

Integrated Defense Systems
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Directed Energy Systems

Description & Purpose: The Directed Energy Systems (DES) unit of Boeing Missile Defense Systems is developing systems to address multiple defense needs and customers.



Customer: Among key DES programs are the Advanced Tactical Laser, sponsored by the U.S. Air Force; the High Energy Laser Technology Demonstrator, funded by the U.S. Army; the Free Electron Laser, commissioned by the U.S. Navy; and the Tactical Relay Mirror System being developed for the Air Force and the Office of the Secretary of Defense/Director of Defense Research and Engineering.

Advanced Tactical Laser

The Advanced Tactical Laser (ATL) program has equipped a C-130H aircraft with a high-energy chemical laser for engagements against ground targets.

In June 2009, ATL fired its high-power laser for the first time in flight, successfully hitting a target board located on the ground. In August 2009, ATL defeated a ground vehicle target from the air, demonstrating its first air-to-ground, high-power laser engagement of a tactically representative target.

The ATL team plans additional tests to further demonstrate the system's military utility. The system is designed to destroy, damage or disable targets with little to no collateral damage. These demonstrations support development of systems that will conduct missions on the battlefield and in urban operations.

Boeing's Advanced Tactical Laser industry team includes L-3 Communications/Brashear, which made the laser turret; HYTEC Inc., which made a variety of the weapon system's structural elements; and J.B. Henderson, which provides mechanical integration support.

High Energy Laser Technology Demonstrator

Boeing has been awarded a U.S. Army contract valued at approximately \$36 million to continue developing a truck-mounted, high-energy laser weapon system that will destroy rockets, artillery shells and mortar rounds.

Under the High Energy Laser Technology Demonstrator (HEL TD) Phase II contract, awarded in August 2008, Boeing will complete the design of, then build, test and

evaluate, a rugged beam control system on a Heavy Expanded Mobility Tactical Truck. Boeing also will develop the system-engineering requirements for the entire HEL TD laser weapon system. Boeing successfully completed the preliminary design of the beam control system in the summer of 2008, under the HEL TD Phase I contract it was awarded in 2007.

The objective of the HEL TD program is to demonstrate that a mobile, solid-state laser weapon system can effectively counter rocket, artillery and mortar projectiles. The program will support the transition to a full-fledged Army acquisition program.

Free Electron Laser

Boeing has been awarded a U.S. Navy contract valued at up to \$163 million, with an initial task order of \$6.9 million, to develop the Free Electron Laser (FEL) weapon system, which will transform naval warfare in the next decade by providing an ultra-precise, speed-of-light capability and unlimited magazine depth to defend ships against new, challenging threats, such as hyper-velocity cruise missiles.

Under the task order, awarded in April 2009 by the Office of Naval Research, Boeing will complete the preliminary design of the electric-powered Free Electron Laser, the key step toward building a FEL prototype for realistic tests at sea.

Boeing will partner with U.S. Department of Energy laboratories, academia and industry partners to design the laser.

This contract award is significant because it will be a cornerstone of the Navy's plan to incorporate directed energy systems into its future all-electric ship architecture

FELs are capable of achieving the megawatt power the Navy requires for ship defense. They operate by passing a beam of high-energy electrons through a series of powerful magnetic fields, causing the intense emission of laser light.

Relay Mirror Systems

Relay mirror systems will greatly enhance the performance of laser weapon systems by reducing the atmosphere's effects on laser beams, extending their range beyond line of sight and expanding potential laser engagement geometries.

Boeing and the U.S. Air Force announced in 2006 that they successfully redirected a laser beam to a target using their Aerospace Relay Mirror System (ARMS). This demonstration was a major step in the development of relay technology because it showed that a relay mirror system can receive laser energy and accurately and precisely redirect it to a target, extending the laser's range. The Air Force has established the ARMS hardware as a permanent test bed for relay system technology development.

In 2006, Boeing was awarded a \$40 million contract by the Air Force and the Office of the Secretary of Defense to design, fabricate and test a smaller, tactical version of the ARMS payload that could be carried on unmanned aerial vehicles or balloon-like aerostats and be used with tactical ground and airborne lasers. Tactical relays would be most appropriate for shorter-range missions, such as providing persistent intelligence,

surveillance and reconnaissance coupled with the ability to relay lethal laser energy to a variety of targets in coastal, maritime and urban settings.

Boeing Internal R&D

Boeing is investing its own money in several efforts that promise to equip the warfighter with real directed energy capability.

These efforts include Laser Avenger, a system that integrates a laser on a Humvee-based Avenger system to destroy improvised explosive devices (IEDs), unexploded ordnance (UXO) and unmanned aerial vehicles (UAVs). During laser firings conducted in September 2007 at Redstone Arsenal in Huntsville, Ala., the Laser Avenger engaged and destroyed five static ground targets representing IED and UXO threats. During December 2008 testing, Laser Avenger engaged and destroyed a small UAV from an operationally relevant range, marking the first time a combat vehicle has used a laser to shoot down a UAV.

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