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EUROFIGHTER TYPHOON

- CAPABILITY DEVELOPMENT
- INTEROPERABILITY AIMS
- COMBAT MISSIONS
- OPERATOR PROFILES





future mid-life upgrade of the existing Eurofighter Typhoon, industry leaders are confident that a new European fighter could become a reality.

This partly stems from the success of Eurofighter, and its journey from concept to today's reality offers valuable lessons. A four-nation European partnership was the only way that such a costly project could be realized, under the umbrella of the NATO Eurofighter and Tornado Management Agency (NETMA). While it ultimately delivered a large fleet of common aircraft, it also served as something of a millstone around the necks of those who sought to push the basic entry-into-service-standard Typhoon forward. It was perhaps inevitable that individual national requirements and funding would be hard to align; indeed, the partners were initially forced to set

their pace with that of the slowest ship in the convoy.

Ultimately, the partnership has prevailed and the benefits of joint funding and a coherent joint plan are now making good their promise, albeit not always in the swiftest of fashions. The early rigid uniformity of the program has given way to a more versatile approach that is better-suited to embracing national aspirations, and to accommodating a willingness to share technology and fund spiral development ambitions.

Dispelling a dated view

The initial Tranche 1 Eurofighters were first handed over to operator air forces in 2003. Initially optimized for the air-to-air role, only now are we seeing the aircraft reaching their potential as versatile, combat-proven, all-rounders. The Royal Air

Cover image: A Royal Air Force Typhoon FGR4. **Jamie Hunter**

Inset: BAE Systems test pilot Nat Makepeace checks an inert MBDA Meteor beyond-visual range air-to-air missile pre-flight. **Jamie Hunter**

Below: Quick reaction alert (QRA) and air policing has become a staple for Eurofighter squadrons in Europe. In addition, all four partners have embraced multi-role to an extent. **Jamie Hunter**

TYPHOON TRANCHES

Eurofighters are built in three tranches, or batches.

Tranche 1 consisted of 148 aircraft: 33 for Germany, 28 for Italy, 19 for Spain and 53 for the UK, plus 15 for Austria.

Tranche 2 initially covered 236 aircraft. However, with the UK securing the Royal Saudi Air Force as the second export customer under Project Salam, the figures were adjusted. The UK, which brokered the 72-aircraft Saudi order, diverted 24 jets to supply an initial batch to the RSAF, and an additional 48 aircraft were added to the tranche. The 24 diverted aircraft should have been added to the back end of Tranche 2 production for the UK but were not, instead being added to Tranche 3 and counted by the UK as part of its overall commitment. In the event, Tranche 2 took in 299 aircraft: 79 for Germany, 47 for Italy, 34 for Spain and 67 for the UK, plus the 72 for Saudi Arabia, all of which were assembled in the UK and have been delivered.

The partner nations eventually agreed to split Tranche 3 into two parts, 3A and 3B. Tranche 3A was signed on July 31, 2009, and was for just 112 aircraft at an estimated €9 billion. This divided up as 31 for Germany, 21 for Italy, 20 for Spain and 40 for the UK. Tranche 3B has never been signed.

The UK's 40 Typhoons in Tranche 3A comprise 16 extra aircraft, plus the 24 diverted to the RSAF from Tranche 2. This effectively takes the RAF allocation to a total of 160 aircraft: 53 Tranche 1, 67 Tranche 2 and 40 Tranche 3A.

Export orders for Oman (12 aircraft), Kuwait (28) and Qatar (24) take overall production to 623 aircraft.



Above: The Royal Saudi Air Force has pressed its Typhoons into combat operations over Syria and Yemen, armed with Paveway II and IV weapons. Its last 24 jets were built as Tranche 3 standard. **Jamie Hunter**

Below: Airbus Defence and Space delivered the first two Eurofighters in the latest PIEb FW (Phase 1 Enhancement Further Work) configuration from the Getafe final assembly line on January 23. The remaining six of 73 aircraft contracted by Spain will be delivered to the same PIEb FW standard by 2019. **Eurofighter**

The Eurofighter now has a meaningful foundation as a solid swing-role performer and a clear path of upgrades and capability insertions will only help to take the aircraft into the next decade. The type has had its fair share of bloody noses, but British Typhoons have flown in two combat theaters, the aircraft has stood toe-to-toe with fifth-generation fighters and it has earned praise on the international stage. The Royal Saudi Air Force has pressed its jets into combat over Yemen and it is at the front of the pack when it comes to getting the most capability from them.

A bright future?

The rhetoric surrounding the Eurofighter program today is very different to five years ago. The rash of sales in the Middle East to Oman, Kuwait and Qatar has offset any fears of slippage in the incremental phased enhancement (PE) — the new customers will receive jets with the latest weapons and systems, and a new active electronically scanned array (AESA) radar. Few doubt the importance of the AESA, with Kuwait being the lead customer for the so-called Radar 1. For the Typhoon, the E-Scan story is a little painful, dating back to 2002 when the Euroradar consortium first launched an E-Scan radar

demonstrator program. The CAPTOR Active Electronically Scanned Array Radar (CAESAR) was hoped to be the core for Tranche 3 Typhoons. The reality is that the mechanically-scanned CAPTOR has proven itself highly effective, and other upgrades have taken priority with regard to funding, but now there is a weight of responsibility to provide a capable E-Scan for expectant export customers.

There is a genuine feeling that there is a new impetus behind the Typhoon. British government-to-government success in selling 72 jets to Saudi Arabia, 12 to Oman and now 24 to Qatar is likely to be joined by follow-on orders and possible new deals. Many expect Saudi Arabia to buy around 24 more fighters and Qatar is likely to take a further 12. In addition, there is potential for new German orders for Eurofighters as a replacement for the Tornado.

Remarkably, Typhoons continue to roll off all four partner nations' final assembly lines, although Getafe in Spain is in the final throes with just six Eurofighters still to be produced for the Spanish Air Force by 2019. Even if new sales materialize, a rationalization of final assembly must be close, even if recent successes are joined by campaign wins in Belgium, Canada, Finland and Poland. **Jamie Hunter**

GREAT EXPECTATIONS

The Eurofighter Typhoon program has proved to be a huge success for the European aerospace industry in terms of capability development and export success – is this set to continue?





OPINION: DEBUNKING THE TRANCHE 1 MYTH

Project 'Gordian', or CP193, was the RAF's thrust to bring a swing-role capability to its Tranche 1 aircraft, adding an 'austere' integration of the Litening targeting pod that enabled the aircraft to self-designate its own Enhanced Paveway II (EPW2) laser/GPS-guided bombs.

This multi-role capability was declared to great acclaim with an operational employment date of July 1, 2008. It provided the Typhoon with a useful precision strike capability that was added to the UK's Block 5-standard jets.

The last two years have seen a dramatic change in fortunes for the Tranche 1s. The RAF had originally planned to retire them as an economy measure; indeed, 16 two-seaters are to be reduced to spares by the end of 2018, although there are also reports that another nation has shown interest in purchasing these jets.

Although the Typhoon has a 6,000-flying hour life, which may be extended, and although the Tranche 1 aircraft only entered full operational service in 2005 (after the 18-month 'Case White' introduction-to-service period at Warton), it was said that those aircraft built in the first production tranche would face insurmountable supportability and obsolescence issues, and that they could not be economically upgraded to Tranche 2 standard. The Tranche 1s did use different processors, requiring a different avionics architecture, and had a different front bulkhead, which mitigated against the later retrofit of an AESA radar, for example.

But many seasoned program insiders found this claim puzzling, not least since Eurofighter GmbH once offered to upgrade a number of Austrian Tranche 1 aircraft to Tranche 2 standard at the company's own expense — an indication

that such an upgrade would not be prohibitively expensive. This received rather less press coverage than Austria's more recent decision to retire its Tranche 1 aircraft prematurely, some time between 2020-23.

Austria's defense minister Hans Peter Doskozil justified the decision by saying that the aircraft lacked the full capabilities needed for Austria's sovereign air surveillance mission, conveniently omitting the fact that any lack of capability was a result of short-sighted attempts to shave cost from the program, which included omitting the Pirate infrared search and track, elements of the DASS (defensive aids sub-system) and integration of the AIM-120 AMRAAM.

But the standard Tranche 1 Typhoon remains one of the most capable and most effective air defense aircraft in service today, and with proper support arrangements in place, operators are finding costs to be reasonable. Under the new TyTAN (Typhoon Total Availability Enterprise) initiative, BAE Systems has committed itself to a goal of achieving a per-hour operating cost equivalent to that of a (single-engine) Lockheed Martin F-16.

Brig Karl Gruber, the commander of the Austrian Air Force, backed up his minister, saying that he feared that there would be no uniform Tranche 1 system in the future and implying that support for the aircraft would become problematic. This is extremely misleading, since the UK RAF has committed to keeping the Tranche 1 aircraft in service until 2030-35, thereby ensuring that the type will be fully supported for another 12-17 years.

The RAF's Tranche 1 aircraft have been proving their usefulness in recent times, beginning with the type's use over Libya in 2011. In September 2015, Tranche 1s took over the rotational deployment to the Falkland Islands, after six years of using Tranche 2 Typhoons. More recently, Tranche 1 aircraft were selected for Operation 'Biloxi', the RAF's deployment to Romania for a NATO Enhanced Air Policing commitment, augmenting the Romanian Air Force's own MiG-21bis LanceRs and F-16AM/BMs. **Jon Lake**

By the end of this year the Royal Air Force will be in possession of an impressive swing-role Typhoon that is ready to effectively replace the popular Tornado GR4. **Jamie Hunter**

There is a definite feeling that the Typhoon is coming of age. A raft of coherent upgrade projects are at last paying dividends both for the core operator nations and for the European partner companies on the export stage.

REPORT **Jamie Hunter**

ESTABLISHING CREDIBILITY AND capability sums up the primary challenge that has faced the Eurofighter partner companies over the past decade. With notable disappointments in Switzerland, the United Arab Emirates (which hasn't yet procured a new fighter) and India, the Eurofighter and its manufacturing base suffered from a lack of either of these attributes. Limited weapons options and roles, tied to a sluggish four-nation industrial behemoth, and a high price tag, made the Typhoon an easy target for criticism.

Operation 'Ellamy' in Libya in 2011 has been recognized as a turning-point. The Royal Air Force had all but hibernated its pioneering 'austere air-to-ground' role for the Typhoon due to a lack of funding, but the ability for pilots to spin this back up at short notice as the Libya situation evolved was remarkable. The RAF was coming out of a particularly low ebb after a battering in the Strategic Defence and Security Review (SDSR) of 2010, and 'Ellamy' sparked renewed enthusiasm with the realization that the Typhoon had to step up to the mark as the Tornado GR4's natural successor.

The timing of a UK government-to-government deal with Oman for 12 Typhoons in December 2012 came as something of a lifeline for a program

that was struggling to attract new export sales. At the same time, top export customer Saudi Arabia was pressing ahead with swing-role ambitions for its 72 jets. Indeed, the Royal Saudi Air Force was seen as being every bit as forward-leaning as the RAF when it came to Typhoon capability. The wind was back in the Typhoon's sails and the UK in particular was helping to both garner international interest and develop the aircraft's capability.

Phased enhancement

Through a fog of different acronyms and buzz-phrases, Phase 1 Enhancement (or P1E) emerged as the first big step towards taking the Typhoon into the important swing-role environment. The previous air-to-ground initiative from the RAF had been a national effort for the early Tranche 1 jets, whereas P1E was aimed squarely and coherently at

the more advanced Tranche 2 Typhoons and beyond.

While P1E was a significant step, it was painfully slow. The initial contract was signed on March 30, 2007 but it took until late 2014 to reach the front line. P1E was divided into two stages — P1Ea and P1Eb. In the event, only the RAF opted to take delivery of a small number of P1Ea-upgraded in-service aircraft, with other nations taking P1Ea as an 'inline fit' for new Tranche 3 aircraft. It was quickly superseded by the refined P1Eb.

In broad terms, P1Eb added the Paveway IV precision-guided bomb for the UK, GBU-48 for the Luftwaffe and EGBU-16 for Italy and Spain, plus the Litening III laser designator pod (LDP). The Royal Saudi Air Force (RSAF) actually led the way regarding air-to-ground capabilities for Tranche 2 jets. It hastily sought a Paveway II clearance in tandem

with the French Damoclès targeting pod ahead of the formal P1Eb clearances, which subsequently added Paveway IV.

To add kudos, both the RAF and the RSAF had the chance to validate P1Eb in combat. The RAF deployed its latest-standard Typhoons to Cyprus to join Operation 'Shader' in late 2014 and immediately began flying missions over Iraq, then Syria. The RSAF had already been flying periodic sorties against so-called Islamic State (IS) and it also put its Typhoons to work in operations over Yemen.

Whereas the Tranche 1 jets that went into combat in Libya in 2011 had a relatively rudimentary UK-only air-to-surface capability, Operation 'Shader' saw the RAF flying a fully functioning multi-role Tranche 2 Typhoon, harnessing the HMSS (helmet-mounted sighting system), the Litening III pod, the Paveway IV bomb and other cockpit display refinements.

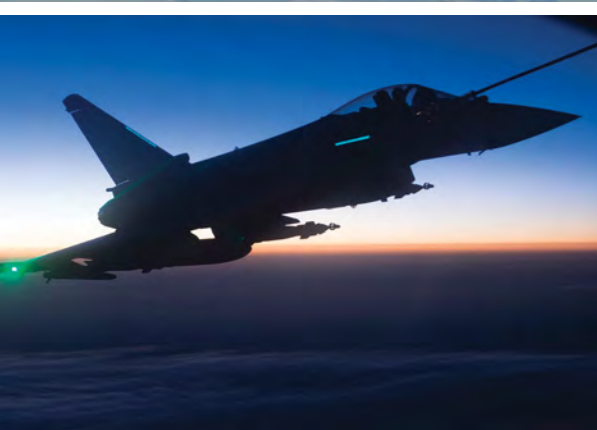
Typhoon 'Centurion'

At the Farnborough International Air Show in 2014, Eurofighter made a number of notable announcements, all of which were crucial to building upon P1Eb. Importantly, they included the signing of an integration contract for the MBDA Storm Shadow stand-off cruise missile that included BAE Systems, Airbus Defence and Space and Leonardo collaborating to integrate the weapon under the so-called Phase 2 Enhancement (P2E). As well as Storm Shadow, this phase would bring in the long-awaited 'big stick' of the MBDA Meteor beyond visual range air-to-air missile (BVRAAM).

With both Meteor and Storm Shadow work on contract, the RAF was realizing its ambitions for a coherent path towards replacing the Tornado GR4. Adding MBDA's Dual-Mode Seeker (DMS) Brimstone to the Typhoon under the follow-on P3E completed the picture. Project 'Centurion' was born.



UNLEASHING THE POTENTIAL



For the RAF's Tranche 2 and 3 Typhoons, this structured upgrade means that by the end of 2018 it will be in possession of a Typhoon that is able to replace the GR4.

Test work for these weapons saw BAE Systems taking the lead on Meteor, which culminated in a dual firing in April 2017. The campaign included firings by Airbus Spain, BAE Systems and Leonardo. In parallel, BAE Systems and Leonardo spearheaded the Storm Shadow campaign, which was signed off following a 'powered release' in July 2016 to complete the developmental flight test phase for that weapon.

Operational evaluation of P2E is now being wrapped up by the RAF's No 41 Test and Evaluation Squadron (TES) at

RAF Coningsby, after the first suitably configured aircraft was delivered to the unit in July 2017. The RAF expects to start training its lead squadrons for P2E in April as the capability is introduced to the force.

The P3E program saw BAE Systems embarking on an aggressive Brimstone flight trial in 2016. This took a major step forward on July 13, 2017, with the first live firing of the weapon from a Typhoon, which was conducted at the Aberporth Range in Wales during a mission flown from BAE's Warton site in Lancashire. The company's chief test pilot Steve Formoso fired the anti-armor weapon at a sea target following some 40 captive carry trials flights alongside the RAF in a combined test team approach.

Andy Flynn, the head of capability delivery programs for combat air at BAE Systems, told *Combat Aircraft*, 'Through the combined test team approach, 'Centurion' has remained on track. We're unleashing the full potential of [the] Typhoon. We are gaining momentum and we've made a lot of progress in the last couple of years.' Regarding Brimstone, he said, 'We had an intensive campaign last summer, including nine firings and nine jettisons.' According to Flynn the next phase will be a trial installation at RAF Coningsby; No 41 TES will run its formal operational evaluation over the summer, before it goes to the front line for training. As for timelines, Flynn says both BAE Systems and the RAF have maintained the delivery objective for 'Centurion' of December 31 this year. He adds: 'We've improved the HMI [human-machine interface], and we've given the pilot more weapons, so it's about enabling the pilot to do more whilst the software simplifies the task and maximizes the capability.'

Ultimately, Project 'Centurion' brings about a Typhoon that will embody everything — a deadly close-in fighter, a quick reaction alert (QRA) thoroughbred, a BVR air-to-air slayer, a precision air-to-ground striker, and a long-range stand-off cruise missile penetrator.

While 'Centurion' is a UK-only campaign, in a clear illustration of the power of the Eurofighter partnership it paves the way for other countries to follow suit. Notably, P3E is the delivery standard for Kuwait's 28 aircraft that are now on order and will be the most advanced Typhoons produced to date. In addition, the German Luftwaffe is set to incorporate Meteor as it adopts elements of P2E.

Export advances

Kuwait became the eighth Eurofighter customer when it signed for 28 jets on April 5, 2016. Leonardo of Italy is acting as

the prime contractor for the deal, which will see deliveries from 2020 until 2023. The complex Kuwaiti contract will see capabilities being provided in two releases — the first at entry into service and the second 24 months later in the shape of an 'enhancement package'. Kuwait is the lead customer for the E-Scan radar, Captor E, and the jets will be delivered from the Italian production line with the new radar installed. Giancarlo Mezzanatto, Eurofighter program unit vice-president for the Leonardo Aircraft Division says, 'Production activities started in the second half of 2016 and are currently in line with the baseline plan and, in some cases, ahead of schedule.'

'The capability packages for Kuwait will include the integration of Storm Shadow and Brimstone and other air-to-surface weapons. This configuration foresees the integration of a new advanced laser designator pod [the Lockheed Martin Sniper] that will expand Eurofighter's portfolio of cleared laser designator pods, the introduction of the DRS-Cubic ACMI

P5 combat training pod, an enhanced navigation aid [VOR] and the E-Scan radar CAPTOR with its antenna repositioner.'

Typically, the E-Scan radar story is a complex one. Farnborough 2014 saw the public unveiling of the prototype Euroradar Captor-E active electronically scanned array (AESA) radar fitted to BAE Systems' instrumented production aircraft IPA5, serial ZJ700. A second aircraft (IPA8, GT026/98+08) first flew at Manching, Germany, in September 2017 — this is a Tranche 3 twin-seater that is also set to join the E-Scan test program.

A variety of E-Scan radar standards have been mooted, starting with the EIS (export interim standard) 'Radar 1' to meet initial requirements. 'Radar 1+' and even 'Radar 2' have been mentioned as a means of meeting national requirements, but officially there is a single product. 'The Captor-E radar development program for Typhoon remains on track, with a number of flights, with the radar both powered and unpowered, having now taken place as part of the scheduled

RAF KEEPS TRANCHE 1 JETS RELEVANT

Original plans for the RAF involved purchasing 232 Typhoons to equip seven operational squadrons, giving a front-line inventory of 137 available fighters. Despite having cut back on its Tranche 3 commitment by only ordering 40 aircraft in this batch, the RAF is now expected to operate these alongside 67 Tranche 2 and 'around 30' original Tranche 1 Typhoons — an overall fleet of 137 jets.

Speaking at the Royal International Air Tattoo at RAF Fairford in July 2017, RAF Typhoon force commander Air Commodore Ian Duguid said preparations were on track to increase the UK Typhoon force to seven front-line squadrons from the current five. Until the Strategic Defence and Security Review (SDSR) of 2015, the RAF said it would retire its 53 Tranche 1 examples by 2020 and operate just 67 Tranche 2 and 40 Tranche 3 aircraft. The post-SDSR vision is to employ the Tranche 1s to enable the establishment of the two additional units, which are likely to be directed toward air defense

as well as having a limited aggressor role. This will enable the service to free up the more advanced Tranche 2 and 3 Typhoons for higher-end, multi-role, expeditionary operations, with the two Tranche 1 units being likely to shoulder more of the burden of the quick reaction alert (QRA) mission.

'We are in the middle of strategic fleet management in terms of the rebalance,' continued Duguid. 'Up until 2015, the plan was to take out of service the Tranche 1 aircraft and effectively replace them with the Tranche 3 aircraft. We now plan to keep the Tranche 1s in service until 2035.'

He explained that while the airframes of these initial RAF Eurofighters aren't that old, the RAF has been reviewing which essential items it will need in order to keep them in service. Elements such as the Meteor are currently not planned to be incorporated onto the Tranche 1s; therefore, they are likely to retain the existing AIM-120 AMRAAM in the short term. Duguid said, 'Because the Meteor contract was set on the premise that the Tranche 1s would be taken out of service, at the moment that missile is not planned to be equipped onto the Tranche 1 aircraft.' He added that, under the current review of the Tranche 1s, the RAF is evaluating what to do regarding the future beyond visual range missile capability as well as obsolescence and mandatory requirements that must be addressed to retain these Typhoons.

Clockwise from far left: Armed to the teeth — this Tranche 3 RAF Typhoon FGR4 carries Paveway IV and Brimstone, two crucial weapons for the air-to-ground role. **Jamie Hunter**

BAE Systems has been engaged in flight trials with the Captor-E radar during 2017. **BAE Systems**

The Captor-E sits on a repositioner, which enables the radar array to be moved in order to increase detection angles. **BAE Systems**

Striker II is a night-capable version of the helmet-mounted sighting system (HMSS). **Jamie Hunter**

No 41 Test and Evaluation Squadron Typhoon FGR4 ZK315 taxis at Coningsby on January 23, 2018, for a live Storm Shadow firing under the formal operational evaluation phase. **Dean Wilkinson**

Operation 'Shader' over Iraq and Syria provided the perfect opportunity to test the PIEb-standard Typhoon in combat. **USAF/TSgt Gregory Brook**

TyTAN EFFORT

Last summer the RAF marked the first anniversary of the start of its Typhoon Total Availability Enterprise (TyTAN). This complete package of servicing and availability support, in collaboration with BAE Systems, will yield operational cost savings of nearly £550 million over its 10-year lifespan. These savings are then being 'recycled' into capability developments for the aircraft.

TyTAN has seen some fundamental changes in the way RAF Typhoons are serviced, both in terms of rectifications and the periodicity of deep maintenance. With so much experience of working on the jet, service intervals have been extended, with an ambition to increase them to 750 flight hours between major inspections. BAE Systems says that the Typhoon's cost per flight hour is now comparable to that of an F-16, and is expected to come down further. The cost reductions will likely help support the UK's national Fury programs, which provide rapid capability enhancements outside the core Eurofighter structure.

The Chief of the Air Staff, Air Chief Marshal (ACM) Sir Stephen Hillier, said, 'In the RAF today we are working hard with our industrial partners to enhance our capability whilst improving efficiency and driving down costs. The Typhoon Total Availability Enterprise [maintenance agreement with BAE Systems] has generated cost savings of 40 per cent.' Hillier added that these will equate to a saving across the Typhoon fleet of half a billion pounds over the 10-year lifespan [of the contract]. The model not only assists the RAF in realizing greater capability from its Typhoons, but in turn helps generate a more competitive offering on the export market.



Air Commodore Ian Duguid, the current RAF Typhoon Force Commander. **Eurofighter**



DROPS

A versatile project led by BAE Systems reacted to RAF requirements to 'drop in' enhancements in response to operational demands, under a project that the partners and export customers can opt in or out of.

The 'Drop' program was developed for Tranche 1 jets by BAE's capability sustainment team. Drop 1 introduced a package of HMI (human-machine interface) improvements, as well as Link 16 MIDS (multi-functional information distribution system) and Litening targeting pod enhancements. The RAF deployment to Gioia del Colle for Operation 'Ellamy' attracted the interest of Italian Eurofighter crews, who pressured their leadership into joining the subsequent Drop 2 activity, along with Germany. Drop 2 dates back to 2012 and was primarily focused on enhancing situational awareness in the air-to-air role, improving attack and identification, as well as refinements to the defensive aids sub-system (DASS). All four core partner nations bought into Drop 3, which added further MIDS, DASS and radar improvements, and the project continues today with successive refinements.

program of activity,' said Alastair Morrison, senior vice-president of radar and advanced targeting at Leonardo Airborne and Space Systems. 'The first phase of flight tests wrapped up last year and we've seen some excellent results. There have been some really good long-range tracking results and we have been able to test the synthetic aperture radar [SAR] mode as well. The next step will be for the second Captor-E flight test asset to begin flights in Germany very shortly. Currently we've been working with the first asset in the UK; having the second asset will allow us to run multiple programs in parallel. This year we'll be performing a series of high-intensity flight trials with incremental software updates to enable the required capability [P3E] to be available for the first deliveries to the Kuwait Air Force.'

E-Scan progress comes as a major boost for the overall program. While the RAF has gone on record to say the E-Scan is part of its future fleet plans, no further specific details have emerged regarding the European partners.

The RAF played a particularly important role when it came to securing Qatar as the ninth Typhoon customer, when it signed an \$8-billion contract for 24 aircraft in Doha on December 10 last year. The Typhoons will be assembled

Left top to bottom: No II (AC) Squadron (aircraft nearest the camera) became the RAF's fifth front-line Typhoon unit in 2015. The RAF plans to establish a further two squadrons. **Jamie Hunter**

Deliveries of 12 Typhoons to Oman will be completed this year, with the aircraft being stationed at Adam Air Base. **Eurofighter**

Kuwait will receive 28 Typhoons in the latest configuration, complete with the E-Scan radar. **Eurofighter**



Above: Spanish instrumented production aircraft IPA4 is continuing trials of the Meteor beyond visual range air-to-air missile (BVRAAM) from the Airbus plant at Getafe, Madrid. The aircraft is pictured on January 4 equipped with four Meteors as part of the integration trials for Spain. IPA4 was also used for the double Meteor firing in April 2017 over the UK's Hebrides Range. **Roberto Yañez**

in the UK, which extends the life of the production line at Warton until at least 2024. The Qatar deal also includes an agreement with MBDA for the Brimstone and Meteor and with Raytheon for the Paveway IV.

The UK has agreed a package of training and co-operation between the air forces which will see them working together more regularly, including training in Britain for Qatari pilots and technicians. A joint squadron with both British and Qatari pilots will provide airspace protection during the 2022 Soccer World Cup.

On December 14, UK Defence Minister Harriett Baldwin gave further details of the deal, revealing that the new joint squadron will be UK-based and that it will be No 12 (Bomber) Squadron.

Qatari personnel, including pilots and groundcrew, will be temporarily integrated into the unit at RAF Coningsby. This will occur ahead of the delivery of their aircraft, providing them with valuable front-line experience and helping speed up their preparation for when their own jets are delivered.

Looking further ahead, the European partner companies are evaluating which elements will form P4E and P5E. A spokesman told *Combat Aircraft*, 'We have a good understanding of what the packages will be.' The Tranche 3 aircraft are the only jets configured from the outset for the E-Scan radar and provisioned for conformal fuel tanks. It's expected that the latter will form an element of the follow-on upgrade phases. ☑



EUROFIGHTER OPERATORS

GERMANY

Luftwaffe Tactical Air Wings (Taktischen Luftwaffengeschwader) that operate the Eurofighter are TaktLwG 73 'Steinhoff' at Laage, which acts as the main training unit. TaktLwG 74 at Neuburg became the first front-line wing equipped with the EF2000, as Germany still refers to the type. Next to convert was TaktLwG 31 'Boelcke' at Nörvenich from 2007. The former Jagdgeschwader 71 'Richthofen' at Wittmund moved to the EF2000 in 2013 and is now TaktLwG 71.

ITALY

Eurofighters are known as F-2000A/Bs in Aeronautica Militare (Italian Air Force) service. They first equipped the two squadrons of the 4^o Stormo at Grosseto, and then formed a second wing, the 36^o Stormo, at Gioia del Colle; a third is now the 37^o Stormo at Trapani.

SPAIN

113 Escuadrón de Ala 11 at Morón is the Ejército del Aire (Spanish Air Force) Typhoon training unit. The first front-line units comprised two additional squadrons within the Morón wing. The second Spanish Typhoon wing (Ala 14) is now operational at Albacete.

UK

RAF Coningsby is the home station for two front-line Typhoon FGR4 units — Nos 3 and XI (Fighter) Squadrons — alongside No 41 Test and Evaluation Squadron, the operational evaluation unit, and No 29 Squadron, the operational conversion unit. Four aircraft are assigned to No 1435 Flight in the Falkland Islands. No 6 Squadron, which started training at Coningsby in early 2010, was then based at RAF Leuchars alongside No 1 (F) Squadron before both moved to RAF Lossiemouth in 2014 and were joined by No II (Army Co-operation) Squadron in 2015. No 12 (Bomber) Squadron is expected to become a sixth RAF unit in 2018, with another unidentified squadron to follow.

AUSTRIA

Austria became the first Eurofighter export customer, taking delivery of its initial aircraft (serial 7L-WA) for the Überwachungsgeschwader (Surveillance Wing) at Zeltweg on July 12, 2007. Austria's original requirement was for 18 aircraft, but this was reduced to 15 due to budgetary constraints. The first six were new-build, whereas the final nine were updated to Block 5 standard and transferred from the Luftwaffe. The aircraft

also do not feature the PIRATE IRST or DASS and are armed only with the 27mm cannon and IRIS-T short-range air-to-air missiles, being used exclusively in the air-policing role.

SAUDI ARABIA

Eurofighter's second export success came on the back of a government-to-government deal between the UK and Saudi Arabia. Project Salam was officially launched on September 17, 2007, and involved the £4.43-billion purchase of 72 aircraft including 24 diverted from RAF slots and assembled in the UK by BAE Systems. The first RSAF aircraft was single-seater 1001, delivered on June 23, 2009. The balance of 48 aircraft was to have been assembled in country by the Alsalam Aircraft Company, and the first ship sets should have been delivered in 2008. However, BAE Systems agreed a contract amendment to assemble these 48 jets in the UK, and they have all now been delivered. RSAF Typhoons are in service with the 3rd and 10th Squadrons at Taif. The 80th Squadron has also received jets but is yet to be formed. Indeed, this unit is unlikely to be formally established until a new base in the north of the country is ready.

Persistent rumors suggest that the RSAF is likely to purchase an unspecified number of additional Typhoons in a follow-on deal.

OMAN

BAE Systems secured a long-awaited deal for the supply of 12 Typhoons (three two-seaters and nine single-seaters) to the Sultanate of Oman in December 2012. Deliveries of the Tranche 3 jets to the Royal Air Force of Oman commenced on June 19, 2017, when serials 400 and 401 departed the UK for Adam Air Base. Serials 406 and 407 were delivered from Warton on February 5, taking deliveries to eight aircraft to date.

KUWAIT

The contract with Kuwait is for 22 single-seat and six two-seat Eurofighters, built to Tranche 3 standard and fitted from the outset with the new E-Scan radar. The deal includes the design and construction of the infrastructure at Ali Al Salem Air Base to accommodate two squadrons, plus a suite of training devices to establish an operational conversion unit. Deliveries will run from 2020 to 2023.

QATAR

The government-to-government deal signed in late 2017 for 24 Typhoons to Qatar is likely to include options on a further 12 jets. It's part of a massive expansion effort for the Qatar Emiri Air Force.



THE ROAD AHEAD

Eurofighter is well into studies that not only map out the immediate future for Typhoon, but also keep it at the forefront of air warfare until 2050 and beyond.

THE EUROPEAN PARTNER companies — working in tandem with Eurofighter — see the Typhoon as a bridge to a next-generation European Future Combat Air System (FCAS). While the current Phase 3 Enhancement project takes the Typhoon into the next decade, the route to 2030 and beyond is already becoming clear. This not only taps into emerging requirements of existing customers, but also opens the door to potential additional sales.

Eurofighter says it is working with the partner nations to finalize a Phase 4 Enhancement (P4E) plan as well as scoping a follow-on P5E. 'We are looking at P4E and we have the requirements from the partner nations,' says Raffael Klaschka of Eurofighter GmbH. While Klaschka remains tight-lipped on specifics, a number of capabilities would seem an obvious fit here — the E-Scan radar, Striker II digital day/night helmet, conformal fuel tanks, MBDA's SPEAR 3 glide weapon, the new Litening V laser designator pod, satellite communications and the dual-carriage common weapons launcher.

Klaschka says, 'We are also into the study phase for the long-term evolution [LTE] initiative [beyond P5E]. LTE is focused on some significant new 'kit' for the Typhoon: the potential for a new cockpit layout and enhanced avionics structure. 'The central idea is not to make a big-bang change; rather [to] introduce changes that will

facilitate ongoing refreshes quickly and affordably,' says Rob Wells, Eurofighter weapon system manager. 'We know that the threats — aircraft, surface-to-air missiles and other types of weapons systems that are coming into play — are all evolving. We need to be able to counter [them]. So we will have to evolve too, and we will firstly have to be able to do it quickly, and secondly, as you're not actually sure exactly what's around the corner, we have to plan for the un-plannable.'

Long-term evolution

Typhoon LTE is focused on three main areas. One is giving the aircraft a longer service life — this was originally planned at 25 years and 6,000 flying hours but Typhoons will comfortably exceed that. Evolving threats are another important focus, as are opportunities to introduce new technology that enable updates to be carried out quickly, cheaply and flexibly.

'The world of sensor development, sensor exploitation, is often driven by either evolving threats, [for example shoulder-mounted missiles whose frequencies can be changed overnight], or because the rules of engagement are changing as well as a focus on low collateral damage and so on,' explains Wells.

The Eurofighter team is aiming to make weapons easier, cheaper and faster to integrate. 'In general,' Wells continued, 'that means getting smaller weapons rather

The long-term evolution plan is aimed to keep the Typhoon viable past 2030 with a host of new capabilities. **Jamie Hunter**

than bigger weapons and potentially using multiple weapons on a station, so things like Brimstone and the introduction of a common weapons launcher. In essence we're moving away from one store per station to multiple stores per station, usually with small warheads, all individually targetable. Therefore the amount of information is multiplied.

'The rapid evolution in technology means there's an expectation that more information will be exploited by [the] Typhoon in the future. This may mean changes to the avionics architecture to optimise that performance.'

Former Luftwaffe Eurofighter weapons instructor Marco Gumbrecht now works in the Airbus combat air division. 'The Eurofighter program is all about firm developmental road-maps,' he says. 'Our heritage was air dominance, and if you look at the mission sets now they weren't foreseen on day one — that's testament [to] the flexibility and evolution of this aircraft. That road-map doesn't stop.'

'There will always be substantial versatility in the multi-national program. The customer nations have a lot of inputs, some may wish to look at things that others may not. But they complement each other. Sure there will be minor national silos, but in general the multi-national approach gives flexibility. A lot of the capabilities for the next-generation European fighter will emerge and [be] fielded through LTE to mature them.'

Renewed European potential

Learning from fellow operators is something Eurofighter hopes the Luftwaffe will do when it comes to replacing its Tornados by 2030. With a clear nod to the RAF's Project 'Centurion' — which will herald a P3E-standard Typhoon to supersede the Tornado GR4 — Eurofighter's Raffael Klaschka says, 'We are convinced the Typhoon does everything the Luftwaffe needs for its Tornado replacement.' The German Ministry of Defense (Bundeswehr) issued a request for information to Eurofighter in respect of its Tornado IDS/ECR replacement requirement, as well as making approaches to Boeing for the F-15 and F/A-18E/F, and Lockheed Martin for the F-35.

In November, Luftwaffe chief Lt Gen Karl Müllner controversially indicated a preference for the F-35, which was subsequently dismissed by the Bundeswehr. It said additional Eurofighters was the favored option.



Eurofighter is confident that establishing an enhanced Typhoon fleet will give the Luftwaffe a strong combat aircraft force that will dovetail with FCAS, which currently sees Germany partnering with France. If the Luftwaffe did opt for the F-35, it would require a fairly aggressive acquisition strategy — it has taken the Luftwaffe more than 10 years to realize the Eurofighter's potential. In addition, it's not clear that the F-35 fits with the Luftwaffe's operational doctrine. A stealthy bomber is offensive in nature, which contrasts against the Luftwaffe's recent defensive stance.

When it comes to specifics for the Typhoon standard to replace the Tornado, it's likely to draw heavily on LTE. Klaschka says, 'We have the basic layout and it offers more options and weapon loads.' Eurofighter is likely to be looking at several key areas, including the KEPD-350 Taurus cruise missile, which is currently carried by the Tornado and has been flight-tested on Typhoon; the aerodynamic modification kit, which will provide additional agility and potential for improved lateral asymmetry; and growth potential for the EJ200 engines, which could be uprated by as much as 25 per cent for improved thrust and fuel efficiency.

The German Tornado replacement has led to the Luftwaffe discussing common ground with the Belgian Air Component, which is in the midst of a similar competition for 34 aircraft to replace its F-16s. Like Germany, Belgium is evaluating the Typhoon and the F-35, and there are critical elements to both efforts — neither are F-35 partner nations, and they have nuclear strike requirements. In fact, Belgium is the only existing F-16 European Partner Air Force (EPAF) nation that hasn't signed up to the Lightning II. While the nuclear mission is incredibly sensitive and Belgium is understood to have remained silent on the matter, it's clearly a significant factor. It is already planned for the F-35 to include the B61-12 nuclear bomb in its arsenal. While similar plans don't currently exist for the Typhoon, it is believed that a similar nuclear capability could be on the

Top : Eurofighter says the Typhoon acts as an ideal interoperable partner to the F-35. The UK is set to cement this partnership as it starts to receive F-35Bs at RAF Marham this year. **Jamie Hunter**

table for Eurofighter and that feasibility studies have been completed.

The competition in Belgium is in a critical phase — best and final offers were submitted on February 14. It's a straight fight between the Typhoon and the Lightning II, with entry into service in 2023 and full transition by 2030. The Typhoon offer is from the UK government on behalf of the Eurofighter EPCs and it represents a full partnership with the RAF.

Anthony Gregory is the campaign director for Belgium at BAE Systems. He told *Combat Aircraft*, 'Belgium is looking for a deep and enduring collaboration and this represents the most extensive partnership the RAF has ever put forward.' The UK offer to Belgium is understood to include the full Project 'Centurion' weapons set and full integration into the TyTAN support model for the most efficient cost per flying hour. The aircraft on offer is understood to be a snapshot of what the RAF expects to be flying in 2023 — probably a P4E vision with the E-Scan radar, Striker II helmet, SPEAR 3 and the full UK weapons set: Meteor, ASRAAM, Storm Shadow, Brimstone and Paveway IV.

'The offer extends far beyond aircraft and training,' says Gregory. 'It's full alignment with the UK Typhoon road-map. Belgium will receive everything that the RAF has in its sights, but they will avoid the non-recurring development costs.' Air Commodore Ian Duguid, the UK Typhoon force commander, says the proposed partnership between the RAF and the Belgian Air Component will extend to joint exercises, squadron exchanges, shared airspace, working 'side-by-side' on pilot and ground crew training and joint combat operations.

Traditionally, Belgium has enjoyed a close working relationship with the Royal Netherlands Air Force, but the Dutch involvement as a Tier 2 partner in the F-35 program means their Benelux brothers are left on the sidelines and standing to incur a significant cost to buy into the Lightning II program. Gregory points to the UK and US Air Force models of partnering the F-35 with the F-22 Raptor or the Typhoon, a 'complementary mix' of assets — the Typhoon being the high-end air defender, and the F-35 not as well suited to quick reaction alert or air policing. Partnering Typhoon with F-35 could provide a rounded solution for the Benelux countries.

While the Belgian jets would be assembled in the UK, the Eurofighter

FUTURE BATTLESPACE

The Typhoon long-term evolution is planned around a vision of the future battlespace. Marco Gumbrecht says that while there is a lot of focus on the future denied environment, it's important to find 'the right balance' when it comes to fighter assets. 'Our vision of future air power is focused on a system of systems approach, with manned and unmanned components.'

Raffael Klaschka adds, 'The Typhoon will never be a stealth aircraft, but our perception is that not every future conflict will be in denied airspace.' He acknowledges that stealth is important, but not always vital. 'There are many scenarios where a Typhoon will play a key role. We didn't see stealth in Afghanistan, even on day one. Stealth brings with it some significant factors, not least maintenance and cost, while Typhoon offers the aerodynamic performance and payload.'

With a vast array of weapons and sensors at a Typhoon pilot's fingertips, speeding up and simplifying the process of finding, fixing and prosecuting targets is where Eurofighter is pushing its idea of a 'kill web'. Gumbrecht says, 'The kill chain is the cycle from the moment something is detected to the time you have kinetic or non-kinetic effect on it. You have to find it, track it, identify it, then engage it. It remains a very linear, layered and lengthy process. The 'kill web' removes that layered approach, with the command and control authority being delegated down to a weapons platform. Different sensors push information to a combat cloud or web, and the various agencies can pull the information as needed.' Gumbrecht says this is a new matrix approach to battle management, using enhanced situational awareness to solve complex situations.

EPCs have offered local companies some attractive industrial proposals including Typhoon 'work packages'. The feeling is that while the Belgian deal in itself may not offer the volume to justify significant work when it comes to the Typhoon specifically, a win in Belgium could open the floodgates to a host of new orders, thereby providing both the required manufacturing volume and making it possible for Belgium to join the supply chain for the European future fighter program. **Jamie Hunter**



COMBAT AIRCRAFT

In order to replace the Tornado GR4 in Royal Air Force service, the Eurofighter Typhoon FGR4 is receiving a raft of enhancements under 'Project Centurion'. This includes the MBDA Meteor beyond visual range air-to-air missile, the MBDA Dual-Mode Seeker Brimstone missile and (not carried here) the Storm Shadow stand-off cruise missile. **Jamie Hunter**





TYPHOON MASTERS

The Royal Air Force's Typhoon qualified weapons instructor course merges the highest levels of aircraft capability with the best possible operators to create a honed team of man and machine.

HAVING A FIGHTER as advanced as a Project 'Centurion' Typhoon is only half the battle. Manning that fighter with a pilot who is effectively able to massage the potent tools at his or her fingertips is what brings ultimate capability to the fore.

For the Royal Air Force, the qualified weapons instructors (QWIs, pronounced 'q-whys') are the essence of making this high-end vision a reality. They are the subject matter experts, the problem-solvers, the 'go-to' officers on each squadron who possess the deep knowledge of the weapons systems — the ones a squadron turns to when the chips are down.

No 29 Squadron, the Typhoon operational conversion unit at RAF Coningsby, is where the RAF's Typhoon QWI course is based. This is the most demanding of courses for a hand-picked selection of the brightest young Typhoon



QWI students in the cockpits of their Typhoon FGR4s, ready for a mission from Coningsby. While the simulator events have grown in complexity and realism, the live flying is still hugely important. **All photos Jamie Hunter**



“ We write all the desired touch points into the plans to provide far richer scenarios.

Al Allsop, Inzpire

pilots. It teaches them — to degree level — the intricacies and the broad spectrum of capabilities the Typhoon offers. As the pages of this supplement testify, it's a task with many elements.

The Typhoon mission set has grown exponentially over recent years, from fighting the most complex air-to-air battles to the array of weaponry becoming available to strike the ground with pinpoint precision. First came the Paveway IV precision-guided bomb, the helmet-mounted sighting system (HMSS), the PIRATE infra-red search and track sensor and the Litening III laser designator pod (LDP). Now there's the direct-fire Brimstone missile, the 'game-changing' Meteor long-range ramjet-powered air-to-air slayer, and the Storm Shadow stand-off cruise missile, all pushing the art of the possible a step further.

The Typhoon QWI course lasts for seven months; it starts in January and runs until August. Working with the experts of the RAF Air Warfare Centre (AWC) the pilots have a lot to take in about their platform and others, not to mention the basics of how to be instructors. After all, they will go back to their squadrons and impart their knowledge to fellow pilots.

The standard class of six students runs at a pace that is relentless, merging air-to-air with ground attack skills, learning in intricate detail how to fight in every regime at the highest level.

Working hand-in-hand with the RAF to maximize the output standard, British defense company Inzpire has embedded two former RAF experts into the QWI staff for a hugely beneficial level of continuity and experience. 'Myself and my colleague Mark Doney, who is an aerospace battle manager, act as a 'White Force' to devise the scenarios for the seven-week capstone event — the 'Triplex Warrior' exercise,' says Al Allsop, a fast jet pilot with an impressive 23 years of RAF service. Allsop continues to pass on his precious knowledge to young Typhoon pilots as a specialist in threat replication and

Above: Wearing the helmet-mounted sighting system, a QWI student pre-flights the ASRAAM missile.

Below: Paveway IV is set to be joined by the Brimstone and Storm Shadow missiles, increases the range of effects available to the Typhoon.

simulation. Indeed, the efforts of the Inzpire team have enabled the RAF to make increased use of simulation on the QWI course. 'We've saved considerable live flying hours, whilst increasing the standard,' explains Allsop. Recent gains in the simulator regarding the course include more consistent enemy threat presentations and the ability to fly electronic attack missions.

The Inzpire remit is to devise the best scenarios to tax and teach the students. 'We write all the desired touch points into the plans to provide far richer scenarios,' says Allsop. 'For example, the students may need to find and fix a moving target. They know they can go and look for it, but they also know they might not be able to find it. It's about teaching them how to integrate with the ISR [intelligence, surveillance and reconnaissance] assets — and we play that role for them — to establish and understand what capabilities they may have for finding that target. It's likely to develop into a scenario that they've never even thought could be possible.'

Of course, many of these situations are made all the more realistic with enhanced enemy threat presentations. This translates into the live flying, with Allsop working alongside the QWI staff, monitoring and managing the large force employment phases out over the North Sea. The emphasis placed on effective 'Red Air' in the US military is mirrored on the QWI course, with people like Allsop bringing a deep and vital understanding of threat scenarios. It's clearly a role that he relishes: 'You devote your working life to making our Typhoon pilots better.'

Jamie Hunter





COMBAT AIR CORNERSTONE

The Royal Air Force first pressed its Typhoons in combat action in 2011 over Libya. Since then, they've continued to demonstrate their evolution in capabilities in operational theaters.

REPORT **Jon Lake**

WITH MUCH ATTENTION focused on the imminent retirement of the Tornado GR4 from Royal Air Force service next year and on the progress being made towards bringing the F-35B Lightning II into service, the Typhoon FGR4 continues to demonstrate its credentials. It now forms the meat of the RAF's 'combat air' capability.

Air Vice-Marshal Gerry Mayhew, Air Officer Commanding No 1 Group, recently spoke to reporters about the contribution the Typhoon is making to the RAF's fast jet front line, for which he is responsible.

Mayhew, who joined the RAF in 1988, is an extremely experienced fast jet pilot. A former Jaguar qualified weapons instructor, Mayhew flew the F-16 on exchange with the US Air Force and commanded a Tornado GR4 squadron. Having also flown the Typhoon, he describes it as, 'the best aeroplane I have ever flown, a superb multi-role fighter, a superb swing-role aeroplane, and exciting to fly.'

A committed force

Mayhew oversees a Typhoon force that currently consists of five front-line squadrons, an operational conversion unit (OCU), and an operational evaluation unit (OEU). The five operational squadrons hold 24-hour quick reaction alert (QRA) seven days a week from RAF Coningsby and RAF Lossiemouth in the UK and in the Falkland Islands, where No 1435 Flight has four aircraft and crews on rotational detachment at the end of an 8,000-mile sustainment line. Maintaining this is 'quite a challenge,' according to Mayhew, but one that is manageable 'thanks to the whole-force approach that we take, working with our partner nations and with our partner companies.'

The Typhoon force is also cycling its squadrons through Operation 'Shader,' the British commitment to missions against so-called Islamic State in Iraq and Syria. Each squadron deploys to RAF Akrotiri in turn to fly missions from this UK sovereign base on the southern tip of Cyprus.

Mayhew said that Operation 'Shader' has evolved from being simply a kinetic operation for the Typhoon to a swing-role mission. 'The aircraft is armed [for]



air-to-air and air-to-ground every time she flies,' he said.

The Typhoons have operated from Akrotiri alongside Tornado GR4s since late 2014. '[The] Typhoon and Tornado sometimes operate separately, and sometimes together, to make sure that we have the right kind of weapons available for the right kind of task,' Mayhew

comments, 'because all kinds of targets are being intercepted, sometimes in towns and cities [which are always challenging for us] to those that are out in more open countryside. So it is about weapons-to-target matching.'

On Operation 'Shader,' the Typhoon has been working with a large number of coalition partners, gaining useful experience of using datalinks, including for kinetic and air-to-air operations.

Air Commodore Johnny Stringer served as the UK air component commander for Operation 'Shader' in Al Udeid, Qatar, until November last year. 'On [the] Typhoon we've had excellent availability,' he told *Combat Aircraft* in January. 'We've also used the swing-role capability on numerous occasions including combat air patrols and strike on the same sorties.' Stringer said that Typhoons regularly flew missions lasting more than eight hours over Syria.

The RAF is now into the second rotation of the squadrons on 'Shader,' in addition to the raft of ad hoc responsibilities that the

Above: A RAF Typhoon FGR4 takes on fuel from a US Air Force KC-10A Extender during an Operation 'Shader' mission. **USAF/SrA Preston Webb**

Right: AVM Gerry Mayhew chats with Typhoon personnel during a recent detachment in Romania. **Crown Copyright**



Typhoons shoulder. These have included NATO's Baltic Air Policing obligation and similar NATO Enhanced Air Policing commitments in Romania. 'We must remind ourselves that NATO is still the bedrock of our defense and we continue to offer as much support and partnership for any of the NATO operations we are required to do,' Mayhew observed. 'That will continue to grow in 2018.'

The Typhoon force is participating in what Mayhew described as 'a significant exercise program' in 2018, with no less than seven large exercises. This, he said, is a testament to the 'serviceability of the aircraft, and also to the supply chain.'

Growing and evolving

The RAF Typhoon force is set to grow, both in terms of squadrons and of course in physical capabilities. Mayhew said that he was, 'looking forward to bringing on two more Typhoon squadrons in the next few years,' referring to the decision announced in the 2015 Strategic Defence and Security Review to retain a number of Tranche 1 Typhoons until 2030-35 instead of retiring them by 2019. However, with improvements in synthetic training, the RAF plans to retire all of its two-seat Tranche 1 aircraft this year.

Original plans for the RAF involved 232 Typhoons equipping seven operational squadrons, giving a front-line inventory of 137 available fighters. Despite cutting back its Tranche 3 commitment by only ordering 40 aircraft in this batch, the RAF is now expected to operate these alongside 67 Tranche 2 and 'around 30' original Tranche 1 Typhoons. The latter number is where the RAF has found airframes with which to equip the two additional units.

It was announced in December that No 12 (Bomber) Squadron will convert from the Tornado GR4 to the Typhoon. It will initially serve as a new joint squadron, being UK-based and temporarily integrating Qatari personnel, including pilots and ground crew at Coningsby. The Qataris will not be a permanent part of the squadron, but will be integrated ahead of the delivery of their aircraft, providing valuable front-line experience and helping

Above right: Pilots wear the helmet-mounted sighting system (HMSS) on daylight operations. They are able to cue weapons and sensors with the helmet. **Crown Copyright**

Below right: RAF Typhoons over Syria. They tend to operate as pairs or as mixed pairs with Tornado GR4s. **USAF/SSgt Trevor McBride**

Below: This Typhoon FGR4 shows off a combat load that includes three Paveway IVs, plus a single live ASRAAM and AMRAAM. **Crown Copyright**



speed up their preparation for when their own jets are delivered.

Mayhew confirmed that the two new RAF units will be front-line squadrons and part of the operational fleet, rather than just being for aggressor or training roles. He was unable to say what upgrades and capability enhancements might be incorporated in the retained Tranche 1 jets, because these decisions have not yet been taken.

There has been speculation that the surviving Tranche 1 aircraft might not be upgraded to carry Meteor missiles, and will have to continue to operate with the existing Raytheon AIM-120C-5 AMRAAM. Experts differ as to whether they will retain a swing-role capability with the Enhanced Paveway II, whether they will be upgraded to carry the Paveway IV, or whether they will be pure air defense aircraft.

Talking specifically about growth plans for the Tranche 2 and 3 aircraft, initially via 'Project Centurion' — which Mayhew described as 'a crossover from [the] Tornado' — bringing Storm Shadow and Brimstone capability to the Typhoon will enable the RAF to retire the Tornado GR4 in 2019. 'That is important for us and we are holding the companies very much on contract to make sure we meet those timelines,' he said. Meteor integration is to be achieved in the same timeframe.

Mayhew confirmed that the Tornado's RAPTOR reconnaissance pod would not be integrated on the Typhoon. 'We are not buying a specific reconnaissance pod in our Typhoon upgrade program

at this current stage,' he said, adding, 'we're looking at other ways of delivering ISR [intelligence, surveillance and reconnaissance] across the future fleets, including 'combat air'. Obviously you can do reconnaissance from some of the pods that are on [the] Typhoon, in a different way, and we are looking at an evolution of those. I would also wish to look across the market at other ways of doing it.'

Of radar enhancements, specifically regarding an E-Scan, Mayhew said, 'We made a declaration in 2015 that we would move to the next generation of radar and that is still our absolute intent.'

Looking towards integration with the F-35B Lightning II, Mayhew continued, 'This is not something we are dreaming of, it's something we are doing. We are already operating fourth and fifth-generation fighters together in exercises and in training. I've been doing this with [the] Typhoon and F-22 already, through 'Red Flag' and other exercises in the US, and I know our partner nations are doing the same. This is using new systems as well as the Link-16 systems that are out there. These are evolving systems, and I won't detail what they are, but we are already proving this kind of communication is working between the aircraft without using voice comms.

'This is an exciting time — the Royal Air Force is very happy with the Typhoon, we've had it a long time now, and I can say from professional experience that it is a super aeroplane, proven, and multi-role.'





LUFTWAFFE EUROFIGHTERS GO AIR TO GROUND

The recent delivery of GBU-48 precision-guided bombs has provided the Luftwaffe EF2000 fleet – the Typhoon name is not used in German service – with an air-to-ground capability, meeting the requirement for the Eurofighter to be multi-role.

REPORT **Thomas Newdick**

THE FIRST EXAMPLES of the GBU-48 Enhanced Paveway II were officially handed over to Taktisches Luftwaffengeschwader 31 'Boelcke' (TaktLwG 31 'B', Tactical Air Force Wing 31) at Nörvenich on December 18 last year.

Generalmajor Klaus Veit, military vice-president of the Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw), said, 'With the GBU-48, the BAAINBw is making its contribution to the multi-role capability of the Eurofighter and to fulfilling the requirements of the Luftwaffe.'

Accepting the new weapons on behalf of the German Air Force was Generalmajor

Günter Katz, commander of the flying units within the Luftwaffe command. He noted that the arrival of the GBU-48 would allow the Luftwaffe to 'respond to challenges that we do not even know today'. He described the EF2000's new armament as, 'the final piece of the puzzle to realize an all-weather and precision air-to-ground role.'

NATO role

Certification to use the dual-mode bomb was received shortly before the official hand-over. Beginning on January 1, the EF2000 was declared operational in its new role and available for the NATO Response Force.

'In 2018 we will have to prove that the Eurofighter's swing role — a fighter in

the morning, a bomber in the afternoon — is our daily business', explained Stabsfeldwebel (Master Sergeant) Raphael Mörs-Zander. He has served with the Nörvenich wing for more than 30 years and is responsible for one of the resident EF2000 maintenance lines. In the past, Mörs-Zander worked with the GBU-24 laser-guided bomb, utilised by the Tornado IDS, the EF2000's predecessor at the 'Boelcke' wing.

The 2,000lb (907kg) GBU-24 Paveway III was a Cold War-era 'bunker-buster' and its acquisition was originally pursued by the German Navy for anti-ship missions. For some time it has been judged too large and inflexible for modern close air support requirements.

The GBU-48 is an altogether more modern proposition. With a length of 12ft (3.68m) and a weight of 1,112lb (504.5kg), the GBU-48 has dual laser/GPS guidance. It can hit a target at up to 15.5 miles (25km) with an accuracy of 32.8ft (10m). In a press release accompanying the official hand-over, the Luftwaffe noted that the bomb is, 'very precise and can be used in almost all visibility and weather conditions. The GPS can be used to pre-determine the exact angle at which the GBU should hit the target.'

The Enhanced Paveway II consists of three basic components: the guidance unit with GPS sensor and laser seeker head, the active bomb body, and the tail unit with stabilizers. At the front end is the free-moving laser sensor, which can detect laser reflections. Directly behind it is the control unit with the GPS package. This is followed by the moveable control surfaces, which are attached to the bomb body. At the rear end is the tail with its rigid stabilizing fins.

Below: Last year's GBU-48 test campaign in Sweden involved not only dropping the bombs, but also examining changes in the flight characteristics of the jet.
**Bundeswehr/
Ulrich Metternich**

Left: The Eurofighter can carry a total of four GBU-48 Enhanced Paveway IIs, representing an additional weight of around two tonnes.
**Bundeswehr/
WTD 61**

Expanding capabilities

TaktLwG 31 is the first of four Luftwaffe Eurofighter wings to declare itself multi-role. The milestone followed the deployment of EF2000s to the Vidsele test range in Sweden in September for several weeks of trials in the air-to-ground role before national tactical verification in October.

According to the Luftwaffe, 'safe operation of the weapon system was the top priority' during the Swedish trials. The first sorties involved the pilots becoming used to the modified flight characteristics of the Eurofighter with a heavy armament load (adding around 2,000kg/4,409lb to the take-off weight), and ensuring the software and electronics functioned as required. The first weapon launches were made against individual targets, before moving on to multiple targets towards the end of the campaign.

Pilots and technicians from the 'Boelcke' wing will now serve as subject matter experts as they share their experiences with the three other Eurofighter wings: TaktLwG 71 'Richthofen' at Wittmund, TaktLwG 73 'Steinhoff' at Laage (which also serves as the EF2000 training unit) and TaktLwG 74 at Neuburg.

As work continues to introduce the multi-role capabilities across the Luftwaffe fleet, the BAAINBw will continue to co-operate closely with the Luftwaffe, supporting the GBU-48 as well as the Eurofighter. The Koblenz-based organisation is also responsible for German military hardware equipment once it has been delivered and is being utilized.

Since 2014 the Luftwaffe's EF2000 has been demonstrating its air-to-air capabilities during participation in NATO's Enhanced Air Policing (eAP) mission in the Baltic. Between September 2014 and January 2015, Luftwaffe EF2000s were stationed at Ämari in Estonia, the first time they had assumed full responsibility for the mission. Now, the fighter has shown it can also take on offensive missions if required.

'From now on, the challenge is to broaden the new capability by training technicians and pilots', concluded Katz. 'From 2018, we can provide the required capabilities through TaktLwG 31 'B' here in Nörvenich. Now we have the task of integrating the same capability in the other Eurofighter units.'





SPANISH SWING ROLE

Having originally planned to field its Eurofighters solely as air-to-air fighters, Spain quickly embraced multi-role plans and has played a leading role in air-to-surface capability development.

A Tranche 2 Eurofighter (serial C.16-53) of Ala 11 noses out of its shelter clutching a 1,000lb EGBU-16 (GBU-48). All photos this spread EdA

AIRBUS DEFENCE AND Space delivered an initial pair of Eurofighter Typhoons completed to P1Eb FW (Phase 1 Enhanced Further Work) standard to Albacete air base in December 2017. There the first two new-build aircraft in P1Eb FW configuration were handed over to the Ejército del Aire (Spanish Air Force).

The aircraft were manufactured at the final assembly line in Getafe, Spain, and include increased integration of a variety of air-to-surface weapons and enhanced targeting, among other improvements. Airbus describes the P1Eb FW configuration as, 'a key step in the overall Eurofighter evolution plan.'

The remaining six aircraft out of the 73 total jets contracted by Spain will be delivered to the same P1Eb FW standard this year and next.

Airbus operating officer, military aircraft, Alberto Gutierrez said, 'The smooth introduction of these enhanced features is a vital element of Eurofighter's

“Spain has actually played a lead role in developing air-to-ground capabilities for the partner nations in the program, with the 1,000lb EGBU-16 (GBU-48) now cleared on Spanish Tranche 2s.

evolution. It is a big tribute to the Airbus and Spanish customer teams that they achieved this on time through effective collaboration and clearly demonstrates the rich manufacturing capability here at Getafe.'

Spanish plans

Spain initially planned to acquire 87 Eurofighters, but this figure was cut to 73 due to budgetary constraints. The original Tranche 1 airframes are assigned to the training wing, Ala 11 at Morón.

While Spain initially planned its Eurofighters (locally designated as C.16s) to be air-to-air fighters, the move toward 'swing-role' came quickly. Indeed, Spain has actually played a lead role in developing air-to-ground capabilities for the partner nations in the program, with the 1,000lb EGBU-16 (GBU-48) now being cleared on Spanish Tranche 2 jets.

Eight aircraft from Spain's two wings deployed to Nellis AFB, Nevada, for Exercise 'Red Flag 17-2' last March and demonstrated the initial P1Eb standard.

By 2021, the Spanish Air Force plans to have two complete wings equipped with the Eurofighter. Alongside 111, 112 and 113 Escuadróns at Morón, Ala 14 at Albacete should be fully equipped with two full squadrons — 141 and 142 Escuadróns.

The latter had received the wing's first eight Eurofighters by mid-2013, initially in the form of loaned Ala 11 jets, but it now has its own jets adorned with the famous Don Quixote badge.

Unique strategy

The operational flight program (OFP) software development capability pioneered 'in-house' with its EF-18 Hornets convinced Spain to follow a similar path with its early Eurofighters. A decision to develop its own software for its Tranche 1 aircraft is already producing enhancements with 'minimum connection to the international effort.'



Right top to bottom: Maintainers load an EGBU-16 (GBU-48) GPS/laser-guided 1,000lb bomb.

Spain's ultimate plan is to operate two Eurofighter wings – Ala 11 at Morón and Ala 14 at Albacete.

Spanish pilots train at Morón with 113 Escuadrón.



Concerned by a lack of growth potential within the wider Eurofighter program when it comes to its 19 initial Tranche 1 airframes, the Spanish Air Force opted out of the core plan for the Tranche 1s and instead elected to develop its own OFP 01 and OFP 02 upgrades. While this may appear to illustrate a shortcoming of the core Eurofighter program, which appears to be mainly orientated towards the newer Tranche 2 and 3 aircraft, it usefully demonstrates the ability for a country to follow an indigenous path if it suits domestic requirements, seemingly without restrictions. It also represents an important organic development capability within the Spanish Air Force and local industry.

Having received the Tranche 1 enhancement packages 1 and 2 from Eurofighter in 2015, the indigenous OFP 01 was already in development.

This includes human-machine interface (HMI) improvements and integration of the digital version of the IRIS-T air-to-air missile, two of which had been test-fired by early 2017. OFP 02 was set for a mid-2017 delivery and added Litening III, GBU-48, AIM-120C-7 and an updated computer symbol generator.

Spain's 34 Tranche 2 and 20 Tranche 3A aircraft are set to remain within the international development program. The Spanish P2Eb upgrade adds MBDA Meteor, FLIR improvements, T2R radar software, the Drop 4 software package and HMI improvement for the Litening II pod.

Future P3E and P4E upgrade cycles will see Spain adding defensive aids sub-system (DASS) enhancements, integration of the AIM-120C-7 and Small Diameter Bomb II, and enhanced IFF modes. **Jamie Hunter**





WORKING AROUND THE CLOCK

Throughout 2017 the Aeronautica Militare (Italian Air Force) Eurofighter F-2000 force was engaged in quick reaction alert duties at a range of locations, from national commitments to detachments in Iceland and in Bulgaria.

REPORT AND PHOTOS
Giovanni Colla and Remo Guidi



An Italian Eurofighter F-2000A kicks up a storm as it gets airborne at Keflavik during the NATO mission here.



THE EUROFIGHTER F-2000, as it is known in Italian service, is today the bastion of the country's air defense mission and firmly established with the 4° Stormo at Grosseto, 36° Stormo at Gioia del Colle and 37° Stormo at Trapani. The Italian Eurofighter wings have also been called upon to fulfill NATO air policing missions, notably during 2017 deploying to Iceland and to Bulgaria.

To kick things off in 2017, the Aeronautica Militare decided to reorganize its domestic air defense system, and in January it set about moving the rotational quick reaction

alert (QRA) detachment from Cameri to Istrana to better protect Italy's north-eastern approaches.

The first NATO commitment of 2017 ran from March 17 until April 14 and saw the Italian F-2000s policing Iceland's airspace under Task Force Air Northern Ice. Two jets from each of the three wings deployed with around 140 personnel to Keflavik and mounted a constant QRA cycle, with a pair of aircraft on alert. In addition, the detachment flew daily training missions from this rather austere location, where the weather can fluctuate significantly. The six Eurofighters logged some 160 flight hours throughout the period, in

Above left to right: Engines running and ready to taxi from a dark and damp hardened aircraft shelter at Keflavik.

Col Moris Ghiadoni led the Italian detachment in Bulgaria.

Below: Pre-flight checks of a live AIM-120C Advanced Medium-Range Air-to-Air Missile (AMRAAM).

what was the second Icelandic stint for the F-2000s, which previously deployed here in 2013.

In short order after the northern trip, the Italian Eurofighters were readied for the summer heat of Bulgaria as from July they headed to Graf Ignatievo to jointly secure the regional airspace.

Dubbed 'Task Force Air 4° Stormo — Operation Bulgarian Horse', the mission started on July 7 and concluded at the beginning of November after 500 hours of flight operations. It involved four aircraft that worked hand-in-hand with the Bulgarian Air Force, manning QRA and flying joint interoperability and core training missions. Of note is the fact that





the Aeronautica Militare pilots notched up around 40 per cent of their air-to-air currency training fighting the resident MiG-29s. Dissimilar air combat training (DACT) was very much the order of the day, as well as electronic warfare missions to make use of the local ground-based air defense system.

These NATO missions were interspersed with a packed exercise schedule, which included 'DACT 2017' at Gando air base in the Canary Islands in January, the NATO Tiger Meet at BAN Landivisiau in France during June,

“ Italian Eurofighters were readied for the summer heat of Bulgaria as from July they headed to Graf Ignatievo to jointly secure the regional airspace

Above: Three Aeronautica Militare F-2000As and a single two-seat Spanish Eurofighter on the flight line at Gando during 'DACT 2017'.

Below: This shot was taken to mark a change of command at the 18° Gruppo at Trapani.

Tactical Leadership Programme (TLP) 2017-1 and 2017-3 at Albacete in Spain and Exercise 'Joint Stars 2017' across Italy in November.

It's worth reflecting on the varied range of partners and types the Italian F-2000s operated with during 2017. Deployments take an unexpectedly heavy toll on the day-to-day operations of squadrons, both from the manning and aircraft availability perspectives. The sheer level of commitment from the Italian Eurofighters is therefore all the more remarkable. 📷

