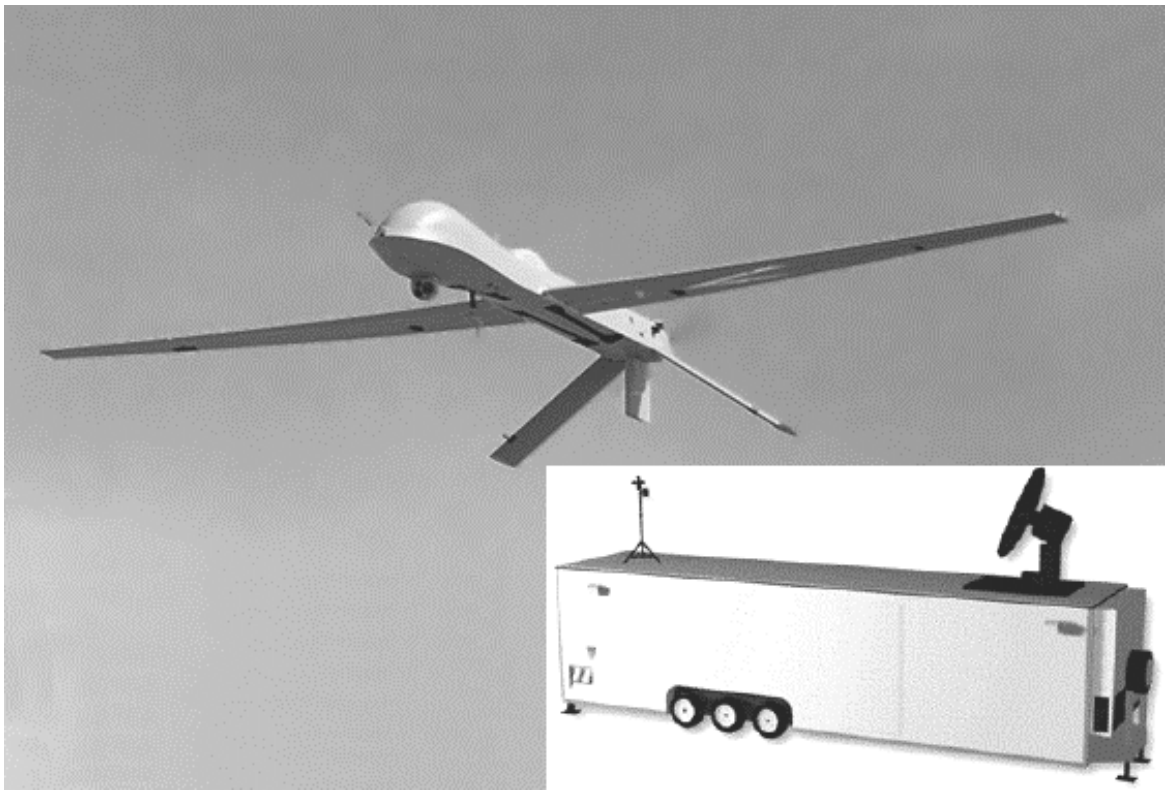
RQ-1A PREDATOR UNMANNED AERIAL VEHICLE (UAV) SYSTEM



Air Force ACAT II Program

Total Number of Systems:	12
Total Program Cost (TY$):	604.9M
Average Unit Cost (TY$):	20.5M
Full-rate production:	1QFY00

Prime Contractor

General Atomics Aeronautical Systems, Inc.

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Predator medium altitude endurance Unmanned Aerial Vehicle (UAV) system is a theater asset that is to provide both cued and non-cued reconnaissance, surveillance, and targeting capability. The long dwell capability provides the theater commander with continuous 24-hour coverage of the area of interest. RQ-1A will help the in-theater CINC conduct ***precision engagement*** by helping provide ***information superiority***.

The Predator system comprises both air and ground segments. The air segment consists of four full composite air vehicles powered by a turbo-charged Rotax 914 engine. The air vehicle can carry simultaneously Electro-Optic (EO), Infrared (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 safely fly with the alternate weeping wings has not been demonstrated, 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 (PPSL) for satellite communications between the air vehicle and the ground station. (Dissemination of imagery beyond the GCS is the responsibility of the supported commander.) The typical crew in GCS comprises one air vehicle operator and one sensor operator per flight shift.

BACKGROUND INFORMATION

In August 1997, Predator completed its transition from an Advanced Concept Technology Demonstration (ACTD) to an ACAT II acquisition program. Six systems were residuals from ACTD, and subsequently, three Production Rate Verification (PRV) contracts were awarded, bringing the total number of systems delivered or under contract to eleven. A twelfth system is still an option under the last PRV contract.

The Air Force Operational Requirements Document (ORD), approved in July 1997, delineated a number of system upgrades, with the top priorities being a de-icing capability, a UHF/VHF radio link for air traffic control through the air vehicle, improved Identification Friend or Foe transponders, and re-packaging 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, relief on station capability, and reliability improvements. Predator system Number 6 was the first system retrofitted with all baseline capabilities and was used for initial operational testing. U.S. Air Force 11th and 15th Reconnaissance Squadrons at Indian Springs Air Force Auxiliary Field, NV currently operate Predator.

Three Predator systems deployed to Tuzla, Bosnia in 1999 to support Operation Allied Force. One of those systems was the baseline system Number 6that had been modified to incorporate a laser designator payload. Although some training and CONOPS development were done in theater, the laser-equipped Predators were never used in combat. On April 1, 2000, the baseline system Number 6, with technical orders, was delivered to the 11th Reconnaissance Squadron for training and preparation for IOT&E. (The laser designator payload is not part of the baseline system. It will be evaluated independently by the Air Force for its military utility and CONOPS development.)

The initial operation test was conducted during October 2000, after a total slip of more than three years. All the planned production contracts were awarded prior to operational testing so the operational test results will be used only to refine CONOPS and define any follow-on development efforts.

In January 2000, the Joint Requirements Oversight Council (JROC) approved a revised Tactical Control Station ORD. The revised ORD made interoperability between the Predator air vehicle and other Services' TCS-equipped ground stations an objective (vice threshold) requirement. TCS functionality in the Predator ground control station will be evaluated in follow-on tests. When all Services have fielded UAVs and TCS-equipped ground stations, a joint interoperability test will be conducted. Predator will be required to provide direct down link of imagery to another Services' TCS-equipped ground station.

TEST & EVALUATION ACTIVITY

Lessons learned from the operational deployment to Bosnia, as well as flight testing of Navy Predator's by the Naval Air Warfare Center, indicated that the target location accuracy of the Predator sensors could be in excess of one kilometer. Therefore, AFTOEC conducted several flight tests to analyze Predator's target location capability. Five flight tests were flown using three different aircraft between April and June of this year.

The AFOTEC-led Joint Reliability and Maintainability Evaluation Team (JRMET) collected and scored reliability data from all operational and training systems over a two-year period prior to the operational test. Most of the data were collected on non production-representative systems in non-operational environments; therefore, careful consideration of these data must be made prior to inclusion with any test results.

AFOTEC conducted the initial operational test at Indian Springs, NV during October 2000. The test consisted of two days of standalone sorties followed by taskings for seven days of 24-hour continuous flight operations.

The Joint Interoperability Test Center (JITC) worked with ACC to develop a prioritized list of C^4I nodes to be certified during IOT&E. The nodes include ATC, AWACS, DCGS, Trojan SPIRIT II, GCCS, TBMCS, and GBS. The JITC will only certify the joint-interfaces (i.e., GBS) but reviewed interoperability capability with the other Air Force nodes during operational testing.

TEST & EVALUATION ASSESSMENT

The baseline system flew 89.5 hours during its deployment to the Kosovo theater. During this time, the system experienced five operational mission failures resulting in a Mean Time Between Operational Mission Failure of 17.9 hours. While this is greater than that reported by the JRMET, it is still far less than the 40 hour requirement. No maintenance data were collected.

Results of the target location study indicate that the baseline Predator system had improved target location accuracy over the ACTD system, but that the ORD requirement for target location could not be met for some operational slant ranges. There is no requirement for slant range associated with the Target Location Error (TLE) requirements, however, other payload requirements such as target recognition and classification are required at 30,000 feet threshold and 60,000 feet objective slant ranges. A number of error sources were discovered that contribute to Predator's TLE including slant range to the target and the computational algorithm to predict the intersection of the sensor with the earth; the inherent accuracy of the digital terrain elevation data, boresight procedures (or lack thereof); positional error in altitude (differences in barometric versus GPS altitude up to 1000 feet were observed); sensor gimbal errors; induced errors (not keeping the crosshairs directly on the target); and bank angle. More target location data were collected during operational testing and will be presented in the test report.

The System Program Office (SPO) certified the Predator system readiness to enter operational testing with limitations regarding the wet wing sets, Effective Time On Station (ETOS) calculations, and the SAR sensor capability. Two pre-production wing sets were to be used for operational testing because the only two production wing sets were supporting real-world operations. However, prior to any flights with wet wings during the operational test, the 57th Operations Group Commander issued a restriction on

flying Predator aircraft with wet wings. A deficiency was discovered that could have allowed the aircraft, with the wet wings installed, to fly below the stall speed if lost link conditions occurred. Because Relief On Station procedures require one of the two air vehicles to operate in lost link mode, the procedure was not deemed safe to operate with wet wings. The second limitation identified by the SPO prior to the test was that they would evaluate ETOS only for the dry wing configuration of the Predator system. Test data will only reflect the dry wing configuration, but the ETOS capability of a wet wing equipped Predator will be simulated based on the reduced endurance of that configuration. Finally, the SPO acknowledged that the SAR sensor would likely not be able to meet the JROC-approved key performance parameter requiring recognition of tactical sized targets at 30,000 feet slant range.

Endurance flights of the baseline air vehicle revealed a maximum endurance of approximately 20 hours for the dry wing configuration (with three-hour reserve) and 16 hours for the wet wing configuration. This was a large (and perhaps unexpected) trade-off of endurance for the more powerful turbo-charged Rotax 914 engine. Simulations of ETOS based primarily on endurance and reliability indicated that with these reduced endurances, a 75 percent ETOS could not be met at the maximum ranges of 400 nautical miles.

Five Predator air vehicles crashed between June and October 2000. At least three crashes were attributed to pilot error, while one crash resulted during the integration of a laser designator payload.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Since no disciplined developmental testing was conducted on this system, many high-risk areas in performance remained prior to operational testing, and several limitations affected the conduct of the operational test. Furthermore, because all the production contracts were awarded prior to operational testing, motivation for testing and use of the test results were diminished.

Predator assets were often diverted from engineering development and testing for real-world deployments. Also, as a result of these operational deployments, the CONOPS for Predator evolved from one of strictly initial service release to include target acquisition and engagement. In this capacity, Predator assets were also diverted for other projects such as laser designation and weaponization.