

Oerlikon/Martin Marietta Adats On November 30, 1987, this laser-beam-riding missile was selected by the US Army to meet the requirement for a line-of-sight forward heavy (LOS-F-H) air-defence missile system able to move forward with, and operate alongside, the tanks of an armoured division. Adats will be built in the United States, and the choice is about to be made between two industrial teams, Boeing/Hughes and Raytheon/Martin Marietta. Operational test and evaluation trials are due to take place at Fort Hunter Liggett in California and Fort Grayling, Michigan, starting in late 1989. IOC with the 3rd Armoured Cavalry Regiment at Fort Bliss, Texas, is scheduled for 1992. The first customer for the weapon was Canada, which plans to use the system for brigade and airfield defence. First deliveries to Canada are imminent.

LTV/Thomson-CSF VT-1 originally developed for use in Crotale-derived Liberty, the joint LTV/Thomson-CSF candidate for the US FAAD-LOS requirement, this hypersonic missile is now being marketed in its own right. Finland became the first customer for the weapon in the summer of 1988, ordering SAM systems for installation on the locally-developed six-wheeled Pasi AFV. These will carry a fire unit based on Thomson-CSF radars and electronics, plus eight ready-to-fire VT-1 rounds.

Fams France, Italy, Spain, and the UK signed an MoU in the first half of 1988, covering 18-month feasibility studies of a family of naval anti-air missile systems (Fams). These would include systems for point, area, and medium-range defence.

Nato Anti-air Warfare Systems (NAAWS) France, Italy, the Netherlands, Spain, the UK, and the USA are conducting feasibility studies of a short-range naval SAM system. This weapon could form the short-range component of Fams (see previous entry).

Orbita/BAe MSA-3.1 British Aerospace is reported to be negotiating with the Brazilian company Orbita Aerospace systems on the joint development of a shoulder-fired SAM based on the UK's company's Thunderbolt, an unsuccessful contender for the British Army requirement being met by the Shorts Starstreak.

ISRAEL

Israel Aircraft Industries Barak 1 Field testing of this vertically-launched point defence missile is expected to end in 1989, leading to production deliveries in late 1990/early 1991. A version fitted with an active-radar seeker has also been proposed.

The land-based version is known as Adams (air defence advanced missile system). An LAV 8x8 wheeled vehicle will carry two rows of five vertically-launched missiles. A limited ATBM capability is claimed for the system, presumably against short-range Frog-type weapons.

Israel Aircraft Industries Arrow In July 1988 the USA and Israel signed an MoU covering joint development of an ATBM system. Known as Arrow, this is intended to intercept tactical missiles during the first stage of their trajectory. At first it was thought that Arrow was aimed at countering Frog-class weapons, but it now seems that weapons of up to 625 miles range will be engageable. Under the agreement, the USA will fund 80 per cent of the anticipated \$400 million development bill. IAI now faces the task of developing and integrating the system's early-warning, guidance, and warhead subsystems. A full-scale test of Arrow is expected to take place in 1991.

ITALY

Selenia Albatros Similar in concept to the Nato Sea Sparrow, Albatros combines the Aspide missile and four- or eight-cell launchers with a variety of fire-control equipment from different manufacturers. Fifteen nations have adopted the system, which is available in single-director (Mk1) or twin-director (Mk2) versions.

Operators Italy (8 Maestrale-class frigates, aircraft carrier *Garibaldi*, 2 Audace-class destroyers, two planned Animoso (Improved Audace) destroyers, 4 Minerva-class corvettes), Argentina (4 MEKO 360-class frigates), Colombia (4 FS 1500 frigates), Ecuador (6 CNR corvettes), Egypt (2 Descubierta-class frigates), Iraq (4 Lupo-class frigates, 6 Assad-class corvettes), Libya (1 Mk7 frigate, Morocco (1 modified Descubierta-class frigate), Nigeria (1 MEKO 360 frigate), Peru (4 modified Lupo-class frigates), Spain (8 Descubierta-class frigates), Thailand (ordered for corvettes), Venezuela (6 Lupo-class frigates), plus one unidentified customer.

Selenia Spada The basic system consists of three six-round launchers controlled by a G/H-band radar tracker incorporating an I-band illuminator. Four such systems can be controlled by a single E/F-band search radar. Deliveries have been under way to the Italian Air Force since 1983, and a follow-on order was placed in early 1985.

Operators Italian Air Force.

JAPAN

Toshiba Tan-SAM (Type 81) This short-range SAM is operational with the Japan Ground Self-Defence Force. The four-round launcher and fire-control system are each carried on a Type 73 3.5-ton truck. Up to six targets may be simultaneously tracked by a pulse-Doppler phased-array radar, whose detection range is believed to be between 20 and 30km. The missile is similar in configuration to the British Aerospace Rapier, but more than twice the weight. The first portion of the flight to the target is under autopilot control. The nose-mounted IR seeker then acquires the target and guides the missile to interception.

The Tan-SAM Kai programme being developed will add an active-radar seeker with lock-on-after-launch capability. Range, hit-probability, and ECCM performance will all be improved.

Operator Japan Ground Self-Defence Force (24 platoons planned).

Toshiba/Japan Defence Agency Keiko Development of this shoulder-fired SAM has been under way since 1979. The weapon has a separate booster and sustainer motors, and uses a novel form of homing. The seeker is of the imaging type. Based on charge-coupled device (CCD) technology, it is dual-mode, operating at both visible light and IR wavelengths. After being locked on to the target, it "memorises" the appearance of the latter, a technique which allows all-aspect homing. Seeker hardware from Keiko has already been evaluated in the USA, and the US Army purchased two trials missiles in 1986. Procurement could begin in FY 1991. In February 1988 Toshiba was awarded a contract for what has been described as a "light-wave combined guidance system"—presumably for a future version of Keiko.

SWEDEN

Bofors RBS.70 Rayrider In addition to its tripod-mounted form, this laser-beam-riding missile is also available in vehicle-mounted form, and in the Armad turret-mounted variant. The RBS.70 SLM naval version tested aboard an Arko-class coastal minesweeper in 1983 is now ready for production. Firing trials have begun of the RBS.70/M113

system, which mounts the basic SAM on an MI 13 APC, the mounting being arranged to fold down under armour when the vehicle is moving. Bofors is working with Signaal to mate a twin-round RBS.70 launcher with the Dutch company's LIOD electro-optical tracking and fire-control system. The resulting system, designated Sweeper, is intended for naval applications.

A new version of the missile has almost completed development. Known as the Mk2, and visually identical to the current model, it has digital guidance electronics which take up less space, a larger sustainer motor, and a 50 per cent heavier warhead incorporating a hollow charge plus fragmentation pellets. Directly interchangeable with the existing missile, it is due to enter production in the winter of 1988/89.

Operators (standard version): Sweden, Australia, Bahrain, Brazil?, Eire, Indonesia, Iran, Norway, Pakistan, Singapore, Tunisia, and the United Arab Emirates (plus 3 others?); (Mk2) Norway, Sweden.

Bofors RBS.90 Bofors is now developing the RBS.90 (originally known as the RBS.70M Night-rider). This uses the updated Mk2 missile and a new remotely-controlled twin-round launcher incorporating the laser transmitter, TV and IR cameras, and two launch tubes. A group of between four and six launchers will be linked to a central fire-control vehicle fitted with a PS-91 local-surveillance radar. Target alerting may be performed by a separate Ericsson PS-90 search radar. Swedish Army trials are expected to end this year.

TAIWAN

Chung Shan Institute Tien Shung I and II Two SAM systems are being developed by the Chung Shan Institute of Science and Technology. Tien Shung I (some sources use the spelling Tien Kung) is a rocket-powered weapon in the Improved Hawk/Patriot performance class, and generally resembles the latter weapon. Firing trials were completed in March 1985. The weapon is radar-guided, and fired from a four-round launcher. The ramjet-powered Tien Shung II is intended as a Nike Hercules replacement, and is due to begin flight testing in late 1988 or early 1989. In April 1986 Taiwan downed a Hawk missile target using a "Tian Chien" SAM, but this was reported to use IR-guidance. Its relationship to the above projects is not clear.

UNITED KINGDOM

British Aerospace Rapier More than 25,000 rounds of this low-level SAM have now been built, and more than 11,500 have been fired. The British forces have completed an update programme which modified their Rapier systems from the original Field Standard A to the improved Field Standard B1. Troop trials of the fully-digital Electro-Optical Rapier (formerly known as Darkfire) started in 1985. This introduced the Scorpio infrared tracker which replaces the current optical unit, a six-round towed launcher incorporating an improved Racal-Decca surveillance radar with 50 per cent greater range, and a Console Tactical Control for the commander.

On November 13, 1986, BAe announced that it had received a contract worth about £1,000 million (\$1.5 billion), covering development and initial production of the improved Rapier 2000. Due to enter service in the early 1990s, it will equip two Royal Artillery air-defence regiments and three Royal Air Force Regiment squadrons.

Rapier 2000 introduces an eight-round launcher with four launch rails per side and a steerable spherical housing for a Darkfire-style optronic tracker. This occupies the location used by the surveillance radar on current systems. Rapier 2000 uses a trailer-mounted Plessey 3D