

PLUS AESA & METEOR

An even more potent Rafale



Extremely rare view of a French Air Force Rafale B with a single MBDA 3 kiloton ASMPA thermonuclear missile in the central position, plus 4 MBDA Mica air-to-air missiles. The aircraft is in full nuclear strike configuration with a pair of 2,200 litre drop tanks. Pictures with nuclear weapons are hard to come by. (Official Armée de l'Air photo - SIRPA-Air)

Till very recently it was only US fighters that could boast of new generation airborne radars. Among these aircraft with this great asset are the Lockheed Martin F-16E/F Block

60 Fighting Falcon (using the Northrop Grumman AN/APG-80 AESA radar), the updated USAF late model Boeing F 15C, Republic of Singapore Air Force's F-15SG (fitted with the Raytheon AN/APG-63(V)2

and AN/APG-63(V)3 respectively), the Boeing F/A-18E/F Super Hornet and EA-18G Growler (equipped with Raytheon APG-79 or APG-82(V)1). The Americans now have a 'rival' in shape of the French Air Force's Rafale F3 fighter, fitted with the Thales RBE2/AA (*Antenne Active*) AESA lightweight radar. Rafale F3, the first European fighter to be fitted with AESA radar, was inducted in the French Air Force in 2012.

On 1 October 2012, Dassault Rafale C 137 single seater aircraft, equipped with the new Thales RBE2 active electronically phased array radar, was delivered to the French defence procurement agency (DGA) virtually on schedule. The ceremony took place at Dassault Aviation's Mérignac production plant in Bordeaux, France.

A committed research and development programme coupled with sustained application by the French industry have been behind the Rafale emerging as the first European combat aircraft with a functional electronically phased array radar and a completely indigenous hi-tech sensor. Other European efforts relying on non-European technology are still at various stages of development and testing. Ericsson's PS-05/A MK-5 (NORA) for the JAS 39 Gripen and Euroradar's Captor-E CAESAR (Captor Active Electronically Scanning Array Radar) for the Eurofighter are two examples.

French Air Force Général Joël Rode, commanding officer of the *Centre d'Expériences Aériennes Militaires* (CEAM) at Mont-de-Marsan is "completely satisfied" with the upgraded aircraft. He heads the French Air Force test centre where the aircraft will undergo an eighteen-month period of operational air trials. The Général has declared, "Our Rafale F3 is already a splendid multirole fighter aircraft, it will be even better with this new radar. To be frank, this technological step is even higher than when we switched from the Thales RDI radar to the RDY on the Mirage 2000 fifteen years ago!" General Rode's testimony carries a lot of weight as his credentials include being the commanding officer of

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Escadron de Chasse 1/2 *Cigognes*, the sole French Air Force squadron to fly the Mirage 2000-5 air superiority fighter equipped with the Thales RBY multi-target agile Doppler radar cued to the MBDA Mica air-to-air missile.

The new RBE2 AESA brings to the Rafale F3 an extended range of capabilities like low-observable target detection, full use of new weapon systems such as the new MBDA Meteor long-range

with the present F3-O4T standard (previously known as the 'roadmap' standard), which in fact is the latest standard retained for the sixty Tranche 4 Rafales earmarked for France. In short, 25 Rafale C single-seaters, 25 Rafale B duals and 10 Rafale M ship-borne variants for the *Aéronavale*, will be delivered between 2013 and 2019.

In France, the first operational squadron to acquire the Rafale with new

well as Mirage 2000s can exchange their 'tactical picture' securely in near-real time. The frequency range used by Link 16 today limits the exchange of information between aircraft within line-of-sight (LOS) of one another, but this is not considered a major issue in current military operations, particularly since tactical staging of fighter aircraft is always performed within the detection range of a Boeing E-3F AWACS.



The new MBDA Meteor Beyond Visual Range (BVR) air-to-air missile is the latest addition to the Rafale's weaponry. (MBDA photo)

BVR hypersonic air-to-air missiles, a much higher reliability with relatively low maintenance costs and greater waveform agility for SAR (Synthetic Aperture Radar) imaging and improved resistance to jamming.

The *Armée de l'Air* will be followed by the *Aéronautique Navale* to acquire the aircraft joining the flight testing programme with EC 5/330 "Côte d'Argent" and CEPA/10S at Base Aérienne 118 in Mont-de-Marsan early in 2013.

All export versions of the Rafale, including the 126 earmarked for the Indian Air Force's MMRCA programme, will incorporate Thales AESA advanced radar technology as standard. This is consistent

radar will be EC 2/30 *Normandie-Niemen* at Mont-de-Marsan whose proximity with the CEAM will help resolve teething problems that might occur during the initial period.

General Rode is of the opinion, that "Since the new radar is of the 'plug-and-play' type, there will be no problem in operating both the old and the new types of RBE2 radars, PESA and AESA at the squadron level. Furthermore since all Rafales now use the NATO Link 16 tactical data exchange network, aircraft engaged in an aerial operation will benefit from the 'big picture' painted by those Rafales fitted with the RBE2 AESA." With Link 16, all Rafales as

A smarter radar

An active electronically scanned array (AESA) radar, also known as 'active phased array' radar, is that type of radar whose transmitter and receiver functions are composed of numerous independent solid-state transmitter and receiver modules (TRMs). Other components include an advanced receiver/exciter, ruggedised COTS processors, and power supplies. AESA radars simply aim their 'beam' by emitting separate radio waves from each module at certain angles which form a virtual sheaf in front of the antenna. Such radar is an improvement on the older passive electronically scanned (PESA) radar which emitted across a

much larger band of frequencies, making it difficult to detect over background noise and clutter. The Rafale with its AESA radar, will broadcast powerful radar signals to detect enemy aircraft or surface targets, while itself remaining unobserved. The complete 'electronic cloak' provided by the Rafale's Thales Spectra ECM suite, which is unique, is another advantage that this aircraft boasts of.

With Rafale C-137's intensive test campaign due to end during the summer of 2014, the CEAM will be able to tackle a brand new world of systems, armed with hi-tech systems like the DDM-NG devised by MBDA or the OSF-IT long-range optical passive identification sensor from Thales.

The DDM-NG (*Détecteur de missile de nouvelle génération*) demonstrated its high value some three years ago when a prototype DDM-NG began trials on-board the Rafale during the summer of 2009 at the DGA's test flight centre in Cazaux. Flight trials produced very convincing results, and the DGA ordered this new system as the standard fit for the 60 supplemental Tranche 4 Rafale aircraft ordered by France in December 2009.

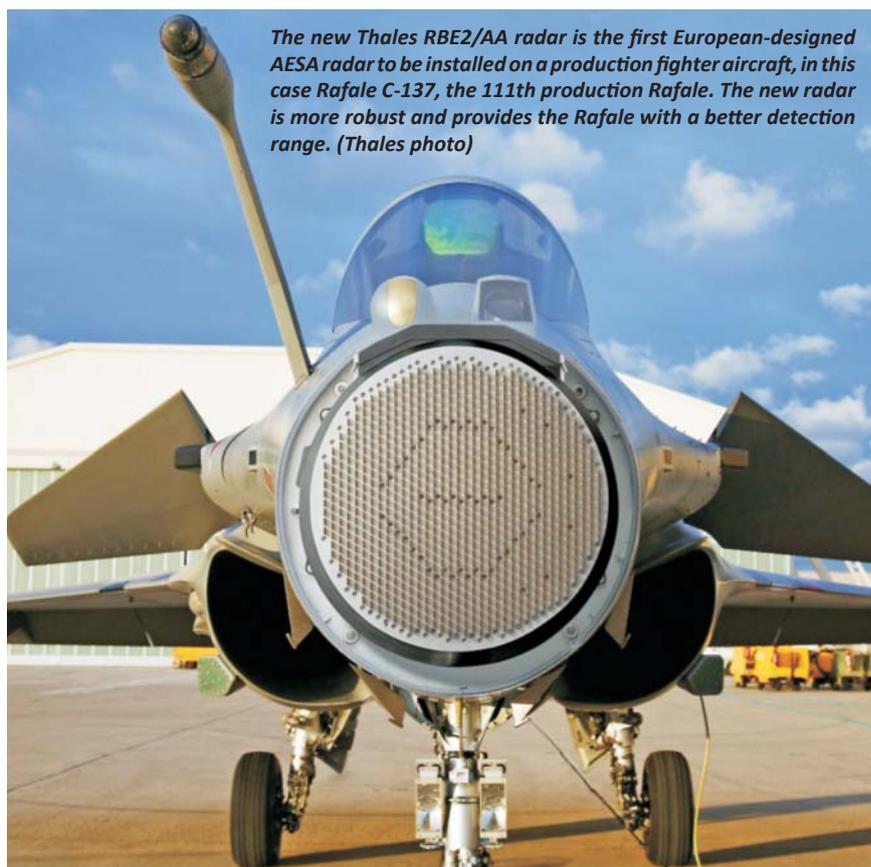
As explains a DGA pilot: "The concept behind DDM-NG is the ability to detect incoming missiles from any direction and also the angle of attack from the host aircraft. It will supersede the current DDM system installed on the Rafale as a *form, fit and function* replacement." Characterised by two 'fish-eye lenses' fitted on both sides of the fin, between the Spectra EW antennae, the DDM-NG provides a complete 360° spherical field of view around the aircraft. It also incorporates a new IR array detector which enhances performance with regard to the range at which a missile firing will be detected. It also provides an improved rejection of false alarms (often produced by intense solar reflection on the ground or water surface) and gives a novel angular localisation capability which will be compatible with the future use of Directional Infra Red Counter-Measures (DIRCM) systems, the ultimate device to defeat incoming IR-guided missiles.

The quality of the DDM-NG's detection algorithms and its very

low false alarm rate, allows it to be effectively incorporated within an integrated aircraft self-protection system such as SPECTRA (*Système de Protection et d'Évitement des Conduites de Tir du Rafale*) and to automate the sequence of counter-measures. In addition, operating in passive infrared, the DDM-NG has no electromagnetic compatibility issues with other sensors and can therefore be easily integrated into all aircraft platforms.

endeavour, with a team of engineers from Britain, France, Germany, Italy, Spain and Sweden, to be fitted as the standard long-range BVRAAM to the Eurofighter, Gripen and Rafale. France launched a procurement of a first batch of 200 Meteors in December 2010.

The Meteor is an active radar guided beyond-visual-range Mach 4+ air-to-air missile that will offer a multi-shot capability against long range manoeuvring targets in a heavy



The new Thales RBE2/AA radar is the first European-designed AESA radar to be installed on a production fighter aircraft, in this case Rafale C-137, the 111th production Rafale. The new radar is more robust and provides the Rafale with a better detection range. (Thales photo)

Adding more punch

Along with the new AESA radar, the Rafale F3 has also recently been cleared for the MBDA Exocet AM39 Block 2 antiship missile, thus adding more punch to the aircraft. Both the French Air Force and Navy Rafales are now compliant with this missile.

Significantly, in October 2012, a Rafale testbed (B-301) performed the first live firings of the MBDA long-range BVR Meteor air-to-air missile, at Cazaux AB on. The Meteor is now achieving its final acceptance trials, with the first deliveries earmarked for early 2013. This new missile is an exclusively European

electronic counter-measure (ECM) environment. The Meteor's active radar seeker is derived from MBDA's highly agile Aster and Mica air intercept missiles. According to MBDA, this new missile has three to six times the kinematic performance of current air-air missiles of its type. The key to the Meteor's exceptional performance is a throttleable ducted rocket (ramjet) manufactured by Bayern-Chemie in Germany. For a CAP sortie, each Rafale will carry two Meteors altogether with six Micacs, making it a formidable air superiority fighter.

Jean-Michel Guhl in Paris