FACT SHEET

UNITED STATES AIR FORCE

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Airborne Laser (YAL-1A)

ABL on a refueling mission over California, December 2002

One of the Missile Defense Agency's highest priority programs involves putting a weapons class laser aboard a modified Boeing 747-400 series freighter aircraft and using that laser to destroy ballistic missiles shortly after launch. The program is called the Airborne Laser, and its development could forever change the way that nations wage war.

Destroying ballistic missiles is a complicated process, one that is confounded even more by the revolutionary use of a directed energy device as a weapon rather than as a targeting or range-finding apparatus. To be successful, ABL must:

- Be housed aboard a stable platform that can stay aloft for hours on end above weather systems whose clouds could refract its laser beams and nullify its effectiveness;
- Be equipped with sensors able to locate a ballistic missile shortly after launch and hold the track long enough for other system elements to swing into operation;
- Be implemented with a sophisticated computer system capable of keeping track of dozens of missiles and prioritizing them so that the most threatening is targeted first;
- Have a highly developed optical system capable of measuring the amount of thermal disturbance between the aircraft and the target, then be capable of directing a beam of energy that self-compensates for the clear-air obstacles;
- Possess the ability to focus the killer beam on a rapidly rising target, which may be traveling at a speed of Mach 6 or more, then keep the shaft of energy in place long enough to burn a hole in the missile's metal skin;
- And lastly, be provided with a laser powerful enough to prove lethal at a distance of hundreds of kilometers.

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Some of those requirements already have been tested:

- The first ABL aircraft – YAL-1A -- made its virgin flight over western Kansas on July 18, 2002, staying aloft for one hour and 22 minutes before returning to the Boeing modification facility in Wichita. Between then and the time it transitioned to its new temporary home at Edwards Air Force Base, Calif., in December, YAL-1A made an additional 13 flights logging more than 60 flight hours;

  

  First Flight

- As part of a Missile Defense Agency test over the Pacific Ocean in December 2002. ABL's infrared trackers successfully detected a Minuteman booster rocket as soon as it broke the clouds, holding a lock until the rocket's engines burned out 500 kilometers downrange;
- Its battle management (computer) system was flight tested in late summer and early fall of 2002 to verify internal crew communications and the V/UHF radios, plus the data acquisition system and High Definition VHS;
- The six infrared search and track sensors were successfully flight tested;
- The first COIL module that will be installed on YAL-1A tested at 118 percent of anticipated power during a shakedown run at TRW's facility in San Juan Capistrano, Calif., in January 2002. Shortly afterwards, it was disassembled and shipped to Edwards Air Force Base.

In December 2002, YAL-1A was pulled into a hangar at Edwards' Birk Flight Test Facility where it will be grounded while the lasers and optical components can be tested and installed.

The goal of the Missile Defense Agency, which has overall management responsibility for the program, and the Airborne Laser System Program Office at Kirtland Air Force Base, N.M., is to have YAL-1A ready to shoot down a threat-representative ballistic missile by December 2004. Currently, the missile is scheduled to be launched from Vandenberg Air Force Base, Calif., with the shootdown to take place over the Pacific.

Construction and testing of YAL-1A (prototype attack laser, model 1A), the first aircraft in a proposed fleet of so-far undetermined size, are the results of an effort by MDA, the program office, the Air Force, and three major contractors – Boeing, Lockheed Martin,

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and Northrop Grumman Space Technologies (formerly TRW). In addition, the U.S. Air Force's Aeronautical Systems Center, headquartered at Wright-Patterson Air Force Base, Ohio, has provided office personnel. The Air Combat Command, headquartered at Langley Air Force Base, Va., will assume control over the plane once it is declared operational and transferred back to the Air Force.

The ABL program office was formed in 1993. Three years later, in November 1996, the Air Force awarded a $1.1 billion contract to the Boeing Defense Group of Seattle, Wash., TRW Space and Electronics Group of Redondo Beach, Calif., and Lockheed Martin Missiles & Space of Sunnyvale, Calif.

Boeing built the aircraft in Everett, Wash., and modified it in Wichita. The company also developed the hardware/software used in the battle management system and is managing integration of the main components. TRW built the megawatt-class COIL laser that produces the knockout punch to ballistic missiles, and Lockheed Martin is responsible for the optical system.

Another key organization is the Air Force Research Laboratory's Directed Energy Directorate, also at Kirtland Air Force Base, N.M., where the COIL was invented in 1977. For a quarter of a century, the Laboratory has been conducting research into a myriad of technologies needed to make a laser-carrying aircraft a reality. Besides the COIL, the Laboratory also developed the technologies that will increase the distance laser light can travel through the atmosphere to destroy attacking missiles.

The Aircraft – The Air Force bought a 747-400F straight off the Boeing Commercial Aircraft assembly line and flew it to Wichita, Kan., in January 2000. Boeing workers virtually rebuilt the aircraft, installing miles of wiring, grafting huge sheets of titanium to the plane's underbelly to protect the exterior from the heat of the laser exhaust and, most importantly, adding a 12,000-pound bulbous turret on the front of the aircraft to house the 1.5 meter telescope through which the laser beams will be fired. Company officials said it was the largest military modification to a commercial aircraft that Boeing had ever attempted.

Acquisition, Tracking & Pointing – In addition to a powerful laser, an airborne laser system also must be able to find and hit its targets. Numerous tests have been conducted at the White Sands Missile Range in southern New Mexico, both with lab-type instruments and the actual aircraft, to demonstrate the system's ability to identify and follow a potential target.

The Lasers – Central to this system is the COIL. As a laser that generates its energy through chemical reaction it has advantages over solid-state lasers, most notably in the amount of energy it can produce. COIL energy is produced by chemical reaction when oxygen and iodine molecules are mixed. A tremendous additional advantage is that the laser propagates at 1.315 microns in the infrared (invisible) spectrum. This wavelength travels easily through the atmosphere and has greater brightness – or destructive potential

– on the target. There are three other important lasers aboard the aircraft: the Active Ranger System which provides preliminary tracking data; the Track Illuminator Laser, which produces more refined data, and the Beacon Illuminator Laser, which measures the amount of atmospheric disturbance.

Correcting For Atmospheric Turbulence – The ability to find and track a boosting missile would be meaningless without a corresponding ability to lock onto and destroy the intended target. Since air, like water, is made up of many layers, scientists needed to find a way to compensate for these disturbances in the atmosphere in order to focus a high-energy beam on the target and hold the beam in place long enough for it to complete the destruction process. The system that will be installed on YAL-1A is the result of more than 15 years of research conducted by scientists at the Laboratory's Directed Energy Directorate and the Massachusetts Institute of Technology's Lincoln Laboratory. Working out of astronomical facilities at the Starfire Optical Range in the southeastern corner of Kirtland Air Force Base, researchers made revolutionary breakthroughs using lasers, computers and deformable optics.

Systems Integration Laboratory (foreground)
Ground Pressure Recovery Assembly (background)

The ABL Integrated Test Force – Actually a complex of buildings located at the historic Birk Flight Test Facility at Edwards Air Force Base, Calif. The gem of the ITF is the System Integration Laboratory (SIL), an 18,000 square-foot building housing a surplus 747 fuselage test stand that will serve as a laser template for the ABL aircraft. The six modules that compose the COIL component initially will be tested in the SIL. Once those tests have been completed, the modules will be disassembled, then reassembled on YAL-1A. Other resources in the ITF complex include a Ground Pressure Recovery Assembly (GPRA), which will enable simulation of ABL's anticipated cruising height, and a mixing area for Basic Hydrogen Peroxide, a vital ingredient to the main laser's chemical reaction process.

History – Almost 20 years ago, the Air Force Research Laboratory and its predecessor units completed a project that showed the potential for an airborne laser. A KC-135A tanker airplane (a military version of the Boeing 707) was modified and equipped with a gas dynamic laser. This aircraft shot down a low-flying drone and five air-to-air missiles, proving the concept was possible.

The Airborne Laser Laboratory aircraft

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Later tests also were conducted at White Sands Missile Range aimed at finding out how effective a laser would be. For these tests, the nation's most powerful laser, the Mid-Infrared Advanced Chemical Laser, was used. In every case, scale models of typical targets were easily destroyed.

The System – Computer simulations indicate that an airborne laser would be very effective under battle conditions. Currently, the program will provide the United States with its only near-term boost-phase missile defense, that is, the ability to find and destroy a missile between the time it is launched and its booster rockets burn out.

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(Current as of 27 February 03)