



The ABL will be ready in two years. Planners think it might be possible to expand the mission.

By John A. Tirpak, Executive Editor

Setting a Course for

WITHIN two years, the first Airborne Laser is expected to shoot down a Scud missile and be declared ready for “emergency” duty overseas. At the same time, the ABL mission may expand to encompass not only theater missile defense but also defense against ICBMs.

ABL program officials predict that by early 2005 they will have the first aircraft fully configured, tested, and ready to take a shot at a live Scud missile. If it succeeds, the ABL will

then be available for limited duty overseas to protect US or allied forces against theater ballistic missiles. As more ABLs are built, the capability would grow. Plans call for fielding a full seven-aircraft fleet sometime in the next decade.

Since its integration into the Missile Defense Agency in October 2001, the ABL program has been transformed in ways that may widen its portfolio beyond simple defense against theater ballistic missiles.

DOD has made no decision yet



the Airborne Laser

about “the full application of ABL,” said program director Col. Ellen M. Pawlikowski. However, she added, the Airborne Laser is “being considered” not only for theater but also for national missile defense. “We can contribute to both of those missions, in the boost phase,” she said.

The ABL is a system of lasers mounted on a 747-400 airframe. It will be able to detect the launch of a ballistic missile, track it, and shoot it down with a high energy laser. Orbiting just outside enemy terri-

tory, the ABL will spot a hostile missile launch by “seeing” the plume of the rocket engines and then employ its lasers to determine range to the target and the turbulence of the atmosphere. It will then use these data to fix a focused, high-power laser beam on the missile’s skin, causing it to rupture and explode.

The ABL’s actual power level is classified, but it is described as being in “the megawatt class.”

Early plans envisioned ABL as a system to protect deployed US and

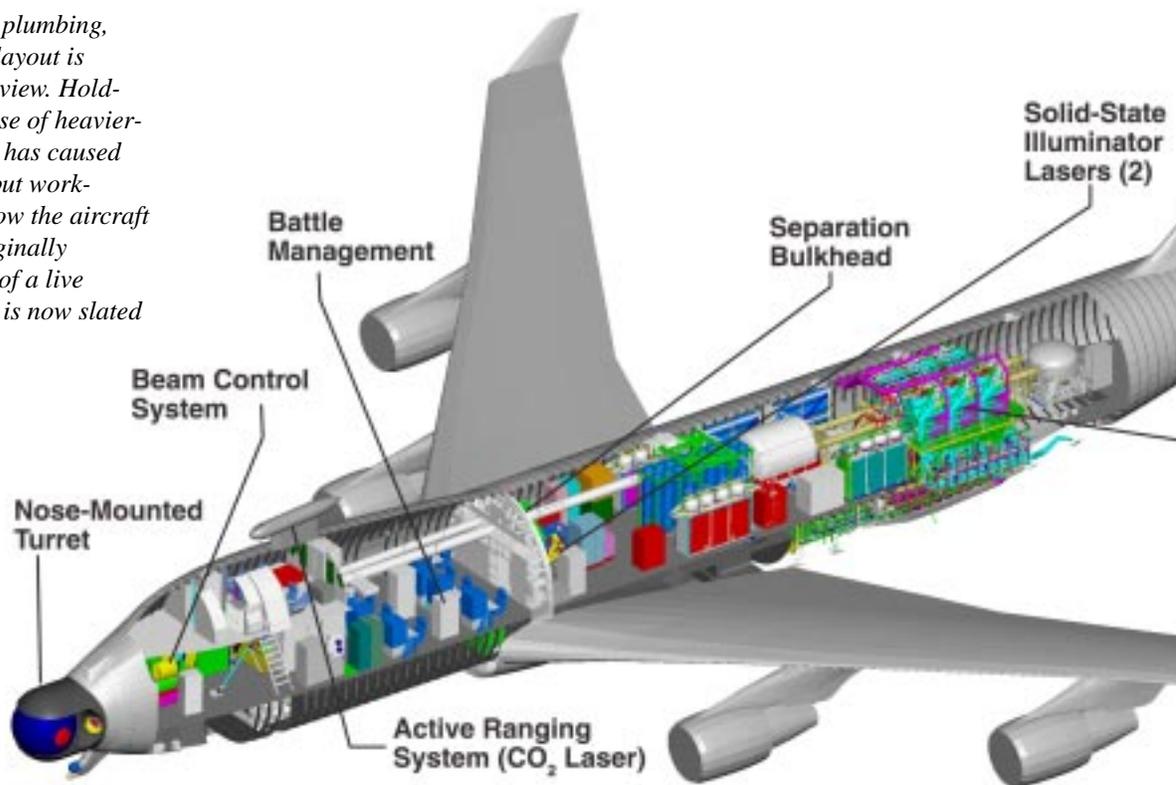
allied forces in combat areas. Some number of ABLs could be deployed worldwide to watch for the launch of an ICBM, determine its intended point of impact, and destroy it before it even left the launching nation’s airspace.

Powerful Deterrent

Such a capability would be a powerful deterrent since the missile and its warhead would fall back on the nation that launched it.

It is easier to track and destroy a ballistic missile in its boost phase.

The ABL's labyrinthine plumbing, optics, and electronics layout is evident in this cutaway view. Hold-downs, fasteners, and use of heavier-than-planned materials has caused ABL's weight to grow, but work-arounds should still allow the aircraft to perform much as originally expected. A shootdown of a live theater ballistic missile is now slated for early 2005.



Once it releases a warhead and that weapon reaches its terminal phase of flight, complications multiply. The target becomes smaller and faster and usually would be attended by decoys. The result is that an anti-ballistic missile system almost literally must “hit a bullet with a bullet.” The first phase of the Administration’s national missile defense system takes this terminal-phase approach.

Giving the Airborne Laser capabilities against ICBMs would chiefly require adding power to the system’s destructive laser. Because ICBMs are faster than TBMs, the laser would have a shorter time to dwell on the missile’s skin and thus have to be more energetic to pierce the booster skin.

In addition, the ABL as an ICBM interceptor would also likely be farther away from potential launch points deep inside the attacking nation’s territory, meaning it would have to be more powerful to traverse greater distances with the same effectiveness.

To expand the ABL charter to include defense against ICBMs would require more aircraft. One Pentagon official who has examined various missile defense architectures said that

a “highly capable” round-the-clock ABL deployment, covering most of the nations possessing ICBMs, could be achieved with 10-15 “orbits,” each of which could comprise five airplanes. He said a “comprehensive” defense against nations with ICBMs could be achieved with 20-25 orbits, requiring about 100-125 aircraft. However, a report by the American Physical Society challenged whether ABL could be used as an ICBM defender. (See “Washington Watch,” p. 11.)

The Pentagon’s Fiscal 2004 budget request projects spending \$3.4 billion on ABL through 2009, part of the \$50 billion to be spent on missile defense collectively during the same period.

Stretching Technology

When USAF conceived the ABL program in 1994, officials acknowledged the project would be a technological “reach.” They would be required to create laser hardware at power levels and a physical size not then possible. USAF has done tremendous work reducing the size and increasing the power output of the laser modules, developing lighter plumbing systems for the chemicals that power the high energy laser, and

creating a battle management system that ties it all together.

Significant challenges persist, though.

The weapon system carried aboard the first ABL—designated YAL-1—was expected to weigh about 175,000 pounds at the time of its critical design review, which is the point in a program where hardware designs are finalized and major changes are locked out.

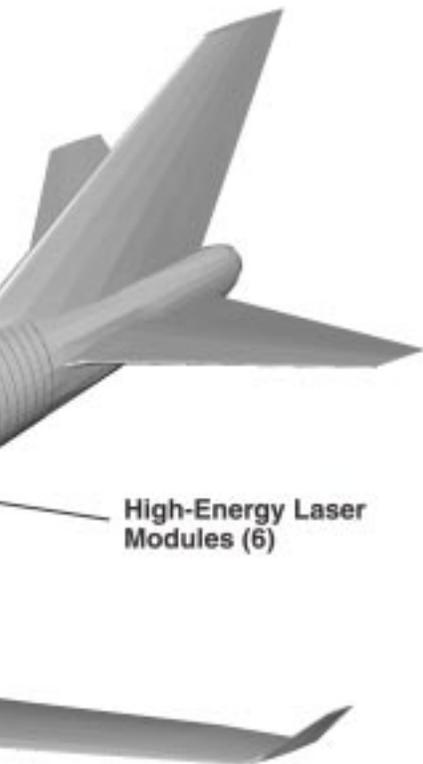
It has ballooned to more than 200,000 pounds.

“We have grown since our critical design review,” Pawlikowski admitted.

The weight growth has taken place in two areas, she said. One was in the laser itself. The original plan called for some components to be made out of composite materials rather than metal alloys. However, said Pawlikowski, “We just didn’t know enough about the composites”—how they would react with the types of chemicals to be used.

The mixing of oxygen and iodine creates a chemical reaction that yields large quantities of energy.

There was little data to show how the composites would hold up over time, so designers decided to add thicker layers of composites to pro-



High-Energy Laser Modules (6)

vide a greater safety margin. “The safety factors we were adding on ... got us close to the weight of ... titanium,” said Pawlikowski.

USAF was uncertain about the long-term effect of using chemicals with composites. As a result, program officials switched to titanium, a proven alternative that is both strong and relatively light. However, tita-

nium is heavier than the original composite materials.

There was a second factor that led to weight gain—the large number of fittings and components that were needed to mount everything inside the airplane, Pawlikowski explained. These ranged from fasteners to tubing to bulkheads, all of which had to be beefed up to keep the now-heavier laser system secure inside the aircraft.

Weight problems surfaced only when actual construction began. Previously, all weights were estimates. “We’re getting ‘actuals’ in, as opposed to estimates,” Pawlikowski said.

All this added up to a weight penalty “far more than we had originally anticipated at critical design review,” she noted.

More weight translates to some operational limitations.

“There’s little I can do in terms of redesigning things this late in the game,” Pawlikowski pointed out, meaning there will be no redesign fix to drastically cut weight. Any offset will have to come in a reduced fuel load, she went on. “If the weight goes up a little bit, we just put a little bit less jet fuel in, at this point.”

The changes will not affect the aircraft’s ability to take off and reach cruising altitude expeditiously, she said, and there’s no danger of exceeding the strength of the flooring or bulkheads within the aircraft.

“We’re still within the bounds of where we need to be,” she said.

The direct effect of the weight

gain, though, will be to reduce unrefueled on-station time by 90 minutes. The actual on-station time is classified, but Pawlikowski observed that, with aerial refueling, the ABL could stay aloft as long as necessary.

Flight tests last year demonstrated the first aircraft’s aerial refueling capability. The refueling receptacle is the same as that found on the E-4B, another 747-derived USAF aircraft.

It will take some skill to avoid the large turret on the front of the Airborne Laser aircraft, but, Pawlikowski said, “We have some pretty talented and skilled boomer operators in the Air Force.” She noted that USAF tanker crews have no trouble with the B-2, which has super-sophisticated skin and composite materials and must not be damaged in the slightest.

To protect the exotic and expensive turret, crews will roll the ABL optics inward when they are not in use. The turret itself has been painted with a special flame-retardant paint.

Schedule Slip

USAF expected two program milestones set for this summer to slip until the fall. One was getting “first light” through six laser modules of the high energy laser. The other was integration of the beam control system.

Getting light out of the laser means “running all the plumbing lines that are needed in order to get all the chemicals flowing in all the right places and all the cooling material,” said Pawlikowski. The program is progressing but “maybe not as fast as I had hoped,” she said.

Because of the powerful nature of the laser, the presence of hazardous chemicals, and the delicacy of the system, safety is a priority.

Some systems are being checked for form, fit, and function on a 747 rather than on the YAL-1. By doing so, officials can engage in several types of integration and checks simultaneously and thus save time.

The difficulty in achieving first light likely means there will be a delay in the first live test. The plan had been to conduct the Scud test by the end of 2004. “It’s on the ragged edge of getting it done by then,” Pawlikowski acknowledged. She estimated that the shutdown would take place at least by early summer 2005.

Integrating the beam control sys

USAF photo by Kristie Hogbin



ABL flight testing revealed the need to alter the shape of the active-ranging laser pod atop the fuselage. Otherwise, the airframe itself is considered good to go. The ABL handles basically like any other 747-400.



modification, lighter and more powerful laser modules will be available. While the Block 04 airplane is the prototype, the Block 08 airplane will be a production-representative version and feature a full suite of capability. Both, however, are considered test assets.

The Missile Defense Agency plans to obtain the Block 08 aircraft and five more production-representative aircraft. That would enable the US to put up a 24-hour-a-day capability in any given theater overseas. More would be needed to cover more theaters. The MDA has not stated any intention to deploy more than seven ABLs—so far.

Pawlikowski noted that, while the Air Force has contemplated assign-

tem also has moved more slowly than anticipated. The ABL's target designator sits in a pod atop the cockpit area of the airplane. Flight testing last year showed rougher than expected turbulence and aerodynamic flow around the pod.

Wind tunnel tests and computational fluid dynamics modeling led to a redesigned pod, which will be tested once the aircraft takes to the air again next summer.

All the pieces necessary to fire the high energy laser will be installed, integrated, and tested this winter. In spring 2004, said Pawlikowski, "We'll have a ground test period in which we'll actually, for the very first time, fire the laser through the beam control system." By summer, the full system is to be up flying, and USAF will commence testing against instrumented targets designed to ascertain laser cohesion at various distances as well as the power with which the targets are being hit.

One such target, or "board," will be suspended below noted aircraft designer Burt Rutan's Proteus high-altitude aircraft. The manned Proteus can fly at 60,000 feet and loiter for up to 14 hours.

"We've contracted with him to fly at high altitude for us," Pawlikowski said. "That will be the first series of tests we'll do, and that gives us lots of opportunities. He can fly back and forth for us and it's a fully instrumented board."

To kill a Scud-type missile, the ABL must keep its high energy laser



In an artist's concept (top) the ABL is shown destroying a missile as it breaks through the overcast. By 2008, USAF will have two ABLs: one developmental and one "production representative." A fleet of seven is planned.

focused on the same spot of the missile's skin for 90 to 500 seconds, depending on the distance to the target.

Once the program obtains first light from the laser modules on the airplane, the Air Force will proceed to contract with Boeing for the second airplane, which would be available for modification in 2006.

The initial aircraft is referred to as the Block 04 airplane. The second aircraft is called the Block 08 aircraft. It will feature advances developed from experience with the YAL-1. Officials expect that, by the time the Block 08 aircraft is ready for

ing the ABL to a range of other missions such as cruise missile defense and direct attack against ground targets, those initiatives have been halted.

She said that she has been told by Chief of Staff Gen. John P. Jumper that the ABL, which is considered a pathfinder for directed energy systems, has tremendous potential for other applications. However, she added, "I believe that the current Air Force position is, 'Let's get that first mission down, and then we'll look at the others.'" What she described as "adjunct missions" will have to wait. ■