-8C OA presented a partial assessment of MQ-8C performance. DOT&E is concerned that the land-based-only MQ-8C OA presented an overly optimistic assessment of this capability.
- DOT&E assessed the MQ-8C performance based on OA testing in a June 21, 2016, memorandum to the Navy, which highlighted the following results from the OA:
  - Crews employing the BRITE Star II EO/IR sensor demonstrated the ability to detect and classify targets given accurate cueing conditions. Under ideal conditions, classification ranges varied widely and did not always support sufficient stand-off distance to ensure air vehicle survivability. While these results suggest the technical performance of the sensor is meeting Navy requirements in some conditions, it is not clear whether this performance is adequate to support an LCS defense scenario.
  - Since the system's design does not tie the MQ-8C MCS directly to the ship's combat information center, there is no common operating picture between MQ-8C operators and the combat information center. MQ-8C operators must pass accurate target course and speed information to the combat information center to increase situational awareness.
  - The MQ-8C demonstrated the capability to broadcast full-motion video to ground observers equipped with a remote video terminal. The lack of trained and proficient remote video terminal operators during this OA prevents a full characterization of TAC-ISR performance.
  - The AIS is a passive receiver of commercial ship AIS broadcasts, which integrates a very high frequency transceiver with a GPS and provides identification, position, course, and speed data to the MCS over the secondary datalink. The MQ-8C system integrates the AIS into the MCS, which is a marked improvement over the MQ-8B.
  - MQ-8C operators were successful at establishing, and demonstrated the ability to relay, communications between the MCS and airspace control authorities and other land-based agencies. The sparsity of communications relay data points preludes a full characterization of communications relay capability performance. Operators did not attempt to replicate use of the communications relay capability to extend the host ship's over-the-horizon communications capability in the tactical environment.
  - The MQ-8C performance demonstrated during this OA suggests that it is on track for meeting suitability requirements at IOT&E. The data collected during the OA are not sufficient to determine if the system meets its requirements while operating as part of the LCS SUW mission package. Testing collected suitability data for MQ-8C operating from land locations.
  - The air vehicle encountered three OMFs during 82.8 flight hours for a demonstrated mean flight hours between operational mission failure rate of 27.6 hours (threshold greater than or equal to 30 hours).
  - The demonstrated operational availability exceeds the threshold requirement of 60 percent. The MQ-8C achieved the demonstrated operational availability during land-based operations.
  - The excessive presentation of nuisance Warning, Caution, and Advisory (WCAs) indications contributed to operator workload. During operator training, crews received a list of 16 nuisance WCA indications. These 16 nuisance-warning indications should alert operators to the presence of any hazardous conditions that exist. Over time, an excessive number of nuisance WCAs desensitizes operators to all WCAs. As an example, during 1 flight operators received 1,400 nuisance WCAs. During another flight, operators failed to recognize an actual WCA related to their radios. Desensitized by nuisance WCAs, operators delayed execution of the appropriate emergency procedure, and, in the event of a cascading failure, could have resulted in the air vehicle being in an unsafe situation.
  - The normal operating procedures and emergency procedures sections of the Naval Air Training and Operating Procedures Standardization (NATOPS) manual require refinement.
    - During one flight, operators following the communications relay checklist induced the loss of the command and control datalink. Once operators reestablished the datalink, developmental testers provided them with a different checklist for future use that did not induce a lost link condition.
    - During a different flight, operators encountered a failed workstation. The NATOPS procedures for this emergency induced another loss of the air vehicle command and control datalink. The loss of the command and control datalink did not become apparent until the air vehicle failed to respond to operator commands. In this case, operators called upon a developmental test engineer to reestablish the command and control datalink.

- None of the operator manuals addresses user interface menus internal to the BRITE Star II payload. Operators did not understand BRITE Star II built-in-test indications of system degradation because of this lack of documentation. In each case, mission payload operators relied upon developmental test engineers to correct the deficiency.

Recommendations

- Status of Previous Recommendations. The Navy is addressing the previous recommendations.
- FY16 Recommendations. The following recommendations are from the FY16 QRA and OA reports.
  1. Prior to fielding the radar-equipped MQ-8B in the fleet, the Navy should:
     - Consider whether an MQ-8B equipped with a 180-degree radar is capable of providing area surveillance in all operational scenarios.
     - Conduct additional testing investigating MQ-8B ability to identify intended targets during operationally realistic scenarios.
     - Identify tactics, techniques, and procedures for aircrews to maximize MQ-8B coverage of a protected entity given the inherent limitations of the radar.
     - Improve the AN/ZPY-4(V)1 radar's ability to detect targets in high clutter environments.
     - Provide an interface between the RSS and the standard MQ-8B mission payload controls so that the MPO can more easily operate the RSS and standard payload simultaneously. For example, the MPO should be able to provide the location of a track on the RSS to the AVO.
     - Characterize the performance of the AN/ZPY-4(V)1 radar in different conditions (such as high and low sea state) and in different environments so that commanders can better understand the level of accuracy and probability of detection to expect from MQ-8B system performance.
     - Provide guidelines for when crews should operate the RSS in short-range mode vice long-range mode.
     - Improve operator training by including all of the features of the RCCS, including how to cue the radar's search area efficiently while operating in short-range mode.
     - Conduct cybersecurity testing on the radar-equipped MQ-8B system.
     - Conduct additional testing to determine the maximum detection range for the AN/ZPY-4(V)1 radar-equipped MQ-8B.
  2. Prior to IOT&E and fleet introduction, the Navy should improve MQ-8C capability to assist LCS in defeating SUW attacks as an integral part of the LCS SUW mission package. Specific recommendations include:
     - Improve the center-field-of-view target course and speed algorithm to improve MQ-8C contributions to the ships common operating picture.
     - Improve BRITE Star II auto-track performance to reduce operator workload and increase tactical utility.
     - Clarify the target detection and classification ranges needed for the MQ-8C concept of operations to support LCS missions.
     - During IOT&E, conduct end-to-end HELLFIRE missile engagements to characterize the BRITE Star II auto-track capability.
     - Continue to mature the procedures checklist and emergency procedures in the NATOPS manual to allow for safe operations.
     - Eliminate nuisance WCA indications to reduce operator workload and prevent desensitization to indications.
     - Increase focus on MQ-8C emergency procedures training during operator training to allow for safe and proper operator reactions to pre-flight and in-flight anomalies.
     - Expand the MQ-8C operating theory within the training syllabus to allow operators to fully understand and react to anomalous system behavior.
     - Increase the fidelity of the MQ-8C simulator (especially BRITE Star II operations) and eliminate MQ-8B defaults to increase the value of simulator training.
     - Include instruction on the AIS and TAC-ISR payloads to operator training to allow them to properly employ and troubleshoot the systems.
     - Expand the NATOPS manual to include BRITE Star II user menus and built-in-test indications to allow operators to recognize and troubleshoot system degradations.
     - Review items required in the shipboard spare part kits to ensure inclusion of single point failure items (such as the datalink control processor) to increase system availability aboard ship.