

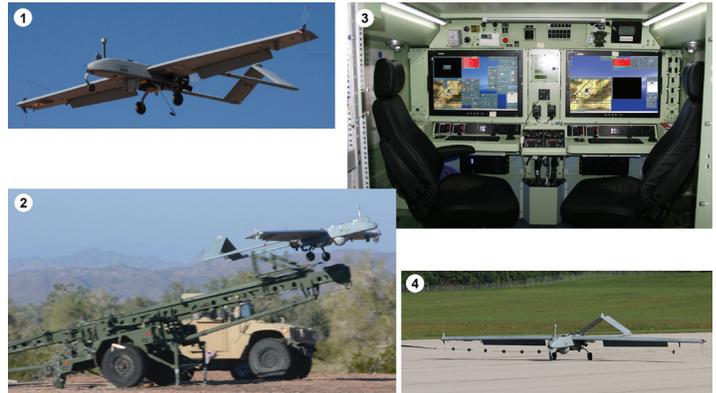
## RQ-7BV2 Shadow Tactical Unmanned Aircraft System (TUAS)

### Executive Summary

- The Shadow Tactical Unmanned Aircraft System (TUAS) program completed IOT&E in May 2002, supporting a Full-Rate Production decision in September 2002. Since that milestone, the Shadow TUAS Program Office has fielded 119 Shadow systems. The Army has received 104; the Marine Corps, 13; and the Australian Army (via Foreign Military Sales), 2. The Shadow fleet has flown over 900,000 flight hours.
- The program employs a block upgrade and an evolutionary acquisition approach and has to date produced four versions. The four versions are designated the RQ-7A, RQ-7B, RQ-BV1, and the RQ-7BV2. The latest version, the RQ-7BV2, is the subject of this report. To complement this acquisition approach, the T&E Working Integrated Product Team is using a corresponding test strategy as part of a continuous evaluation as the system receives upgrades in capability. DOT&E approved the Shadow TUAS Test and Evaluation Master Plan (TEMP) update in May 2014.
- The Army conducted the Shadow TUAS FOT&E at Fort Bliss, Texas, and the White Sands Missile Range, New Mexico, in May 2014 during the Network Integration Evaluation (NIE) 14.2 and the Joint Tactical Exercise Bold Quest.
- DOT&E concludes that during the FOT&E, the RQ-7BV2 Shadow TUAS-equipped unit was effective at employing the system and demonstrated it is capable of providing effective support to combat units; the Shadow TUAS is operationally suitable, but not reliable; and as assessed after the 2002 IOT&E, the Shadow TUAS is not survivable in the presence of an air threat for reconnaissance and surveillance missions. Through developmental testing, it has been determined that the Shadow TUAS is survivable in the presence of older, less capable electronic warfare threats, but further testing is required to determine Shadow's performance in the presence of the latest electronic warfare threats.

### System

- The Army designed the Shadow RQ-7BV2 to provide coverage to a brigade area of interest for up to 7 hours at a range out to 50 kilometers from the launch and recovery site. The maximum range is 125 kilometers (limited by datalink capability). Operations are generally conducted from 8,000 to 10,000 feet above ground level during the day and 6,000 to 8,000 feet above ground level at night.



1 - RQ-7BV2 Aircraft in Flight  
 2 - RQ-7BV2 Aircraft Being Launched  
 3 - Inside of the Universal Ground Control Station  
 4 - RQ-7BV2 Aircraft Landing Using the Arresting Cable Hook System

- The Laser Range Finder/Designator provides the ground maneuver Brigade Commander the capability to conduct cooperative HELLFIRE missile engagements.
- Shadow RQ-7BV2 consists of the following major components:
  - Four small, high-winged, unmanned aircraft, each equipped with an electro-optical (EO)/Infrared (IR) payload. Two of the four EO/IR payloads are equipped with a Laser Range Finder/Designator capability. The RQ-7BV2 aircraft is larger than the RQ-7BV1 model primarily through an extended wing modification that increased the wingspan of the aircraft from 14 to 20.4 feet, added additional fuel capacity, and increased aircraft weight from 375 to 460 pounds.
  - Two Ground Control Stations designated as the Universal Ground Control Station (UGCS) each with a Universal Ground Data Terminal (UGDT).
  - One Portable Ground Control Station (PGCS) with a Portable Ground Data Terminal (PGDT).
  - An integral Single Channel Ground and Airborne Radio System (SINCGARS) communications relay capability on each aircraft.
  - Two One-System Remote Video Terminals (OSRVT).
- The Shadow unit is a platoon-size organization with 27 personnel authorized.
- The aircraft uses a hydraulic/pneumatic launcher and is recovered on a runway using the Tactical Automatic Landing System. An arresting cable/arresting hook system shortens the necessary runway landing length.

# FY14 ARMY PROGRAMS

## Mission

The Shadow TUAS platoon is to provide responsive Reconnaissance, Surveillance, and Security; Cooperative Attack; Battle Damage Assessment; and Communications Relay support to the brigade.

## Major Contractor

Textron Systems – Hunt Valley, Maryland

## Activity

- The Shadow TUAS program completed IOT&E in May 2002, supporting a Full-Rate Production decision in September 2002. Since that milestone, the Shadow TUAS Program Office has fielded 119 Shadow systems. The Army has received 104; the Marine Corps, 13; and the Australian Army (via Foreign Military Sales), 2. The Shadow fleet has flown over 900,000 flight hours with over 755,000 of those hours being flown in support of combat operations. As of September 2014, seven deployed systems currently support combat operations.
- The program employs a block upgrade and evolutionary acquisition approach. To complement this approach, the T&E Working Integrated Product Team is using a corresponding test strategy as part of a continuous evaluation as the system receives upgrades in capability. DOT&E approved the Shadow TUAS FOT&E Operational Test Plan on April 8, 2014, and the Shadow TEMP update on May 27, 2014.
- The Army conducted the Shadow TUAS FOT&E at Fort Bliss, Texas, and the White Sands Missile Range, New Mexico, in May 2014 during NIE 14.2 and the Joint Tactical Exercise Bold Quest, in accordance with the DOT&E-approved TEMP and test plan. The FOT&E enabled the evaluation and assessment of the unit's ability to employ the system with upgrades, such as the UGCS, Tactical Common Data Link, and the extended-wing configuration of the aircraft in an operational environment. The test provided the opportunity to conduct an operational assessment of the OSRVT-40 block configuration and its contributions to the supported unit's situational awareness. The test was supported by two AH-64D Longbow Aircraft and the Brigade Combat Team fires battalion provided indirect fire support during call-for-fire missions. The Shadow test unit flew 260 flight hours during the FOT&E.
- DOT&E published a report on the RQ-7BV2 Shadow TUAS FOT&E and OSRVT operational assessment in December 2014.
- The Shadow TUAS has more capability and functionality today than it demonstrated in previous operational testing. Significant increases in capability demonstrated in the May 2014 FOT&E include:
  - The ability to conduct aircraft operations via encrypted Tactical Common Data Link
  - Increased aircraft flight endurance due to the extended-wing configuration
- The Shadow TUAS is operationally suitable.
  - The Shadow system demonstrated an operational availability of 88.6 percent for the duration of FOT&E, exceeding the requirement of 85 percent.
  - During FOT&E, the Shadow TUAS demonstrated its ability to meet its normal operational tempo requirement of providing 16, non-continuous hours of on-station time in a 24-hour period.
  - The RQ-7BV2-configured Shadow platoon is also required to support surge operations consisting of 72 hours of continuous time on-station. High winds throughout the test prevented the system from executing a 72-hour surge. By design, the Army provides each Shadow platoon with the personnel and equipment required to support 72-hour surge operations. In an attempt to assess this capability, a Monte Carlo simulation (repeated random sampling of reliability, availability, and maintainability data to obtain numerical results for the amount of on-station time achieved during any 72-hour surge period) calculates that 90 percent of the time, Shadow should provide 64.1 hours of coverage during a 72-hour surge period (an 89 percent coverage capability).
  - The unit achieved the operational availability requirement in spite of failing to meet its reliability requirement due to subsystem redundancy.
- During FOT&E, the Shadow demonstrated a Mean Time Between System Abort (MTBSA) point estimate of 8.7 hours versus a 20-hour MTBSA requirement.
- The unit demonstrated the ability to conduct cooperative HELLFIRE missile engagements with AH-64D Longbow helicopter crews. The Plug-In Optical Payload (POP) 300D (Laser Range Finder/Designator capable) payload continues to support cooperative engagements with laser-guided munitions.
- The Median Target Location Error (TLE) for the POP 300D payload improved from 74 meters observed during the 2010 Limited User Test to 25 meters observed during FOT&E. The POP 300D payload TLE requirement is 50 meters.

## Assessment

- During FOT&E, the Shadow TUAS-equipped unit was effective at employing the system and demonstrated it is capable of providing effective support to combat units. An example of this support occurred during one two-day mission during FOT&E. A supported Infantry Battalion utilized the Shadow TUAS and the OSRVT to defeat the enemy force in detail.

# FY14 ARMY PROGRAMS

- During FOT&E, DOT&E observed that in order to more readily anticipate ground commander mission support, the Shadow Platoon Leader sought to have a laser designator capable payload on every mission. As reflected in the description above, the system is fielded with two of the four payloads having this capability. During the test, Shadow maintenance personnel switched payloads from one aircraft to another 21 times in order to have the most laser designator capable flights. This frequent swapping of payloads increases the probability of maintainer-induced damage to the component or aircraft as well as increasing maintainer workload.
- The Shadow-equipped unit continues to demonstrate the capability of conducting effective call for and adjust fire artillery missions via the Advanced Field Artillery Tactical Data System electronic messaging system.
- The Shadow TUAS communications relay capability is provided by the use of two SINCGARS radios onboard the aircraft, one in each wing tip. During FOT&E it was observed:
  - That maintenance personnel on the ground initially developed and continually refined pre-flight procedures for the communications relay capability to make sure it was operational prior to launch.
  - In the four times the communications relay package was employed operationally during the test, it worked successfully three times. Shadow operators communicated with AH-64 aircraft during two cooperative engagement missions and on one other occasion, communicated with their forward-based ground unit to coordinate aircraft movements into and out of restricted airspace. In the one instance when the communications relay package did not work, Shadow operators could hear elements of the 1-6 Infantry unit loud and clear, but Shadow transmissions to 1-6 Infantry were broken and unreadable. Unable to communicate by voice with the Shadow unit, the 1-6 Infantry commander coordinated mission support using chat.
  - The FOT&E provided no data to evaluate the communications relay capability between two ground units. Given the flat terrain and the digital communications focus of the NIE exercise, supported units did not need or were not aware of the Shadow communications relay capability. Additional testing is required to support a complete assessment of this capability.
- The Shadow TUAS demonstrated the capability of meeting its 8-hour flight endurance requirement. During test, its longest flight was 9.2 hours.
- The UGCS reduces operator work load when compared with the legacy One System Ground Control Station. The checklist steps required to start the UGCS and launch the Shadow aircraft have decreased from 514 to 456, a 13 percent reduction. Start-up checklists remain time consuming and unforgiving of error and deviations. Start-up procedures, especially for the configuration of the encryption datalink, added to workload and system reliability deficiencies.
- As assessed after the 2002 IOT&E, the Shadow TUAS is not survivable in the presence of an air threat for reconnaissance and surveillance missions. Since the 2002 IOT&E, there has been significant development and proliferation of electronic warfare threats on the battlefield. Through developmental testing, it has been determined that the Shadow TUAS is survivable in the presence of older, less capable electronic warfare threats, but further testing is required to determine Shadow's performance in the presence of the latest electronic warfare threats. Cybersecurity testing demonstrated that the Shadow system has exploitable vulnerabilities that could impact Shadow operations. Cybersecurity testing did not address Detect, React, or Restore capabilities of the unit equipped with the Shadow system nor did it test the cybersecurity of the UGCS to aircraft control datalinks. Further details can be found in the classified annex to the Shadow Operational Assessment report.
- The OSRVT-40 system has more capability and functionality today than it demonstrated in previous operational testing. Its software is now "plug and play," which increases user friendliness. Additionally, the system has increased range (mostly through the use of the Mobile Directional Antenna System) and it supported unit Intelligence, Surveillance, and Reconnaissance and current operations.

## Recommendations

- Status of Previous Recommendations. The Army satisfactorily addressed the four recommendations from the FY10 DOT&E Annual Report. There was no annual report written for this system in FY11-13 due to lack of operational testing during that time period.
- FY14 Recommendations. The Army should:
  1. Increase the number of POP-300D payloads issued to the Shadow platoon from two to four to reduce maintainer workload and increase Shadow platoon flexibility.
  2. Reduce the number of UGCS checklist steps (and automate the process to the greatest degree possible) to reduce the amount of time required to start-up the system and launch an aircraft.
  3. Conduct continued developmental testing to further characterize Electronic Warfare threats against the Shadow.
  4. Conduct additional cybersecurity testing to fully assess detect, react, and restore system capabilities of units equipped with the Shadow TUAS. Conduct cybersecurity testing on the UGCS-to-aircraft control datalinks.

# FY14 ARMY PROGRAMS