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

Executive Summary
- The Army conducted the Gray Eagle IOT&E at Edwards AFB, California, and the National Training Center (NTC), Fort Irwin, California, July 30 through August 17, 2012.
- The Army conducted the IOT&E in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan.
- DOT&E is completing a Beyond Low-Rate Initial Production (BLRIP) report supporting the Gray Eagle Full-Rate Production decision planned for April 2013. In that report, DOT&E concludes the Gray Eagle-equipped unit was effective at operating the MQ-1C system and has the potential to provide effective support to combat units, but the Army needs to continue to develop the tactics, techniques, and procedures; the training; and the doctrine required to effectively integrate this capability into combat operations. The Gray Eagle system is operationally suitable. The Gray Eagle meets its crew force protection survivability requirements by providing up-armored capability to the cab of the vehicles transporting the Ground Control Stations during company movement. The Gray Eagle aircraft is not survivable in a mid- to high-threat environment.

System
The Gray Eagle Unmanned Aircraft System (UAS) is composed of the following major components:
- Twelve unmanned aircraft each with a Common Sensor Payload (CSP) with an electro-optical/infrared with a Laser Range Finder/Laser Designator capability, a STARLite Synthetic Aperture Radar/Ground Moving Target Indicator (SAR/GMTI) sensor payload, 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 P+ missiles
- Five Ground Control Stations designated as the One System Ground Control Station (OSGCS)

- Five Tactical Common Datalinks (TCDL) Ground Data Terminals
- One Satellite Communications (SATCOM) Ground Data Terminal
- Six SATCOM Air Data Terminals
- Two Automatic Take-off and Landing Systems, which consist of four Take-off and Landing System-Tracking Systems and antennas

Mission
Commanders employ Gray Eagle Companies to execute Reconnaissance, Surveillance, Security, Attack, and Command and Control missions in support of assigned Division Combat Aviation Brigade, Fires Brigade, 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 Gray Eagle UAS participated in the Apache Block 3 IOT&E in March through April 2012, at the NTC in Fort Irwin, California, to conduct Manned-Unmanned Teaming operations. A single Gray Eagle UAS with associated flight crew and personnel provided mission support to the IOT&E from Edwards AFB, California.
- In July 2012, and as a result of the direction received from the Low-Rate Initial Production (LRIP) III Acquisition Decision Memorandum, the project manager for UAS requested the Army Aviation Center seek a deferral of the requirement to meet the Reliability Key System Attributes (KSAs) and the Sustainment Key Performance Parameter (KPP) from IOT&E to FOT&E. The Army deferred the requirement of meeting the KSAs on August 16, 2012. The Joint Requirements Oversight Council approved the deferral of meeting the KPP on November 16, 2012.

- The Army conducted the Gray Eagle IOT&E at Edwards AFB, California, and the NTC, Fort Irwin, California, July 30 through August 17, 2012, in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan. The Army based the IOT&E unit at Edwards AFB, and from there it conducted missions in support of the Brigade Combat Team conducting a training rotation at the NTC approximately 130 kilometers away. The IOT&E unit flew 1,090 flight hours and conducted missions at operational ranges exceeding 150 kilometers. The IOT&E unit routinely flew aircraft between 8,000 and 13,000 feet mean sea level (MSL) with a maximum altitude being flown of 24,500 feet MSL.
- There were eight Hellfire missile engagements during IOT&E. Six were cooperative engagements with Apache helicopters, meaning one aircraft provided the lasing of the target while the other aircraft launched the missile. Two engagements were autonomous, meaning the Gray Eagle provided the lasing of the target and launched the missile on its own. All eight missile engagements hit the intended target.
- DOT&E is completing a BLRIP report supporting the Gray Eagle Full-Rate Production decision planned for April 2013.

Assessment

- During IOT&E, the Gray Eagle-equipped unit was effective at operating the MQ-1C system and demonstrated the potential to provide effective support to combat units, but the Army has not effectively integrated this capability into combat operations. Army integration of Gray Eagle into employment concepts, and development of tactics, techniques, and procedures are not mature and training afforded to the IOT&E unit before the test was not complete. Soldiers did not receive training on fundamentals of reconnaissance, mission planning, set-up and operation of radios, distribution of video, STARLite SAR/GMTI capabilities and operation, or employment of Gray Eagle.
- The Gray Eagle system has more capability and functionality today than it demonstrated in previous operational tests. Increases in capability demonstrated during the 2012 IOT&E include:
  - The CSP providing the electro-optical/infrared with a Laser Range Finder/Laser Designator capability
  - A STARLite SAR/GMTI payload
  - The ability to conduct aircraft operations via encrypted TCDL, SATCOM datalink, as well as the ADR aircraft control capability
- The IOT&E unit completed 223 of 307 attempted missions during test, resulting in a mission success rate of 73 percent.
- The Gray Eagle system is operationally suitable. During IOT&E, the Gray Eagle unit demonstrated its ability to meet its operational tempo requirement to provide three simultaneous and continuous missions (24-hour continuous reconnaissance, 24-hour continuous armed reconnaissance, and two 5-hour attack missions in a 24-hour period). The Gray Eagle system demonstrated a Combat Availability of 81 percent, exceeding the Sustainment KPP requirement of 80 percent. The unit achieved the Combat Availability requirement in spite of failing to meet its reliability requirements. The IOT&E demonstrated that the modeling assumptions that established the reliability requirements thresholds were not valid. As a result, the Army is reassessing whether or not the reliability KSAs need to be changed. Those modified reliability requirements, if made, are planned to be tested in FOT&E.
- During the IOT&E, the Gray Eagle demonstrated KSA Mean Time Between System Abort (MTBSA) compared to the deferred MTBSA requirements of 44 hours versus 150 hours for the OSGCS, 55 hours versus 100 hours for the aircraft, 218 hours versus 500 for the CSP, and 97 hours versus 500 hours for the STARLite SAR/GMTI.
- The Gray Eagle Company depended heavily on the maintenance expertise of Contractor Field Service Representatives.
- During the IOT&E, remote video from the Gray Eagle to the One System Remote Video Terminal (OSRVT) was generally not available, not clear, and not reliable. Integration of the Gray Eagle with a reliable remote video display system is not complete.
- The IOT&E unit demonstrated effective target detection and recognition capability using the electro-optical/infrared sensor with Laser Range Finder/Designator.
- The Hellfire P+ missile is fully integrated into the Gray Eagle system when using the TCDL and SATCOM datalinks. The Army has not demonstrated Hellfire engagements via the ADR datalink in developmental or operational testing.
- The Automatic Take-off and Landing System worked as designed.
- The Gray Eagle is vulnerable to computer network attack.
- The Gray Eagle meets its crew force protection survivability KPP requirement by providing up-armored capability to the cab of the vehicles transporting the ground control stations during company movement. Testing indicates that the Gray Eagle aircraft is not survivable in a mid- to high-threat environment. The aircraft can be detected at operational altitudes visually, acoustically, by late-model man-portable air defense systems, and by threat radar systems.
- The operator's manual is not current and in some cases not accurate.
- The design of the OSGCS shelter has a number of features that reduce operator efficiency and increase operator stress and fatigue: volume control of radios, OSGCS start-up procedures, procedures for operators to establish SATCOM and ADR datalinks, work station climate control, and poor ergonomics of the OSGCS operator's joy stick controller.
  - Operators are not able to control the volume on any of the radios within the OSGCS. On numerous occasions during missions, the air traffic control radio calls would drown out the operator's ability to hear other communications on the tactical radio networks.
  - The OSGCS start-up procedures entail 191 checklist steps and require up to 2 hours to execute.

- Procedures for operators to establish SATCOM and ADR datalinks are numerous and complex in nature. If the operator does not follow the prescribed sequence, they have to re-execute the procedure in its entirety, taking up to 45 additional minutes to complete the task.
- The computers and avionics within the OSGCS require air conditioning to maintain normal operation. Air conditioning controls have been improved; however, in order to stay warm, OSGCS operators continue to wear hats, gloves, and cold-weather gear even in hot weather environments.
- Operator controls are not efficient. OSGCS employs a joystick that has no triggers or buttons that would allow one-handed control of the payload or aircraft. Both hands are required for many basic tasks as the operator provides inputs to both the joystick and the keyboard while operating the system. A cyclic-type joystick, such as those found in Army helicopters, would allow for one-handed multifunction operation of the system.

Recommendations

- Status of Previous Recommendations. The Army addressed four of the seven previous recommendations. Outstanding previous recommendations include:
  1. The Army should develop, optimize, and publish standardized procedures for the OSRVT terminal.
  2. The Army should revise and expand the training program and update the operator's manual.
  3. The Army should improve the Ground Control Shelter design.
- FY12 Recommendations.
  1. The Army should:
     - Continue to develop doctrine; employment concepts; and tactics, techniques, and procedures to fully integrate the Gray Eagle unit into combat operations.
     - Train operators on fundamentals of reconnaissance, mission planning, set-up and operation of radios, distribution of video, and optimal employment of the Gray Eagle.
     - Continue to develop and publish standardized procedures for distribution of Gray Eagle video to OSRVT and institute training across the Army to facilitate integration of Gray Eagle into supported unit operations.
     - Revise and expand the training program for operators and update the operator's manual.
     - Modify the personnel plan to retain or offset the anticipated loss of Contractor Field Service Representative support.
     - Refine and train procedures for collection and exploitation of SAR/GMTI imagery.
  2. The Product Office should:
     - Simplify, and to the greatest extent possible, automate routine operator tasks. The 2-hour, 191 checklist steps required to start the Ground Control Station should be streamlined and be made less susceptible to operator errors.
     - Simplify procedures for operators to establish SATCOM and ADR datalinks.
     - Qualify the ADR datalink for employment of Hellfire missiles.
     - Improve OSGCS functionality by increasing operator control of radio volume, temperature, and joy stick functionality.