FIRE IN THE SKY

THE AIRBORNE LASER TEST BED

FUTURE DEFENSE AGAINST BALLISTIC MISSILE ATTACKS

WRITTEN BY LEWIS CARLYLE | IMAGES COURTESY OF THE AIRBORNE LASER TESTBED

THE BEGINNING OF THE END

Three hundred miles southeast of Port Elizabeth, South Africa, a torrid sun beats down upon the fishing boat trolling the shimmering waters of the Indian Ocean. Waves lap against the hull as the ship rocks gently in the summer breeze, its trolling nets extended and trailing in the frothy wake of the engines. A deck hand stubs out his morning cigarette and leans across the gunwale, shading his eyes against the harsh sun. The cloudless sky meets the ocean in a seamless horizon of flat blue in all directions. *No fish for days*, the boy muses, *and likely another miserly catch this morning.* With a frown, he resumes his post at the rusted winch when he notices the enormous plume of water guysering high into the air off the starboard side. He rushes across the boat, squinting into the sun just as a bright light explodes from the sea, and the pristine horizon is interrupted by the gigantic cylindrical shape rocketing towards the heavens. His heart pounding, he watches in horror as the intercontinental ballistic missile climbs higher into the sky, its course altering to the west, towards North America.

THE WAR THAT NEVER WAS

To the credit of the human race, the prospect of an ICBM attack against the United States today is best reserved for spy novels and action movies. With our armed forces engaged with a viscous insurgency in two ground wars, the thought of defending against a nuclear missile attack is far from everyone's mind. Yet that does not mean the threat no longer exists, and the Indian Ocean scenario is just one of many possibilities that could stem from any number of politically charged disputes in these ever-changing times.

In the early days of the Cold War, the nation watched in fear as the nuclear arms race took hold of the world's two great superpowers. For decades, both the United States and the Soviet Union stockpiled and deployed warheads across the globe, their deadly payloads trained on both military installations and major

cities. For a time, the theory of mutually assured destruction (MAD) kept the launch codes from reaching final countdown. The prospect that a first strike, followed by a counter strike, would decimate populations and poison entire nations with years of radioactive fallout was a major deterrent in keeping the missiles from crossing paths over our great oceans. As history would have it, the USSR eventually fell into financial and political ruin, the Cold War crumbled along with the foundations of the Berlin Wall, and the world rejoiced as nuclear arsenals were dismantled.

However, as both rogue states and terrorist networks now begin to enter the fray of nuclear proliferation, the MAD theory is no longer a safeguard against the unthinkable first strike. With social and political pressure reaching a boiling point in nations such as Iran and North Korea, and terrorists becoming more brazen in their attacks against civilian populations, our armed forces have once again renewed their interest in strengthening a viable missile defense network.

Many of us may remember the spectacular war fighting images which came out of Desert Storm back in the early 1990s. From the special ops teams firing rockets into the open doors of Iraqi bunkers, to the Patriot Missile-led decimation of Saddam Hussein's fleet of Scuds, the US military employed a myriad of technologies to free Kuwait and push the Republican Guard back across the desert to Baghdad.

Today, many of those technologies have evolved, and are now deployed in the 21st Century version of missile defense. One such technology, which flies upon the cutting edge, is the Airborne Laser Test Bed. ▷

AIRBORNE LASER

THE FUTURE IS NOW

Lt. Col. Michael Contratto, '90, is commander of the 417th Flight Test Squadron, and director of the Airborne Laser Combined Test Force at Edwards Air Force Base, California. He oversees the group effort between the Missile Defense Agency, the Air Force, Boeing, Lockheed Martin and Northrop Grumman in the continuing mission to develop the world's first and only airborne, laser-based, missile defense system. The Airborne Laser Test Bed, as the project is called, is essentially a high-intensity laser contained inside a modified 747. The aircraft is designed to track, acquire and shoot down enemy missiles in midair.

Contratto explains, "The second Bush administration established the Missile Defense Agency with the mandate to create a layered ballistic missile defense system; and so, the Airborne Laser was envisioned to be a part of that system, specifically covering the boost phase of an enemy missile."

When launched, an ICBM goes through four phases—boost, ascent, midcourse and terminal—before reaching its target. During the boost phase, the missile accelerates from the surface of the earth. Its exhaust plume is bright and hot, making it easy to detect; yet its rapid acceleration makes it very difficult to track and shoot down. The ascent is the second phase, during which powered flight ends and the missile escapes the earth's atmosphere, approaching the apex of its flight. The midcourse begins when a missile's booster has burned out and it begins coasting in space towards its target; and the terminal phase begins when the warhead re-enters the atmosphere and descends towards its

target. This is the least-desirable phase to engage, as the window of opportunity to safely destroy the missile becomes smaller as it approaches its target.

While the prospect of an ICBM descending in terminal phase over New York City is frightening, there is hope to be found among the countermeasures the Ballistic Missile Defense System has in place. Many ground based operations constantly monitor the skies, and long-range interceptor missiles deployed in Alaska and California have the capability to defend the homeland against a limited number of ICBMs.

The speed of light is approximately 186,000 miles per second. No physical body, missile or otherwise, can outrun a laser, making directed energy an excellent technology for future missile defense application. In the case of the ALTB experimental platform, Contratto describes, "There are three primary lasers we use to complete the mission. Each is contained within the modified 747. The first two are the tracking laser and atmospheric compensation laser. They are both kilowatt class solid state lasers. Then there's the COIL, (Chemical Oxygen Iodine Laser) which is the megawatt class laser that actually negates the target."

Both the targeting lasers and the high-intensity COIL beam are emitted from a specially designed turret on the nose of the aircraft. The system uses infrared to acquire the exhaust plume of an enemy missile. Once a threat missile is identified, the Track Illuminator locates a precise aim point on the body of the warhead. Next, the Beacon Illuminator measures atmospheric turbulence, which is used to focus the COIL. Once a target is acquired, the missile is destroyed by the COIL's high intensity beam. ▷

The Airborne Laser system is contained within a modified 747 with a specially designed nose cone targeting turret.

Contratto explains, "The only technology available for the foreseeable future to generate the power levels required to shoot down these missiles is a chemical laser. To produce the photons, we mix these chemicals in the back of the aircraft and flow them through laser modules. The process generates enough photons to produce a megawatt-class laser." Future directed energy technology development could include powerful solid-state lasers.

The COIL is the specific high energy laser. Contratto continues, "A general estimate is that a few seconds worth of discharge could power an average household for a couple of hours. Ironically, the fire control system, which has tracked and targeted missiles traveling in excess of Mach 5, is far more difficult to perfect than producing the firepower itself. There are many technical miracles which take place every time we turn the system on."

Over the years, the Air Force Academy has provided a great deal of officers who have contributed to the Airborne Laser Test Bed, and Contratto is proud to be a part of that lineup. He explains, that despite the state of warfare today—fighting door to door against an insurgency—there are still hostile forces out there who have the assets to endanger not only the United States, but our allies. "Having the capability to combat ICBMs with a laser defense system can provide theater commanders with a lot of options in the event that someone wanted to start launching ballistic missiles."

Skeptics of the program need only look at the Airborne Laser Test Bed's track record. The aircraft has completed more than 50 sorties since April of 2009, and has flown 159 times since the inaugural voyage in 2002 (stats current as of April 15, 2010). The team is a perfect 8 for 8 in meeting objectives during missile engagements with either the low power or COIL lasers. The ALTB's lethal demonstration test was completed on February 11, 2010, when the COIL engaged and terminated a short range threat-representative missile. A week prior, the team destroyed a boosting sounding missile with the COIL.

Contratto is quick to point out that while the program has achieved great success since its inception, there are no plans as of yet to start building a fleet of missile-hunting COIL lasers. "Fiscal reality," he says, "and directional changes over time have altered the program somewhat. We're the Airborne Laser Test Bed. We're still part of the Missile Defense Agency, but our mission has changed. We're no longer a full on acquisition program, but a testbed platform which the MDA uses to develop applications which utilize lasers in a ballistic missile defense role." The current plan is to transfer the ALTB to DoD's Director, Defense Research and Engineering (DDR&E).

While the Airborne Laser may not be out hunting missiles just yet, the program is setting the foundation for a new paradigm of warfare. The prospect of using focused light as a defense mechanism is very promising for the future. Lasers do not emit hazardous materials. They do not rely on fossil fuels and they do not break down into carcinogenic by-products. They track, acquire and destroy targets at the speed of light. Theoretically, they are the perfect weapon. "It's beyond revolutionary," Contratto concludes fondly, "Decades from now, history will look back and see that science fiction first became reality when the ALTB started shooting missiles out of the sky." ☑

ALTB's Airborne Diagnostic Target aircraft, a Gulfstream II, flies along side the YAL-1A. The team conducts lasings against the target aircraft with low power solid state lasers. Photo by Chad Bellay.

AIR FORCE ACADEMY GRADS IN ACTION

The following USAFA Grads are both current and former contributors to the Airborne Laser since mid 2008.

Dr. Roc White, Lt. Col. Retired, Class of 1976, taught in Physics Department from 90-99 and retired as the Deputy Department Head: currently government contractor Test Director and airborne Mission Commander.

Mark Stuben, Colonel Retired, Class of 1972, Test Pilot School Class 81B, currently Northrop Grumman Laser Test Lead.

Dr. Steve Watson, Lt. Col. Retired, Class of 1975, Test Pilot School 82A, government contractor test conductor aboard airborne diagnostic target.

Lenita Gentry, Class of 1984, Lockheed Martin Senior Staff Multi-Functional Financial Analyst.

Douglas Benjamin, Colonel Retired, Class of 1978, currently Chief Pilot, Military Transport—Tanker, Airlift, Airborne Battle Management Boeing Test & Evaluation and Airborne Laser Chief Test Pilot.

Ronald Johnston, Lt. Col. Retired, Class of 1977, Test Pilot School Class 86B, currently Boeing Chief Test Pilot on the KCX program.

Dave Fedors, Colonel—USAF Reserves, Class of 1985, civilian test pilot in the ABL and C-130.

Colonel (Select) Michael Contratto, Class of 1990, currently Commander 417th FLTS and Director ABL Combined Test Force.