Boeing X-31A Vector Completes International Flight Test Program

The Boeing [NYSE: BA] X-31a VECTOR aircraft completed a three-year, multinational flight test program last week, successfully demonstrating the use of thrust vectoring technologies for performing extremely short takeoff and landing (ESTOL) operations.

In its final flight on April 29 at Patuxent River Naval Air Station, Md., the X-31A performed the last in a series of fully automated ESTOL landings on an actual runway, approaching at a high 24-degree angle-of-attack (twice the normal 12 degree AOA) at only 121 knots (more than 30 percent slower than the normal 175 knot landing speed).

"The high angle of attack landing was very exciting and dramatic," said Gary Jennings, VECTOR program manager for Boeing Phantom Works. "More important, we proved that an integrated flight and propulsion control system has potential for use in extremely short takeoffs and landings.

"With ESTOL capabilities, fighter aircraft would have greater operational flexibility and lower life cycle costs, Jennings explained. "They would be able to operate from dramatically shorter runways or roads, land on carriers with less wind over the deck, and not have to jettison ordnance or fuel. And because of reduced wear-and-tear from slower, softer landings, the aircraft could be built with lighter, more affordable structures and materials and not require as much maintenance," he said.

The VECTOR program ESTOL demonstrations were jointly conducted by the U.S. Navy, Germany's defense procurement agency, the European Aeronautic Defence and Space (EADS) Company, and the Boeing Phantom Works, which served as lead systems integrator for the X-31 VECTOR, the world's only international X-plane.

For demonstrating ESTOL operations, the X-31 is equipped with three paddle-like tail vanes that allow the flight control system to vector the engine's exhaust to retain control at angles-of-attack beyond the stall limit of traditional aircraft. In addition to this system, the X-31 was also equipped with an Integrity Beacon Landing System which is a GPS-based navigation system provided by IntegriNautics, an auto-throttle system from an F-18 and an autopilot developed by the VECTOR team.

"Since the pilot can't see the runway at such high angles of attack, all these systems operate together to automatically de-rotate the aircraft to its normal landing attitude for a safe landing when the engine nozzle is only two feet above the runway," Jennings said.

Demonstrating an automated ESTOL landing on an actual runway completed Phase III flight testing of the X-31 VECTOR, which began April 3 of this year. Phase I flight testing, from February 2001 to April 2001, focused on pilot familiarization and validating systems. Phase II, from May 2002 to March 2003, focused on ESTOL control law development using a virtual runway in the sky, validation of the IBLS navigation system and data collection for the EADS flush air data system (FADS). The FADS was a separate experiment performed by EADS and not part of the ESTOL technology.

In closing out Phase III, the program will perform data analysis and record information for future research and programs.

The X-31A was originally developed and flown under the Enhanced Fighter Maneuverability (EFM) program, conducted from 1990 to 1995 as a joint venture by the U.S. Navy, DARPA (Defense Advanced Research Projects Agency), NASA and Germany. That program demonstrated how thrust vectoring could be used to enhance performance in air-to-air fighter engagements.

Capitalizing on this previous EFM investment, the VECTOR program started with Boeing Phantom Works restoring the X-31A to flight status after nearly five years in storage. As the advanced R&D unit and a catalyst of innovation for the Boeing enterprise, Phantom Works provides advanced solutions and innovative, breakthrough technologies that reduce cycle time and cost while improving the quality and performance of aerospace products and services.

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