On a clear, crisp morning in June 2014, history was made on the North Slope in Alaska. For the first time in the United States, an FAA-certified unmanned aircraft, the Puma AE, was hand-launched into the air and flew over land to perform commercial services, including imaging and GIS. These information services deliver engineering-quality, decision-making information safely, reliably and effectively while also helping to protect the sensitive North Slope environment. This is an important, first-ever achievement in demonstrating the safe and effective use of proven UAS technology for commercial applications.

While this article will focus on the game-changing events in Alaska, the potential for engineers and others to work with timely, decision-quality aerial mapping data—at resolutions never before available—is boundless. For example, in the United States alone there are more than 2 million miles of energy pipelines, including 55,000 miles of crude oil pipelines connecting regional markets. Some are as short as a mile, while others extend more than 1,000 miles. There are more than 607,000 bridges that average 42 years old and many require inspection. More than 4,000 mines in the U.S. produce metal, industrial minerals or crushed rock.

The U.S. has more than 2.2 million farms and 41 percent of total U.S. land is farmland, where farmers are increasingly employing aerial mapping (primarily from satellites) and computers for precision agriculture to match seed, fertilizer and crop protection applications. Because of the flexibility and portability of small UAS information services, engineers and mapping professionals can easily and affordably incorporate these services into their respective businesses related to these various industries.

UAS Mapping in Alaska
In Alaska, BP Exploration awarded a five-year contract to AeroVironment to deliver a comprehensive solution for generating, processing and converting
data collected by portable UAS into actionable information. BP’s forward-thinking embrace of UAS technology has enabled the delivery of tangible economic and operational advantages. Integrated into BP’s routine operations, this new solution helps BP manage its extensive oil field operations, which account for about two-thirds of Alaskan oil production, in ways that enhance safety, protect the environment, improve productivity and accomplish activities never before possible, including imaging and 3D mapping.

The comprehensive information solution incorporates the proven Puma AE UAS, equipped with either custom integrated LiDAR or other electro-optical and infrared sensors. The sensors produce imagery and data for processing into 3D computerized models of roads, pads and pipelines, and other actionable information, including precision volumetric measurement and topographic analysis of gravel pits at the North Slope field. Highly skilled flight operators, many of whom are U.S. military veterans, operate the Puma AE systems.

The 13.5-pound Puma AE is fully waterproof, man-portable and can be assembled in minutes, hand-launched, operated and recovered on sea or land by a team of two people. It requires no infrastructure, such as runways, launch pads or recovery devices. In addition, the system is quiet and operates autonomously, providing persistent observation data. The unmanned aircraft is capable of up to 3.5 hours flight time per battery and has a wingspan of about nine feet. It is well suited for operations in highly sensitive ecological areas because of its electric propulsion, low acoustic signature and small operating footprint.

BP’s IT&S Chief Technology Office pursued the application of unmanned aircraft systems technology to enhance BP’s oil and gas operations. Recent FAA restricted category aircraft type (RCAT) certificates for Puma AE and a larger UAS over water were the first for UAS in the national airspace systems (NAS). BP defined its mapping needs for the Alaska North Slope and issued a request for information in June 2013 to multiple geographic information system (GIS), manned and unmanned aircraft systems companies. BP selected AeroVironment’s response and invited the company to perform a proof-of-concept demonstration.

AeroVironment successfully demonstrated mapping and inspection services incorporating UAS at the Prudhoe Bay field in September 2013 under a public certificate of authorization through the University of Alaska Fairbanks. These services included 3D road mapping, 3D gravel pit volumetric analysis, visual and 3D pipeline analysis, general topography and environmental monitoring services, and demonstrated the ability to support wildlife protection, ice floe monitoring, search and rescue and oil spill response. The team also demonstrated inspection of critical infrastructure, including flare stacks, tanks, bridges and power lines.

**Services included 3D road mapping, 3D gravel pit volumetric analysis, visual and 3D pipeline analysis.**

**UAS Advantages**

As part of a comprehensive data collection, processing and reporting solution,
AeroVironment integrated a LiDAR sensor payload into its battery-powered Puma AE UAS. Expert UAS operators are now performing photogrammetry and LiDAR analysis to survey Prudhoe Bay infrastructure including the gravel roads, pipelines and a gravel pit. The Puma AE’s ability to fly low, at 200 to 400 feet above ground level, and slowly, at less than 40 knots, provides BP with highly accurate geospatial information capabilities to help manage its complex.

FAA-approved commercial UAS operations for BP in Alaska represent a milestone for mapping, for both companies and the oil/gas and UAS industries. The service solution for BP combines Puma’s vantage point and performance capabilities to capture a much richer data set than otherwise available. The data sets are integrated with other geospatial data using large-scale back office processing to give customers unprecedented actionable information. One data product is delivering 3D imagery that is orders of magnitude better than anything available to customers from satellites.

In one application, surveying the 200 miles of roadways built to support North Slope activities is critical to the effective operation of the Prudhoe Bay field. Drill rigs that traverse the roadways span up to 28 feet wide, 132 feet long and weigh up to 3.5 million pounds, with a driver at each end. The highly accurate LiDAR-produced maps delivered by Puma AE, along with precision GPS guidance systems, assist drivers in keeping moving drill rigs centered on the roadways, even in low visibility conditions.

In another related application, the UAS information services provide specific information to BP’s road grading crews that tell them where to cut and fill, as well as the exact amount of gravel needed for the job. This information allows the team to achieve significant savings by resolving specific trouble areas instead of focusing on the entire network of gravel roads spanning the North Slope operation. The ability to process and provide onsite inspection of industrial infrastructure can help reduce costly shutdowns and detect some characteristics only measurable during operation.

**UAS Track Record**

While the employment of small UAS in the field of mapping and surveying is new and may seem “revolutionary,” small UAS have been used extensively for more than a decade to keep U.S. and allied military safe and to give them unmatched advantages in urban environments or rugged mountains. AeroVironment’s UAS also have been used by other non-military customers, including sheriff and search and rescue departments, the National Oceanic and Atmospheric Administration and the U.S. Geological Survey.

AeroVironment’s extensive operational track record includes the production and delivery of nearly 25,000 new and replacement small UAS with cumulative flight time estimated at more than one million hours. The company has delivered its small UAS to customers in the U.S. and more than 30 allied nations, and supplies more than 85% of the UAS fleet to the U.S. Department of Defense. The time, rigor, and resources AeroVironment invested to develop, test, and qualify military small UAS are allowing the company to satisfy FAA requirements for reliability and safety certification and facilitating approval of our systems for commercial operation.

AeroVironment developed the first hand-launched unmanned aircraft system (UAS) in the late 1980s. Even then, AeroVironment’s engineers believed UAS would be used in many applications. With changes in U.S. airspace regulations pending, a commercial market is beginning to present itself, independent of the defense market, which provided the opportunity to refine and prove small UAS technology in the most demanding applications. The solution launched for BP is a natural extension of AeroVironment’s UAS business, which remains focused on delivering valuable information to customers when and where they need it.

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