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THE ASTER MISSILE FAMILY

The ASTER modular family of vertically launched missiles is being developed under the leadership of MBDA within the Franco-Italian FSAF (Future Surface-to-Air Family) programme. Under this programme, France and Italy agreed to develop and produce a family of naval platform and ground based air defence systems for the armed forces of both countries. A subsequent trilateral agreement signed between France, Italy and the United Kingdom resulted in the development of a third naval air defence system using the Aster family of missiles known as PAAMS (Principal Anti-Air Missile System).

The ground based air defence system comprises:

SAMP/T is a land-based medium range area defence system using the Aster 30 (120 km range) missile for the French and Italian armed forces. The system comprises a fire control system based on a multi-function electronic scanning radar and a Vertical Ground Launcher mounted on Italian Astra/Iveco and French Renault-KERAX 8x8 trucks and capable of firing eight missiles in rapid sequence. The Aster 30 missile system offers high-level tactical and strategic mobility and due to its high rate of fire is capable of countering saturating threats. Moreover, it features outstanding manoeuvrability and agility in order to achieve a direct hit on the target ("hit-to-kill").

In addition to all aerodynamic targets, including cruise missiles, SAMP/T with the Aster 30 Block 1 missile can intercept short-range or theatre ballistic missiles having a range of 600km.

Naval air defence systems comprise:

SAAM (Surface-to-Air Anti-Missile): Using the Aster 15 (30km range) missile, SAAM is a high performance and highly manoeuvrable medium range anti-aircraft and anti-missile system for point and local defence against a new generation of threats including high speed, stealthy and highly manoeuvrable sea skimming anti-ship, cruise and anti-radar missiles.

SAAM provides effective defence against anti-ship missiles and modern combat aircraft and is able to counter saturation attack in extreme countermeasures environments. The system comprises a fire control system with multifunction electronic scanning radar, Sylver vertical launchers each containing eight ready-to-fire missiles and the Aster 15 anti-missile missiles.

The French SAAM/FR and Italian SAAM/IT variants are both the same except for the fire control system. The French Navy will use the Thales ARABEL radar while the Italian Navy will deploy the Selex Integrated Systems EMPAR radar.

The Aster 15 missile active RF seeker and inertial mid-course guidance gives the system great advantages over comparable systems in terms of target handling. Employing a unique combination of



Press Information

aerodynamic and thrust vector control, the Aster 15 missile has unrivalled agility and manoeuvrability, making the weapon highly effective in all operating conditions against highly agile and stealthy targets.

PAAMS (Principal Anti-Air Missile System): A 360° omni-directional system providing multi-layer air defence to armed fleets or groups of unarmed support and merchant ships. It incorporates three separate mission capabilities in a single naval air defence system – ship self-defence for protection of the PAAMS warship; local area defence for nearby ship defence; and medium and long-range air defence for deployed joint forces. PAAMS has been designed to provide optimum protection against omni-directional and co-ordinated attacks from sub- or supersonic missiles, aircraft and high value UAVs.

PAAMS comprises a Multi-Function Radar (MFR), a sophisticated Command and Control sub-system (C2), and a dual missile Vertical Launch Sub-system (VLS) containing a combination of 48, ready-to-fire Aster 15 and Aster 30 missiles (from the same Aster missile family as deployed with SAMP/T). PAAMS is supported by a Long Range Radar (LRR) for long-range surveillance.

Two PAAMS system variants have been developed. The Royal Navy system - PAAMS(S) which is now known as Sea Viper - uses the BAE SYSTEMS SAMPSON radar while the French and Italian navies deploy a system equipped with an EMPAR radar/fire control unit – PAAMS (E).

Depending on the threat, the combination of the Aster 15 and Aster 30 missiles enables the PAAMS system to fire in any configuration from the PAAMS Sylver A50 launcher providing an impenetrable defence envelope day or night, even in cases of extreme ECM and in all weather conditions.

Programme status

November 2012 marked the achievement of another key milestone in the history of the Aster family of missiles. Not only had all the naval and ground based air and missile defence capabilities been qualified—with the various supplied systems having also entered operational service with their respective domestic and export customers—but significantly, the integration and final assembly of the 1,000th Aster missile was also completed. This significant production milestone is further evidence of both the maturity and the success of the Aster family.

SAMP/T

ASTER 30 SAMP/T is part of the Franco-Italian FSAF programme. The industrialisation and first production contract signed in 1997 and known as FSAF Phase 2 includes the first two SAMP/T production systems, one for France and one for Italy.

The FSAF Phase 3 series production contract was signed in November 2003 with provision for 12 SAMP/T systems for France and six for Italy. This includes the evolved Block 1 version of the missile with its TBMD capability.

The SAMP/T ASTER 30 munition qualification trials were concluded at the end of 2003. Operational evaluation of the system has been taking place in France and Italy with a series of test firings having taken place, notably in Italy during May 2008. Prior to the delivery of the first serial SAMP/T system to the



Press Information

French Air Force (in France SAMP/T is now referred to as the Mamba system) a system firing trial was carried out in France in December 2008. During this trial the target, representing a high speed aircraft flying at low altitude making an evasive manoeuvre, was intercepted by a direct impact.

In October 2010, the DGA carried out a successful firing of the Aster Block 1 missile against a target representative of a short range ballistic missile. Significantly, this was the first European missile to ever carry out a ballistic intercept. In November 2011, a second, successful, ATBM firing was achieved with the SAMP/T system, this time by a French Air Force crew who were carrying out the first firing of its Mamba system since it being formally declared operational the month before.

In May 2014, a joint Franco-Italian firing of the SAMP/T Mamba surface-to-air weapon system was carried out at the DGA missile test range at Biscarosse, in south-western France. This was the first operational firing by the French air force's 5/590 "Barrois" Air Defense Squadron, stationed at Saint Dizier, in north-eastern France. This firing was carried out as part of an air-defence firing campaign which demonstrated the interconnection of various air-defence networks operated by the French Air Force, the French Army and the Italian armed forces.

SAMP/T ASTER 30 is now available for the export market.

SAAM

The first successful firing of the SAAM system was conducted in 1999 from the French *Ile d'Oléron* experimental ship when a direct hit was registered on a manoeuvring sea-skimming target. In the same year installation on board the French aircraft carrier *Charles de Gaulle* was completed. The French SAAM/FR system was qualified in December 2001. On 30th October 2002, Aster 15 was successfully test fired using the complete SAAM system for the first time from the *Charles de Gaulle*, registering a direct frontal hit and totally destroying a target simulating an attacking anti-ship missile. Operational firings were carried out between December 2004 and May 2006.

The first qualification firing of an Aster 15 missile for the Italian SAAM/IT system took place in November 2001 from the Italian *Carabiniere* experimental ship. SAAM/IT system qualification was completed in December 2003. In July 2006 installation of the system was completed on board the Italian Navy's *Conti di Cavour* aircraft carrier.

A total of 200 Aster 15 naval missiles have already been ordered to equip 11 naval defence systems intended for the nuclear-powered French aircraft carrier *Charles de Gaulle*, the Italian aircraft carrier, *Conti di Cavour*, the three F3000S frigates for the Royal Saudi Arabian Navy and a further six foreign frigates. The SAAM air defence system will also provide the anti-air warfare capability on the new Franco-Italian FREMM multi-mission frigates.

PAAMS

The PAAMS programme was launched on 11 August 1999 with the award of a contract by the DGA in France on behalf of France, Italy and the UK, for the full-scale engineering development, production engineering, system qualification and first of class deliveries for the three nations.



Press Information

Three PAAMS systems were ordered in 1999 along with the required Aster 15 and Aster 30 Naval missiles to equip the first-of-class air defence vessels for each of the three countries. The UK Royal Navy has deployed its initial Sea Viper system on the first of its *Daring* class Type 45 destroyers. The French Navy has equipped the first of its *Horizon* class frigates while the Italian Navy has deployed PAAMS on the first of its *Orizzonte* class frigates.

In 2003 contracts were placed for an additional five PAAMS systems for the follow-on Type 45 destroyers for the Royal Navy and one system each for a French *Horizon* and an Italian *Orizzonte* and the supply of additional Aster 15 and 30 missiles.

The development of the Aster missiles for PAAMS is complete. A number of successful missile live firings were carried out in 2005 including a firing scenario simulating the protection of a friendly ship being attacked by an anti-ship missile in skimming flight, executing a "dog-leg" manoeuvre (90° high-load factor turn). A further trial was carried out in October 2005 in which the test scenario replicated exactly the kind of aerial threat that Aster PAAMS has been designed to counter – an attack on an escort ship by a salvo of two missiles at close range at an altitude of 1,000 metres. This test validated the Aster 30 missile's ability to discriminate between targets and confirmed that the missile's seeker would not be confused by the presence of a second target in the vicinity.

The first system qualification firing of PAAMS (E) using the EMPAR radar took place at the French DGA's CELM missile testing facility in May 2006. Carried out from an Italian navy *Carabiniere* trials ship, the Aster 30 missile registered a direct hit on the target. In May 2007, the final qualification firing of PAAMS (E) was successfully completed. The firing comprised the EMPAR radar and associated fire control system, the A 50 Sylver Vertical Launcher and the Aster 30 missile.

In June 2008 and February 2009, two firings of the Sea Viper system were successfully carried out from the UK's "*Longbow*" Sea Trials Platform in the Mediterranean

A further test programme, comprising four firings in less than a month, was completed in June 2010. These were carried out from the Italian *Orizzonte* frigate "*Andrea Doria*", the French *Horizon* frigate "*Forbin*" and the "*Longbow*" trials barge at different ranges in the Mediterranean. The trials were conducted over a range of scenarios of steadily increasing complexity, culminating in the final trial from *Longbow* featuring a salvo firing against a sea skimming target performing a high-g terminal manoeuvre. All the trials were fully successful with both the PAAMS ship equipment and Aster missiles operating as expected in each case.

In September 2010, the Sea Viper system was successfully tested on the Royal Navy's *HMS Dauntless* Type 45 destroyer with the firing of an Aster 30 missile during trials in the Hebrides. Deliveries of Sea Viper equipment to all of the Type 45 destroyers are now complete. In the UK, with the earliest ships now being in service, the emphasis is turning towards through-life support, with the previously contracted interim support arrangements now in the process of being replaced by through-life support contracts.

In April 2012, the Aster missile posted another major first for a European air defence missile. During a test firing from the French Navy frigate, *Forbin*, an Aster 30 missile successfully engaged a supersonic manoeuvring target simulating an anti-ship missile flying at very low, sea-skimming altitude. This success provides further proof of Aster's ability to defend against the most severe of naval anti-ship missile threats.



Extended Air Defence capability enhancement projects

MBDA is already committed to ballistic missile defence with the French and Italian SAMP/T and the Italian PAAMS (E) contribution to the lower level of NATO's ALTBMD programme.

The 2014 French military programming law has earmarked funds to launch the development of Aster Block 1 NT in cooperation with Italy. This new version of Aster will extend the antiballistic capability of the missile from a range of 600km up to 1,500km.

Additionally, MBDA is investing in a new and complementary interceptor, Aster Block 2, dedicated to the anti-ballistic mission and capable of being launched from the current family of Aster system ground and naval launchers already used to fire ASTER 15 and 30 missiles.

Designed as an evolution to the current capability, the Aster Block 2 interceptor will provide extended coverage to protect high value naval assets at sea, forces' entry points and harbours as well as forward deployed troops.

This new, two-stage interceptor will engage the new generation of manoeuvring, short and medium range ballistic missiles in the medium/high endo-atmospheric domain. IR guidance and a highly reactive solid DACS (Diverted Attitude Control System) combine to ensure hit-to-kill. Adding the Aster Block 2 capability to that provided by the current Aster air defence systems will significantly enhance protective coverage for external theatre operations or for sensitive territory areas.

In addition, the Aster Block 2 capability offers a contribution in kind to the burden sharing of NATO's ALTBMD (Active Layered Theatre Ballistic Missile Defence) upper layer extension. Similarly, it can provide a significant complementary capability to the USA Administration's EPAA (European Phased Adaptive Approach) to homeland and European territory missile defence.