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BALLISTIC MISSILE DEFENSE 2:[1]
BOOST-PHASE INTERCEPTS

Compiled by Bob Aldridge

The boost-phase is the time the first phase of a missiles flight, when the booster rocket motors are burning and accelerating the missile to altitude and speed. It lasts from 3 minutes to 5 minutes, for strategic missiles. For short-range missiles it can be as low as 1 minute to 2 minutes. To intercept a missile during this phase, it must be done in that time frame. However, intercepting in the boost phase has advantages. First of all, it would destroy the missile before it has had time to dispense multiple warheads or chemical-biological canisters. The debris would then likely fall back onto the hostile country's own territory. Finally, a given boost-phase intercept system would be effective against missiles of any range. The Pentagon's fiscal year 2002 budget request contains $685 million to explore such boost-phase intercept systems.

The Russians have proposed boost-phase intercepts as something they can work on cooperatively with the US, so it has advantages for diplomatic maneuvering. Since it can be used as a theater missile defense system it is more politically correct in a divided Congress. But one must remember that it gets into technologies that were at the heart of Star Wars during the Reagan years. It will involve the militarization of space and will be hideously expensive. Furthermore, as former Pentagon operational test and evaluation director Phillip E. Coyle has pointed out, there are some fairly simple countermeasures for the boost phase. A missile could be coated with a reflective substance to deflect a laser beam, or the exhaust plume could be disguised to look like a peaceful rocket launch.

The Bush administration's boost-phase intercept program has three segments -- Airborne Laser, Sea-based Boost, Space Laser Experiment, and Space Hit-To-Kill Experiment. The latter two will run contrary to the Outer Space Treaty.

AIRBORNE LASER (ABL)

The main thrust of killer lasers is to destroy hostile missiles during their boost phase -- that is, while their rocket motors are still burning. Within a minute the early warning radars and space-

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[1]This is the second in a set of four papers. The set includes:

PLRC-010821 -- Ballistic Missile Defense 1: BMD Structure, Battle Management, and Sensors.
PLRC-010822 -- Ballistic Missile Defense 2: Boost-Phase Intercepts.
PLRC-010823 -- Ballistic Missile Defense 3: Midcourse-Phase Intercepts.
PLRC-010824 -- Ballistic Missile Defense 4: Terminal-Phase Intercepts.

based sensors detect and characterize the hostile missile's launch. The ABL, which is patrolling above the cloud tops at about 40,000 feet, has to then locate and point at the hostile missile. It then trains the high energy laser beam on the missiles pressurized rocket motors or fuel tanks. After a few seconds the missile bursts from the intense heat. All of this must be done within 3 - 5 minutes.

The airborne laser employs Boeing 747 airplanes, equipped with passive infrared sensors and a multi-megawatt Chemical Oxygen-Iodine Laser. There are three additional lasers on board for tracking, targeting, and beam correction. The ABL would attack hostile missiles when they are between 35,000 and 70,000 feet with the speed of light over a distance as far as 250 miles. The distance restriction means it would not be 100% effective against countries with a geography like Iran's. It would theoretically be be useable against Iraq and North Korea.

Each aircraft could carry enough chemicals for 20 to 40 shots. Each shot would cost about $1,000. The estimated life cycle costs for the ABL program total about $11 billion – $1.3 billion for the Program Definition and Risk Reduction Phase, $1.1 billion for the Engineering and Manufacturing Development phase, $3.6 billion for production, and $4.6 billion for operation and support over 20 years.

On 12 November 1996 a team composed of Boeing, TRW and Lockheed Martin was awarded the $1.3 billion, 77-month Program Definition and Risk Reduction contract to build a prototype laser mounted on a 747-400F freighter aircraft, and demonstrate its ability to track and destroy short-range and medium-range ballistic missiles shortly after launch. Boeing Defense and Space Group's Military Airplanes Division (Seattle, Washington) will produce the battle management system software, modify the 747-400, and integrate the laser and beam control system into the aircraft. TRW Space and Electronics Group (Redondo Beach, California) is developing the high-energy laser, and Lockheed Martin Space Systems Company (Sunnyvale, California) is providing the Infrared Search and Track system to target the laser and the Beam Control/Fire Control system (mirrors) in a 1.5 meter telescope that serves as the laser's lens. Intervac (Santa Clara, California) and Applied Aerospace Structures (Stockton, California) are working with Lockheed Martin. The prototype system, designated YAL-1, was to demonstrate its ability to destroy a short-range, Scud-type missile in a test over the Pacific Ocean in 2003, but due to technical problems that test has been postponed to late 2004. If that is successful, the team will move to the Engineering and Manufacturing Development phase the following year. Full rate production probably won't start until 2010. The cost will likely exceed $1 billion per aircraft.[2]

A second ABL-equipped aircraft is scheduled to be built during the Engineering and Manufacturing Development phase. Production is to begin in 2005. Initial operation of 3 ABLs is scheduled for 2008, and full operation of 7 ABLs in 2009. However, the US General Accounting Office (GAO) has advised the Secretary of Defense not to order this second unit until the first test proves the concept achievable in combat situations.[3]

Fiscal year 2000 funding was cut by $15 million. The fiscal year 2001 request for $148.6 million was upped to $233.6 million by Congress. The Bush administration asked for $153 million supplemental to the fiscal year 2001 in order to keep the initial deployment date from slipping. The fiscal year 2002 budget is $410 million.

Serious obstacles still face a killer laser to be used in the atmosphere -- diffusion of the beam, accurate target tracking during air turbulence, miniaturization and packaging for an airplane, and

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[2]Coyle.

[3]GAO/NSIAD-99-50, p. 8.

assurance that the missile target will be destroyed. It would have to be used above 40,000 feet where the air is thinner -- when deployed, two aircraft would be flying around the clock, orbiting at about 40,000 feet. Army Lt. Gen. Malcolm O'Neill, then director of the Ballistic Missile Defense Organization (BMDO -- now renamed Missile Defense Agency, or MDA), said on 24 May 1996 that air turbulence could turn the beam of the Air Force's Airborne Laser into a flashlight.[4] David Collier, chief scientist for the Army Space and Strategic Defense Command, said: "Laser geeks tend to overestimate their effectiveness,... There's a major disagreement on the effectiveness of almost any laser system."[5] The US General Accounting Office in October 1997 was critical of the Air Force's approach to the problem and ability to resolve unknown issues.[6]

In a 2002 report the GAO itemized six technical areas in which the ABL lacked maturity even after over 25 years of scientific development: a) ability to stabilize and aim the laser aboard an aircraft, b) optics to focus and control the laser beam and allow it to pass safely through the aircraft, c) optical coatings to enhance and reflect the laser beam, d) computer driven hardware to actively track the target, e) devices to measure and compensate for atmospheric turbulence that could distort and weaken the beam, and f) safety systems to automatically shut down the laser in case of emergency.[7] It sounds like there has not been much progress over the past quarter century although hundreds of millions of dollars have passed into the contractors' hands.

SEA-BASED BOOST

The Sea-Based Boost intercept system (formerly called Navy Theater Wide) will probably be expanded to development of a larger diameter, faster burning, longer range interceptor with a newly designed hit-to-kill warhead, and be compatible with the Navy's Aegis cruisers and destroyers. The new missile, dubbed the Standard Missile-"27" because it would be 27 inches diameter, would also require a new and larger launcher. This concept, called the "New 6-Pack," would have range of more than 1,500 kilometers (932 miles) and a speed of 6.5-kilometers-per-second carrying a 50-kilogram (110-pound) kill vehicle. MDA estimates that this system could be available by 2010-2012 for a cost of up to $10 billion. MDA asked $110 million for fiscal year 2001 to proceed with space-based interceptors and those based on Navy ships -- the sea-based boost-phase interceptor and space-based hit-to-kill interceptor (described below). The distribution between the two basing methods is not known.

SPACE BASED LASER-INTEGRATED FLIGHT EXPERIMENT (SBL-IFX)

This Space Based Laser (SBL) concept is not new. It was conceived in 1977 and was a prominent element of Ronald Reagan's Star Wars fiasco. Nevertheless, it could be the Pentagon's first space-based weapon to destroy hostile missiles in their boost phase.

The system is to consist of 20 to 25 (some sources say 30) satellites to provide global coverage, each with a cylindrical hydrogen-fluoride chemical laser capable of destroying 100 missiles from a range of 4,300 kilometers (2,672 miles).

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[4]*Defense News*, 17 June 1996, p. 8.

[5]*Defense News*, 17 June 1996, p. 8.

[6]GAO/NSIAD-98-37, pp. 1-5.

[7]GAO-02-631, pp. 6 & 7.

The prime contractors make up what is known as "Team SBL-IFX." TRW Space & Electronics Group (Redondo Beach, California) leads the integration of the SBL payload, is developing laser payload technologies, and is leading development of the SBL space test facility. Lockheed Martin Space Systems Company (Sunnyvale, California) leads the development of the SBL spacecraft and its integration with the laser payload, is developing the beam directing technologies, and is heading up the definition of an operational SBL architecture. Boeing Space & Communications Group (Seal Beach, California) is developing the laser beam control technologies, leading the systems engineering, integration & test of the SBL, and heading up the SBL mission operations segment.

In February 1999 a $127-million, 18-month contract was awarded jointly to these three corporations to initiate the Space Based Laser Integrated Flight Experiment. Actual work began the following May. This experiment will integrate a megawatt-class chemical laser, the beam control system, and acquisition/tracking/pointing elements into a space platform. The goal is to put a SBL into orbit by 2012 and shoot down a ballistic missile in its boost phase in 2013. This concept is called the Space Based Laser-Integrated Flight Experiment (SBL-IFX).

In November 2000 Team SBL-IFX was awarded a $97 million contract modification to extend the technology demonstration program through November 2001. The original contract must have been previously modified because this latest modification brings the total contract value to $240 million. The technology demonstration phase will culminate with a systems definition review scheduled for the autumn of 2001.

The Administration's request of $137.7 million was increased by Congress to $147.7 million for fiscal year 2001. The fiscal year 2002 budget request is $165 million. Pentagon estimates are that the SBL test phase (SBL-IFX) will cost $3 billion and the total system will exceed $30 billion. On 1 October 2001 the Space-Based Laser was transferred to the MDA but the 2003 budget document proposes returning procurement funds to the Air Force.

SPACE HIT-TO-KILL EXPERIMENT

Something new under the Bush administration is to resurrect the Brilliant Pebbles concept of the Reagan Star Wars era. It involves stationing many small interceptors on satellites ready to shoot down hostile missiles in the boost phase. MDA asked for $110 million for fiscal year 2001 to proceed with space-based interceptors and those based on Navy ships -- the sea-based boost-phase interceptor (described above) and space-based hit-to-kill interceptor. The distribution between the two basing methods is not known. It is planning a test in space for 2005 or 2006.

During the Reagan administration the Brilliant Pebbles program was in the engineering, manufacturing and development phase. When George bush (Sr.) Became president he reduced it to a technology development program -- no development tests. The Clinton administration terminated it in 1993. Now the George W. Bush administration is breathing new life into the concept.

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GLOSSARY

747	A US commercial jetliner built by Boeing.
ABL	Airborne Laser.
ABM	Anti-Ballistic Missile. An interceptor of ballistic missiles.
BMD	Ballistic Missile Defense.
BMDO	Ballistic Missile Defense Organization
BPI	Boost Phase Intercept.
CBO	Congressional Budget Office.
DOD	Department of Defense (US).
DOE	Department of Energy (US).
Endoatmospheric	Within the atmosphere.
Exoatmospheric	Outside the atmosphere.
GAO	General Accounting Office (US Congress).
ICBM	Inter-Continental Ballistic Missile.
IFX	Integrated Flight Experiment.
MDA	Missile Defense Agency.
SBL	Space-Based Laser.
SLBM	Submarine-Launched Ballistic Missile.
Strategic	Pertaining to nuclear weapons: ICBMs, SLBMs and intercontinental bombers designed for a thermonuclear war between the superpowers.
Tactical	Pertaining to nuclear weapons: those designed to be used in battlefield or theater operations.
US	United States.