MQ-1C Gray Eagle Unmanned Aircraft System (UAS)

Executive Summary

- The Army conducted the MQ-1C Gray Eagle Unmanned Aircraft System (UAS) FOT&E at Edwards AFB, California, and the National Training Center (NTC), Fort Irwin, California, May 14 through June 12, 2015, in accordance with the DOT&E-approved test plan and Test and Evaluation Master Plan.
- DOT&E submitted an FOT&E report in January 2016. In that report, DOT&E concludes:
  - The Gray Eagle-equipped unit was effective at conducting split-based operations while operating the system from two separate launch and recovery sites and can provide effective reconnaissance, surveillance, and security support to combat units.
  - Interoperability with the One System Remote Video Terminal (OSRVT) has improved since the 2012 IOT&E.
  - The Gray Eagle system is operationally suitable.
  - Army integration of Gray Eagle into employment concepts, and development of tactics, techniques, and procedures (TTP) have not matured since IOT&E, and training for the FOT&E unit before the test was not complete.

System

The Gray Eagle UAS is composed of the following major components:

- Twelve unmanned aircraft, each with a common sensor payload with an electro-optical/infrared (EO/IR) and a Laser Range Finder/Laser Designator capability, a STARLite Extended Range Synthetic Aperture Radar/Ground Moving Target Indicator (SAR/GMTI) radar, and an Air Data Relay (ADR) control capability
- Each aircraft is equipped with a Standard Equipment Package that includes a communications relay package, Identification Friend-or-Foe equipment, and Air Traffic Control radios
- Each aircraft has the ability to carry up to four HELLFIRE II P+ or R variant missiles
- Six Ground Control Stations designated as the Universal Ground Control Station (UGCS)

- One Mobile Ground Control Station
- Seven Tactical Common Datalinks Ground Data Terminals
- Three Satellite Communications Ground Data Terminals
- Twelve Satellite Communications Air Data Terminals
- Six Tactical Automatic Landing Systems

Mission

Commanders employ Gray Eagle companies to conduct reconnaissance, surveillance, security, attack, and command and control missions that support assigned division combat aviation brigade, division artillery, battlefield surveillance brigade, Brigade Combat Teams, and other Army and joint force units based upon the division commander's mission priorities.

Major Contractor

General Atomics Aeronautical Systems, Inc., Aircraft Systems Group – Poway, California

Activity

- The Army conducted the Gray Eagle FOT&E at Edwards AFB, California, and NTC, Fort Irwin, California, May 14 through June 12, 2015, in accordance with the DOT&E-approved test plan and Test and Evaluation Master Plan.
- The FOT&E unit conducted missions in support of the Brigade Combat Team conducting a training rotation at the NTC. This combination of testing with training created a

realistic, challenging, and stressful test environment for the Gray Eagle Company. The company flew 1,147 flight hours during test.
- The Army collected data from the FOT&E to assess significant changes within the company's organizational structure and system components. These changes include:
  - Organizational structure from one flight platoon to three identical flight platoons

- The capability of the company to conduct continuous and simultaneous split-based operations from two separate launch and recovery sites
- The replacement of the One System Ground Control Equipment with the Universal Ground Control Equipment
- The replacement of the three portable subsystems with one Mobile Ground Control Station
- Upgrades to the payloads and the HELLFIRE missile, and significant software functionality enhancements made to the system since IOT&E
- During the FOT&E, Gray Eagle crews completed three autonomous HELLFIRE missile engagements of targets on the NTC range and examined the capability of the Gray Eagle UAS to interface with OSRVT Increment II.
- DOT&E submitted a combined Gray Eagle FOT&E and OSRVT IOT&E report in January 2016.

Assessment
- During FOT&E, the Gray Eagle-equipped unit demonstrated it was effective at conducting split-based operations from two separate launch and recovery sites and can provide effective reconnaissance, surveillance, and security support to combat units. Split-based operations testing exposed single points of failure in equipment and personnel within the Gray Eagle organizational structure.
- The Gray Eagle unit contributed to the situational awareness of supported units at NTC. In surveys of subject matter experts with the supported units, 32 of 36 respondents agreed that Gray Eagle provided all the information required. Gray Eagle crews located and reported enemy vehicles in 42 of 48 mission segments when at least one threat vehicle was in the designated search area.
- The Army has not effectively integrated the Gray Eagle capabilities into combined arms combat operations. Gray Eagle TTP have not matured since the 2012 IOT&E. Although not fully trained before the test, Gray Eagle Soldiers became more proficient during the test, but many remained weak on the fundamentals of reconnaissance, mission planning, and employment of Gray Eagle sensors. Neither the Soldiers in the Gray Eagle unit nor those requesting Gray Eagle support understood the capabilities, limitations, and employment of the SAR/GMTI radar.
- Compared to the OSRVT Increment I performance during the 2012 Gray Eagle IOT&E, OSRVT Increment II facilitated an increased level of situational awareness of the supported unit by providing more effective full motion video. Additional information on the OSRVT demonstrated performance may be found in the OSRVT Increment II Annual Report.
- Gray Eagle is operationally suitable. The Gray Eagle system demonstrated an operational availability of 87.4 percent, higher than the 76 percent availability demonstrated during IOT&E. High availability, low Mean Time To Repair, and system redundancy allowed operators to meet operational requirements.
- The Gray Eagle demonstrated Key System Attribute Mean Time Between System Abort of 23 hours versus the 42 hours requirement for the Ground Control Equipment; 67 hours versus 63 hours requirement for the aircraft; 1,146 hours versus 300 requirement for the common sensor payload; and 53 hours versus 89 hours requirement for the SAR/GMTI radar.
- Integration of the HELLFIRE II Romeo missile into the Gray Eagle system is complete. During FOT&E, the unit successfully demonstrated the ability to conduct engagements with the HELLFIRE II Romeo missile. Three autonomous engagements of targets on the NTC range complex were completed. The unit hit two of the three intended targets. The Army demonstrated HELLFIRE engagement via the ADR datalink in developmental testing.
- The Gray Eagle cybersecurity posture has improved, but the system remains vulnerable to cyber and electronic warfare threats.
- The Gray Eagle Operator's Manual states that flight through light rain for 1 hour falling at a rate of up to ½ inch per hour poses no hazards to the aircraft and that operation of the aircraft in heavier rain than this rate is not recommended. Visible moisture can induce mismatched pressure inputs to the engine computer resulting in a warning to operators to land as soon as possible, creating a mission abort. During FOT&E, the unit did not conduct flight operations when any visible moisture conditions (fog, clouds, and rain) were present. This practice limited and at times precluded tactical operations support.
- The design of the UGCS shelter is an improvement over the One System GCS seen in previous testing, but has a number of deficiencies that reduce operator efficiency and increase operator stress and fatigue. Those deficiencies include:
  - Operators reported that headsets became uncomfortable over a period of time and pose a health risk because the operators must share the few headsets.
  - The Aviation Mission Planning System is not well integrated into the UGCS set up /starting procedures. Operators must manually input most pre-mission data.
  - Payload and Air Vehicle Operators rated the usability of UGCS controls. Operators rated the controls for Link 16 and ADR datalink as not acceptable. Payload operators gave marginal ratings to the controls for the SAR/GMTI radar and to the interfaces between the radar and EO/IR sensor.
  - UGCS employs a thumb-force controller on the keyboard that replaced the mouse track ball in the One System GCS. Operators state that the thumb-force controller is not smooth or responsive during operation and after periods of non-use, the curser tends to drift. Both the Air Vehicle and Payload operators rated the thumb-force controller usability as not acceptable.
- Since IOT&E, the Army has incorporated improvements to ADR usability and has reduced the number of steps required to establish the ADR capability from 130 to 93. While the 28 percent reduction in the number of steps is admirable, further improvements need to be made.

Recommendations
- Status of Previous Recommendations. The Army addressed three of the six FY12 recommendations. Outstanding previous recommendations include:
  1. Continue to develop doctrine, employment concepts, and TTP to fully integrate the Gray Eagle unit into combat operations.
  2. Train operators on fundamentals of reconnaissance, mission planning, and optimal employment of the Gray Eagle.
  3. Continue to simplify procedures for operators to establish ADR datalinks.
- FY15 Recommendations. The Army should:
  1. Implement plans to modify the engine computer sensor inputs that will allow flight in visible moisture.
  2. Develop TTP, and train Gray Eagle operators and supported combat units in the utility of and employment of SAR/GMTI radar and Link 16 capabilities.
  3. Simplify and integrate Aviation Mission Planning System into pre-mission UGCS setup procedures.
  4. Review unit organizational documents for personnel and equipment single points of failure affecting split-based operations and make adjustments to those documents as necessary.
  5. Eliminate cybersecurity vulnerabilities and confirm corrections in follow-on testing.
  6. Improve UGCS functionality by addressing the operator headset and thumb-force controller observations made during test.
  7. Integrate the SAR/GMTI radar controls and displays with the EO/IR controls and displays. Target detections from the MTI radar in particular should overlay the same map that displays the location of the air vehicle and the footprint of the EO/IR sensor.