missile/tactical weapons

CALCM AGM-86C

More Information

The Conventional Air Launched Cruise Missile (CALCM) is an affordable, long-range standoff weapon that has proven itself in combat in Operation Desert Storm, Desert Strike, Desert Fox and Operation Allied Force.

CALCM is produced by modifying surplus nuclear-armed AGM-86B Air Launched Cruise Missiles (ALCM). CALCM Block 0 and Block I configurations feature a high explosive, blast-fragmentation warhead and a Global Positioning System (GPS) receiver for accurate GPS-aided inertial navigation. Launched from B-52H aircraft, CALCM provides the US Air Force with an economical, rapid response, worldwide conventional strike capability, making it a cost-effective choice for additional system upgrades and new mission applications.

Similar to the AGM-86B in appearance and mechanical operation, CALCM is the only air-launched, conventionally armed, long-range standoff missile deployed in the Air Force inventory today. Coupled with long-range bombers and air-refueling aircraft, the CALCM missile provides the Air Force a highly responsive capability to launch very accurate conventional attacks against targets located nearly anywhere in the world, without the support of bases located outside the continental United States.

Conversion from ALCM to CALCM
Boeing began modifying the ALCM inventory from nuclear to nonnuclear in June 1986. Operational capability was achieved in January 1988, with the conventionally armed missile being designated AGM-86C. The CALCM program successfully met schedule, cost, and missile-performance goals.

Engineering design for the conventional configuration was developed at an accelerated pace, with hardware and software critical design reviews conducted after only five and seven months, respectively, from program go-ahead. Successful flight test occurred within the first year of the program, and the first four production missiles were delivered within 13 months of contract go-ahead.

On January 16, 1991, during the first days of Operation Desert Storm, 35 conventionally equipped missiles were successfully launched from seven B-52 aircraft against high-priority Iraqi targets. Since the CALCM missile conversion was a Special Access program, it was not until January 1992 that the Department of Defense publicly acknowledged its existence and role in Operation Desert Storm.

Boeing delivered the last unit on the initial CALCM contract (Block 0) in June 1993. A Block I contract was awarded in June 1995 for conversion of 100 missiles (Lot 1) with producibility improvements. In March 1996, Boeing received a contract for an additional 100 Block I conversions (Lot 2).

In December 1996, Boeing completed a contract to demonstrate precision strike

accuracy using precision on-board GPS optimization (POGO) in a CALCM vehicle. An ALCM airframe, modified with precision GPS-aided inertial navigation, flew for 4.5 hours, performed a steep terminal dive, and impacted on target within 2.5 meters of the aim point. A steep dive increases the effectiveness of penetrating warheads against a wide range of hard and deeply buried targets.

The December flight demonstration was very successful, showing the capability of the AGM-86C as a precision strike weapon. The Air Force subsequently decided to develop retrofit Block 0/I missiles with precision strike capability (Block IA).

Block IA precision accuracy retrofit kits will upgrade the existing CALCM fleet to provide a precision strike capability. The AGM-86D program will modify additional ALCM missiles with three-meter accuracy and an advanced penetrating warhead to quickly provide theater commanders with a long-range weapon to precisely attack an enemy's most valuable facilities.

Block IA - Precision Accuracy Retrofit Kits
Block 0/I missiles are being retrofitted to Block IA with a precision accuracy kit that uses a third generation GPS receiver along with advanced navigation software, and a GPS anti-jam electronics module and antenna for a significant increase in jamming immunity.

The contract for Block IA was awarded in April 1998 with initial kit deliveries scheduled for July 2000. Under the development and production contract, Boeing will develop and deliver 28 missile retrofit kits to the Air Force, which will complete the missile kit installation.

Major kit components include the GPS Receiver Interface Unit/Precision (GRIU/P) built by Interstate Electronics Corporation; a GPS anti-jam module built by Harris; and a four element GPS antenna array based on the design by Boeing Phantom Works.

To increase CALCM effectiveness against a wider spectrum of targets, a capability for shallow to near-vertical dive angles from any approach reference point also is being integrated.

Flight software improvements include a large-state Kalman filter for optimizing GPS accuracy, to include code and phase measurement data, pressure and temperature measurements, and wide-area GPS enhancement to reduce system errors.

New CALCM Conversion Contract
The U.S. Air Force awarded Boeing a $41 million contract in April 1999 to convert 95 surplus ALCMs to CALCMs. The action allows the Air Force to replace the cruise missiles expended in Operation Desert Fox in late 1998.

The company's most recent conversions were completed less than two years ago at its Oak Ridge, Tenn., facility. The new round of CALCM conversions will be performed in St. Charles, Mo., alongside production of the Navy's Harpoon and SLAM-ER missiles and the Air Force's JDAM precision weapon.

Boeing personnel in Seattle will provide engineering and logistics support work. Initial deliveries are scheduled for late 1999.

AGM-86D - Hard Target Defeat Capability
Precision strike accuracy combined with an advanced penetrating warhead will

be incorporated into the AGM-86D CALCM to provide an enhanced capability against hard and deeply buried targets. A Foreign Comparative Test (FCT) program was initiated in June 1997 to evaluate the integration of the British Aerospace Royal Ordnance BROACH/Multiple Warhead System (MWS) with CALCM.

The MWS uses a shape charge and a follow-through penetrator to perforate reinforced concrete targets in excess of 10 feet. A successful sled test of the MWS in a CALCM fore-body was conducted in the United Kingdom in May 1998. In a dynamic sled test using a BROACH, the CALCM missile successfully penetrated a reinforced, 12-foot-thick concrete target. Two verification sled-tests of the MWS in CALCM will be conducted in late 1998 at Eglin AFB, Florida.

The Lockheed Martin, US-developed Advanced Unitary Penetrator (AUP-3M) warhead is also being evaluated for CALCM. Sled tests of that configuration against similar concrete targets are planned for fall 1998. The Air Force is conducting a Cost Benefits Analysis (CBA) of the two warhead alternatives and will make a selection of a CALCM AGM-86D warhead based upon performance, cost and risk by the end of January 1999.

The Defense Special Weapons Agency (DSWA) has included funding for CALCM AGM-86D in FY99 through FY01. Productionization of the AGM-86D missile would begin by March 1999, with flight tests in the second quarter of 2001, followed by production of an initial lot of up to 85 missiles. Existing requirements to attack select targets from long stand-off ranges may generate additional production.

Events | Evolution | History | News Releases | Photos | Specifications | Industry Team

---

Boeing Home | Missile Systems & Tactical Weapons