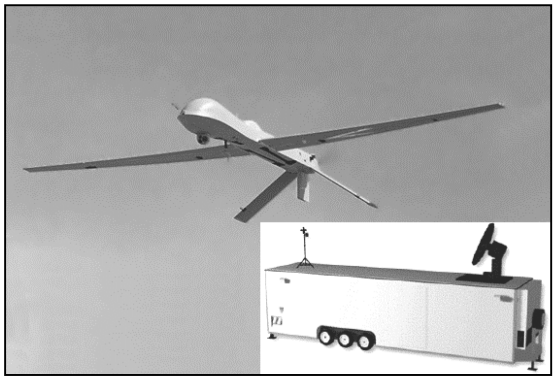
RQ-1A PREDATOR UNMANNED AERIAL VEHICLE (UAV) SYSTEM



The Predator medium altitude endurance unmanned aerial vehicle (UAV) system is a theater asset intended to provide a cued and non-cued reconnaissance, surveillance, and targeting acquisition capability. The long dwell capability is intended to provide the theater commander with continuous imagery coverage of any area of interest. A capability is also being developed for the Predator to carry and fire the Hellfire laser-guided antitank missile, making it the first U.S. unmanned system to employ live weapons.

The Predator system comprises both air and ground segments. The air segment consists of four full composite air vehicles powered by turbo-charged Rotax 914 engines. The air vehicle can carry simultaneously Electro-Optic, Infrared (EO/IR) and Synthetic Aperture Radar (SAR) sensor payloads. Four EO/IR payloads and three SAR payloads will be provided for each system of four air vehicles.

The system will be required to operate in less than ideal weather conditions, and a glycol weeping-wing de-icing system was developed to provide the capability to transit through moderate icing conditions. Two sets of weeping wings will be provided for each system with four air vehicles. (The ability of the air vehicle to fly safely with the alternate weeping wings remains questionable, however.) The Predator will fly at altitudes up to 25,000 feet Mean Sea Level, and data link systems between the air vehicle and the ground system include C-band line-of-sight (LOS), and Ku-band satellite for operations beyond LOS.

The ground segment consists of a shelter containing the Ground Control Station (GCS) and a Predator Primary Satellite Link for satellite communications between the air vehicle and the ground station. Dissemination of imagery, both video and still image files, beyond the GCS is the responsibility of the supported commander. The typical crew in GCS comprises one air vehicle operator and one or two sensor operators per flight shift; an additional person may be present to input future targets and ad hoc target coordinates. For certain operations, such as relief-on-station procedures with two air vehicles under the control of one ground control station, an extra pilot is needed.

BACKGROUND INFORMATION

Originally developed as an Advanced Concept Technology Demonstration (ACTD) program (1994–1996), Predator transitioned to an Acquisition Category (ACAT) II program in August 1997. The United States Atlantic Command (USACOM) was the operational user representative for the Predator during the ACTD period and determined that the Predator had sufficient military utility to warrant production of more systems. The Joint Requirements Oversight Council (JROC) designated the USAF as the Service provider for the Predator. As such, the USAF developed an Operational Requirements Document (ORD), approved in July 1997, that delineated a number of system upgrades from the ACTD system with the top priorities being a de-icing capability, a UHF/VHF radio link for air traffic control through the air vehicle, improved IFF transponders, and repackaging of the GCS into a military style shelter. Other system capabilities upgraded from the ACTD to the baseline system are the more powerful turbo-charged Rotax 914 engine and reliability improvements. The USAF also developed a new concept of operations for the Predator that requires the air vehicle to maintain continuous coverage of the battlefield at ranges up to 400 nautical miles; a relief on station capability had to be developed in order to do this. The threshold requirement for this continuous coverage was stated as 75 percent effective time on station (ETOS).

USAF 11th and 15th Reconnaissance Squadrons at Indian Springs Air Force Auxiliary Field (ISAFAF), Nevada, currently operate Predator. Although the USAF has operationally deployed residual assets from the ACTD program nearly continuously since the ACTD ended, the first production-representative system with technical orders was delivered to the Air Force in April 2000. The Air Force has already procured its planned force structure of 12 Predator systems. Predator system number six was the first system retrofitted with all baseline capabilities and was used for initial operational testing.

According to the JROC-approved Tactical Control Station (TCS) ORD, the Predator air vehicle must be able to provide imagery directly to other Services' TCS-equipped ground stations, and TCS functionality in the Predator ground control station will consist of interoperability with defined Command, Control, Communications, Computers, and Intelligence (C4I) interfaces. When all Services have fielded UAVs and TCS-equipped ground stations, a joint interoperability test will be conducted. The U.S. Joint Forces Command (USJFCOM) is operating developmental TCS software with Navy-owned Predator air vehicles as part of their UAV Joint Operations Test Bed System to demonstrate this capability early on.

TEST & EVALUATION ACTIVITY

AFOTEC conducted the initial operational test and evaluation (IOT&E) at ISAFAF during October 2000. The IOT&E comprised three phases. The first phase was the collection and scoring of reliability data on the production-representative system during training flights for several months prior to the flight operations phases of the IOT&E. The second phase consisted of two dedicated sorties designed to examine specific mission areas such as strike support, search and rescue, and mortar adjustment. The third and final phase of the OT&E began with a simulated deployment to a designated area at ISAFAF. This 7-day, continuous operations phase focused on examining the ability of the system to maintain a continuous presence over the battlefield. Imagery was provided to a simulated exploitation cell where imagery analysts assessed image quality. The exploitation cell received video from the Predator GCS via the Nellis local area network. SAR imagery had to be manually transported from the GCS on floppy disks. The C4I architecture used for the tasking and dissemination during the IOT&E represented a deployed situation where there is access to local telephone landlines. It did not include satellite transmission of the EO/IR video from the GCS to other nodes including the Global Broadcast System (GBS). The test included one system comprising four air vehicles with EO/IR/SAR payloads, a ground control station, and 58 personnel (a planned deployed increment for a Predator squadron). Two sets of pre-production wet wings were provided.

The Joint Interoperability Test Command (JITC) assessed the Predator's C4I interoperability in three phases. The first phase assessed Predator imagery exploitation by the Distributed Common Ground System–Deployable Transit-cased System (DCGS-DTS) as disseminated by the GBS at Beale AFB, California. The DCGS-DTS and the GBS were actively supporting Predator operations in the European theater during this phase. The second phase was an assessment of the Predator interface to the video injection point into the GBS at the Bosnian Command and Control Augmentation Operations Center (BOC) located in the Pentagon. The final phase during the IOT&E was an assessment of the GCS link to the air traffic control and surveillance radars.

Air Combat Command conducted testing throughout the year to demonstrate the capability to employ the Hellfire air-to-surface antitank missile from the Predator UAV. The Air Force has maintained that this activity is experimental only. Neither test results nor information indicating an acquisition strategy to retrofit or purchase additional mission capability such as this in the Predator system has been made available to DOT&E.

TEST & EVALUATION ASSESSMENT

Several limitations affected the continuous operations phase of the test. Continuous operations were interrupted by both weather and range restrictions. An unsafe flight profile discovered by the program office led the operations group commander to preclude any flights with the wet wings during the IOT&E. The lack of wet wing capability prevented transition through clouds, often keeping Predator close to home base. The lack of glycol-weeping wet wings (anti-icing) capability, combined with other weather and range constraints, prevented coverage of targets in the northern ranges for most of the test. Poor weather grounded the system on three separate occasions, and the loss of range time for 24 hours on another occasion reduced the flight hours to nearly half of the original plan. (Since the IOT&E, the Air Force has begun flight operations with the wet wings capability in training and operational deployments.) Feedback from users of imagery such as strike mission aircrew or planners was not solicited. Limited airspace and the necessity to deconflict with other flight operations on the Nellis ranges further restricted the air tasking order and provided little tactical uncertainty for the Predator operators who train over the same ranges routinely. However, the testing was adequate for the conclusions that follow.

The Predator UAV system is not operationally effective or suitable as tested during the IOT&E. This judgment rests primarily on an operational assessment against the user's standards for effectiveness and suitability as stated in the operational requirements document. The disparity between the apparently successful fielded system and a system that did not perform well in the IOT&E is largely attributable to the fact that the fielded system is tasked and operated well within known limitations such as ETOS, weather restrictions, expected threats, and expected accuracy and dissemination abilities. Additionally, the operators in the field have developed workarounds, somewhat effective but often cumbersome, for many system deficiencies.

AFOTEC found the Predator "to be effective, but not without limitations and difficulties" and "suitable though reliability and maintainability problems persist." While both AFOTEC and DOT&E agree on the limitations and difficulties encountered by the Predator system, the different conclusions about operational effectiveness are a result of DOT&E's perception that the system's limitations have a substantial negative impact on the Predator's ability to conduct its missions as described in the operational requirements document.

Although fielded operations prove that Predator has utility in certain mission environments, the IOT&E highlighted numerous shortcomings that limit its effectiveness. If uncontested by weather, threats, or other factors that introduce tactical uncertainty, a deployed Predator unit is capable of surveillance, reconnaissance, and battle damage assessment missions. However, poor target location accuracy, ineffective on-aircraft radio communications, and limits imposed by relatively benign weather, including rain, negatively impact missions such as strike support, combat search and rescue, area search, and continuous coverage. The Predator sensor suite can provide only the desired performance during daylight or for slant ranges below the required 30,000 feet, and it cannot operate in less than ideal weather or sustain operations under conditions requiring chemical/biological protective posture. Furthermore, the system is unable to provide reliable, effective communications through the aircraft, as required, or meet the target location accuracy requirement under operational conditions (at slant ranges greater than 10,000 feet). The system demonstrated target location errors approximately twice what the accuracy requirement allows under operational conditions. The cumulative effect of the system's limitations renders Predator not operationally effective in meeting the mission requirements delineated by the Key Performance Parameters (KPPs) and the ORD.

Data extrapolated from the IOT&E suggest that the Predator could obtain *60 percent* ETOS at 400 nautical miles, *if relief-on-station procedures are used*. However, the procedures were exacting and confusing, immature, and developed solely for the IOT&E. The 57th Operations Group Commander restricted Predator from flying using relief-on-station shortly after the test concluded. The lack of relief-on-station procedures, combined with poor reliability, renders the system unable to meet the ETOS requirement of 75 percent (excluding weather downtime) at the ORD-required range of 400 nautical miles.

Additionally, the frequency of required preventive maintenance (every 19.4 hours on average during the IOT&E) is incongruous with the aircraft's expected sortie length (at least 20-hour sorties to maintain continuous coverage). Maintainability was affected by technical orders that were found inadequate by the maintainers. Additionally, a lack of in-depth system design makes the system not user friendly and difficult to learn, impacting training and mission effectiveness. Sixteen mission critical deficiency reports were cited at the end of IOT&E, many of which were related to human factors issues.

JITC has not yet certified the Predator system for interoperability in accordance with DoD Directive 4630.4 and DoD Instruction 4630.8 because of untested critical requirements. JITC certified only three of seven critical interfaces; the remaining interfaces have not been made available for JITC evaluation. The combination of poor reliability and maintainability, deficient human factors design, and lack of interoperability results in the finding that the Predator is not operationally suitable.

Predator's transition process from an ACTD to an acquisition program did not take full advantage of operational assessments (1995–2000) that identified key system shortfalls, many of which were repeated in the IOT&E. Development efforts did not correct many previously identified deficiencies. If the Predator system is to be effective and suitable in accordance with the ORD-structured mission capability, the shortfalls identified in the IOT&E must be addressed.