

# Better Than Bombs



Lockheed Martin's 70-mm Direct Attack Guided Rocket (Dagr)

**Unpowered guided bombs now dominate the drop-count, but there are better ways to attack low-value ground targets and those protected by modern air defences. There are also better armaments for drones and helicopters.**

## Roy Braybrook

**G**round attacks in prolonged counter-terrorist operations that involve no effective air defence systems must combine precision with low cost. The current widespread use of bombs with add-on guidance and control kits obscures the need for further developments in powered air-to-ground guided missiles, which provide a much larger 'footprint' and higher kinetic energy at impact. There is in particular a demand for cost-effective lightweight and operationally flexible weapons for drones and helicopters.

Improvements in turbine engines, low-cost sensors and variable-geometry wings are meanwhile encouraging the development of a new breed of air-launched missiles that can loiter above potential targets, expanding the surveillance area provided by the launch aircraft.

### Guided Rockets

Armada has often discussed the attractions of adding a guidance kit to a simple rocket projectile, this at the lightweight end of the missile scale, to produce a cost-effective means to engage small numbers of personnel and soft-skinned vehicles.

In 2004 the Royal Norwegian Navy began funding Kongsberg's development of guidance and control packages for 70 mm rockets, initially using a laser seeker. Imaging-infrared and anti-radiation seekers were to be studied later. In 2006 a teaming agreement was announced between Kongsberg and Magellan Aerospace to develop the CRV7-PG (Precision Guided) projectile.

In April 2006 the US Army selected BAE Systems as prime contractor for the SDD (System Development and Demon-

stration) phase of the new APKWS-II (Advanced Precision Kill Weapon System II), which is based on a laser-homing 70 mm General Dynamics Hydra 70 rocket projectile.

Partnered by Northrop Grumman and GD, BAE Systems employs a mid-body guidance section with fin-mounted laser seekers for the APKWS-II. Flight tests began in January 2007, and a decision on low-rate production was planned for September 2008, to provide initial operational capability in June 2011. However, the US Army requested no funds for the APKWS-II for FY2008.

In March 2007 Lockheed Martin unveiled its 70 mm laser spot-homing Direct Attack Guided Rocket (Dagr), offering full compatibility with the company's Hellfire. Shortly afterwards, South Korea and the US announced the intention to co-operate in developing a guided 70 mm Low-Cost Imaging Rocket (Logir), evidently using an inexpensive imaging-infrared seeker.

In April 2007 Elbit Systems unveiled its Star laser guidance kit for 68/70 mm rockets. It seems likely that such a kit has been in service for some years with the Israel Defense Force.

For several years there have been reports of Russia developing the laser-homing 122 mm S-13L projectile, which appears in brochures for fixed- and rotary-wing aircraft. In late 2006 the Tula-based Splav company unveiled the course-corrected 80 mm S-8 Kor1, with improved propellant and a semi-active laser seeker that triggers control impulses by small sideways-firing rockets.

### Anti-Armour

The laser-homing, helicopter-launched Lockheed Martin AGM-114 Hellfire II has recently found a new lease on life, since its relatively light (45 kg) weight allows it to arm the General Atomics MQ-1 Predator drone. The Hellfire might also be the obvious choice for the US Air Force's MQ-9 Reaper (formerly Predator-B), but a recent General Accountability Office report (GAO-07-406SP) states that the Reaper programme was delayed by the addition of Hellfire in 2006. Maximum range of the Hellfire II is 9.0 km.

Following 60,000 of the original version, more than 21,000 Hellfire IIs have been produced for the US services and 16 export customers. Over 5000 of the series have been launched in anger. Current laser-homing models include the AGM-114M with blast-fragmentation warhead, the AGM-114N with an ATK-produced metal-augmented charge (thermobaric) warhead and the AGM-114P, which was



Developed by BAE Systems, the US Army APKWS-II 70 mm guided Hydra 70 rocket would have a mid-body guidance section with fin-mounted laser seekers. (BAE Systems)



*Spain will arm its Tigers with Rafael Spike-ER anti-armour missiles, which employ fibre-optic guidance. This maintains man-in-the-loop control in attacks on obscured targets. (Rafael)*

developed specifically for the Predator. The seeker of the AGM-114P has its field-of-view expanded from eight to 90°, facilitating off-boresight engagements and launches at up to 25,000 ft. The 49-kg AGM-114L Longbow Hellfire employs millimetre-wave (MMW) radar guidance, and is used on the Boeing AH-64D.

The MBDA Brimstone, with active millimetre-wave radar guidance, is a derivative of the helicopter-launched Hellfire. It was developed to meet a British RAF requirement for a fire-and-forget anti-armour missile suited to faster

The Hot 3 will serve on the French and German versions of the Eurocopter Tiger, but the German Army will later switch to the 50-kg infrared-homing MBDA Pars-3 LR (or Trigat-LR) which has a range of six km. Development of the Pars-3 LR was completed in mid-2004, and in June 2006 a € 380 million contract for 680 rounds was signed by the German Army. In this case the industrial contractor is Parsys, owned by LFK-MBDA Deutschland and Diehl BGT Defence.

Export Tigers differ in anti-armour missiles. Australia has opted for the Hell-



*The MBDA Brimstone anti-armour missile is shown on triple racks under the wing of a British RAF Harrier GR9, with the same company's AIM-132 Asraam mounted inboard. (MBDA)*

platforms. It entered service on the Panavia Tornado GR4 in 2005. It will be cleared on the Harrier GR9 by 2008, and later on the Eurofighter Typhoon.

The supersonic Hellfire was developed to replace the helicopter-launched form of the subsonic, wire-guided Raytheon BGM-71 Tow series, although the latter (also operated on large numbers of ground launchers) will not be completely phased out of US service until after 2025.

In October 2006 Raytheon announced receipt of a US Army contract for a radio-guided version of the Tow, based initially on the 22.9-kg Tow-2B Aero, which has a reduced-drag nose and (in wire-guided form) a range of 4.5 km. A radio-guided version of the 28.9-kg 3.75-km-range Tow Bunker Buster is expected to follow. However, it is not clear whether this RF Tow or Wireless Precision Assault Missile will ever be used from helicopters.

Europe's helicopter-launched, wire-guided anti-armour missile is the MBDA Hot, the latest version of which is the 24.5-kg Hot 3 with improved terminal effectiveness and anti-jamming performance.

fire, and Spain has selected the Rafael Spike-ER. The latter uses fibre-optic guidance, which provides advantages in urban warfare, in its ability to attack vehicles hidden behind buildings and in min-



*German Army Eurocopter Tigers will replace the MBDA Hot 3 anti-armour missile with the same company's Pars-3 LR, shown here in wing-mounted four-round pods. (MBDA)*

imising collateral risk. The Spike-ER weighs 33 kg in its launch canister and has a maximum range of eight km by virtue of a lofted trajectory.

## Lightweights

The Rafael product is not related to the much smaller (2.4 kg) Spike developed by the US Naval Air Warfare Center as an economical substitute for RPGs in attacking soft targets. The Spike would have a TV-seeker that would be locked on to the target before launch. Although some firings took place in 2004 there has been no recent news of Spike from the Naval Warfare Center or its industry partner DRS Technologies

The 49-kg Lockheed Martin AGM-169 Joint Common Missile (JCM) project was intended to replace the Hellfire and the Raytheon AGM-65 Maverick on US Army and US Marine Corps aircraft. It was to have a tri-mode (semi-active laser, millimetre-wave and imaging-infrared)



*Elbit Systems has recently unveiled its Star laser guidance kit for 68/70 mm rocket projectiles, representing another alternative to the US Army's APKWS-II programme. (Elbit Systems)*

seeker and a range of 16 km from helicopters and 28 km from fixed-wing aircraft. In late 2004 the Pentagon proposed to terminate the programme but Congress voted \$ 30 million in FY2006 and FY2007 to continue maturing key technologies.

The FY2008 budget request included \$ 53.5 million «with the intent of rebaselining the original JCM SDD Phase II to completion», under the revised designation Joint Air-to-Ground Missile (Jagm). Lockheed Martin continues as prime contractor and the programme (in which Britain is participating) remains Army-led. Following a Defense Acquisition Board review in August 2007, the aim is to complete the SDD phase by the end of FY2011 and launch Lrip (low-rate initial production) in FY2012.

Assuming that the Jagm project goes ahead, this appears to rule out the projected Modernized Hellfire, with a tri-mode seeker, dual-mode warhead and possibly the Brimstone airframe. Another possible substitute for the JCM was the Raytheon Precision Attack Air-to-Surface Missile (Paasm), an air-launched version of the company's ground-launched Precision Attack Missile (Pam) being developed for the US Army's FCS.

In an effort to prevent America monopolising the tactical air-ground mis-



The MCT will probably serve as a basis for the development of the new EMM family of anti-armour and anti-structure weapons. This is the MBDA air-launched variant of the planned MCT. (Armada/EHB)

sile sector with the Jagm, Britain, France and Sweden are co-operating in studies that are expected to lead to technology demonstrators for a European Modular Missile (EMM). Full-scale development of this direct/indirect fire weapon is scheduled to begin around 2010 and it will be produced in several forms with ranges of up to 100 km.

In essence, the EMM combines Britain's Multi-Role Surface Combat Missile, France's Missile de Combat Terrestre and Sweden's European Common Missile efforts. The principal companies known to be involved are MBDA (presumably with the rest of the UK's Team CW), Thales and Saab Bofors Dynamics.

In 2006 British Ministry of Defence announced its intention to award a Loitering Munition demonstration and manufacture contract to the MBDA-led Team Complex Weapons. MBDA is known to be developing an Active Diamond Back joined tandem wing kit for loitering munitions.

### Miscellany

The 300-kg, 24-km-range Raytheon Maverick family needs no introduction. The latest development is the Lock-On-After-Launch (Loal) Maverick, employing GPS/INS mid-course navigation and a video digital datalink for the terminal

involving firings against stand-off targets (with one totally off-boresight) and a salvo of three weapons; all missiles reached their designated targets.

The anti-radiation missile market continues to be dominated by the supersonic Raytheon AGM-88 Harm, which entered service in 1984. When production was terminated in 1996, over 22,800 Harms had been constructed for the US services and the air forces of seven allies. The US fired over 2000 during operation Desert Storm in 1991 and a further 408 during the 2003 invasion of Iraq.



Shown on a Dassault Rafale, the Sagem AASM will replace laser-guided bombs and the AS.30L missile in French service. It is already cleared on the Mirage 2000. (Dassault Aviation)

The 365-kg Harm has been the subject of several upgrade programmes. It has recently completed a series of firing trials in Harm Destruction of enemy air defence Attack Module form, with INS/GPS guidance added. Aside from enabling attacks on non-emitting targets and low-power emitters, this precise navigation upgrade (PNU) allows the system to respect zones of exclusion and restrict its search to user-defined missile impact zones. The PNU turns the AGM-88B into the -88B+, and the AGM-88C into the -88D.

From around 2010 the Harm series is scheduled to be replaced in US Navy and US Marine Corps service by the ATK AGM-88E Advanced Anti-Radiation Guided Missile (Aargm), an ARM-88B/C derivative that is currently in the SDD phase. It has an improved 68-kg (150 lb) warhead anti-radiation homing receiver and retains GPS/INS navigation, but adds an active MMW radar that can find the target, even if it has shut down, thanks to target co-ordinate updates and an onboard library of targets. This radar is also used for fuzing of the warhead. It is anticipated that the US Navy will buy 1750 Aargms and that Italy (which is sharing in development) will take around 250. □



At the recent Paris Air Show, Sagem revealed a new family of Aasm missiles, like this 1000-kg weapon, to complement the current 250-kg Aasm. The other members use 125 and 500-kg bombs. (Armada/EHB)

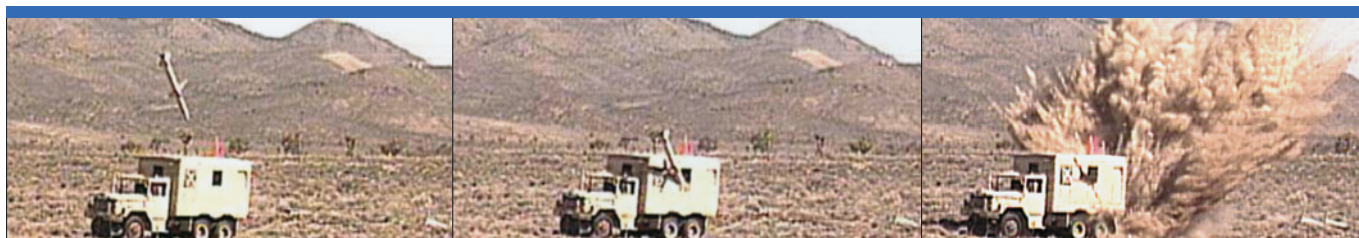
It is hoped that the EMM will be ready to enter service around 2015.

### Loitering with Intent

Returning to the subject of the FCS programme, it may be noted that, although development of the turbojet-powered, swing-wing Lockheed Martin Loitering Attack Missile (Lam) component of the Nlos-LS (Non-Line-of-Sight - Launch System) has been deferred, Raytheon is working on a Multi-Purpose Loitering Missile system. Boeing has likewise done considerable work on its Area Dominator long-endurance munition.

phase. This allows attacks to be performed despite bad visibility and low cloud, attacking through or under the weather.

One important new western European development in the tactical air-to-ground category is the Safran/Sagem AASM (Armement Air-Sol Modulaire), of which 3000 units are to be supplied to the French services. The AASM has GPS/INS navigation as baseline, later to be augmented by an imaging-infrared seeker. A laser-guided version is also under development. The AASM delivers a 250-kg warhead over a range of more than 50 km. A major milestone was achieved in April 2007 during a test



This sequence of stills taken from a video shows the direct impact achieved by an Aargm missile during the so-called DT1 developmental test firing on 1 May 2007, the first of 20 that will lead to full qualification. The missile will reach its initial operational capability in FY09. (ATK)