

## **AFRL, Boeing Demonstrate That UAVs Can Perform Automated Aerial Refueling**

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Can an unmanned air vehicle be made smart enough to autonomously rendezvous with a tanker aircraft and refuel? Based on recently concluded flight tests by the U.S. Air Force Research Laboratory and Boeing [NYSE: BA], it can.

"By adding an automated aerial refueling capability to UAVs, we can significantly increase their combat radius and mission times while reducing their forward staging needs and response times," said David Riley, Boeing Phantom Works program manager for the Automated Aerial Refueling (AAR) program.

The goal of the government-industry AAR program is to develop and demonstrate systems that will enable UAVs to safely approach and maneuver around tanker aircraft so they can successfully perform boom and receptacle refueling operations. The systems -- including a flight control computer and control laws developed by Boeing Phantom Works -- are demonstrated using a Calspan Learjet specially equipped to fly autonomously as a UAV.

During a recent flight test, the AAR system autonomously guided the Learjet "UAV" up to a Boeing KC-135R tanker and successfully maneuvered it among seven air refueling positions behind the tanker -- contact, pre-contact, left and right inboard observation, left and right outboard observation, and break away. The system controlled the Learjet for more than 1 hour and 40 minutes and held the aircraft in the critical contact position for 20 minutes.

While a pilot flies the Learjet to and from the vicinity of the tanker and stands by to take over if necessary, he does not otherwise control the aircraft during the refueling maneuvering portion of the experiment.

"These tests show that we are making great advancements in system integrity, continuity and availability through improved relative navigation algorithms, control laws and hardware," Riley said. "They also show we are making great strides toward transitioning AAR technology into production."

Plans call for a follow-on Phase II program that will include autonomous multi-ship operations and delivery of fuel to the surrogate UAV.

The AAR team includes a diverse set of government and contractor organizations. The U.S. government team includes:

- The Air Vehicles, Sensors, Human Effectiveness and Information Directorates at the Air Force Research Laboratory
- Air Force Flight Test Center and Air Force Test Pilot School at Edwards Air Force Base
- Naval Air Systems Command (NAVAIR)
- 107th Air Refueling Wing, New York Air National Guard
- 827th Aircraft Sustainment Group at Tinker Air Force Base
- Defense Advanced Research Projects Agency Information Exploitation Office
- Aeronautical Systems Center
- Air Mobility Command

The AAR industry team includes:

- Boeing Phantom Works, which built the AAR flight control computer and developed the AAR control laws
- Calspan, which operates the Learjet

- Rockwell Collins, which supports KC-135 operations, builds the Tactical Targeting Network Technologies data link, and produces the GPS receiver card
- L3 Communications, SySense and the Illinois Institute of Technology, which work with NAVAIR to develop the precision global positioning system-based relative navigation system
- Northrop Grumman, which built the INS/GPS, developed PGPS algorithms, and developed an EO/IR position sensing system
- General Dynamics Advanced Information Systems, which provides systems engineering and flight test management assistance
- Syngenics, which coordinates the AAR trade studies
- Bihrl Applied Research, which integrates simulation environments
- The Institute for Scientific Research, which develops image processing algorithms
- Coherent Solutions, which develops required navigation performance

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