Excalibur Family of Artillery Projectiles

Excalibur is a family of precision-guided, extended-range modular projectiles incorporating three unique payload capabilities. The high explosive, fragmenting, or penetrating unitary munitions (Block I) are intended to enhance traditional fire support operations with increased range and improved accuracy against personnel, light materiel, and structure targets. The smart munitions (Block II) will be designed to search, detect, acquire, and engage fleeting and short-dwell targets common to open-terrain battlefields. Discriminating munitions (Block III) are expected to add the capability to selectively identify and engage individual vehicular targets in urban environments by distinguishing specific target characteristics. Excalibur's precision capabilities are intended to be used by Future Combat System (FCS) Non-Line-of-Sight (NLOS) Cannon units to provide close support to maneuver units in urban or complex terrain. Digitized light-weight 155mm howitzer systems will be used to develop and test Excalibur's capabilities before FCS NLOS Cannon is fielded.

The Excalibur development team combines U.S. guidance expertise with Swedish airframe experience. The projectile will employ Global Positioning System (GPS)-aided inertial guidance and navigation, free spinning base fins, four-axis canard airframe control, base bleed technology, and a trajectory glide to achieve increased accuracy and extended ranges beyond 35 kilometers. The FCS NLOS Cannon will incorporate an inductive fuze setter to transfer target and fuze data to the integral fuze.

Excalibur system development began in 1997 with a dual-purpose improved conventional munitions variant. However, in January 2001, the Army shifted the development priority to the unitary projectile. In November 2001, the Army Acquisition Executive decided to merge the Raytheon Excalibur (U.S.) and Bofors (Sweden) Trajectory Correctible Munition programs and directed the program to schedule an in-process review for FY02. Following a Systems Review in February 2002, Army leadership directed Excalibur to follow a block acquisition strategy. An early, limited production version of the unitary round (Block IA) will provide an initial capability for the Army in FY06. The Block I (unitary) Milestone C is scheduled for FY06 and an initial operational capability (IOC) in FY08. For Block II (smart) and Block III (discriminating), Milestone B is scheduled in FY08, Milestone C in FY13, and IOC in FY16.

TEST & EVALUATION ACTIVITIES

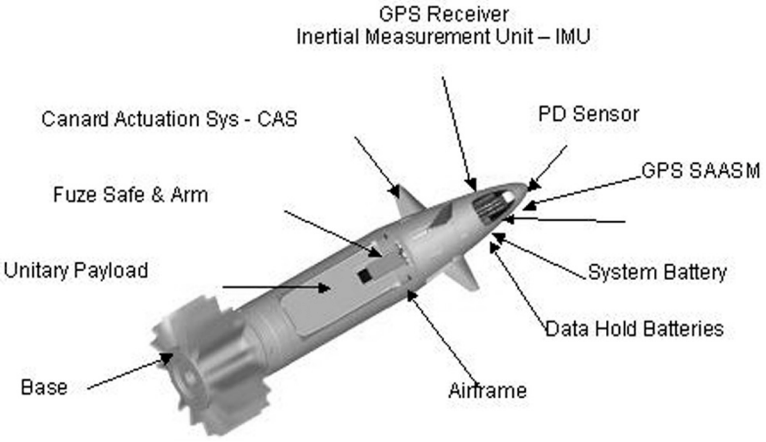
Raytheon and Bofors have conducted merger negotiations and trade studies. Contract award is planned in FY03.

Test events thus far have been limited to component-level testing. Raytheon has tested the Guidance, Navigation, and Control system and the payload, while Live Fire Test and Evaluation (LFT&E) activities were limited to preliminary developmental testing of the unitary warhead.

DOT&E worked with the Excalibur Integrated Product Team to develop a Block I Excalibur Test and Evaluation Master Plan (TEMP), including a comprehensive LFT&E Strategy.

TEST & EVALUATION ASSESSMENT

Key technical risks for the unitary program include reliable fin deployment, airframe maneuverability, warhead fuze development, inertial measurement unit (IMU) hardening, and GPS acquisition. In the last year, gun-hardening tests demonstrated integrated GPS acquisition and tracking, and IMU mechanical performance



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to mid-zone acceleration levels. The canard actuator system passed the static deployment test. Raytheon is making progress on hardening the IMU and should be on schedule for the Block I series. Accuracy required for engaging area targets should be achievable, but achieving the greater accuracy required for structures and other point targets is higher risk. The fielding of the early production version in FY06 is high risk however, the two years between this fielding and the full-rate production of the Block IB in FY08 reduces this risk.

Smart projectiles such as SADARM (U.S.), Smart155 (Germany), and Bonus (Sweden) that employ millimeter wave variants and infrared sensors to engage armored targets already exist. They have shown success against benign targets, but are less successful against countermeasured targets. Germany and Sweden are working on product improvements that should make the technology more effective by the start of the Block II and III programs. Technology that discriminates between individual targets is unproven.

No testing supporting the assessment of system lethality has been completed at this time. The Army has proposed an LFT&E based on static arena tests, warhead penetration tests, end-to-end firings against representative targets from each of the expected target classes, and modeling and simulation. DOT&E has stressed the importance of demonstrating the effects of fuze function variation, terrain, and projectile angle of fall. The Army understands these concerns and is currently working to revise the draft LFT&E Strategy.

Excalibur may be susceptible to GPS jamming. If GPS jammers are employed in the vicinity of the target, then the Army expects Excalibur to use its inertial navigation system to hit the target. However, if the round encounters jamming that prevents initial GPS acquisition, then the round will follow a ballistic trajectory instead of achieving guided flight. This ballistic trajectory may endanger friendly forces if they are in the area of the ballistic round's impact.

Excalibur will require accurate target location data in order to achieve desired effects for the unitary variants. Target location errors will need to be 35 meters or less for personnel targets, and approximately 10 meters or less for targets requiring a direct hit.

Excalibur susceptibility to height of burst spoofing and its resultant diminished weapons effects are undetermined at this point.

Test and Evaluation issues of concern for DOT&E to be resolved in the TEMP development include: conducting an end-to-end evaluation of effectiveness against the likely Excalibur target set from target acquisition to effects on target; the development and inclusion of embedded instrumentation into the projectile to separate the measure of reliability from effectiveness; the selection of an adequate test site that can accommodate testing in a GPS-jammed environment and at the extended range Excalibur offers; and the adequacy of testing to support the early production and Milestone C decisions (i.e. most available data will come from contractor development testing).