

AIRBORNE LASER (ABL)



The Airborne Laser (ABL) is intended to shoot down enemy Theater Ballistic Missiles (TBMs) during their boost phase of flight. The ABL engagement concept calls for the laser to focus on a missile's booster skin, rupturing it or damaging it sufficiently to cause the missile to lose thrust or flight control and fall short of its intended target. The ABL engagement of TBMs in the boost phase should result in the negation of the missile before decoys, warheads, or submunitions are deployed.

ABL is designed to be rapidly deployable and add a boost-phase layer to the Theater Missile Defense (TMD) capability. It will be positioned behind the forward line of friendly troops and moved closer toward enemy airspace as local air superiority is attained. The Air Force is proposing a seven-aircraft fleet and envisions that five aircraft would deploy to support two 24-hour combat air patrols in a theater.

The aircraft will be a modified Boeing 747-400F (freighter), carrying a megawatt-class Chemical Oxygen Iodine Laser (COIL) operating in the near infrared (1.315 microns). In addition to the laser, the ABL system will also have a Beam-Control/Fire-Control (BC/FC) system and a Battle Management, Command, Control, Communications, Computers, and Intelligence (BMC4I) system. The BMC4I system will provide autonomous capability to detect and track the target and manage much of the engagement. A passive IR sensor suite will provide boosting TBM detection capability, and an active laser ranger system provides precise ranging and angular pointing. After a target has been acquired, the BC/FC system will actively track the missile and use adaptive optics to compensate for the degrading effects of atmospheric turbulence on the laser beam's path. Once the BC/FC system has established a track, the high-energy laser will irradiate the missile until it has been negated.

BACKGROUND INFORMATION

The program passed Milestone I and entered the Program Definition and Risk Reduction (PDRR) phase in November 1996. During the PDRR phase, one ABL system will be built to demonstrate the feasibility of the system. The high-energy laser on the PDRR system will have about half the energy of the full production-representative system, and a number of the other subsystems will also not be production-representative.

There are several interim milestones during PDRR. AFOTEC completed EOA-1 in May 1998 to support the Authority to Proceed (ATP-1) decision in June 1998. Overall, EOA-1 found the ABL

program and system design were on track at that early stage of the PDRR phase. The team did not assess potential operational effectiveness and suitability because of the lack of performance data on flight-representative hardware and software. The ATP-1 decision allowed the Air Force to commit to the purchase of the commercial 747-400F, which will be used for the PDRR system. As currently planned, an ATP-2 review is scheduled for late FY02. This review will authorize the long-lead purchase of the EMD aircraft. Current ATP-2 criteria are (1) performance of the integrated PDRR beam control system at low power; (2) multi-module operation of the PDRR laser modules; and (3) an integrated surveillance system performance.

The program took delivery of the PDRR aircraft from Boeing's commercial assembly line in January 2000, and modifications began that same month at Boeing's Wichita plant. A system-level critical design review was held in April 2000. The aircraft begins ground testing in November 2001, in Wichita, and is scheduled for first flight in January 2002. In FY01, the Tracking Illumination Laser (TILL) and the flight weighted, high-energy laser module both demonstrated initial lasing capabilities. Fiscal Year 2001 was very turbulent for the ABL program. The program was underfunded and ran out of money in March 01, although the contractor team continued to work at risk. This problem was resolved in September when supplemental funding was received. The Department decided to transfer management of ABL from the USAF to BMDO, effective October 2001.

TEST & EVALUATION ACTIVITY

Much progress was made on the MS I TEMP update during this period, but finalization was hampered due to program changes resulting from budget cuts and program restructuring. The System Program Office is planning to finish this update and submit the TEMP to OSD in early FY02.

Laser development and testing have continued and contributed to the final laser-module design for the PDRR aircraft. Several experiments were conducted by the Air Force Research Laboratory (AFRL) to measure fundamental thermodynamic and optical properties of relevant materials, including a number of potential countermeasures and threat target vulnerabilities. Critical components and sub-systems have been investigated under simulated flight and propulsive conditions to gain a better understanding of the internal operating condition of an in-flight missile.

In support of the ATP-2 decision, the 12-month EOA-2 was started in July 2001 by AFOTEC. EOA-2 will address potential operational effectiveness and suitability, potential operational impacts, programmatic issues, requirements, and program support for OT&E. EOA-2 will obtain data from a variety of events and activities, including aircraft/BMC4I ground and flight tests; laser development, tests, and integration; and BC/FC integration and ground tests.

TEST & EVALUATION ASSESSMENT

Overall, the PDRR program contains reasonable amounts and types of tests, but the schedule is ambitious and clearly success-oriented. Although the proposed EMD schedule has increased from 2 to 4 years since last report, ABL remains a high-technical risk program, and the aggressive schedule allows for no significant problems or test failures. The abbreviated EMD phase was originally justified because the PDRR and EMD systems were assumed to be scalable, identical except for the number of laser modules and weight reduction of basic module design. However, the PDRR and EMD designs are beginning to differ more significantly, and further design changes may be required in the future. The

current EMD plan may result in a high degree of concurrency between the PDRR and EMD phases, which would increase risk, and might not provide adequate time to transfer all lessons learned during PDRR testing into the EMD design. When compared to other major acquisition programs that are less complex, the 4-year EMD program is relatively short.

There will be significant challenges involved in adequately testing and evaluating ABL. Specific concerns include the following:

It will be difficult to test the ABL against an appropriate mix of threat targets the ABL is required to negate. The ABL System Threat Assessment Report (STAR) lists approximately 30 threats that the ABL is required to negate. These missiles include a diverse range of physical and operating characteristics. However, of the various combinations of physical and operating characteristics, it is unlikely that more than one or two of these missile types will be available for testing, and it is unclear how the program will demonstrate effectiveness against the array of different threat missile types. The Live Fire Test and Evaluation (LFT&E) lethality strategy must address targets that will not be included in the flight test program.

It may be difficult and/or cost prohibitive to perform end-to-end operational tests that cover all of the important parameters of the ABL operating environment. These parameters include range, level of turbulence, azimuth and elevation angles, day and night engagements, and the presence of clouds and other atmospheric conditions.

Likely countermeasures that reduce ABL's effectiveness need to be identified and included in ABL's test and evaluation program.

The ABL survivability must be addressed. Early understanding of the threats to the ABL system and ABL system vulnerabilities will be crucial for development of an executable LFT&E strategy for survivability.

- Producing a system that is operationally suitable will be a challenge. The ABL system will have new and unique maintenance requirements compared to other airborne military systems. Thus, adequately assessing the reliability, maintainability, availability, safety, and the required logistics support of the ABL in operationally realistic conditions is an important part of the OT&E.