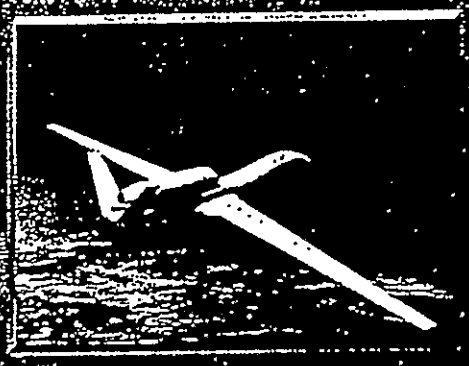
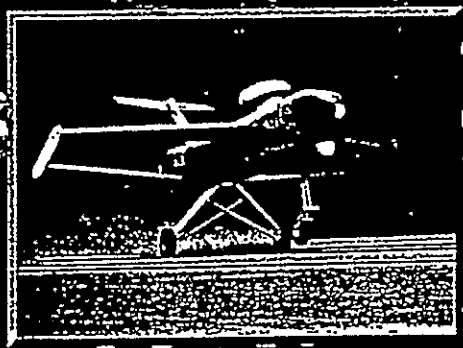
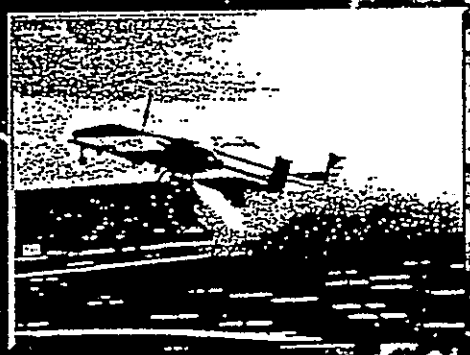
UAV Annual Report
FY 1996
6 November 1996



Endurance

Tactical





OUR SECOND UNMANNED AERIAL VEHICLE (UAV) ANNUAL REPORT provides an overview of the Defense Department's UAV program activities for fiscal year (FY) 1996. The Defense Airborne Reconnaissance Office (DARO) is chartered to manage the Defense Airborne Reconnaissance Program (DARP), which includes both tactical and endurance UAVs among its component program elements.

DURING THE PAST YEAR, UAVs have seen major programmatic changes, have continued to demonstrate unique capabilities, and have experienced increasing acceptance by operational users. This report highlights their recent achievements, describes their acquisition plans and issues, and projects the DARO's UAV vision for the future. Key accomplishments, together with a DoD-wide perspective, are summarized below.

I've seen the cities of men and understand their thoughts.

Homer, c. 900 B.C.

As indicated by Homer's insightful statement, THE CONCEPT OF INFORMATION DOMINANCE *has a long history. What is so vastly different today is that technological capability, system performance and operational infrastructure support have converged to allow us to exploit new opportunities in ways never before imagined. For years warfighters have articulated the needs for* situational awareness, target identification, dominant battlefield awareness, dominant battlespace knowledge, *and* information superiority. *Now we have the ability to move from words to deeds.*

The DARO's first responsibility is to develop and maintain the DoD's integrated airborne reconnaissance architecture as a framework for the development and acquisition of improved airborne reconnaissance capabilities. Today, we have an abundance of exciting and important collection, processing, exploitation and dissemination opportunities and the problem is to make choices among them and integrate them into the architectural structure. For our manned platforms, we have a game plan to selectively improve sensors. For our UAVs, we are now ushering in new capabilities in both platforms and sensors to constitute our family of tactical and endurance UAVs. As our architecture migration pictorial shows (p. 3), we are concentrating on the best "mix" of manned and unmanned systems to meet warfighting needs well into the next century.

Last year we published our first UAV Annual Report. This is our second edition, and its purpose is to provide updates from last year and highlight the significant accomplishments that UAVs have achieved this year. Simply stated, UAVs are moving from words to deeds. They are being recognized in out-year "vision" documents as providing both a cost-effective solution to our goal of extended reconnaissance and bases for other high-value military and civil applications. There are many Services and agencies involved in the rapid improvements and fielding of UAVs, and on their behalf we are pleased to publish this second edition.

OVER THE PAST TWELVE MONTHS, our expanding UAV community has tackled new doctrinal, operational concept, requirements and interoperability issues. It was a year of "firsts" on many fronts and each achievement is the product of a great deal of dedicated effort and DoD-contractor teamwork.

a. Analysis and Architecture. The overarching efforts that went into refining our integrated airborne reconnaissance strategy as well as laying the groundwork for a joint, interoperable mix of UAVs

The video mosaics on the covers were provided by
the National Information Display Laboratory (NIDL).

in an architectural framework deserve much praise. We need to continually improve the analytic base on which decisions are made. The analysis must reach to an assessment of the contribution of intelligence systems to military outcomes in scenarios that are judged to be consequential. Several on-going efforts to quantify the airborne reconnaissance force mix, such as the Reconnaissance Study Group, Joint Warfare Capability Assessments, the SIGINT Mix Study, the C4ISR[1] Mission Assessment, DARO analysis, the National Reconnaissance Office imagery mix study and others, have proven most helpful. Thus, we see our reconnaissance architecture as embedded in a larger information system roadmap. The value of any architecture is in helping to shape investment decisions for the future, and we have started this process.

b. Acquisition Initiatives. Integrating acquisition reform initiatives into our UAV programs has helped lead the way for other DoD Advanced Concept Technology Demonstration (ACTD) programs. For example, the Predator *ACTD was the first successful ACTD to transition to a production program and its experiences will be applied to other DoD efforts. Four of our five active UAV programs are (or were) ACTDs —* Outrider, Predator, DarkStar, *and* Global Hawk; Pioneer *is a fielded system — and are progressing well. In addition, integrated product teams (IPTs) are helping to develop requirements and concepts of operations (CONOPS) for the Tactical Control System (TCS), a new development to assure interoperability between our UAVs and their intelligence products for joint operational users. IPTs have also helped to determine tactical synthetic aperture radar (SAR) and data link options. Another key area of IPT support is identification of commercial processes, products and services to support our open architecture.*

c. Funding Support and Program Prioritization. The Congress has been very supportive of the Department's UAV programs and, for the third year in a row, has added funds to our UAV efforts. In addition, the Joint Requirements Oversight Council (JROC) prioritized UAV programs and provided stability in the joint requirements process that supports warfighter needs. The new JROC Review Board (JRB) has also helped us by framing UAV issues, evaluating operations, and proposing recommendations for JROC considerations. The number one priority for UAVs remains the tactical UAVs (Outrider *and* Pioneer), *with* Predator *and the High Altitude Endurance (HAE) UAVs as numbers two and three, respectively.*

d. Achievements. During the last year, we have accomplished the following UAV program-specific actions:

- *On 2 May 1996, the Tactical UAV, or* Outrider, *ACTD contract was awarded for a 24-month period of performance. First flight will occur within six months of contract award and a low-rate initial production (LRIP) option for six systems may be exercised before the ACTD ends, i.e., late in FY 1998. The current requirement is for 62 systems (at four air vehicles [AVs] per system), plus attrition spares.*

- Predator *has been the most operationally active UAV program this year. During FY 1996,* Predators *have flown more than 530 missions for nearly 2,500 flight hours — 159 missions and 1,169 flight hours supporting Bosnia operations alone.* Predator *flew the first UAV SAR and Ku-band satellite link mission this year. Dissemination of imagery via the quickly constructed Joint Broadcast System provided a long-sought-for "common picture of the battlefield" to multiple receiving sites both in-theater and back in the U.S. It also operated under control of, and sent information to, a submerged submarine during one demonstration exercise, and supported a carrier battle group during another.* Predator's *marinization feasibility study has been completed and its report will be available in early FY 1997. The JROC identified near-term configuration upgrades that include UHF voice radio, IFF, and wing de-icing. The SecDef approved system and program management agreements for its follow-on acquisition and operational support. The current operational requirement is for 16 systems (at four AVs per system), plus attrition spares.*

[1] *Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance.*

- Pioneer *also deployed to Bosnia and supported the 1st Armored Division; additional* Pioneers *support fleet operations offshore. The Congress provided funding to improve both engine performance and the avionics.* Pioneer *has experienced an unusual rate of mishaps this year, but the improvements cited will help the situation. Thus,* Pioneer *has helped us gain experience to improve reliability for all UAVs. We are planning to extend its operational life from FY 2000 to 2003, when* Outrider *is expected to be available in quantity. The revised requirement is for nine systems thru FY 1999 (at five AVs per system), with a gradual phase-out.*

- DarkStar *experienced both its first flight and its first mishap within 24 days of each other. The first successful fully autonomous UAV flight with a low-observable design took place in March 1996. The mishap took place in April and resulted in a year's delay and an approximately $22 million impact to the program. To correct the problem, three configuration design changes are being considered: "hiking" the nose gear, moving the main gear, and sweeping the wings. The next flight is planned for May 1997.* DarkStar's *eventual force size is being determined.*

- Global Hawk *is proceeding well. The wing and body were mated without a problem. Static and integration tests are on schedule. First flight is scheduled for 1997. This will be the first UAV to use a common processor for both electro-optical/infrared (EO/IR) and SAR imagery.* Global Hawk's *eventual force size is being determined.*

- *The TCS development is now underway. The JROC fully supports a common, modular and scalable ground station for tactical UAVs. The TCS will be compliant with the Joint Technical Architecture, Airborne Reconnaissance Information Technical Architecture and the Joint Interoperability Interfaces, thereby assuring UAV and product interoperability and utility among multiple operational users.*

- *Finally,* Hunter *has enjoyed considerable success during the past several months. Although the DoD decided to cease production after the LRIP buy of seven systems,* Hunter *has performed flawlessly on several exercises and demonstrations to refine UAV employment concepts, and, like* Pioneer, *continues to be used for payload development.*

FROM A DoD-WIDE PERSPECTIVE, Joint Vision (JV) 2010, *published in July 1996, represents the vision of the Chairman, Joint Chiefs of Staff (CJCS), for joint warfighting in the 21st century. Its C4I "building codes" are contained in the JTA. Our Integrated Airborne Reconnaissance Strategy and its implementing Airborne Reconnaissance Information Technical Architecture remain in full agreement with JV 2010's provisions for the employment of information to support its key operational concepts —* dominant maneuver, precision engagement, full-dimension protection, *and* focused logistics. *We are continuing to study how UAVs can support joint warfighting concepts as the Defense Department prepares for the Quadrennial Review of Roles and Missions during FY 1997.*

Finally, in the post-Cold War era we can expect our forces to be deployed for a variety of purposes in many parts of the world. The rule, rather than the exception, will be deployment with coalition partners, notably NATO members. We will need to be interoperable — not only with our own forces but also with NATO forces and those of our coalition partners.

All in all this has been a good year for UAVs and we expect an even better year, next year. Thank you for your continued support.

MajGen Kenneth R. Israel, USAF
Director, Defense Airborne Reconnaissance Office

UAVs Over Bosnia

UAV deployments to Bosnia, in support of joint and combined operations, are the major UAV "success story" of FY 1996. They include both operational triumphs and acquisition lessons learned. Principally, they illustrate how UAVs can contribute vital information to enhance tactical operations and strategic decision-making.

Predator Deployment #1 (1995) Gjader, Albania

The first deployment, from July through November 1995, involved three *Predators* in essentially a "come-as-you-are" ACTD demo configuration, which included an electro-optical/ infrared (EO/IR) sensor, and C-band line-of-sight (LOS) and UHF SATCOM beyond-line-of-sight (BLOS) data links. Despite two early losses,[1] the *Predator* system and its operators showed steady improvements in operational practices, supportability in the field, liaison with other in-theater agencies, and the military utility of imagery products. Ad hoc taskings sometimes produced better mission results than planned "point target" taskings, and several additional steps assured better image quality.

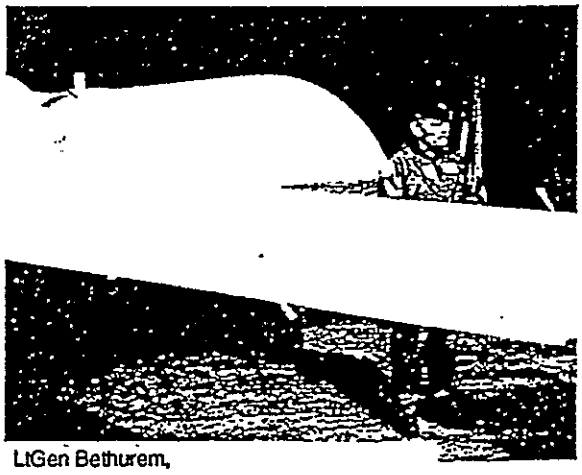
Despite its early limitations for all-weather operation, *Predator* helped determine the course of the Bosnia conflict. During September 1995, after several diplomatic and operational initiatives to relieve shelling and intimidation of civilian enclaves, especially in Bosnia's Sarajevo-Gorazde area, NATO forces resorted to active bombing to bring the warring factions to the negotiating table. Many previous agreements to remove field weapons from the area had been broken, and NATO forces could not hold the violators responsible without confirmation. With *Predator*, however, weapons movements became subject to long-dwell video surveillance, and continuous coverage of area roads showed no evidence of weaponry being withdrawn. This single ISR resource thus gave NATO commanders the key piece of intelligence that underlay their decision to resume the bombing campaign that, in turn, led to the Dayton peace accord signed in December 1995.

The needs for (1) an all-weather sensor, and (2) an all-weather flight capability, were clearly demonstrated. Other needs included a more robust communication link throughput, improved data dissemination to better exploit the near-real-time imagery products, the ability for UAV pilots to talk directly to air traffic control agencies, and a full IFF capability for the UAVs.

Predator Deployment #2 (1996) Taszar, Hungary

When another three *Predators* deployed on 1 March 1996, they were in a final ACTD configuration, which included:

- A synthetic aperture radar (SAR) sensor, as well as the basic EO/IR payload;
- A Ku-band SATCOM BLOS link, as well as the original C-band and UHF SATCOM links;
- Ice-mitigation features to reduce the risks of flying in poor weather;[2] and
- A progressively expanding information dissemination infrastructure, to provide theater-wide and international access to imagery products.



LtGen Bethurem, Commander, AIRSOUTH, presides over *Predator* transition ceremony at Taszar, Hungary, 2 Sep 96

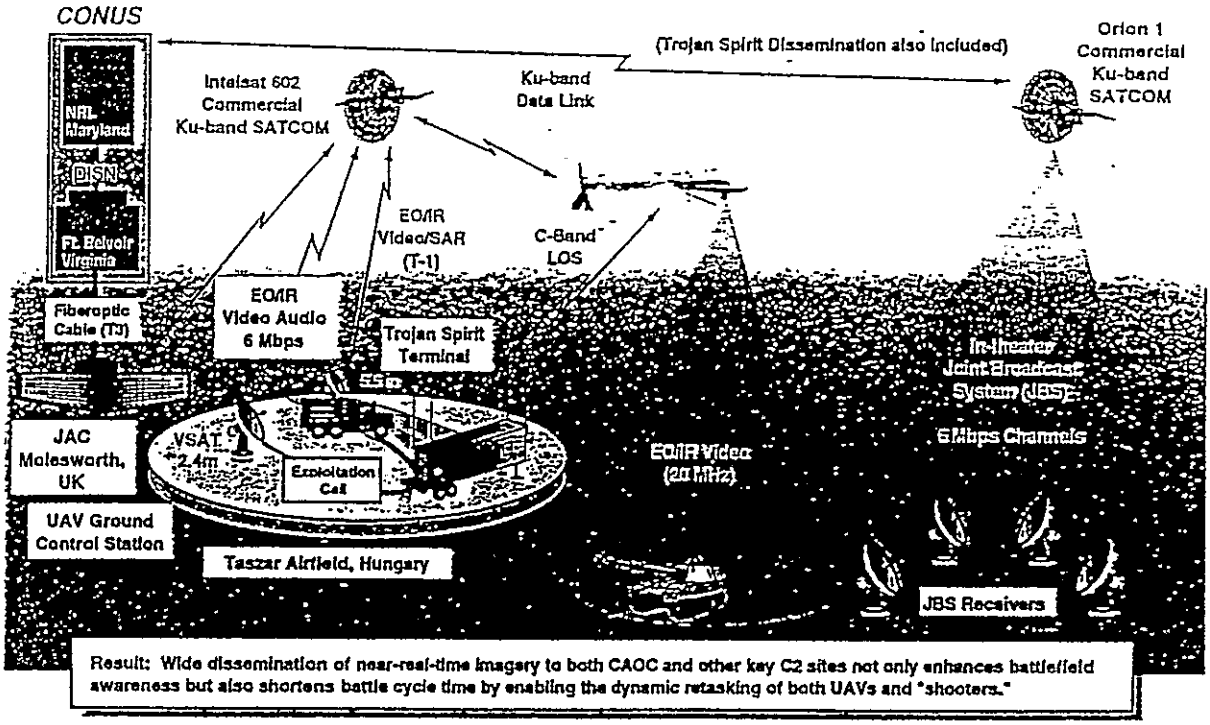
[1] One *Predator* was lost from hostile fire, the other from engine failure.

[2] Active de-icing capabilities were installed in late-1996, and will be part of the production baseline.

(Replacement page 7: different graphic)

Continuing Support for Joint- and Combined-Force Contingencies

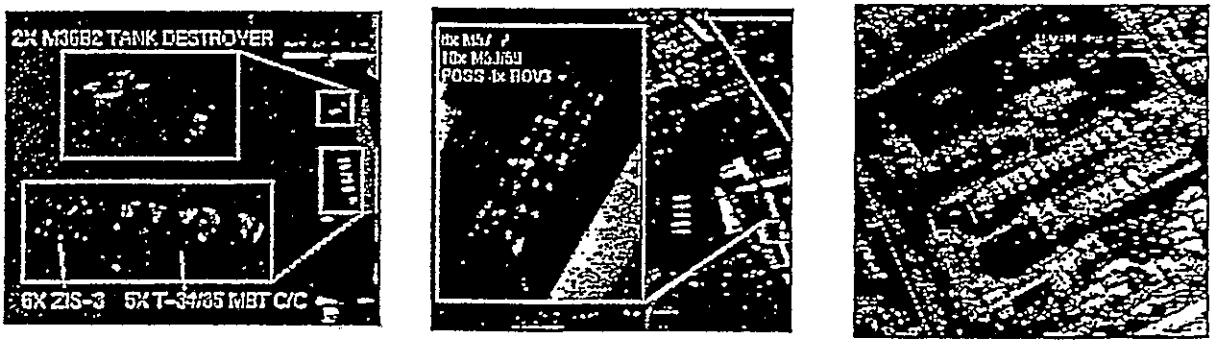
Even more significant than the *Predator* performance "firsts" is the wide use made of its imagery, amplified by the increased network of receiving stations — both in-theater and back in CONUS. The development of this dissemination capability is shown below. It first used VSATs at selected receiving sites, and then the SATCOM-based Joint Broadcast System (JBS).[3]



CAOC Combat Air Operations Center DISN Defense Information System Network JAC Joint Analysis Center
NRL Naval Research Laboratory VSAT Very Small Aperture Terminal

The Predator-JBS network represents the first time for the simultaneous broadcast of live UAV video to more than 15 users. This provided a common picture of the "battlefield." Video imagery can be viewed either as full motion video or (as the cover shows) via a "mosaicking" technique at the ground station. Examples of single-frame *Predator* imagery are shown below.

Bosnia Imagery



EO IR SAR

[3] The JBS is a combined effort by the DARO, National Reconnaissance Office (NRO), Defense Information Systems Agency (DISA), and other DoD agencies.

UAVs Over Bosnia (Cont'd)

Pioneer Deployments (1995–96)

During their ten-year history of supporting contingency operations world-wide, *Pioneers* have deployed three times in support of Bosnia, twice afloat and once on land.

Navy VC-6 Pioneer systems have supported Sixth Fleet operations in the Mediterranean and Adriatic Seas since 1994. Most recently, one system deployed aboard USS Shreveport (August 1995 – February 1996) and flew three missions over Bosnia in January. Another deployed aboard USS Austin in July 1996 in support of fleet operations, and is available for contingencies ashore as needed.

On 12 June 1996, the 1st Marine UAV Squadron (VMU-1) deployed one *Pioneer* system to Tuzla, Bosnia, to support peacekeeping operations. They flew more than 30 missions before returning to the U.S. in October 1996.

Today, *Pioneer* is the Department's only marinized UAV for the near term to support contingencies.

Key *Predator* Accomplishments
• Jul 95: Deployed to Gjader, Albania, to support UN operations, monitor hostilities • Aided search for downed pilots • Imagery proved Serbs had not withdrawn forces threatening Sarajevo and Gorazde • Imagery helped NATO target resulting air strikes, provided real-time BDAs • Nov 95: Returned to U.S.
• Mar 96: Deployed to Taszar, Hungary, to support NATO peacekeeping operations and monitor belligerents • Routine flight in congested airspace, across two national boundaries; control by AWACS in operations area • Passed video imagery to Joint STARS ground station module in Hungary – first UAV-Joint STARS interoperation. (Live cross-cueing operations planned, but weather & Joint STARS' departure from theater intervened) • During late Summer/early Fall of 1996, monitored mass grave sites near Sarajevo, which provided evidence of 1995 massacres • Sep 96: Monitored the Bosnia election activities • Quick-response observations to preclude confrontations between Bosnia factions or with NATO units • Oct 96: Covering and monitoring of deploying forces

Key *Pioneer* Accomplishments
• Aug 95: VC-6 deployed aboard USS Shreveport to support fleet operations • Jan 96: Flew three sorties over Bosnia in support of Implementation Force (IFOR) and Marine Expeditionary Unit (MEU) requirements • Successfully demonstrated video retransmission to the command ship (USS Wasp) to support amphibious task force and landing force commanders (CATF/CLF) • Feb 96: Returned to U.S.
• Jun 96: VMU-1 deployed to Tuzla, Bosnia, to support Task Force Eagle commander • Real-time imagery provided via *Pioneer's* Remote Receiving Station (RRS) directly to IFOR units • Task Force Eagle demonstrated dynamic retasking, using *Pioneer* • Surveillance of population centers, suspected terrorist training areas, and route reconnaissance • Oct 96: Returned to U.S.
• Jul 96: VC-6 deployed aboard USS Austin to support fleet operations, be available for contingencies

On 2 September 1996, at Taszar, Hungary, the 11th Reconnaissance Squadron of the Air Force's Air Combat Command (ACC) assumed operational control of Predator assets.

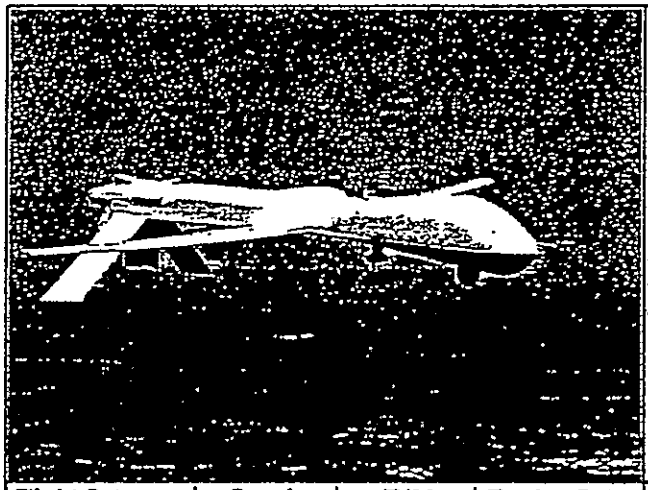
... We received an inkling of what combat will look like in the 21st century during Desert Storm and more recently in our support of NATO action in Bosnia. In both cases, unmanned aerial vehicles have demonstrated the ability to provide continuous real-time battlefield surveillance.

Dr. Paul G. Kaminski, USD(A&T)
Statement before the House Permanent Select Committee on Intelligence on Enabling Intelligence Technologies for the 21st Century, 18 October 1995

Predator (MAE UAV) Program

General

Predator, also identified as the Medium Altitude Endurance (MAE) or Tier II UAV, is a derivative of the Gnat 750 (Tier I) UAV. In July 1996, *Predator* completed its 30-month ACTD program and is transitioning to low-rate initial production (LRIP) in the formal acquisition arena. The system provides long-range, long-dwell, near-real-time imagery intelligence (IMINT) to satisfy reconnaissance, surveillance and target acquisition (RSTA) mission requirements. The air vehicle carries both EO/IR and SAR sensors which, with Ku- as well as UHF-band satellite communication (SATCOM) links, enable the system to acquire and pass imagery to ground stations for adverse weather, beyond-line-of-sight (BLOS) use by tactical commanders. Recent addition of de-icing equipment now allows transit and operation in adverse weather conditions. This capability was deployed to Bosnia in October 1996. As production assets augment ACTD assets, *Predator* will be the operational endurance UAV workhorse for the next several years. Prime contractor is General Atomics – Aeronautical Systems, Inc., San Diego, CA.



SUBSYSTEMS
4 Air Vehicles
1 Ground Control Station
1 Trojan Spirit II Dissemination System
Ground Support Equipment

KEY OPERATIONAL FACTORS	
Sensors:	EO, IR, and SAR
Deployment:	Multiple* C-130 sorties
Radius:	926 km (500 nm)
Endurance:	>20 hrs
Max Altitude:	7.6 km (25,000 ft)
Cruise Speed:	120-130 km/hr (65-70 kts)

*Depends on equipage and duration

Flight Data*	Bosnia	FY96	Total to Date
• Flights / Hours	159 / 1,169	537 / 2,477	1,575 / 4,590

*As of 30 Sep 96

Funding ($M):	FY96	FY97
RDT&E (Defense-wide)	44.9	6.1
Procurement (Navy)*		115.8

*Includes $8 million for U-CARS

Program Status

After a November 1995 return from Albania and support of United Nations operations in Bosnia, *Predator* AVs incorporated both a SAR sensor (with imagery transmitted through the Ku-band SATCOM link) and initial ice sensing features to enable poor weather operation. *Predators* redeployed in March 1996 to Taszar, Hungary, supporting NATO operations in Bosnia; return is currently planned for February 1997. Concurrently, other *Predators* participated in a succession of interoperability demonstrations, specifically with the U.S. Customs Service (Fall, 1995), a Navy carrier battle group (CVBG) (Fall, 1995), and a Navy submarine with SEAL team aboard (Spring, 1996); details are on pages 32-33.

On 30 June 1996, *Predator* completed its 30-month ACTD. On 26 July, General Atomics received a $23 million contract for another five AVs and ancillary equipment. On 2 September, the Air Force Air

The Predator has proved its ability to provide a significant and urgently needed reconnaissance capability in many mission areas and the continued participation of each Service must be maintained.

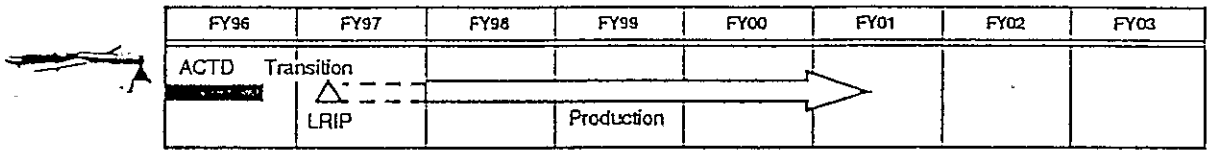
Dr. William J. Perry, SecDef
Memo for Secretaries of the Military Departments (et al.)
on Assignment of Service Lead for Operation of the Predator UAV, 9 April 1996

Providing Multi-Role Support to All Operational Echelons

Combat Command's 11th Reconnaissance Squadron, Nellis AFB, NV, assumed operational control (OPCON) of assets.

In the Defense Appropriations Act for FY 1997, the Congress transferred *Predator's* production funding from the Defense-wide Procurement account to the Navy's Procurement account and increased the amount by $50 million to $115.8 million for the year (which included funding for U-CARS integration on *Predator* and *Outrider*).

Schedule



Transition and Acquisition Program Features

Predator constituted a Class II (weapon/sensor system) ACTD and will enter formal acquisition as an LRIP program. The JROC recommended an initial force of 16 systems (plus attrition spares) (JROCM 010-96), including one system for R&D, or more than 60 AVs, counting the retrofitted ACTD versions. Resource programming to support life-cycle acquisition, operations and support is ongoing and candidate capabilities are listed below. The DoD plans to continue all system development and procurement through the Navy's UAV JPO, while the Air Force manages system operations and maintenance. *Predator's* LRIP production configuration and longer-term P3I program will be more fully defined in FY 1997.

Configuration Feature	Baseline	P3I*	Remarks
De-icing system	X		Required for reliable all-weather operation
Onboard UHF voice radio	X		For BLOS communications with ATC
Improved identification friend-or-foe (IFF)	X		Positive airborne control requirement
Engine upgrade		√	Rotax 914 to replace Rotax 912
Heavy fuel engine (HFE)		√	Mandatory for a marinized *Predator*
UAV Common Auto Recovery System (U-CARS)		√	Feasibility study to be completed Dec 96
Engine and propeller quieting		√	Exhaust system muffler, variable-pitch prop
Upgraded IR sensor		√	Under study for near-term P3I
Moving target indication (MTI)		√	Under study for near-term P3I
Improved GPS		√	Under study for longer term
SATCOM suite (Trojan Spirit) replacement		√	Under study for longer term
Upgraded GCS communications suite		√	Under study for longer term
Communications relay		√	Under study for longer term
Laser designation/rangefinder		√	Under study for longer term
SIGINT payload		√	Under study for longer term

*Recommended P3I candidates

The operational capabilities embodied in the Predator UAV system are a significant first step toward the continuous, real-time Reconnaissance, Surveillance and Target Acquisition (RSTA) required by 21st century joint warfighters. ACC is committed to developing our ability to employ the family of UAVs in that role.

General Richard E. Hawley
Commander, Air Combat Command
August 1996