Attachment 1: Aircraft, Control and Communications Systems
Reference: FAA AIR-160 UAPO Guidance Document 08-01

RNR APV3 Airframe

INL uses several types of light, under 55 lb, fixed wing and rotary airframes with a variety of 1 to 5 horse power electric, glow fuel, and gasoline piston engines. One RC class fixed wing UA is the RNR APV3 , Photo 1.

Photo 1: RNR APV3 UA

APV3 Configuration		Comment
Approximate Speed (stall/cruise/dash)	33/55/90 kts	Stable, includes full flaps for slow speed
Endurance	~6.0 hrs	2 gallons of fuel
Max Ceiling/Max Service	10,000 ft	
Max Payload Weight Wet	~20+ lbs	Removable payload pod can be custom
Payload Volume	~1200+ cu in	Large; removable shell, easy access
Launch	Landing Gear	Manual Pilot
Recovery	Landing Gear	Manual Pilot
Avionics	Cloud Cap	

Flight Control Systems and Ground Stations

The APV3 is remotely controlled using a waypoint autonomous/manual system from Cloud Cap Technologies, specifically the Piccolo II autopilot and ground station packages. See www.cloudcaptech.com.
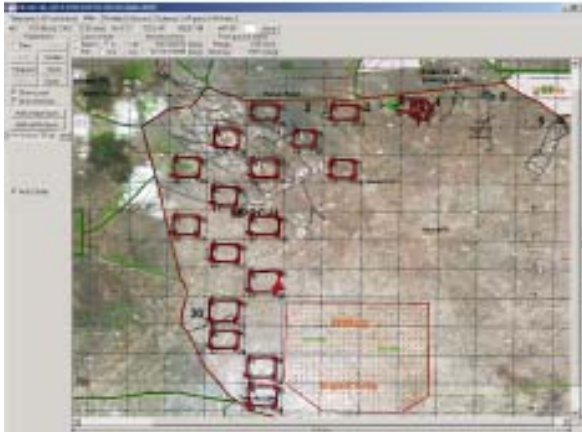

Photo 2: Cloud Cap Ground Station Software

Each flight of a single UA is controlled via a single ground station. However, extended flights may hand off control (and Pilot and Observer roles) from one ground station to another to allow constant line of sight over several miles. Photo 2 shows the Cloud Cap ground station software map with waypoint defined orbits in red. Waypoint autonomous flight uses an onboard GPS for navigation. UA locations are shown as icons on the map by downlinking GPS and other telemetry.

The Cloud Cap avionics package provides the capabilities of a high-end autopilot at a significantly lower cost. A standard autopilot system consists of the Piccolo II avionics and a ground control station.

Key features of the autopilot system include:

- Programmable GPS waypoint navigation
- Altitude and airspeed hold
- Auto Assist flight modes
- Full integration with 3-axis gyros, accelerometers, a GPS receiver, and pressure sensors all on a single circuit board
- Integrated 900 MHz RF link
- Ground and in-flight programmable flight plan
- Control of lights, parachute deployment, autonomous drop function, and brakes (to be exploited for camera control)
- Programmable flight termination
- Access to flight controls via secondary serial interface

Included with the autopilot system is ground-control software that offers the user a "… friendly point and click interface for mission planning" that runs on a Windows-based computer or laptop. If line-of-sight control is maintained, the software allows the operator to monitor and log vehicle telemetry data, change waypoints, upload new flight plans, initiate holding patterns, and adjust feedback loops, all while the UAV is in flight.

The INL has developed a mobile version of the ground control station to allow the UA PIC and Observer to follow UA flights to maintain line-of-sight. Photo 3 shows the mobile ground station.

Photo 3: Mobile UA Ground Station

Communications

Cloud Cap systems use unregulated (Instrumentation, Scientific & Medical ISM band) low power radio frequency links for command and control of the UA from the ground. The INL also has an onsite dedicated cellular communication infrastructure for research and development. It may be used as the communications medium. The INL may also use military or other frequency radios during R&D. If so, all frequencies used are approved by the INL site frequency manager. The INL is an National Telecommunications and Information Administration (NTIA, federal executive branch agency) Wireless Experimental Station and it's RF spectrum is managed in accordance with NTIA's rules and regulation for emittance of RF energy.