

Boeing Defense, Space & Security
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Missile Defense Systems

Description and Purpose:

The Missile Defense Systems (MDS) division of The Boeing Company provides integrated missile defense solutions for all phases of ballistic missile threats – boost, midcourse and terminal.

In addition, the Directed Energy Systems (DES) unit of MDS develops systems to address multiple defense needs and customers. Strategic Missile Systems supports the U.S. intercontinental ballistic missile (ICBM) force.

Customer:

Boeing is the prime contractor for the Ground-based Midcourse Defense system and the Airborne Laser Test Bed, both U.S. Missile Defense Agency programs.

Boeing and Israel Aerospace Industries (IAI) co-produce the Arrow II interceptor and are developing the Arrow III interceptor for the Israel Ministry of Defense.

Among key DES programs are 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.

Boeing physically integrated the Minuteman weapon system and has been the U.S. Air Force ICBM guidance, navigation and control system integration contractor for 50+ years.

Ground-based Midcourse Defense

The Missile Defense Agency's Ground-based Midcourse Defense (GMD) system is the United States' only operationally deployed capability to defend against long-range ballistic missiles.

GMD is designed to detect, intercept and destroy long-range ballistic missiles during their midcourse phase of flight. It provides early detection and tracking during the boost phase, as well as midcourse target discrimination, precision intercept and destruction of the target through force of collision. The system uses a three-stage ground-based

interceptor equipped with an exo-atmospheric kill vehicle, and multiple sensors, communications systems and fire control capabilities.

As prime contractor, Boeing is designing, producing, integrating, testing and sustaining all GMD components. Key subcontractors include Raytheon, which provides kill vehicles and radars; Orbital Sciences Corp., which supplies interceptor boosters; and Northrop Grumman, which provides the battle management.

GMD has been in development since 1998 and incorporates decades of research, development, test and evaluation on proven “hit-to-kill” and other advanced technologies.

In December 2002, President Bush directed the Department of Defense to field an initial set of missile defense capabilities, including GMD, by 2004-2005. Two and half years later, in the fall of 2004, the Boeing GMD team began fielding ground-based interceptors at Ft. Greely, Alaska, and Vandenberg Air Force Base, Calif. Initial GMD components also included high-powered radars based on land and at sea, and a command-and-control system consisting of an extensive communications network and two fire control nodes.

There are currently over 20 interceptors fielded and the program continues to field additional interceptors and to integrate additional sensors into the GMD system. GMD system elements reach across 12 time zones and are linked by over 20,000 miles of fiber optic cable.

The system is alert-capable, providing the first-ever active defense of the United States against intercontinental ballistic missiles. Under rigorous testing, the GMD system has demonstrated impressive capabilities, including the ability to shoot down an incoming ballistic missile.

The system has achieved a total of eight successful intercept tests, including three successful intercept tests with the operationally configured interceptor. Flight testing is scheduled to continue.

Airborne Laser Test Bed

Boeing, industry teammates and the U.S. Missile Defense Agency on Feb. 11, 2010, successfully demonstrated the speed, precision and breakthrough potential of directed-energy weapons when the Airborne Laser Test Bed (ALTB) engaged and destroyed a ballistic missile in the missile’s boost phase of flight.

This experiment marks the first time a laser weapon has engaged and destroyed an in-flight ballistic missile, and the first time that any system has accomplished it in the boost phase. ALTB has the highest-energy laser ever fired from an aircraft, and is the most powerful mobile laser device in the world.

During the experiment, the aircraft, a modified Boeing 747-400F, took off from Edwards Air Force Base and focused its high-energy laser at the missile target as the aircraft flew over the Western Sea Range off the coast of California.

MDA officially recognized directed energy's warfare-changing potential in March 2009, when it awarded its Technology Pioneer Award to three Boeing Airborne Laser Test Bed engineers and three of their government and industry teammates for advancing key ALTB technologies.

Arrow

The Arrow Weapon System is Israel's national missile defense system, designed to defeat the threat of a ballistic missile attack. The Arrow system uses the two-stage Arrow II interceptor to destroy an incoming target with a fragmentation warhead. Arrow III, also a two-stage interceptor, will destroy an incoming target with an exo-atmospheric kill vehicle and provide additional defense capability for evolving threats. Other system elements are a launch control center, fire-control radar and battle management center. Arrow provides Israel with flexible and cost-effective protection from ballistic missile threats.

Boeing and Israel Aerospace Industries (IAI) co-produce the Arrow II interceptor and are developing the Arrow III interceptor for the Israel Ministry of Defense (MoD). Boeing is responsible for production of about 35 percent of the Arrow II interceptor components. IAI, the prime contractor for the Arrow system, is responsible for total system integration and final interceptor assembly in Israel. Boeing production and management are in Huntsville, Ala.

Israel's MoD, in cooperation with the U.S. Missile Defense Agency, has completed three successful flight tests of the co-produced Arrow II interceptor since 2007. In two of those tests, conducted in February 2007 and April 2009, the interceptor destroyed a target missile. In the other test, which occurred in March 2007, the objective was an interceptor fly-out to collect flight test engineering data of an enhanced capability interceptor and did not involve a target intercept.

Boeing-IAI co-development of the next-generation Arrow III interceptor began in late 2008 and will be followed by co-production.

Directed Energy Systems

Boeing has been awarded a U.S. Army contract 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, 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. In December 2009, Boeing accepted the military truck that will carry the beam control system.

Boeing has been awarded a U.S. Navy contract 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 initial task order awarded 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.

Relay mirror systems developed by Boeing 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 is under contract to the Air Force and the Office of the Secretary of Defense to design, fabricate and test the Tactical Relay Mirror System, which could be carried on unmanned aerial vehicles or balloon-like aerostats and be used with tactical ground and airborne lasers.

Boeing is investing its own money in several efforts that promise to equip the warfighter with real directed energy capability. These efforts include integrating a laser on a military vehicle to destroy improvised explosive devices, unexploded ordnance and unmanned aerial vehicles.

Strategic Missile Systems

Strategic Missile Systems comprises development and sustainment programs for the nation's intercontinental ballistic missile (ICBM) force. Boeing works under a subcontract to Northrop Grumman on certain programs, and also serves as a direct contractor to the U.S. Air Force on several programs.

Strategic Missile Systems includes the following:

- **Boeing – Heath, Ohio**, which provides repair and final assembly capability for guidance, navigation and control systems and antenna systems;
- **The Guidance Replacement Program (GRP)**, which extends the life of the Minuteman III missile guidance by updating obsolete electronics;
- **Guidance & control sustainment**, which provides engineering support for Minuteman III;
- **Trainer contractor logistics support**, which includes total contractor logistics support for all ICBM trainers;
- **Weapon & ground systems sustainment**, which includes weapon system test and hardware replacement activities needed to keep the Minuteman system viable for the foreseeable future;
- **Little Mountain Test Facility**, a Boeing-operated nuclear hardness test facility, and
- **Field services**, which provides system modification deployment across the Minuteman force.

Boeing is defining future options for more affordable operations, increased system effectiveness (accuracy) and maintenance, and continued nuclear weapon security.

Boeing leads a team creating concepts for a Conventional Strike Missile capability and is executing a key material development contract. Boeing's Hypersonic Strike Vehicle is a key technology in any future operational system.

Background: MDS is headquartered in Huntsville, Ala., and also has major business activities in Alaska, California, Colorado, Hawaii, Kansas, New Mexico, Ohio, Texas, Utah, Washington state and Washington, D.C.

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March 2010