

# VAYU

V/2015

## Aerospace & Defence Review



**IAF at 83 : CAS Interview**

**75 Years : Battle of Britain**

**50 Years : Air War 1965**

**'Indradhanush' 2015**

**RIAT 2015**

**The AMCA Programme**

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In this juxtaposition painting by Priyanka Joshi, RAF Hawker Hurricane is seen in air combat with Luftwaffe Messerschmitt Me-109 during 1940 while, 25 years later, IAF Hawker Hunter dogfights PAF F-86 Sabre in 1965.

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# VAYU

## Aerospace & Defence Review

V/2015

### 34 The IAF at 83 : Interview with CAS



In his interview with Vayu on eve of the IAF's 83rd anniversary, Air Chief Marshal Arun Prakash talks about the Rafale procurement, issues on the FGFA, development of the AMCA, timelines on the LCA, additional C-17s and on much else.

### 42 Beyond the MMRCA : the AMCA



With formal announcement that the MMRCA programme has closed, with a limited purchase of 36 Rafales being negotiated, ADA's advanced medium combat aircraft (AMCA) might just be the panacea that the IAF is hoping for. Based on the joint workshop organised by SAS and ORF, this is a detailed look at the AMCA programme, highlighting key areas of concern.

### 50 FGFA facing headwinds ?



Sayan Majumdar writes that despite technical progress of the PAK-FA a.k.a. T-50 Fifth-Generation Fighter Aircraft (FGFA), there are serious 'headwinds', with Russia scaling down its purchase commitments almost continuously and Indian Defence Minister confirming that no progress has been made on the FGFA since mid-2013. Even if the Indo-Russian contract is signed this year, the IAF will not receive the first FGFA before mid-2023.

### 59 Rainbow Warriors



In the second half of July 2015, Exercise *Indradhanush* ('Rainbow') was held in the UK, this bilateral exercise between the IAF and RAF taking place after five years. The IAF's Su-30MKIs were pitted against the RAF's Eurofighter Typhoons while Commandos of the two Arms interacted elsewhere. This exclusive coverage for Vayu is by Patrick Smitshoek, Stephan van Geem and Remco Stalenhoef.

Phil Camp contributes his review of the Exercise where **The Typhoons of Coningsby hosted the Flankers of Tezpur.**

And **Beyond Indradhanush 2015**, there was some 'shadow boxing' with NDTV quoting the IAF Contingent Commander's "12.0 victory", which was quickly sobered down !

### 68 Remembering 'The Few'



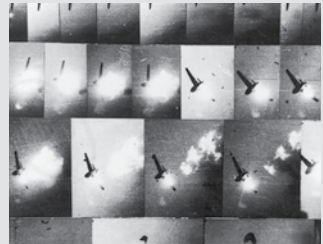
This year marks 75<sup>th</sup> Anniversary of The Battle of Britain (July-October 1940), with numbers of flying displays and other special events to mark the memorable occasion. Vayu's UK Editor Richard Gardner writes on the commemorations.

### 70 Legends of the Air



75 years ago an epic air battle raged over Europe. When it was over, 'The Battle of Britain' swiftly ascended into legend. Vayu's Angad Singh was in England during July 2015 to experience part of the UK summer air show season commemorating this incredible air war.

### 86 Air War 1965



**The Way We Wrote – and Painted !**

The Air War of 1965 has been recalled in numerous books and various actions recorded for posterity by artists from both sides of the Radcliffe Line. Gp Capt SMA Hussaini and the duo of Sameer and Priyanka Joshi. Vayu was present at Lucknow when the Keelor Brothers and other alumni were honoured by their *Alma Mater* and later in New Delhi when Alfred Cooke's incredible dogfight over Kalaikunda was recounted, and recorded by NDTV in Vayu's presence.

### 77 The Greatest (Air) Show on Earth



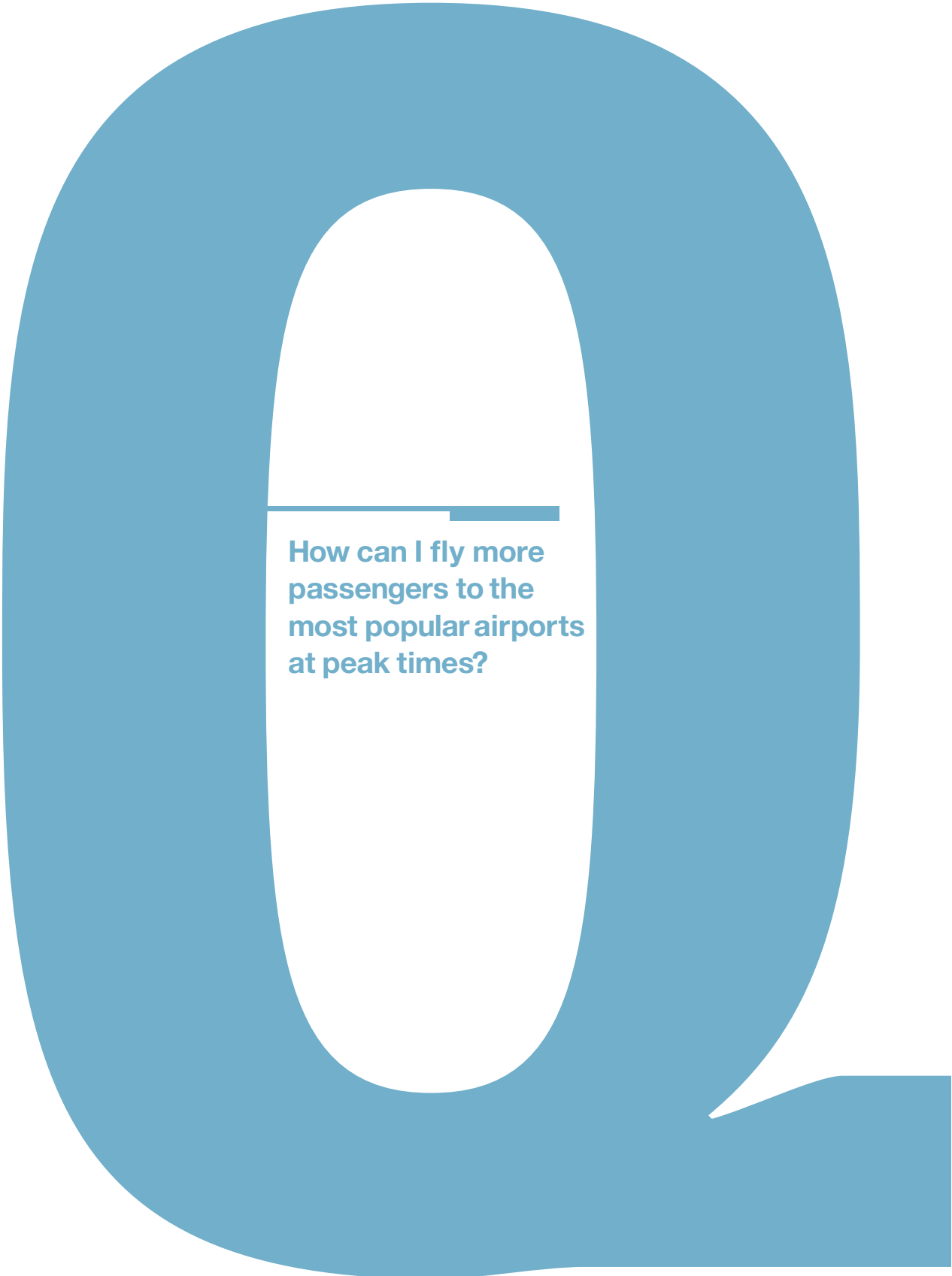
Vayu's Angad Singh covers the Royal International Air Tattoo (RIAT) 2015 at RAF Fairford which is arguably the most beloved such event in the world.

**Also : Défilé Aérien over Paris; Swamp Foxes in Poland; Rolls-Royce's 'Make in India'; The AgustaWestland Connection; Interview with Alex Cresswell; Hunt for CG791; The Dragon's New Colours; MBDA air-launched systems; The Derby BVRAAM.**


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## Pachaas Saal Baad

India is officially marking the 50th anniversary of the 1965 war as a victory over Pakistan. The truth is more nuanced: neither side gained much of an advantage over the other. Some aspects of the 1965 war are remarkably similar to today. What has changed and what hasn't in India-Pakistan relations over the last half century?

Then as now, Pakistan's principal motivation was to nab the Indian part of Jammu & Kashmir through a mix of covert warfare, internal insurrection and overt aggression. Thus 30,000 Pakistani troops crossed the LoC on 5 August 1965 dressed as Kashmiri locals. At the time Pakistan armed forces were better equipped mostly with US arms; Pakistan's economy was held up as an example for other developing countries; and Pakistan had ceded a portion of Kashmir to China to secure Chinese support. Iran and Indonesia too supported Pakistan while the USSR, which India had counted on, proved surprisingly neutral. While the Indian economy was held back by Nehruvian socialism the Indian military was just emerging from the shadow of Nehruvian pacifism after the 1962 China debacle.

Nevertheless Indian forces had superiority in numbers and surprised the Pakistanis by opening a second front in Punjab. In the end the war proved a stalemate. Today, Indian armed forces are far more modern and better supplied. India's annual per capita income (\$5,800 PPP) exceeds Pakistan's (\$4,700 PPP) while growth rates of both are comparable. But the critical difference is that both sides are nuclear armed and extensive conventional conflict as in 1965 isn't possible.

Second, due to its cultivation of covert paramilitaries, Pakistan is overflowing with terror groups some of whom have turned their guns against the state. Third, following 9/11 Pakistan has come to be known as the epicentre of global terror and lost all international sympathy on its claims to Kashmir. Terror has metastasised and become a global phenomenon, while India has moved closer to the West. So even as there is concern over human rights violations by Indian forces in Kashmir, the world doesn't really want to see it become a staging ground for global terror groups including Islamic State. The configuration of forces has changed dramatically in India's favour. The only issue is when Pakistan sees this and gives up on a futile conflict. Till then we have a stalemate.

*From The Times of India*

## Stand at ease

Defence Minister Manohar Parrikar's announcement of the implementation of One Rank One Pension (OROP) for military veterans was expected to bring closure to the 83-day-old protests at Jantar Mantar in the capital. The veterans have accepted OROP from July 1, 2014, with 2013 being the base year of calculation, while rejecting five of the six announcements. The points of disagreement are technical: the veterans want the pensions to be equalised every two years, while the government is willing to do so every five years; the veterans want the pension of old retirees to be fixed at the maximum of current retirees, while the government has agreed to fix it at the average of the maximum and minimum; the veterans wanted a five-member commission

with military representation to submit its report on the anomalies in implementation within a month, while the government has set up a one-member judicial committee with a time-frame of six months. These technical minutiae can be resolved by the two sides after mutual consultations.

But what seems to have angered the veterans is the attempt by the government to sneak in a new clause about the denial of OROP to volunteer retirees. Because the armed forces have no concept of a voluntary retirement scheme (VRS), it surprised most observers when the defence minister used this term. Military personnel who take premature retirement do so for organisational reasons — the armed forces are a steeply pyramidal hierarchy, where only a fraction of personnel get promoted, and the military would want the young and motivated among its ranks. Excluding these premature retirees from OROP — about 40 per cent of all pensioners — would be discriminatory and detrimental to the organisation. The prime minister has announced that this clause will now be removed.

Even though the impasse continues for now, a final resolution is near. It is thus time to step back and look at the consequences of what has happened in the last few months. A government committed to fiscal prudence has agreed to Rs 12,000 crore in arrears, and an additional annual defence pensions bill of Rs 8-10,000 crore. This bill will increase every year, with a quantum jump when a new pay commission announces its award, as is scheduled to happen next year. In this period of global economic downturn, the government will have to ensure that it doesn't breed OROP-like demands from other employees, such as those in the paramilitary forces. More importantly, the fabric of civil-military relations in India has been bruised during the recent protests, with an overt politicisation of the veterans community. Serving military personnel, who have deep connections with the veterans, have also been impacted by the acrimony and bitterness. The political leadership urgently needs to soothe frayed tempers and restore the delicate balance in civil-military relations.

*From The Indian Express*

## Tiananmen Square parade

China's display of its range of ultra-potent missiles during the victory parade on Thursday caused quite a few tremors among Western analysts but the lesson for India is considerably different. This is the first time China opted for a military parade on September 3, a day after Japan's surrender to mark the closure of World War II in 1945. India decided for a low-key representation in order not to displease its allies-in-the-making, many of whom did not turn up for the parade. As a former military man, Gen V K Singh (ret'd), the Indian representative at the parade, would have understood that Beijing was primarily messaging Japan and the US in the context of its confrontation with them in areas considered Western preserves till some time back.

China displayed more than a new range of missiles. It demonstrated diplomatic finesse also. First, a parade-eve editorial in the People's Daily talked of the need to "deter Japan" and "show off China's military might". Then it was diluted to "conveying that China is devoted to safeguarding international order rather than challenging it". The point was made. And made well. China



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was basically replying to the US forward military presence in the Pacific and Japanese Prime Minister Shinzo Abe's plans for large scale militarisation and did not heed Tokyo's express plea not to turn the parade into an anti-Japanese event.

India should be concerned about China's plans to invest more in the navy at a time when both countries are trying to project their sea power in each other's maritime domains with their impressive naval capacity of "anti-access and area denial". This helped China check America's maritime forward posture. India too can respond similarly. But this means a massive commitment and equally massive investment. It is clear that this frittering of resources will be disastrous for both when China and India are struggling with their economies. Rather, it is time to enhance mutual trust that was emphasised by both Prime Minister Narendra Modi and Chinese President Xi Jinping.

*From The Tribune*

## Getting their due

Human Resource Development Minister Smriti Irani's decision to allow stories showcasing the valour of our soldiers – as school material – is a matter of pride for us all. Unlike other countries who venerate their military; sometimes to the point of sycophancy; we have been shockingly lackadaisical in our attitude towards our soldiers. This is not from lack of pride but from lack of knowledge.

Ask the average Indian on the street and one can guarantee that he would be hard pressed to tell you the various ranks of the Army. This is because our politicians have so far not bothered to highlight the pride of the nation.

Hopefully, the introduction of these textbooks will help fill in those gaps of knowledge. This, combined with the recent introduction of OROP, should give our Forces the belief that the government is both proud of them and actively concerned about their welfare, a belief that past governments have either not thought about, or not thought important enough to put on the table.

But there is more on the anvil. In July this year, Finance Minister Arun Jaitley had allocated funds for a National War Memorial. According to the Finance Minister, this memorial, which will be located in the vicinity of India Gate, will not only list the names of our martyrs in all the wars India has fought but it will also be supplemented by a war museum. The National War Memorial – should it come up soon – will complete the tribute to the people who have given their lives to safeguard our nation.

The public response – which has been one of joy – shows the average Indian wants to honour our soldier by knowing more about them. Finally, India's military history will be studied by future generations ensuring 'The Tomb of Unknown Soldier' will be a thing of the past. Our soldiers will now never be unknown.

*From Mail Today*

## Better, but not enough

INS *Kochi*, the second of India's three new generation destroyers, has been commissioned into the navy. This is a good time to review how the Modi government has been doing on getting

India's defence equipment up to scratch-new orders for equipment, 'making in India', maintenance, and budgeting. On new orders, the government has over the past year cleared three helicopter purchases: for attack, heavy-lift and anti-submarine warfare. However, the combined total of 53 that have been ordered for the air force and navy make up only a small part of the total number required. In fixed-wing aircraft, Airbus in partnership with Tata has won a contract to buy/make 56 transport planes to replace ancient Avros, while rocky negotiations continue for the purchase of 36 Rafales announced nearly six months ago. Among ships, the long-delayed order for a new line of seven frigates has finally come through, while another long-delayed order for towed-array sonar (for submarine detection) has also been placed. There is also much routine spending on equipment that goes on each year, while many other big-ticket orders are in the works. Just the headline-hitting orders that have been placed in the last year total up to a cost of more than Rs 85,000 crore. If the Rafale order gets placed, the run-rate on new orders will get well ahead of the trend expenditure on defence hardware (under Rs 95,000 crore for 2015-16).

Yet, the orders placed are a small fraction of what is required. The navy needs at least 25 towed-array sonars for ships built or bought over the last quarter century (a prolonged attempt at indigenous development got nowhere, necessitating imports, which were further delayed by unfounded allegations of skulduggery). Destroyers, frigates and corvettes continue with the scandalous situation of having to share helicopters while some have none at all-the 16 Sikorsky S-70Bs that have been ordered are simply not enough, some three times that number are required. In other words, while some of the gaps in defence equipment are being filled, much remains to be done-and bigger capital budgets are needed.

Meanwhile, 'making in India' has notched up some successes-many of the new orders involve local partners and local manufacture after an initial set of imports. Orders that are in the works, such as two for a combined total of 300 helicopters and another for field artillery, will certainly mean local manufacture. Unfortunately, manufacturing/development delays continue. Little is heard about Arihant, the nuclear submarine that was launched into the water in 2009; after six years, it is yet to be commissioned into the navy though the navy chief insists that sea trials have gone well. The final operational clearance for the Tejas light combat aircraft has been promised each year for the last few years, and once again has been pushed back by another year. Some crucial missile projects too seem to be progressing slowly.

So it is a matter of relief that maintenance standards seem to have improved. The defence minister has told Parliament that the combat availability of the Su-30MKI fleet of fighter aircraft has improved from the highly problematic 49-50 per cent range to 56-57 per cent; further, he has promised to get it up to 70 per cent by the end of the year. This would be a substantial achievement, implying a 40 per cent increase in aircraft availability for a fleet that is already more than 200 aircraft-in effect adding more than two squadrons to the operational fleet. The country needs more such breakthroughs if its defence preparedness, sadly lacking on many fronts, is to get up to scratch.

*From Business Standard*



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## “I TOLD YOU SO!”



Admiral Arun Prakash, former Chief of the Naval Staff writes on

## A CASE OF DÉJÀ VU

It is difficult to resist the temptation of saying ‘I told you so!’ but the Medium Multi-Role Combat Aircraft (MMRCA) programme for the Indian Air Force (IAF) is yet another case of what the French would term ‘déjà vu’ or ‘seen it before’.

By the standards of India’s lethargic MoD (Ministry of Defence) however, the quest for a MMRCA is still young, a mere 13 years is nothing in the timeless cosmology of our bureaucracy, especially when compared to the score of years (and lives of many young IAF pilots) that it took for the Advanced Jet Trainer and three decades (and counting) for the army’s new howitzers.

The difference in this case is that when Prime Minister Modi and French President Francois Hollande announced the government-to-government deal for sale of off-the-shelf 36 Rafale fighters on 10 April, it was supposed to represent not just a panacea for the IAF’s ills but also a major coup for the new and ‘decisive’ NDA government.

Citing India’s “urgent defence needs”, Modi chose to bypass the entire gamut of procedures mandated by the Defence Procurement Procedures (DPP) manual and deal directly with Paris for a smaller order. The expectation, obviously, was that the minutiae of the new deal would be quickly

worked out by government officials. On 16 May, when Raksha Mantri Parikkar confidently told media that negotiations over pricing would be finished in a “month or two”, he had conveniently overlooked a lot of recent history.

Having short-listed a set of six contenders for the MMRCA competition, the IAF played strictly by the rules of DPP 2006 and meticulously evaluated the performance of each competing machine over the full range of maintenance and operational criteria laid down in the Air Staff Requirement (ASR).

It must have been as much of a challenge for the IAF to organise and execute field

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trials for six competitors in diverse locations, as it was for the aircraft manufacturers to demonstrate their products under demanding conditions, far from home. But they did it, notwithstanding a uniquely bureaucratic DPP clause that requires the trials to be conducted at “no cost, no commitment” to the Government of India (GoI), thus ensuring that quotations are jacked up to defray these costs!

In January 2012, more than a decade after initiation of the MMRCA proposal, the MoD declared that the French Rafale had been selected for induction into the IAF. A letter of intent for acquisition of 126 aircraft was issued to Dassault Aviation : of these, 18 were to be built in France and the rest assembled and progressively manufactured in India by HAL. Contract negotiations commenced soon after, with the programme costs being estimated at between \$12-15 billion.

Although there was no official pronouncement since conclusion of the MMRCA competition, over three years ago, negotiations appeared to be dead-locked with no contract in sight. According to industry and media reports, the impasse was over two substantive issues.

The Ministry of Finance having thrown a fit at the colossal, all-inclusive cost of the project, the GoI was reportedly insisting on a price lower than what had been discussed during the commercial negotiations. Dassault, in its turn, had expressed unwillingness to guarantee quality of the 108 Rafales to be assembled or manufactured by HAL – or to stand warranty for them.

It was in the midst of this complex scenario that the PM’s made his breathtaking announcement about an ‘off-the-shelf’ purchase of 36 aircraft from France. No one thereafter mentioned the MMRCA global tender, the world-wide responses, the elaborate IAF evaluation programme and the letter of intent issued to Dassault, all of them with serious legal and contractual implications.

It quickly became clear that delivering 36 Rafales to the IAF in less than three years would be possible only if some aircraft were withdrawn from French service and refurbished for transfer to India, as was done in the case of British-supplied Jaguars in 1979-80. More intriguing was the question whether the 36 ‘off-the-shelf’ Rafales were part of the MMRCA tender, or was this a

stand-alone deal and if the latter, what of the fate of the contract being negotiated? For three months after PM Modi’s announcement, speculation ran rampant, until Defence Minister Manohar Parrikar confirmed in a statement to the upper house of Parliament on 30 July 2015 that the larger MMRCA tender for 126 aircraft had formally been withdrawn.

Which brings us to the important question of costs. A smaller order for off-the-shelf Rafales would certainly cost less than the complete MMRCA deal, but there remains no clarity from the MoD on the overall cost of this revised arrangement, options for follow on orders and the commercial terms for these, offsets and technology transfer.

In the arena of national security, however, costs and other considerations must take a back-seat and we must view this complex issue as being the IAF’s dilemma. Aircraft attrition, obsolescence and declining numbers constitute a triple spectre that haunts every air chief, making him ‘ask for more.’ The IAF’s problem has been aggravated by the fact that a significant proportion of its battle-order consisted of Soviet-era MiG-21, MiG-23 and MiG-27 combat aircraft. About 850 MiG-21s (and many times that number of aero-engines), were ‘manufactured’ by HAL under licence, but when time came to modernise the aircraft, this huge conglomerate threw up its hands and the IAF had to go find a Russian contractor.

Planned replacement for the MiG-21 was to be the indigenous Light Combat Aircraft (LCA), this programme undertaken by the DRDO (Defence Research and Development Organisation) from the early 1980s. It has come 25 years late and despite its many virtues, may turn out to be a case of ‘too little, too late.’

At the turn of the current century, dwindling numbers coupled with the operational challenge posed by rapidly modernising air forces of neighbouring China and Pakistan, then led the IAF to decide that a quick-fix for its problems would be to induct additional numbers of the French Mirage 2000. This aircraft had an excellent record in IAF service and Air Headquarters felt that this could become the future MMRCA, not only bridging the gap between the Sukhoi Su-30 and the Tejas LCA but also compensating for the eventual de-induction of refurbished MiG-21s.

The Indian Ministry of Defence was perhaps not aware that Dassault was on the verge of closing down the Mirage 2000 production line, and refusing to treat the IAF proposal as a ‘repeat order,’ the MoD then insisted that a fresh ASR be drawn up and followed by a world-wide ‘request for proposals’ (RFP), a process that consumed nearly a decade.

Having examined responses to the RFP, the IAF wasted little time in initiating a rigorous evaluation process in which each of the six competing aircraft were assessed against 650 odd laid-down criteria.

However, in order to satisfy DPP requirements, the IAF rendered an already complex process even more difficult by casting its net too widely. The six aircraft short-listed for evaluation fell into conspicuously different categories of vintage, weight, technology, number of engines and cost, making it truly a contentious contest between apples and oranges. It is to the credit of the Service that a fair and objective assessment threw up the ‘best’ fighter, even if its exorbitant cost made it sub-optimal.

The rest of the story has already been told, but a few issues bear further scrutiny. Media speculation has focused on Dassault’s lack of confidence in the ability of HAL to attain requisite aviation manufacturing standards. Apart from the reflection it cast on India’s aerospace giant, a direct implication is significant cost-escalation, with figures of \$22-30 billion being mentioned as project costs.

Given HAL’s track record of poor quality control in every product it has delivered to the three Services, Dassault’s reservations are understandable. However, this issue should have been addressed by the French company before it submitted its bid and not at the stage of contract negotiations.

This appears to be almost a replay of the serious problems faced by the MoD in the *Scorpene* submarine project. In that case, some fine print in the contract was invoked after it had been signed in good faith, leading to huge time delays and cost overruns.

While this brings out the need for caution when dealing with foreign firms, it also highlights the lack of expertise within the MoD and Service HQs in contractual matters. Almost every single contract signed by the MoD in the past two decades has run into problems, sooner or later. There exists

a very strong case for creating a cadre of MoD officials and Service officers formally trained in cost-accounting, acquisition processes, contract negotiation and contract implementation. In the interim, it would be prudent to induct experts from the private sector to render assistance in drawing-up and negotiating contracts.

The hiatus in conclusion of the Rafale contract had inevitably led to wild speculation in the media, perhaps fuelled by losers in the MMRCA competition. Some commentators castigated the IAF for a flawed force-planning process, focusing on a few key issues.

Firstly, the high cost of the MMRCA programme and its immense scale were certain to have immense impact on future defence budgets and military planning, yet was entirely overlooked. The position of an MMRCA-class fighter in the IAF's order of battle seemed unclear, given the Su-30MKI already in service with the LCA and FGFA on the horizon. A third focus of criticism arose from concerns about the proliferation of aircraft types in IAF inventory. The addition of an *eighth* type to its existing inventory of seven combat aircraft of Russian, British, French, and Indian-origin would further compound its logistics nightmare. These observations have merit and call for serious reflection.

However, everything is not black and white and there are a few other points that deserve objective consideration. The egregious failure of the DRDO and India's defence industrial complex to meet the operational needs of the IAF is matched only by the detachment shown by the latter towards the indigenous aeronautics industry. The first Indian-built fighter, the HF-24 Marut, rolled out of HAL in 1961, a full seven years before our first indigenously built warship INS *Nilgiri* was launched in 1968 by Mazagaon Docks. Had the IAF assumed positive "ownership" of aircraft projects and production, like the IN did in the case of warships, it may not have had to seek a BTT, an IJT, an AJT, the LCA, MMRCA and FGFA from abroad. Even at this late stage, a Directorate of Aircraft Design in Air HQ would greatly help create a symbiotic linkage between the Air Staff and India's aerospace industry.

To compound India's discomfiture, the Chinese aerospace industry seems to be galloping ahead in an effort to catch up with the USA. Apart from the J-20

and J-31 fifth generation fighters under development, the PLA Air Force is flying large numbers of J-10 fighters while the J-15 (based on the Su-33) has been cleared for carrier operation with the PLA Navy : all are indigenously produced. Even Pakistan is basking in China's reflected glory, now producing the JF-17 Thunder light combat aircraft in quantity.

The persistent IAF demand for making up aircraft numbers or squadrons certainly sounds convincing when cited in the context of a 'two-front' war. However, these numbers were stipulated in an era when two squadrons of MiG-21s could have been procured for the price of a single Rafale today. Conversely, the versatility, payload, weapon accuracy and relative invulnerability of a modern multi-role combat aircraft make it the equivalent of a dozen or more of its predecessors. The emphasis logically must shift from 'dumb' numbers to 'smart' capability.

There is food for thought that against the IAF's strength of 750-800 combat aircraft, both the Royal Air Force and the French Air Force undertake world-wide commitments with just 225 aircraft of two types each : the FAF with the Rafale and Mirage 2000 and the RAF with Tornados and Typhoons. However, this comparison may not really be fair because both these air forces enjoy excellent support from their domestic aerospace industry. The IAF, on the other hand, has to contend with support from HAL or Russian vendors, both sources indifferent and unreliable.

The fifth generation fighter aircraft (FGFA) or T-50 / PAK-FA, being touted as an Indo-Russian joint project, is yet another example of things having gone wrong. Based on a Russian pledge that they would share the design, engineering, testing and intellectual property in a 50-50 proportion, India was asked to contribute US \$300 million up-front for the PDP, and eventually 35 percent of the \$15 billion project cost. While details are scanty, currently five T-50 prototype are already flying in Russia with absolutely no Indian participation or contribution.

This project promises to become a clone of the BrahMos, an entirely Russian product that carries an ersatz Indo-Russian trademark.

So what now ? The fog surrounding the government's plan to purchase 36 Rafales off-the-shelf persists and many questions

hang in the air. If this is just a 'modification' of the original MMRCA deal to expedite deliveries in the short term, it will only complicate negotiations. This can already be seen by the six-month delay since PM Modi announced his intention to procure flyaway aircraft, and may render a severe blow to the 'Make in India' campaign.

However, if it is indeed a change of heart on the government's part, it may constitute a good all-round compromise. While partially satisfying French commercial interests, it permits India an honourable exit from the MMRCA commitment, allowing it to review other options. The IAF, too, can look forward to an early boost for its combat capability, without being saddled with a crippling financial liability.

However, India will keep encountering such conundrums unless the politician acquires some comprehension of complex security issues and installs a professionally competent organisation in the MoD for acquisition of military hardware instead of relying blindly on bureaucrats who are not only generalists but regularly subject to transfers.



# With Due Honour

It is important to value the sacrifice of warriors



*Spitfire Mark Is during the Battle of Britain: painting by Roy Cross*

Not very long ago, what struck one on return from an overseas visit was the sheer shoddiness of the Delhi international airport along with all that is associated with an overseas arrival, namely immigration, customs, baggage retrieval and, indeed, the mayhem of touts and taxis outside. In all fairness, we have come some way from that embarrassing past and today the International Airport in Delhi (T3) is amongst the finest. Alongside that, much has changed for the better in the clearance of arrival formalities, although the same can hardly be said once one is outside the terminal building.

But it is not airports and air travel that this piece is about, even though at the time of writing our infotainment industry is going ballistic over some airline flight delays caused by errant VIPs, quite forgetting that we are at the receiving end of a VIP culture in a hundred different ways in our daily

lives. This piece, however, is about a culture shock that, to one's mind, is of far greater significance, since, in a sense, the very idea of our nationhood hinges on it.

This writer is no Anglophile, but he has been exposed to the deep respect and admiration that the British people have for their military veterans. This is effectively portrayed in the electronic and print media which, uniformly, are of a very high journalistic quality. That has left a striking impression of the deep sense of nationhood of the British people. Then, to return to one's motherland and learn of veterans on relay hunger strike in some 50 cities across the country, with no air of concern on anyone's part, came as a shock of far deeper import than the earlier return to a shabby airport. To see life proceeding as normal not just for the government of the day but also for our parliamentarians (with one notable Rajya Sabha MP from Karnataka

as an exception), ordinary citizens and the media – which would rather cover scandals and trivialities - one is left haunted by a flood of disturbing thoughts and questions. More of that later.

Britain is in the midst of a four-year national commemoration programme marking the centenary of the First World War, to honour and remember the lives of those who served and were affected by that war. This national programme commenced in 2014, marking the 100th anniversary of the outbreak of the First World War and is due to continue till 2018. A befitting beginning to the programme was a work of installation art placed in the moat of the Tower of London, between July and November 2014, that consisted of 8,88,246 ceramic red poppies, each representing one British or colonial serviceman killed during the war. Poignantly, the title of this creation, *Blood Swept Lands and Seas of Red*, was taken



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from the first line of a poem by an unknown soldier of the First World War. Whilst one did not have the privilege to see this homage in person, images were adequate to get a sense of the pride and honour that the nation, especially the successors of those so honoured, must have felt when witnessing this emotion-filled work of art.

Clearly, the British media are playing a major role in celebrating the spirit of this commemorative period through a feast of reporting and writing, as various events take place and historic milestones and battles are commemorated. The BBC has planned some 2,500 hours of television, radio and online programmes that include documentaries, drama, arts and music. More importantly, there are special programmes for children and schools, because it is in these cradles that, through the history of sacrifice, the spirit of nationhood is being nurtured amongst future generations. Not surprisingly, it was exciting to wait for morning papers or to watch programmes and to be treated to the many facets of this history, the battles fought and won or lost, the human and military side of those who took part and, not the least, the contribution that every member of society made to this valiant national effort.

But love and respect for their men and women in uniform in Britain is not limited to commemorations like these - they go far deeper. On one's way to have lunch with an old RAF friend at the RAF Club on Piccadilly, one was surprised to see a recent and imposing Royal Air Force Bomber Command Memorial unveiled by Queen Elizabeth II on 28 June 2012 across the road in Green Park. It has not been seen on earlier visits. Intrigued by this rather belated memorial, which depicts seven crew members of an RAF bomber just returned from their mission, with the inscription, "For the 55,573 aircrew of Bomber Command who died during the Second World War", this writer asked the RAF friend the reasons behind this belated honour.

It turns out that the controversy over the tactics employed by the RAF Bomber Command during the Second World War, when even cities suffered bombing, had resulted in this delay. The sheer depth of this feeling can be judged by how Winston Churchill, who had famously said of the Battle of Britain fighter pilots, "Never in the history of mankind have so many owed so much to so few" and who had, in 1940, described bombers as "the means of



*RAF Hurricanes intercepting Luftwaffe Ju-88s during the Battle of Britain in September 1940 (from the Ian Kennedy Collection)*

victory" chose not to mention the role of Bomber Command in his famous speech at the end of the war. That the nation is able to overcome controversy and prejudice for serving the larger cause of honouring its uniformed sons, even after an internal debate of some seven decades, surely is a sign of the strength of nationhood.

With this background, one is left wondering whether we have any sense of nationhood. If it is there, where should it begin to manifest itself? Is there not a single cause that can unite this richly diverse society of ours for the larger good of the people and quality of our nation? Is there any better place for this than at the altar of those whose only mission is to protect national frontiers and provide us with security to get on with our lives and those of their predecessors who have either perished in this mission or are in the twilight of their lives? For these are the ones who have voluntarily committed themselves to an unwritten contract of unlimited liability to protect the nation and its people. Ironically, what we are witnessing today is not idealism, but benign indifference to the spectacle of our veterans returning their medals to their supreme commander and being forced to resort to dharnas and relay fasts across the country.

Not many of us may be aware of the fact that India Gate, originally called the All India War Memorial, situated at the end of Rajpath, is a war memorial to some 82,000 soldiers of the undivided British army who laid down their lives during the First World War. The structure beneath the memorial archway called *Amar Jawan Jyoti* is a recent

addition after the Bangladesh Liberation War and serves as India's modest tomb for the unknown soldier. Once again, we are indifferent to the fact that a befitting memorial to our soldiers, sailors and airmen who have laid down their lives to protect independent India continues to be absent, notwithstanding electoral promises by political parties of all shades.

The sad conclusion is that we, as a people, care little for these sacrifices. This is reflected in the lack of interest shown by the pillars of our much-heralded democracy, be it Parliament, the government or the fourth estate. Even amongst those lakhs of red poppies that were earlier mentioned, some 82,000 honoured sons were those of our soil. But one recalls no reflection or recognition of this in our official announcements and certainly none in the media, when this was on display in faraway London. Indeed, no one bothered to reflect that these are the same sons of our soil in whose memory stands India Gate.

The inscription on the Bomber Command memorial referred to above reads, "Freedom is the sure possession of those alone who have the courage to defend it". For the sake of preserving freedom for future generations, it is the turn of our political leadership to display courage. Let this be a fervent appeal to the supreme commander to take command and apply a balm to the wounded psyche of the veterans and a call to our Parliament to pick up the gauntlet to repair the archaic model of the now broken civil-military relationship.

*Air Marshal Brijesh D. Jayal (retd)*



US Ambassador to India, Mr. Richard Verma on

# “Need to preserve our shared spaces”



*‘Nimitz’-class aircraft carrier USS ‘Carl Vinson’ and Indian Navy replenishment vessel INS ‘Shakti’ conduct a refueling-at-sea exercise during Malabar 2012 (photo: US Navy / Andrew K. Haller)*

India has much to celebrate as it reflects on the last 68 years since Independence, and much to look forward to in the years to come. We recently commemorated the 10th anniversary of the Civil Nuclear Initiative, a milestone that unleashed the potential of the US-India relationship. At that time, partnering on defence production, space and other forms of high technology was almost unthinkable. Today those issues are part of the foundation of the enduring partnership we are building as we seek to make our citizens and the world more free, secure, and prosperous. US-India ties become more necessary by the day as the shared values that we hold dear face profound challenges, whether it is from emboldened terrorist organisations, attempts to discredit the principles of democratic governance or aggressive tactics in the seas and skies.

Challenges to access to shared spaces—through the seas, the skies, and space—compromise the ability of nations to provide their citizens with rising living

standards and stability. However, the US-India relationship, and our commitment to defending and preserving these spaces can help promote global peace and prosperity for the long-term. As leading powers, our work to ensure the integrity of these shared spaces should drive our strategic cooperation for decades.

Our seas are more relevant now than ever before. Ninety per cent of trade worldwide is conducted via the oceans. Our food and fuel depend on the safe passage of cargo through our shared sea lanes, yet the safety and security of these sea lanes face threats ranging from terrorists and organised criminals. We must confront these threats and be vigilant against the use of intimidation or force to assert unfounded territorial or maritime claims. Natural disasters also affect the stability of the maritime domain, particularly as we face greater climate uncertainty.

The US and India can take a leading role to address the risks facing maritime zones. In fact, under our *Joint Strategic Vision*

*for the Asia Pacific* announced in January, our leaders affirmed the importance of safeguarding maritime security and ensuring freedom of navigation throughout the Indo Pacific. We are both maritime powers. Our navies engage in regular trainings and joint exercises as partners. We can do more, such as increasing our intelligence exchanges and collaborating even further on issues of common concern such as piracy, counter-terrorism, the illegal drug trade, and human trafficking. We are well into the planning stages for the *Malabar* joint US-India naval exercise, which will include Japanese participation, and we have established a new aircraft carrier working group to support India’s efforts to construct an indigenous carrier. India has also proven itself to be a leader in responding to natural disasters, with crisis response capabilities stretching from the Bay of Bengal to the Arabian Sea. The US would be proud to increase its support of India’s regional disaster response capability through increased coordination, exercises,



*An IAF Boeing C-17 Globemaster III taking off from Yelahanka AFS (photo: Angad Singh)*

and information sharing to achieve a more secure maritime domain.

Freedom of navigation also applies to the skies. Skies that are safe for flight demand that nations respect overflight freedoms, and protecting such freedoms requires airpower. The US is working with India to pursue opportunities for the co-production and co-development of next generation engines to power Indian aircraft. We can do more in this area by expanding our bilateral defence cooperation.

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**“I see no reason why we cannot build fighter aircraft together, right here in India.”**

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The potential for our collaboration stretches into the stratosphere. The world has truly become reliant on space, and the scale of space cooperation between our countries has grown rapidly — including our collaboration on the Chandrayaan Mission and India’s hugely successful Mars Orbiter Mission.

We have only scratched the surface of what we can accomplish. We welcome additional path-breaking work between NASA and ISRO to explore deep space, someday enabling us to study the furthest reaches of our galaxy. Partnering on space-based climate research will also become increasingly important as the effects of climate change continue to impact our planet.

The world increasingly depends on satellites for communications, navigation, and national security. We cannot allow our space-based assets to be threatened by entities that pursue disruptive counter-space capabilities. As space-based activity increases, there needs to be greater global consensus on how to monitor space, so as to protect our resources and promote scientific exploration. This will require US and Indian leadership. The first Space Security Dialogue took place this year during which we discussed transparency measures as well as how to enhance shared awareness of the space environment. More can be done in this field.

Of course, it is in all of our best interests to protect these shared spaces responsibly. This means setting clear parameters for commercial fishing activities to avoid severely depleted stocks, continuing

to partner together to battle dangerous pollutants and emissions in our skies, and keeping Earth’s orbit clear of debris.

With India and the US working on these problems and opportunities together, we can have a dramatic impact on global peace and prosperity. This is the path for unlocking the full potential of the US-India strategic partnership. Let us celebrate all that India has achieved as well as reflect on what we can do together to be a force for greater good.

**Extracts from a talk at ORF in August 2015**



*US Ambassador Richard Verma*



# A PEACEFUL SKY THANKS TO THOSE WHO DEFEND IT.

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as it celebrates its 83rd anniversary.



### 'Surya Kiran' team re-formed

The Indian Air Force has re-established its aerobatic display team, the *Surya Kirans*, with new BAE Hawk Mk.132 aircraft. The team, which was disbanded in 2011 owing to a critical shortage of flying training aircraft, originally flew the HAL HJT-16 Kiran aircraft in a distinctive orange-and-white paint scheme, and were one of only three aerobatic teams in the world that displayed with nine aircraft in formation. The revitalised *Surya Kirans* will reportedly make their public debut on Air Force Day 2015 at Hindon AFS, initially flying a limited profile with only four aircraft, but will commence full nine-aircraft displays in 2016.



The new Hawk aircraft have received an updated livery, different from the original colours displayed on the older HJT-16 aircraft, with a distinct 'sunbeam' motif originating at the tail (photo above).

### DAC clears additional Mi-17, Akash, Chetak purchases

The Defence Acquisition Council (DAC) has approved various procurement programmes worth over Rs 14,400 crore (\$2.2 billion) on 1 September 2015. These included 48 more Mil Mi-17V-5 medium-lift helicopters worth Rs 6,900 crore and seven more locally developed Akash-2 surface-to-air missile squadrons worth Rs 4,700 crore for the IAF. The Air Force will also receive four surveillance radars for Rs 270 crore and four of its airfields will receive new air traffic control radar systems for Rs 230 crore.



For the Navy, the DAC cleared eight HAL-built Chetak helicopters worth Rs 300 crore, nine tugs for Rs 300 crore, dockyard repair facilities for Revathi radars at a cost of Rs 30 crore and electronic warfare systems amounting to Rs 200 crore. The Army was cleared to purchase 102 short-span bridges (Rs 490 crore).

The DAC has reportedly given a 'go-ahead' to the MoD committee negotiating the purchase of 36 Dassault Rafale fighters for the IAF, indicating that the deadlock over pricing, offsets and IAF-specified configuration changes was under resolution. "The MoD hopes that a government-to-government agreement between Indian and France would be signed in the near future to finalise the contract for the IAF to induct this aircraft."

The DAC, however, deferred decisions on two major proposals: the Rs 80,000 crore Project-75 (India) for construction of six conventional submarines and a Rs 15,000 crore project for 110 naval utility helicopters to replace the ageing Chetak fleet. Both these long pending proposed projects are to be undertaken in India with foreign collaboration.

### Report of Standing Committee on Defence

The latest report of the Standing Committee on Defence presented at the end of Parliament's Monsoon session has brought out several shortcomings "to be addressed by the government." The thrust of the report concerns arms and ammunition, vehicles to carry missiles and the below acceptable standard of INAS rifles developed by DRDO. The committee has questioned as to why replacements have not been procured from other sources. Another significant issue highlighted by the report is the lack of progress of HAL's Intermediate Jet Trainer project forcing the IAF to extend the life of obsolescent Kiran trainers.

The committee has also pointed out the current shortage of officers, especially in junior ranks: the Army is short of 9,642 officers, the Navy 1,561 and the IAF 659. While more attractive service conditions are being planned, the Committee has urged the Ministry of Defence to explore reasons why "a defence services career has ceased to attract the youth of India".

### Armed Heron UAVs ordered

In early September 2015, the Indian government reportedly approved the procurement of ten missile-armed UAVs from Israel, in a deal valued at around \$400 million. The armed Heron





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TP drones will be operated by the Indian Air Force, which already operates a fleet of reconnaissance drones. The IAF also has a number of Harpy UAVs from Israel, which are self-destructing systems primarily utilised in the SEAD role. Heron drones can carry a payload of over 1,000 kg and will be equipped with air-to-ground missiles that detect, track and strike targets deep in enemy territory. Defence ministry officials stated that the Heron TP may enter service within a year. In addition, IAI officials are reportedly in talks to build the drones locally under the 'Make in India' initiative.

Indian armed forces already operate unarmed Heron and Searcher UAVs for surveillance and intelligence gathering. An indigenous medium altitude long endurance (MALE) UAV being developed by the Defence Research and Development Organisation is several years away from induction, and adding weapons to this platform will take even more time which would explain the decisive action taken on procurement of the Israeli platform.

## Flight Testing of FGFA by the IAF



According to reliable reports, the Government of India have requested that Russia facilitate test flying of the Sukhoi T-50 fifth generation fighter aircraft (FGFA) by Indian Air Force test pilots. "Flight-testing will help decide the way forward on the collaboration between the two countries on the FGFA. All options, ranging from an off-the-shelf purchase of 60-65 jets to joint production, are on the table", according to MoD officials.

This request is timed with Prime Minister Narendra Modi's planned official visit to Russia in December 2015 but the Indo-Russian Inter Governmental Agreement for the FGFA was subject of protocol between the two Governments eight years back in 2007. Initially, the IAF's requirement was stated as 166 single-seat and 48 twin-seat FGFA's but this was later reduced to 127 and is now half of that number.

## Successful 'hot and high' trials for HAL LCH

'Hot and the high' flight trials for HAL's Light Combat Helicopter (LCH) were successfully completed at Leh during September 2015. Cold-weather trials had earlier been completed in February 2015. The flight trials at Leh established hover performance and low speed handling characteristics of the helicopter under extreme weather conditions at varying altitudes (3,200 to 4,800 metres). These were carried out with the third LCH prototype (TD3), with temperatures ranging from 13 to 27°C, and included participation of pilots from the Air Force and Army, along with representatives from CEMILAC and DGAQA. The various tests, including assessment and validation of the flight envelope in 'hot and high' conditions, culminated in landing at forward bases at geographic elevations of 13,600 feet to 15,800 feet. The LCH also proved its ability to land and take off at forward bases making this the first attack helicopter to operate from the Siachen Glacier area. These operations were demonstrated with realistic weapon and fuel loads.



With extensive trials now carried out on the three LCH prototypes, including sea level at Chennai in November 2013, cold weather at Leh during January/February 2015, hot weather at Jodhpur in July 2015 and now hot and high trials at Leh, the performance and handling qualities of the helicopter have been established in its basic configuration: with electro-optical turret, rocket launchers, turret gun and air-to-air missile launchers. System functionality has been assessed and found satisfactory during the trials and long-duration ferry flights across India. Further development activities are underway and live weapon firing trials are planned for mid-2016.

## Mini drones for IAF Garuds

Defence Ministry sources have indicated that the IAF's Garud Commando force, trained to target high value enemy assets such as radar and aircraft, will be equipped with new man-portable drones with an over 5-km range, for surveillance of airbases, counter terrorism and covert operations. With an operational endurance of over 30 minutes, the lightweight drones have an additional feature of FLIR (forward looking infra-red) payloads.

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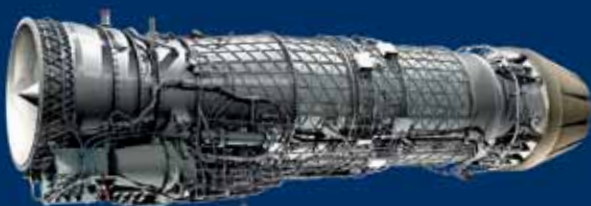
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## Honeywell F125IN engines for IAF Jaguars ?



(Photo : Simon Watson)

Defence sources have indicated that the process of upgrading IAF Jaguars has progressed following the decision to power these fighter aircraft with the Honeywell-built F125IN engines in place of Rolls Royce Turbomeca Adour engines. Some hurdles related to offset clauses involving Honeywell have also since been removed to facilitate progress in upgradation. “Powering the Jaguars with this new engine will result in increased payload and improved manoeuvrability”.

Plans to re-equip Jaguars with new engines have been under consideration since 2010 and it has assumed a serious dimension in the content of the dwindling fighter aircraft strength of the IAF and delays in acquisition of adequate replacements. At present, six IAF squadrons – Nos. 5, 6, 14, 16, 27 and 224 – are equipped with Jaguars. Over the years, IAF Jaguars have undergone modifications, receiving new generation navigation and attack avionics, newer weapon systems and precision munitions.

## Samtel/Thales MFDs on upgraded IAF Mirage 2000s

The IAF’s upgraded Mirage 2000I/TI fighter aircraft will be equipped with Indian-made multi-function displays (MFDs), as part of a programme to enhance the operational life of multi-



Upgraded IAF Mirage 2000(I) (photo: Dassault Aviation - V Almansa)

role fighters. Samtel-Thales Avionics Ltd (STAL), a joint venture between Samtel Avionics and French firm Thales, has successfully dispatched the first batch of multi-function displays for Mirage 2000 upgrade programme of the Indian Air Force from its newly-commissioned production facility in Greater Noida.

The Mirage 2000 upgrade include a night vision goggle-compatible glass cockpit, advanced navigational systems, advanced Identification Friend or Foe (IFF) system, advanced multi-mode multi-layered radar, fully integrated electronic warfare suite besides others. It also includes a new firing system for MBDA MICA missiles.

## Indian JV partner for Ka-226T production

Russian Helicopters is reportedly considering a number of Indian companies, both private and public sector firms, from which to select a partner for licence-manufacturing the Kamov-226T light helicopter in India. Prospective partners include Hindustan Aeronautics and Anil Ambani’s Reliance Defence and Aerospace (RDA).



A team of executives from Russian Helicopters are to visit India for evaluation of the shortlisted Indian corporations before finalising plants. The Russian government hopes to sign an inter-governmental agreement (IGA) with India when Prime Minister Narendra Modi visits Russia later this year for his annual summit meeting with Russia’s president, Vladimir Putin.

## Night flying capability for helicopters

The IAF is planning to carry out helicopter missions at night to helipads located in remote hilly areas and to facilitate this the IAF will procure at least 50 sets of helipad lighting systems compatible with night vision goggles used by aircrew. These can be used for both permanent helipads as well as temporary landing zones as required during military operations or missions in aid of civilian



authorities. The IAF's RFI describes helipad lighting systems capable of functioning in  $-40^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ , catering for frigid mountain conditions as well as high desert temperatures.

The ability to fly to remote areas by day and night assumes significance against the backdrop of acquisition of more capable helicopters, including the Russian Mil Mi-17V5, proposed procurement of US CH-47 Chinook heavy-lift helicopters and Kamov Ka-226T light utility helicopters.

## Walong ALG upgraded

According to MoD sources, the advance landing ground (ALG) at Walong in Arunachal Pradesh is now fully upgraded, paved and connected with the Indian Air Force's data network. Aircraft such as the C-130J Super Hercules, C-17 Globemaster III and Antonov An-32 could operate from there, allowing for rapid movement of troops, artillery, armoured vehicles and tanks. Four more ALGs in Arunachal Pradesh, at Ziro, Mechuka, Passighat and Along, are being also being upgraded and are expected to begin operating toward the end of this year. These ALGs are considered vital in the context of rapid deployment by the Army in close proximity to the McMahon Line along the India-China border.

## Tata, L&T compete to upgrade IAF depots

Major private sector firms such as Tata and L&T have responded to an Indian Air Force Request For Information (RFI) to upgrade base repair depots (BRDs) under the IAF's Maintenance Command. The plan was to involve private companies to upgrade the depots, which undertake maintenance of aircraft and other defence hardware. Under an earlier plan, responses were supposed to be opened in July, but the process was suspended to amend the terms of contract implementation. The IAF is expected to release a revised proposal within 3-4 months. The contract, which the Air Force would reportedly prefer to sign with a single firm, is understood to be worth around Rs 400 crore.

## Indian and Chinese border meeting



A ceremonial Border Personnel Meeting (BPM) took place in the AChushul sector of Eastern Ladakh on 1 August 2015 to mark People's Liberation Army (PLA) Day. The delegations were led by Brigadier JKS Virk, SM and Senior Colonel Chen Zheng Shan (in picture). Another meeting, hailed as a milestone in India-China relations, saw the PLA hosting an Indian Army delegation for the first time in the area of Daulat Beg Oldie. The Indian team was led by Col BS Uppal, while the PLA Delegation was led by Colonel Song Zhoanli.

## Exercise 'Yudh Abhyas' 2015

The annual India-US combined military training exercise *Yudh Abhyas* was conducted between 9 to 23 September 2015 at Joint Base Lewis-McChord, in Washington, USA. The exercise had troops of the 6<sup>th</sup> Kumaon Regiment and a Formation Headquarters of Indian Army deploy to the USA for two weeks, to carry out joint training with their US Army counterparts from 1-2 Stryker Brigade Combat Team, 7th Infantry Division. This was the eleventh exercise in the *Yudh Abhyas* series, which began in 2004 under the US Army Pacific.



Indian and US soldiers training together during the exercise  
(photos: US Army)

The exercise provided an ideal platform for the personnel of the two countries to share their experiences on Military Operations in Urban Terrain (MOUT), under the UN mandate. A concluding Consolidation and Validation Exercise, witnessed by senior officers and observers from both Armies, had troops of both nations will carry out sub-unit level operations in MOUT and urban insurgency scenarios.

## Indian Navy warships visit Iran, UAE

“A goodwill visit to strengthen bilateral relations between India and Iran” had two Indian Navy frigates, INS *Betwa* and INS *Beas* make a five-day visit to Bandar-e-Abbas port in August 2015. During their stay the ships undertook various professional interactions with their counterparts in the Iranian Navy, including exercises at sea.



File photo of INS Betwa (photo: Angad Singh)

In September, Western Fleet ships INS *Deepak*, *Delhi*, *Tabar* and *Trishul* made a four-day visit to Dubai as part of a long-range deployment to the Persian Gulf to enhance bilateral ties and improve co-operation in areas such as naval operations, disaster management and combating maritime terrorism and piracy.

## Indo-Australian Navy Exercise AUSINDEX-15

The first bilateral maritime exercise between India and Australia, AUSINDEX-15, was conducted off the eastern coast of India from 11 to 19 September. The exercise was inaugurated by Rear Admiral Jonathan Mead, Head Navy Capability Royal Australian Navy (RAN) and Rear Admiral Ajendra Bahadur Singh, FOC Eastern Fleet, on board INS *Shivalik* at Visakhapatnam.



HMAS *Sheean* and HMAS *Sirius* with INS *Shivalik* during AUSINDEX-15 (RAN photo)

“AUSINDEX is a tangible example of the defence co-operation between the two countries as envisaged in the Framework for Security Co-operation announced by the Australian and Indian

Prime Ministers in 2014”. The week-long exercise involved RAN fleet tanker HMAS *Sirius*, *Anzac*-class frigate HMAS *Arunta*, and *Collins*-class submarine HMAS *Sheean*. The Indian Navy was represented by the guided missile frigate INS *Shivalik*, guided missile destroyer INS *Ranvijay* and fleet tanker INS *Shakti*. One RAAF Lockheed AP-3C Orion maritime surveillance aircraft and Indian Navy Boeing P-8Is operated from Chennai during the exercise, which began with a harbour phase before transitioning to the sea phase, which included fleet manoeuvres, weapon firing as well as coordinated anti-submarine warfare (ASW) exercises.

## “South Australian defence industry to benefit from Indian industry”



The South Australian Government has signed an agreement with the Confederation of Indian Industry, which will foster closer economic ties and defence industry investment opportunities. South Australian Minister for Investment and Trade Martin Hamilton-Smith signed the Memorandum of Understanding during the State’s largest trade delegation to Bangalore, Delhi, Jaipur and Mumbai in August.

In 2014, the Australian and Indian Governments established a new *Framework for Security Cooperation* and this has paved the way for South Australia’s defence industry to engage with India’s. Hamilton-Smith was supported on the trade mission by Sir Angus Houston, South Australia’s Special Envoy - Trade and Investment, and the Defence Teaming Centre Chief Executive Officer Chris Burns.

## INS *Trikand* in Exercise ‘Konkan 2015’

This year the IN was represented at the joint exercise with the Royal Navy, *Konkan 2015*, by the *Talwar*-class guided missile frigate INS *Trikand*, which deployed with an integral helicopter and a team of marine commandos. RN vessels included Type 23 guided missile frigate HMS *Iron Duke*, an auxiliary vessel, a nuclear



INS Trikand entering Devonport harbour (photo: Brian Burnell)

submarine and various shore-based assets. The exercise, based out of Devonport, was conducted between 5-11 September, before which *Trikand* made port calls at Djibouti, Haifa and Valencia en route to the UK. After the exercise, the vessel sailed to London for the DSEI trade show (see next issue) before heading back to India on 18 September.

## Israeli Navy Chief in India



Vice Admiral Ram Rutberg, Commander-in-Chief of the Israeli Navy made an official visit to India from 24 to 27 August 2015. He was received by Admiral RK Dhowan at South Block, and the two then had discussions to explore avenues for greater cooperation between the two navies. Vice Admiral Ram Rutberg also met COAS Gen Dalbir Singh and CAS Air Chief Marshal Arup Raha, in addition to other MoD officials.

Admiral Rutberg also went to Mumbai and Kochi to visit various Indian Navy ships and shore establishments.

## INS Vajrakosh commissioned

Defence Minister Manohar Parrikar commissioned INS *Vajrakosh*, the third and newest Indian Navy establishment at the Service's sprawling Karwar base in Karnataka. INS *Vajrakosh*



The Defence Minister seen with Admiral Dhowan and Vice Admiral SPS Cheema, FOC-in-C, Western Naval Command, during the commissioning ceremony

is a specialised storage and service facility for naval armament and will support all air and sea units operating from Karwar which has emerged as the Indian Navy's premier Western base and will eventually be the largest naval facility east of the Suez. Admiral RK Dhowan, CNS noted that Karwar hosts some of the most significant naval assets in service or under induction, and will allow the Indian Navy to further bolster the offensive and defensive capabilities of its platforms.

The commissioning ceremony was marked by a parade, after which Captain Arvind Chari, Commanding Officer, read out the Commissioning Warrant and the Naval ensign was hoisted. Defence Minister Parrikar emphasised the importance of a potent navy for a maritime nation such as India, and exhorted the crew to ensure that the "missiles in *Vajrakosh* remain ever ready for operational deployment."

## CSL launches 17th FPV for CG

Cochin Shipyard has launched the seventeenth of 20 Fast Patrol Vessels being built for the Indian Coast Guard. The vessel, named ICGS *Arush*, was launched by Jyothi Devanand, wife of DIG G Devanand, Coast Guard Refit and Production Superintendent in a ceremony at Cochin Shipyard. Cmde K Subramaniam, CMD,



CSL, DIG MV Pathak, Commander District IV, Capt RS Sundar, Director (Operations) CSL, D Paul Ranjan, Director (Finance), CSL, and other senior officials of CSL and ICG were present on the occasion.

Meanwhile, CSL delivered the fourteenth of twenty Fast Patrol Vessels under construction for the Indian Coast Guard, just under two months ahead of schedule in July 2015. Fourteen FPVs out of the contracted 20 have been delivered to the Indian Coast Guard, the 17th vessel has been launched and keel of the 18th has been laid. Cochin Shipyard has delivered 13 ships in a span of 20 months, with an average delivery interval of 1.6 months, which compares favourably against the contractual requirement of 3-month intervals. The last vessel of the order was to be delivered by March 2017 but with the current pace of construction, Cochin Shipyard is targeting completion of deliveries by mid-2016, well ahead of schedule.

## Eastern Air Command Commanders' Conference



A two-day Eastern Air Command Commanders' Conference commenced on 12 August 2015 at Shillong, with Air Chief Marshal Arup Raha updating the Commanders on the security scenario with special reference to the North Eastern region. He also stressed on "the importance of leadership, teambuilding and discipline, which are pivotal in achieving operational goals".

During the conference, the Air Chief Marshal awarded Trophies to Commanders for achieving excellence in the fields of Operations, Maintenance and Administration. Air Force Station Chabua was awarded the 'Pride of EAC' trophy for overall performance while Air Force Station Dinjan was awarded the 'Best Non-Flying Station' trophy.

## Defence Minister launches IAF- HAL ePortal

Defence Minister Manohar Parrikar launched the IAF-HAL ePortal at HAL's Corporate Office in Bangalore on 6 September 2015. This is the first Inter-Organisation Information Sharing System (IOIS) between a defence service organisation and a defence PSU, and is taking place under the 'Digital India' initiative. Air Marshal SBP Sinha, Deputy Chief of Air Staff, Dr G Satheesh



Defence Minister Manohar Parrikar launching the HAL-IAF ePortal at HAL's Corporate Office, Bengaluru, seen with T Suvarna Raju, CMD, HAL, Air Marshal SBP Sinha, DCAS, and Dr G Satheesh Reddy, SA to RM.

Reddy, SA to RM, T Suvarna Raju, CMD, HAL and other senior officials were present on the occasion.

Defence Minister Parrikar said that he hoped the e-portal would synergise the competencies of Indian Air Force and HAL, noting that the portal provides authentic information to the stakeholders involved, saves considerable time and eliminates the need for frequent joint meetings at various levels. HAL's Chairman, T Suvarna Raju said that the customer centric portal would go a long way in leveraging the benefits of information sharing in real time, and would provide information on status of supply of required parts. Air Marshal Sinha was confident that "the e-portal would facilitate secure information sharing between the IAF and HAL for better coordination, improved transparency and faster decision making."

## Air Chief visits Thailand and Vietnam

The IAF CAS Air Chief Marshal Arup Raha made a four-day visit to Thailand and Vietnam in September 2015. The Indian Air Chief first visited Thailand, where he met the Commander-in-Chief of the Royal Thai Air Force and called on the Deputy Defence Minister of Thailand, General Udomdej Sitabutr. On the second leg of his visit, the Air Chief held discussions with the Chief of General Staff (CGS) of the Vietnam People's Army. He also met with the Chief of the Vietnam People's Air Force and called on the Vietnamese Minister of Defence.

In recent years, there have been close and frequent contacts at political and military levels with both Thailand and Vietnam. Air Chief Marshal Raha's visit to Thailand and Vietnam was intended "to boost bilateral relations between the Armed Forces of the two countries and is likely to provide greater convergence at the operational level".

## Vistara signs V2500 V- Services agreement

Vistara, the Tata-SIA JV airline, has signed a V-Services agreement to maintain its fleet of 26 V2500 engines. The V2500 engine is offered through IAE International Aero Engines



AG, a multinational aero engine consortium whose shareholders comprise Pratt & Whitney, Pratt & Whitney Aero Engines International GmbH, Japanese Aero Engines Corporation and MTU Aero Engines.

“Since our operational launch, we have been able to achieve on-time performance (OTP) in excess of 90 percent and we want to consistently maintain that superior level of service for our customers,” said Phee Teik Yeoh, CEO Vistara. “We needed a reliable and effective maintenance partner and we are confident that the V-Services agreement with Pratt & Whitney will help us minimise unscheduled removals of engines and provide the highest standards of safety.”

## Turbo Megha Airways launched

Hyderabad-based Turbo Megha Airways has become the fourth company to launch a regional airline in the past two years. The company will operate under the brand name *Trujet*. Director General of Civil Aviation M Sathiyavathi handed over the Air Operator Permit (AOP) to Turbo Megha’s managing director, V Umesh, in the presence of Civil Aviation Minister Gajapathi Raju.

Umesh said that the new carrier has already acquired two 72-seat ATR-72s and is to induct three more by January next year. Trujet will operate regional air services to Rajamundry, Bengaluru and Chennai from its Hyderabad base.



## Pratt & Whitney opens Customer Training Centre



Palash Roy Chowdhury, Country Manager – India, Pratt & Whitney along with Union Minister for Civil Aviation Ashok Gajapathi Pusapati Raju at the Customer Training Centre at Hyderabad.

Pratt & Whitney, a United Technologies Corporation company, opened its India customer training centre in Hyderabad on 10 September 2015. The centre will be housed at UTC India, and will train aircraft engineers and technicians on current and new engine models. Over 300 aircraft in India are powered either by Pratt & Whitney or IAE aero engines, with this number set to rise as the new PurePower family of geared turbofan (GTF) engines enters service with airlines such as IndiGo, GoAir and Air Costa.

The customer training centre will provide key training for GTF and V2500 engine customers, beginning with a capacity of training the equivalent of 2,000 students attending a one-week class per year, with growth capability of up to 4,000 students per year. Building on Pratt & Whitney’s training facilities in East Hartford and Beijing, this third centre in Hyderabad will satisfy training demand in the fast growing Indian market.

## Boeing forecasts demand for 1,740 new aircraft in India



Dr Dinesh Keskar, Senior Vice President, Asia Pacific & India Sales for Boeing Commercial Airplanes and Dr Pratyush Kumar, President, Boeing India at a press briefing on ‘Current Market Outlook 2015 for India’ in New Delhi.

Boeing has projected a demand for 1,740 new airliners in India, valued at \$240 billion, over the next 20 years. The company released its annual India Current Market Outlook (CMO) on 12 August in Delhi. The largest demand from airlines in India will be for single-aisle airplanes such as the Next-Generation 737 and new 737 MAX, while demand for twin-aisle aircraft, such as the 777 and 787 Dreamliner families will also continue. The number of low cost carriers is projected to grow to more than 30 percent of the total Indian market.

## IndiGo confirms order for 250 Airbus A320neo



India's largest domestic airline by market share, IndiGo, has firming its commitment from last year and ordered 250 A320neo family aircraft, the largest single order Airbus aircraft in history. This agreement was signed on 15 August 2015. IndiGo initially placed an order in 2005 for 100 A320s, which have all now been delivered. In 2011, IndiGo became the first Indian operator to commit to the A320neo bringing their total to 280 Airbus aircraft, and with the latest order, IndiGo has a total of 530 A320 family aircraft in service or on order.

## Spicejet to augment fleet

Even as Spicejet has turned around its financial situation with two consecutive quarters of profit, its CEO Mr Ajay Singh has indicated that apart from discussions with Boeing and Airbus for a substantial order of single-aisle jetliners, the airline plans to order a large number of turboprop airliners. Spicejet currently operates a fleet of 14 Bombardier Q400s on regional routes which have generated satisfactory returns.



## International airport at Chandigarh

The newly inaugurated international airport at Chandigarh is yet to receive its name, since many options are being suggested and a final decision has not been taken. The government of Punjab wants to name it *Shaheed-E-Azam Sardar Bhagat Singh International Airport Mohali-Chandigarh*, which name was accepted in a state assembly resolution passed in 2009 and conveyed to Ministry of Civil Aviation. The government of Haryana, however, is in favour of a name acceptable to both governments with only *Chandigarh* as its suffix.

## FIA against removal of 5/20 rule

On 25 August 2015, in a presentation made to Prime Minister Narendra Modi, it was proposed that the current rule stipulating that an Indian airline must be at least 5 years old and have at least 20 aircraft on strength to be qualified to operate international flights, should be removed. However, the Federation of Indian Airlines (FIA) with IndiGo, SpiceJet and GoAir as members, has opposed this move with the plea that it would not provide a "level playing field" in Indian civil aviation and would be tantamount to favouring domestic operators controlled by foreign airlines.

## Cochin airport to operate on solar power

Cochin International Airport, the country's first airport built under a Public-Private Partnership (PPP) model has made aviation history by becoming the first airport in the world to completely operate on solar power. Kerala's Chief Minister Oommen Chandy inaugurated the airport's 12 MW solar power plant on 18 August 2015, this comprising 46,150 solar panels laid across 45 acres near the cargo complex. Cochin airport will consume 50,000 to 60,000 units of electricity per day while remaining 'power neutral.'

This solar power initiative has so far saved more than 550MT of carbon dioxide emissions, therefore minimising the airport's environmental impact. Over the next 25 years, the airport will save the equivalent of 300,000 metric tonnes of carbon dioxide emissions, an effect that would be equivalent to planting 3 million trees.



### BEL establishes Integrated Test Bed

Bharat Electronics Ltd (BEL) has established an Integrated Test Bed facility at its Bengaluru Complex for Missile and Weapon Systems Integration. The facility was inaugurated by Manmohan



Manmohan Handa inaugurating the Integrated Test Bed Facility at BEL-Bengaluru

Handa, Director (Bangalore Complex), at a ceremony held on 21 August 2015. The Integrated Test Bed Facility is first of its kind in India for testing and integration of missile and weapon systems. Spread over an area of 14 acres, consisting of nine concrete hard stands, strategically positioned to verify various interfaces between the combat elements of missile systems under complex threat conditions, including ECCM scenarios, all elements are interfaced either in 'Line mode' or 'Radio mode.' The test bed will be utilised for calibration of navigational equipment fitted in Radars and Launchers, Radar calibration and compensation of bias between target and missile channels.

### BEL wins PSU award

Defence PSU Bharat Electronics Ltd (BEL) has been chosen as the top Indian company in the Electrical & Electronic Equipment sector in the Dun & Bradstreet 'India's Top PSUs Awards 2015.' SK Sharma, Chairman & Managing Director, BEL,



SK Sharma, CMD, BEL, receiving the Dun & Bradstreet Top PSU Award 2015 for BEL from RM Malla, Chairman, Smera Ratings Limited.

received the award for BEL along with Anandi Ramalingam, GM (National Marketing), BEL, from RM Malla, Chairman, Smera Ratings Limited, at the awards ceremony held at New Delhi on 23 July 2015.

The Dun & Bradstreet 'India's Top PSUs Awards are an acknowledgement of the critical role that the PSUs play in the development of the Indian economy.

### CAS inaugurates BEL test range



Air Chief Marshal Arup Raha inaugurated the Electro-Magnetic Interference (EMI) – Electro-Magnetic Compatibility (EMC) test facility and Near Field Test Range (NFTR) at Bharat Electronics Limited (BEL), Ghaziabad on 21 September. The Air Chief was given a brief presentation on BEL which was followed by an address by Mr. SK Sharma, Chairman & Managing Director of Bharat Electronics Limited.

Setting up of these state-of-the-art testing facilities is a part of the transformation process of BEL into a major R&D and manufacturing centre of excellence in the critical field of electronic systems in the country for the armed forces. "This will give fillip in developing and manufacturing products of superior performance and reliability with capability to operate in dense electro magnetic environment in the battlefield".

### GSLV launch puts GSAT-6 into orbit

In its ninth flight (GSLV-D6) conducted on 27 August 2015, ISRO's Geosynchronous Satellite Launch Vehicle, equipped with the indigenous Cryogenic Upper Stage (CUS), successfully launched GSAT-6, the country's most recent communication satellite, into a Geosynchronous Transfer Orbit (GTO). The launch took place from the Second Launch Pad at the Satish Dhawan Space Centre, Sriharikota, "the spaceport of India." This was the fifth developmental flight of GSLV and the third to carry the indigenous CUS, GSLV-D6 being intended to further test and qualify the CUS developed by ISRO. The GSAT-6 satellite is now



orbiting the Earth with a perigee (nearest point to Earth) of 168 km and an apogee (farthest point from Earth) of 35,939 km with an orbital inclination of 20.01 degrees with respect to the equator. Soon after its injection into GTO, the two solar arrays of GSAT-6 were automatically deployed and the Master Control Facility (MCF) at Hassan in Karnataka took control of GSAT-6 shortly after it entered its orbit.

### IAF marks 50<sup>th</sup> anniversary of 1965 air war



*IAF Su-30MKIs carry out a 'Missing Man' flypast over Rajpath on 20 September, during the 'Indradhanush' carnival held to commemorate 50 years of the 1965 India-Pakistan War (IAF photo).*

## Appointments

### Ashwani Lohani appointed CMD of Air India

The Appointments Committee of Cabinet has approved Ashwani Lohani as Chairman and Managing Director of Air India. A 1980 batch officer of the Indian Railways Service of Mechanical Engineers and a fellow of the Chartered Institute of Logistics and Transport, he is the first non-IAS officer to head Air India, succeeding Rohit Nandan.



As CMD, Lohani faces the challenge of sustaining Air India, which has consistently struggled to turn a profit and has required repeated capital infusions from the central government. Lohani's success and administrative experience as Chief Administrative Officer at the Indian Railways Organisation for Alternate Fuels Division, as Chief Mechanical Engineer at Northern Railways, and as former head of the Madhya Pradesh Tourism Development Corporation have earned him the sobriquet 'Mr Turnaround' and his selection to head Air India is clearly intended to benefit from this.

### Lt Gen MMS Rai is VCOAS

Lt Gen MMS Rai took over as Vice Chief of Army Staff (VCOAS) from Lt Gen Philip Campose on 1 August 2015. Lt Gen MMS Rai was commissioned into the Corps of Engineers (Bombay Sappers) on 15 December 1976 and joined an Armoured Engineer Regiment. He is a third generation officer in the Indian Army and has held varied staff and instructional appointments and attended various prestigious Army



courses including the Defence Services Staff College Course at Wellington and Higher Command Course at Mhow. He has commanded an Armoured Engineer Regiment, a Mountain Brigade in the North East, a Counter Insurgency Force in the most volatile and highly militancy-infested region of J&K and a Desert Corps.



### Lt Gen Praveen Bakshi is GOC-in-C Eastern Command

Lt Gen Praveen Bakshi took over as the 25th General Officer Commanding-in-Chief of the Eastern Command in Kolkata on 1 August 2015. He succeeds Lt Gen MMS Rai, who took over as the Vice Chief of Army Staff in the Army Headquarters at New Delhi.

An alumnus of the National Defence Academy, Lt Gen Praveen Bakshi was commissioned into the 1st (Skinner's) Horse and has commanded an Armoured Brigade in the Western Sector, a Division in the desert sector and a Corps in the Punjab. Prior to his appointment as Eastern Army Commander, he was Chief of Staff of Northern Command at Udhampur.



### Lt Gen PM Hariz takes over ARTRAC

Lt Gen PM Hariz has taken over as GOC-in-C of the Army Training Command (ARTRAC). He was commissioned in June 1978 into the Mechanised Infantry Regiment, originally 16 Mahar (Para). The General Officer is a graduate of Staff College at Camberley, UK and has attended Higher Command Course at Mhow and National Defence College, New Delhi.

Important appointments held by him include commanding a Mechanised Infantry (Reconnaissance & Surveillance) Battalion on the Western borders, an Infantry Brigade where he was involved in the transformation of the Brigade as an Amphibious Brigade, a Sub Area and a RAPID Division. Lt Gen Hariz has also served as Additional Directorate General of Mechanised Forces and has been a Military Observer in UN (Mission) at Angola.



### Lt Gen Gurdeep Singh is COS Western Command

Lt Gen Gurdeep Singh has taken over as Chief of Staff, Western Command from Lt Gen Venugopal Menon. Commissioned into the Kumaon Regiment in June 1977, Lt Gen Gurdeep Singh is an alumnus of National Defence Academy and Indian Military Academy. The General Officer has a distinguished career spanning more than 38 years during which he had various command, staff and instructional appointments in Western, Eastern and Northern

Commands. He has commanded an Infantry Battalion in J&K including the Siachen Glacier, besides an Infantry Brigade and Infantry Division, with varied operational roles in J&K.

Lt Gen Gurdeep Singh served as a Directing Staff at the IMA Dehra Dun and Defence Services Staff College, Wellington. The General Officer was Commandant, Infantry School, Mhow prior to taking over his present appointment.



### Lt Gen NPS Hira is COS Northern Command

Lt Gen Narinder Pal Singh Hira took over as Chief of Staff of Northern Command on 25 August 2015. Commissioned into the Sikh Light Infantry in 1978, the General Officer has experience in tackling counter insurgency both in J&K and the North East. He commanded an Infantry Battalion in Assam, Brigade in Uri, Division in Akhnoor and Corps in Jalandhar. Apart from holding many instructional and staff appointments in schools of Instruction.



### Air Marshal SB DEO AOC-in-C Western Air Command



Air Marshal SB Deo took over as AOC-in-C of Western Air Command on 1 September 2015. Commissioned into the fighter stream on 15 June 1979, the Air Marshal has more than 4000 hours of operational and training flying and has been a Fighter Combat Leader, A2 qualified instructor and Directing Staff at TACDE.

Air Marshal SB Deo was Chief Operations Officer of a frontline forward base and commanded Air Force Station Jodhpur. Prior to taking over as the AOC-in-C WAC, he was Director General Air Operations at Air Headquarters and AOC-in-C of Eastern Air Command.

## Air Marshal C Hari Kumar is AOC-in-C EAC

Air Marshal C Hari Kumar took over as the Air Officer Commanding-in-Chief of Eastern Air Command on 1 September 2015. A Fighter Combat Leader and Qualified Flying Instructor, Air Marshal C Hari Kumar was commissioned in the Fighter Stream on 14 December 1979 and has held various important field and staff appointments during his service career spanning over 36 years. Prior to taking over as AOC-in-C Eastern Air Command, he was Senior Air Staff Officer, South Western Air Command.



## Air Marshal S Harpal Singh appointed SASO, HQ South Western Air Command

Air Marshal S Harpal Singh has taken over as Senior Air Staff Officer South Western Air Command, IAF on 1 September 2015. Commissioned in the fighter stream of Indian Air Force on 15 June 1980, Air Marshal S Harpal Singh has over 2400 hrs of flying on various



aircraft and has commanded a fighter squadron, was the Chief Operations Officer of a major fighter base in the western sector, commanded a radar base and was Air Officer Commanding of a major Fighter Station in the Eastern sector. He has served in various staff appointments at Air HQ and in Tri Services organisations.

## Vice Admiral AR Karve is Chief of Personnel, Indian Navy

Vice Admiral AR Karve assumed charge as the Chief of Personnel at Naval Headquarters on 25 August 2015. An alumnus of the National Defence Academy, he was commissioned into the Indian Navy on 1 July 1980. After his initial sea appointments, he completed his specialisation in anti-submarine warfare in 1986 and has served onboard various frontline fleet ships. He has been the commissioning crew of INS *Viraat* (ex-HMS *Hermes*, the aircraft carrier which he subsequently commanded) and has undergone training at UK. During his 35 years of service he has held various important operational and staff appointments, both ashore and afloat.



## MS Easwaran appointed Director CABS

MS Easwaran has been appointed as Director of the Centre for Air Borne Systems (CABS) under DRDO, and assumed charge on 16 July 2015. Mr Easwaran had been officiating as Director of CABS after the former Director Dr Christopher had been elevated as Secretary, Defence R&D and Director General DRDO.

An MSc in Physics and Electronics from University of Delhi and M Tech in Electrical Engineering from IIT Delhi, M S Easwaran joined DRDO as a Scientist in Electronics and Radar Development Establishment (LRDE). He was part of the team developing the first technology demonstrator phased array based multi mode radar and contributed to several radar projects such as Akash, radar for Light Combat Aircraft (LCA), maritime patrol radar and others and also worked as a member of G-FAST for some years. He joined the Centre for Air Borne Systems (CABS) in 2004 and was also the Associate Programme Director for the Airborne Early Warning and Control (AEW&C) Programme.



### MZ Siddique appointed Director GTRE

MZ Siddique, Project Director (Kaveri) has been appointed as Director, Gas Turbine Research Establishment (GTRE), under DRDO, Bangalore on 11 August 2015. A Mechanical Engineer, MZ Siddique joined the GTRE, Bangalore as Scientist 'B' in 1988 after completion of one year fellowship programme on 'Gas Turbine Technology' from Institute of Armament Technology (IAT), Pune in 1988. Subsequently he had on-the-job training at General Electric, USA on aero gas turbine engines. MZ Siddique was also associated with the design and testing of axial flow compressor systems. Under his leadership the airborne testing of Kaveri engine was conducted in Russia.



Manjula is an alumnus of Osmania University and joined DRDO in 1987 and was with the Defence Electronics Research Laboratory (DLRL) in Hyderabad for more than 26 years, working on Integrated Electronic Warfare. She has designed and realised fast signal acquisition receivers, high power RF systems, responsive jammers, and other such systems for various military and paramilitary requirements. Her specialisations include configuration of communication and radar ESM and ECM systems, and she is a recipient of the DRDO award for 'Performance Excellence' and 'Scientist of the Year,' the latter awarded to her in 2011. She is also the recipient of *India Today's* Woman Summit award for 2014.

### INS Kochi commissioned

INS *Kochi*, the second Kolkata class destroyer, was commissioned by Defence Minister Manohar Parrikar at the Naval Dockyard in Mumbai on 30 September. The first vessel of this class, INS *Kolkata*, was commissioned in August last year, while the third INS *Chennai* will be inducted towards end-2016.



### First woman DG for DRDO

Ms J Manjula has been appointed Director General of the Electronics & Communication Systems cluster at the Defence Research & Development Organisation (DRDO), making her the first woman Director General of a DRDO cluster. She has been heading the Defence Avionics Research Establishment (DARE) as a Director since July 2014.



### STOP PRESS

### India orders 22 Apache and 15 Chinook helicopters

The Indian Ministry of Defence has finalised its order with Boeing for production, training and support of Apache and Chinook helicopters: India will receive 22 AH-64E Apache attack helicopters and 15 CH-47F Chinook heavy-lift helicopters. Both are the newest models of those aircraft. "This is a milestone in Boeing's expanding commitment to India," said Pratyush Kumar, President, Boeing India. "This acquisition enhances the Indian Air Force's capabilities and offers us an opportunity to further accelerate 'Make in India.' Large sections of the Chinook fuselage are already manufactured in India and discussions are ongoing with our Indian partners to make Apache parts."

The Apache is the world's leading multi-role attack helicopter. The AH-64E Apache, the most modern variant also flown by the

US Army and the CH-47F Chinook is an advanced multi-mission helicopter operated by the US Army and 18 other defence forces. India is the 14<sup>th</sup> nation to select the Apache and the 19<sup>th</sup> nation to select the Chinook. "The Apache and Chinook represent the best of high-performing technologies that will modernise India's defence capabilities," said Dennis Swanson, Vice President, Defence, Space & Security in India. "We look forward to delivering the newest Apache and Chinook to our customers and remain focused on delivering on its commitments to the Indian Air Force and India's Ministry of Defence."



Computer generated image of the CH-47F Chinook and AH-64E Apache

# VAYU Exclusive Interview with

## Air Chief Marshal

# Arup Raha

**VAYU** : Since your last interview with Vayu, much has changed for the IAF, for India and our regional security scenario. Which are the areas where you would like to priorities over the next decade, with ageing MiG-21 and MiG-27s having to be withdrawn without any replacement either identified or procured?

**CAS**: IAF is a technology-intensive organisation and skill development is a long drawn process. Our major challenge has always been to synchronise these two for optimum results. As a result of our critical self-analysis we, as an organisation, are focusing on processes rather than events. Our operational capability is dependent on five verticals namely equipment, training, infrastructure, procedures and force application, based on knowledge and in-depth analysis. Our capability at any instance is governed by the vertical least developed. Therefore, our endeavour is to keep all verticals moving up in sync. We are aggressively pursuing our acquisitions and simultaneously changing training philosophy and operational procedures to exploit our equipment profile fully. While infrastructure is being developed on ground to assist aerospace operations, minds are being trained for holistic capability development.

**VAYU** : The MMRCA tender stands formally withdrawn and there has been little movement since PM Modi's April announcement on the direct purchase of 36 'flyaway' Rafale fighters from France. Can you kindly comment on the status of this programme? Our belief is that at least twice that number of such fighters are required for a credible force level?

**CAS**: The contract negotiations for the 126 MMRCA had reached a stalemate and the process was not making any headway for almost two years. Realising the critical operational necessity of fighter aircraft in the IAF and likelihood of further delays in concluding the MMRCA contract negotiations, the Government of India



decided to procure 36 Rafale aircraft from France through an inter-government route. The negotiations for the procurement of 36 Rafale aircraft from France are presently in progress. The requirement of fighter aircraft for the IAF is known to the Government and it would take a decision on induction of additional fighter aircraft in due course.

**VAYU** : The Fifth Generation Fighter Aircraft (FGFA) programme appears to be facing headwinds with issues regarding Indian workshare and the overall technical/ operational aspects of the Russian prototypes (Sukhoi T-50). With Russia itself having reduced its procurement purchase to a single test and evaluation squadron, what are the IAF's revised plans for procurement of this next generation fighter?

**CAS**: The Inter-Governmental Agreement (IGA) for development and production of FGFA was signed on 18 October 2007 between India and Russia. The IGA had envisaged equal participation

and funding by Indian and Russian sides in this project. There are certain issues involving technical features, cost and delivery timelines, which are being addressed at the highest level.

**VAYU** : Following from the previous question, is the IAF considering additional Su-30MKIs orders to bolster numbers in the shorter term?

**CAS**: Presently, IAF has 35 active fighter Squadrons against Government authorised strength of 42 Squadrons. The shortfall in fighter aircraft strength is planned to be made good through induction of the remaining contracted Su-30MKI, LCA, Rafale and other suitable fighter aircraft. We are not contemplating any additional procurement of Su-30MKI aircraft over and above the numbers already contracted for.

**VAYU** : The ADA-led AMCA programme is gaining momentum: kindly articulate the place of this new generation fighter in the IAF's future order of battle. Is this to be a strike-oriented platform or more focused toward air-to-air engagements? How many aircraft of this type does the IAF intend to operate?

**CAS**: IAF is also looking forward to the development of Advanced Medium Combat Aircraft (AMCA), which will be our indigenous fifth generation fighter aircraft. The AMCA would be able to execute multiple roles. Since obsolescence management as well as capability enhancement is a continuous process, the AMCA is planned to be inducted when some of our current fourth and earlier generation fighter aircraft are phased out.

**VAYU** : After the first 'series production' Tejas LCA was delivered to the IAF in January this year, further production LCAs have yet to be handed over. What explains this inordinate delay, and what



HAL Tejas conducting air display during Aero India 2015 (photo: Angad Singh)



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WHEN RESULTS MATTER

**impact will this have on timelines for its FOC and establishment of the first LCA squadrons?**

**CAS:** The Initial Operational Clearance (IOC) of LCA was achieved in December 2013. The documents for the first series production aircraft were handed over to the IAF on 17 January 2015; however, the aircraft is yet to be delivered to the IAF. IAF is ready to form the first LCA Squadron after receipt of the first four LCA, which is now expected in 2016. The first 20 LCA will be in IOC configuration; therefore, delay in Final Operational Clearance timelines has no impact on their delivery.

**VAYU :** The Surya Kiran Aerobatic Team (SKAT) will resume performing this year on new HAL-built Hawks, and we eagerly look forward to seeing them in the skies over Hindon on Air Force Day 2015. Could you share details about the re-formed team? When is the team expected to reach full display status?

**CAS:** The formation aerobatic team was resurrected in January 2015. The team has been allocated six Hawk Mk 132 aircraft to initially form a four-aircraft display team. The new team retains the 'Surya Kiran Aerobatic Team'(SKAT) name and the aircraft colour scheme. The team is expected to carry out its first display on Air Force Day 2015 with four aircraft. The team would gradually build up to a full complement of nine aircraft in the future. Negotiations are underway to provide new Hawk Mk.132 aircraft for the team, with smoke generation capability that does not exist in the present Hawk Mk.132 aircraft.



HAL-built BAE Hawk Mk.132 in the new Surya Kiran livery (photo: MoD)

**VAYU :**Recent reports have suggested that HAL's IJT has not made substantial progress towards achieving IOC and that the MOD is even considering closing down the programme. The IAF has also floated an RFI to assess alternative options. What is ahead for the IAF's intermediate training needs? Could the entire training sequence be revised along global lines, with Stage-II being taken care of by Hawk trainers and Stage-III with higher performance Lead-In Fighter Trainers (LIFTs)?

**CAS:** The Pilatus PC-7 basic trainer aircraft and Hawk advanced jet trainer are already fully integrated into the IAF's training pattern. Both these trainer aircraft are supported by their respective simulators.

Hence, IAF has initiated the process for conducting a flying training pattern based on two aircraft types: PC-7 Mk.II and Hawk AJT, to replace the 'three aircraft – three stages' programme that had so far been in place. Limited number of flight cadets have already started training on this pattern wherein Stage-II is being conducted on PC-7 and the number of trainees will gradually go up with increase in the number of PC-7 Mk-II aircraft.

**VAYU :**The HAL HTT-40 is predicted to make its first flight within the year. Should this programme proceed satisfactorily and the type added to the IAF's inventory, what are the challenges foreseen in operating two parallel basic



An IAF Pilatus PC-7 Mk.II in flight over Yelahanka AFS during Aero India 2015 (photo: Angad Singh)

**trainer types for the same (Stage-I) phase of training?**

**CAS:** The first flight of the HAL-built HTT-40 that was earlier expected in June 2015 has now been rescheduled to December 2015. Although there would certainly be challenges in simultaneous operations of two different types of Basic Trainer Aircraft, I am sure they would not be insurmountable.

**VAYU :** The IAF has recently moved a proposal to purchase 3 additional Boeing C-17 heavy airlifters, but it is understood that Boeing only has a single new C-17 available for purchase. Is the IAF open to procuring low-hour C-17s from the USAF through an FMS deal?

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**CAS:** In view of the long-term strategic airlift requirement of the IAF, we have initiated a case for the procurement of three additional C-17 aircraft. In case a need arises, all options would be considered for procuring these aircraft.

exercise provided exposure to aircrew in a near-realistic training environment. It also provided an insight into Network Centric Warfare (NCW) concepts of USAF that has helped IAF in refining its operational concepts.

**CAS:** It would be fair to state that 'Op Maitri' has been the largest ever Humanitarian Assistance and Disaster Relief (HADR) operation conducted by IAF in any of our friendly countries, both in terms of assets, air effort and the time duration. It has not only earned goodwill from a friendly neighbouring country but also demonstrated India's capability. It was a success in all respects. The challenges of working in a multinational environment are different from those of working within the boundaries of our country. However in our case, the aim of operation was clear from the word go. Our aim was to "render all possible support to the victims of the disaster in the fastest and most efficient manner." With this aim, our cooperation with all multinational agencies was good. The Nepalese Army was the coordinating agency on ground. Certain requirements in aspects such as establishment of communications, procurement of HADR-specific medical stores and equipment were observed during 'Op Maitri.' Lessons in all these aspects have been drawn for future HADR operations.



IAF C-17s being loaded with relief materiel during Operation Maitri. The C-17 has fast become the backbone of the IAF's airlift capability (photo: IAF)

**VAYU :** The Golden Jubilee of the Indo-Pak War of 1965 has been marked by

**VAYU :** Indradhanush 2015 was the IAF's first foreign air exercise since 'Red Flag' in 2008, and there are reports that the IAF considering going back to the USA for another 'Red Flag' exercise in 2016. Considering the importance of such bilateral/multilateral exercise, does the IAF plan to extend its foreign outreach along the lines of the Navy and Army, both of which services conduct regular joint exercises with regional as well as global nations?

**CAS:** IAF undertakes bilateral exercises with the Air Forces of a large number of friendly foreign countries like US, UK, Singapore, France, Oman, UAE etc. Last year the IAF conducted bilateral exercise with Russian Air Force both in India and Russia for the first time. The overall aim of these exercises is to enhance mutual operational understanding with different air forces. It exposes IAF aircrew to a near real-time scenario under safe and controlled conditions and presents opportunity to our aircrew to tackle new types of aerial and ground threats in large force engagements. IAF has also derived lessons from the experiences of the USAF through their participation in 'Red Flag' earlier. The



IAF Su-30MKIs in flight during Exercise Indradhanush in the UK

**VAYU :** In April-May this year, the IAF took the lead in a mammoth multinational relief and rehabilitation effort following devastating earthquakes in Nepal. What were the challenges of working in such an environment, alongside various relief missions from around the world? What lessons has the IAF taken on board that may be applied to similar relief operations in the future?

various events, including the publication of several books encouraged by the Indian Air Force. The air war 50 years ago is regarded by many as having been a 'draw' but the December 1971 war was a clear victory for the IAF and the other armed forces. What are the plans to mark that seminal campaign and what is the status on establishment of a world standard IAF museum in Delhi coincident with the event?



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*Air Chief Marshal Raha addressing IAF personnel after a relief operation (photo: PIB)*

**CAS:** The Commemoration of ‘50 Years of the Indo-Pak War of 1965’ has been marked by various events through August and September 2015 to honour our veterans and sacrifices of our martyrs. Establishment of the IAF Aerospace Museum in Delhi is not coincidental with this event and the case is being progressed vigorously with MoD. The plans for commemorating the 1971 War will be finalised at an appropriate time.

**VAYU:** *On the eve of the IAF’s 83<sup>rd</sup> anniversary, what is your message to the air-warriors under your command, and also to the young men and women of the country who will make up the ranks of the IAF in the near future?*

**CAS:** Over the last eight decades the Indian Air Force has modernised itself into a professional force that ranks amongst the most competent and respected Air Forces in the world. I am extremely proud of our operational achievements in spite of resource constraint and extremely challenging conditions. The competence and synergy displayed by everyone was indicative of a well-trained cohesive team striving for victory against all odds. I urge each one of you to remain anchored to our core values and continue honing your skills with single-minded devotion.

Over the years IAF has taken great strides in transforming itself into a formidable force with multi-spectrum capability. The challenges of transformation in terms of creation of appropriate infrastructure, training of Air Warriors in absorbing high-end technology and expeditious operationalisation of weapon systems are

being met through dedicated hard work and professional competence. With the induction of new generation aircraft, IAF has acquired greater capacity for airlift and strategic reach, which has enabled effective conduct of Out of Area Contingency Operations. Forthcoming inductions such as MMRCA, attack helicopters, heavy lift helicopters, force enhancers, SAGW and AD radars along with upgrading of airfield infrastructure and communications network will provide unprecedented operational capabilities to the IAF. We need to train extensively so as to exploit these capabilities effectively.

Our people are our most valuable assets and in consonance with IAF’s vision ‘People First Mission Always’ we have reviewed our human resources policies to ensure professional growth of our Air Warriors. A strong, motivated and cohesive team, which is dependent on the professional competency of each member, is the key to success. Therefore, each Air Warrior must aim to achieve high degree of professional knowledge and exemplary standards. Creation and upgradation of infrastructure for sports and games, living accommodation and auditoriums have provided an impetus to enhanced quality of life and standard of living of our personnel.

As we rededicate ourselves today, we take the opportunity to pay tribute to our veterans and acknowledge their outstanding contributions. Events towards commemoration of the 1965 Indo-Pak War were organised throughout the year specially to honour our martyrs and war veterans. We are immensely indebted to our brave pioneers who endured tremendous hardship during the formative years of the IAF. On behalf of all serving Air Warriors, I salute their tenacity and leadership. Their vision will always serve as a beacon and will guide us in the completion of our mission with honour and pride.

Jai Hind !

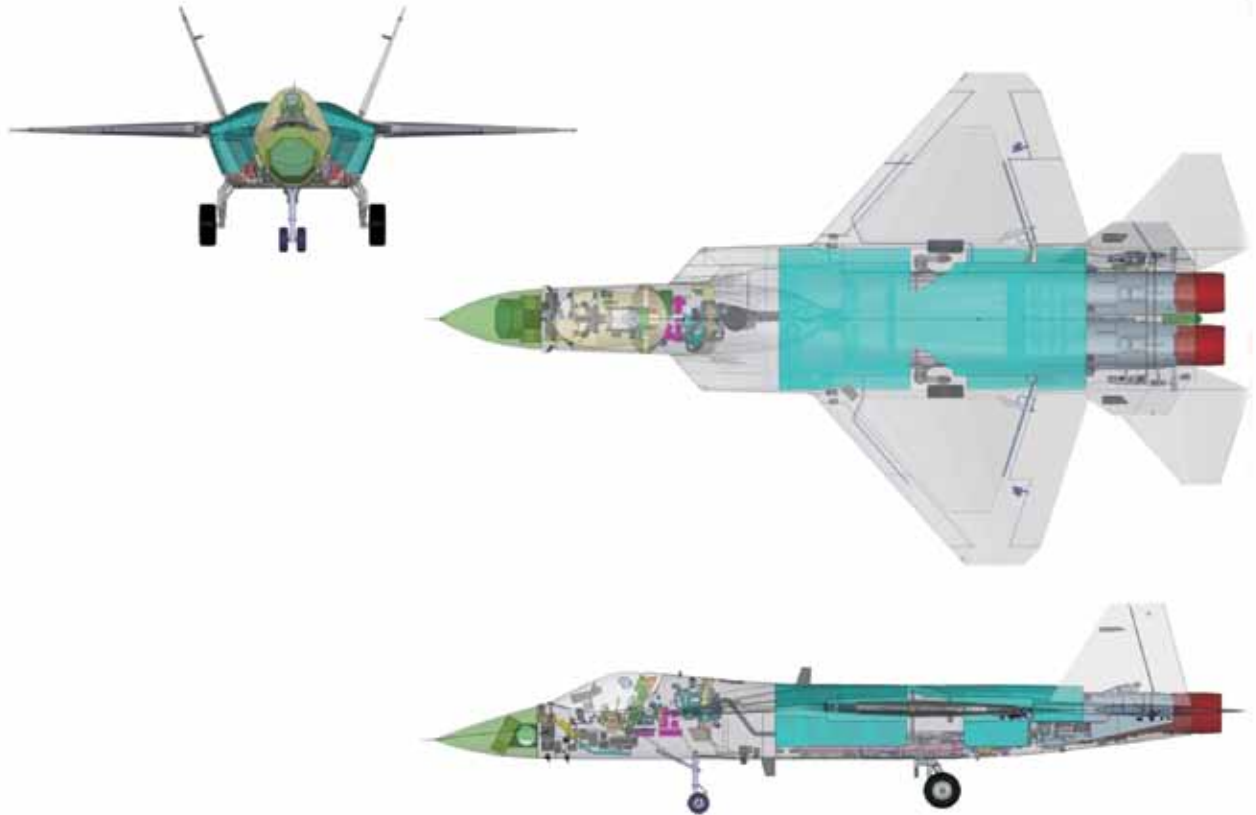


*Acquisition of 36 Dassault Rafale fighters will shore up the IAF’s shrinking combat force (photo: Angad Singh)*



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# Beyond MMRCA :



## The Advanced Medium Combat Aircraft

*On 26 May 2015, The Society for Aerospace Studies, publishers of the Vayu Aerospace & Defence Review, held a joint workshop with the Observer Research Foundation (ORF), in New Delhi covering the twin topics 'Beyond the MMRCA : Numbers and Missions' and 'Fast Tracking the AMCA.'*

*A detailed look at the AMCA programme, highlighting key areas of concern is published here, following on from a summary published in Vayu IV/2015.*

Thirteen years from concept to closure": the Indian Air Force's tender for a Medium Multi-Role Combat Aircraft (MMRCA) has been formally cancelled. Instead, a limited purchase of 36 Dassault Rafales is being negotiated without the transfers of technology and local production envisaged in the original RFP for the MMRCA. Cancellation of the tender to locally produce the winning candidate, Rafale, is compounded by the fact that fighter strength of the IAF is diminishing alarmingly. The IAF already operates a wide variety of aircraft types imposing significant strains on logistics, training budgets, as well as

having an impact on force synergy. The acquisition of a 'mere' two squadrons of Rafales will only add to these issues. It is in this scenario that many believe that ADA's Advanced Medium Combat Aircraft (AMCA) may just be the panacea that the IAF is hoping for.

The AMCA programme, while still very early into its design and development phase, is believed to hold immense potential to replace the wide range of legacy IAF aircraft. The AMCA will, at the same time, increase the force's capabilities as the aircraft will be a generation ahead of what the IAF currently fields, or is considering, for its requirements. Development of ADA's

Light Combat Aircraft (LCA) has over the last 30 odd years certainly created a reliable aeronautics eco-system for the AMCA programme, making it a realistic and deliverable programme. Many believe that, if the IAF were to throw their force behind the AMCA programme, it would result in a shift from short term tactical thinking to a more long term strategic overview keeping pace with technological developments and future threats.

This presentation on, and an analyses of the AMCA programme to meet the IAF's requirement of a fifth generation medium weight fighter aircraft, aggregates officially available information on the programme

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and attempts to understand the drivers of, and obstacles to, the AMCA.

### IAF combat fleet projections

As seen below, this graph has been collated from official statements on the phasing out and introduction of extant and new combat aircraft of the Indian Air Force. Over the two decades 2012-2032 without querying the feasibility of this induction-retirement schedule, some aspects stand out clearly. The first of these is that the weary MiG-21 will perform continue to remain in Indian

necessarily mean a shortfall in overall effect or capabilities.

Still, this projection of expected force structure post 2025 will be seen with the MMRCA and Sukhoi Su-30MKI forming the bulk. This means that, contrary to international trends and economics where countries have more lighter (and affordable) fighters and fewer high-end heavy fighters, the Indian Air Force will virtually be almost entirely dominated by twin-engined 'heavies,' with their attendant high life cycle and operational costs.



Air Force frontline service well into the 2020s, or close to 60 years of front-line service. Second, specialist aircraft like the Jaguar optimised for ground strike and the air superiority MiG-29 will continue to play a significant role in the Air Force order of battle till at least 2032 with their retirement phase out beginning only in 2027.

The graph shows that the number of front-line fighters is expected to remain well below authorised numbers, assuming that the government will procure another fighter in lieu of the MMRCA programme. Should such a fighter not be procured, and the Rafale procurement remain capped at 36, or should the Fifth Generation Fighter Aircraft (FGFA) being considered for co-development with Russia be cancelled, this shortfall will increase dramatically. However, it is important not to merely translate falling numbers with a drop in overall combat capability or effectiveness. In the age of beyond visual range air-to-air combat, stand-off precision attack and the ability to strike multiple targets per aircraft per sortie (as opposed to multiple sorties per target some decades back) means that the numeric shortfall does not

### AMCA Design Drivers

The AMCA programme is envisaged as a replacement of a host of aircraft currently operated by the Indian Air Force and to fill gaps left by retirement of the Dassault Mirage 2000, SEPECAT Jaguar and MiG-29. The ADA has received definitive design drivers for the AMCA after issue of the Air Staff Requirements (ASR) in 2010.

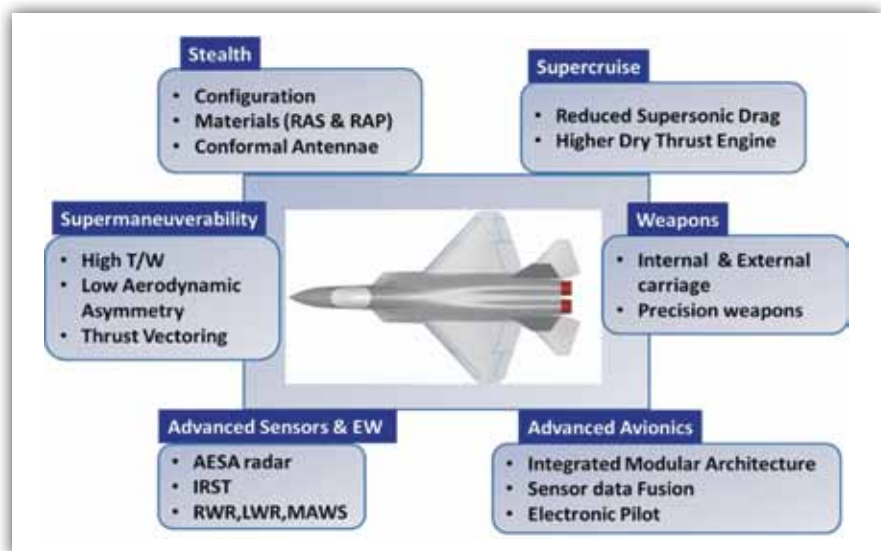
The broad requirements outlined for the AMCA are for it to incorporate a high degree of stealth, substantial internal and external weapons payload, good internal fuel capacity and the ability to swing from the air-to-air to an air-to ground role. It is also expected to have the capability of supercruise, which allows the aircraft to fly at supersonic speeds without the use of afterburner so providing greater endurance through lower fuel consumption. Even though future air combat is envisaged to be conducted at beyond visual ranges excluding the need for close combat, the AMCA is expected to have a thrust vectoring system which will give it superior manoeuvrability against opponents in the eventuality of an aerial dogfight.

The ADA is designing the AMCA as a platform with high survivability to meet the challenges of future air defence environment through a combination of moderate stealth, electronic warfare capability, sensor fusion and kinetic performance including possible super-manoevrability. The design philosophy seeks to balance aerodynamics with stealth capabilities.

### Design features

The official AMCA layout shown at the lead bears a marked similarity to the F-22 in several aspects of the overall design, and the structural layout of the aircraft incorporates some of the key design features that define a 5th generation fighter aircraft.

ADA indicates a horizontal S-curve for the inlet trunk with the internal weapons bay providing a vertical S-curve of sorts. However, since these are still merely





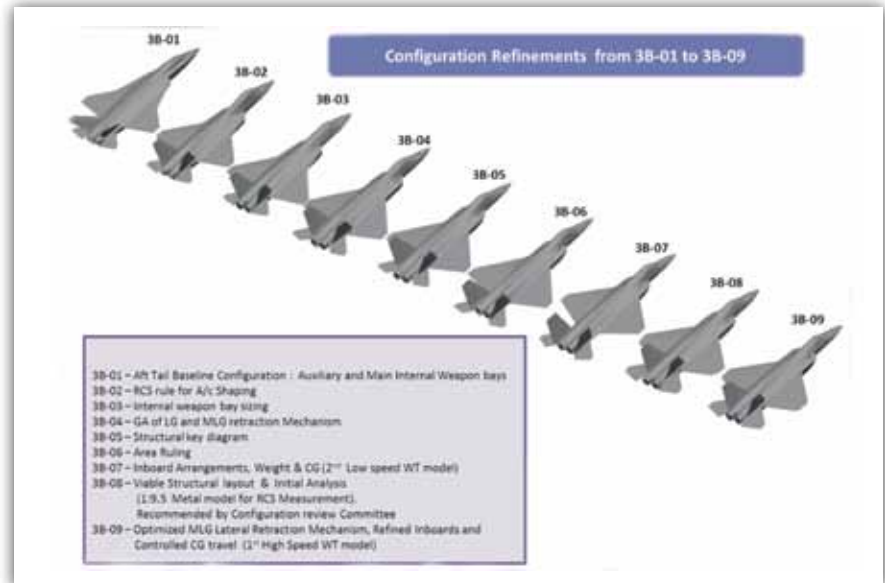
*The large, heavy and costly F-22 Raptor*

renderings, one does not know what the extent of the offsetting and hence radar masking of the engine will be. The F/A-18 for example has a partially offset engine and requires the addition of an inlet blocker to mask the engine from incoming radar waves.

The PAK-FA (Sukhoi T-50) has a distinctly serpentine duct and significantly more offset engines than the F/A-18. However, it has a vertical S-curve, which still does not manage to mask the engines completely, therefore requiring an inlet blocker similar to the F/A-18.

On the other hand as can be seen from the F-22 and the AMCA layouts, both share the use of broad central internal weapons storage just aft of the air intakes. While one can speculate that this combined with the vertical S-curve may mask the engines entirely, it is impossible to tell at this stage given that the dimensions of the engine remain unknown and hence their volumetric and alignment implications are unclear. Moreover, it should be remembered that the F-22 is a large heavy fighter with much space for such expansive configurations. Whether such a configuration will suit a smaller and lighter fighter remains to be seen. It is to be noted that the official drawings only show the internal carriage of air to air weapons, possibly a conscious compromise given the volumetric restrictions of the design, unless India develops munitions similar to the American Small Diameter Bomb (SDB) or obtains US variants for integration with the AMCA.

The following drawing clearly indicates evolution of the AMCA design and is consistent with the several modifications to that design over the years. The initial tailless double engine, delta design is clearly not considered any more.

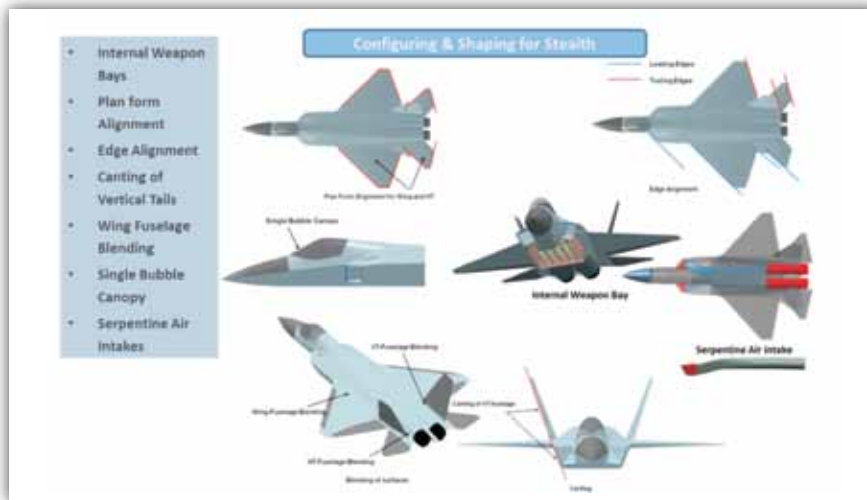


Despite the obvious similarities with the F-22, note must be made of the front end shaping which seems much closer to the unmanned Boeing X-36 demonstrator than the F-22. Irrespective, the design shows significantly greater emphasis on all-aspect stealth shaping than does the Russian PAK-FA. If current graphics are transferred accurately into production aircraft, a high

level of stealth can be expected against radars operating in the L band. X to C band stealth however will be majorly dependent of the quality of construction, the shaping of the facets and of the equipment and weapons bay doors and most importantly, the jointing. The exact nature of the skin's radar absorbency has not been discussed. It is safe to assume however this will be in the nature of a Radar Absorbent Material (RAM) coating, possibly paint rather than the integrated RAM treatment cured into the F-35's panels. What kind of treatment will be applied to the joints is unclear, though the possibility of the maintenance intensive 'adhesive strips' of the B-2 and F-22 appear likely.

Perhaps the most significant feature that detracts from stealth in these early design phases is the circular engine exhausts. These are not just radar reflective but also erode stealth in the infrared and other electro-optical detection arenas. By way of contrast, square exhausts as on the F-22 reduce infra-red signatures by up to 25 per cent given the 25 per cent increase in surface area of a square over a circle of the same dimensions. The exhausts of the YF-23 combined this approach of squaring out

the exhausts, with a long trailing pathway embedded with heat reflecting tiles in the downward section. Cooler air flowing over the top of the aircraft would combine with the hot exhaust in this pathway to further reduce the heat signature. The large tails shield the exhaust troughs from the sides, providing a significantly reduced heat signature across 270 degrees.



## The weaponry

There still seems to be a lack of clarity on the size of the weapons bay. The illustrations in this article variously indicate 4 or 5 air-to-air missiles that look exactly like the American AMRAAM. Some indicate the carriage of 4 Russian RVV-AE (AA-12 *Adder*) missiles, which have a much greater diameter than the AMRAAM that is further increased by the grid-fin control surfaces aft. Others seem to indicate two 1,000 lb indigenous *Sudarshan* Laser Guided Bombs (LGBs). Interestingly, earlier graphics showing smaller side weapons bays for dogfight missiles exactly mimic the configuration of the F-22's side bays. Such a large volumetric capacity would therefore also appear to approach the F-22s weapons load of two 1,000 lb Precision Guided Munitions (PGMs) along with two BVRAAMs in the main bay, in addition to two close combat missiles in the side bay. The latest graphics however seem to have eliminated the side bays. There is also an inconsistency with the depth of the bays, the latest drawings demonstrating a loadout of AMRAAMs are clearly not deep enough to hold the much bigger *Sudarshan* LGB.

Perhaps the biggest design challenge for the AMCA's weapons bay is the lack of a suite of indigenously produced weapons systems. As of now the beyond visual range *Astra* and *Sudarshan* LGB are in their test phases. This means an optimal weapons bay size cannot be arrived at without significantly constraining the size of future weapons developed domestically. This may, in fact, have significant positive effects on future weapons designs by volumetrically limiting their size and prioritising compactness, and miniaturisation.

It is for this reason that the latest official drawings show a single large bay with two bi-fold doors as opposed to previous graphics that showed a middle ridge separating two distinct weapons bays. The implications for hull integrity however cannot be gauged till the prototypes roll out.

## The Sensors

The AMCA will incorporate an active electronically scanned array (AESA) radar and official illustrations clearly seem to indicate additional mechanical steering for the array, along the lines of the Eurofighter Typhoon's Captor-E radar. This explains the legacy 'bulge' of the radome as opposed to the more tapered radomes of other AESA-equipped fighters such as the F/A-18E/F Super Hornet and the F-22 Raptor. ADA claims that radome of the AMCA will be of 'advanced construction,' presumably meaning that it will only allow the mated radar's operating frequencies to transmit to and from, while blocking other frequencies. This is a significant stealth measure since conventional radomes are merely shaped for aerodynamic efficiency but freely allow electromagnetic waves through. This means radar waves 'see' past the radome to a flat antenna, which increases the Radar Cross Section (RCS). It remains to be seen if the radar will be acquired from abroad or developed indigenously, given the experience with the indigenous radar for the Tejas LCA.

No mention has been made of radar-evading glass for the cockpit canopy, which presents a similar problem as with the radome. Conventional plexiglass allows radar waves into the cockpit, where the internal equipment strongly reflects radar energy. The

F-22 solves this problem with a canopy that is counter-intuitively designed to be radar *reflective* (with a metallic coating) and has a continuous curve structure, minimising the radar return. This ensures that RCS is controlled at the canopy surface and the interior surfaces do not come into play at all.

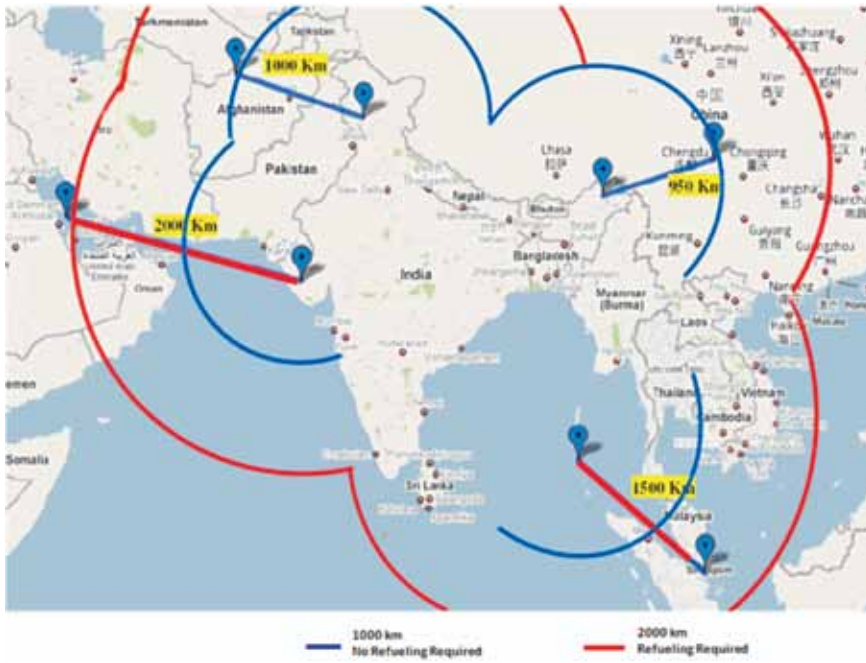
Present graphics and statements indicate that the AMCA is expected to house most sensors conformally to maximise stealth. What cannot be discerned from these graphics is presence of an electro-optical detection system, either for missile approach warning and general situation awareness, or for air-to-air or air-to-ground detection and targeting. Unlike the F-35 but similar to the F-22, the AMCA does not appear to have a conformal Electro-Optical Targeting System (EOTS), which would seriously hamper its strike capabilities by forcing use of an external pod. While the ADA does indicate that the AMCA will have an IRST, drawings do not show the shape and location of this sensor. Conventional dome-shaped IRST installations such as the OLS-series used on Sukhoi and MiG fighters, and even the F-35's faceted EOTS, are constructed of artificial leuco-sapphire. Various attempts at tracking down local producers of leuco-sapphires in India have yielded no results, and possibly implies a local production deficit.

## Range

The ADA is designing the AMCA with an internal fuel capacity of 4 tonnes to obviate the necessity of carrying wing-mounted fuel tanks, which significantly compromise the aircraft's stealth properties. The ADA estimates that the AMCA will have a combat radius of 1,000 km on these 4 tonnes of internal fuel. It will however be equipped with air-to-air refuelling capability, increasing its endurance and operational radius as can be seen in the range arcs provided alongside.

It must be noted that the F-35A carries 8.3 tonnes of fuel and the F-35C close to 9 tonnes, enabling both these aircraft to achieve a combat radius of around 1,100 kilometres at a maximum take-off weight (MTOW) of approximately 31 tonnes. It would seem therefore that the AMCA would have to be half the weight of the F-35 in order to achieve a 1,000-km unrefuelled combat radius or have revolutionary engines that cut fuel consumption in half. Given that the AMCA is a twin-engine aircraft





with greater fuel consumption, the range statistics as given by the ADA simply do not hold up to preliminary scrutiny.

### Leveraging LCA developments

The AMCA programme, unlike the LCA, will be able to leverage experience gained from development projects over the decades. When the LCA programme was sanctioned in the 1980s, India not only lacked the

technical wherewithal to develop and build 4th generation fighters, it had not even built a 3rd generation fighter on its own, resulting in a protracted development process, with no relevant institutional knowledge to rely upon.

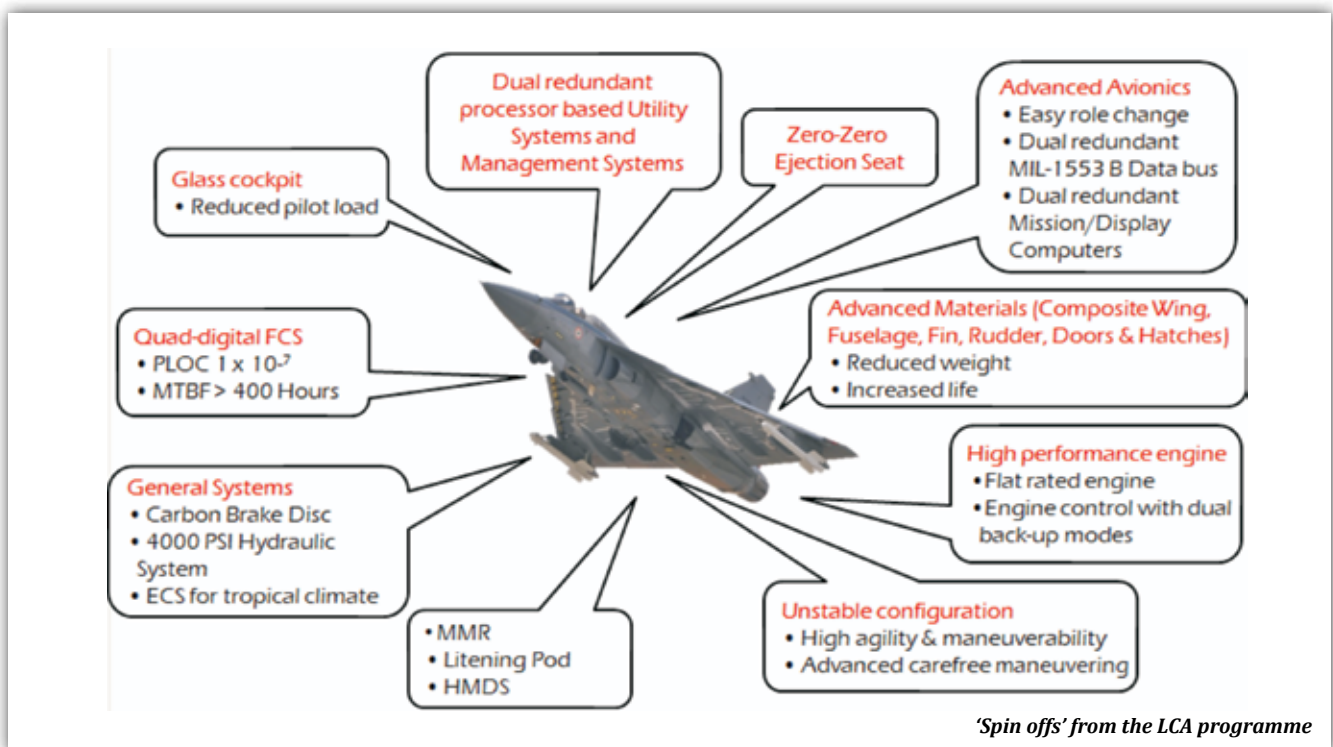
When the AMCA programme gets underway and moves towards its first technology demonstrator, it will have access to a number of 4th generation aircraft technologies that can be improved upon

and employed. Like the LCA, lightweight composite materials are expected to form a high percentage of the AMCA's construction. Indigenous developments in composite technology, avionics, digital fly-by-wire flight control systems, glass cockpits which reduce pilot work load and some in-counting weapon systems programmes, will have given the AMCA a strong base from which to start its development. On the other hand, India's failure in aero-engine development will perforce have ADA selecting a foreign vendor for the AMCA's engine requirements.

### Modular Design Approach

Still, the AMCA programme faces a number of practical constraints and the ADA has devised strategies to work around these. As the ADA realises its limitations concerning available manpower and in-house resources, the expertise and resources of the private industry could well be leveraged.

It is envisaged that the AMCA programme will make a clear break from the approach followed in the LCA development and production. Not only will the private sector be embedded as part of the development process, it will also play a major role in production of the aircraft. The aircraft design will be divided into a number of major modules developed and (see image), with each module built independently and undergoing final



'Spin offs' from the LCA programme

assembly by a 'lead integrator.' In a novel approach, select private companies will execute construction of each module (see drawing). These modules will conform to laid down design processes and procedures, requiring stringent testing and quality assurance 'sign off' before delivery for final assembly.

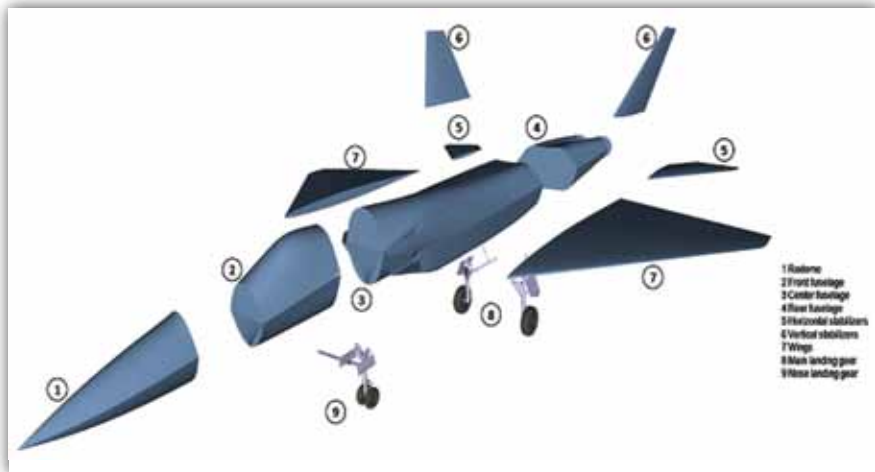
infrastructure and expertise be identified early enough if ADA plans to overhaul the existing supply chain and production models in place.

The identified agency for integration will be involved early in the design process. While ADA will create a framework for the outsourcing of modules and their integration, the selected agency will be responsible for

At the same time, sensor fusion and stealth characteristics are stated by the ADA as 'prime drivers' of the design, which seems to indicate an incomplete understanding of what it is that a fifth generation fighter actually *does*. To be noted here is the festering problem of systems integration and sub-system size, which are issues that have also dogged the F-35 programme, one which is the product of a mature aerospace industry and already has prior fifth-generation experience to draw upon. Largely as a result of these and associated problems, stop-gap measures have been adopted for the F-35's synthetic vision systems, while weapons bays have shrunk owing to the volume of certain sub-systems. External shaping to maximise stealth has also been compromised, prompting several commentators to reclassify the fighter from the 'Very Low Observable' (VLO) category to the 'Low Observable' (LO) category.

The lack of several core optical and electronic sub-systems manufacturers, production expertise and end user knowledge and expertise are particularly worrying as several of these will be produced and used for the first time in India. Consequently the potential for each of these to significantly add to time delays, late stage design modifications and the associated massive cost escalation remains immense, albeit any public proposals for concrete risk-reduction measures. In that sense the concept of 'creating space' loses meaning unless sub-systems bloat, and mass and volume increases of these sub-systems are not factored in. Of equal concern is the lack of public discussion on expected operational and life cycle costs of this aircraft or specifications from the Indian Air Force as to what the desired price range of such cycles should be.

The second issue is what the term 'medium' really means in the Indian context. Is it a definition based on cost? weight? range? payload? Given that MoD representations to successive parliamentary standing committees on defence have variously blurred the definition of this aspect, the question remains: can India afford a heterogeneous fleet of five different kinds of aircraft, with almost zero commonality across systems, maintenance standards, support infrastructure, and training? There is no clear cost-benefit analysis in the Indian context of the weight-based categorisation of aircraft, given the lack of any document



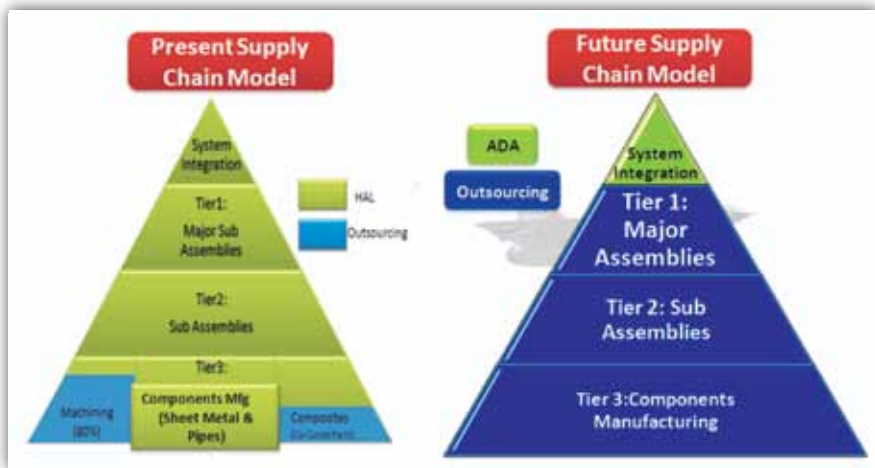
Presently, state-owned HAL is the only company in India with the experience and technical capacity to play the role of a lead integrator. It is also the only company in the country that has the infrastructure and experience for flight-testing, certification and series production. But given that the AMCA programme will take a decade or more before it is ready for full-scale production, the possibility of private players developing such technical wherewithal to play the role of lead systems integrator cannot be ruled out. Tata's and Reliance Industries are both in the process of forming collaborations with foreign companies to enter aircraft production. It is therefore imperative that the lead integrator with requisite

monitoring companies charged with the construction of different modules, who in turn will be responsible for outsourcing the sub-systems required for the module.

The graphic below is a representation of the work load that the ADA expects to outsource when the AMCA goes into the production phase compared to the current supply chain model in place for the HAL LCA.

### Need for clear focus

As clarified several times by ADA, prime objective of the design phase remains the 'creation of space.' This means that given restrictions on weights and dimensions, the size of the weapons bay is to be optimised.





*The F-35 Joint Strike Fighter represents the 'Lo' end of the USAF's future fighter 'mix'*

that publicly states desired effects. It is telling that the F-35 represents the 'Lo' end of the USAF's 'Hi-Lo' mix and yet has twice the range of the AMCA. More importantly, the question of what effects the IAF desires from its fleet remains unanswered – even in private discussions! This is problematic both in the context of the overall fighter force but specifically on the AMCA. This clearly indicates that the AMCA's design drivers have not been back-calculated based on required effects.

Importantly, while LO and VLO are just one aspect of a fifth generation fighter the most critical aspects are in fact sensor fusion, man-machine interface and the integration of the aircraft with other land sea and air forces and as part of a broader fleet of aircraft comprising a totality of air power. An elaboration of these aspects has been notably absent from the design phases.

While HAL's move from being prime manufacturer to prime integrator of the AMCA is a laudable shift, several lessons that have been learnt in the Sukhoi and LCA programmes seem to have been ignored. Chief among these is that India faces a shortfall in capacity not just in manufacturing but also systems integration. Most manufacturers in fact consider systems integration to be the hardest, most expensive part of building a weapons system. To complicate matters, not a single Indian university offers a course in systems integration, indicating a significant lack of domain knowledge.

Similarly the openness to foreign manufacturers for local co-production is a laudable goal and indicates a shift in the right direction. The issue is that ADA needs to be investing heavily in a smart team to lobby parliament and policy makers for changes to the Intellectual Property Rights

(IPR) and investment laws, as these would abort any useful transfers of technology and processes from these foreign manufacturers.

There are further aspects to consider as well, including the all-important issue of *industrialisation*. A country that imports and industrialises such high-end technology needs to have broad spectrum amortisation plans to make the costs of technology absorption bearable. This must include active consultation with the private sector for spin-off of technology and scientific knowledge gained into future projects. Unlike the HDW Type 209 submarine procurement, where India gained knowledge but failed to leverage it after the last submarine was built, India must now look towards innovative models such as that in Australia. The building of the *Collins*-class submarines, for example, saw migration of the highly skilled workforce to the mining sector after the completion of the submarine programme and resulted in the Australian mining revolution with innovative approaches to mineral extraction.

Equally important, given the level of customisation involved for a (so far) single customer, and the consequently expected low production run, the economics of a standalone programme and the willingness of the private sector to invest in this must be examined closely at the embryonic stages.

### The Way Ahead

It might be a good idea for the Aeronautical Development Agency to implement or consider the following before concrete proposals for funding are forwarded to the government:

- ➔ Consolidate and define the exact meaning of the term 'medium' in IAF thinking, including clear measures pertaining to

range and payload, but more importantly a price range significantly lower than 'high,' and correspondingly lower operational and lifecycle costs.

- ➔ Commence intensive negotiations with the private sector for a joint proposal to the government on:

(a) framework of investment and IPR laws to facilitate technology transfers specific to this programme.

(b) comprehensive feasibility study on the capacity of Indian industry, both public and private, to absorb technologies so transferred.

(c) costs and knowledge amortisation programme for the private sector.

- ➔ Identification of manufacturers of key sensor and subsystems technology and the data linking and networking and systems integration requirements. This should be followed by clear parameters regarding volume and power consumption. The design of the aircraft should optimally be built around these systems rather than having the systems attempt to conform to a pre-conceived airframe configuration.

- ➔ Have a Public-Private document clearly analysing the possible failure points and the necessary risk reduction measures to be undertaken.

- ➔ Request from ADA to the Indian Air Force to clearly spell out *effects* rather than *capabilities* and generate a clear understanding of what the term 'fifth generation' really means in our context.

*Adapted from an ORF Issue Brief by Abhijit Iyer-Mitra and Pushan Das*

# FGFA facing headwinds ?



## The Fifth-Generation ‘Striker’

**T**he PAK-FA a.k.a. the T-50 Fifth-Generation Fighter Aircraft (FGFA) prototype's maiden flight, piloted by Sergey Bogdan, took place on 29 January 2010, from KnAAPO's Dzemgi Airport and lasted 47 minutes. This was to verify manoeuvrability and normal operation of engines and main systems. Importance of the T-50 project may be summed up in the words of Mikhail Pogosyan, Sukhoi's Director General, on launch of the test campaign: "Today we've embarked on an extensive flight test programme of the fifth-generation fighter. This is a great success of both Russian science and design schools.

This achievement rests upon a cooperation team comprised of more than a hundred of our suppliers and strategic partners. The PAK-FA programme advances Russian aeronautics together with allied industries to an entirely new technological level. These aircraft, together with upgraded 4th generation fighters will define Russian Air Force potential for the next decades. Sukhoi plans to further elaborate on the PAK-FA programme, which will involve our Indian partners. I am strongly convinced that our joint project will excel its Western rivals in cost-effectiveness and will not only allow strengthening the defence power of Russian

and Indian Air Forces, but also gain a significant share of the world market."

That first flight invoked considerable curiosity among the military aviation community worldwide as it was the first fighter to have 'emerged' in Russia after dissolution of Soviet Union. In contrast to the common perception of being an uncompromising air superiority fighter to challenge the United States Lockheed Martin F-22 Raptor, this *Vayu* writer feels that in the T-50 programme, the Russian aviation industry has begun an 'initial point' to develop a formidable strike fighter (conceptually similar to the

Dassault Rafale and Boeing F-15E Strike Eagle) while retaining full capabilities of being a formidable adversary in the air-to-air combat arena. Progress of the T-50 project has been relatively smooth and swift and on 3 November 2011, the T-50 prototypes achieved their 100th flight. The 200th flight was achieved in January 2013 with credit due to five Sukhoi test pilots: Sergei Bogdan (who performed the maiden flights on the four prototypes), Roman Kondratyev, Yuri Vashchuk, Sergei Kostin and Taras Artsebarsky.

India was initially to procure 144 Fifth Generation Fighter Aircraft (FGFA) for fulfilling air defence missions in critical sectors, and as a long-range strike aircraft. With an internal fuel of 25,000-lb plus supercruise attributes, the aircraft would be able to attain a combat radius of over 2,000-km, further boosted by Air-to-Air Refuelling (AAR).

### Describing the T-50

Displaying standard attributes of Very Low Observable (VLO) airframe design, especially in the forward and upper fuselage, inlets, wings and tail surfaces, the T-50 has a flat appearance with a humped canopy area optimised for low-level stealthy flight over enemy territory. For the aforesaid ingress, the FGFA will (like the Sukhoi Su-35S) employ a dual mode GLONASS (Global Navigation Satellite System)/GPS receiver (military grade GLONASS signals will be made available to India and Russia) and Kalman filter based inertial navigation suite, with a Ring Laser Gyroscope (RLG). The combination of Active Electronic Scanned Array (AESA) radar and automation and high degree Artificial Intelligence (AI) systems (often referred by the Russians as the second pilot) will reduce pilot workload.

The T-50 is superficially similar to Lockheed Martin's F-22 Raptor with a quasi-trapezoidal wing with Leading Edge Root Extensions (LERX) (with vortex controllers) and traditional control surfaces. The vertical stabilisers angled out at about 25-degrees are trapezoidal and fully movable while the 'tail sting' houses the brake parachute and a rearward facing radar similar to the Phazotron N012. The Infra-Red Search & Track (IRST) will be based on OLS-35 highly integrated with other electro-optical systems by 101KS Atoll system comprising 101KS-V, 101KS-O, ultraviolet 101KS-U and 101KS-N. Composites (polymer carbon fibre

reinforced plastic) comprise 25 per cent of the weight and 70 per cent of the outer surface with high degree of titanium content. The Radar Cross Section (RCS) of the forward section is aimed to be 40 times smaller than that of the Sukhoi Su-30, or about 0.5-square metres. This will ultimately decrease to 0.01-0.03 square metres after application of Radar Absorbent Material (RAM) coating. According to sources, Hindustan Aeronautics Limited (HAL) would contribute largely on the composites, mission computers, avionics and cockpit displays.

Two tandem main weapon bays in the centre fuselage between the engine nacelles measure between 4.5 to 5 metres long (doors of those have saw tooth-shaped edges) augmented by bulged, triangular-section bays at the wing root. The two main weapon bays can accommodate a total of six R-77 Beyond Visual Range Air-to-Air Missiles (BVRAAM) or appropriate air-to-surface ordnances developed by Tactical Missile Weapon Corporation while each triangular-section bays at the wing root can accommodate a single Close Combat Missile (CCM) each. For combat operations where stealth requirements are not paramount there are provisions for six additional external hardpoints that include two under the air intakes. It may be reasonable to assume that as per Russian air combat tactics, multiple missile shots will be conducted during opening phases of an engagement at enemy high-value targets usually with different terminal homing heads to increase the kill probability (pK). This necessitates the carriage of at least ten BVRAAMs, thus attachment of a stealth pod with additional missiles may be a common feature especially when operating within friendly airspace.

It is interesting that India's Astra BVRAAM project, guided and led by the Defence Research and Development Laboratory (DRDL) appears to be optimised for internal carriage. The single stage, smokeless, solid fuelled Astra with a length of 3570 mm, body diameter of 178 mm and weight of 154 kg, is powered by high energy lithium thermal batteries making it the lightest in its class and thus enjoying a wide range of applications. T-50s armed with this BVRAAM will be capable of destroying high manoeuvring 9 g enemy targets at high altitude in the head-on mode at a range of 80 km and in tail-chase mode at 20 km, thanks to the missile's low drag,

low aspect ratio wings and capability to pull a lateral acceleration of 40g in both yaw and pitch planes which means it should be able to engage a non-maneuvring targets well in excess of 100 km and capable of operating in the altitude bracket from sea level to 20 km.

Sparse details have emerged of the Russian RVV-SD BVRAAM, which was unveiled for the first time at MAKS-2011. It will be interesting to learn whether it will be equipped with a dual-band (active radar and passive radiation) seeker. At least four external hardpoints can accommodate the dual-mode solid-fuelled RVV-BD BVRAAM, which is capable of fulfilling the BVR role for 'outer-air battles' by taking out enemy Airborne Early Warning and Control (AEW&C) and AAR platforms at the initial stages of conflict. The RVV-BD weighs 510 kg, has a range up to 200 km and is capable of destroying targets with overload up to 8g at an altitude from 15 m to 25 km.

The T-50 is to be equipped with Tikhomirov NIIP N050 (further development of Irbis-E) X-band AESA radar in the nose with a 1-metre antenna containing 1,526 solid-state transmit/receive modules by NPP Pulsar, with a range of about 400 km against a 1 metre square RCS target. With such attributes, N050 will remain fairly effective against ground and as well as stealthy airborne targets employing active countermeasures, and will be supplemented by long-wavelength L-band radar antennae on the wing leading edges, specifically for detection of stealth targets. The surfaces of the radar arrays are also angled off from the vertical plane, helping to 'deflect' enemy radar signals. Additionally the covers of the radar arrays are selective, letting through their own signals but blocking other frequencies. The array compartments are also edged with radar-absorbing 'curtains' to reduce possible leaks of these amplified signals. The third and fourth flying T-50 prototype flight-tested the fighter's composite cutting-edge avionics suites that might well include the Polyot S-111N Intra-Flight Data Link (IFDL).

Kinematics have traditionally been a key strength of the Sukhoi design bureau and variable-cycle AL-41F1 (Izdelye 117) turbofan engines with 12 tonnes of dry thrust will enable the aircraft to supercruise at Mach 1.5 effectively enhancing the range of BVRAAMs by 30 per cent. With afterburner, 14.7 tonnes of thrust will be



obtained. Further development of more powerful engines is projected to feature three-dimensional thrust vectoring and complex automation systems, to facilitate super manoeuvrability for domination of close combat engagements plus defeat of hostile missile shots.

The engines are placed wide apart in isolated pods, with air intakes located further apart in respect to the vertical and horizontal planes than the engines, creating a curvature that hides the compressor and reduces the frontal RCS. The engines are also placed at an acute angle relative to the vertical plane, allowing thrust vectoring, as mentioned earlier, in the longitudinal, transverse and travel channels. The engine nozzles point outwards, which transfers a significant portion of the control of the aircraft to them even at low altitudes.

The T-50 is fitted with an unusually robust high sink rate undercarriage, intended for operations from Short Take-Off and Landing (STOL) operations from short unprepared runways which will also be an added asset while operating from aircraft

carriers in the future especially if the aircraft is fitted with strengthened undercarriage and an arrester hook from baseline models.

### Facing headwinds

However, despite technical progress of the programme, the T-50 and its Indian variant, the Fifth Generation Fighter Aircraft (FGFA) appear to be facing headwinds. According to sources in Russia, that country has been scaling back its purchase commitments almost continuously since last year, with the most recent statement coming from Deputy Defence Minister in charge of Armaments, Yuri Borisov, who stated in March 2015 that the Russian Ministry of Defence would dramatically scale back its procurement of the new fighter. It is understood that the Russian Air Force is slated to receive, at least initially, only a single squadron of twelve production aircraft, down from an earlier commitment of 55 fighters, which itself was reduced from a much larger prospective order.

Then, in early August 2015, Indian Defence Minister Manohar Parrikar confirmed that no progress has been made

on the FGFA project since June 2013, when the preliminary design phase was concluded following a contract signed in December 2010. The preliminary design phase was to be followed by signing of a full scale R&D contract, which would include prototype development in advance of actual production. However, the Indian side, which is expected to fund around half of the entire programme, and indeed has already spent nearly Rs 1,500 crore (ca. \$230 million) on preliminary design, is expected to receive only a 13 per cent work share in industrial terms.

Uncomfortable with the scope of industrial cooperation relative to the financial burden, the Indian Government has held off on committing to the R&D contract. Under the terms of the draft R&D contract, the IAF would have begun receiving its first FGFA 94 months (7 years and 10 months) after contract signature, which would mean even if the contract were signed this year, the IAF will not receive its first FGFA before mid-2023.

*Sayan Majumdar*

# MALE UAVs for India



## The 'Vigilant' Heron

The fourth generation GPS-enabled IAI Heron/Machatz-1 Medium Altitude Long Endurance (MALE) Unmanned Aerial System (UAS), has entered operational service with the Indian Air Force. The Heron is capable of fully automated take-off and landing, even under adverse weather conditions, and flying at a height of 30,000 feet, the UAV provides its operators with real-time information on enemy battlefields/activities by performing Information, Surveillance, Target Acquisition and Reconnaissance (ISTAR) roles using multiple sensors and satellite communication (SATCOM) for extended-range capture and transfer of critical data. IAI's Malat Division is to supply around 50 Heron MALE UAVs to the Indian Armed Forces although senior IAI officials decline to admit whether the consignment also includes the armed Heron TP/Eitan. *[see news item]*

Powered by a single 85 kW Rotax 914 turbocharged piston engine manufactured by Austria's BRP-Rotax, the Heron can climb at 150m per minute and fly at a maximum speed of 207km/h with a range of 350 km and has demonstrated 52 hours of continuous flight with a modular space of up to 250 kg for customer furnished equipment. These include Electro-Optical (EO) and Infra-Red (IR) sensors (supplied by Northrop Grumman and Tamam Division of IAI), thermal surveillance equipment and laser designator. While the EO sensor converts light rays into electronic signals for capturing images, real-time data and videos, the laser designator is applied for targeting the enemy on the battlefield. Thermal surveillance equipment is used to capture high-resolution images during night by penetrating through clouds, rain, smoke, fog and smog. Communications are established through a direct Line-

of-Sight (LoS) datalink, UAV airborne data relay for beyond LoS missions and ground-based data relay for communicating with the Ground Control Station (GCS). Additionally, Electronic Support Measures (ESM) helps the Heron in threat detection and examination of the area to determine signals emitted from the surrounding radars and other electromagnetic emitters.

For maritime roles, the Automatic Identification System (AIS) gathers details of ships such as vessel type, vessel name and destination. The Elta Maritime Patrol Radar (MPR) identifies vessels from very long distances by applying silhouette target acquisition procedures. MPR also provides Synthetic Aperture Radar (SAR) images, and near coastline detects ground vehicles using its Ground Moving Target Indicator (GMTI) mode.

The Heron can be controlled either manually from the GCS or operate



in autonomous mode. As mentioned earlier, it is fully equipped with automatic launch and recovery (ALR) system, which helps in automatic safe landing during communication failure with the GCS. The processing, retrieving and storing of the real-time data provided by Heron UAV is undertaken by the GCS to convert the sensor data such as live and stored images, imagery and spatial information, including EO, SAR, MTI maps, SIGINT and ESM, into actionable intelligence.

Super Heron is a refinement of the Heron UAV with a heavy fuel 200-horsepower engine that increases its rate of climb and performance. With a top speed of 280km/h the range extends to 250 km LoS and 1,000 km by satellite control, while endurance is 45 hours at a maximum altitude of 30,000 ft.

An enhanced variant, the Heron TP/Heron 2/Eitan developed under an Israel Ministry of Defence programme, can carry multiple payloads and perform multiple missions such as Communication Intelligence (COMINT), Signal Intelligence (SIGINT) and image intelligence (IMINT)

and has entered service in Israeli Defence Forces (IDF).

Capable of Automatic Take-Off and Landing (ATOL) Heron TP can fly at 45,000 feet with endurance of approximately 36 hours. Apart from long range, long endurance Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) missions, the Eitan is designed to execute a large variety of operational missions, having made its maiden flight on 15 July 2006. The new MALE UAS will provide the Israeli Air Force persistent, High altitude, Long Endurance (HALE) ISR capability well beyond the reach of enemy air defences, well beyond Israeli borders. The Heron TP is powered by a single 1,200 hp Pratt & Whitney Canada PT6A turboprop engine, powering a four blade propeller. The use of such powerful turboprop engine enables the aircraft to climb and operate at altitude above 40,000 feet, avoiding any airspace conflict with commercial aircraft traffic. Using on board fuel and power resources, the Heron TP is able to sustain continuous

missions for over 36 hours with full mission payload and is also equipped with de-icing systems protecting the aircraft when flying through icing conditions.

With maximum takeoff weight of 4,650 kg, the Eitan can carry over 1,000 kg of EO/IR/SAR/MPR sensors in its forward main payload bay and the two bulges located at the end of each tail boom, offering optimal separation for specific systems. Other stores can be mounted along the wing, in internal and external positions. Eitan can also be fitted with wing hardpoints for external stores. The aircraft is equipped with multiple datalinks, supporting LoS and Beyond Line-of-Sight (BLoS) links via satellite communications. This giant drone maintains the twin tail boom principle offering stable and redundant design and large payload bay located around the aircraft centre of gravity, uninterrupted by the retractable landing gear. This configuration allows for quick and simple payload reconfiguration on the flight line.

*Sayan Majumdar*



# Maximising Capability

## MBDA air-launched systems



An IR variant of the MBDA MICA mounted to the wingtip station of a French Navy Rafale M

**M**BDA is an assured innovation leader in terms of technology. This technology is being deployed to offer the most advanced air-launched weapon systems extant to maximise the operational capabilities of today's new generation of combat platforms.

The IAF has taken advantage of this technology through its recent orders of MICA and ASRAAM as part of its Mirage 2000 and Jaguar upgrade programmes respectively. Both weapon systems offer unique capabilities that will give the IAF winning edge in mastering any disputed airspace. MICA, with its two seeker options covering the air battle from short to beyond visual range, brings the IAF's fleet of Mirages up to the very latest operational



A clear view of the infrared seeker on an MBDA ASRAAM missile

standard as deployed by the French Air Force. ASRAAM, which has the fastest reaction time from button push to intercept of any other short range air-to-air missile, will give the IAF's Jaguar pilots the best possible means of defending themselves against any attack from the air.

MBDA's portfolio includes Meteor which has long been recognised as an out-and-out game changer in the air-to-air battle. Because of its unmatched *No Escape Zone* (several times greater than that of any existing or planned beyond visual range weapon) provided by its ramjet-induced speed and end of flight envelope agility, Meteor offers air forces both strategic as well as tactical advantages. Any enemy considering aggression using air power will know in advance that significant losses of aircraft will occur before they get anywhere close to being within effective range of their own weapons. The Meteor offers guaranteed air superiority in the form of a clear deterrent. The weapon is already being delivered to the six European partner nations involved in the programme for the Dassault Rafale, Eurofighter Typhoon and Saab Gripen.

Recent combat operations in Libya and Afghanistan have highlighted capability of yet another MBDA missile system that is unique. The 50kg Brimstone can

be deployed from a range of platforms, such as fast combat jets, helicopters and UAVs, to strike a range of static and fast moving surface targets either individually or in salvo mode. With its dual mode seeker (millimetric wave radar and Semi-Active Laser), the pilot has the option of fire-and-forget or remaining in control throughout the operation depending on battle environment considerations such as collateral risks. Recent trials have also shown it to be the best weapon currently available capable of providing an effective response to the growing threat presented by swarming FIACs (Fast Inshore Attack Craft) such as small armed motor boats and inflatables.

Controlling the airspace is one aspect of an air force's mission, but it also needs to be able to deliver effects against key ground targets such as control bunkers and infrastructure. For long stand-off attack, MBDA leads the sector with two systems capable of surgical precision at ranges well over 250km : Storm Shadow / SCALP, a weapon associated with the Rafale and Eurofighter Typhoon, showed its capabilities with devastating effect during operations in Iraq and Libya. Its success even led to the US showing unprecedented interest in a non-American produced weapon. MBDA also has the Taurus KEPD 350 ER whose 'Tritec' navigation system allows it to operate effectively even in the absence of a GPS signal. It also has the unique capability of counting voids as it penetrates the various floors of a targeted building, heading for its intended point of detonation.



**Loïc Piedevache, Country Head, MBDA India**

# Astra



## The Spear for Air Dominance

Self-reliance in air-launched missiles and particularly in Beyond Visual Range Air-to-Air Missile (BVRAAM) systems, is of strategic importance considering the new paradigm of 'air superiority warfare.' With the anticipated service entry (around 2016) of the indigenous Mach 4 Active-Radar Homing (ARH) Astra BVRAAM, India's Defence Research and Development Organisation (DRDO) seems to have produced a missile that is arguably capable of outmatching similar missiles from the United States, Russia and Europe.

As part of induction trials the missile was tested on 21 May 2015 with a Sukhoi Su-30MKI fighter conducting high-g manoeuvres at high altitude. The prototype missile was first tested on 9 May 2003 from the Integrated Test Range (ITR) at Chandipur on the Odisha coast. On 27 March 2007, vertical launch of the missile was carried out, suggesting development of a Surface-to-Air Missile (SAM) variant. Following further tests dual-mode guidance was fully proved during May 2009, followed by captive flight tests on a Su-30MKI, which were carried out near Pune in November. A series of tests initiated on 20 May 2011,

also from the ITR at Chandipur, focused on evaluating the performance of the smokeless non-metallised high specific impulse propulsion system, the configurations of the vehicle, and an aerodynamic evaluation.

The project is guided and led by the Hyderabad-based Defence Research and Development Laboratory (DRDL). The single stage, smokeless, solid fuelled Astra with a length of 3,570 mm, body diameter of 178 mm and weight of 1,54 kg, uses high energy lithium thermal batteries, making it the lightest in its class, thus having a wide range of applications. The BVRAAM will be capable of destroying manoeuvring 9-g enemy targets at high altitude in the head-on mode at a range of 80 km and in tail-chase mode at 20 km, thanks to its low drag, low aspect ratio wings. Capability to pull lateral acceleration of 40-g in both yaw and pitch planes means it should be able to engage non-maneuvring targets well in excess of 100-km and be capable of operating from sea level to 20 km.

The all-important seeker is provided by Russian firm *Morinformsystem Agat* with an autonomous homing range of 25 km and is to be produced in India through a total transfer-of-technology process. Prior

ARH homing during terminal stage, Astra follows Fibre Optic Gyro (FOG)-based Inertial Navigation System (INS) during midcourse with high-g accelerometers along with a secure data link to allow midcourse re-tasking. While autopilot and guidance software uses Artificial Intelligence (AI) for accurate guidance and optimised trajectory, the on-board Electronic Counter Counter Measures (ECCM) capability allows it to stay on course in spite of enemy Electronic Counter Measures (ECM) procedures. At close ranges the missile can be fired in Lock-On Before Launch (LOBL) mode. The 15 kg high explosive warhead is pre-fragmented and radar proximity fuse armed plus directional to enhance lethality and high Single Shot Kill Probability (SSKP). Additionally, the DRDO is currently working on a new laser fuse. The choice of an Agat seeker is interesting as the establishment is highly reputed for development of infra-red seekers and may point to the possibility of an Imaging Infra-Red (IIR) version of the Astra. As ARH is effective in one set of conditions and IIR in another, the open choice of different seeker heads complicates defences of the adversary.



Projected to be a 'game changer' at tactical levels, Astra BVRAAMs are reportedly to be integrated with all frontline Indian Air Force fighter aircraft such as the Sukhoi Su-30MKI, MiG-29, Mirage 2000 and the indigenously developed Light Combat Aircraft. Its low weight and compact dimensions make it an obvious candidate for internal weapon bays of the Indo-Russian Fifth Generation Fighter Aircraft (FGFA) and the Indian Advanced Medium Combat Aircraft (AMCA). Reportedly, Mk2 version of the Astra will have a maximum range of 150-km and tail chase range of up to 35-km, propelled by a dual-pulse rocket motor. DRDO is also looking at rocket/ramjet propulsion for greater range and enhanced kinematics performance. However adopting a rocket/ramjet approach has certain limitations as the need for controlled airflow to the ramjet ducts means that the 'skid-to-turn' manoeuvring of a conventional rocket-powered missile is not acceptable (since it will risk disrupting air intake) and instead 'bank-to-turn' manoeuvring

needs to be adopted resulting in a reduced instantaneous turn rate.

The emergence of top quality Phased Array radars in IAF service has made it possible to detect fighter-sized targets at ranges well beyond 150 km with only high quality stealth platforms remaining 'invisible' at those ranges. The primary concern of the IAF and the Astra development team will be positive identification of enemy targets at those extended ranges since Identification Friend or Foe (IFF) remains a challenge because of incorrect and absent returns and 'spoofing.' Notably even while United States Air Force (USAF) tactics are BVR focused, very few BVR launches had occurred in combat prior to Operation *Desert Storm*. Even during *Desert Storm*, the United States Navy's F-14 Tomcats were disallowed the use of their AIM-54 Phoenix BVRAAMs owing to IFF complications at extended ranges. In contrast, USAF fighters did possess on-board systems to supplement data from Airborne Command Posts (ACP) like E-3B Sentry Airborne Early Warning & Control (AEW&C) platforms and were

allowed to conduct BVR engagements without resorting to risky visual verification, where the flight leader comes unacceptably close to the enemy formation for positive identification to pass the data to other fighters to enable BVR shots. Hopefully in the long term, development of electro-optical seeker technology coupled with an on-board threat database will let the missiles themselves determine legitimacy of the target. The IAF will receive adequate support from A-50EI AEW&C platforms as well as indigenous command and control aircraft for positive confirmation of enemy airborne targets at extended ranges. In this concept of 'Cooperative Fighter Operations' or Mixed Fighter Force Concept (MFFC) that will be essential for optimum performance and results in future BVR engagements, assets such as Intra-Flight Data Link (IFDL) will allow one fighter to launch the missiles against the targets while target illumination is provided by another allied aircraft.

*Sayan Majumdar*

# Derby - Israel's BVRAAM Solution

The Israeli missile and munitions giant, Rafael Advanced Defence Systems, has unveiled the I-Derby ER, the extended range (100+ km) version of its Derby Active Radar Homing (ARH) Beyond Visual Range Air-to-Air Missile (BVRAAM) currently completing development. It is an evolutionary version of the I-Derby BVRAAM shown earlier this year at Aero India 2015. The Derby entered service in the mid-1990s and is fielded with six customers worldwide.

The Israeli Defence Force-Air Force (IDF-AF) realised the value and operational flexibility of BVRAAM long back as it was repeatedly frustrated by high-altitude over flights by the MiG-25R Foxbat-B reconnaissance aircraft of the Soviet Expeditionary Force between October 1971 and March 1972. Soviet MiG-25Rs based at Cairo covered the Israeli-held coastline from Haifa to Port Said and flew the length of Sinai Peninsula involving 500 km penetration of the Israeli airspace. With a speed of Mach 2.5 to 2.8 at a cruising altitude of 80,000 feet they successfully evaded formidable Israeli defences including F-4 Phantoms, thus gathering valuable real time intelligence, and transmitting this to ground-stations through secure data-links for further analysis. Appropriate IDF-AF BVR tactics underwent development and during June 1982 two Syrian MiG-25 Foxbat-A were destroyed by the IDF-AF with carefully planned and executed 'snap up' attack by the F-15/AIM-7 Sparrow BVRAAM combination, emphasising the growing maturity of BVR tactics and procedures of the IDF-AF pilots. For the first time the formidable high-altitude MiG-25, hitherto regarded as 'untouchable', was shot down. The Raytheon AIM-120 AMRAAM succeeded the AIM-7 Sparrow in IDF-AF inventory in course of time and holds the distinction of being the first operational ARH 'fire-and-forget' BVRAAM.

However, the Derby BVRAAM, developed by Rafael Missile Division, was born from an Israeli desire to retain full control of BVRAAM technology especially in relation to Electronic Counter Counter Measures (ECCM) modes. The 3.62 metre long, 118 kg ARH BVRAAM shares design commonality with the Israeli Python 4 missile (including warhead and proximity fuse and even the same launcher), with the addition of mid-body wings, while its own 'no escape zone' overlaps that of the Python 4. The Derby is fitted with an ARH seeker with a compact gimballed antenna developed by Israeli Aerospace Industries' MBT Division. Derby has look-down/shoot-down capability and advanced programmable and adaptable ECCM to operate under dense electronic warfare environments while remaining reconfigurable upon the emergence of new threats. For BVR engagements a Lock-On After Launch (LOAL) mode is adopted in which the missile initially fired using cues from the launch aircraft's fire control radar, or perhaps an Infra-Red Search & Track (IRST) system employing inertial guidance immediately after launch until the ARH seeker is activated at appropriate distances to home in on the target with substantial kinematic performance allowing 'end game' manoeuvrability thanks to a slightly enhanced rocket motor.

For greater accuracy over extended ranges, the 'Derby Uplink' capability allows targeting data to be transmitted from the launch aircraft to provide accurate mid-course guidance while dealing with fast-moving or manoeuvring targets. The missile also has the ability to receive data-link updates from other platforms besides the launch aircraft thereby permitting 'stealthy' engagements. According to Rafael even the baseline Derby (now no longer in production) has a launch range in excess of 63 km if launched at Mach 0.9 at 25,000 feet against a head-on target, although its maximum range and its effective seeker range remain



highly classified. Derby also has a very low minimum range and an option for Lock-On Before Launch (LOBL) mode thus also capable of being employed for short-range engagements with Derby's seeker slaved to the aircraft's radar or the pilot's helmet mounted cueing system. During short-range engagements Derby's capabilities are regarded similar to Python 3 close-combat missile, trapping enemy aircraft in 'killing fields' out to 60 km.

In the present I-Derby ER evolution, the BVRAAM appears to have reached its inherent optimum potential. The latest variant is equipped with a new seeker that employs an advanced solid-state Software Defined Radar (SDR) technology, based on combat proven technology derived from the Tamir interceptor used in Rafael's Iron Dome system. The new lighter and more compact seeker has cleared valuable space which has been used by the missile designers to augment the propulsion system by adding a 'second kick,' thereby increasing the range of the I-Derby ER beyond 100 km against 'straight line' targets, and more importantly specifically to accelerate the missile at the critical terminal phase of the flight prior intercept of manoeuvring targets by increasing the BVRAAM kinematic envelope, and trapping the target in a 'no escape zone.'

The 'second kick' operates independently of the primary rocket propulsion and can be activated at any time during the fight, by the BVRAAM Flight Control System (FCS). The use of SDR technology means the missile seeker can be reprogrammed with software upgrades including new waveforms, duty cycles and processing techniques, addressing new threats, countermeasures and techniques that may evolve in foreseeable future. Smooth integration is a plus point as I-Derby ER BVRAAM will be compatible with aircraft currently cleared to carry the Derby. Rafael claims it is superior to the AIM-120C7 AMRAAM variant and will be able to deliver 80 per cent of the MBDA Meteor's performance at a third of its cost. The missile is already cleared on F-16I (Block 50/52), F-5E, Kfir and Indian Navy Sea Harrier. I-Derby ER integration tests are currently under way on India's Tejas LCA.

*Sayan Majumdar*

# Rainbow Warriors



*Exclusive coverage for Vayu by Patrick Smitshoek, Stephan van Geem and Remco Stalenhoef*

**D**uring the last two weeks of July 2015, the much anticipated fourth edition of Exercise *Indradhanush* ('Rainbow' in Hindi), a bilateral air and ground exercise between the Indian Air Force (IAF) and the Royal Air Force (RAF), took place in the United Kingdom. With the last such exercise having taken place in 2010, this was time again to exchange current ideas on the concept of operations in a dynamic modern warfare environment between these partner countries. However for the IAF this meant much more, as we soon found out.

## Advanced combatants

The IAF's initial model Su-30Ks had faced USAF F-15Cs and F-16s during their joint exercises, *Cope India*, in 2004 and 2005.

Although this was a start and useful, the IAF was seeking to exercise against an Air Force operating the latest fourth generation combat aircraft to further test the abilities of its newest combat aircraft, the Sukhoi Su-30MKI variant. Based on a long standing relationship (the IAF has historically chosen many UK-origin aircraft for its fleet and has maintained continuous ties with the Royal Air Force, exemplified by training on the Hawk AJT at RAF Valley) it was natural that the IAF would want to exercise with the RAF as the opportunity presented itself.

The first *Indradhanush* exercise was held at Gwalior Air Force Station in India during 2006 when the RAF sent its Panavia Tornado F3s, Vickers VC-10 mid-air refueling tankers and a Boeing E-3D AWACS for the exercise. This was

described as "a great experience" by both sides although performance of the 1980s–technology RAF Tornado F3 against the fourth generation IAF Su-30MKI was quickly apparent. It was thereafter agreed that *Indradhanush 2007*, which was held at RAF Waddington in the UK, would involve more advanced combatants on both sides. Britain's Eurofighter Typhoon, whose advanced aerodynamics and intuitive controls and avionics have rated this as the "second-best air superiority aircraft in the world", was supplemented by the Tornado F3 of the RAF and the very latest Harrier GR9 from the Royal Navy. Facing them was the IAF's Su-30MKI, the most evolved operational version from the Sukhoi family of *Flankers*, whose aerodynamics allow unique manoeuvres

and full thrust vectoring. Back in 2007, (the former) Air Chief Marshal Sir Clive Loader, Commander-in-Chief (C-in-C) Air Command emphasised the importance of this bilateral event, stating that the exercise was an “outstanding success”.

The following Exercise was held a few years later at Air Force Station Kalaikunda in Eastern India in 2010 with an all-Typhoon participation by the RAF as the Tornado F3 was being decommissioned by the RAF. For various reasons (mostly because of world events in which the RAF participated) it took another five years to organise the recently held fourth edition of exercise *Indradhanush*.

### The participants

During their stay in the UK the Indian Air Force were scattered over three RAF air bases. Four Sukhoi Su-30MKIs of No.2 Squadron ‘Winged Arrows’, normally based at Air Force Station Tezpur in Assam, operated from RAF Coningsby where they were hosted by No.3 (F) Squadron flying Eurofighter Typhoon FGR4s. The Typhoon was one of the contenders to meet India’s multi-billion dollar medium multi-role combat aircraft (MMRCA) programme and therefore was an interesting partner in the duel with the IAF. As Squadron Leader Avi Arya, a Qualified Weapons Instructor responsible for training pilots on the radar

and weapons systems of the Su-30MKI commented: “Both are fourth generation aircraft and are matched evenly, so the learning value comes from person to person contact, it’s the man behind the machine which matters. All fighter pilots speak the same language, that’s the common thing we have and it’s very comfortable to learn from each other”.

The IAF’s transport support aircraft for the exercise were a Lockheed Martin C-130J-30 from No.77 Squadron and Boeing C-17A from No.81 Squadron plus one Ilyushin IL-78MKI air-to-air refueling aircraft from No.78 Squadron IAF, all based at RAF Brize Norton during the exercise and, except for the C-17A, took part in missions along with the fighters. Brize Norton is also the home base for the RAF C-130 and C-17 fleet which made it an ideal support base for these assets.

Last, but not least, the Indian Air Force commando unit (*Garuds*) joined their RAF counterparts of the II Squadron (Parachute) RAF Regiment, at RAF Honington for bilateral training during the exercise. The RAF fielded their Typhoons, an Airbus A330-200 Voyager tanker aircraft and a C-130J. The latter was used for various tasks among them joint parachute drops of the RAF Regiment and IAF Garud troops over the Stanford training area (STANTA) in Eastern England. Because of no standing

arrangements concerning mutual air-to-air refueling, the IAF IL-78MKI and the RAF Voyager only refueled their own airforce aircraft.

### Different Missions

During their two-week stay in the UK the Indian contingent of 185 personnel accomplished different missions with their RAF counterparts. The four Su-30MKIs at RAF Coningsby began with familiarisation sorties with the Typhoon FGR4s of No.3(F) Squadron to get acquainted with flying conditions in this part of Europe where airspace is more crowded and compact. Wing Commander Moon, commanding officer No. 3(F) Squadron explained how the exercise evolved: “All missions scheduled for this exercise were Air Defence missions both BVR (Beyond Visual Range) and WVR (Within Visual Range). After the familiarisation flights the exercise worked up progressively, from basic one versus one missions (Dissimilar Aerial Combat Training or DACT) to two versus one and on to larger mixed formations with up to 20 fighters”. The IAF pilots were enthusiastic about the path that the exercise followed: “It’s going well. We’re flying a lot of missions that are proving our air combat missions. We brief on the ground, we go up there, set up the fights and thereafter it’s a free for all. The Typhoon is a good and powerful



*Sukhoi Su-30MKIs of No.2 Squadron IAF in English skies*



*Eurofighter Typhoons of the Royal Air Force*

aircraft. The RAF pilots are really amazing and flying with the Typhoon we're learning a lot of new lessons from the RAF which we will take back to India. Of course we're also giving some good points to the Typhoon pilots," said Squadron Leader Amit Gehani who trained on the Hawk jet trainer with the RAF in the UK. Missions were flown against each other (RAF versus IAF) but also utilised to integrate forces by mixing up formations. This added a higher level of complexity to the exercise which was said to result in a higher learning curve for all those involved.

**Commandos All**

A special aspect in a normally aircraft-dominated exercise was the exchange between the commandos of both the IAF and RAF. Operating out of RAF Honington, home base of II Squadron RAF Regiment, both units interacted together and shared ideas on special operations. "It was a busy two weeks" said Squadron Leader Jorden, Officer Commanding II Squadron RAF Regiment before another paratroop drop over STANTA. "Together with our Indian partners we talk about special operations procedures like low level paradrops, which helps diplomacy for future operations. You never know with

whom you will work in future world events and therefore it is good to synchronise procedures." Later that afternoon a RAF Special Operations C-130J-30 took off with 40 mixed IAF and RAF paratroopers on board who were dropped in pairs at 800 feet (275 metres) above ground level after the green light in the cargo bay. On the

ground the paratroopers ran into (Special Operations) exercise scenario provided by personnel of the Operational Training and Advisory Group (OPTAG) at STANTA. Warrant Officer Mishra, loadmaster on the participating IAF C-130J of No.77 Squadron 'Veiled Vipers' praised the exposure the Garuds were getting in the



*RAF and IAF Commandos move to C-130 Hercules for joint exercises*



UK. IAF personnel in the UK were a mix of six different units randomly chosen after doing an academics course and half day ground school training to check RAF jump procedures. While in the UK, the IAF used RAF Regiment parachutes and the jumps were under control of RAF jumpmasters while operating from a RAF C-130 (only static line jumping). Purpose of the parajumps together was to get more confident with RAF Regiment procedures, tactics and performing on operations together.

### Future Exercises

The IAF has been keen on participating once again at the prestigious *Red Flag* exercise in Alaska during 2016, which will be some eight years after their last participation in such an exercise in 2008. According to the MoD, it has taken the IAF this long mainly because of the financial costs of the exercise, including the long ferry flights to/from the United States. During May 2015, the IAF Chief, Air Chief Marshal Arup Raha, on a four-day visit to the USA, reportedly discussed future participation of the IAF in the exercise apart from the possible purchase of AH-64E attack and CH-47 heavy transport helicopters. It is learnt that the green light was given for the IAF to take part join the exercise next April in Alaska.

Thus, Exercise *Indradhanush* could well be a precursor for the more challenging exercise on the IAF's future calendar. With *Indradanush*, the IAF sought to demonstrate its ability to project air power in transcontinental deployment of a task force comprising fighters, air refueling tankers, strategic and tactical airlift aircraft in air operations. As articulated by Group Captain Ashu Srivastav the detachment commander (DETCO): "All assets in air operations are present in this exercise. The

Il-78 will act as mid-air refueling aircraft thus complementing the operational capabilities". Amidst the excitement of the aerial 'battles', the successful deployment of Indian aircraft using IAF aerial refueling and logistics personnel might well be unnoticed but from India's point of view however, the significant aspect of IAF's continued enhanced strategic reach capability may be even more important than the results of the fighter duels in the air."



*Su-30MKI and Typhoon in close formation*

Su-30MKI is the mainstay air superiority fighter for the IAF, the aircraft renowned for its maneuverability. The C-17 and the C-130J are part of the planned special operations which will see the participation of IAF's Garud commando unit and the II Squadron RAF Regiment. Finally, our

### Tremendous Experience

Joint exercises such as *Indradhanush* are valuable for the insights they provide, but are also valuable for the trends they presage. The logistics and interoperability lessons learned by the IAF during this exercise are an indicator of, and a contributor to, some trends worth watching. Multinational joint exercises offer an interesting view of the 'actual' operational capabilities of weapons systems as well as national competencies. *Indradhanush* was an opportunity for both Air Forces to get an insight into each other's operational philosophies and work cultures. "This will greatly enhance the understanding of both forces to operate in scenarios involving state of the art technologies." Wing Commander Joardar who was exercise director for the IAF detachment concluded: "The IAF is expanding with new platforms, weapons and avionics. This bilateral exercise was a good way to exchange our experiences and share our tactics. Aviation itself is not that different around the world. The RAF flies similar types of missions as the IAF does. Therefore we both gain tremendously when we exchange our experiences together."

With both the RAF and IAF rating exercise *Indradhanush* 2015 as a "big success," it is more than likely that follow up exercise(s) will be scheduled in the coming year(s).



*Gp Capt Ashu Srivastav, IAF*





# The Typhoons of Coningsby ...

## ... host the Flankers of Tezpur

Royal Air Force Coningsby is located some 8 miles south west of Horncastle in Lincolnshire, England, the station being prime base for the RAF's Typhoons, housing four squadrons of this frontline combat aircraft. These are No. 41 (Test and Evaluation) Squadron, the Operational Evaluational Unit, No. 29(R) Squadron (the Operational Conversion Unit) and No. 3(F) Squadron, the first Typhoon operational squadron, flying the Eurofighter Typhoon FGR4 and T3. No.XI Squadron became part the station as a Typhoon unit in 2006.

Since June 2007, the Typhoons of No. 3(F) Squadron have been backbone of the UK air defence along with RAF Leuchars near St Andrews, Fife, Scotland, both of which were earlier equipped with Panavia Tornado F3 fighters. RAF Coningsby is also home to No. 121 Expeditionary Air Wing.

In July 2015, RAF Coningsby had unusual 'guests', playing host to four Sukhoi Su-30MKI 'air dominance' fighters from No.2 Squadron Indian Air Force, in the fourth of a series of exercises called *'Indradhanush'*. Also included in the exercise were transport and tanker assets from both nations that operated



Location of RAF Coningsby in NE England



## Seen at RAF Coningsby, July 2015



*Typhoon two-seater*



*Typhoon of No. 3 Squadron RAF with its centenary markings*



*Su-30 MKI on landing*

from RAF Brize Norton. The exercise was beneficial to both air forces, both of which have similar traditions, but have evolved in so many different ways.

The four Su-30MKI aircraft detachment left Tezpur in Assam for Coningsby in England, some 11,000 km away, staging via a number of air bases, beginning with Air Force Station Jamnagar. On 15 July, the IAF aircraft flew to Taif Air Base in Saudi Arabia which was a journey of 4,500 kms. Then following an overnight stay, a distance of 3,300 kms took them to Athens, before another 3,300 kms had them arriving at Coningsby on 17 July, with a total flying time of 13 hours. The Su-30MKIs were supported by an Ilyushin Il-78 from No.78 Squadron, a C-130J from No.77 Squadron and a C-17A Globemaster III from No.81 Squadron. The IAF detachment was headed by Group Capt Ashu Shivastra, currently with Central Air Command, but having over 2000 hours on the Su-30MKI and previously commanding No.31 Squadron. Included in the group were 15 pilots and 5 navigators/WSOs from No.2 Squadron, plus numerous other officers from the TACDE and various other squadrons flying the Jaguar, MiG-21 and Mirage 2000.

The fighter part of the exercise had the two combat squadrons, No.3. RAF and No.2 IAF develop a 'crawl-walk-run' approach as both sets of crews became familiar with each other and their aircraft. This involved flying missions twice a day that started as 1v1, then 2v1, then 2v2 'dog fighting', before some beyond visual range exercises. Other RAF assets participated in these including more Typhoons from RAF Lossiemouth and No.100 Squadron Hawks from RAF Leeming in the EW role. As CO of No.3 Squadron, Wg Cdr Chris Moon commented "as soon as it became clear that IAF Flankers were going to participate in Exercise *Indradhanush*, we were inundated with requests from other RAF squadrons to participate." No wonder, as the Typhoons are certainly tasked to confront, and perhaps combat, the Flanker family (Su-27/Su-30) in other than IAF colours!

The initial drills were aimed at working up to a complex large force exercise which effectively took part on 29 July. This involved the four Su-30MKIs along with four Typhoons from No.3 Squadron as



*Picture worth a thousand words*

‘Blue force’ in a mission to escort two C-130s (one each RAF and IAF) in a para drop mission that included troops from the RAF Regiment and the IAF Garuds. Against them were eight ‘Red Force’ Typhoons from RAF Lossiemouth. Assessing the entire scenario were ‘White Force’, which consisted of RAF Air Warfare

Centre personnel and IAF personnel, including those from TACDE.

Both the Royal Air Force and Indian Air Force were pressed to comment on “who had won the exchanges”, but both remained tight lipped. One said that there was not much between the 4th generation aircraft, one of which relied on a high rate



*Wg Cdr Chris Moon*



*Gp Capt Ashu Srivastava*



*Air Cdre G.S. Bedi, the AA with Indian High Commission in London*



of turn and the other on a high AOA, but the difference in the main had been that experienced pilots on both sides had scored kills on each other’s aircraft.

Wg Cdr Moon said “strength is our people” and that “everyone had enjoyed working with the IAF, the best part being getting to know the IAF personnel”.

It was confirmed by IAF pilots that the Su-30 radars had been switched on for the exercise and that thrust vectoring “had been crucial in getting the edge”, in order to get a snap shot on opposing fighters. Group Capt Ashu Shivastra confirmed that they had simulated BVR missiles such as the R-27/R-77 and close range R-73. However, no stores were carried live on the aircraft during Exercise *Indradhanush*.

The IAF aircraft departed eastwards for their return to India on 31 July.

*Phil Camp*

# Beyond *Indradhanush* 2015 : Some shadow boxing !



*IAF contingent commander Group Captain Ashu Srivastav (left) presenting a memento to his RAF counterpart Wing Commander Chris Moon (right), CO 3 (F) Squadron, at RAF Coningsby*

Barely had the AL-31FP turbofan engines of No.2 Squadron Sukhoi Su-30MKIs shut down on their return to India after Exercise *Indradhanush* 2015, than some off-hand remarks reignited the duel. In his officially cleared interview with NDTV at South Block, headquarters of the Indian Ministry of Defence, Gp Capt Ashu Srivastav, the IAF Contingent Commander said that the performance of his pilots was “exceptional”, the IAF Su-30s in fact scoring a resounding “12:0 victory over Royal Air Force Typhoon jets in Within Visual Range (WVR) combat.” He said his pilots had showed “flexibility and adaptability to a new environment and operating conditions and on this benchmark, I would rate them exceptional.”

However, in subsequent Large Force Exercises (LFE) which featured combined Typhoon and Su-30 formations, the IAF fighters were somewhat less successful “but

consistently held an edge over the Typhoon.” First, there were 1 v 1 encounters where a single jet of each type engaged each other in Within Visual Range (WVR) combat, firing simulated missiles to a range of two miles. The exercises progressed to 2 v 2 engagements with two Eurofighters taking on two Su-30s and 2 v 1 exercises where two Sukhois took on a single Typhoon and vice versa.

Notably, in the exercise where a lone Su-30 was engaged by two Typhoons, the IAF fighter emerged the victor by ‘shooting’ down both ‘enemy’ fighters. In all dogfighting exercises, IAF Sukhois were able to turn sharply into the extremely agile Typhoons using their thrust-vectoring engines to keep the RAF jets locked in their sights. The Su-30’s advanced Infrared Search and Track System (IRST), a passive sensor, which cannot be tracked, proved to be a distinct advantage for the IAF’s pilots in close-combat manoeuvring.

Both the IAF and RAF used the full capabilities of their onboard radars albeit in training mode, which meant that actual radar frequencies used in combat conditions were never exposed for confidentiality reasons. However, the detection ranges of the radars of both aircraft were not curtailed per se. This was air combat as close to the real thing as possible.

The Royal Air Force was quick to contest the IAF claims : “There must have been some clouded recollection on the flight back to India, as the headlines of the Indian press bear no relation to the results of the tactical scenarios completed on the exercise in any shape or form.” Other RAF sources were quoted as saying that the IAF claims were “comical” and “clearly designed for a domestic audience”.

The official press releases reflect the different approaches. That of the Royal Air Force quoted Wg Cdr Chris Moon, Commanding 3(F) Squadron as saying,



*Typhoons and Flankers in British skies (RAF photo - Crown Copyright)*

“This is an exciting exercise for us. In the Typhoon Force we deploy around the world on various exercises, so to have an Air Force as respected as the IAF with their Su-30 Flankers is a huge experience for us and we’re really enjoying flying with them.”

Another RAF officer exulted :“This is fantastic. It’s the first time I’ve flown against a Flanker this morning and it’s fascinating to see another air force do its thing in a different aeroplane. Flying against an aircraft which is equally comparable to the Typhoon isn’t something we get to fight against on a regular basis in the UK. It’s very exciting. The Su-30 is an incredibly impressive fighter but the Typhoon is a good match for it.”

Thereafter, in an obvious damage control exercise, the Indian Air Force Public Relations Directorate sobered the hype : “Such exercises are conducted under controlled conditions with mutually agreed weapons performance parameters, with the basic aim of learning from each other’s best practices. Additional advantages that accrue are greater understanding of each

other’s general operational philosophy and exposure to a different operating environment. In combat exercises, definite objectives are laid down for each component participating. After the exercise, during

debrief, a detailed analysis is carried out to assess the extent of achievement of laid down objectives. There are no classic wins and losses as no weapons are fired as per their actual capability.” *Touché*



*No. 2 Squadron IAF Su-30 MKI*

**Although foreign media outlets and journalists were granted almost unrestricted access to the Exercise by the RAF including flight sorties in operational RAF tanker and transport aircraft, their IAF counterparts kept Indian trade media away and all attempts to cover the Exercise were met with reticence. Although a member of *Vayu’s* Editorial team was in the UK at the time (covering other events), this journal’s coverage of Exercise *Indradhanush* 2015 has been conducted by freelance UK and Europe-based journalists.**

Vayu's UK Editor, Richard Gardner

# Remembers 'The Few'

*This year marks 75th Anniversary of The Battle of Britain (July-October 1940), and there are numerous flying displays and other special events to mark the memorable occasion.*



*Today's RAF Typhoon in wartime colour scheme flying alongside a Hurricane of the RAF Battle of Britain Memorial Flight (Crown Copyright)*

The number of surviving veterans from this epic air battle is sadly reducing quite rapidly, as even the youngest combat pilots at the time (some were mere teenagers) are now in their 90s. The fact that 'The Few' are becoming fewer has not prevented many of them continuing to take part in various anniversary events, including squadron reunions and airfield visits, and wherever they appear they are rightly treated as the real national heroes.

Most of them, when interviewed show the same levels of amazing modesty, even all these years later, which was also a hallmark of their earlier lives when after the Second World War, they simply blended into normal society to carry on with their careers, whether in the Royal Air Force, commercial aviation or industry, or something completely different.

It was only two decades or more later when more official records were released and

biographies and auto-biographies appeared, plus the ultimate star-studded big-screen movie 'The Battle of Britain,' that a wider audience was able to appreciate in the true sense global significance of what 'The Few' had achieved, and how that changed the history of the world. In more recent times, as the results of further research have emerged in book-form, articles and films, the important role played by all the other nationalities who fought overhead in



*Selection of photos taken at the RIAT air show of the Spitfires and Hurricanes flying a 75th Anniversary tribute to the Battle of Britain (photos: Richard Gardner)*

British skies alongside the RAF has received wider recognition. Pilots from as far away as India, Australia, Canada and New Zealand as well as those who escaped from Occupied Europe, played a key role in helping to defeat the Nazi Luftwaffe bombers which came so close to achieving their aim of clearing the skies in preparation for the invasion of the British Isles. The outstanding contribution made by the Polish squadrons

in particular has only been fully appreciated quite recently.

The decisive day in the battle is regarded as 15 September 1940, which is the official commemorative day each year when RAF ceremonies take place in London and at other locations in the UK. But the number of air displays is spread across the whole summer, and this year most of them have a Battle of Britain theme, as well as exhibitions

in the RAF Museum and other heritage centres. The biggest international gathering this year of military aircraft and high level military guests was at the Royal International Air Tattoo held at RAF Fairford 17-19 July. As well as participants from air forces and army and naval air squadrons from all over the world, there was also a nostalgic pageant of vintage and classic warbirds representing a century of military aviation. The most impressive flying display item was a mass flypast of 16 Spitfires and Hurricanes, representing almost every different version of these two Battle of Britain fighters. Four of the vintage aircraft actually took part in the real battle, and the flypast began with aircraft taking off in twos and threes before forming up to fly in a mass formation. The spectacle provided the unique sight of four airworthy Hurricanes, including a Mk.1, and the only two airworthy Spitfire Mk.1s in the world. Also in the formation were several late-model Griffon-engined Spitfires and a Seafire. Other anniversary air displays are taking place in many locations around Great Britain, from Prestwick in Scotland to Bournemouth on the South Coast, as well as at such well-known heritage airfields as Duxford and Biggleswade, where newly restored veteran aircraft demonstrate the ongoing enthusiasm and dedication that keeps alive interest in aviation history for the benefit of future generations.

To commemorate the 75th Anniversary of the Battle of Britain a contemporary Royal Air Force Typhoon of No 29 Squadron was repainted in the 1940 wartime colour scheme with the identification code of the aircraft flown by Flt Lt James Brindley Nicholson, the only Fighter Command pilot awarded the Victoria Cross during the battle. This Typhoon has carried out displays this summer in a unique synchro-pair sequence with a Spitfire from the RAF Battle of Britain Memorial Flight. The display routine requires great skill as the two fighters fly in close formation despite the great disparity in their performance. Needless to say, the Mach 2 Typhoon has to throttle back with a high angle of attack as the Spitfire maintains maximum speed !

With the enduring popularity of the Spitfire and Hurricane, and each year more airworthy restorations increasing the total number of flying examples, it is a fair bet that there will still be RAF Spitfires and Hurricanes flying long after the last Typhoon has been retired around 2030 !



# LEGENDS OF THE AIR

**75 years ago an epic air battle raged over Europe. When it was over, ‘The Battle of Britain’ swiftly ascended into legend. Vayu’s Angad Singh was in England during July 2015 to experience part of the UK summer air show season commemorating this incredible air war.**

Shortly after the fall of France in June 1940, and well before the United States of America became ‘formally’ involved in the Second World War, it fell to British pilots and some from other Commonwealth and European countries, flying fighters from a small island nation across the Channel, to halt the Nazi juggernaut that had made such short work of mainland Europe.

And halt them they did! Although Prime Minister Winston Churchill had reposed great faith in the abilities of the men and women of Great Britain (and her allies) to stand successfully against the might of Hitler’s hitherto-undefeated army, it is unlikely that even he expected so incredible an effort—and result.

Hitler and his military leaders (*Oberkommando der Wehrmacht* – OKW ‘Supreme Command of the Armed Forces’) had judged—correctly—that for any invasion of Britain to succeed, control of the air and sea must first be assured. Towards this end, Reichsmarschall Hermann Göring’s Luftwaffe threw everything they had at the RAF. For a little under four months, German air power struck repeatedly at Britain in a manner akin to a hammer on an anvil. From the outset, and indeed almost throughout the Battle of Britain, the Luftwaffe held the advantage in terms of absolute numerical superiority of both men and machines. However, superior RAF tactics, innovative aircraft design,

better training and above all, sky-high morale, allowed the British to first hold the Luftwaffe off, and then decisively turn the tide of the battle.

This remarkable achievement is now considered as the crucial turning point of the Second World War, and is immortalised in Churchill’s eloquent statement: “*Never in the field of human conflict was so much owed by so many to so few.*”

Unsurprisingly, the 75<sup>th</sup> anniversary of this great air campaign is being commemorated with great enthusiasm throughout the 2015 air show season in the UK. *Vayu* reports from two fantastic shows held back to back in July 2015.





## Flying Legends

As the name suggests, the two-day *Flying Legends* air show at Duxford, near Cambridge, features only vintage aircraft, primarily those from WWII, with the odd interwar aircraft thrown in. The show is put on by *The Fighter Collection*, which also owns and operates one of the finest selections of 'warbirds' in the world. The aircraft and maintenance facilities are co-located with the famous Imperial War Museum (IWM) Duxford, making *Flying Legends* an excellent opportunity to take in the museum exhibits as well. Established in 1993, the event quickly became a hit on the European air show calendar. In fact, this year's edition featured air enthusiasts

visiting from as far afield as the USA, Australia—and India, this writer being informed that it is not uncommon for enthusiasts around the world to make the long journeys for the show.

The venue itself is also quite special. The RAF station at Duxford dates back to 1918, and was used as a fighter station in the interwar period. The resident No.19 Squadron then was the very first unit to receive the Supermarine Spitfire in 1938, and the station saw extensive activity during WWII, including during the epic *Battle of Britain*. It was here that the famed ace Douglas Bader rose to fame commanding No.242 Squadron. Duxford was also the site where Ronnie Harker, a Rolls-Royce

test pilot, evaluated an Allison-engined P-51 Mustang and asserted that the fighter, though perfectly competent, could be made superlative with a Rolls-Royce Merlin powerplant. The rest, as they say, is history, with the Merlin-engined P-51s (P-51B onward) proving absolutely invaluable to the Allied war effort from 1942 onward.

When the United States entered WWII, Duxford came under the US Army Air Force, with the 78th Fighter Group taking up residence here in April 1943 and through till end of the war. The base was returned to RAF control shortly after the war, and continued as an operational field until it was decommissioned in 1961. Duxford then played a major role in the star-studded 1968 movie *'Battle of Britain.'* By the late 1970s, after the UK MoD had sold off the airfield, the Imperial War Museum bought the property and there is now a thriving partnership between permanent museum exhibits and several vintage aircraft operators and restorers, including *The Fighter Collection*, *The Aircraft Restoration Company*, and *Historic Flying Limited*. Small wonder then, that it has become the de facto 'mecca' for warbird enthusiasts the world over!

2015 was a particularly exciting year for the *Flying Legends*. While there certainly have been larger editions of the show, the sheer variety of aircraft types represented among the 50 or so warbirds in attendance this time was staggering. A number of aircraft appeared in the UK for the first time, including a newly-restored Curtiss P-36C that had just made the long journey back to the UK from California, and a stunning Merlin-engined Supermarine Seafire Mk.III fresh from a mammoth twenty-year restoration. Also represented were a pair of Hispano HA-1112-M1L Buchón in markings representative of Luftwaffe Messerschmitt Bf-109s, along with an Airbus-owned Buchón restored to Bf-109G-4 specifications, including its Daimler-Benz DB605 engine. Other rare types in attendance included a Curtiss Hawk 75, Morane-Saulnier MS.406, a graceful three-engine Junkers Ju-52, a Lockheed P-38 Lightning and a North American B-25 Mitchell, the latter pair owned and operated by the Austrian drinks company *Red Bull* and displayed in a phenomenal polished-metal finish.

Both show days began with an incredible 'Spitfire Scramble' involving eleven Spitfires



*The flight line seen before the show, with a Tiger Moth taking off for a joyride in the background*



*Vintage aircraft and vintage flying kits!*

of various marks, led by four Rolls-Royce Griffon-engined examples, taking off together. After a few passes with all eleven in formation, the Spitfires then split into three individual elements—two groups of four and one of three—to conduct ‘tail chases’ over the airfield. The intermingled sounds of seven Merlins and four Griffons at varying throttle settings were simply heavenly!

These legends of British aviation were followed by an American trio of two Vought

Corsairs and a Grumman Bearcat. The Bearcat, renowned as one of the fastest piston-engined aircraft ever built, put on a fantastic display, highlighting the sheer power delivered by the Pratt & Whitney R-2800 Double Wasp in the nose. The gull-winged Corsairs performed tail chases and formation aerobatics, with the matte-black F4U-5NL looking particularly striking when paired with the blue-and-yellow Goodyear-built FG-1D variant.

Continuing the American theme after the naval fighters were done came one of the highlights of the show—the ‘Curtis Hawk Family Formation’ comprising a Hawk 75 in French ‘Lafayette Escadrille’ markings, a P-36C in USAAC colours, an Allison 1710-engined P-40C Warhawk also in USAAC markings, and a Merlin-engined P-40F Kittyhawk in rather fetching desert camouflage. After a formation pass (a ‘family photo op’ if you will), the P-40s split off for a slightly higher-level aerobatic display while the P-36 and Hawk 75, the only surviving airworthy examples left in the world, stayed closer to the crowd, putting on some stunning low-level passes in formation. Toward the end of the display, the Curtiss aircraft were joined by the Morane HS.406, in Swiss Air Force marking.

Another incredible American showcase was a quartet of North American P-51 Mustangs, a pair of single-seat P-51Ds and two twin-seat TF-51Ds. Three of the Mustangs conducted aerobatics and tail chases all over the airfield while the fourth conducted a solo aerobatic display over the runway. The P-51 segment was perhaps the most spirited of the entire show, with the trio of tail chasing Mustangs practically re-defining the phrase ‘beating up an airfield.’ The crowd was raucous in its appreciation



*The incredible 'Spitfire Scramble' in action*

of the fast passes and rapid transitions from high level to low, as the pilots threw their aircraft around with seemingly wild abandon.

As the Mustangs wrapped up, Europe's last remaining airworthy Boeing B-17 Flying Fortress (*Sally B*) took off and rendezvoused with a shark-mouthed Mustang flown by Lars Ness. *Sally B* was featured in the famous 1990 movie *Memphis Belle* and is a well-loved air show participant around the UK. After a few slow and low passes, with and without her fighter escort, the B-17 returned to *terra firma* to hand the display over to a trio of aircraft that three-quarters of a century ago would have been blasting holes in her with machine guns and cannon!

Two Hispano HA-1112-M1L Buchóns (Spanish-built Messerschmitt 109s with Merlin engines in place of the original Daimler-Benz DB-605) took off trailing Klaus Plasa of the *Messerschmitt Stiftung*, who flew *Rote Sieben* (Red Seven), a Buchón restored to Bf-109G-4 specification, complete with a Daimler-Benz engine. Plasa flew the Bf-109 fast and low near the crowd, which was a special treat, given the paucity of airworthy Bf-109s in the world, while the Buchóns carried out a parallel display higher up and a little further away. The British were clearly not parochial about having Axis fighters on display even with a



*Stunning black Corsair in a Korean War scheme*



*The 'Hawk Family Photo': the family resemblance is quite obvious!*



*B-17 'Sally B' with her P-51D escort, just as it would have been 75 years ago*



*The evocative Messerschmitt Stiftung Bf-109G-4 making a fast pass*



*Pair of Hawker Nimrods in formation over Duxford*

Battle of Britain commemorative theme, given how rare these aircraft are.

A short pre-war biplane display followed, with a Hawker Fury, a pair of Hawker Nimrods and two Gloster Gladiators taking to the air. After the fast and loud fighter displays that had characterised the first part of the show, this segment felt almost serene! Nevertheless, it was once again incredibly gratifying to see these aircraft not only cared for in a manner befitting their place in history, but actually airborne, as all aircraft are really meant to be.

Then followed a 'proper' Battle of Britain formation: a Bristol Blenheim Mk.I, three Spitfire Mk.IIs and a Hawker Hurricane Mk.XII. Not only did these represent the crucial aircraft types in service during the Battle of Britain, they also highlighted the incredible pace of aircraft development, from the early-1930s Blenheim to the high performance single-engined fighters of the Battle of Britain and later war period.

Formation flypasts gave way to a Blenheim solo piloted by the masterful John Romain of the *Aircraft Restoration Company*, followed by the Spitfire trio led by Paul Bonhomme with Steve Hinton and Dave



*The Blenheim Mk.I takes off with Spitfires and a Hurricane ready to depart*

Ratcliffe on each wingtip, while Dave Harvey conducted higher level solo aerobatics above in his Hurricane. The Blenheim's participation was particularly well received given the circumstances of its resurrection. As the sole airworthy Blenheim in the world, this aircraft crashed while landing at Duxford in August 2003. It was configured as a Blenheim Mk.IV at the time of the accident, but during the course of the restoration, it was decided to rebuild it as a 'short nosed' Mk.I. The task took eleven years, but the aircraft finally flew again in November 2014 and has been enthusiastically welcomed back to the show circuit in the UK.

The British gave way to the Americans in the form of the polished metal Red Bull duo of a Lockheed P-38 Lightning and a North American B-25J Mitchell. Although many purists decry non-authentic colour schemes and garish corporate logos on restored warbirds, if that is what it takes to get them back in the sky where they belong, so be it! Indeed, seeing this pair in the sky over Duxford was an extraordinary pleasure, for the clattering roar of the B-25 is something that must be experienced in person, while the grace and form of the sleek P-38 are hard to match by anything, albeit in any colour scheme!

There was a brief return to naval aviation after the *Red Bulls* concluded their display, with a Grumman Avenger



*The B-25 (above) and P-38 (below) looked stunning in a bare-metal finish*





**The three-engine Ju-52 gets airborne**

lead into the Balbo on each show day was, in the view of this writer, a touching and fitting tribute to his association with the show and the aviation community at large.

Once the formation was ready, it droned in from the east, turning the lush Cambridge countryside for a few brief moments into a fantasy landscape, where Spitfires, Hurricanes, Bearcats, Corsairs, Blenheims, Messerschmitts and Mustangs flew together. Friends, former foes, large, small, bomber or fighter—there are few more uplifting celebrations of flight than this.

It is the stuff of, well, *legends*.

***Text and Photos by Angad Singh***

and Hellcat taking off, before a stunning display by the Hawker Sea Fury FB.11 in pristine Royal Australian Navy colours. This was followed by a 'liaison flight' of three Piper L-4 Grasshoppers. These light non-combat types are far from the glamorous fighters one often sees at warbird shows such as *Flying Legends*, but were nonetheless very much part of the war effort and it was fitting to have them included in the display programme.

After the Pipers, Anna Walker took off in her Bücker Jungmann biplane to display along with a Ju-52 in Luftwaffe camouflage. A Breitling-owned DC-3 continued the transport theme with a graceful solo display before the final segment, the finale that sets *Flying Legends* apart from every vintage air show—indeed any air show of any kind—in the world. It was now time for the Balbo.

Any massed aircraft formation is a thing of beauty, but the Balbo at *Flying Legends* is particularly special. While twenty-plus aircraft got airborne and began to form up over the north end of the airfield—a complicated and time-consuming affair at the best of times—a single aircraft performed aerobatics to keep the crowd entertained. This aircraft is called the 'Joker' and at *Flying Legends 2015*, the honour of flying the 'Joker' went to Nick Grey, with a Gloster Gladiator as his steed. Nick conducted flawless, almost fluid, aerobatics with a musical composition by the Oscar-winning James Horner as accompaniment. Horner, who had been killed in a tragic flying accident just a few weeks prior to the show, was a keen aviator and a strong supporter of the *Flying Legends* air show. Using his work to

**The incredible 24 vintage aircraft in flight together, seen approaching the airfield from the east**





# The Greatest (Air) Show on Earth

Vayu's Angad Singh at

## The Royal International Air Tattoo 2015

Established in 1971, the Royal International Air Tattoo (or RIAT) is possibly the most beloved air show in the world. It may occasionally be eclipsed in terms of size and glamour by the likes of EAA AirVenture in Oshkosh, Wisconsin, or the big trade shows such as Farnborough and Paris, but as recent years have illustrated, nothing can beat RIAT at delivering a consistently high standard as an almost 'purely military' air show. The sheer variety and number of aircraft on the ground and in the air are hard to match at any other event on earth, with each edition of RIAT delivering at least a few 'coups' with unique attendees or rarely-seen aircraft from around the world.

Indeed, the Indian Air Force's was one such 'coup,' dropping by RAF Fairford in 2007 whilst in the country for Exercise *Indradhanush*. Unfortunately this was not repeated for the 2015 edition, even though IAF transport aircraft were staging from RAF Brize Norton only a few miles from Fairford, with Su-30MKIs just a little farther away at Coningsby (see *Indradhanush* exercise reports in this issue).

Regardless, for a week in July, the sleepy Cotswolds turn into a hive of activity (and no small amount of noise) as enthusiasts from around the world stream in to enjoy this amazing spectacle. RAF Fairford, which is nominally under control of the USAF and typically hosts the Boeing B-52

Stratofortress, Northrop Grumman B-2 Spirit and Lockheed U-2 reconnaissance aircraft, suddenly has its gates thrown open and its aprons become home to hundreds of other aircraft types and many tens of thousands of visitors.

The *Royal Air Force Charitable Trust*, organisers of the Air Tattoo, have always been very spectator-friendly: from 2014 onwards, the show added an extra public day, turning it into a three-day event (Friday through Sunday), and for two days before the event and one day after, the organisers have created enclosures at either end of the runway to allow the more committed fans to enjoy the hordes of aircraft arriving at and then departing from the show. For

many aircraft on static display, these are the only opportunities to really catch them 'in action' and the extra effort on the part of the organisers is greatly appreciated. The show services and side activities are equally brilliant, with a range of attractions such as the Vintage Village, RAF Village, Techno Zone, not to mention rows of aviation-related shops to keep one occupied during gaps in the action, while food, drinks and other amenities were available in sufficient numbers so as to minimise queues and crowding. All the more impressive given the sheer size of the event and its 150,000-odd attendees.

The theme for this year's Air Tattoo *Securing the Skies - Past, Present and Future* highlighted, in appropriately forward looking fashion the Battle of Britain's platinum anniversary. A special warbird segment, not too dissimilar from that at Duxford, was a wonderful juxtaposition with the national aerobatic teams, helicopter displays and fast jet slots at the show. The organisers, and indeed much of Britain at large this year, have been keen to commemorate not only the British element of the Battle of Britain, but also the scores of foreign pilots who flew and fought over the United Kingdom in the summer of 1940. It was fitting, therefore, to have flying and static displays from the Czech Republic, Poland, France, Belgium, Ireland and the USA.

One of the biggest attractions at the show—this year's 'coup,' so to speak—was a pair of never-publically-seen-before Japanese Maritime Self Defence Force Kawasaki P-1 maritime patrol aircraft from Air Development Squadron VX-51 based in Atsugi. The P-1 flying display was short but incredibly vigorous for a relatively large four-engine aircraft, and drew admiration every day that it performed. The second P-1 was in the static park, positioned near its Boeing rival, a US Navy P-8A Poseidon from Air Test and Evaluation Squadron VX-1 'Pioneers' based in NAS Patuxent River, and a German *Marineflieger* Lockheed P-3C Orion from *Marinefliegergeschwader* MFG-3 'Graf Zeppelin' based in Nordholz. The P-1 is also understood to have taken a number of British and foreign officers on a demonstration flight from Fairford during its stay at RIAT.

In addition to the Poseidon, a large number of American military aircraft, ranging from relatively common types such as the F-15 Eagle and KC-135 Stratotanker, to rarer special operations aircraft such as the Lockheed Martin MC-130J Commando II and Bell-Boeing CV-22B Osprey from the 67<sup>th</sup> and 7<sup>th</sup> Special Operations Squadrons respectively, based at RAF Mildenhall, were on static display, alongside a pair of perennially popular Fairchild-Republic

A-10C Thunderbolt IIs on detachment from the 354<sup>th</sup> Fighter Squadron 'Bulldogs' based in Arizona. The US Army sent two helicopters, an AH-64 Apache and a medevac-configured UH-60 Blackhawk. In the air, American participation was restricted to a single demonstration, but given that it was the dynamic CV-22B, the stars and stripes flew high!

Among the US companies, Boeing and Textron had a strong presence at the show, with the former displaying their Bombardier Challenger-based Maritime Surveillance Aircraft (MSA) demonstrator on the ground. Textron AirLand's Scorpion ISR/strike/trainer aircraft, which has been on a European tour since June, was on display alongside an AT-6 light attack turboprop aircraft and a number of Textron special missions aircraft. Shortly before the show, the Scorpion had made a number of demonstration sorties for the Royal Navy, even operating in conjunction with a Sea King Airborne Surveillance and Control Mk.7 (ASaC7) from 849 NAS in Culdrose.

Another static park highlight was a three-aircraft feature on the 35<sup>th</sup> anniversary of Tri-National Tornado Training Establishment (TTTE), with three examples of the Panavia Tornado from the UK, Italy and Germany lined



7<sup>th</sup> Special Operations Squadron CV-22B during its demonstration



up alongside each other with special vinyl decals on their tails. The flying programme was a TTTE tribute, with a formation of Tornados, one from each country, making a series of flypasts.

Making its debut in the static park at RIAT was an A400M Atlas from RAF's No.70 Squadron based at nearby Brize Norton. Airbus Defence and Space's own A400M demonstrator was also in attendance as part of the flying programme, and put up a display that could give many fighters a serious run for their money! Other RAF aircraft in the static park included a Sentry AEW.1 (Boeing E-3D) and a brand new Voyager KC2 (Airbus A330 MRTT) straight from the production line. In the air, RAF displays included two impressive solo displays, a Boeing Chinook HC4 from 27 Squadron and a Typhoon from 29 (Reserve) Squadron, and two multi-aircraft displays. First of these was the commemorative RAF Typhoon and Spitfire Synchro display, a duet of a specially-painted 29 (R) Squadron Typhoon together with a Battle of Britain Memorial Flight Spitfire Mk.IIA, conceived for the Battle of Britain platinum anniversary. Seeing a WWII-era Spitfire performing aerobatics with a modern fighter is the ultimate sensory experience – visually stirring to be sure, but the aural delight of a Merlin and a pair of EJ200s running in harmony is truly wonderful. The other two-ship display was also a relatively new innovation, showcasing



*Tri-national Tornado formation making a flypast to commemorate 35 years of the Tri-national Tornado Training Establishment (TTTE)*

the RAF's BAE Hawks in a thoroughly engaging 'Hawk Role Demo,' complete with simulated air combat, ground attack and close formation flying.

The Royal Navy and Army Air Corps also had a number of aircraft on static display, including older Sea Kings, the recently retired AgustaWestland Lynx AH7, and more recent acquisitions such as the EH 101 Merlin. The AAC also conducted their famous two-ship Apache display, wowing

the crowd with powerful manoeuvres and dramatic pyrotechnics.

The Royal Netherlands Air Force, unable to bring their trademark orange F-16 solo display jet over for the Air Tattoo made do with an Apache display which, although a solo performance bereft of pyrotechnics and smoke, was enthralling nonetheless. The RNLAf also had a strong presence on the ground, with another Apache, a Boeing CH-47F Chinook, a Coast



*The Airbus A400M demonstrator put on a phenomenal display*



*RAF Chinook in action, diving toward the ground*



*The RAF Synchro display was enthusiastically received on each of the show days*

Guard Dornier 228, a C-130H Hercules and a KDC-10 tanker.

Belgium and Greece both sent F-16 solo displays, and although the Belgian F-16 is an Air Tattoo regular, the Hellenic Air Force's 'Zeus' F-16 solo team was making its RIAT debut with an elaborately painted F-16 Block 52 complete with shoulder-mounted conformal fuel tanks (CFTs). Both displays showed off the F-16 to fine effect, with plenty of hard manoeuvring and long stints in afterburner. Other impressive solo acts were the Slovenian Pilatus PC-9M Swift and Finnish Air Force F/A-18C Hornet, the latter proving to be a surprising crowd favourite with a loud, close display.

Several visiting European displays were from countries closely linked with the Battle of Britain, including Poland, the Czech Republic and France. Although not part of the British-organised Battle of Britain tributes, there was a clear feeling of appreciation for their attendance among showgoers. The Czech Air force had an Aero L-159 ALCA and Mil Mi-35 Hind in the flying display, with another Mi-35 in a commemorative Coastal Command B-24 Liberator paint scheme, plus an Airbus C295M on static display. The Polish Air Force had a single Su-22M4 'Fitter,' a C295M, a PZL Mielec M-28 Bryza and a Mil Mi-14 amphibious helicopter at the static park, as well as a fantastic MiG-29 solo display featuring lots of hard manoeuvring and plenty of the trademark thick black MiG-29 smoke trail.

The French Air Force quite surprisingly elected not to send Capitaine Benoit 'Tao' Planche to conduct his superb Rafale solo display, but instead sent their famous Mirage 2000N 'Ramex Delta' two-ship team.



*'Gunship 2' of the two-ship AAC Attack Helicopter Display Team in action*



*The brilliantly painted 'Zeus' F-16 Block 52 taking off to commence its display*



*The award winning Finnish F/A-18 solo display was flown by an operational aircraft, as evidenced by the captive training missiles on the wingtips*



*Belching streams of black smoke, the Polish MiG-29 is pictured against a rare patch of clear blue sky above Fairford*

Presumably the Rafale force has operational commitments in on-going conflicts, while the nuclear-strike Mirage 2000Ns are rarely deployed outside the country. Whatever the reason, the Ramex Delta team was very well received on their Air Tattoo debut – and

they did not disappoint. The elegant lines of the ultimate pure-delta fighter perfectly complemented the flowing routine, which was flown pleasingly low and close to the crowd. Special mention must be made of the Ramex Delta display on 19 July, when one

aircraft was forced to land with technical difficulties shortly after take off. Instead of aborting the display, the remaining pilot gamely conducted an impromptu solo display, to much cheering and clapping from the crowd, who clearly appreciated the commitment to providing a good show.

For enthusiasts in search of rarely-seen aircraft, one of the major highlights on static display was a pair of Northrop SF-5M Freedom Fighters from the Spanish Air Force. Indeed, there was a palpable air of excitement during their arrival on 16 July, with thousands of camera shutters going off at once. The Spanish also contributed to the flying display with their national team *Patrulla Acrobatica Aguila* flying their trademark CASA C-101 Aviojets.

Other national display teams included the Swiss PC-7 Team, Royal Jordanian Falcons, *La Patrouille de France* and, of course, the Red Arrows. The PC-7 Team, in their 26<sup>th</sup> display season, now have smoke systems on their aircraft, adding to the spectacle already provided by their stereotypically Swiss precision. At RIAT 2015, they displayed alongside a Swiss Air Force AS532 Super Puma, which provided one of the most dynamic helicopter acts of the show. *La Patrouille de France* are RIAT regulars but their display is nonetheless unique and captivating, and their Dassault-Dornier Alpha Jets boast one of the finest paint schemes in the world. The Jordanian Falcons, also RIAT regulars thanks to patronage of the late King Hussein bin



*A thrilling display of speed and precision – Ramex Delta in action!*



*The Swiss PC-7 team in formation with the AS532 Super Puma*

Talal from 1982 until his death in 1999, and the subsequent patronage of his son Prince Feisal, continued their longstanding support of the Air Tattoo as they displayed their Extra EA300 aerobatic monoplanes over Fairford.

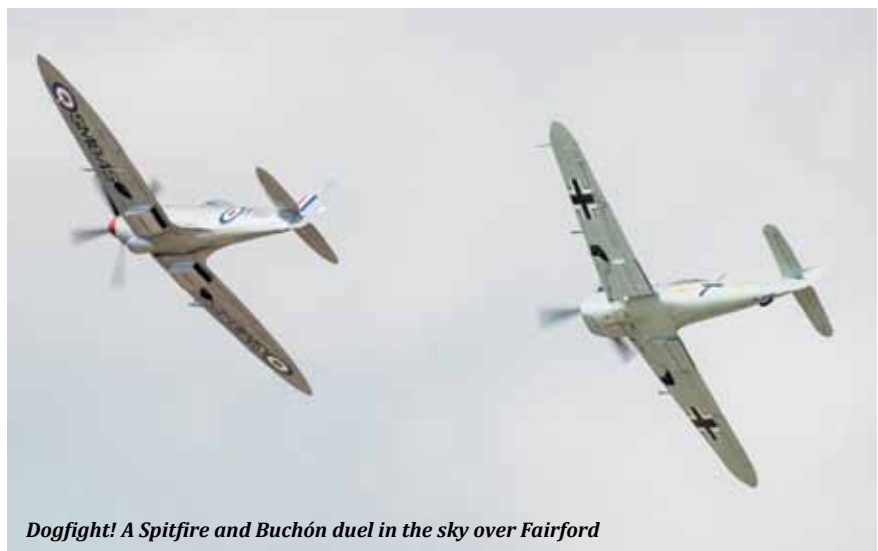
For the Battle of Britain commemoration, 18 warbirds lined up on Fairford's runway before taking off in quick succession. Leading the combined flypast were Spitfire Mk.IIa (P7350) and Hurricane Mk.I (R4118), both aircraft that actually saw action in the Battle of Britain 75 years ago! The Messerschmitt Stiftung Bf-109G-4 'Red 7' made another appearance, this time in the hands of Volker Bau, who flew a solo routine that was enthusiastically received by the crowd. John Romain also returned for a solo demonstration in the cockpit of his Bristol Blenheim Mk.I, followed by the ex-Indian Air Force Spitfire Mk.XVIIIe (SM845) and a HA-1112-M1L Buchón, flown by Ian Smith and Steve Jones respectively, conducting an enthralling mock dogfight, as it might have been in English skies 75 years ago. The commemorative displays were truly a marvellous tribute to the men and machines over the skies of Britain in the summer of 1940.

However, the jewel in the RIAT 2015 crown was another type of heritage aircraft altogether. Avro Vulcan (XH558) has been a living legend since it first took to the air in 2007, following a lengthy and

expensive restoration that was the result of unswerving determination on the part of the *Vulcan To The Sky* (VTTS) Trust to get this Cold War icon back into the air where she belonged. The beautiful delta-winged bomber has flown nearly constantly ever since, but rising costs and lack of technical support to maintain requisite flight safety standards means that 2015 is her final year of flying, after which it she will be grounded at Doncaster Sheffield Airport, where she will be maintained as a working exhibit to educate and inspire young people to join science and engineering fields of study. There was no question that XH558's

final Air Tattoo appearance would be an emotional affair for the show organisers, her operators, and of course the public at large. What nobody could anticipate was just how utterly *spectacular* her last Fairford outing would be. The take-off on Saturday 18 July will forever be referred to as "that take-off" and nobody who was there to witness it is likely to forget pilot Kev Rumens flinging the huge craft into a sharp 90-degree right bank seconds after the wheels left the runway.

The trademark 'Vulcan howl,' the graceful turns and steep, noisy climbs are all quite impressive, but are also quite typical



*Dogfight! A Spitfire and Buchón duel in the sky over Fairford*



***XH558 banks away from the crowd, displaying her cavernous bomb bay***

of XH558's display. The extra verve with which she was flown at RIAT 2015 made it seem almost as if the pilots wanted to give the old girl a particularly memorable send off from RIAT. Moreover, less than a month before the show, VTTS and the RAF Red Arrows decided to replicate their famous formation flypast, last conducted at Farnborough in 2012. The result was a sight to behold, made all the more poignant by the fact that this may be the last time this evocative aircraft flies together with the ambassadors of the RAF. XH558 may be

gone by the end of this year, but if RIAT was any indication, she will certainly never be forgotten.

Come Sunday evening, as last of the turbines spooled down and silence finally descended on Fairford, organisers and participants had themselves a well-deserved party, which included an awards ceremony for a range of coveted Air Tattoo recognitions. The *Paul Bowen Trophy for the Best Solo Jet Demonstration* was awarded to the Finnish F/A-18 Hornet display, *The Cannestra Trophy for the Best Flying*

*Demonstration by an Overseas Participant* went to the Slovenian PC-9, the coveted *Sir Douglas Bader Trophy for the Best Individual Flying Display* was picked up by the German Bolkow Bo105 helicopter display, the RAF Typhoon and Spitfire Synchro Pair not unsurprisingly received *The Steedman Display Sword for the Best Flying Demonstration by a UK Participant*, equally unsurprising was the *Best Livery* award for the aircraft with the best special paint scheme, which went to the Hellenic Air Force's stunning Zeus Demo Team F-16 Falcon, while the *King Hussein Memorial Sword for the Best Overall Flying Demonstration* was awarded to the Battle of Britain 75th Anniversary Flypast, a fitting tribute in this year.

At the static park, the RAF Airbus A400M display in the RAF Village took home the *Northrop Grumman Concours d'Elegance* trophy for the best presented aircraft, with the JMSDF Kawasaki P-1 receiving the runners-up trophy. As for the public's choice, the *As the Crow Flies* award for the best overall flying demonstration, voted for by the 'Friends of RIAT' went to the *Vulcan To The Skies Trust* for a sterling demonstration by Vulcan XH558 in her final display season.

***Vayu warmly thanks Simon Watson, Roland Fane, Justin Sawyer, Peter Hill, and Ian and June Sayer for their advice, assistance and cheerful company at RIAT.***



***Over 50 years after the team was first established, the RAF Red Arrows continue to be a favourite of the UK air show circuit***

# The Sun Also Rises



## Debut of the Kawasaki P-1 in England

**P**ost-Second World War, after millions of casualties in the Asia-Pacific theatre, it is understandable as to why the new peacetime Japanese administration incorporated legislation which made it illegal to export military weapons (including aircraft), or to participate in overseas military operations. Still, this allowed the Japanese aviation industry to develop and build military aircraft, often in cooperation with Western partners, but restricted them to “home defence”.

Seventy years later, following increased concerns over the expansion of Chinese and Russian forces in the Pacific region and with rising tension over disputed sovereignty concerning islands in the South China Sea, the Japanese government is introducing new legislation to allow its military forces to play a more active role in supporting wider military cooperation with regional allies as

well as the United States. For the first time since the Second World War, the Japanese aerospace industry has demonstrated a new military aviation programme in Europe in an attempt to interest potential export customers. The surprise appearance of Japan’s latest military aircraft, the Kawasaki P-1 at the recent RIAT air show in the UK, marked the first public expression of this new, more outward-looking defence initiative. It was also the first time that this new four jet-engined Maritime Patrol Aircraft had been on display outside Japan, which provided an interesting comparison with Boeing’s new P-8 Poseidon MPA, which also took part in the event, and which is one of the newest operational aircraft types to enter service with the Indian Navy.

The Kawasaki P-1 was designed to provide a jet-powered long endurance/long range patrol aircraft that could cover

the large number of scattered and remote Pacific islands that are under Japanese national jurisdiction as well as the main Japanese coastal waters that have very large numbers of commercial shipping. These waters are seeing more submarine movements than ever before, and because of the large distances involved in carrying out maritime patrols, the Japanese Maritime Self-Defence Force (JMSDF) decided upon its requirement for a jet-powered replacement for its fleet of Kawasaki/Lockheed P-3C Orion MPA aircraft. These P-3s had been built under licence in Japan and have served the JMSDF well for many decades, but their turboprop power is now dated and although this format provides good low-level performance in seeking and tracking surface and sub-surface vessels, as also in the search & rescue role, the transit times are long. The US Navy had reached

similar conclusion regarding its own P-3C replacement, which resulted in development of the Boeing 737-based P-8 Poseidon MPA. However, before the P-8 was selected by the USN, Japan had embarked on its own, lengthy and very expensive 'home-grown' jet MPA programme, which finally resulted in the P-1.

This was certainly a very ambitious project as it comprised an all-new platform aircraft, with new avionics, mission and weapons systems, and all-new turbofan engines. The total requirement was for up to 70 aircraft for the JMSDF and during development this cost has not been shared with any overseas industrial partners, as until now, it was not considered likely that it would ever be offered on the international defence market. Thus appearance of the P-1 at RIAT in July 2015 represents a major turning point in over 60 years of post-war Japanese aerospace regeneration.

The P-1 is built by Kawasaki, which also have overall design responsibility for the onboard electronics, including the integrated mission system. The new turbofan engine is designated as IHI F-7-10 and is more compact, with lower thrust than the CFM-56 which powers the P-8 Poseidon. But unlike the twin-engined configuration

on the P-8, the P-1 has four turbofans. This gives excellent high-speed transit time and extra safety on long endurance missions but is thought to be more costly to operate and maintain as a one-off design than the P-8 which has many standard 737 features and is supported by a global support network. The P-1's maximum range is around 5,000 miles. The two aircraft which flew to Europe were not fitted with in-flight refuelling probes and with what appeared to be a satellite communications dome just behind the cockpit, there did not appear to be provision or space for a boom refuelling receptacle on the upper front fuselage.

The first flight of the prototype P-1 took place at Gifu Air Base in Japan in September 2007 and the first production-standard P-1s from an initial batch of 20 entered Japanese military service in 2013. Very little has been revealed about this aircraft and until now, few outside Japan have seen it. There are several aeriels distributed about the airframe, indicating a comprehensive communications fit and suggesting an advanced Electronic Warfare capability, perhaps extending into Communications Intelligence.

A Magnetic Anomaly Detector (MAD) 'stinger' in the tail highlights its anti-submarine capability, along with

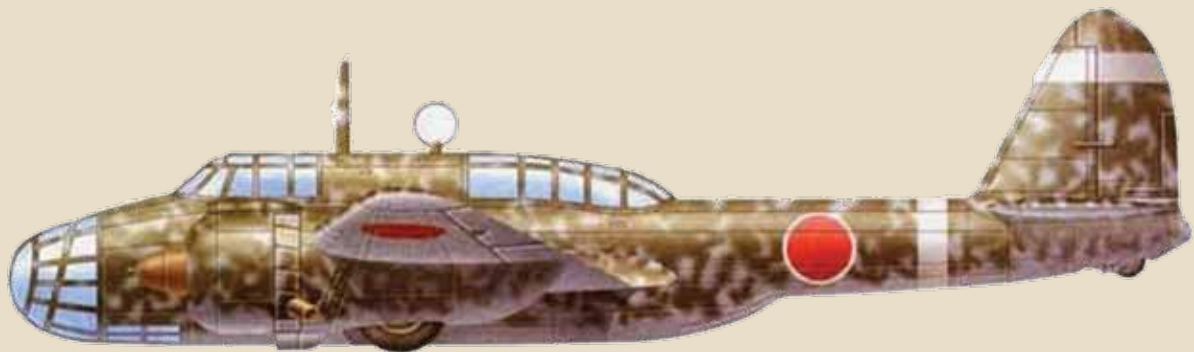
multiple sonar launch tubes beneath the rear fuselage. There are also multiple radar-warning sensors giving all-round situational awareness for self-defence, no doubt with missile-jamming countermeasures capability. A Harpoon missile can be carried in the small forward weapons bay, or torpedoes, and there are provisions for weapons pylons below the wings. Toshiba has developed an advanced HPS-106 Active Electronically Scanned Array air-to-sea search radar for the surface surveillance and tracking mission. Although no details were announced at RIAT, the company has stated that the P-1 is the first operational aircraft to be fitted with a 'fly-by-light' flight control system.

Most recent military surveillance or special mission aircraft have been produced by adapting existing commercial or military transport or business jet platforms, thus the appearance of the P-1, which is conventional and has been optimised around its anti-submarine/MPA role, makes an interesting new departure for an industry that is clearly keen to break away from a policy of only offering flying-boat designs for export.

*Richard Gardner  
(Lead photo by Angad Singh)*

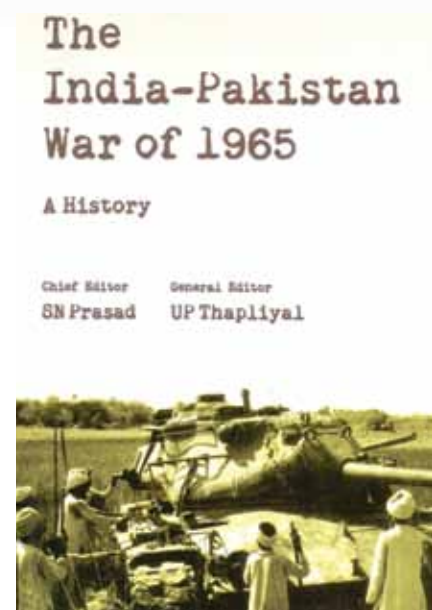
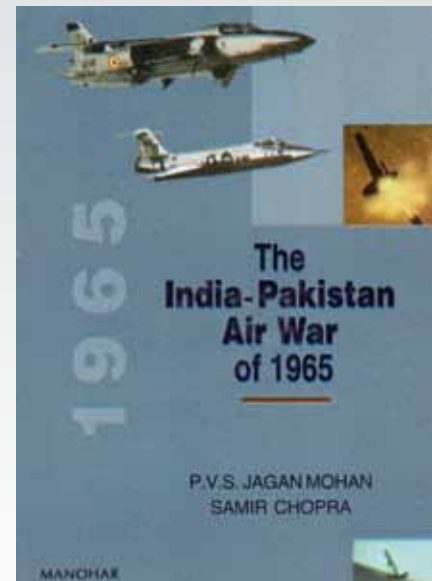
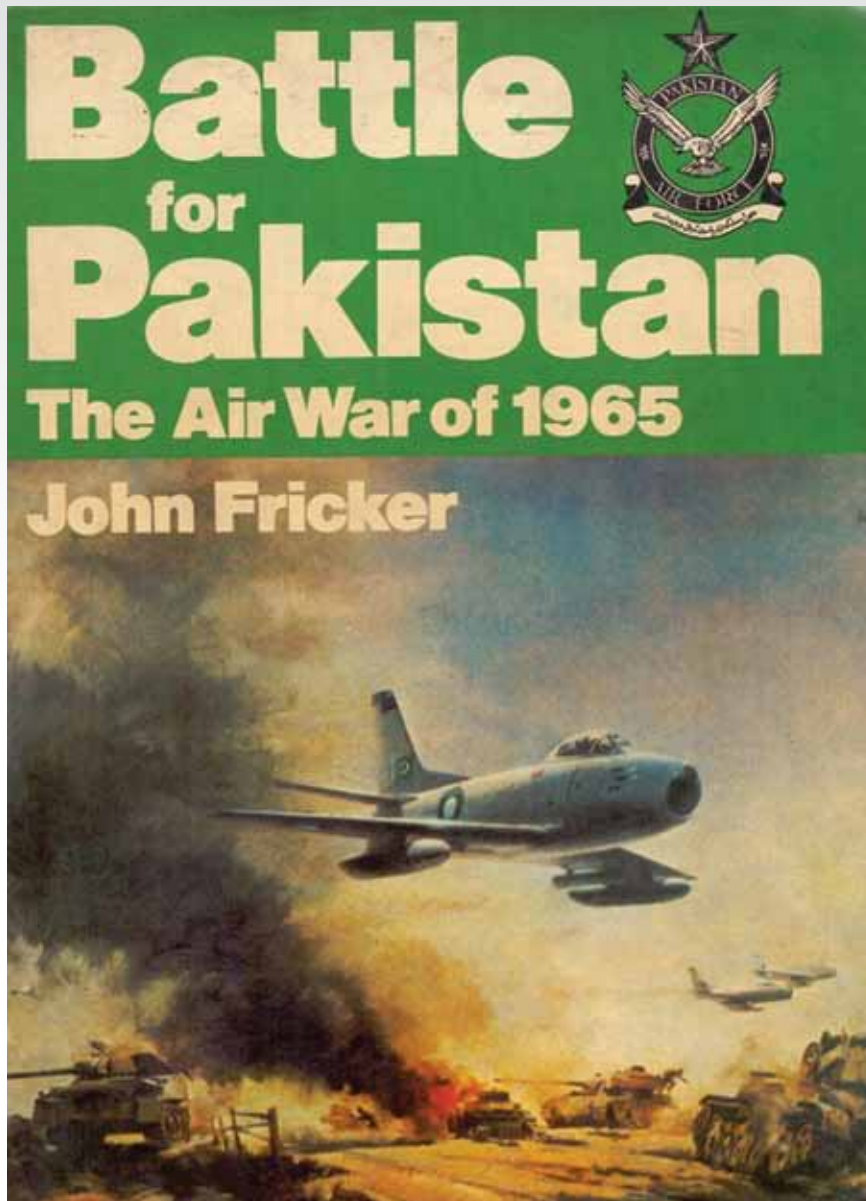
## The way they were : Kawasaki Ki-48 light bomber in WW II

Amongst Japan's range of light bombers fielded during the Second World War was the Kawasaki Ki-48 *Sokei* Army Type 99 and known to the Allies as the 'Lily'. Inspired by the Soviet Tupolev SB light bomber, development of the Ki-48 began in late 1937 but this aircraft had certain limitations including a low bombload of 800kg and three machine guns. However, it was quite manoeuvrable and was often employed as a dive bomber, particularly in the Burma campaign.



# Air War 1965

## The Way We Wrote - and Painted



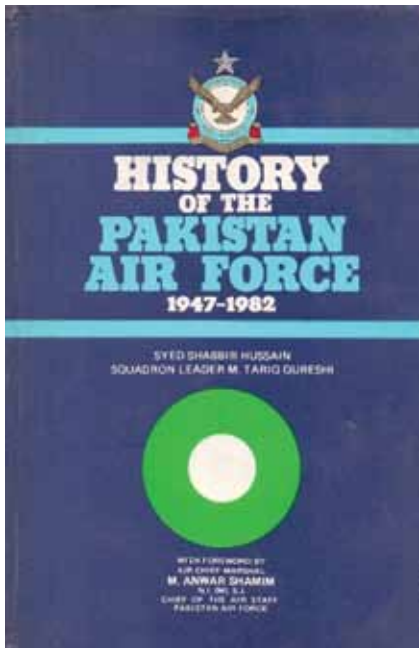
Undoubtedly the honours for the first book on the 1965 air war go to John Fricker, the Englishman whose book *Battle for Pakistan* was published in 1979. This publication in fact, virtually became the reference-source for subsequent histories written by both Pakistani and Indian authors, quoted extensively (or denied assiduously) by those who researched and wrote on this air war.

Subsequent books included *Fiza'ya: Psyche of the PAF* by Pushpinder Singh and Ravi Rikhye in 1991 and *The India-Pakistan Air War of 1965* by PVS Jagan Mohan and Samir Chopra in 2005.

The unofficial (official) *India-Pakistan War of 1965* by SN Prasad and UP Thapliyal, with its chapter 'War in the Air' was later published in 2011 while the Pakistan Air Force had earlier published

their histories in 1982 and 1988 with dedicated chapters on the air war of 1965. This was followed in 2000 by the book *The Story of the Pakistan Air Force* but which only glanced at the past. Perhaps the most well-known aviation artist in the sub-continent is Gp Capt SMA Hussaini, the official military aviation artist of the PAF whose much acclaimed artwork has been compiled into several coffee table books, particularly





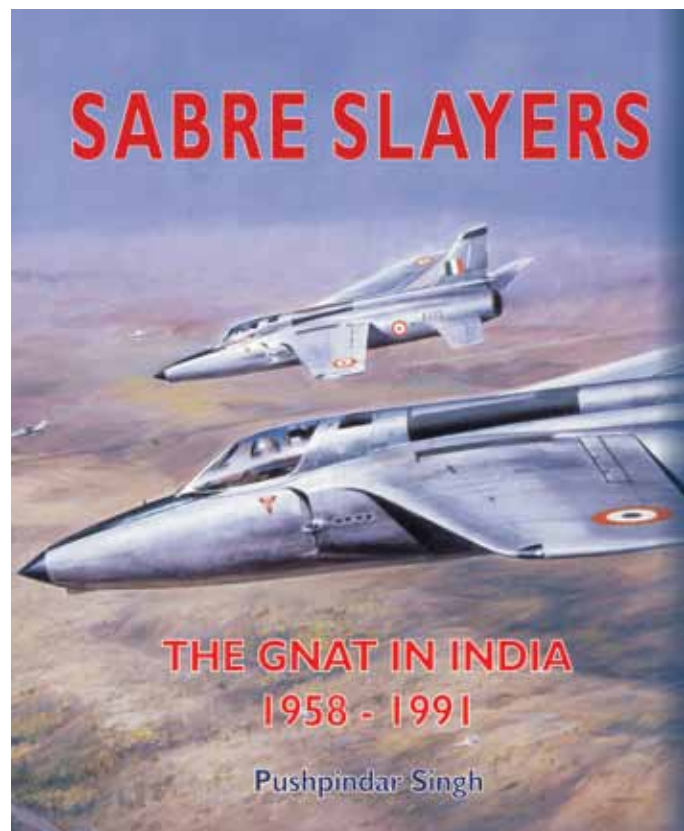
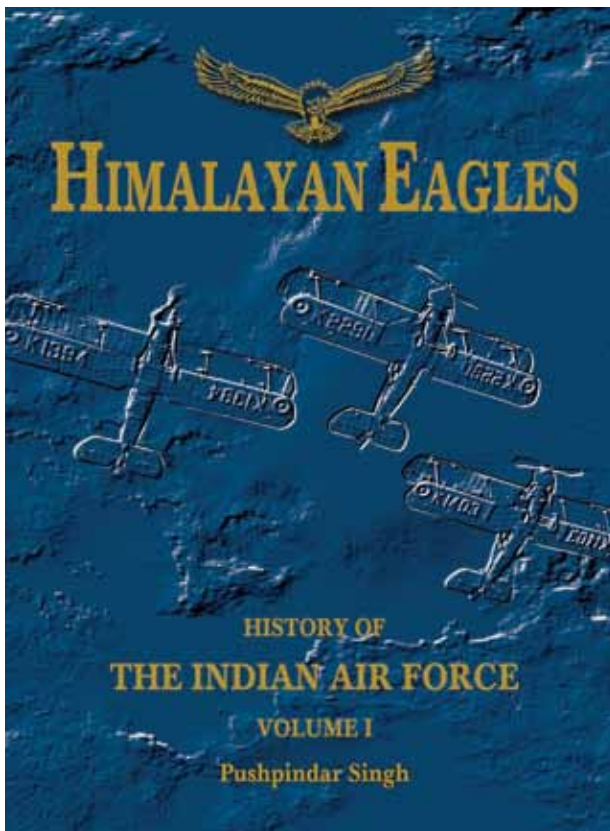
In the three-volume History of the Indian Air Force (*Himalayan Eagles*), published by *The Society for Aerospace Studies* in 2007, a major chapter was dedicated on the 1965 War in the sub-continent and in fact this is perhaps the most objective summary of that three-week war in the air.

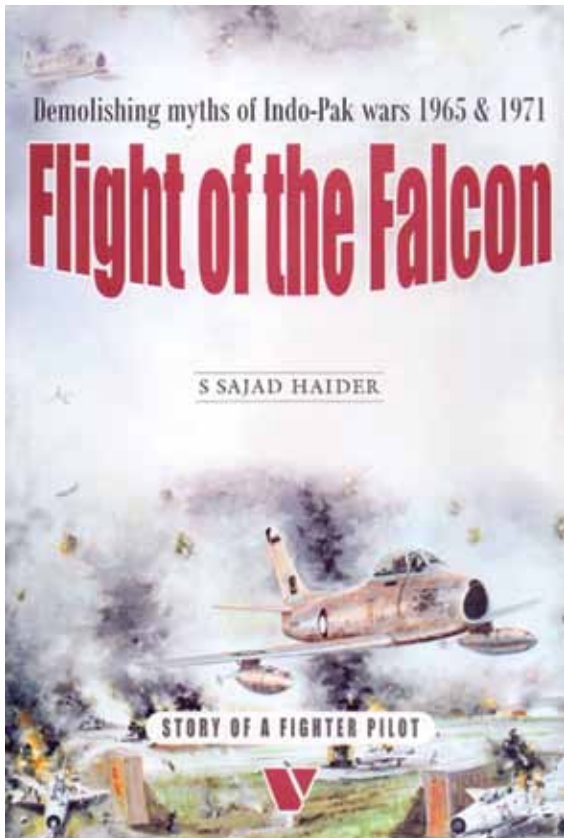
Over the past several decades, articles on the 1965 Air War have appeared in various magazines, both in the sub-continent and abroad. The erstwhile *New Delhi* edited by the redoubtable Khushwant Singh, after his stewardship of the *Illustrated Weekly of India*, carried a 16-page article in its December 1979 Issue refuting the claims articulated by John Fricker. Therein lies a tale which involves some of the key personalities (writers) involved.

Soon after John Fricker's book was released in England, the same magazine *New Delhi* had printed an entire chapter from it which did not reflect the Indian Air Force in good light. The then IAF CAS Air Chief Marshal Idris Latif was extremely upset and wanted an immediate rebuttal. *Vayu's* Editor Pushpindar Singh was sent for by the CAS and tasked to write the Indian Air Force 'rejoinder'. The Director Air Intelligence was instructed to make available all required information and data. Most unfortunately, as it turned out, records had not been diligently maintained at Air Headquarters and there was little time to collate material from the various commands, stations and squadrons. What

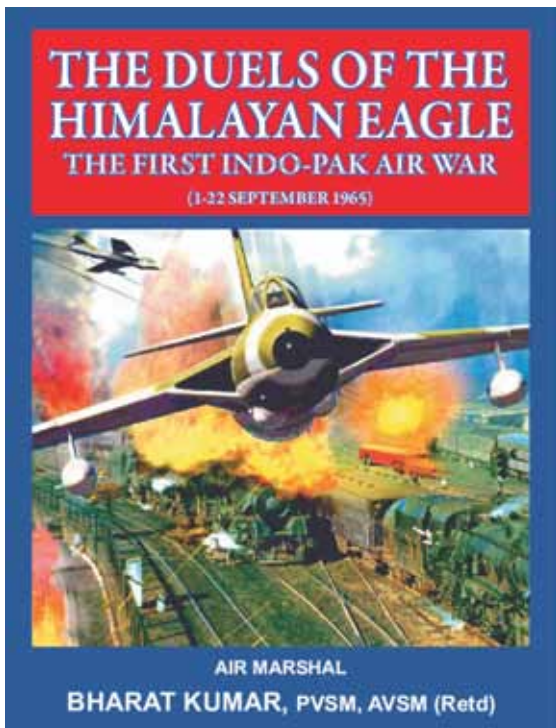
*Air Warriors* which included several paintings depicting actions of the PAF in 1965.

On other side of the Radcliffe Line, it is only recently that the husband-wife duo of Sameer and Priyanka Joshi have done a slew of paintings of the IAF in action during September 1965, some of them being used for the IAF's 2015 Calendar and also included in their just-released book (*Air Warrior Tales of 1965 War*).





followed can only be described as a frantic scramble to interview individuals, examine logbooks and selected squadron dairies and then to put together a reasonable article so as to meet the printer's deadline. In retrospect, and looking back on this positively, this effort was to become



the foundation for beginning serious research to archive the IAF's history including first hand accounts by the dwindling number of personalities who actually took part in this first air war over the sub-continent as also search for squadron and wing records, as also the war dairies.

This enabled *The Society for Aerospace Studies* to research on and publish several IAF Squadron histories where their participation in the 1965 air war was included, gleaned from original war dairies and these include Nos 1, 5, 6, 7, 14, 20, 28, 47 and 221 Squadrons, authored by Pushpinder Singh, now collectively a treasure for those who are really interested in the subject. The book *Sabre Slayers* on 'The Gnat in India 1958-1991' again by Pushpinder Singh, is a veritable treasure on the conception, adoption, nurturing and baptism in fire of this remarkable light fighter which became the most vivid symbol of the IAF's prowess in September 1965.

From the PAF's side, No.14 Squadron's *Legend of the Tail Choppers* includes that devastating raid on Kalaikunda on 7 September 1965 where they claim to have destroyed a dozen IAF Canberras and Vampires on the ground. Air Commodore Kaiser Tufail, after retirement from the PAF has been a prolific writer on his air arm and his book *Great Air Battles of Pakistan Air Force* includes many of those in September 1965.

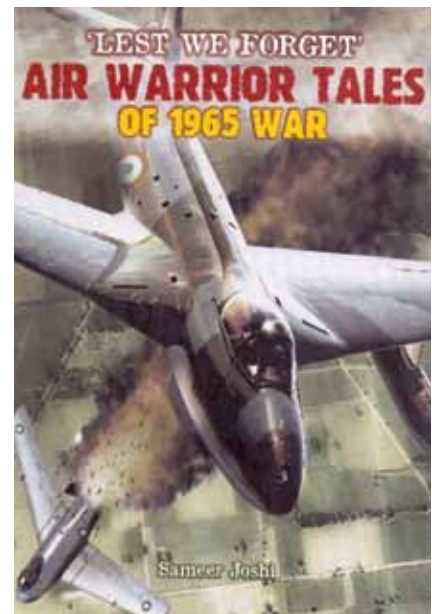
Over the past decades, highly researched articles on various aspects of the 1965 air war have appeared in the *Vayu Aerospace Review*, the most quoted being *Laying the Sargodha Ghost* in November 1985 and *No.1 Squadron and its Mysteres at War* in June 1988. Marking 40 years of September 1965 war, *Vayu's* Issue VI/2005 carried two exclusive first hand articles by two of the pilots who had created history then : Air Marshal (retd) Tirlochan Singh wrote on *Tank busting in the Chhamb* while Air Commodore (retd) Sajad Haider wrote on *The Pathankot Strike : 6 September 1965*.

The latter has since written his autobiography *Flight of the Falcon' Demolishing myths of Indo-Pak wars 1965 & 1971* in which he has been characteristically candid. Not surprisingly, his career in the PAF came to an abrupt end when he stood up to General Zia-ul-Haq during a formal briefing after the latest Army coup had taken place.

The wave of enthusiasm by the Government of India in 2015 to commemorate the 50<sup>th</sup> anniversary of the 1965 Indo-Pak war has predictably generated a number of new books, two of them dedicated to the Air War.

These are *The Duels of the Himalayan Eagles* by Air Marshal Bharat Kumar, officially released at the Tri Service Seminar in New Delhi on 1 September 2015 during the Golden Jubilee Commemoration of the 1965 War. This was followed by the lavishly illustrated *Air Warrior Tales of 1965 War* by Sameer and Priyanka Joshi which was released at Air Headquarters on 15 September.

Enough seems to have been written 50 years after that first clash between the (Indian) Himalayan Eagle and (Pakistani) Falcon, but this air war still evoking recollection and analysis and perhaps there will be more books to come, just as the Battle of Britain does, even 75 years after that epic battle.



# Air War 1965



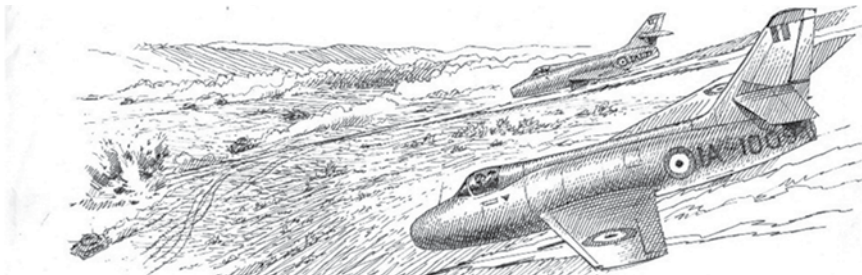
## An (official) assessment of the IAF's Role

[EXTRACTS FROM THE 1965 WAR HISTORY BY SN PRASAD & UP THAPLIYAL, SPONSORED BY INDIAN MoD, PUBLISHED IN 2011]

It is surprising that despite the Kutch affair and subsequent unfolding of Pakistan's 'Operation Gibraltar', Indian defence planners had not prepared any inter-service contingency plans. IAF had no inkling of its role in the event of a war with Pakistan. It appeared on the scene only on 1 September 1965, when the Pakistan Army threatened to cut the Jammu-Poonch highway, and air-support became necessary to stem the tide. IAF responded with alacrity to meet the threat.

The IAF's role during the Indo-Pak War 1965 included close air support, fighter sweeps and interceptions, interdiction and counter air operations. In the opening phase of the war, it blunted the Pakistani thrust in the Chhamb sector and denied a breakthrough to Pakistani armour in Khem Karan sector. IAF not only damaged and destroyed Pakistani tanks, guns, equipment and installations, but also demoralised them. Bearing in mind that the IAF fought the war with poor quality aircraft over a

large area, from far off airfields without any advance notice, its performance could perhaps be rated as near satisfactory.



*'Tank hunting in the Chhamb': Mystere IVAs blunted the Pakistani armoured offensive in the first week of September 1965. Flt Lt Tirlochan ('Tango') Singh of No. 3 Squadron (Cobras) was one of the first IAF pilots to go into action on 1 September 1965. The employment of obsolescent Vampires (top picture) for the opening attacks, in which four were lost, has long been debated*

There were certain deficiencies in the command and control of operations. Air defence and offensive support, two vital aspects of air operations, were controlled by two separate organisations, viz. AD (Air Defence) Area and Advance HQ, WAC (Western Air Command) respectively. This led to grave problems during the war.

In the absence of favourable air equation, the IAF had to perforce devote much of its effort to defensive measures. CAPs and escorts used up 66% of the entire GA/AD effort, which at times even gobbled some of the air effort, urgently needed for offensive support. As ground attack aircraft on offensive missions (close support to army)

to TACs as planned. The actual procedure for seeking the air support was as follows: When a Brigade or a Division Commander required close air support, he made a request to the next higher Commander, and all such requests finally reached the Corps HQ. The same evening, the Corps Commander, TAC Commander and other



*'Sabre Slayers' all : pilots scramble to the Gnats on ORP ; (right): Flt Lt Trevor Keelor of No. 23 Squadron at Pathankot who shot down the first PAF Sabre on 3 September 1965*



*Flt Lt VS Pathania, above, also of No. 23 Squadron who shot down the second Sabre in a fighting chase. (Right) Flt Lt Denzil Keelor, second of the famous brothers flew Gnats with No. 9 Squadron, shooting down a Sabre at very low level towards the end of the war*

In the initial stage, when the objective was to achieve a favourable air equation, air effort in the tactical area should have been appropriately controlled by a single authority.

had to be provided with fighter escorts the need could not be easily dovetailed with the requirement of Air Defence, particularly due to dual control. Consequently, offensive efforts could not be sub-allotted by Air HQ

concerned officers held consultations, and decided upon the priority of each request. The TAC Commander then projected the requirements to the Commanders of two or three air stations allotted to him. Some



*Four squadrons of Hawker Hunter fighter bombers were deployed in the western sector during the September 1965 air war. On the right, a Hunter is seen being rearmed with 30 mm cannon rounds at Halwara*



*Four squadrons of Dassault Mystere IVAs were part of the IAF's order of battle in the western sector. Wg Cdr Jim Goodman (below) commanding No.31 Squadron with Mystere IVAs*



air stations were allotted to more than one TAC. Some requirements like Air Defence and Counter-Air Operations were projected by Western Air Command or Air HQ and in such cases the Air Station Commander gave first priority to them. The remaining sorties available to him were allotted according to the priorities decided at Corps HQ. In the circumstances close air support sorties could take place by the next morning, at the earliest !

When these sorties finally arrived overhead, the Air Control Team (ACT) operating on the ground with the forward troops, visually directed the planes to the targets. For the purpose the ACT maintained Radio or Radio Telephone (RT) contact with the planes. Sometimes, the ACT was unable to establish contact with the planes overhead, due to dysfunctioning of the RT set. Again during the shelling, the ACT had to take shelter underground, and in that case it could not visually direct the planes to the target.

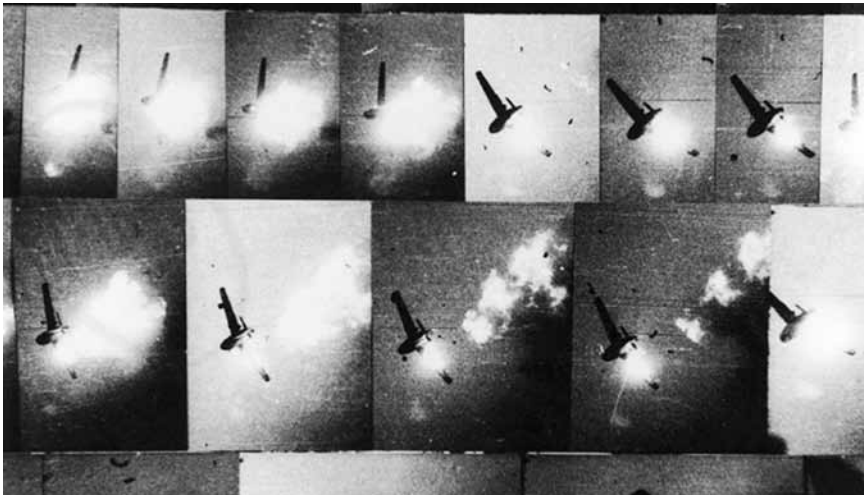
The percentage of losses in relation to the numbers of aircraft possessed by each country was as follows:

In the 1965 war the IAF lost nineteen aircrew as against thirteen by PAF. Seven IAF personnel were made POWs. The IAF won four Mahavir Chakra and forty three Vir Chakra awards for acts of gallantry.

The level of performance of both the IAF and PAF was almost the same, though Pakistan possessed superior aircraft like F-104s and F-86s. Neither side used full combat potential with a view to conserve resources for a long drawn war. Both sides avoided daylight raids after 7 September, 1965.



*Air Marshal Arjan Singh with Fg Offr VK Neb and Flt Lt DN Rathore of No. 27 Squadron each of whom shot down Sabres over Halwara on 6 September evening, including that flown by the PAF fighter ace Sqn Ldr Sarfraz Rafiqi.*



*Cine gun record of a PAF Sabre being shot down by IAF Hunter over Halwara*

The IAF did not launch pre-emptive strikes on Pakistani airbases, when the Indian Army advanced across the border,

in the Lahore sector. Had it done so on or before 6 September 1965, a different scenario might have emerged. Regardless of

the reasons behind the decision, it enabled PAF to play a crucial role in stemming the Indian advance. Furthermore, it provided PAF the opportunity to carry out surprise attacks against the Indian airfields and radar stations the same evening.

In the pre-emptive strike, a large number of IAF aircraft were destroyed on the ground, primarily due to the following reasons:

- Insufficient radar coverage, hence lack of warning.
- Too many aircraft clustered at one base, e.g. Pathankot and Kalaikunda.
- Lack of aircraft shelters.
- Inexperience of local commanders.

The scare of pre-emptive PAF strikes persisted and forced the IAF to deploy major part of its force (almost 60%) on combat air patrols for the rest of the war. This greatly reduced its capacity to support the Army and to strike targets inside Pakistan. Incidentally, CAP sorties even covered rear air bases like Hindan, Agra, Kalaikunda and Dum Dum.

There was total absence of joint planning on the Indian side. Both the Army and the IAF had their sights firmly fixed on their respective objectives and cooperation, if any, between them was incidental, rather than planned. In the absence of joint planning, large gaps persisted in the air cover over the combat zone. There was no dependable system by which the Army could call for interceptors, when attacked by the PAF. It is true that 'sweep' sorties were flown over the tactical areas, but this was more of an attempt to draw the PAF fighters into combat, rather than to intercept the PAF ground-attack aircraft. On the Pakistan side, coordination and joint planning between the Army and PAF appears to have been better.



*Defence Minister YB Chavan meeting No.23 Squadron pilots at Pathankot.*



*Air Marshal Arjan Singh and Defence Minister YB Chavan visiting No.7 Squadron at Halwara.*

There was complete lack of air intelligence at the commencement of hostilities. The IAF could not even locate the PAF aircraft in East Pakistan. In the west, it was not known for quite some time that Pakistani air operations in Jammu and Punjab sectors were being conducted from Sargodha or Peshawar.

It should be conceded that this was the first experience of a real air war for the IAF.

convincing victory, on either side resulted in a stalemate.

In assessing the role of the IAF in the 1965 War, the observations made by Air Commodore PM Wilson need perhaps be considered seriously: “My impression about all air force operations, whether East or West, was that nobody seemed to know what to do. According to me the level of professionalism at all levels

was extremely low and I do not exclude my own performance”. Further : “The lessons learned in 1965 were all negative ones – in other words what not to do, should there be another conflict. These lessons were so numerous and so cogent that they were more valuable than any positive lessons.

**Ed:** Curiously, sources of information and data acknowledged by these authors of India’s official /unofficial 1965 war history are essentially of Pakistani-origin : given pride of place is John Fricker’s *Battle for Pakistan : The Air War of 1965* and *The Story of the Pakistan Air Force* published by *Shaheen Foundation*, Islamabad.

There has been little attempt to quote from Indian sources, not even from the official history of the Indian Air Force (*Himalayan Eagles*’ Volume II) which was released by the Marshal of the Air Force, Arjan Singh in March 2007, four years before Prasad and Thapliyal’s book was published.

Of course, a series of first hand accounts and documented analysis of the air war 1965 have appeared in several issues of the *Vayu Aerospace Review* over the decades, but have not been sourced by the ‘official’ historians (see *The Way We Wrote*).



*The IAF pilots who were POW in Pakistan, seen on return to India in early 1966*

Adequate attention had not been paid to the vulnerability of the IAF installations. The facilities for air defence and tactical support were also inadequate. Still, after the initial reverses, the field units of the IAF more than recovered their ground. The aircrew performed well, doing all that was expected of them, and perhaps a little more.

Taking an overall view of the air war, it appears that neither IAF nor PAF won a decisive victory. Both mauled each other, but could not kill. Both operated without a clear-cut plan and failed to concentrate their resources on close support, or counter-air attacks to achieve decisive results. Heavy day light attacks, to knock out enemy air bases, were discontinued without any serious reason. In fact these could have brought success to either side, at a heavy but acceptable cost. Night bombing proved ineffective. The use of CAPs on an extensive scale resulted in a major diversion of limited resources. In a nutshell, the absence of a clear-cut operational doctrine to achieve a



*During his visit to Peshawar in February 1966, Air Marshal Arjan Singh was received by his counterpart and ex-colleague Air Marshal Nur Khan which was an appropriate epilogue to the September 1965 war between the neighbouring countries.*

**(Photographs from the Directorate of Public Relations, MoD and archives of The Society for Aerospace Studies).**

# Air War 1965

## The Nur Khan Plan



*Mainstay of the PAF fighter force was the North American F-86 Sabre*

Because of the disparity in its size compared with the IAF, the PAF's plan envisaged that it would have to be maintained at as high a state of operational readiness as resources would permit. It was also assumed that its primary task would be the air defence of Pakistan. Air Marshal Nur Khan's immediate predecessor Air Marshal Asghar Khan had maintained that no air effort would be available for army support, and the most that he could offer the troops could be to try and keep the IAF off their backs.

Apart from the allocation of a portion of the PAF's F-86F Sabre force for immediate support of the Pakistan Army, the 'War Readiness Plan', as modified by 29 June 1965, was not greatly changed from that of 1962. The committee appointed by Air Marshal Asghar Khan to revise the War Plan were given a number of possible political contingencies to work on, but their findings were mainly based on the presumptions that hostilities would result over Kashmir,

and the main battle for Pakistan would thus be fought in the area of the former West Punjab. There was little dispute that the main objective for the PAF would be to neutralise selected vital elements of the IAF by striking them on their airfields, thereby reducing the margin of numerical superiority held by India, ensuring the survival of the PAF and preventing the attainment of air superiority by India and of effective interference by the IAF in the land battle.

To review and recast the plans, Nur Khan constituted a committee of senior officers to consider and make recommendations on : "How, while maintaining the security of the air bases, to gain local air superiority over the main Army area of operations with a view to influencing the land battle by providing the maximum support to the Pakistan Army while preventing the IAF from supporting the Indian Army."

The main points that the committee had to consider and make recommendations on were :

- ◆ The area between Kashmir and the Sutlej River as the most probable location of the main land battle, to plan to gain local air superiority
- ◆ Recommend methods of neutralising the IAF's numerical superiority
- ◆ Plan to effect the maximum economy of effort in defence of the air bases
- ◆ Plan for the availability of support to the Army in its main operational area
- ◆ Plan for the maximum harassment of the enemy without dissipating effectiveness of the first line aircraft and personnel for the PAF
- ◆ Recommend methods of surprising and deceiving the enemy
- ◆ Ensure that the logistical plan adequately supported the operational plans.

The C-in-C and the operational planners of the PAF had three main problem areas in drawing up the plans to achieve their desired aims in a confrontation with the IAF.

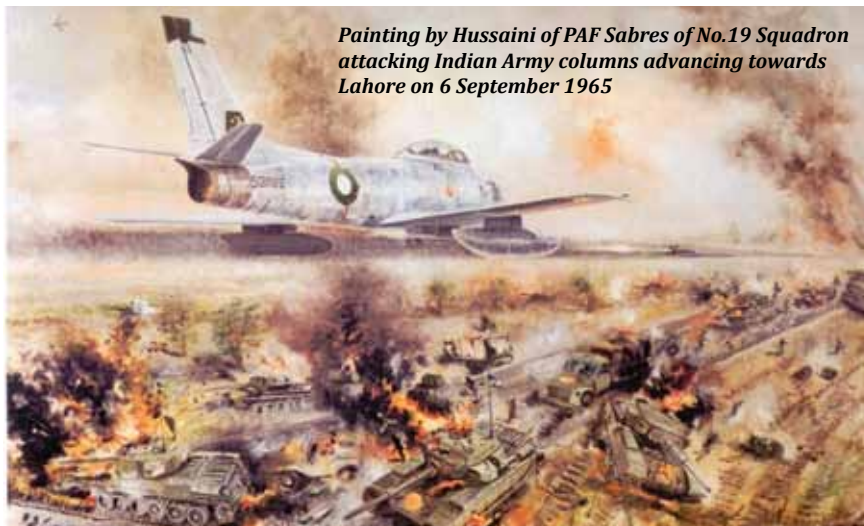




*Painting by Hussaini depicting shooting down of IAF Vampires by Sqn Ldr Sarfaraz Rafiqi of No.5 Squadron PAF over the Chhamb on 1 September 1965*



*SqnLdrRafiqi(4th from right) CO No 5 SqnPAF*



*Painting by Hussaini of PAF Sabres of No.19 Squadron attacking Indian Army columns advancing towards Lahore on 6 September 1965*

The first was the wide disparity between the strength of the PAF and the IAF.

The second problem facing the PAF in both its defensive and offensive plans was the complication of a severe shortage of front-line operational airfields. In the relatively narrow strip of West Pakistan, these comprised only Peshawar and Sargodha in the north (the transport and training fields at Chaklala and Risalpur were limited) and Mauripur in the south. Only longer-range types such as the B-57s could make effective use of the rear airfield of Samungli (Quetta) and in East Pakistan, a single base was available at Dacca (Tezgaon). The lack of suitable bases prevented wide scale dispersal of the PAF aircraft, with a corresponding simplification of the IAF's strike problems and also denied Pakistan much of the flexibility essential for effective operation.



*Sqn Ldr Sajjad Haider, CO No.19 Sqn PAF with his Flt Cdr Mo Akbar and F-86 Sabre*

In contrast, the IAF had a wide choice of more than a score of air bases deployed in depth around the frontiers between West and East Pakistan. More than 50% of these airfields posed a low-level strike threat to Pakistan, and the complex made up of Pathankot, Adampur and Halwara, under Amritsar radar control, formed the base of a triangle whose apex centred on the vulnerable city of Lahore, just 16 miles from the frontier with India. This complex was therefore considered the primary target for the PAF in West Pakistan, although the strike plan had to extend to IAF bases and radar stations as far north as Srinagar then Ambala and Jamnagar in the south. From East Pakistan, the most vital strike target for the PAF was the IAF base at Kalaikunda, in West Bengal, although the area was ringed by other Indian airfields at Bagdogra, Barrackpore and Hasimara.

The third problem was that the entire PAF air defence and fighter guidance system depended on the Sakesar early warning and central radar in the north and a similar facility in Badin in the south. The PAF had no alternative or fall back equipment available if these radars were damaged or destroyed.

After deliberations of the committee Air Marshal Nur Khan made the following war plans :

- ◆ To concentrate the PAF in the area Sargodha/Peshawar, leaving one squadron for the air defence of Karachi.
- ◆ The air superiority battle would be fought in defending Sargodha air base thereby effecting the maximum economy of force; safeguarding Sakesar radar and dominating to a large extent the main battle area of the Army.
- ◆ To attack Indian air bases as soon as possible after the outbreak of hostilities and to destroy the maximum number of the IAF aircraft on the ground. This, it was hoped, would also induce the IAF to retaliate against Sargodha where the F-104 Starfighters and the Sidewinder-armed Sabres could be used in combination to destroy the attacking IAF aircraft.
- ◆ To attack IAF bases with paratroopers to destroy aircraft, aircrew and airfield facilities on the main IAF air bases on the night of D-day/D+1.
- ◆ To double the existing number of missions per aircraft per day to reduce the disparity in the relative strengths of the PAF and the IAF.
- ◆ To fly combat air patrols consisting of one F-104 Starfighter, armed with Sidewinder air-to-air missiles and two F-86 Sabres, also armed with Sidewinders.
- ◆ On hostilities becoming imminent, air defence measures to be fully operational to safeguard against pre-emptive or surprise attack.
- ◆ At least one squadron to be available for close support to the Army
- ◆ Harassment of the enemy's air bases to be carried out by lone bomber raids repeated a number of times every night to keep the enemy's air bases under constant air attack alerts
- ◆ Trainers and other non-operational aircraft to be used, at night, to attack road and rail communications and troop

concentrations, to harass the enemy's ground forces.

These objectives of Air Marshal Nur Khan primarily sought to cripple the IAF, if possible on the ground with every means available. If this did not prove practical, he then planned to fight in an area which was vital to the PAF and to the Pakistan Army and where he could concentrate his maximum strength. His concern for air support for the Army, which hitherto had not featured at all prominently in PAF

planning, and his implementation of the means to provide such support revealed a deep understanding of the influence that air power has had on land combat.

With such an operational concept and vital decisions made, the operational staff officers proceeded to work out the details. Two vexing problems required careful consideration. One was the division of resources between the requirements of air defence, offensive air strikes and the support of the Army. The other was the

*Pair of Lockheed F-104A Starfighters of PAF's No.9 Squadron*



*SqN Ldr MM Alam, CO No.11 Squadron PAF seen in F-86 Sabre cockpit, below which are stenciled Indian flags purporting to represent 'kills' and 'damages' in air combat versus the IAF in September 1965*



*Air Marshal Nur Khan, the PAF Air Chief in September 1965, seen with pilots of No.9 Squadron flying F-104s*

question of the timing of the air strike on the IAF bases.

Given superiority in numbers, an airborne strike force can begin attacking enemy airfields at dawn and continue throughout the day to inflict the maximum possible damage. But the PAF assessed its numerical strength as insufficient to ensure that its initial strike would be massive enough to prevent immediate and effective retaliation. Dusk—or more accurately, 15 minutes before sunset—was therefore selected as the optimum time-over-target (TOT) for airfield strikes at the end of the first day of hostilities.

This would minimise the danger of an immediate counter-attack and enable harassing pressure by B-57s from Mauripur to be maintained during the night. It would also give the air defence system plenty of time to prepare to meet reprisal attacks on the following morning, and the strike force to be ready for follow up attacks planned for a TOT of 15 minutes before sunrise. Because sunset was much earlier in East Pakistan the strikes against Kalaikunda were

planned for dawn on the following day, to avoid preceding those in West Pakistan and thus alerting the Indian defences.

From that point, further planning was a question of detail. Since the F-86 Sabre was then the only fighter-bomber in PAF service, the mission profiles had to be tailored to the characteristics of the F-86F. The PAF plan assumed 12 aircraft, allocated to each target, in three sections of four at five-minute intervals, using underwing rockets as well as the standard internal armament of six 0.5in machine-guns, for ground strafing. Further examination, however, indicated the necessity of carrying external fuel tanks to give an adequate combat allowance over the required ranges, and permit two attacks per aircraft, since the most forward PAF strike airfield of Sargodha was nearly 130 miles behind the frontier with India. This meant dispensing with the use of rockets, although in any case these weapons were considerably less accurate than the Sabre's front guns.

One final point to be decided was whether the strike force should cross the Indian frontier simultaneously on the way to their various targets, or aim for a common TOT (time-over-target). Since Indian defensive measures would almost certainly be initiated by the act of border penetration, the PAF plan decided in favour of the simultaneous frontier crossing and the acceptance of differing TOTs.

**\*Extracted from 'Battle for Pakistan' by John Fricker**



*Sqn Ldr Sajjad Haider being awarded the SJ by Field Marshal M Ayub Khan, President of Pakistan Commanding No. 19 Squadron, he led the Sabres which effectively halted the Indian Army's advance towards Lahore on 6th September morning and the same evening, attacked the IAF base at Pathankot, with devastating results*

# Air War 1965



## The Keelor Brothers Honoured

*La Martiniere College, Lucknow (inset: Air Marshal Denzil Keelor)*

Exactly 50 years after Sqn Ldr Trevor Keelor shot down the first PAF Sabre over the Chhamb, his Alma Mater, La Martiniere College, Lucknow hosted a series of programmes at their magnificent campus on 3 September 2015.

Amongst the Alumni of La Martiniere so honoured, were the late Wg Cdr Desmond Eric Pushong VrC, the late Wg Cdr Trevor Keelor VrC, his brother Air Marshal Denzil Keelor PVSM, KC, AVSM, VrC, Flt Lt Alfred Cooke VrC, Air Vice Marshal Harbans Perminder Singh VrC, VSM and Commodore Arvind Singh, MVC, NM.

Chief of the Air Staff IAF, Air Chief Marshal Arup Raha presided, took the salute of NCC cadets, presented plaques to those honoured and addressed the select gathering assembled in front of the historical building, *Constantia*.

The CAS later unveiled the Memorial Tablet to the 'War Heroes' alongside



*Air Chief Marshal Arup Raha presenting a plaque to Air Marshal Denzil Keelor*

*The mounted Gnat light fighter depicted at take off from the specially built runway section at the Memorial Park of La Martiniere College*



*Mrs Patricia Keelor at the Memorial Hall*



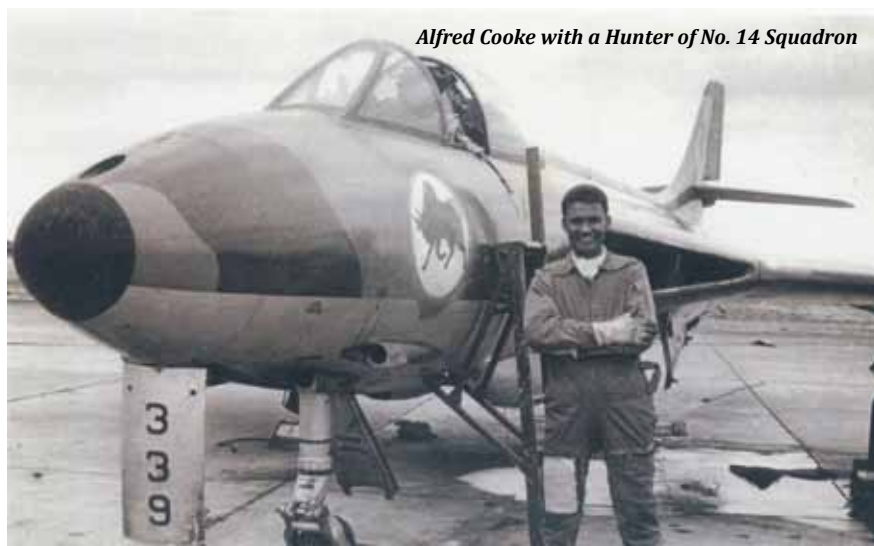
*Pushpinder Singh of Vayu presenting 'Gnats in action' painting to Mr Carlyle McFarland, Principal La Martiniere College, Lucknow*

Mrs Patricia Keelor before the party moved to the Memorial Park for ceremonies around of the Gnat light fighter aircraft presented to La Martiniere College by the CAS.

The statement "the Keelor brothers and the Gnat fighter are synonymous" was never more apt !

# Air War 1965

## An Incredible Dogfight The Alfred Cooke Story



Alfred Cooke with a Hunter of No. 14 Squadron

**T**his story of the Indian Air Force has perhaps not been told enough, that of a Hunter's incredible combat with four Pakistani F-86 Sabres in what was not only the most memorable dogfight of the 1965 War, but perhaps in the history of jet fighters. Flt Lt Alfred Cooke, who was later awarded the Vir Chakra (VrC) for this action, is quite literally a living legend and he shared this with *Vayu* in an exclusive talk in New Delhi, almost exactly fifty years after the event.

Early morning on 7 September 1965, five F-86 Sabres of the PAF in East Pakistan had come in at low level from direction of the sea to catch on ground IAF Canberras and Vampires lined up and being refuelled at Kalaikunda AFS in West Bengal. The hapless aircraft were promptly strafed, with two Canberras and four Vampires destroyed. This was the first of two PAF attacks on Kalaikunda that same day and was the more successful one.

The second raid that day was carried out by four PAF Sabres at 1030 hours, but these were intercepted by two Hunters of No. 14 Squadron IAF, airborne from Calcutta's Dum Dum airfield. The lead Hunter was

flown by Flt Lt Alfred Tyrone Cooke, with Flying Officer SC Mamgain as his wingman. The two Hunters split over Kalaikunda and engaged separate targets, commencing what was to become one of the most incredible aerial encounters of the war. During the engagement, Cooke shot down one Sabre and heavily damaged a second. Mamgain meanwhile is credited with a single kill of his own, but by the time the battle was over, Alfred Cooke had actually tangled with all four Sabres over Kalaikunda!

Flt Lt Alfred Cooke VrC, originally from Lucknow and currently resident in Australia, specially came to India with his family for the 1965 War commemorations, being honoured by his Alma Mater, La Martiniere College, Lucknow on 3 September 2015 (the day exactly 50 years earlier when another Martinian, Trevor Keelor shot down the first PAF Sabre over the Chhamb, to be followed by his brother Denzil Keelor who shot down his Sabre two weeks later).

In his own words, Alfred Cooke recalled his air action on 7 September: "they were flying very low to avoid me... I just pressed on with the attack, not realising that my wingtip was grazing the scrub! When I pulled the trigger I realised the Sabre was not getting hit and I was merely targeting the shrubs and bushes. My speed was some 400 knots and we were engaged in the very low dogfight for some time. Then I fired again and managed to hit the Sabre 'bang on.' It exploded in a huge fireball, which I flew through."

Cooke then engaged a second Sabre, but only managed to damage it with ball ammunition, having run out of high-explosive ammunition during course of the first dogfight. On the verge of finishing off this second Sabre, Cooke broke off to engage a third, which had targeted him during one



Vishnu Som of NDTV interviewing Alfred Cooke in New Delhi



PAF Sabre seconds before being shot down near Kalaikunda on 7 September 1965



Air Marshal Arjan Singh DFC, Chief of the Air Staff, IAF with Alfred Cooke and Hunter

of his diving attacks. In tangling with this aircraft, he finally ran out of all ammunition and when he came up against the fourth Sabre, he literally chased it away from the airfield by constantly harassing him in a tail chase over the base, frustrated by his empty guns! It has since been established that the second Sabre — heavily damaged by Cooke's ball ammunition — eventually crashed while returning to Dacca, which should put Cooke's tally at two aircraft destroyed.

This action is well described in the 'official history': 'Of the score or so fighter versus fighter combat actions during the 22-day war of September 1965 that stretched both man and machine to their limits, one may be recorded here. This took place on 7 September over Kalaikunda, as IAF Hunters on combat air patrol intercepted PAF Sabres

mounting repeat strikes on the airfield. Flt Lt Alfred Cooke of No. 14 Squadron IAF got behind a Sabre of, by curious fact, No. 14 Squadron PAF. The Sabre, with its low-speed manoeuvring flaps, has a better radius of turn than the Hunter, although the latter has better acceleration. As the Hunter was jockeying for position, the Sabre threw in a turn, forcing Cooke to mush out and the Sabre reversed, trying to get into the Hunter's turn. Cooke, then carried out a reversal, trying to decay his speed and these scissor manoeuvres continued as the Sabre, in a bid to break out, would throw in a turn once more, the classic scissors being repeated again and again. After over ten minutes of this text-book, intense dogfighting, the Sabre finally straightened out and dived to accelerate and exit but Cooke reacted immediately with a burst of cannon fire, the 30

mm shells striking the Sabre which broke up and crashed not far from the air base, the entire sequence having been watched by hundreds of personnel below, including students of the Indian Institute of Technology at Kharagpur.'

When the combat was over, Cooke and Mamgain were forced to recover to Dum Dum in Calcutta instead of simply landing at Kalaikunda, because 'friendly' anti-aircraft guns around the airfield they had just successfully defended had begun to mistakenly fire upon the 'friendly' fighters!

In all, Alfred Cooke had spent over twelve minutes engaged in combat at low level with four enemy aircraft in quick succession, a feat that has not been matched in the jet era of air combat. Chasing away the final Sabre with no ammunition remaining was the *pièce de résistance*!



Post script : Flt Lt Alfred Cooke briefing young Plt Offr of No.14 Squadron at Kalaikunda 1966



Pushpindar Singh of Vayu presenting painting done by Sameer and Priyanka Joshi to Alfred Cooke (see cover story)

### Funding for Brazilian Gripen

Under the FX-2 programme, Brazil and Sweden have come to an agreement on the \$4.6-billion financing for the Brazilian Air Force's 36 Gripen NGs. According to official sources, successful negotiations were followed by legal procedures and final approval by the Brazilian Senate. The first 13 Gripens for Brazil will be built in Sweden, while Brazilian personnel seconded to Saab will produce the remaining eight. The remaining 15 will be built in Brazil, with deliveries scheduled for 2019-24.



Meanwhile, the Czech Air Force has deployed five Gripen fighters to Iceland for NATO's airborne surveillance and interception mission. The Czech Air Force are reportedly to upgrade its Gripens with new air-to-ground attack capability by 2018.

### Su-35 fighters for Pakistan?

According to a credible European publication, in a report datelined Islamabad, the Government of Pakistan is negotiating procurement of an unspecified number of Sukhoi Su-35 fighters from Russia. This contemporary multi-role combat aircraft could well become the most strategic military deal between Pakistan, a longtime adversary of India, and Russia, which has provided India with bulk of its major weaponry for half a century. Although a senior Pakistani official is quoted as saying that a final decision is "yet to be made," the confirmation that discussions have taken place demonstrates Russia's willingness to sell advanced hardware to Pakistan, despite Moscow's traditional ties with India.

Pakistan's interest in the Su-35 is understood to be driven by "the PAF's need for a fighter with higher payload range than the JF-17 or F-16, giving it deep penetration capability." This has come in the wake of Russian media reports that quoted Russian Deputy Foreign Minister Sergei Ryabkov saying that Pakistan was in talks to procure Su-35s, following a recent agreement for Russia to provide Mi-35M 'Hind E' attack helicopters to Pakistan, which deal was signed in June 2015 when Pakistan Army Chief General Raheel Sharif visited Russia.

### Indonesia selects the Su-35

The Indonesian Government has meanwhile selected the Sukhoi Su-35 'Flanker-E' multirole combat aircraft to replace the Indonesian Air Force's (TNI-AU's) Northrop F-5E Tiger II fighters in a competition which included the Typhoon, Gripen, F-16 and Rafale. This is the first export order for the Su-35.



Defence Minister Ryacudu said that the TNI-AU was "accustomed" to operating Russian fighter aircraft procured over the past decade, which includes a mix of 16 Su-27SK 'Flanker' and Su-30MK2 'Flanker-C' fighters (see photo). The new programme is valued at around US\$1 billion and features the procurement of 16 aircraft, with options to procure additional units in the future. The programme could be funded by a loan from Russia, the Indonesian government negotiating the terms of US\$3 billion credit deal to support Indonesia's purchase of a range of Russian materiel.

### Kuwaiti interest in Typhoons, Super Hornets



Reports from Rome state that the Kuwaiti Government is likely to purchase 28 Typhoons in a multi billion euro deal with the Italian government. The deal is still in negotiation but Kuwait has indicated that it requires 22 single-seat and six twin-seat Typhoons in a government-to-government agreement. Italian firm Finmeccanica's Alenia Aermacchi division has been leading



the Eurofighter effort to sell the Typhoon to the Kuwaitis. This contract would, in fact, mean that Kuwait will be the first export customer for the active electronically scanned array (AESA) radar being developed by Italy's Selex ES.

Information on the Kuwaiti interest in Typhoon has been around since early 2015 and is in wake of news that the Kuwaitis were in discussion with the US to purchase up to 40 Boeing F/A-18 fighters. A US source has stated that there is always a chance for a split buy from Kuwait and said talks on a Super Hornet sale to Kuwait "are still moving forward". While declining to name Kuwait specifically, a Boeing spokeswoman said the company and the US government are still in conversation with potential Middle Eastern customers.

### New Chinese weapon systems

Highlight commemorating '70<sup>th</sup> Anniversary of the Chinese People's War of Resistance against Japanese Aggression and the World Anti-Fascist War' in Beijing on 3 September, was the military parade that had 'official' revelation of many new weapon systems apart from participation of 12,000 troops from the People's Liberation Army (PLA), plus 1,000 troops from 17 other countries, including Pakistan.



The parade included 500 ground-based weapons of more than 40 types and 200 aircraft of some 20 types. Strategic missiles took centre stage at the parade, in particular the China Aerospace Science and Industry Corporation (CASIC) DF-21D anti-ship ballistic missile (ASBM) for attacks against moving ships at sea. Also making appearance was the CASIC DF-16 medium-range (800-1,000 km) ballistic missile, which was deployed by the Second Artillery Corps in early 2011. The multiple-warhead-armed CASC DF-5B 15,000 km-range intercontinental ballistic missile was also unveiled, which has the same missile shroud technology as CASC's *Long March-2C* space launch vehicle. Naval systems included the Hongdu YJ-12 ramjet-powered supersonic air-launched anti-ship missile while the flypast included J-15 carrier-based fighters (see above).

### Chinese unveil new sensors for J-20, J-31

A privately-owned Chinese sensor company has unveiled a suite of air-to-air and air-to-ground sensors under development for

the latest Chinese and Russian fighters. Wang Yanyong, technical director for Beijing A-Star Science and Technology, has stated that two systems – the EOTS-89 electro-optical targeting system (EOTS) and the EORD-31 infrared search and track (IRST) – are in development for China's J-20 and J-31 fifth generation fighters.

It is suggested that the J-20 could use passive sensors to detect and aim missiles against the Northrop Grumman B-2 bomber and Lockheed Martin F-22 fighter, even while its radar is being jammed by a Boeing EA-18G Growler. It lists detection ranges for the B-2 at 150 km and for the F-22 at up to 110 km. Chinese combat aircraft manufacturer AVIC is considering integrating the sensors on a testbed aircraft, then could decide to integrate them on the J-20 and J-31.

### Vietnamese Su-30MK2Vs

A further two Su-30MK2V fighters have been delivered to Vietnam, flown to that country on 6 August on board an An-124-100. They are the fifth and sixth to be delivered from an order for 12 signed in May 2013. The first four were delivered last October.

### IOC for US Marines F-35B

The US Marine Corps have declared initial operational capability of the Lockheed Martin F-35B Lightning II with Marine Fighter Attack Squadron 121 (VMFA-121), based at MCAS Yuma Arizona, becoming its first operational squadron. "VMFA-121 has ten aircraft in the Block 2B configuration with the requisite performance envelope and weapons clearances to include training, sustainment capabilities and infrastructure to deploy to an austere site or a ship. It is capable of conducting close air support, offensive and defensive counter air, air interdiction, assault support escort and armed reconnaissance as part of a Marine Air Ground Task Force, or in support of the Joint Force," according to Gen Joseph Dunford, Commandant of the Marine Corps.



VMFA-121 will be followed by Marine Attack Squadron 211 (VMA-211), an AV-8B squadron, which is scheduled for transition to the F-35B in fiscal year 2016 while the VMA-311 will conduct its transition to the F-35B in 2018. Meanwhile, the USAF has activated the first combat squadron to fly the F-35A, being the 34<sup>th</sup> Fighter Squadron 'Rude Rams' which was formally stood up in a ceremony at Hill AFB, Utah on 17 July.

## New F-16s for Iraq



The first four F-16C/D Block 52s for the Iraqi Air Force arrived at Air Force Base Balad on 13 July 2015. The aircraft, which were routed via Lajes Field in the Azores, had been temporarily based at Tucson International Airport, Arizona, where they were used for training of Iraqi Air Force pilots alongside the Arizona Air National Guard's 162<sup>nd</sup> Wing.

## F-16C deliveries to Egypt

An additional eight F-16C Block 52s have been delivered to the Egyptian Air Force in end-July following the lifting of a freeze on weapons deliveries imposed after the military-backed coup in 2013. All were flown from the factory in Fort Worth, Texas, via Lajes Field in the Azores, to Cairo West Air Base. These were immediately integrated into the EAF's existing F-16 fleet which include 20 F-16 Block 52s. With the additional eight F-16Cs now in Egypt, this leaves just four more F-16Cs to be delivered to complete the delayed order.



## Turkish F-16 Block 30s

Turkish Aerospace Industries (TAI) will upgrade the Turkish AF Lockheed Martin F-16 Block 30. The F-16 Block 30 Structural Modernisation Programme includes the 25 oldest F-16s in the Turkish Air Force inventory, and will provide a service-life extension. The work is likely to be conducted by the Turkish Air

Force's 1<sup>st</sup> Air Supply and Maintenance Centre Command. The Turkish Industry has also been involved in upgrading early model Pakistan Air Force F-16s to new Block standards.

## Korean KF-16 upgrade plans

Upgradation of 134 Republic of Korea Air Force KF-16C/D Block 52 fleet is to be awarded to Lockheed Martin after a similar contract with BAE Systems was terminated last year. The new deal requested by the ROK Government is to include 150 Modular Mission Computers (MMC 7000AH) and 150 active electronically scanned array (AESA) radars. Weapons will include GBU-54 laser Joint Direct Attack Munitions (JDAM), KMU-57C/B bomb tail kits, GBU-39 Small Diameter Bomb guided test vehicles, eight



GBU-39 Small Diameter Bomb tactical training rounds, two BRU-61 Small Diameter Bomb common carriage assemblies and five Mk 82 general purpose practice bombs.

## PAF to get more Sniper ATPs

Lockheed Martin has received a follow-on Foreign Military Sales contract to produce and upgrade Sniper Advanced Targeting Pods (ATPs) for the Pakistan Air Force's F-16 fleet. The contract, announced by the company on 14 July includes the production of 15 new Sniper ATPs and upgrades to the PAF's 22 existing pods. To meet the PAF's urgent operational need, pod deliveries will begin in



late 2015. The upgrades, which will increase compatibility with the aircraft and enable enhanced features, will also begin in late 2015.

“Sniper ATP has supported the Pakistan Air Force’s mission since 2010. Additional Sniper ATPs and upgrades will give the Pakistan Air Force a more robust precision targeting capability to support the nation’s security requirements.” The pod provides pilots with high-resolution imagery for precision targeting, surveillance and reconnaissance missions. “It detects, identifies, automatically tracks and laser designates small tactical targets at long ranges. It also supports employment of all laser and GPS-guided weapons against multiple fixed and moving targets.”

## Re-built Su-22s by Iran



According to sources in Iran, the country’s Air Force has carried out the maiden flight of a former Iraqi Sukhoi Su-22, one of 12 it is restoring to new configuration. The aircraft, which are from a batch of 40 Su-22s that the Iraqis had sent to Iran for ‘safe keeping’ during Operation *Desert Storm* 24 years ago, are to be operated by the Islamic Revolutionary Guard Corps Air and Space Force (IRGCASF). Iran is planning to restore five Su-22M4s, two Su-22UMs and five Su-22UM3s with work being carried out by Pars Aviation Aircraft MRO Centre and powered by R-29BS-300 engines. According to reports, the aircraft will be wired to carry C-704KD Nasr 2 anti-ship/cruise missiles.

## Mi-35Ms for Pakistan

Sale of an initial four Mi-35M attack helicopters has been negotiated between Russia and Pakistan according to senior Russian officials. Pakistani requirements were for upto 20 attack helicopters but the parties have agreed to an initial batch of four “to avoid negative reactions from India”. Further, “the Mi-35Ms are intended only for counter-terrorist operations in northwest Pakistan.” The sale has also been confirmed by Anatoly Isaikin, director general of Rosoboronexport, who hinted that the initial contract will cover a small number of aircraft. According to Russian sources, “if Pakistan were pleased with its initial acquisition, the first Mi-35Ms would be followed by more, with an eventual aim to bring the fleet up to between 18 and 24 helicopters.”

## Upgraded MiG-21s for Croatia

Twelve overhauled MiG-21s for the *Hrvatsko Ratno Zrakoplovstvo i Protuzračna Obrana* (HRZ I PZO—Croatian Air Force and Air Defence) has been successfully completed, final aircraft



being declared operational on 16 July. The Croatian Ministry of Defence signed a contract on 9 July 2013 with Ukrainian company Ukrspesexport for work on the 12 aircraft, which included three MiG-21bis and four MiG-21UMDs, plus five ‘new’ MiG-21bis. The latter were ex-Yemen Air Force aircraft which had been stored at the Odessa plant for some time.

## Pampa III's first flight

Even as the future of the Indian HJT-36 IJT programme is uncertain, Argentina’s very similar FAdeA IA-63 Pampa III advanced training aircraft made its first flight in August 2015. The Pampa III maintains the general characteristics of the earlier Pampa II (see photo), but incorporates two Elbit-supplied multi-functional screens, daytime and nighttime modes and a simulation system. The Argentinian Air Force is also considering adding Elbit’s Targo helmet-mounted display (HMD) system. Early in 2014, production had reportedly stopped on the 40 IA-63 Pampa III aircraft ordered so far because funding was scarce and FAdeA operators focussed instead on maintaining current aircraft, with the air force retiring its ageing Mirage III.



## The new generation L-410NG

Czech Aircraft Industries has developed a new generation version of its long-serving L-410 twin-turboprop. The first L-410NG was unveiled at the company's factory in Kunovice on 15 July and made its maiden flight from there on 29 July. Based on the current production L-410UVP-E20, improvements include a new wing structure with integral fuel tank giving an increased capacity and longer range. The 19-passenger aircraft is also equipped with a Garmin G3000 digital glass cockpit with advanced new avionics. The type is powered by new, more powerful 850hp GE H85 engines with AV-725 propellers, has an increased maximum payload of 4,749lbs (2154 kg) and larger forward baggage compartment. Projected for the short-haul commuter market, the L410NG could be offered for maritime patrol purposes as, with an extended endurance of up to ten hours "makes it an ideal platform for such tasks. Aviation Industries hopes to achieve EASA certification and begin series production in 2017, with plans to eventually produce up to 30 L-410NGs per year."

## Typhoon Aerodynamic Upgrades

Airbus Defence and Space has completed flight-testing a package of aerodynamic upgrades to the Eurofighter Typhoon which will further "enhance the aircraft's agility and weapons-carrying



ability." The Aerodynamic Modification Kit (AMK) is part of a wider Eurofighter Enhanced Manoeuvrability (EFEM) programme. Announcing completion of the trials on 15 July, Airbus said that modification essentially involved addition of fuselage strakes and leading-edge root extensions, which increase the maximum lift created by the wing by 25%. This results in an increased turn rate, tighter turning radius and improved nose-pointing ability at low-speed – all critical fighter capabilities in air-to-air combat. Introduction of the AMK would not only enhance the Eurofighter's current capability as a 'swing-role fighter-bomber', but provide additional growth potential, enabling easier integration of future air-to-surface configurations and much more flexible options, enhancing the aircraft's mission effectiveness in the air-to-surface role. According to Eurofighter Project Pilot in Germany, Raffaele Beltrame, "We saw angle of attack values around 45% greater than

on the standard aircraft and roll rates up to 100% higher, all leading to increased agility. The handling qualities appeared to be markedly improved, providing more manoeuvrability, agility and precision while performing tasks representative of in-service operations.

## Jordan orders nine PC-9Ms



The Royal Jordanian Air Force (RJAF) will purchase nine Pilatus PC-9M turboprop trainers, the Swiss manufacturer stating that it had won the order "after several years of hard negotiations, from which the PC-9M finally emerged as the winning contender." The RJAF PC-9Ms will be ready for delivery from January 2017, to be used for both basic and advanced pilot training. Currently, pilot training is carried out at the King Hussein Air College at Al Mafraq. Initial basic training use the T-67M-260 Fireflies, from which pilots progress onto CASA C101CC Aviojets. Meanwhile, Pilatus has been carrying out major refurbishment and overhaul of four Omani PC-9s at its facilities at Stans-Buochs, Switzerland.

## Israel "donates" 16 AH-1F Cobras to Jordan



Israel has "donated" 16 of its retired Bell AH-1F Cobra attack helicopters to Jordan, the helicopters refurbished gratis by the USA. Official sources state that not all Cobras had been put into operational service with the Royal Jordanian Air Force (RJAF), 'some' being used purely for spares. It is believed up to 12 are active, with at least four being used for parts. The RJAF took delivery of 24 AH-1S Cobras in 1985, while nine AH-1Fs were delivered from

September 2000. A batch of 16 of the older RJAF AH-1S variants were transferred to the Pakistan Army on 16 March 2010. Prior to the latest arrivals from Israel, it is believed the RJAF had only around a dozen AH-1F/S Cobras in operational service.

## Qatar Aerobatic Team with PC-21s

According to the company, Pilatus has begun flight testing of the first PC-21 for the Qatar Emiri Air Force's (QEAF's) new aerobatic display team. The QEAF has 24 PC-21s on order under a contract signed on 30 July 2012. To date, 17 QEAF PC-21s have been built and 12 delivered.



10 April this year by the Australian Government, the eighth due to arrive at Amberley before the end of the year. The two aircraft are part of a batch of ten 'white tails' built by Boeing without an existing contract from a customer.

## CH-47Ds for Morocco

Columbia Helicopters has completed refurbishment of three former US Army CH-47D Chinooks for the Royal Moroccan Air Force (RMAF), which were earlier ordered through a \$78.9



## Grob G120TP deliveries for Myanmar

Grob of Germany have delivered five G120TP turboprop trainers to the Myanmar Air Force and will supply a further five before the end of September 2015. The order for these aircraft was signed on 24 October 2014. They are replacing the Chinese Nanchang PT-6 (CJ-6) piston-engine trainers that are currently operated by the Flying Training School at Shante Air Base, Meiktila. It is planned to retire the PT-6s by the year-end.

## Japan orders V-22 Ospreys

An order for an initial five V-22B Osprey Block Cs for Japan has been placed with the Bell-Boeing Joint Project Office, marking the first overseas sale for the Osprey tilt rotor aircraft. Japan had been considering purchasing the Osprey for a number of years and its five-year defence plan, approved by the Cabinet in 2013, included plans to acquire 17 V-22s for the Japan Ground Self-Defence Force (JGSDF) over that period. The DSCA stated that the total cost for the 17 V-22Bs will be \$3billion, including associated equipment, parts and logistical support, and include six spare Rolls-Royce AE1107C engines. The Osprey is already based in Japan with the US Marine Corps having two squadrons of the type based at Marine Corps Air Station Futenma.

million Foreign Military Sales deal. Work on these had been carried out in Columbia Helicopters' Military Maintenance Facility at Aurora (Oregon) State Airport, Oregon. The seven-month refurbishment programme comprised a complete inspection and repair process, including overhaul of all major components. US Army Training and Doctrine Command's Security Assistance Training Field Activity carried out pilot and maintenance training of RMAF personnel on the type.

## Seventh RAAF C-17A delivered

The seventh Boeing C-17A Globemaster III was delivered to the Royal Australian Air Force on 29 July. The aircraft is one of two additional aircraft for which an order was announced on

## L-410s for Bangladesh

Aviation Industries has delivered all three L410UVP-E20s ordered by the Bangladesh Air Force (BAF) to supplement its transport aircraft fleet. The third and final aircraft arrived in Dhaka in late June 2015. For their delivery flights, all three aircraft had 'Aviation Industries' titles taped over the Bangladesh Air Force



markings and still wore their Czech test registrations, in addition to their BAF serials. The aircraft are all equipped with modernised Garmin digital avionics and the passenger cabins have leather seats.

## Afghan MD530Fs

Advanced weaponry is to be provided for the Afghan Air Force's (AAF's) fleet of MD530Fs through a new foreign military sales contract awarded to MD Helicopters by the US Army Contracting Command. The project covers the procurement, installation, integration, testing and US Army-approved airworthiness qualification support of M260 rockets and fixed forward weaponsights on the armed MD530F Mission Equipment Package (MEP) helicopters.

Integration will be carried out at the contractor's facility in Mesa, Arizona, as well as the development and shipment of 19 MEP modification kits for installation, with estimated completion date of 12 July 2016. The FN Herstal M3P 0.50 calibre machine gun, installed in the company's Heavy Machine Gun Pod, has already been integrated on the Afghan MD530Fs. At present the AAF has a fleet of 11 MD530Fs, with six more due for delivery shortly. The original AAF order for MD530Fs in March 2011 covered a firm order for six helicopters, plus options on a further 48. A contract was subsequently awarded to manufacturer MD Helicopters on 26 September 2014 converting 12 of these options to firm orders.



## PLANAF Shaanxi Y-8GX-6 enters service

The People's Liberation Army Naval Air Force (PLANAF) has recently inducted the new Y-8GX-6 long-range, anti-submarine warfare aircraft into operational service. Distinctive features of the new variant include the extremely long magnetic anomaly detector tail boom, surface search radar in a chin radome and an electro-optical turret under the forward fuselage housing a FLIR, CCD TV camera and laser rangefinder.



## First RAAF EA-18G Growler handed over

The Royal Australian Air Force has received its first Boeing EA-18G Growler, handed over by prime contractor Boeing and the US Navy during a formal presentation ceremony at the factory in St Louis, Missouri, on 29 July. The Growler will enhance the RAAF's current fleet of 24 Super Hornets and future fleet of F-35A Lightning II Joint Strike Fighters. It further advances 'Plan Jericho', an initiative to transform the RAAF into an integrated, networked force able to deliver air power in all operating environments.

The second RAAF Growler has also flown, while the following ten aircraft are in various stages of assembly at Boeing's St Louis plant. Under current plans, all 12 aircraft are due to arrive in Australia by the end of 2017. Boeing was awarded a contract for 12 Growlers for the RAAF under an FMS agreement with the US Navy on 30 June 2014.

## Ex-Qantas A330 for KC-30A conversion

It is reported that Airbus Defence and Space has taken delivery of the first of two former Qantas A330-203s for conversion to KC-30A Multi-Role Tanker Transports (MRTTs) for Royal Australian



Air Force (RAAF) service. Both had been leased to Qantas by CIT Aerospace and returned to the US lessor before being sold to the Australian Department of Defence. These will be first in-service

A330-200s to be converted to MRTT configuration, which will involve fitting a refueling boom, hose-and-drogue refueling pods under the wings and other military equipment. All other MRTTs to date have been converted straight after coming from the production line. They will be delivered in 2018 to join five other KC-30As serving with 33 Squadron at RAAF Base Amberley, Queensland.

## UK accepts 7th Airbus A400M

Airbus Defence and Space has welcomed the decision of the UK Ministry of Defence to declare that the key contractual milestone known as In-Service Delivery (ISD) has been met following the handing-over of its seventh Airbus A400M new-generation airlifter. The transfer of the aircraft, known as Atlas in UK service, means that the Royal Air Force now has four A400Ms in day-to-day service at Brize Norton and three undergoing installation and testing of the UK-specific Defensive Aids Sub-System (DASS). Operating data shows that the RAF A400M fleet is achieving excellent in-service results and will pass 1,000 hours flying soon, with the first RAF aircraft about to become the A400M global fleet leader in terms of flight-time. The aircraft are achieving a mission success rate in excess of 90%.



The RAF's Deputy Commander Capability, Air Marshal Sir Baz North said: "This significant milestone is an important achievement in the A400M Atlas' contribution to the Royal Air Force's operational air transport inventory. Over the last 5 years the service has been able to recapitalise its air transport Fleets into an agile and adaptable capability, delivering a modern and highly reliable Air Mobility force for UK defence."

## Boeing delivers 7 Australian Chinooks

Boeing delivered the seventh CH-47F Chinook to the Australian Army on budget, three weeks ahead of schedule, supporting modernisation of Australia's cargo helicopter fleet and eventually replacing the Commonwealth's six older CH-47D Chinooks. The seven advanced Chinooks were ordered as part of a US Government Foreign Military Sales agreement with Australia in 2012. Major developments on the CH-47F include a digital cockpit, an advanced communications system and new avionics. Those allow the Australian Army to operate more effectively with US and international forces through the easy exchange of digital maps

that facilitate coordinated responses for military and humanitarian missions. The Australian Chinook configuration also includes a new rotor brake that enables shipboard operations by actively stopping the rotor blades rather than allowing the blades to naturally 'spin down' once the engine is turned off after landing.

## New contracts for Boeing P-8A Poseidons

Boeing will provide the first P-8A Poseidon maritime surveillance aircraft for Australia and additional P-8As for the US Navy following a \$1.49 billion contract award from the Navy for 13 such aircraft, including nine for the US Navy and four Poseidon aircraft for the Royal Australian Air Force (RAAF), a long-time partner of the US Navy on P-8A development. This puts Boeing on contract to build the Navy's second lot of full-rate production aircraft, bringing the US Navy's fleet total to 62 P-8As. Boeing has delivered 28 Poseidons to date.



The US Navy has deployed the first two P-8A patrol squadrons since operations started in 2013 and production of the first Australian P-8A will begin later this year, with delivery to the RAAF scheduled for 2016. Boeing will also provide the RAAF with a complete training system for the P-8A, using simulators to train pilots and mission crews to operate the aircraft, its sensors, communications and weapons systems without relying on costly live flights.

## Air Canada's first 787-9



Air Canada has taken delivery of the first of 29 Boeing 787-9 Dreamliners on order, joining an earlier eight 787-8s. Benjamin Smith, President, Passenger Airlines at Air Canada, stated, “This new aircraft’s larger capacity and greater range will accelerate our international expansion strategy and allow us to offer customers more non-stop services to new international destinations. Already, we have announced two new 787-9 routes to Delhi and Dubai from Toronto beginning this fall and as more of these aircraft enter the fleet we will expand our international network even further.” Before the flights to Delhi and Dubai, the aircraft will operate between Toronto and Vancouver in August, and Toronto to Milan and Munich in September and October.

### A350 and B-787 for Vietnam

Vietnam Airlines has taken delivery of its first Airbus A350 XWB in parallel with the Boeing 787-9 Dreamliner. The Vietnamese flag carrier is the second airline to receive the A350, which arrived



in Hanoi on 1 July and will be used on domestic services between Hanoi and Ho Chi Minh City before making its long-haul debut on non-stop flights from Hanoi to Paris on 30 September. The aircraft is configured with a three-class layout, with 29 seats that convert to fully flat beds in Business Class, 45 seats in Premium Economy and 231 in Economy. Vietnam has 14 A350s on order.

Meanwhile, the carrier’s first 787-9 was delivered to Hanoi on 2 August and is also being used on domestic routes prior to operating the Ho Chi Minh City to London Heathrow service. This is the first of 19 Dreamliners the carrier has on order.

### ATR 72-600 for Myanmar National Airlines

On 3 August, Myanmar Airlines received the first of six ATR 72-600s from a contract signed in 2014. The carrier also agreed options for six more examples. Myanmar National Airlines’ current fleet includes three ATR 72-500s, two ATR 72-200s and a single ATR 42-300. Managing Director ThanTun stated



“We are upgrading our fleet with an aircraft that is proving to be outstandingly successful, particularly in Asia. Upgrading to the newest -600s came naturally after having successfully operated former ATR versions for years.”

### Production of the Airbus A330neo

Production has begun of Airbus’s first A330neo, one year after the programme was launched, with the first ‘cutting of metal’ underway at its production facilities in Toulouse and Nantes. The first A330neo Centre Wing Box rib 1 produced in Nantes uses an innovative Isogrid design with 330 triangular pockets which enables the part to meet all rigidity, strength and low weight requirements. The all-new pylon produced in Saint-Eloi is a key element in the A330neo’s innovative design, attaching the latest generation, fuel-efficient Trent 7000 engines to the wings. Made out of light weight titanium, the A330neo pylon uses cutting-edge aerodynamics, materials and design technologies derived from the A350 XWB.

### 50th A330 for Air China

The 50th A330 to be operated by Air China, which is also China’s first A330-300 with the increased 242 tonne maximum take-off-weight (MTOW) capability, made its maiden flight at Toulouse, France. Displaying a special livery to celebrate the ‘50th A330 for Air China’, the aircraft was delivered to the Chinese carrier in September 2015. Air China is the flag carrier of China, “one of the world’s most





dynamic aviation markets.” Air China introduced its first A330 in 2006 and since then has become Air China’s benchmark widebody aircraft, supporting its tremendous growth both on domestic and international routes. Air China operates a fleet of 169 Airbus aircraft, comprising 120 A320 Family and 49 A330 Family aircraft.

### EASA Certification for A330-200



The Airbus A330-200 has received EASA (European Aviation Safety Agency) certification for the new 242 tonne (MTOW) version, following certification in April 2015. Certification from the US authorities (FAA) will follow. Eric Zanin, Airbus Head of the A330 Programme stated, “With this new 242t A330-200 our customers will benefit from even more range plus a proven 99.4 percent reliability, while offering their passengers best-in-class comfort. Its unbeatable operating costs and unique versatility make the A330 Family a highly competitive solution in the medium to long haul market.”

### IAG orders 31 Airbus airliners

International Airlines Group (IAG) has signed a firm order for 31 Airbus aircraft, which includes 11 wide-body aircraft (eight A350-900s, three A330-200s) and 20 A320neos. The A350s and A330s are slated for Iberia’s fleet modernisation and to open new long-haul routes, while the A320neos will be allocated to the group’s airlines for fleet replacement. With this latest order for 31 aircraft IAG and its airlines have ordered a total of nearly 450 aircraft from Airbus. IAG’s airlines British Airways, Iberia and Vueling, between them operate nearly every aircraft in Airbus’ product range from the smallest single aisle A318 to the world’s largest wide-body A380.

### Next Generation Airbus ‘wide-body’ airliner

The wings for the first Airbus A350-1000 have begun the process of assembly at Broughton, North Wales. The A350-1000 wing has the same span of the A350-900 that is already in service, but

90% of the parts have been modified and the trailing edge extended to resize the wing for the additional payload and range. At 32 metres long by six metres wide, the A350 XWB wing is the largest single part made from carbon fibre composite material in use in civil aviation today. They are designed and developed at Airbus’ facility in Filton, near Bristol, where a number of other systems are designed and tested including fuel systems and landing gear.

The high-performance wings of the A350 XWB make the aircraft faster, more efficient and quieter. The wing design includes several streamlined features. Among these are droop-nose leading edge devices and new adaptive dropped-hinge flaps, which increase the jetliner’s efficiency at low speeds. To improve efficiency at higher speeds, the A350 XWB can deflect its wing flaps differentially, optimising the wing profile and providing better load control.

### Beluga XL programme design freeze

The new Beluga programme, christened Beluga XL, has successfully passed the latest maturity gate milestone, marking the end of the ‘concept phase’ or design freeze ‘at aircraft level’ which is a key step in any development programme. The maturity gate review demonstrated that the Beluga XL programme is robust and mature enough to move to the next phase of development, the detailed design phase.



The Beluga XL was launched in November 2014 to address transport capacity requirement to support the A350 XWB ramp-up and other aircraft production rate increases. Based on the A330-200 Freighter with a large re-use of existing components and equipment, the Beluga XL will be powered with Rolls Royce Trent 700 engines. The fleet of five Beluga XL aircraft will provide Airbus with an additional 30 percent extra transport capacity and the first of five Beluga XLs will enter into service in 2019.

### Wizz Air to buy 110 Airbus A321neos

Hungarian low-cost carrier Wizz Air has formalised the Memorandum of understanding (MOU) to purchase 110 Airbus A321neos. In a statement released on 11 September, Wizz Air said the order was worth \$13.7 billion at list prices, but said “Airbus had granted significant discounts.” The airline added that



it retained its commitment to purchase a further 48 aircraft from Airbus, comprising 21 A320neos and 27 A321neos. The first Wizz Air A321neo aircraft will enter service in November, configured with 230 seats.

### Finnair's 1st A350 XWB in maiden flight



Finnair will become the first airline in Europe to operate the A350 XWB and the third operator in the world. Finnair has acquired a total of 19 A350 XWBs and will operate its fleet on premium long haul routes, beginning with services between Helsinki and Shanghai. The A350 XWB had received 782 firm orders from 40 customers as of August 2015.

### Elbit DIRCM for European and Asian customers

Elbit Systems have been awarded two contracts for their MUSIC family of directed infra-red countermeasures (DIRCM) airborne multi-spectral self-protection systems. The first contract is a follow-on contract from "an Asian country", to supply its mini MUSIC systems for the customer's Blackhawk helicopter fleet. An additional order was received from a NATO member European country for the supply of C-MUSIC systems. Both contracts will be performed during 2015 and are in amounts that are not material to Elbit Systems.

Elbit Systems' MUSIC family of DIRCM systems are under contract for numerous customers worldwide including the Israeli

national programme for protection of its commercial fleet for platforms such as the B747, B737, B757, B767, B777 and A320; the Italian Air Force for the C130J, C27J and CSAR AW101; the KC-390 for Embraer and the Brazilian Air Force; the German Air Force's Airbus A400; Blackhawk helicopters for Asian customers, VIP helicopters and other aircraft.

### LM acquires Sikorsky Aircraft



Lockheed Martin has entered into a definitive agreement to acquire Sikorsky Aircraft, a world leader in military and commercial rotary-wing aircraft, for \$9.0 billion. The price is effectively reduced to approximately \$7.1 billion, after taking into account tax benefits resulting from the transaction. The acquisition is subject to customary conditions, including securing regulatory approvals, and is expected to close by late fourth quarter 2015 or early first quarter 2016. The transaction will have no impact on the company's previously stated commitments to return cash to shareholders through dividends and to reduce outstanding share count to below 300 million shares by the end of 2017. The Corporation plans to align Sikorsky under the Lockheed Martin Mission Systems and Training (MST) business segment.

### Finmeccanica-Selex ES to upgrade RAF Pumas

Finmeccanica-Selex ES has been awarded a contract to provide an ongoing radar warning capability for the UK Royal Air Force's fleet of Puma helicopters. The company was selected by the UK Ministry of Defence to provide its SG200-D Radar Warning Receiver (SG200-D RWR), which is a UK-specific product from the family of Selex ES's SEER system. An advanced digital Radar Warning Receiver, SG200-D is self-protection equipment which detects and identifies emitters in high density and complex radar environments. The contract includes a number of full sets of SG200-D equipment for installation onto the Puma helicopters, additional sets for spares and training and several sets of 'A-kit' equipment; the antennas and cockpit control equipment needed to quickly install the full system as a helicopter switches over from a training to operational environment.

## First MH-60R Helicopter for Denmark

Denmark will be the second international customer to have the US Navy's MH-60R Seahawk helicopter in its inventory. The first two such aircraft arrived at Lockheed Martin's Owego, New York facility for digital cockpit and integrated mission systems and sensors installation July 9 and are anticipated to be delivered to the Navy later this year.



## Finmeccanica's AW189s for RN-Aircraft

Finmeccanica has been contracted for ten AW189 commercial helicopters sold to RN-Aircraft, a subsidiary of the oil company Rosneft. Delivery of the aircraft is expected between 2015 and 2017. Moreover, as set in the framework agreement signed in December 2014 and with the involvement of Russian Helicopters, a subsidiary of Rostec corporation, Rosneft plans to order further helicopters by 2025, for a total of up to 160 units.

The parties have also reached an agreement for the progressive restructuring of HeliVert, a 50-50

Finmeccanica-AgustaWestland and Russian Helicopters joint venture, which foresees the future participation of Rosneft, worth 30% of the shares. Subsequently, shares in HeliVert will be redistributed as follows: 40% to Finmeccanica-AgustaWestland, 30% to Russian Helicopters and 30% to Rosneft.

## Elbit Systems to support Israeli Police Force

Elbit has been awarded an Israeli Ministry of Public Security and Israeli Police contract to supply leasing and maintenance services for the Israeli Police Force's aircraft. The contract will be



performed over a twenty-year period, and will include acquiring six new helicopters, adapting them to meet the Police requirements and performing routine maintenance. The helicopters' configuration and onboard mission systems will be fitted to accommodate a wide variety of missions such as surveillance and policing, search and rescue, command and control and fire-fighting. Elbit Systems, which will operate the helicopters under a PFI (Private Finance Initiative) contract, has been successfully operating PFI projects with the Israeli Defence Forces and in a number of countries around the world.

## Russian Helicopters' unmanned tiltrotor concept

Russian Helicopters has expressed new interest in developing tiltrotor technologies that could be used to design a new family of unmanned and potentially even manned aircraft. The holding that includes Russian design houses Kamov and Mil announced the internal initiative.

Although tiltrotor technology is mainly associated with Bell Helicopter's 60-year legacy of development work, Russian engineers have experimented with different tiltrotor concepts since the 1930s. More recently, Mil had launched development of the Mi-30, which resembled a slightly larger version of the V-22, in the mid-1980s, but it was cancelled as the Soviet economy slid. In the following decade, the Yakovlev design bureau also introduced a concept for a 450kg-class unmanned tiltrotor called the Albatross, which design faded from public view, but in 2012 Russian Helicopters disclosed a new UAV project also named the Albatross, featuring a partial tiltwing rather than only a tiltrotor. That project was reportedly scheduled to begin deliveries in 2017.

## Italian Coast Guard expands AW139 Fleet



Augmenting the Italian Coast Guard's helicopter fleet, Finmeccanica-AgustaWestland has delivered three AW139 intermediate twin aircraft and procured an order for two more aircraft. The AW139s will be used for a range of missions including maritime patrol, search and rescue (SAR), and emergency medical services. The latest order also includes a comprehensive support and training package and options for four additional helicopters.

This latest contract signed by the Italian Coast Guard brings the total number of AW139s chosen by all of these Italian government operators to 37, covering a wide scope of public utility roles including law enforcement and homeland security, patrol, special operations, search and rescue, command and control, government/VVIP transport, disaster relief and training.

### First flight of Bell 525 Relentless

Maiden flight of the super-medium Bell 525 Relentless helicopter has taken place at Bell Helicopter's aircraft assembly centre in Amarillo, Texas. The Bell 525 was designed



with input from the Customer Advisory Panel "as an aircraft to meet future requirements for operational safety, payload & range, cabin comfort and configuration and reliability." One of the unique characteristics of the Bell 525 is the ability to perform CAT-A takeoffs and landings, to and from a helipad at maximum gross weight. With over 60 helicopters reserved under letters of intent, the Bell 525 is designed to provide operators and end users unmatched situational awareness and the ability to perform a wide variety of missions under challenging weather conditions.

### NH90s for Finland



Assembly of the NH90 has marked an important milestone in delivery of the 20th and last serial NH90 during a ceremony at Patria's facility in Halli, Finland on 9 July 2015. "These helicopters are used for various tasks of the Finnish Defence Forces such as national defence, international crisis management and for SAR missions" stated Jussi Ristimäki, FDF Programme Manager for the NH90.

### Operational maturity of helicopter pilot assistance system 'Sferion'

Sferion, the most advanced pilot assistance system from Airbus Defence and Space, has proven its capabilities to protect helicopters in restricted visibility conditions during a series of live



flights during the German Army Aviation's Helicopter Forum at its International Training Centre in Bückeburg. The company demonstrated the systems' ability to prevent the most significant causes of non-hostile losses and mission failures, such as controlled flight into terrain, degraded visual environments (DVE), object and wire strike and lack of situational awareness. Furthermore Airbus Defence and Space demonstrated that Sferion in combination with state-of-the-art flight control systems builds the fundamental baseline for further developments of semi-automatic flying in DVE.

### Storm Shadow flight trial preparations



A series of ground based tests have been completed at Finmeccanica-AleniaAermacchi in Turin-Caselle and at BAE Systems in Warton, Lancashire for Eurofighter Typhoon's flight trials with MBDA's Storm Shadow cruise missile, due to take place in the UK later in 2015. The first set of ground trials had the Italian Instrumented Production Aircraft 2 (IPA2) and UK production Typhoon aircraft BS111, fitted with two of MBDA's Storm Shadow cruise missiles undergo Electro Magnetic Compatibility (EMC) tests. EMC testing ensures the integrity of the electrical systems onboard the aircraft and the missile. Following these tests, the missiles have been prepared for flight by positioning a series of laser tracking points which will allow engineers to accurately analyse the trajectory of the weapon when released from the aircraft.

## FREMM *Tahya Misr* at Suez Canal



On 6 August 2015, the Egyptian Navy's FREMM frigate *Tahya Misr* joined a large naval contingent to celebrate inauguration of a major extension of the Suez Canal. DCNS had delivered the *Tahya Misr* to the Egyptian Navy on 23 June, and its participation in the event "marks a new page in the shared history between Egypt and France". The *Tahya Misr* later led the ships through the new Suez Canal from the Mediterranean Sea heading to the Red Sea.

## Upgraded BAE Mk 45 Naval Guns



The US Navy has awarded BAE Systems a contract to overhaul and upgrade Mk 45 systems on US Navy Destroyer Class (DDG) ships. The initial contract of approximately \$80 million includes the upgrade of six guns to the Mod 4 configuration, with an option for four additional guns expected to be exercised in 2016, bringing the full value of the contract to \$130 million.

The Mod 4 capability upgrades include a 62-calibre barrel, strengthened gun and mount subsystems, enhanced advanced control systems, a reduced signature and low maintenance gun shield. The operational and performance improvements are designed to support potential increased ranges for Naval Surface Fire Support achieved through future extended range guided munitions.

## Patriot Air and Missile Defence innovations



Even as the combat-proven Patriot Air and Missile Defence System celebrated 50 years of innovation, "revolutionary technologies developed by Raytheon Company are evolving the battle-proven platform to face the threats of today and tomorrow." Cold-war era vacuum tubes and monochrome screens have long since disappeared, replaced by state of the art technology: microchips smaller than a grain of salt and hi-res touch-screen monitors that would be the envy of any video-gaming enthusiast. Today's Patriot now uses three new missiles – the GEM-T, PAC-3 and PAC-3 MSE – to engage drones, aircraft, cruise missiles and tactical ballistic missiles.

## Neuron flight test campaign



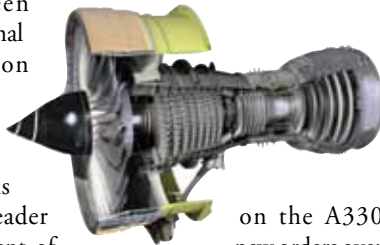
The flight test campaign of the Neuron Unmanned Combat Aerial Vehicle in Italy has been successfully concluded with the achievement of all established goals, thus allowing an important step forward for the programme. Neuron is the European full-scale technological demonstrator for an Unmanned Combat Aerial Vehicle (UCAV) developed by an industrial team led by Dassault Aviation with the collaboration of Finmeccanica-AleniaAermacchi, Saab, Airbus Defence and Space, RUAG and HAI. The aircraft was deployed at the Italian Air Force Decimomannu Air Base, in Sardinia, Italy, where it fulfilled a series of important operational tests. The 12 highly sensitive sorties have verified the characteristics of Neuron's combat capability, its low radar-cross section and low infrared signature, during missions flown at different altitudes and flight profiles and against both ground-based and air radar "threats", using in this latter case, an Eurofighter Typhoon.

## Honeywell's Future Air Navigation System

Honeywell Aerospace is making it easier for Dassault customers to meet the Federal Aviation Administration's upcoming safety mandates with a new Future Air Navigation System (FANS) aftermarket certification. With the certification, all Falcon 900 and 900B operators will be able to upgrade existing cockpit technologies with the communication and navigation system, enabling them to fly more efficient routes and save fuel. This certification for the Falcon 900 series marks a milestone for legacy aircraft as it becomes the first aftermarket-certified FANS system for Honeywell legacy cockpits. Operators will now retrofit compliant technology into existing hardware, instead of completely upgrading cockpit systems, which makes meeting the 2020 mandates deadline more cost-effective. The FANS system also equips Falcon 900 and 900B pilots to take advantage of the North Atlantic Track System, the trans-Atlantic flight paths set every day based on wind conditions, to optimise flight time and fuel savings and help lower operational costs.

## Rolls-Royce Trent 700s for IAFC

Rolls-Royce has been selected by International Air Finance Corporation (IAFC) to provide Trent 700 engines for 20 Airbus A330 Regional aircraft. The Trent 700 is an established market leader on the A330 with more than 60 per cent of new orders over the last three years, and Trent 700 now accounts for 90 per cent of A330 freighters in service and on order. Eric Schulz, Rolls-Royce, President, Civil Large Engines stated, "We welcome our customer's confidence in the Trent 700 as the best solution for fuel burn, emissions and noise performance as well as delivering unrivalled reliability for Middle East operations."



## Rolls-Royce teams with ITP for UltraFan

Rolls-Royce is to work with ITP to support a €43 million research programme to test Intermediate Pressure (IP) turbine technologies for future engine design, UltraFan; which will be available for service from 2025, will offer at least 25 per cent improvement in fuel burn and emissions compared with first generation Rolls-Royce Trent engines. ITP will develop and validate intermediate pressure turbine and rear structure capabilities for the UltraFan engine demonstrator including design, development, testing and manufacture. The IP turbine programme, which is receiving €23.5 million of its total funding from the EU, is part of the wider EU Clean Sky 2 initiative. The remainder of the funding will come from ITP. Clean Sky 2 runs until end 2023, and is a public/private Joint Technology Initiative that brings together Europe's industrial aeronautics leaders, public research organisations and SMEs to develop and demonstrate breakthrough technologies for the civil aerospace market, reducing emissions and noise and securing the continued competitiveness of the European aviation industry.

## First production Turbomeca Arrius 2R

Turbomeca (Safran) has delivered the first production Arrius 2R engine to Bell Helicopter, in August 2015. Selected to power the Bell 505 Jet Ranger X, the Arrius 2R is the only turbine in the 500 shp range to feature a dual-channel FADEC. With seven million flight hours already logged by Arrius variants, the 2R will also offer "an unmatched level of maturity at entry-into-service."



The handover to Bell Helicopter took place at the new Bell 505 assembly centre in Lafayette, Louisiana and marks a major step in the Arrius 2R programme.

Launched in 2013, the Arrius 2R is following a fast development schedule that has successfully passed on schedule all its milestones, among which first ground run (April 2014) at the company's Bordes factory, and a first flight aboard the Bell 505 at Bell Helicopter's Mirabel facility in November 2014.

### Sagem's SIGMA 40 selected by Norway

Sagem (Safran) has won a competitive tender issued by the Royal Norwegian Navy to modernise the navigation system on its three Nordkapp class offshore patrol vessels. These armed, helicopter-carrier patrol boats displace more than 3,300 metric tons, and will be fitted with Sagem's SIGMA 40 laser gyro navigation systems. Developed and produced by Sagem, the SIGMA 40 is a laser-gyro inertial system designed to guarantee high-precision navigation even in the harshest environments. A completely standalone unit, the SIGMA 40 contributes to the effectiveness of shipborne systems and also to the success of even the most demanding missions assigned to warships.

This latest contract further consolidates Sagem's 20-year partnership on navigation systems with the Royal Norwegian Navy, also underpinned by consulting services provided to the navy. Sagem's SIGMA 40 XP system was also selected by the Norwegian navy for the modernisation of six ULA class submarines, starting in 2008.

The SIGMA 40 navigation system is now used on more than 500 surface naval vessels and 75 submarines, especially the latest and most innovative front-line ships, such as the European FREMM and Horizon frigates, the Mistral class amphibious assault ship and the Korean LPX Dokdo amphibious helicopter-carrier.

### Irkut confirms MC-21 weight specifications



Computer rendering of an MC-21-200 in flight

Irkut has confirmed the MC-21 aircraft is meeting weight targets as the first airframe, wings and engines are coming together at the Irkutsk Aviation plant, according to Russian lessor Ilyushin Finance (IFC). So far, Irkut has mated several sections of the fuselage, while continuing to assemble the wings. Meanwhile, Pratt & Whitney has announced delivering the first PW1400G geared turbofan engine to Irkutsk, with the second engine scheduled for delivery soon. Irkut plans to complete assembly of the first flight test aircraft by the end of this year. The MC-21 wing will be fabricated using a new kind

of composite fabrication process for a commercial transport-rated aircraft, with out-of-autoclave technology used to lower costs and boost productivity.

### Belarus signs Yak-130 contract

On 26 August, Belarusian Ministry of Defence and Irkut Corporation signed a contract for four Yak-130 operational trainers at the MAKS-2015 international airshow, the jets to be delivered to Belarus in 2016. The document was signed by the head of the Main Directorate of the Ministry of Defence of Belarus, Alexander Shevchenko, and Irkut Corporation President, Oleg Demchenko. In April 2015, Irkut Corporation delivered the first batch of Yak-130 trainers to Belarus under a contract signed in 2013. A group of Belarusian flight instructors were trained to operate Yak-130 jets with the participation of testpilots of Irkut Corporation.

During military exercises, "Yak-130 jets demonstrated high accuracy while destroying training targets, using different weapons, including smart bombs." Commander-in-Chief of Belarusian air forces and air defence forces, Major General Oleg Dvigalev, said: "We are going to complete training of Lida airbase's personnel this year in order to prepare them for operation of Yak-130s. It is obvious that this aircraft allows us to train personnel at a new level and also carry out combat missions."

### Irkut showcases MS-21 FFS at MAKS-2015

Irkut Corporation showcased a full flight simulator for MS-21-200 aircraft at the recently concluded MAKS-2015 airshow in August 2015. The simulator was developed in the network of implementation of an agreement between Irkut Corporation and Aeroflot on development of a training programme for personnel operating MS-21 aircraft on the basis of Aeroflot training centre.



MS-21 flight deck simulator (photo: Alex Beltyukov)

The company is developing various equipment in order to prepare personnel for operation of MS-21 aircraft: Full Flight Simulator for MS-21-300 aircraft; Procedure trainer for MS-21-300; Cabin Emergency Evacuation Trainer for MS-21; Cabin trainer for MS-21; Door trainer for MS-21; Classroom for training pilots; Classroom for training flight attendants; CBT for training maintenance personnel (Category A, B1, B2); Maintenance trainer for MS-21; Interactive training stand for maintenance personnel (Category B1 and B2); Navigation trainer for MS-21 and lastly Emergency and Safety Equipment kits.

## Irkut debuts laser – equipped Yak-130

Irkut Corporation demonstrated a Yak-130 operational trainer fitted with a laser rangefinder at MAKS 2015. The rangefinder is intended for visual identification of ground and surface targets by the crew, and measurement of slant distance to them. “Yak-130 (tail number 01) was upgraded by Yakovlev design bureau (part of Irkut Corporation) in accordance with the requirements of foreign



*Modified Yak-130 in strike configuration with laser rangefinder clearly visible on the nose, on static display at MAKS-2015*

customers; the upgrade is focused on increasing the Yak-130s combat effectiveness. The laser rangefinder allows operating Yak-130 jets in mountainous regions with ravines, improves the accuracy in the area of target location and usage of weapons,” according to Irkut Corporation.

“The Yak-130 may be fitted with guided and unguided weapons, which allows using the jet for both personnel training and combat missions. The total payload carried by the aircraft using nine weapon stations is 3000 kgs. Open architecture of the jet’s avionics suite allows expanding the nomenclature of weapons used by adding advanced weapons manufactured in Russia and other countries.”

## Pratt & Whitney first PurePower engine for Irkut MS-21

Pratt & Whitney has delivered the first PurePower PW1400G-JM engine to the podding facility at Russia’s Irkut Corporation. The PW1400G-JM engine was assembled and tested at the Pratt



*P&W Geared Turbofan*

& Whitney West Palm Beach Engine Centre in Florida before being shipped to Irkutsk, Russia. The PW1400G-JM engine has been optimised for installation on Irkut’s MC-21 aircraft family. As the PW1400G-JM engine continues rigorous testing, engine certification is expected later this year. The PurePower engine family has completed more than 36,000 cycles of testing and 20,000 hours of testing, including 6,000 hours of flight testing.

## Kazakhstan Su-30SMs

The Kazakh Air Force has taken delivery of four Sukhoi Su-30 receives four Flanker C fighter aircraft from Irkut Corporation. The fighters were transferred at Taldykorgan air base in southern Kazakhstan and then participated at an aviation show during the city’s Armed Forces Day and 70th anniversary Victory Day. Currently, the Kazakhstan Air Force fields the MiG-27, Su-25, MiG-31, Su-27 and MiG-29 aircraft, which were inherited from



the Soviet Union in the early 1990s. In March 2015, the Ministry of Defence reported that a group of pilots and technicians returned to military units of the Kazakhstan Air Force from the Irkutsk Aviation Plant, where they “passed theoretical retraining at the Russian enterprise to prepare for operation of Su-30SM fighters.”





*Under ominous skies, PLAAF KJ-2000 AWACS aircraft leads formation of Chengdu J-10 multi-role fighters*

# The Dragon's New Colours

**China shows off new generation fighters, ballistic missiles and announces military re-structuring at WWII commemorative parade.**

Marking 70th anniversary of the defeat of Japan, China showcased its military might at a parade in Beijing on 3 September 2015, including a range of ballistic missiles, core of its nuclear and conventional deterrent, along with a range of new military equipment. And yet, amidst this pomp and show of its military prowess, Chinese President Xi Jinping announced the reduction by 300,000 troops of its 2.3 million strong People's Liberation Army, the world's largest standing military. Although the move was announced as a means to "reassure the world of China's peaceful stance," it is happening in lock step with acquisition of more modern and capable equipment, thus obviating the need for excessive manpower. The personnel cut is planned to be completed by 2017, and will be the fourth reduction of PLA forces following the country's military modernisation drive that commenced in the 1980s.



*Chinese Tri-Service march past at Tiananmen Square*

At the parade, Xi was flanked by Chinese leaders and foreign dignitaries, including Russian President Vladimir Putin, South Korean President Park Geun-hye and UN

Secretary General Ban Ki-moon. India, which played a prominent role in defeating the Japanese in Burma and frontiers of Assam in 1942-45 as also providing training

facilities to Chinese Army and Air Force personnel during that War, was represented by General VK Singh, Minister of State for External Affairs.

The perfectly choreographed military parade at Tiananmen Square showcased more than 12,000 troops, 500 pieces of military hardware and 200 aircraft of various types, representing what military officials say is the Chinese military's most cutting-edge technology. Aircraft in the skies over Beijing included J-10 and J-11 multirole fighters, the newly developed J-15 carrier fighter, and the KJ-2000 AEW&C platform. Most of the weaponry demonstrating China's full-spectrum fighting skills was indigenous, including the Beidou satellite navigation system, which is set to compete with US-owned Global Positioning System (GPS), following a recent alliance between Chinese entrepreneur Jack Ma's Alibaba Group and Norinco, a state-run military enterprise.

Four missile systems, capable of significantly altering the strategic balance of power in the Pacific, were star attractions of the parade, which took place in the context of the US 'Pivot to Asia,' a doctrinal shift by Washington towards the Asia-Pacific : the DF-21D 'carrier killer' ballistic missile, the DF-5B Inter-Continental Ballistic Missile (ICBM), said to be a vast improvement over the earlier DF-5, the road-mobile solid fuelled DF-31D missiles, and DF-26 Intermediate-Range Ballistic Missile (IRBM) capable of targeting Guam, the premier US military base in the West Pacific.



*Showcasing China's missile inventory*



*The DF-31A intercontinental ballistic missile*

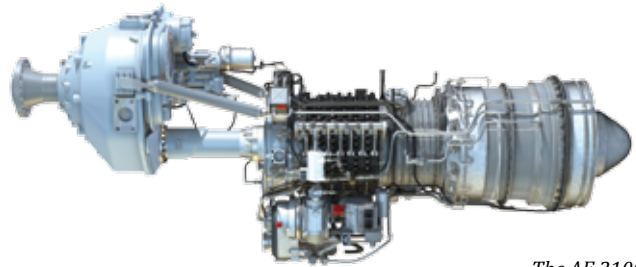


*Chinese Z-10 and Z-19 attack helicopters form the number '70' over Beijing*

# Rolls-Royce's association with the Indian Air Force



The Adour



The AE 2100

## 'Make in India'

Rolls-Royce started its long and distinguished association with the Indian aerospace sector in 1932 with its Gypsy engines on the first Tata aviation aircraft. A year later, the Indian Air Force (IAF) took to the skies powered by Rolls-Royce Bristol Jupiter engines. Today, more than 750 Rolls-Royce engines of 10 types power a range of Indian Air Force and Indian Navy aircraft. The Jaguar has been powered by Adour Mk811 engines since 1981 while the Hawk Advanced Jet Trainer (AJT) is powered by Adour Mk871 to train India's future pilots. AE 3007 powers Embraer jets on VVIP and surveillance missions, and AE 2100 powers the C-130J Hercules.

Gradually, Rolls-Royce has moved beyond sales and licensed production to engineering services, component manufacturing and supply chain to play a strategically important role in the Group's global operations.

### RR technology

Globally, Rolls-Royce has customers in more than 120 countries, comprising more than 380 airlines and leasing customers, 160 armed forces, 4,000 marine customers including 70 navies, and more than 5,000 power and nuclear customers. In 2014, Rolls-Royce invested £1.2 billion on research and development. "India ranks amongst the most important strategic markets for Rolls-Royce as we continue to build on our rich legacy and long-standing

partnerships. With a powerful portfolio of products, we offer the right combination of experience and new technologies. Our engineering excellence and innovation reinforces competitive advantage of products and services across aerospace, land and sea."

### 'Make in India'

For 59 years, Rolls-Royce engines have been *Made in India*, under license by HAL. In order to create a sustainable, Indian, jet engine ecosystem a broad range of skills and capabilities are required to design, develop, manufacture, sell and support engines. Rolls-Royce is investing in the foundations of this ecosystem as India's premier gas turbine partner. In terms of design, development and supply chain capability, it has recently announced the recruitment of 500 Rolls-Royce personnel in Bengaluru by 2017. These people will undertake aerospace engineering for customers in the region as well as support for Rolls-Royce's regional supplier base. "Their work will include the development of new tools and technologies that make best use of the capabilities that exist and ensure we continue to develop our partnerships with new and existing Indian suppliers." In terms of manufacturing, International Aerospace Manufacturing Pvt Ltd (IAMPL) is a joint venture between Rolls-Royce and HAL formed in July 2010. The Bengaluru facility is in full production, employing over 140 people and will produce 25,000 aerospace parts for Rolls-Royce in 2015 across a wide

range of engine programmes including for the Trent XWB. In terms of product support, Rolls-Royce teams are deployed across India, supporting the Indian Armed Forces and drawing upon our global best practices. This work throughout the life cycle creates a launchpad for the Indian jet engine ecosystem that supports *Make in India* and self-reliance in defence.

### Plans for the future

"As the market opens up, we see a huge potential to build strong customer relationships. As India moves ahead on growth path and focus on upgrading its aerospace and marine capabilities, we look forward to strengthening and expanding our commitment to this region and work closely with our customers to enable them to benefit from our innovative products and technologies."



Steven Gillard, Vice President,  
Customer Business - Defence,  
Rolls-Royce

# VAYU Interview with Alex Cresswell, Executive Vice-President, Land and Air Systems, Thales



**VAYU** : Thales has had significant presence in the Indian defence market for years. What is the long-term agenda for Thales in India, in terms of the 'Make in India' initiative, co-development of new products, integration of Indian-made components or products in your global supply chain and so on?

**AC** : Thales stays committed to India, contributing significantly to the growth of Indian aerospace and defence sector by sharing technology and expertise with the Indian counterparts. Thales has devised a list of key strategic countries in which we decided to grow our business and develop for the next ten years. India is on the top of the list.

With the ongoing reforms in the Indian defence sector, a competitive and innovative environment will emerge that will generate significant opportunities for both foreign and domestic players. Thales' strategy is in line with the government's policy of 'Make in India', i.e. to significantly develop our industrial footprint in the country working closely with the local industry – public

and private sector. We have been closely associated with Hindustan Aeronautics Limited for over 50 years and have also formed Joint Ventures (JVs) with Samtel, Bharat Electronics Limited (BEL) and L&T Technology Services, in the fields of military avionics and airborne sensor systems, civilian and select ground-based military radars, and avionics software respectively.

In addition, as part of its 'Go to India' strategy that promotes India as a sourcing destination among the Group, Thales has also been co-operating with the Indian private sector, particularly large corporate players and SMEs to build transfer of technology and supply chain partnerships. We are planning to ramp up our supply chain in India and build a sustainable ecosystem of partners here. We look forward to support the local industry by opening up growth opportunities for them in the west.

**VAYU** : Last year, Thales and BEL formed a joint venture company, BEL-Thales Systems Limited. Please enumerate activities under this new venture, and any major milestones.

**AC** : Thales' distinguished partnership with BEL dates back to the time of the latter's inception. Thales has had the opportunity to collaborate with BEL on many successful and critical projects to service the Indian Armed Forces.

The JV Company was incorporated in August 2014 as BEL-Thales Systems Limited. Thales holds 26% equity in the joint venture, while Bharat Electronics holds 74 % of the stake. With BEL, the company is co-developing radars. These products are for both Indian market and exports. The ultimate objective of the JV is to expand its scope in other fields than radars in various fields of defence electronics (communication, missile electronics, electronic warfare, sonar). The JV will be an instrument of expansion in the sector as it is in congruence with the Government's *Make in India* programme.



Thales plays an important role in the upgrade of the IAF's Mirage 2000 fighter fleet (photo: Dassault Aviation – V Almansa)

**VAYU** : Samtel Thales Avionics currently serves the Indian market, but are there plans to expand this JV to serve export markets as well?

**AC** : Thales signed a Joint Venture agreement with Samtel in 2008 to locally develop and produce Helmet Mounted Displays, Military Avionics and Airborne Sensor systems for the defence market in 2008. Samtel Avionics Limited holds 74% of the stake and Thales 26%. The JV is fully operational and the facility is in Noida. The production of displays for the Mirage 2000 upgrade programme by this JV will pave the way for future opportunities to serve local and export markets.



The Indian Army's T-90 battle tanks use Thales Catherine-FC thermal imaging sights (photo: Angad Singh)

**VAYU** : Thales already equips India's T-90 battle tanks with the 'Catherine' thermal imaging cameras. Is the company also pursuing other vehicles, such as APCs, as candidates for optronics? Does Thales seek a role in programmes such as the Arjun MBT, F-MBT, and FICV?

**AC** : Backed by its strong optronics credentials, Thales looks forward to provide its expertise and solutions in the upcoming military vehicle programmes in India.

**VAYU** : Could you tell us about some of Thales' EW offerings suitable for the Indian Army, Navy and Air Force?

**AC** : Thales is one of the few global companies that have an entire range of Electronic Warfare (EW) systems – intercept, monitoring, direction finding and jamming – in both, communication and non-communication frequency ranges, catering to the tri-services requirements (land, naval and air forces). Thales has already been playing a major role in meeting the

requirements of the three armed forces by providing them with its flagship EW systems.

**VAYU** : What is the latest on Thales' radar technology? Have you made presentations on these radars to the Indian forces?

**AC** : Thales has 300 air defence radars that are delivered across 26 countries. Recently, Thales has invested significantly in new radar technologies; developing innovative air defence radar systems that are capable of handling current and future threats. With a wealth of experience and hundreds of military systems installed worldwide, Thales and Thales Raytheon Systems offer customers the widest portfolio

of surface radars, fulfilling all operational requirements, for system integrators and end-users.

Thales' advanced radar systems provide critical decision makers with the most detailed information available about airborne threats and battle space. Units are readily integrated with existing systems and supported by our worldwide service.

In response to the demands of the Indian Armed Forces, Thales offers the full scope of its defence expertise and experience. Thales has signed major contracts with the

Indian Ministry of Defence. For the Air Force, we have state-of-the-art AESA radar such as GS100 for low level transportable radars (LLTR), for Navy, long-range surveillance radar DA04 and LW08 and for Army, radars and systems such as Flycatcher Mk.1, among others.

**VAYU** : What is Thales' role in air traffic management (ATM)?

**AC** : Thales is committed to designing more efficient air traffic management systems and strives to reduce the impact of air travel on the environment. The ATM market is facing real challenges to manage the continuous increase of air traffic. Especially, Air Navigation Service Providers have to improve their air control capacity, efficiency and safety while reducing air transport's impact on the environment and controlling infrastructure costs.

Thales is committed to support this transformation by renewing its ATM systems offer and by facing ATM systems interoperability challenges thanks to TopSky ATM Solutions, the most complete automation product range available on the market.

Thales is number 1 worldwide in air traffic management and two out of three aircraft in the world take off and land using Thales equipment. Thales is the only company in the world to supply all the components needed for air traffic control.

As highlighted in the Airports Authority of India traffic review, all operational airports taken together handled 1.60 million aircraft movements (excluding general aviation movements), 190.13 million passengers and 2.53 million tonnes of freight during 2014-15. This represents a significant increase from 2014-15 and is a trend that is expected to continue.

Thales ATM systems and solutions are designed to seamlessly handling such large volumes of air traffic, as well as, have the scalability and capacity to handle this increase in aircraft movements, passenger and freight traffic.



Thales LW08 radar (black antenna on rear mast) seen on INS Kolkata of the Indian Navy (photo: IN PRO)

# Swamp Foxes in Poland

157FS/169FW, South Carolina Air National Guard at Łask Air Base



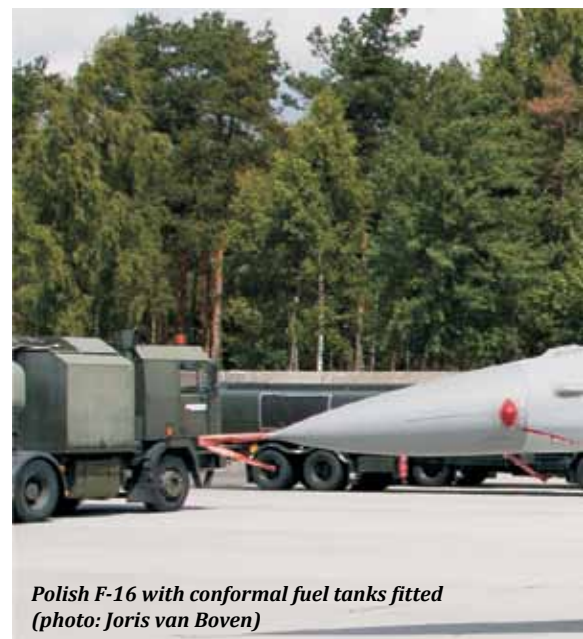
During the first weeks of June 2015, eight Lockheed F-16Cs (Block 52) of the South Carolina Air National Guard (SC-ANG, 169 Fighter Wing, 157th Fighter Squadron ‘Swamp Foxes’) deployed to the Polish 32nd Air Base (*32. Baza Lotnicza*) at Łask.

The aircraft had started their journey from their home base, McEntire Joint National Guard Base in South Carolina, on 28 May 2015. Supported by Boeing KC-135s and McDonnell Douglas KC-10s tankers for an incredible 10 aerial refueling sessions, the aircraft flew directly to Łask.

Since 2012, the USAF has held large bilateral exercises with the Polish Air Force every year, and a local USAF office, the 52nd Operations Group, Detachment 1 (the detachment’s motto is ‘*Razem Silniejsi*,’ which translates as ‘Stronger Together’ in Polish), supports these exercises at the Łask

Air Base. Throughout the year, F-16s from Spangdahlem Air Base (Germany) and Aviano Air Base (Italy) deploy to Łask on a regular basis, and at least once per year a large deployment from the continental USA will visit Łask.

This SC-ANG deployment is supporting the larger United States Air Force exercise ‘*Atlantic Resolve*’ in 2015, which has already seen two USAF F-15 deployments and one USAF A-10 deployment to Europe. During their stay in Poland, the eight SC-ANG F-16s were joined by six F-16s from Spangdahlem, and all these USAF aircraft flew missions together with the local Polish F-16s of 10th Tactical Squadron (‘*Dragons*’). During the exercises, the F-16s flew various missions: air-air, air-ground, ground suppression, air-defence suppression, and close air support. The sorties also involved other US aircraft such



Polish F-16 with conformal fuel tanks fitted (photo: Joris van Boven)



as F-15s and A-10s. The main goal of the month-long deployment was to train the Polish and American F-16s together for better integration of the two Air Forces. Several exercises were planned for the all the Łask F-16s to execute, these being *Eagle Talon*, *Sabre Strike*, *Ramstein Guard*.

The deployment saw four different paint schemes on the participating F-16s : the Spangdahlem F-16s were a grey/silver colour, the Łask-based Polish F-16s had a two-tone 'grey-on-grey' scheme, three of the SC-ANG F-16s had the standard two-tone grey, and the remaining five SC-ANG F-16s had the special radar-absorbing 'Have Glass' paint that is intended to decrease the radar signature of the aircraft. This paint, borrowed from the F-35 programme, will be applied to all US F-16s in the Suppression of Enemy Air Defence (SEAD) role, and can be identified by a distinct darker and more metallic appearance.

### Łask Air Base

Base Commander Lt Col 'Palm' (only callsigns are cleared for publication) briefed the media about Łask Air Base and the roles and functions of the local based F-16s. Łask Air Base is one of two Polish F-16 bases, the other being the 31st Air Base (*31. Baza Lotnicza*) at Krzesiny. Both bases were rebuilt and upgraded to NATO standards before receiving their F-16s. Łask Air Base also employs some 1,400 people, which makes it a huge economic factor in the middle of Poland.



*SC-ANG F-16 in distinctive 'Have Glass' paint (photo: Patrick Harbers)*



A runway modification is foreseen in the near future, in order to lengthen the runway at Łask to make it capable of operating all NATO aircraft. Currently the 2,500 metre (8,200 feet) runway cannot accommodate all aircraft types in wet, snowy or icy weather



*SC-ANG F-16 in 'Have Glass' paint and fitted with pods, tanks and training missiles (photo: Patrick Harbers)*



*Tails of all participating F-16s – from front to back: Poland, SC-ANG, and 480th Squadron, Spangdahlem (photo: Joris van Boven)*

conditions, if they are not equipped with a braking-parachute. A longer runway will eliminate this problem. Owing to runway repairs at Krzesiny, all F-16s from the 31st Air Base are temporarily based at Łask, prior to deployment to Greece for a separate exercise.

### **Pilots interviewed**

The six F-16s from Spangdahlem came from the 480th Tactical Fighter Squadron of the 52nd Operations Group. Captain 'Jarred' a pilot with some 1000 flying hours, stated that six F-16s and 12 pilots would be based at Łask for 3 weeks, with two missions to be flown each day, allowing each pilot to conduct one mission per day. The missions consisted of air-ground (close air support, air defence suppression) and air-air (offensive and defensive roles), and

the F-16s participated in the *Sabre Strike* exercise along with the Polish and SC-ANG F-16s. The squadron brought its own 'weather-man' Technical Sergeant 'Michael' for accurate weather predictions.

Two Polish pilots from the 10th Tactical Squadron 'Dragons' were also interviewed. 1st Lt 'Lenny' and 1st Lt 'Slim' (callsigns) talked about the Polish F-16s and their twice-daily missions in various roles, including recce with the DB-101 recce pod (main role of the 10th Squadron F-16s), Suppression of Enemy Air Defence (SEAD), focused mainly on destroying the radar installations, Destruction of Enemy Air Defense (DEAD), focused on the destruction of all enemy air systems, Offensive and Defensive Counter Air (OCA/DCA) and Close Air Support (CAS). In order to participate in these exercises, all





*SC-ANG F-16 in flight (photo: Joris van Boven)*

Polish pilots need to be qualified ‘Combat Mission Ready.’ The two pilots interviewed flew various missions in June, taking part in exercises *Eagle Talon* and *Sabre Strike* alongside American F-16s. The aim, they said, being to achieve better bilateral cooperation.

The South Carolina Air National Guard detachment commander in Poland was Lt Col ‘Abu’ (callsign), with over 4,000 flying hours, nearly all on the F-16. After 11 years as an active duty USAF officer, he switched to the SC-ANG 14 years ago. The detachment participated in all three June exercises, *Eagle Talon*, *Sabre Strike*, *Ramstein Guard*, and brought 16 pilots and 125 personnel to Poland for the month-long deployment. Some pilots were already very experienced, while the other half were at least ‘Combat Ready.’ The aim of the ‘*Swamp Foxes*’ was to learn to integrate with the Polish F-16s and to work with them as a team. Lt Col ‘Abu’ enjoyed learning from his Polish colleagues and working in European/Polish airspace and regulations. Despite the fact that South Carolina is in the warmer southern part of the USA, they have very similar weather to that in Poland ! Lt Col ‘Abu’ also became keenly aware in Poland that the communication with non-US pilots and non-US ground stations needed good attention. The aviation procedures and language may be standardised within NATO, but care had to be taken to speak clearly and to listen carefully for seamless communications.



*F-16s on the flightline at Łask (photo: Joris van Boven)*



*SC-ANG F-16 taxiing out for a mission (photo: Joris van Boven)*

***Text and photos: Joris van Boven and Patrick Harbers, Sentry Aviation News***

# Défilé Aérien over Paris



Alpha Jets of La Patrouille de France over the Champs-Élysées (photo: S Lafargue/ECPAD)

Every year on 14 July, France's National Military Parade (*défilé*) is held in Paris, to commemorate the beginning of the French Revolution. On 14 July 1789, the Bastille prison was raided by the people of Paris, an event that is regarded as commencement of the French Revolution. Since 1880, a military parade has been held in Paris every year to commemorate that occasion. Troops, tanks and heavy vehicles march down the Avenue des Champs-Élysées, while aircraft and helicopters conduct a flypast overhead in the air parade (*défilé aérien*).

In 2015, theme of the flypast was the liberation of France 70 years ago and the national aerobatic team *La Patrouille de France* opened the show with a formation shaped like the 'Lorraine Cross' (*Croix de Lorraine*), to honour the French Resistance during the Second World War. On this occasion the nine Alpha Jets from the display team were joined by three additional Alpha Jets to form the cross.

Thereafter the 'Free French Air Force' (*Forces Aériennes Françaises Libres*) of WWII was specially honoured by a C-135 tanker trailed by 4 Rafales and 4 Mirage 2000s. Later, a mix of French Air Force (*Armée de l'Air*) and Navy (*Marine Nationale*) aircraft completed the fixed-wing parade. Foreign participants included a Belgian Alpha Jet, a Spanish C-130 and a Spanish CN295. For the first time, an Airbus A340 flew in the parade.

The finale had a number of helicopters from the Army (*Armée de Terre*), Air Force, Navy and the Police (*Gendarmerie Nationale*).

The parade also highlighted ongoing French military operations, namely *Operation Sangaris*, the support operation for the government of the Central African Republic, *Operation Barkhane*, the anti-terror and stabilisation operation in Mali (Africa), and *Operation Chammal*, the operation in Iraq against the Islamic State.

## Base Aérienne 105 Évreux

Various aircraft flew from various airbases, some from their home bases (C-130, A400M, E-3F, C-135F, Navy fighters), some from airbases close to Paris (Évreux



*Mirage 2000C taking off from Evreux (photo: Alex van Noye)*



*Twelve Alpha Jets in 'Lorraine Cross' formation over Paris (photo: SIRPA Air)*



*An EC725 Caracal over Paris (photo: SIRPA Air)*



*A Rafale B departing for Paris (photo: Alex van Noye)*



*Rafale C taxiing out past rows of Mirage 2000s getting ready for flight (photo: Joris van Boven)*

for fighters and transport, Villacoublay for Air Force helicopters, Creil for Army and Navy helicopters).

On morning of the 14th there was a photo-opportunity at Base Aérienne 105 Évreux to witness the flight preparations and launches of most of the fighters that would be taking part in the parade. Participating Rafales, Mirage 2000s and Alpha Jets took off from runway 22 to fly over Paris, while the standby aircraft conducted their flight-preparations but only left BA Evreux once the parade was over. All fighters returned directly to their home bases after the défile aërica.

*Text and photos: Joris van Boven/Sentry Aviation*

*Photos: Alex van Noye/Runway28 unless noted otherwise*



*Mirage 2000Ns prepare for flight as a pair of Rafales take off in full afterburner (photo: Joris van Boven)*



# The Hunt for CG791

The unprecedented search and salvage of Indian Coast Guard Dornier 228 CG791

The Indian Coast Guard (ICG) is rapidly expanding post the 26/11 Mumbai terror attacks, in order to combat piracy, terror and also to provide search and rescue (SAR) for aircraft and ships in distress at sea. Today, the ICG operates about 130 vessels, 18 hovercraft and 61 aircraft (including 39 Dornier 228s for maritime patrol, SAR and much else). In addition, the service has over 80 ships under construction in Indian shipyards.

I am not a pilot, but as a former Director General ICG, have flown many hours over the sea in ICG Dornier aircraft and can vouch for the type's reliability and safety record (200,000 accident free flying hours in the ICG until 8 June 2015), as well as professional capability of the ICG aviators who unflinchingly venture out 24/7 to patrol the seas in the Dornier 228, which has an endurance of over 6 hours.

This article recounts the incredible and tragic saga of the SAR and salvage operation mounted for Coast Guard Dornier CG791, which was the latest addition to the Coast Guard in February 2014 (from HAL

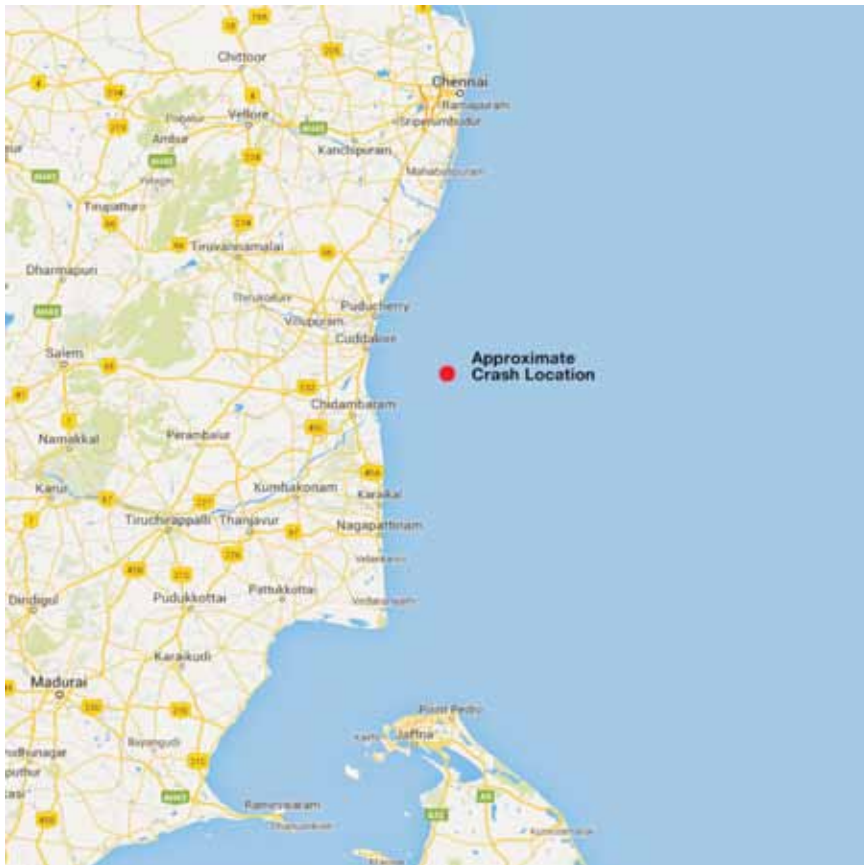
Kanpur) and also became the first ICG Dornier aircraft to be lost at sea, along with its highly trained three-man aircrew, on 8 June 2015.

On the fateful day, CG791 took off at 1805h from Chennai for a patrol in the Palk Bay area. It was due to return Chennai at 2200h (landing with spare fuel for another 2 hours 20 minutes of flying). At 2100h, the aircraft reported to the Chennai Flight Information Centre (FIC), that it was departing from its patrol area and returning to Chennai. When the aircraft did not return by 2230h, the Chennai FIC declared the aircraft "overdue" and the ICG operations room at Chennai swung into action, though some still hoped that the aircraft may have had an emergency and landed elsewhere on land.

Urgent inquiries revealed that Trichy Air Traffic Control (ATC) had been tracking CG791 on radar till 9:23 pm when the radar echo suddenly disappeared, about 90 nautical miles south of Chennai, indicating that the aircraft may have rapidly lost altitude and crashed into the sea. The

satellite service provider (INMARSAT) also confirmed that CG791's satellite communications system, which interacts electronically with the communications satellite, even when not in use, had abruptly 'powered off' at 2124h. Assuming the worst, ICG Chennai operations room established a search area of 45 nm around the last known position ('datum') of CG791, and commenced a massive SAR operation code named *Operation Talash*.

A Coast Guard Dornier from Chennai was launched for SAR and four ships from the ICG and Indian Navy also set sail. By sunrise on 9 June 2015, the Navy launched a Boeing P-8I maritime patrol aircraft, the most sophisticated patrol asset available, and additional ICG and IN ships joined the SAR operations. Tamil Nadu state police boats and local fishermen were also pressed into service. The search area was increased to 70 nm around the last known position of the missing aircraft. Assistance was sought from the Indian National Centre for Ocean Information Sciences (INCOIS) in Hyderabad, who ran a computer simulation



to confirm that the Coast Guard was indeed searching in the most probable area. Assistance of the National Remote Sensing Agency (NRSA) was also sought for any satellite data analysis to indicate presence of aircraft debris. The Indian Air Force (IAF) also sent a C-130J Hercules to join the search effort.

On 11 June the datum was shifted 11 nm north-northeast of the initial datum, and an oil sheen was sighted within 5 nm of the revised datum, indicating that aircraft fuel was oozing out from the crashed aircraft lying at the seabed at depths of 960 metres. In order to locate the transmissions of the crashed CG791 Sonar Locator Beacon (SLB), which transmits at 37.5 khz, the IN dispatched the hydrographic survey ship INS *Sandhayak* on 12 June 2015. The vessel picked up the SLB transmissions on 12 June, within 1.5 nm of the revised datum, but the transmissions were too weak to allow for pinpointing the location of CG791. The Naval Operations Data Processing & Analysis Centre (NODPAC) in Kochi provided valuable inputs about bathymetric data, sound attenuation, sea bed profile and so on.

On 13 June 2015, the *Kilo*-class submarine INS *Sindhuvaj* (with indigenous sonar USHUS) arrived in the search area, dived and detected SLB transmissions, but the signals were still too weak to pin point the location of CG791. The Chennai 'based' National Institute of Ocean Technology (NIOT) sent their research ship *Sagar Nidhi* from 13 to 15 June, but without any success. While INS *Sindhuvaj* continued her search, it was realised that should the submarine succeed in identifying the location of CG791, a special type of ship, a Multipurpose Support Vessel (MSV), with underwater Remotely Operated Vehicle (ROV) would be needed to send an ROV with camera to photograph the debris and recover items such as the aircraft's Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR), which would be needed for accident analysis later. A Singapore-based firm with past experience but limited to salvage from depths of only 630 metres was willing to supply such an MSV for 10 days, with no guarantee of success, for Rs 35 crores.

Realising that the Indian Government's contracting procedures would take weeks, if not months for such an arrangement,

the ICG approached Mukesh Ambani's Reliance Industries (RIL), which had an MSV operating in the KG oil basin in the Bay of Bengal. Reliance immediately offered, free of charge, an MSV, *Olympic Canyon*, to assist in the recovery efforts. The *Olympic Canyon* reached the scene on 19 June, detected the SLB, but was also unable to pinpoint the location of CG791, and departed on 23 June for contractual work.

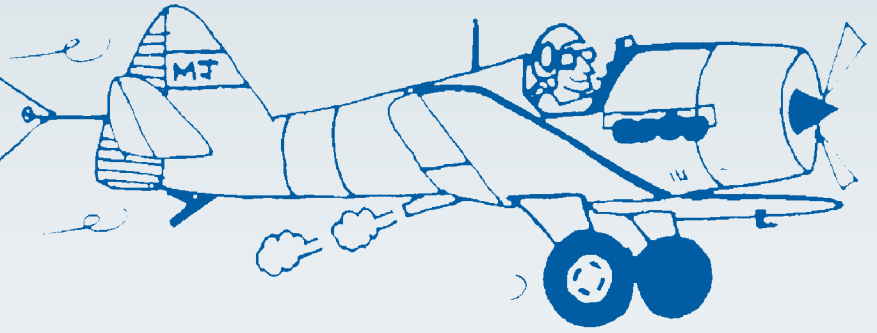
The IN-ICG search continued, and the ICG approached the Japanese and Korean Coast Guards, the Australian Maritime Safety Agency and the Canadian Transportation Safety Board, but no worthwhile inputs were received. On 5 July 2015, the INS *Sindhuvaj*, while dived, again detected the SLB and based on its latest inputs the Reliance MSV *Olympic Canyon* was re-deployed on 10 July and within a few hours its ROV photographed and videotaped the debris of CG791 at an unprecedented depth of 960 metres. The ROV then used its remotely operated mechanical arms to recover and bring to the surface debris, clothing and the all-important FDR (Flight Data Recorder) and CVR (Cockpit Voice Recorder). The recovery of human remains and subsequent DNA testing confirmed the identities of the three aircrew, helping bring solace and closure to the grieving families.

The CVR and FDR will be analysed to indicate the reasons for the loss of CG791 and lessons learnt will be promulgated. What is important to note is that this was a truly massive inter-agency operation, while also looking after and caring for the distraught families of the three ICG aviators. Transparent media management of this tragic loss was also highly appreciated. Finally, the role of Reliance Industries in providing its MSV without charge needs to be remembered, as hiring such a vessel from abroad would have cost over Rs 50 crore and getting timely government approvals would have been impossible. The lesson learnt is that apart from a critically needed submarine rescue capability, India also needs a deep-sea salvage MSV.

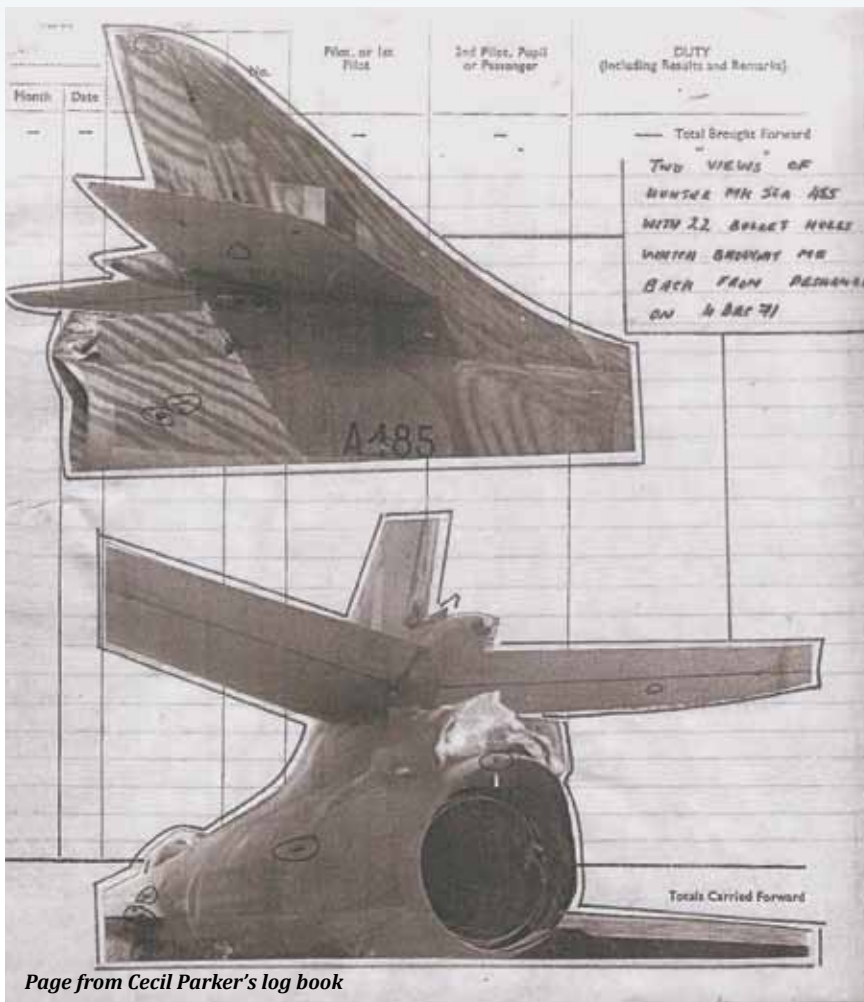
#### ***Vice Admiral Arun Kumar Singh (Retired)***

*A specialist in navigation, fighter aircraft direction and submarines, he was trained in the former USSR on nuclear submarines and missiles. His key appointments include Flag Officer Submarines, Command of Eastern Fleet, DG Indian Coast Guard, C-in-CA&N Command, and finally FOC-in-C Eastern Naval Command.*

## Ancient Aviator Anecdotes



# Air Vice Marshal (R) Cecil Parker's 1971 Air War



Page from Cecil Parker's log book

4 x 30mm cannon. As a Wing Commander I was commanding No. 20 Squadron, one of the two squadrons equipped with the new Hunter and relocated to Pathankot in early 1971. My war orders included Peshawar air base as one counter air target; we trained accordingly. Owing to its location close to the border, Pathankot was vulnerable, hence all our serviceable aircraft, pilots and supporting technicians went off for night harbour to Ambala. On 03 December '71, when the PAF carried out its pre-emptive strike on Pathankot at 1715 hrs, my squadron was away in Ambala and I was alone at base with two young pilots. I was told to carry out a two-aircraft gun strike on Peshawar at sunrise on 04 December '71. When reminded that my own aircraft would only return much later, I was ordered to take two aircraft from our sister squadron but TOT had to be sunrise Peshawar time. I took Flt Lt CS Dhillon (Channi) as my wingman and briefed him thoroughly. When we reached our sister squadron's tarmac at 4.30 am on 04 December '71, I was upset to see that the two aircraft prepared for us still had their rocket projectile (R/P) rails fitted though I had asked for clean aircraft + four tanks + full ammo. A quick calculation told me that we would lose about 500 lbs of fuel carrying these rails but there was no time to remove them and I would have to forego my combat fuel. Since Channi was not currently night qualified, I kept my nav lights on for him to do a formation take off in the dark. He coped well and we stayed low over our own territory as long as possible before I came in from the west for our first pass on Peshawar air base. We seemed to have taken them by surprise : no ground fire was experienced as

**T**ill sunrise on 04 December '71 the well defended PAF rear air base at Peshawar could only be reached by our twin-engined Canberra light bombers which had attacked it by night during the 1965 Indo-Pak war. In the late 1960s, the IAF had acquired the updated Hunter

Mk 56A aircraft which, with its larger fuel capacity (230 gallons on the inboard pylons) increased its radius of action and range. Operating from Pathankot it was now possible to cross the width of Pakistan and reach Peshawar at low level but with no external weapon load : a gun strike only with

I went for an aircraft parked on the tarmac while Channi opened up on what appeared to be an airfield fuel dump. On our second pass made from the south I realised that there was no gun fire from the ground as the airfield was being capped by their aircraft; two Sabres crossed me diagonally but the early dawn visibility was not good and we set course for home at low level and high speed with an indeterminate number of Sabres in chase.

I opened up our pair and placed Channi about 600 yds to my port so we gave each other cross cover and forced the Sabres to divide their attention. They very slowly closed in and, as Channi and I were in R/T contact, was able to break him to the port and into our own air space calculating that the Sabres would not follow him too deeply. I now had two or three Sabres behind me and as they opened fire I broke into them and reversed taking advantage of the Hunter's turning radius around some high ground. One Sabre could not hold the turn and overshot me right in front. I fired but very few rounds must have been left after my two long bursts at Peshawar so, though the camera gun captured the enemy aircraft I was not sure as to whether I had hit him or not. By now we were approaching Akhnoor area where a fierce land battle seemed to be taking place and both sides opened up on me as I was now travelling west to east!

I knew I had been hit and was very low on fuel, as was Channi who was one minute behind me. Pathankot gave us a direct approach and landing from the north and both our aircraft engines flamed out on the taxi track back to the aircraft pens. Our attack had been successful but my aircraft had 22 hits while Channi's had four. Minutes later the SASO HQ WAC New Delhi was on the line for an immediate debrief and congrats but with orders to repeat the attack immediately. I strongly advised him to defer the repeat attack to a later time but he insisted that the pressure had to be kept up so that the PAF could not use their air force in Peshawar to attack our ground forces. Since these were direct orders and my

own aircraft had returned from Ambala, I had no choice and sent off the next pair after briefing them thoroughly to carry out the attack but not to get involved in air combat over the target. Their attack went through but we lost one Hunter and pilot.

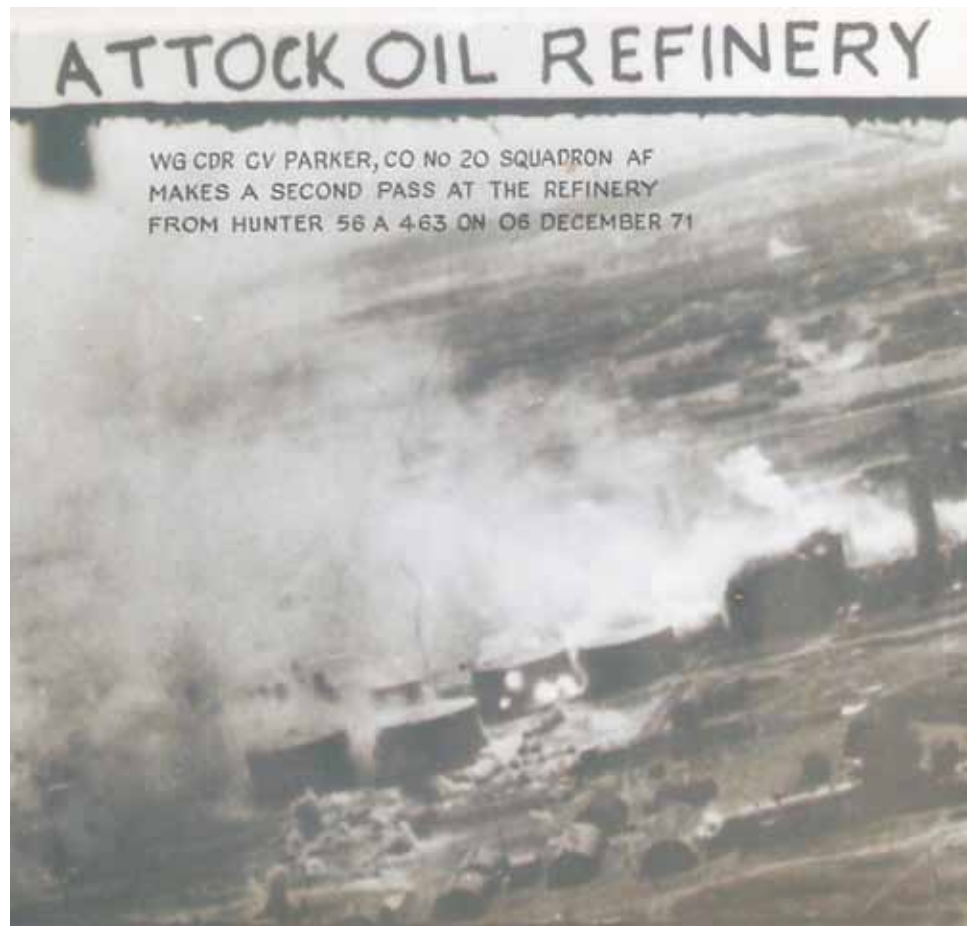
### **Attock Oil Refinery : 06 & 08 December, 1971**

Among the Pakistani 'targets of economic value' allocated to my squadron was the Attock Oil Refinery not too far from Islamabad. Based on Intelligence inputs, we visited our own refineries to learn their vulnerable points. We arranged for our firing range near Jamnagar to place steel sheets of differing widths behind the front gun targets. With my Flight Commander as my wingman and the gun packs in our Hunter fitted with varying sequence of HE (High Explosive) and ball ammo, we made a practice Lo-Hi-Lo flight from Pathankot overflying Ambala and Ahmedabad and carried out a gun strike on Sarmat Range targets firing all four guns. The results helped us determine the optimum belting of ammunition to penetrate steel. It was our

intention to start a fire and allow the fire to do the damage.

On 06 December '71 I led a four-Hunter gun strike with Attock Oil Refinery as our target. Intelligence had briefed us that it was heavily defended with AD Arty. Since such guns were normally controlled by an Air Defence Control Centre, and the nearest one was at PAF air base at Chaklala, I decided to attack Chaklala first to cause disruption. This diversionary attack paid off and our first west-east attack on the refinery, drew no ground fire but our second on the south-north axis drew considerable ground fire. However none of us were hit and we had the unusual sight of a refinery set on fire. The blaze was still visible to our Canberra crew on their night bombing raids.

We repeated the attack two days later when I led another four-Hunter strike but there were mainly charred remains and debris. Along with the IAF attack on the Karachi Oil Refinery on 04 December 71, Pakistan was now running short on fuel which Intelligence told us was being trucked into the country over land.





# 25 Years Back

## From Vayu Aerospace Review Issue V/I 1990

### The IAF is 58

“The Indian Air Force has endeavoured to maintain the highest standards of technical skills and service norms in order to give its best in maintaining the security of the country”. This was the theme of Air Chief Marshal SK Mehra’s speech at the ceremony to mark the 58th anniversary of the IAF. He expressed satisfaction at performance of the IAF units posted in forward sectors. It was important to keep a constant vigil for ensuring the inviolability of the Indian skies. The IAF had also responded “with ease” in the past which witnessed deterioration of security environment around India. The CAS added the need of the hour was to have “constant and rigid vigil”.

### The Great Indian Airlift

The Indian Air Force, Air India and Indian Airlines were all strenuously involved in the evacuation of Indians “stranded” in Kuwait and Iraq during August-September 1990. After some initial confusion and misgivings, the airlift of Indians from Amman in Jordan (to where most evacuees and fled by road) to India called for massive effort which resulted, eventually, in the transportation of some 118,000 people in eight weeks, which must be a record of sorts. Indian Airlines operated the Airbus A.320, much damned by politicians and still-banned from service with India but quite safe and suitable for operations outside, while the Indian Air Force flew Ilyushin Il-76s for the purpose.

### Indian Army Aviation

No.10 AOP Flight of the Indian Army Aviation was awarded the annual Flight Safety Trophy by General SF Rodrigues, Chief of the Army Staff at a function in New Delhi on 20 September. The Trophy, which was instituted in 1989, is to be awarded each year to the AOP Unit with the best flight safety record No. 10 AOP Flight, equipped with HAL-Cheetah helicopters, was part of the AOP Squadron which was based in Sri Lanka with the Indian Peace Keeping Force (IPKF).

### Ex-RAAF Mirage IIIOs for Pakistan

Australia is going ahead with the shipment of 50 ex-RAAF Mirage IIIO fighters to Pakistan, despite reservations expressed by India. The 20-year old aircraft, which have been mothballed and in storage at the Woomera Rocket Range for several years, were sold to the PAF in April 1990 for A\$36

million (\$28.8 million) together with a flight simulator and a spares package.

Sources understand that the PAF will proceed to refurbish the aircraft at its Kamra rebuild facility and recommission them. The aircraft are to be moved by road to Wyalla Port, where they will be loaded onto ships and thence to Pakistan.

### Pakistan denies Mirage 2000 interest

Earlier reports which reported that discussions have been held between the PAF and Dassault concerning the possibility of Pakistan acquiring upto 40 Mirage 2000 air superiority fighters, have been categorically denied by the French company in Paris. The PAF is expecting deliveries of the 50 ex-RAAF Mirage IIIOs, 45 Atar 09C engines and spares bought from Australia to begin in October.

### SLAF in Action

The Sri Lankan Air Force (SLAF) was extensively employed during battles between Sri Lankan armed forces and the LTTE in the Jaffna peninsula during September 1990, particularly for the relief of Jaffna Fort, under siege for well over two months. While Sial Marchetti SF.260s and Bell UH-1s provided suppression fire by strafing and occasional rocket firing, the SLAF improvised bombing with 250 Kg bombs rolled out of various transport aircraft including its BAE 748 and the Chinese-built Y-8 (An-12 copy) and Y-12 utility transport. Sri Lankan forces also used 300 kg barrel bombs (known locally as *pipas*) which were rolled out of the Y-8 rear-loading hatch and although accuracy was impossible, they created great fear and casualties amongst the Tamil population. According to a senior SLAF officer, “even the Americans often missed their targets in Vietnam, inspite of having all the electronic gadgetry. How do you expect us to fare with bombs that are simply dropped off planes?” In mid-October, the LTTE claimed to have damaged a Bell UH-1 helicopter which later crashed at Palaly air force base in the Jaffna peninsula.

### Burma Acquiring Chinese F-7s

In a major move, with long term military and strategic implications for India, Burma (Myanmar) has ordered some \$1 billion worth of Chinese military equipment, including 12 Xian F-7M fighters and four naval attack boats of the Shanqhai-class, air defence radar, anti-aircraft guns and other support systems. The Burmese Air Force has, so far, operated a mixture of obsolescent training and transport aircraft types, plus some helicopters, including the UH-1H Iroquois and Aleuette III. The last jet aircraft type was the Lockheed AT-33A armed trainer, now grounded, and the Air Force has been flying the Sial-Marchetti SF.260WB/MB, Cessna T-37C, Pilatus PC-7 and PC-9. A Burmese military delegation had visited China in October 1989, including the aircraft plants of Shijiazhuang where the F-6s and F-7s were evaluated, as also a rocket factory run by NORINCO.

# Tale Spin

## Lest We Forget !



'Lest We Forget' - but we *have* forgotten ! The official logo devised to mark the Indian Air Force's 1965 Air Campaign excludes a very important aircraft type that actually spearheaded the arm's counter air and close air support missions. Smart readers will identify the five types depicted and will miss the silhouette of a Mystere IV. Then this twin-boomed type is a Fairchild Packet whose role in the war was limited to logistic support (there were many other transport types similarly tasked), and forgotten is the twin-boomed Vampire which flew the very first combat missions.

## Atomic Drones

The Mumbai police may have banned the use of drones within city limits, keeping in view security concerns, but that hasn't stopped some police officials from exploring the technology. "We tried our hand at a drone. It works great," quipped an official, who operated a drone seized in the area where police quarters are located. The aerial vehicle, being operated by a leading real estate search portal was 'captured' recently near the Bhabha Atomic Research Centre headquarters in Trombay, Mumbai.



## Join the Mission ?

Following large advertisements which appeared in all leading national newspapers, exhorting young 'India's best men and



women to join the Indian Air Force for its flying, technical and ground duty branches', some US officials reacted objecting to the depiction of American F-18 Hornets being shot at by Indian MiG-29s.

Red faces at the *careerairforce* office which promptly took off that advertisement.

## Mach 5 to London

The US Air Force is developing a superfast system that can fly over Mach 5.1, which jet could well fly from New York to London in an hour. The X-51 WaveRider, developed by Boeing, has been tested, first dropping out from a traditional aircraft and then propelled by a rocket booster before using its own propulsion system. It was tested in 2013, flying at almost 4000 mph, before it ran out of fuel and dropped into the sea. Oops ! Back to the drawing board !



## 'Big' is not beautiful ?

India's national airline has 'warned' 600 of its 3,500 cabin crew to lose weight within six months or risk being taken off flights and



given a job on the ground. Air India now plans to remove about 130 from cabin crew duty because their body mass index (BMI) levels remain above the prescribed limit. (A BMI is a measure of body fat based on a person's height and weight).

In 2013, Air India said that deploying female flight attendants rather than male could save them about Rs 3.3 crores per year in full costs because they weight on average 33 to 44 pounds lighter.

A member of the All India Cabin Crew Association said the grounding of 130 staff was "ridiculous".

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