

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 and through the end of FY10, the Shadow TUAS Program Office has fielded 99 Shadow systems. The Army has received 85; the Marine Corps, 11; the Army National Guard Bureau, 2; and the Program Office has retained one system for continued testing. The Shadow fleet has flown over 540,000 flight hours.
- The program employs a block upgrade and an evolutionary acquisition approach. To complement this approach, the T&E Working Integrated Product Team (WIPT) 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 Management Plan (TEMP) update on March 17, 2010.
- The Army conducted the TUAS Laser Range Finder/Designator Limited User Test (LUT) in June 2010.

System

- Shadow is a small, lightweight TUAS that consists of the following major components:
 - Four 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
 - Each aircraft has an integral Single Channel Ground and Airborne Radio System communications relay capability
 - Two Ground Control Stations designated as the One-System Ground Control Station (OSGCS)
 - One Portable Ground Control Station
 - Four One-System Remote Video Terminals
- The Shadow unit is a platoon-size organization with 22 personnel assigned.
- The Shadow platoon is designed to provide coverage to a brigade area of interest for up to 4 hours at a range out to 50 kilometers from the launch and recovery site. The maximum range is 125 kilometers (limited by data link 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.
- 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.
- The Army intends for the Laser Range Finder/Designator to provide the ground maneuver brigade commander the capability to conduct cooperative Hellfire missile engagements.

Mission

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

Major Contractor

AAI Corporation, Inc. – Hunt Valley, Maryland

Activity

- Shadow TUAS completed IOT&E in May 2002, supporting a full-rate production decision in September 2002. Since that milestone and through the end of FY10, the Shadow TUAS Program Office has fielded 99 Shadow systems. The Army has received 85; the Marine Corps, 11; the Army National Guard Bureau, 2; and the Program Office has retained one

system for continued testing. The Shadow fleet has flown over 540,000 flight hours. Twenty-four deployed systems currently support combat operations.

- The program employs a block upgrade and an evolutionary acquisition approach. To complement this approach, the T&E WIPT is using a corresponding test strategy as part of

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a continuous evaluation as the system receives upgrades in capability. DOT&E approved the Shadow TUAS TEMP update on March 17, 2010.

- The Army conducted the Shadow TUAS LUT at the Yuma Proving Grounds, Yuma, Arizona, in June 2010, in accordance with the DOT&E-approved TEMP and test plan. The LUT enabled the evaluation and assessment of the unit's ability to employ the system with upgrades such as the EO/IR sensor with laser designator, the OSGCS, the 1101 engine, and the communications relay package in an operational environment. The test was supported by three Kiowa Warrior Aircraft and a section of a 155 mm Paladin Field Artillery Battery. During the test, the Shadow TUAS platoon conducted reconnaissance, surveillance, and target acquisition, laser designation for cooperative Hellfire missile engagements with the Kiowa Warrior aircraft, non-line-of-sight call for fire artillery missions, force protection, battle damage assessment, and communications relay missions. The Shadow test unit flew 112 flight hours during the LUT.

Assessment

- The Shadow TUAS has more capability and functionality today than it demonstrated in previous operational testing. Significant increases in capability demonstrated in the June 2010 LUT include cooperative Hellfire missile engagement via the Plug-In Optronic Payload (POP) 300D laser designator and communications relay.
- The unit was effective in conducting cued reconnaissance and surveillance missions. However, the Shadow platoon demonstrated little independent reconnaissance and surveillance capability. Throughout the LUT, the ground tactical operations center directed Shadow operators where to fly and what to observe, precluding the unit from demonstrating the full tactical employment capability of an organization equipped with this system. Soldiers were trained on how to fly the system with the improved capabilities, not on how to employ the system. Training provided to the unit by the Army on the fundamentals of reconnaissance was poor.
- The unit demonstrated the ability to conduct cooperative Hellfire missile engagements with Kiowa Warrior helicopter crews. During these cooperative engagements, the Shadow TUAS operator laser designated the target while the Kiowa Warrior helicopter crews launched the missile. During the live Hellfire missile engagements, 7 of the 10 missiles hit the intended target. On one of the three misses, the missile was characterized as a "bad" missile that had erratic and uncontrolled flight after leaving the launch rail. The missile impacted the ground without incident. During the other two misses, the Shadow POP 300D payload lost its tracking capability while the missile was in flight, and the Kiowa Warrior self-designated the target to complete the missile fly-out.
- DOT&E observed during test that 30 percent of successful engagements, either live missile or simulated, required multiple passes. This is due to the design of the payload, which requires the Shadow aircraft to close to within 4 kilometers of the target to provide sufficient laser energy for the Hellfire missile to have a high probability of hitting the intended target. Shadow operators flew the aircraft to within 2 kilometers of the target during most engagements, well within aural and visual detection range of the system from ground observation, putting the aircraft at risk of being engaged by threat weapons systems and/or compromising the mission. The POP 300D payload did perform as designed.
- Median Target Location Error (TLE) for the POP 300D payload at standoff slant ranges of 3 to 5 kilometers was 76.5 meters. The TLE requirement is less than 80 meters. There was no degradation in capability from the POP 300 to the new POP 300D payload.
- The LUT was the first time that the Advanced Field Artillery Tactical Data System electronic messaging capability between artillery and Shadow units was demonstrated in operational testing. The Shadow unit demonstrated the ability to conduct a second round fire-for-effect mission in cooperation with the artillery unit during the LUT.
- The Shadow TUAS communications relay capability is provided by the use of two radios onboard the aircraft, one in each wing tip. The frequencies of each radio are selected by the Shadow operators in the ground control stations and are able to be reset during flight. Communications may be either secure (hop set frequency where the radio continuously "hops" from one frequency to the next) or non-secure (set single frequency). The Shadow TUAS unit demonstrated during the LUT that when each of the two radios is set to a different, non-secure single frequency, the system can provide the communications relay capability. The secure hop set frequency capability was not demonstrated during test.
- Operator controls are not efficient. OSGCS employs a joystick that has no triggers or buttons allowing one-handed control of both the payload and aircraft. Both hands are required for many basic tasks as the operator provides inputs to the joystick, laser designation button, 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.
- The Shadow TUAS did not meet reliability requirements as measured by Mean Time Between System Abort (MTBSA). During the LUT, the MTBSA was 14.4 hours, compared with a requirement of 20 hours. The system, due to subsystem redundancy, did meet availability requirements. The system demonstrated an overall availability of 99 percent. The system availability requirement is 80 percent.

Recommendations

- Status of Previous Recommendations. The Army satisfactorily addressed the two recommendations from the FY06 DOT&E Annual Report. There was no annual report written for this system in FY07-09 due to lack of operational testing during that time period.
- FY10 Recommendations. The Army should:
 1. Reassess, revise, and expand the training provided during institutional and New Equipment Training of Shadow units

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to include fundamentals of reconnaissance and cooperative engagement missions.

2. Evaluate the adequacy of the current design of the POP 300D payload on the aircraft, which requires Shadow to close within 4 kilometers of a target to provide sufficient laser energy to have a high probability of hit during Hellfire missiles engagements.
3. Improve training for the communication relay capability and confirm its operation in secure hop set frequency mode prior to fielding.
4. Redesign the ground control station by accommodating Soldier feedback on the design of the keyboard, joystick, and laser designation button.

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