

RQ-21A Blackjack (formerly Small Tactical Unmanned Aerial System (STUAS))

Executive Summary

- The Navy started the RQ-21A Blackjack (formerly Small Tactical Unmanned Aerial System (STUAS)) IOT&E in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan in January 2014. The planned IOT&E consisted of a land-based phase of testing at Marine Corps Air Ground Combat Center, Twentynine Palms, California, and a ship-based phase of testing aboard an LPD-17 class ship. Originally scheduled for completion in March 2014, technical difficulties, including system deficiencies, extended the test into December 2014.
- Concurrent with the land-based phase of IOT&E, the Navy conducted RQ-21A Blackjack ship-based developmental testing. This ship testing identified interference between the ships degaussing system and the air vehicle's magnetometer. This deficiency necessitated software upgrades and regression testing, which delayed the scheduled ship-based phase of IOT&E.
- The RQ-21A Blackjack system provides commanders with a long-endurance Intelligence, Surveillance, and Reconnaissance (ISR) asset. The RQ-21A air vehicle has a demonstrated endurance of more than 12 hours to provide extended dwell times in support of ground units.
- During the land-based phase of IOT&E, the system demonstrated a Mean Flight Hours Between Abort (MFHBA) of 15.8 hours versus the threshold criterion of 50 hours. Low reliability adversely affected the ability of operators to support ground units in a timely manner. In particular, air vehicle engines fail often, and the system software is immature.
- The Navy should conduct an in-depth root cause analysis of the propulsion module to improve engine life so that a greater percentage of modules reach the advertised high time limits, and should review quality control procedures to reduce the number of failed parts delivered to fielded systems.

System

- Each system consists of five RQ-21A unmanned air vehicles, surface components, and assorted government-provided equipment. The surface components consist of ground control stations, launch and recovery equipment, datalinks, multi mission payloads, and support systems. Government-provided equipment includes vehicles and generators to transport and power ground components as well as intelligence workstations.
- The Marine Corps intends the RQ-21A system to have the following capabilities:
 - Reliability to support an operating tempo of 12 hours on station per day at a sustained rate for 30 days, and the



- capability for one surge of 24 hours on station per day for a 10-day period during any 30-day cycle
- Air vehicle with 10 hours endurance, airspeed up to 80 nautical miles per hour, and a service ceiling of 15,000 feet density altitude
- Operating radius of 50 nautical miles
- Electro-optical sensor capable of identifying a 1-meter sized object from 3,000 feet altitude; infrared sensor capable of identifying a 3-meter sized object from 3,000 feet altitude
- Entire system transportable by CH-53E helicopter
- The RQ-21A Blackjack will replace the Shadow RQ-7 unmanned aerial vehicles (UAVs) currently operated by Marine UAV Squadrons.

Mission

- Marine Corps commanders will use the RQ-21A Blackjack to provide units ashore with a dedicated persistent battlefield ISR capability that will reduce their dependence on higher headquarters for ISR support.
- The persistence of the system allows commanders greater coverage of their areas of interest, while providing the capability to concentrate for longer periods of time on a specified target of interest.
- In addition to operating from land bases, detachments from Marine Corps UAV Squadrons will embark the requisite personnel and equipment aboard L-class ships and conduct operations in the maritime domain.

Major Contractor

Insitu, Inc. – Bingen, Washington

Activity

- The Navy started the RQ-21A Blackjack IOT&E in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan in January 2014. Testing consisted of a land-based IOT&E phase (with concurrent ship-based developmental testing) intended to be followed by a ship-based IOT&E phase aboard an LPD-17 class ship.
 - During the land-based phase of IOT&E at Marine Corps Air Ground Combat Center, Twentynine Palms, operators flew 188 flight hours during 31 flights. The first flight ended in a mishap and loss of the air vehicle. Post-mishap investigation suspended operational test flights for 10 days.
 - Concurrent with the land-based phase of IOT&E, the Navy conducted ship-based developmental testing aboard an LPD-17 class ship. This ship testing identified interference between the ship's degaussing system and the air vehicle's magnetometer. This deficiency necessitated software upgrades and regression testing, which delayed the scheduled ship-based phase of IOT&E.
 - Based on poor system performance during the land-based phase of IOT&E and a software update to correct a GPS deficiency associated with shipboard operations, the Navy conducted a second land-based phase of IOT&E in June at Marine Corps Base Camp Lejeune, North Carolina. Operators flew 20.9 hours during 8 flights.
- In May 2014, the Marine Corps deployed an Early Operational Capability (EOC) system (the equivalent of two RQ-21A systems) to support combat operations in Afghanistan. The Marine Corps planned for this detachment to conduct operations until the end of September 2014. The EOC systems flew 995 hours in 115 flights before termination 3 weeks early.
 - commanders have greater flexibility in terms of where to base the system.

Assessment

- The RQ-21A Blackjack provides the Marine Corps with a cost-effective alternative to the current contractor-owned and operated services providing ISR services overseas. A Marine Corps-owned and operated system provides for greater flexibility in the deployment and location of a commander's organic ISR asset.
- The system provides the Marine Corps with a tactical unmanned aircraft system capable of launching and recovering from aviation capable ships. This capability provides the commander with an organic pre-amphibious assault ISR asset that is able to seamlessly transition ashore.
 - For tactical movement ashore, the Marine Corps certified all RQ-21A Blackjack components for transport by CH-53E. Once ashore, a 4 air vehicle, 10-person detachment is transportable by 4 HMMWVs and 2 trailers. While this provides for a robust ISR capability, such a detachment is dependent upon other units for electrical power, shelter, and logistical support (i.e., fuel, food, water).
 - The RQ-21A Blackjack is capable of operating from austere launch and recovery sites. Because the system does not require a runway for launch and recovery,
 - The modular nature of the RQ-21A air vehicle makes it an easy to maintain system at the unit level. Unit-level maintainers easily correct faults by removing and replacing the affected module in a minimum amount of time.
 - During the land-based phase of IOT&E, the system demonstrated an MFHBA of 15.8 hours, well below the MFHBA threshold criterion of 50 hours. Low reliability adversely affected the ability of operators to support ground units in a timely manner.
 - Land-based IOT&E identified production quality control deficiencies, such as an incorrectly assembled air vehicle fueler, a mis-wired operator workstation, and loose and broken servo connectors in several wings. Some spare parts received during the test arrived with either no software loaded, or the wrong software version installed.
 - Propulsion Module Units (air vehicle engines) are not reliable. Each engine has a design high time limit of 100 hours, which means it is designed to fly 100 hours and then be replaced. Each propulsion unit accumulates 16 operating hours during production and operational checks before delivery, resulting in 84 hours of useful life after delivery. During the land-based phase of IOT&E, the test unit used all three spare engines during the course of 188 flight hours. Due to the subsequent lack of spare engines, one air vehicle remained down for a week when its engine reached the high time limit.
 - The May 2014 EOC deployment also revealed problems with propulsion modules:
 - Two propulsion modules with the deployed EOC system failed during flight, resulting in air vehicle loss. Shortly thereafter, maintainers discovered cracks in the generator drive pulley on one propulsion module as they prepared an air vehicle for flight. Subsequent inspections revealed similar cracks on other propulsion modules. As a result, the Marine Corps reduced propulsion module operating life to 50 hours. Because of propulsion module concerns and lack of spares, the Marine Corps terminated EOC flight operations three weeks early.
 - The deployed EOC system replaced 28 propulsion modules during the course of 995 flight hours. This resulted in an average useful life of 35 hours per replaced propulsion module. The EOC unit replaced three of the 28 propulsion modules because of the 100-hour high time limit. The unit replaced nine propulsion modules because of fuel leaks.
 - The current communications relay payload does not allow in-flight frequency changes. Before flight, operators load a single frequency into each relay radio. Any units that require the communications relay payload to support their operations must operate on these frequencies. This design precludes the system from supporting unplanned communications relay missions because supported units would have to switch their communications nets to the two pre-programmed payload

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frequencies. Tactically, this is something that ground units would not do.

Recommendations

- Status of Previous Recommendations. The Navy has made progress in the FY13 recommendation that the program accelerate annual operating hours in order to reach the projected 3,300 flight hours sooner than 2017, which would allow the Navy to identify and correct failure modes before committing to buy a significant number of systems. In May 2014, the Marine Corps had deployed the equivalent of two RQ-21A systems to Afghanistan. This deployed system has identified numerous failure modes not previously encountered. The remaining FY13 recommendation to
- conduct a comprehensive review of RQ-21A reliability versus requirements remains open.
- FY14 Recommendations. The Navy should:
 1. Review quality control procedures to reduce the number of failed parts delivered to fielded systems.
 2. Conduct an in-depth root cause analysis of the propulsion module to improve engine life so that a greater percentage of modules reach the advertised high time limits.
 3. Upgrade the communications relay payload to allow for in-flight frequency changes.
 4. Delay the programs Full-Rate Production decision until additional land-based operational testing verifies correction of those deficiencies identified during OT&E.

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