ABL Beam Control System Laboratory Demonstrator Shows Performance Needed For Airborne Laser

Team ABL -- the U.S. Air Force, Boeing, Lockheed Martin and TRW -- today announced that a scaled Laser Beam Control System built by Lockheed Martin Missiles and Space, Sunnyvale, Calif., has demonstrated the functional performance needed for the Air Force's Airborne Laser (ABL).

The successful laboratory tests addressed a key issue in the development of the weapon system -- how to accurately point and focus a laser at a hostile missile hundreds of miles away despite aircraft platform jitter, atmospheric turbulence, and fast engagement timelines. The experiments were conducted on a scaled beam control system demonstrator that functionally replicates all elements of the full-scale ABL Beam Control System. The system transports the ABL's laser beam up to and out through the nose of the 747 and to the target.

These latest test results provide a firm foundation for the team to proceed with the final design, manufacture and implementation of the Air Force's aircraft-based theater missile defense system. "This successful demonstration validates the tracking, pointing hardware and algorithms approach necessary for the ABL mission," said Paul Shattuck, Lockheed Martin Missiles & Space ABL program manager. "This clearly shows the ABL program is ready to proceed into the critical design phase of the Program Definition and Risk Reduction (PDRR) program."

The ABL weapon system will be mounted in a modified Boeing 747-400 freighter that will operate over friendly territory at altitudes above the clouds. At those altitudes, the system will acquire, track and point a lethal laser beam onto a hostile missile during its highly vulnerable boost phase of flight while still near its launch area.

To ensure the sophisticated beam control flight system is properly designed, Lockheed Martin developed the laboratory demonstrator to simulate the flight hardware as well as the disturbances -- such as aircraft platform motion and atmospheric turbulence -- to which the hardware and software must respond and compensate.

A major technical challenge for ABL is the long movement path through the atmosphere, which causes distortion of the high-energy laser beam. These atmospheric effects were measured by the Air Force as part of their ABL risk reduction program. Lockheed Martin used this measurement data to anchor its Beam Control Laboratory Demonstrator and its high-fidelity optical simulations.

The data also were used to fabricate atmospheric turbulence simulation optics, so-called phase screens, which permitted reproducible and controllable evaluation of the beam control system design. The anchored high-fidelity simulation software code allows for trustworthy performance predications to be generated for other ABL engagement scenarios and studies that cannot be easily tested in the laboratory. Flight software algorithms also were developed and tested during the analysis.

"This testing approach will produce a final beam control design with greatly diminished risk to performance and cost," explains Paul Shennum, Boeing vice president and ABL program manager. These laboratory tracking demonstrations started as a series of tests beginning in 1994 to verify the conceptual design for vibration suppression and laser beam atmospheric correction.

Aircraft-induced vibrations, resulting from aircraft flight through a turbulent atmosphere, are reduced using passive isolators, i.e. shock absorbers, for the low frequency components and compensated with fast steering mirrors for the high-frequency components. The ability to control aircraft to the 100-nanoradian level has been demonstrated in scaled testing at the Palo Alto facility. This level of accuracy is comparable to making a basket in a basketball game 500 miles from the basket.

In the next phase of the laboratory beam control tests, measurements will be made to determine the missile kill range and its variability under a full spectrum of atmospheric turbulence under which ABL may have to operate. The specific conditions are those now being determined by the Air Force in the Atmospheric Compensation Working Group activity that encompasses worldwide measurements.

"The results of the successful test underscore the maturity of the ABL beam control segment's preliminary design," said Dr. Ron Andrews, vice president, Lockheed Martin Missiles & Space Advanced Technology Center, Palo Alto, Calif. "It also shows the maturity of technology which has been developed over the past 20 years at Lockheed Martin."

Team ABL will achieve residual operational capability by completing production, integration and flight demonstration of the first ABL system in 2002, culminating in the successful boost-phase shoot-down of a theater ballistic missile. Initial operating capability of three aircraft will be achieved in 2006 and the system will be fully fielded with four more aircraft in 2008.

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