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Grand Forks Gets First Look at AeroVironment Qube

By Alan Frazier, *Deputy Sheriff, Grand Forks (ND) County Sheriff's Office, Assistant Professor, University of North Dakota's John D. Odegard School of Aerospace Sciences*

The Grand Forks County (ND) Sheriff's Department (GFSD) was selected in July 2012 as one of five evaluation sites for the Qube, AeroVironment's newest small unmanned aircraft system (sUAS).

While AeroVironment maintains a low-key corporate profile, it is a significant player in the sUAS industry. Founded in 1971 by innovator Dr. Paul MacCready, the company has grown to be the world's largest manufacturer of sUAS, with FY2012 revenues of $325 million. Based in Monrovia, CA, AeroVironment has more than 700 employees, most of whom are dedicated to designing and manufacturing sUAS like the Raven, Wasp and Puma.

GFSD collaborates with the University of North Dakota's (UND's) Law Enforcement Unmanned Aircraft Systems Research Project in the administration of a UAS Unit serving public safety agencies in 16 eastern North Dakota counties. Pilots are provided by the university, and sensor system operators/visual observers are provided by area law enforcement agencies. The unit currently operates three sUAS: the AeroVironment Qube and Raven-B DDL and the Draganfly Innovations X6.

In May 2013, the first production model of the Qube was delivered to GFSD, factory OEM training for pilots and visual observers was conducted, and the Qube flew its first mission.

Taking Off in the Qube

When GFSD-UND pilots began working with Gabriel Torres, AeroVironment's Qube program manager, over several months of Qube development, some were skeptical of its advertised capabilities. Now, since unit members have received Qube OEM training and deployed the sUAS on an actual mission, it's clear the Qube does everything promised and more.

The 5.5-pound quad rotor helicopter is stable and predictable. Aircraft control is

sUAS

Photos courtesy of Brenda Riskey, UND Aerospace

provided through a robust Panasonic "Tough Book" tablet computer with a user friendly, proprietary software interface. Touch screen technology enhances the simplicity of the user interface. Simple and intuitive icons and checklists populate the computer screen while still leaving room for a primary and secondary display. The two displays allow the pilot to simultaneously view a map of the area of operations and live video feed from the aircraft. The arrangement allows the pilot to view all vital information and control the aircraft without needing to scroll through multiple screens. To direct the camera, the pilot simply touches a spot on the primary display. The aircraft then turns toward the location and the camera slaves to the selected spot. The pilot can then advance the aircraft using simple forward and aft buttons. A left or right orbit of the camera focal point can be initiated by touching a button. Easy to interpret icons and warning messages keep the pilot apprised of GPS signal quality, aircraft battery condition, ground control station battery condition and link strength.

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The Qube in Brief

List Price:	$50,000
Price as tested:	$65,000 (including color (EO) and thermal (IR) cameras)
Range:	1 km
Endurance:	40 minutes
Length:	36 inches
Weight:	5.5 pounds (with EO/IR camera payload)
Payload:	Dual high-resolution color (EO) and Thermal (IR) cameras

Training Curriculum

Factory training begins with AeroVironment providing access to an online Qube training course. The nine course segments include safety, assembly, launch and recovery, operation of the tablet computer, and malfunctions/emergencies. Each segment concludes with a quiz on the information presented. GFSD-UND's five pilots completed the course in six hours on average.

AeroVironment intends to provide future users with a Qube simulator that resides on the same tablet computer as the Qube Control System Software, as well as copies of the Qube manual prior to face-to-face training. While GFSD-UND trainees did not receive these training aids, each pilot indicated he could assemble, pre-flight and safely fly the Qube based solely on the online training program.

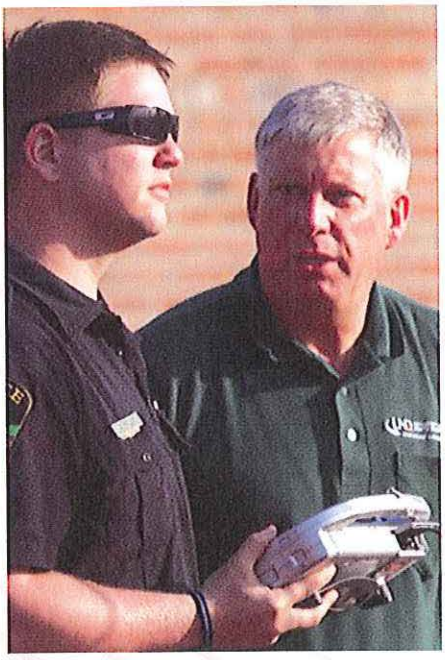
Face-to-face training for the GFSD-UND pilots was administered by Brian Hall, AeroVironment's chief sUAS flight instructor, accompanied by the Qube program manager and a Qube product engineer. The training consisted of PowerPoint-supported briefings, Qube simulator use, and hands-on outdoor Qube training within the GFSD Qube COA area of operations. Day one flights consisted of basic aircraft and ground control station assembly and use, pre-flight procedures, and multiple flights within a half-mile radius. Malfunction procedures, such as lost link and lost GPS, were also practiced. Day two was conducted indoors, as high winds precluded flying. Day three consisted of flying multiple simulated law enforcement mission flights within a large outdoor football stadium.

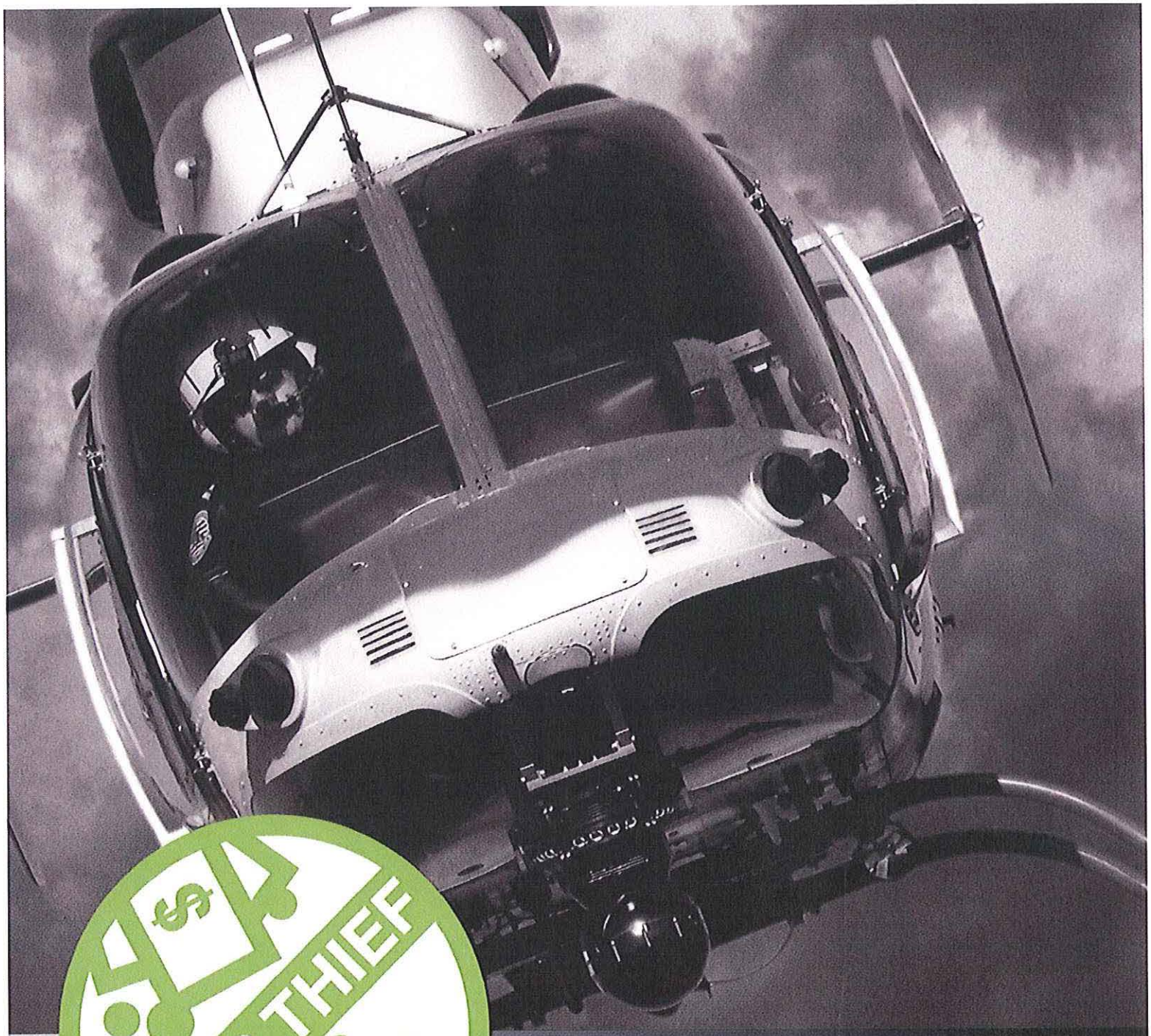
Using the System

The entire Qube system can be routinely assembled, pre-flighted and ready for operation in less than 10 minutes, even by inexperienced users like the GFSD-UND trainees. AeroVironment's claim of 40-minute flight endurance was routinely achieved during training.

A unique feature of the Qube is its ability to pre-program a defined flight radius and maximum operating altitude prior to launch. This "Geo-Net" easily permits operations to be conducted within a defined incident perimeter while remaining below the maximum altitude specified in an agency's FAA-issued COA. A remote video terminal, supported by a second tablet computer that provides real time video and can be linked to a larger monitor, was also used during flight training. The use of the terminal allows the pilot/visual observer team to maintain a sterile flight operations area while other personnel view the video feed at a nearby location.

GFSD-UND trainees reported the video quality was generally good but occasionally choppy and broken. AeroVironment representatives said this was because the Qube uses an unlicensed portion of the frequency spectrum. Although utilization of that portion





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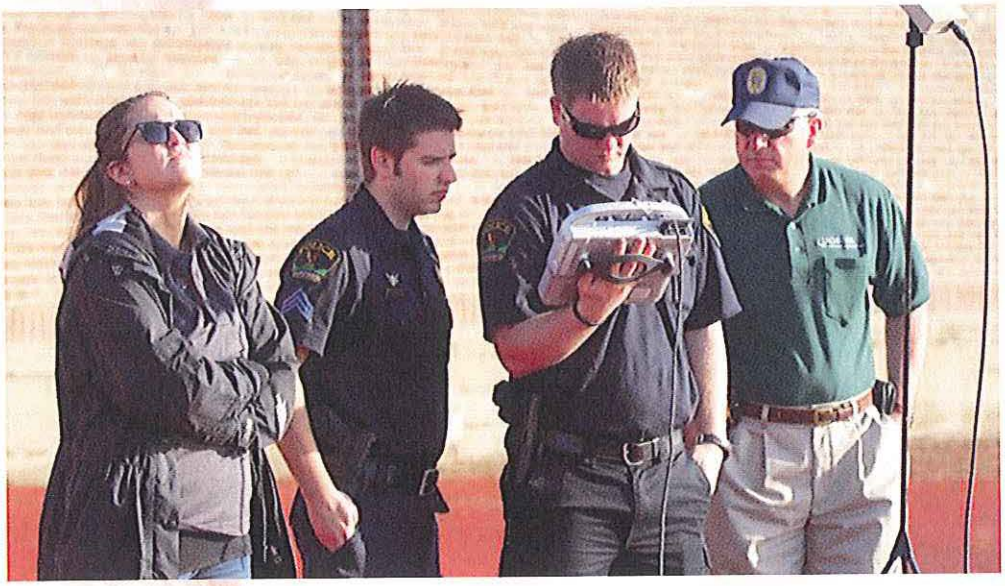

"Day one flights consisted of basic aircraft and ground control station assembly and use, pre-flight procedures, and multiple flights within a half-mile radius."

of the frequency spectrum eliminates the need for a specific Federal Communications Commission Radio License, it also exposes the Qube to potential radio frequency interference from other devices, such as wireless intercoms, WiFi networks and garage door opener remote controls. AeroVironment intends to experiment with a small radio frequency analyzer, which would identify which of the Qubes's five available channels would work best in a particular area. Users would activate the frequency analyzer prior to a flight and select the most interference-free Qube channel for operations. Still, even while the video was experiencing interference, high definition digital photos taken from the Qube were crystal clear when reviewed after the flight.

On two of GFSD-UND's 23 test flights, the Qube software experienced a glitch with the Panasonic Tablet operating system, and a malfunction procedure was used to recover the aircraft. The sUAS performed as required, returning to the launch point and landing within a couple of feet of the original takeoff location. While one type of glitch was considered to be good performance for the first production model of the Qube, AeroVironment identified and corrected the error within one month. GFSD has flown the Qube extensively since the software was fixed and has experienced no problems.

GFSD-UND operators indicated an area for improvement would be the cases used to transport the Qube and Qube Control Station. Although the interior of the cases are well organized, the hinges on the cases were less robust than expected. AeroVironment is searching for a more durable case and anticipates resolving the issue in the near future.

Throughout GFSD-UND's training and use of the Qube, AeroVironment representatives provided thoughtful support. They listened patiently to the trainees' input and made extensive notes on constructive comments. The company's customer service and support has also been good since the training.

The Qube is a step in the right direction for public safety sUAS. It is compact, easy to use, has good mission endurance, appears robust, and is backed by a company with a considerable amount of sUAS experience.