

VAYU

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Cover : Hawk Mk.132s of the IAF's Surya Kiran Formation Aerobatic Team
(Photo courtesy IAF/HAL)

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ADVERTISING & MARKETING MANAGER

Husnal Kaur

BUSINESS DEVELOPMENT MANAGER

Premjit Singh

PUBLISHED By

Vayu Aerospace Pvt. Ltd.

D-43, Sujana Singh Park,

New Delhi 110 003 India

Tel: +91 11 24617234

Fax: +91 11 24628615

e-mail: vayuaerospace@lycos.com

e-mail: vayu@vayuaerospace.in

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11/2017

27 Road map for Future IAF Fighters



In an exclusive interview with the Vayu, Air Chief Marshal BS Dhanoa, Chief of the Air Staff IAF articulates on major thrust areas for the IAF over the next few years and comments on the road map for induction of fighter aircraft to ensure the IAF reaches its authorised strength at the earliest.

32 The way we were (are) !



In retrospect of the recently concluded Aero India 2017 Show, the Vayu Editorial Team takes readers through this biennial event, preceded by the International Seminar (on Aerospace Technology) organised by the DRDO at Bangalore. Clearly, there was a redux of the M-MRCA contest, with three of the original six contenders present. However, 'HAL was King' at the Show, with new aircraft programmes announced (the IMRH) and displayed (the HTT-40).

An Advanced Hawk



Still, the Hawk Advanced Jet Trainer was much in evidence at Yelahanka, both in the air and on the ground with HAL-built Hawk Mk.132s of the Surya Kiran Formation Aerobatic Team (SKAT) performing daily, even as the Advanced Hawk "for India and the World" had pride of place. The joint BAE-HAL development includes a new more powerful engine (Adour Mk.951), and a completely redesigned wing with leading edge slats and updated 'combat flaps' which significantly expands the aircraft's envelope.

42 Some highlights of Aero India 2017



Vayu interviews with some leaders of the industry as also various highlights are collated for reader's reference. Of course, Vayu's Show Dailies were published and widely distributed throughout the Show and – as always – were first on the scene !



Vayu's Angad Singh 'pulled G at Aero India 2017' and his flight in a Gripen D was undoubtedly the 'experience of a lifetime', and is included in this Issue.

60 "A Day in the Life of Air Enthusiasts"



Air Enthusiasts Monami Guha Das and Debaditya Das write on and photograph "the beauties in the skies" at Aero India 2017.

62 The Air at Yelahanka



AFS Yelahanka, where the biennial Aero India international air shows have been held since the 1990s, is nearing its Platinum Jubilee since its establishment. Joseph Antony recalls its chequered history. Its origins lie in the early 1940s when Italian POWs were engaged to build its runways and other facilities to the time it was resurrected post 1962, becoming the key base for multi-engined aircraft conversion training of IAF/IN/CG pilots.

67 Nipped in the Bud !



Dr Sanjay Badri Maharaj explores India's aviation industry with special focus on how a clear and systematic development programme for combat aircraft and trainers was abandoned before it could bear fruit. This has had serious consequences for the industry, which was reduced to becoming a serf for licence-production, with consequential loss of design capability. He laments the fact that there was no follow on to the HF-24 Marut programme and the Tejas LCA has consequently suffered owing to lack of continuity in aerospace design and manufacturing capabilities.

Also: 'Bye, Bye, Lynx, Welcome Wildcat', 'Winds of Change at Guvercinlik' Book Review on IAF - 'We Dare, We Care'.

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Bravo, ISRO !

Launching 104 satellites into space in one rocket called PSLV-C37 is, no doubt, a triumph of India's space research. It is an achievement on a global scale as well, sort of. While the number of satellites launched is more than three times the previous record for simultaneous launches, set by Russia in 2014, the combined weight of the satellites was a mere 1.3 tonnes, of which a cartography satellite weighed more than 700 kg. The rest were nano-satellites, each weighing a few kilograms.

The Indian National Committee for Space Research, founded in 1962 at the initiative of Jawaharlal Nehru and Vikram Sarabhai, metamorphosed into ISRO in 1969, barely a month after humankind's first walk on the Moon. Conquest of the final frontier has been a work in progress, for all nations. Two commercial entities, Jeff Bezos' Blue Origin and Elon Musk's SpaceX, are serious contenders in the satellite launch business. India's space programme has been spectacularly low-cost. However, its ability to launch heavy payloads remains limited — anything above four tonnes stumps it. ISRO's GSLV series of launch vehicles have an indigenous cryogenic engine, after a long delay. But their boosting power remains small. While ISRO must continue indigenous work on rockets, materials, guidance systems, etc, it must proactively source available technology from around the world.

One consequence of India's nuclear deal with the US has been its membership of the Missile Technology Control Regime (MTCR), secured last year, and liberation from assorted technology-denial sanctions that had been imposed after India's nuclear tests. As an MTCR member, India's access to rocket and related technology is much broader than it was, prior to that membership. India must use the new access it has to identify and procure the technologies it needs, to enhance its satellite-launch capability. India can and must stop reliance on foreign launchers for its communication satellites. Further, it must become a significant player in the market for heavier satellites as well.

From The Economic Times

Only for thrills ?

A competent financial audit will calculate the expenses incurred on the biennial military-aviation fiesta Aero India, the 11th edition of which took place at IAF Yelahanka, Bangalore. Unfortunately, it would be difficult to assess in financial terms the "gains" that accrued from the extravaganza. For while 500,000 footfalls, and massive traffic jams when the show was thrown open to the public might testify to its popularity, the prime purpose of such events is business promotion — the thrills that attracted so much attention are a mere side-show. Hence the yardstick by which the success of Aero India 2017 — or the lack of it — must be evaluated is "professional", lest it degenerate into a mela like the annual trade fair in the Capital.

The international aviation industry will not invest much time, effort and money for a mere exhibition. That nearly 100 firms fewer participated this year, when contrasted with the previous show tells a certain tale: it points to a trend that needs to be addressed before the next Aero India. Particularly in the light of the "buzz" that the next event may be staged in the defence minister's political bailiwick, Goa, which unlike Bangalore does not have an aviation industry

track-record; and its lovely beaches are no substitute for an industry that came into being during World War II.

While no deals are expected to be firmed up at such events, it is worth noting that while there is need for some 200 combat aircraft to maintain the desired squadron-strength of the Indian Air Force, no "new" aspirant flipped its wings at Yelahanka. The Lockheed Martin F-16, Swedish SAAB Gripen, Dassault's Rafale and Russian Su-30 have all been evaluated before, and if more attractive financial arrangements are now on offer the event was not where they would be made. The grapevine has it that those firms participated in Aero India 2017 only because they apprehended that staying away would diminish their chances of bagging an order.

The domestic industry did not really "sell" itself: though the public sector HAL displayed a range of helicopters, most of them have been on the market for some time now. The Air Chief flying the Tejas LCA was merely for show. Much was made of the "induction" of an indigenous AWACS, but this 'plane had participated in the flypast on Republic Day, and a "bigger" platform is now being considered.

It was disappointing that the participants were informed that the revised procurement/offsets policy would be announced shortly — prudence demanded that it be made public ahead of the show. The short point being that Aero India will attract the "cutting edge" only if India convinces that it is ready to do business.

From The Statesman

What alone will fly

Recently, Civil Aviation Minister Ashok Gajapathi Raju, when asked about the future of Air India, said the Centre wanted the airline "to survive", but that it did not matter "who runs it". He argued that taxpayer money could not sustain the airline forever. These statements, taken together, are both welcome and disheartening. On the one hand, they open the door to a possible future in which the state-controlled airline is perhaps operated, or part-owned, by the private sector. On the other hand, they betray a lack of confidence in the market and inadequate awareness of how the aviation sector, in particular, works. If Air India is to survive then that will have to be a decision made by passenger choice and market principles — or else it will continue to need taxpayer financing forever.

If the government believes that taxpayers cannot pay for Air India forever, then it does not appear to be acting on that basis. For one, contradictory reports are emerging over whether the airline intends to purchase or lease additional Dreamliner airliners. For another, according to some reports, it is being proposed that public sector banks will be induced to become "strategic investors" in Air India, following which the airline will be listed. This confusion is worrisome. The idea that the already stressed public sector banks could be asked to sustain a white elephant of an airline is deeply problematic. Moreover, it is unclear how an airline with so much debt can ever be listed on the equity markets.

The basic problem continues to be the fact that the government wants to hold on to Air India and believes that its survival is somehow important to the national interest. Very simply, this is not the case. However, important it may have been in the past and whatever mistakes may have been made in its management over the



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decades, Air India is simply no longer necessary for a well-functioning aviation sector. In fact, it drags the entire sector down. Having a player that can draw on the Consolidated Fund of India to cover up its errors, inefficiencies and mispricing means that all other airlines are being penalised and the market is being distorted. It is difficult to avoid the conclusion that bureaucrats and politicians are keeping Air India running precisely because an in-house airline suits them, and not because it serves any great purpose for the nation as a whole or tax-payers in particular.

From Business Standard

Deepening Israeli ties

India's decision to enter into joint development with Israel, cleared by the Cabinet Committee on Security (CCS), for medium range surface-to-air missiles (MR-SAM) for the Indian Army is a further sign of improving qualitative ties between the two nations since diplomatic relations were normalised in 1992. The deal is expected to be pegged at around Rs 17,000 crores for five regiments of the missile consisting of 200 pieces having a range of 50-70 km. It seeks joint development between India's Defence Research and Development Organisation (DRDO) and Israel Aerospace Industries (IAI).

The system will be manufactured in India and is likely to have 80 per cent indigenous content. Deliveries are set to begin by 2023. This system for the Army's use will be based on the older production of Israeli Barack-8 missile system and for the Navy's use collaboratively between DRDO and IAI.

To that extent, there is no novelty in the decision over medium-range missiles for the Army. Indeed, if Prime Minister Narendra Modi does visit Israel in the coming months, as appears likely, it is not unthinkable that a more ambitious India-Israel relationship may be posited. This will be on the lines of the elevating of India-UAE ties after the PM's trip to Abu Dhabi last year.

Given that India is already Israel's largest arms buyer, and Israel is among the top three arms sellers to India — along with the US and Russia — New Delhi's relations with the Jewish state have already attained something of a strategic dimension. Intelligence-sharing is also done due to common concerns relating to terrorism, even if on key international issues, specially those relating to West Asia, a gap still remains between India's perceptions and Israel's, although this gap is narrowing somewhat under Mr Modi, with India abstaining on UN resolutions which criticise Israel. This is the difference with the past.

Two leading considerations have guided the burgeoning of India's ties with Israel. One, India's relations with Israel's Arab neighbours remains sound, except that New Delhi doesn't allow one to have a veto over the other. Such a dynamic, underwritten by practical considerations, has not so far adversely affected either this country's political stance on the Palestinian question or its deepening all-round ties with Israel.

Two, it is also felt in New Delhi that positive and expanding ties with Israel will help New Delhi develop a special constituency in the United States, with which successive Indian governments have sought to build close strategic ties, sometimes to criticism within the country. All in all, positive bilateral relations with Israel are useful to both sides. Specifically on defence acquisitions, the net should be expanded to take in the key European powers as well.

From The Asian Age

The Dysfunctional State

The observation by a parliamentary panel that the Indian Navy (IN) will soon reach a point of near zero mine-sweeping capability when the existing six vessels are de-commissioned by end 2018 is yet another reminder — if such were needed — about the dysfunctional state of higher-defence management in the country. Mines at sea, whether floating or laid on the seabed, have a high index of lethality and can cause unacceptable levels of damage to a warship at very low cost. Thus, mine warfare and mine counter measures are integral to naval capability and port/harbour defence; and most major navies have ensured adequate capability for keeping their vital harbours open for men of war as well as merchant shipping traffic.

Technology has improved both the destructive potential of the mine as also the counter-measure technology and the use of mines as part of covert warfare in the maritime domain is very much the emerging challenge. The cost of a mine — which can be a few hundred dollars — and the damage it can cause to a navy or the sea-borne trading efficacy of a nation are inversely proportional and even the most powerful navies are vulnerable.

The IN was cognizant of the need to acquire appropriate mine counter measure capability and 12 vessels were acquired from the former USSR in the period 1978 to 1988. It is instructive that despite the Navy having prioritised this platform as an operational imperative, no new mine-sweeping vessel was inducted since 1988. Bureaucratic delays and the inability of the higher-defence management matrix to comprehend the strategic salience of the issue (the dysfunctional trait) resulted in a situation where it took almost 15 years for the government of the day to initiate a new acquisition from a South Korean entity. This was the NDA I period.

Desultory attempts were made to have a tie-up with a credible foreign supplier and the process that began in 2008 concluded the price negotiations in 2011. A South Korean firm was identified but in keeping with the Indian penchant to cancel or freeze any defence deal if there is a whiff of fiscal transgression, a charge levied by an Italian competitor saw the entire acquisition project being referred to the CVC (Central Vigilance Commission). The BJP then in opposition went for the Congress jugular and in short, India's zero-sum electoral rivalry laid the perfect 'political' mine for the IN's mine-sweeper acquisition plans to remain still-born.

It is now 2017 and the navy has a shrinking mine-sweeping capability and there is no light at the end of the tunnel. Buying these platforms outright from a foreign supplier or building them in India with a foreign supplier are time-consuming and as the Parliament panel pointed out, the earliest induction is a good five years away. Till then, the ships that enter and leave Indian ports including front-line naval ships will be vulnerable to the lethal mine. The navy needs a minimum of 30 such vessels for the major ports and the grim reality is that it will soon have none.

An immediate option is to explore the possibility of leasing these vessels from navies that have excess capability — and both the USA and Japan could be potential suppliers. India has recently concluded substantive defence cooperation agreements with these countries and some innovative fast-track agreements need to be initiated on a war-footing. The parliamentary committee has alerted the executive and the citizen.

By C Uday Bhaskar, Society for Policy Studies

Brigadier (Retd) Gurmeet Kanwal on **Helming the MoD**



Defence Minister Manohar Parrikar, has been sent back to Goa in the party's interest to take over as the Chief Minister once again. His departure has created a void at a critical time when the state of defence preparedness and slow pace of military modernisation need the government's urgent attention. Major operational voids in the war establishment of the three Services need to be made up early in order to enhance combat readiness.

It is only in the last six months that Mr Parrikar had launched a concerted drive to make up the existing deficiencies by invoking emergency financial powers of the government. The government had at long last begun to address the 'critical hollowness' plaguing defence preparedness – a term used

by General VK Singh. He had also initiated reforms in the procedures for the acquisition and indigenous manufacture of weapons and equipment. A new minister will take time to settle down and learn the ropes of defence procurement.

Large-scale deficiencies in ammunition and important items of equipment continue to adversely affect India's readiness for war and the ability to sustain military operations over 20 to 30 days. According to a CAG report, the Army is reported to have some varieties of ammunition for barely ten days of conflict and it will cost over Rs 20,000 crore to replenish stocks. It will be recalled that during the Kargil conflict in 1999, about 50,000 rounds of artillery ammunition had to be imported

from South Africa. The occurrence of such a situation during a time of crisis must be avoided through a prudent replenishment and stocking policy.

The government has signed contracts with Russian manufacturers to procure ammunition and spares worth Rs 5,800 crore for the Army and Rs 9,200 crore for the Air Force. Similar deals are being negotiated with French and Israeli companies. However, it has been reported that the traditional norms of stocking ammunition at intense rates for 30 days of fighting and normal rates for 30 days are being watered down. If this is true, it would be a retrograde step.

Modernisation of the armed forces has been proceeding at a slow pace due to

the inadequacy of funds, rigid procurement procedures, frequent changes in the qualitative requirements, the black-listing of several defence manufacturers and bureaucratic red tape. Mr Parrikar had appointed a committee led by Dharendra Singh, former Home Secretary, to review the Defence Procurement Procedure (DPP). Several pragmatic amendments were approved by the Defence minister and DPP 2016 was issued in early-April 2016.

Weapons and equipment purchase projects worth over Rs 1,50,000 crore have been accorded 'acceptance of necessity' (AON) by the Defence Acquisition Council (DAC) chaired by the Defence Minister since he took charge in late 2014. Contracts have been signed for acquisitions worth approximately Rs 90,000 crore. However, it will take three to five years before deliveries begin.

In the Army, artillery modernisation is yet to begin. There is an urgent need to acquire approximately 3,000 155 mm/52-calibre guns to replace obsolescent guns and howitzers. So far a contract has been signed only for 145 M777 155 mm/45-calibre howitzers from the US. Air defence and Army Aviation units are also equipped with obsolete equipment that has degraded their readiness for combat and created vulnerabilities.

Modern wars are fought mostly during the hours of darkness, but most of the armoured fighting vehicles – tanks and infantry combat vehicles – are still 'night blind'. Only about 650 T-90S tanks of Russian origin have genuine night fighting capability. The infantry battalions need over 30,000 third generation night vision devices. Other requirements for infantry battalions include 66,000 assault rifles, a soldier's basic weapon, carbines for close quarter battle, general purpose machine guns, light-weight anti-materiel rifles, mine protected vehicles, 390,000 ballistic helmets, and 180,000 lightweight bullet proof jackets. Action to acquire these items has been initiated and needs to be constantly monitored by the minister himself.

The Navy is in the process of building an air defence ship at Kochi to replace the aircraft carrier INS *Vikrant*, six *Scorpena* submarines at Mazagon Docks and 22 destroyers, frigates, corvettes and other ships such as fast attack craft, landing ships and support ships. However, India's maritime security challenges are growing and the Navy

not only needs to modernise but also expand its footprint in the Indo-Pacific region.

Modernisation plans of the Air Force are proceeding ahead, but at a snail's pace. The M-MRCA project to acquire 126 fighter aircraft to replace obsolete MiG-21s appears to have been shelved, except for the government's plans to purchase 36 Rafale fighters from France for which a contract has been signed. Meanwhile, Lockheed Martin (F-16) and Boeing (F-18), both of the US, and Saab of Sweden with their Gripen fighter are reported to have jumped into the fray again with offers to produce their aircraft locally with transfer of technology (ToT).

The IAF also requires two more AWACS early warning aircraft, six tankers, 56 medium transport aircraft, 20 advanced jet trainers, 38 basic turboprop trainers, 48 medium-lift helicopters, reconnaissance and surveillance helicopters, surface-to-air missile systems and electronic warfare suites. All three Services need to upgrade their C4I2SR capabilities to prepare for effects-based operations in a network-centric environment and to match ever increasing Chinese capabilities.

The serviceability state of warfighting equipment needs substantial improvement. Many frontline equipment are 'out of action' for want of spares. It is suspected that the delay in changing the old batteries of INS *Sindhuratna* could have been the cause of the accident that resulted in the death of two officers, injuries to seven sailors and irreparable damage to the submarine. The serviceability state of the SU-30MKI fighter-bomber fleet is reported to be just about 50 per cent. Numerous vehicles in the Army are 'off road' for want of tyres, tubes, batteries and items like spark plugs.

Financial management too needs a major overhaul. All of the required acquisitions are capital intensive and the present defence budget cannot support many of them. The defence budget for FY 2017-18 has dipped to 1.62 per cent of the country's GDP – the lowest level since the disastrous 1962 War with China. Parliament's Standing Committee on Defence and the armed forces have repeatedly recommended that it should be raised progressively to 3.0 per cent of the GDP if India is to build the defence capabilities that it needs to meet future threats and challenges and discharge its growing responsibilities as a regional power in Southern Asia.

The budgetary allocations earmarked on the capital account for the modernisation of the armed forces will continue to be surrendered unless the government sets up a rolling, non-lapsable defence modernisation fund of approximately Rs 50,000 crore under the Consolidated Fund of India. Cutting down on wasteful subsidies from which the people do not really benefit in a meaningful manner would be one way to spare more funds for national security.

The armed forces are now in the fifth and final year – indeed the final month – of the 12th Defence Plan (2012-17). This was never formally approved with full financial backing by the Cabinet Committee on Security (CCS) ! The government also has not formally approved the long-term integrated perspective plan (LTIPP 2007-22) formulated by HQ Integrated Defence Staff.

Without these essential approvals, defence procurement is being undertaken through *ad hoc* annual procurement plans, rather than being based on duly prioritised long-term plans that are designed to systematically enhance India's combat potential. These are serious lacunae as effective defence planning cannot be undertaken in a policy void. The government must commit itself to supporting long-term defence plans.

Structural reforms need to be implemented in an early time frame to improve national security decision making and synergise defence planning. The most important issue that has been pending for long is the appointment of a Chief of Defence Staff (CDS). This was first recommended by the Arun Singh Committee on Defence Expenditure in the early 1990s and then by a Group of Ministers led by Deputy Prime Minister LK Advani. Though the CCS had approved the appointment of CDS, no one has been appointed as yet. It is time for the Modi-led NDA-2 government to implement the decision of the Vajpayee-led NDA-1. The new minister will have a lot on his plate and will need to put in many months of hard labour to come to grips with the complexities of defence preparedness and military modernisation in the prevailing regional environment.

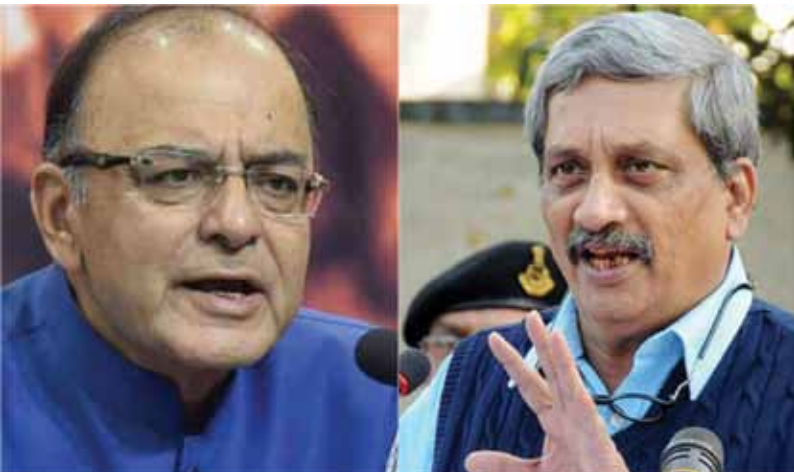


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Change in the Defence Ministers of India



Following the state elections in Goa and with the BJP forming the new government there, Manohar Parrikar (above to the right), who had been India's Defence Minister for just over two years, resigned on 13 March to return to his native state as Chief Minister. As was the case before Parrikar's November 2014 appointment, the post of Defence Minister has been assumed again by Arun Jaitley (above to the left), who also heads the Ministries of Finance and Corporate Affairs. Mr Jaitley was sworn in on 14 March, and although the Government has not formally disclosed the duration of his term, it is understood that he will serve as an interim Minister until a full-time candidate is appointed (*see Viewpoint in this Issue*).

Arun Jaitley clears major military reforms

Displaying his flair for incisive decision making, Mr Arun Jaitley, who took additional charge of the Ministry of Defence very recently, is understood to have approved the proposal for widespread military reforms, based on the report by Lt General (ret'd) DB Shekatkar Committee. This comprised major recommendations for enhancing the combat potential of India's three armed forces, rationalising the defence budget, and improving the 'teeth-to-tail' ratio. The Committee had been set up by earlier Defence Minister Manohar Parrikar in 2015 and had submitted its report on 21 December 2016.

According to MoD sources, on 18 March, Mr Jaitley had reviewed a presentation on the new strategic partner policy, plans to create a chief of defence staff (CDS) post, and restructuring of higher defence structures along with the Shekatkar committee report. The Government is expected to shortly clear the creation of a CDS post (by whatever name) and the strategic partner policy, in order to support the 'Make in India' policy in the defence sector. A major recommendation involves hiking of the defence budget to 2.5 per cent to 3 per cent of the GDP.

"Lackadaisical approach on Defence" : CAG

Very critical of the Government's 'casual' almost 'lackadaisical' approval on Defence matters, the Comptroller & Auditor General (CAG) in its report presented on 9 March 2017, has stated that "this approach would adversely affect the country's defence preparedness as well as hit the morale of the armed forces". The Army has got only 60 per cent of the funds it had sought for modernisation in the 2017-18 budget. The Navy and IAF, in turn, got 67 per cent and 54 per cent. Out of the coming fiscal's total defence outlay of Rs 2.74 lakh crore, only Rs 86,488 crore have been earmarked for 'modernisation'. What makes matters even more serious is that the bulk of this capital outlay will be used to pay "committed liabilities" of earlier arms contracts instead of new projects.

The Navy has been allocated Rs 18,000 crore as the capital budget when its pay-out for committed liabilities already stands at Rs 22,000 crore for 2017-18. The Navy plans to be a 212-warship and 458-aircraft force by 2027, but is making do with just 138 warships and 235 aircraft at present, "with many of them on their last legs." There are massive deficiencies in authorised and existing level of ships, submarines and aircraft," according to the CAG. As for the Indian Air Force, this service today fields only just 32 fighter squadrons, while some 42-44 are needed to tackle the "collusive threat" from China and Pakistan. The Committee opined the number of combat squadrons would go down to 19 by 2027, with the progressive retirement of MiG-21s and MiG-27s (although this has not accounted for new inductions over the same period).

First indigenous AEW&C aircraft inducted by IAF

The first indigenous AEW&C aircraft, based on the Embraer EMB-145 regional airliner, was officially handed over by the Minister of Defence to the Air Chief at Yelahanka on 14 February, during the Aero India show (*photo below*). All on-board sensors and equipment, including the all-important dorsal AESA array, have been developed and produced in India by the Centre for Air-Borne Systems (CABS). The system achieved Initial Operating





Capability (IOC) mere “days before the show”, and while Final Operating Clearance (FOC) is expected to take more time, the system as presently configured has been “deemed adequate” for the IAF’s pressing need for greater airborne surveillance and control. The modifications required for FOC will reportedly only entail “software and avionics changes” and will not involve any further physical modifications to the platform. The aircraft has been named ‘Netra’ (eyes) and will enter service with No.200 Squadron IAF, a new raising.

Later, at his press conference, the Defence Minister accepted that the need for more numbers of AEW&C aircraft is pressing and that “while the indigenous route will take several years, serviceability of the existing fleet is being improved upon while there are new proposals for additional platforms.”

HAL as lead agency for Su-30MKI upgrade

“HAL will be the lead agency for the Sukhoi Su-30MKI upgrade programme, involving back-to-back contracts with Russian partners,” stated HAL CMD T Suvarna Raju at his press conference on 15 February 2017. The programme will be carried out in two phases, the first to be finalised “within 90 days.”

The Chairman also gave detailed statistics on aircraft production, with 183 Su-30MKIs produced as of January 2017, and the balance



to be manufactured by 2020 at rate of 12 aircraft per year. It is understood that the IAF now have twelve squadrons equipped with the type, and one example each from Nos. 8 and 15 Squadrons took part in the daily flying displays at Aero India 2017.

Future IAF bases for Rafales



Although it was earlier reported that the Indian Air Force would be basing a squadron of Rafales at Sarsawa airbase near Saharanpur, this seems unlikely in face of problems of land acquisition Issues. An additional 540 acres of land are needed in the vicinity of the air force station, which would have meant protracted negotiations with nearly 3,200 land owners, while land on the other side is used by the ARC, for its own operational purposes.

Following the contract for 36 Dassault Rafales (to equip two squadrons) in December 2016 in a direct government to government deal worth Rs 59,000 crore, the delivery of first aircraft, is planned for 2019. The IAF had initially planned to deploy one squadron at Sarsawa and the second squadron in Hasimara in the Dooars corridor in northern Bengal. While ideally both the squadrons should be co-located at the same airbase to facilitate training, maintenance and logistics issues, apparently the two squadrons are to be geographically dispersed for strategic reasons. *(In the picture above, taken at Yelahanka, Rafales are seen on the flight line along side Gripens).*

IAF to join multinational Blue Flag exercise in Israel ?

According to reports from New Delhi, the Indian Air Force would possibly participate in the biennial *Blue Flag* multinational exercise, organised by the Israeli Government. This large-scale exercise, similar in concept to the USAF’s *Red Flag* series, will reportedly involve some 100 aircraft from seven countries, including France, Germany, the USA, Poland, Greece and Italy. While it is unclear presently whether or not the IAF will be sending aircraft or simply observers, Indian involvement with a multi-lateral exercise in Israel is nonetheless seen as strategically significant in light of Indo-Israeli relations, IDF-IAF ties, and India’s broader foreign policy imperatives.



Two Indian 'moonshots' in 2018



Two vastly different Indian teams are planning separate 'moonshots' in 2018 – one is an Indian Space Research Organisation effort, while the other is TeamIndus, a private start-up aiming to claim the Google Lunar XPrize (GLXP) winnings of \$20 million and put Indian space businesses on the map.

TeamIndus is led by Rahul Narayan, an IT entrepreneur and IIT-Delhi graduate, along with four co-founders: former IAF fighter pilot Samir Joshi (also a regular contributor to *Vayu*); investment banker Julius Amrit; advertising professional Dilip Chabria; and aerospace engineer Indranil Chakrobarty. The venture is the only Indian entry for the GLXP, which calls for teams to send privately funded robotic spacecraft to the Moon, travel 500 metres, and transmit high-definition video and images back to Earth. Participants are required to launch their spacecraft no later than 31 December 2017.

That deadline will put them ahead of the larger and better-funded ISRO Chandrayaan-2 project, which presently plans for an early-2018 launch and will see a robotic rover probe the lunar terrain for 14 Earth days. However, both missions will launch using ISRO launch vehicles. The 3,250 kg Chandrayaan-2 payload (around four times heavier than the TeamIndus payload) will be launched aboard ISRO's Geosynchronous Satellite Launch Vehicle (GSLV) Mk.II, while TeamIndus will launch using a Polar Satellite Launch Vehicle (PSLV), sharing space with fellow GLXP contestant Team Hakuto of Japan. The end-2017 launch timeframe has led to TeamIndus planning to land their craft on the moon on the morning of Republic Day 2018.

Indian Defence Budget 2017-18

Although there is a modest increase of 5.6 per cent in India's defence budget for 2017-18, this is seen as somewhat 'lean' in view of the growing list of requirements projected by the Armed Forces. The government has earmarked Rs 274,114.12 crore in the Union budget for the next fiscal and in addition, an allocation of Rs 857,140 crore for defence pensions was also announced by Finance Minister Arun Jaitley in his budget speech. Allocations



for Defence for Financial Year 2017-18 are 12.77 per cent of the total central government expenditure, an estimated 2.1 per cent of the national GDP.

Observers feel that the marginal increase in capital expenditure could have an effect on the defence ministry's plans to sign new contracts for defence equipment in the coming year. In November 2016, the defence minister had announced that 85 deals worth approximately Rs 150,000 crore were in various stages of finalisation and approval. Then there are committed liabilities in capital expenditure already made towards Rafale fighter aircraft (picture above), M-777 artillery guns and Apache and Chinook helicopters.

The Indian Army, with a manpower strength of some 1.3 million, is engaged in active counter-insurgency operations and defends a live border in various terrain throughout the year, but its procurement allocation of Rs 25,175 crore for the coming year is significantly lower than that of the Indian Air Force, which will get Rs 33,556 crore. The Indian Navy's capital budget is at Rs 19,348 crore.

Importantly, at Rs 106,922.79 crore, pay and allowances of the defence services for FY 17-18 will now take away 39 per cent of the defence budget. With the implementation of 'One Rank One Pension' and the Seventh Pay Commission, the salaries and pensions of defence personnel are together estimated to be Rs 192,662.79 crore in the coming FY. Revenue Expenditure allocated to the DRDO is Rs 7,266 crore, not much higher than that in 2016-17.

Larsen & Toubro and MBDA establish JV

Larsen & Toubro (L&T) and MBDA have set up a joint venture (JV) to develop and supply missiles and missile systems to meet the growing potential requirements of the Indian armed forces. The Joint Venture Company, named 'L&T MBDA Missile Systems Ltd', will operate from a dedicated work centre, which will include pyrotechnical integration and final checkout facilities. It is expected to be incorporated in the first half of 2017 after necessary approvals.

L&T will own 51 per cent of the Company and MBDA, 49 per cent, fully complying with India's Foreign Direct Investment (FDI) policy norms. The JV will be registered in India and conduct business as an Indian Company, subject to Indian laws. The JV



AM Naik, Group Executive Chairman of L&T and Antoine Bouvier, Chief Executive Officer, MBDA, exchanging the Joint Venture agreement for development of sophisticated missile systems in New Delhi

would focus on business opportunities in the Missiles and Missile Systems domain and target prospects under the Buy (Indian – IDDM), Buy (Indian) and Buy & Make (Indian) categories of Defence Procurement. To begin with, the JV Company will look to develop and supply fifth generation Anti-Tank Guided Missiles (ATGM5s), missiles for Coastal Batteries and high speed target drones.

HAL's IMRH unveiled



Defence Minister Manohar Parrikar unveiled a full scale mock-up of HAL's Indian Multi-Role Helicopter (IMRH) at Yelahanka alongside HAL CMD T Suvarna Raju and other dignitaries (see article on *Aero India 2017*).

With a service ceiling of around 6,500 m, sea level payload capacity of 3,500 kg, and a seating capacity of 24 troops or 8 VVIPs, the helicopter is being uniquely tailored to the needs of Indian military operators. Primary roles will be tactical troop transport, casualty evacuation, under-slung load carrying, combat search and rescue, anti-surface operations, off-shore operations, and VVIP/VVIP transport. The Army/IAF variant will have a significant hovering and payload capability, especially at high altitude, while the Naval variant will trade approximately one tonne of maximum take-off weight for additional sensors and maritime modifications, as well as torpedo and anti-ship missile capability.

Tejas LCA with refueling probe



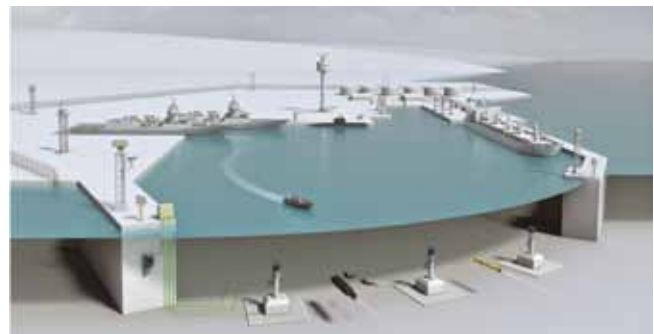
Tejas LSP-8 (serial KH2018) made its first flight fitted with a Cobham in-flight refuelling probe on 31 January. The fixed probe is fitted in front of the canopy, and offset to the starboard side of the aircraft, similar to the Mirage 2000 and Rafale fixed refueling probes.

The first flight test was used simply to collect air data and to monitor aircraft performance with the probe attached. LSP-8 has already gone through all the required structural modifications and software updates required to enable in-flight refueling, and ground trials of in-flight refueling have been carried out successfully demonstrating the capability. HAL will now replicated these trials in the air, first ensuring that the probe does not affect aircraft aerodynamics, then progressing on to multiple 'dry contacts' with a tanker before attempting actual 'wet' fuel transfers.

In-flight refueling is a critical requirement for Final Operational Clearance (FOC) of the Tejas LCA Mk.I for the Indian Air Force. While FOC had earlier been planned for March 2017, HAL CMD T Suvarna Raju recently confirmed (see interview in *Vayu II/2017*) that the milestone would not be achieved before December 2017.

IAI port security and defence project in India

Israel Aerospace Industries (IAI) has developed and delivered a comprehensive security and protection systems, known as



the 'Integrated Underwater Harbour Defence and Surveillance System' (IUHDSS). The Indian Navy, tasked with defending the subcontinent's 7,516 kilometres long coastline, raised the need for such systems.

Developed by IAI subsidiary, Elta Systems, IUHDSS comprises surveillance, observation, surface and underwater sensing arrays that can detect, locate and track various threats – whether from small boats and submersibles, swimmer delivery vehicles (SDV), swimmers or divers.

IUHDSS is a modular system, tailor made to meet specific customer needs. The system includes an advanced command and control system, a range of coastal surveillance radars, diver-detecting sonars, electro-optical sensors and automatic threat identification systems. The central command and control system provides automatic integration of all sensors, creating a common situational picture for port defence.

Axiscades and Drone Volt in MoU

Axiscades and Drone Volt announced signing of a Memorandum of Understanding (MoU) to jointly address the growing market for drones in the Indian defence and aerospace sector. Under the MOU, both companies will evaluate opportunities for drones to address the requirements for the aerial surveillance, including disaster management and hazardous site security.

Axiscades is a licensed defence manufacturer and a preferred Indian Offset Partner (IOP) for high-end strategic technologies for aerospace and defence solutions. This partnership will help Axiscades increase its contribution in the 'Make in India' initiative and become an integral part of OEM's global supply chain delivering drone solutions. French-based, Drone Volt, listed in AlterNext (Euronext Paris), has more than five years of expertise in developing drones, providing a full range of solutions worldwide.



Axiscades' Vice-Chairman, Sudhakar Gande (Right) with Drone Volt's CEO, Olivier Gualdoni (Left)

Thales and Bharat Dynamics MoU for STARStreak

Thales and Bharat Dynamics Limited (BDL), a Government of India enterprise, have signed a Memorandum of Understanding to assess the opportunity for the transfer of technology of the STARStreak missile capability to India with the support of the Government of the United Kingdom (UK). The MoU was signed in the presence of UK Government representatives on the UK Government stand. Through this MoU, Thales and BDL will seek to jointly offer a 'Make in India' solution to help service growing international demand for this product. The STARStreak missile is



in service in the British army and has been procured by the defence forces of a number of countries worldwide. The fastest missile in its category, STARStreak is unique due to its three laser-guided darts, which cannot be jammed by any known counter measure. It has the capability to defeat any air target – even armoured helicopters – as the last line of defence.

Safran takes Maini products onboard for the A350

Safran Landing Systems (formerly Messier-Bugatti-Dowty), world leader in aircraft landing and braking systems, has entered into a long-term agreement with Maini Precision for the supply of build-to-print component for various programmes, which entitles Maini Precision to become a strategic member of Safran Landing Systems sub-tier supply chain. Maini Precision will commence work for the A350 Airbus Aircraft Programme for a period of five years. The agreement was signed between Alain Frehring, Executive VP Purchasing at Safran Landing Systems, and Gautam Maini, Executive Director – Maini Group at Maini Precision Products Ltd. in Bommasandra, Bangalore. Present on the occasion were Alain Dufils from Safran Landing Systems and Naresh Palta – CEO (A & D), from Maini group.

Rolls-Royce defence service delivery centre in India

Rolls-Royce has announced plans to open its first Service Delivery Centre (SDC) in India "to deliver improved support for over 750 military aero engines that power aircraft of the Indian Armed Forces." The new facility will be located at the Manyata Technical Park in Bangalore and will offer localised engineering and technical support designed to improve frontline availability for the Indian Air Force and Navy. The Service Delivery Centre (SDC) will offer expertise in fleet management, service engineering and supply chain co-ordination as well as being the base for Field Service Representatives that can be quickly dispatched to frontline bases in India to provide expert technical support. The SDC will also offer improved support for manufacturing, assembly and test for Hindustan Aeronautics Limited (HAL).

Dr Glenn Kelly, Rolls-Royce Vice President Customer Business India - Defence, said, "The announcement of our first Rolls-Royce



Service Delivery Centre in India demonstrates our commitment to providing the best support possible for the Indian Armed Forces and our partners at HAL. The SDC model has been proven to bring greater levels of responsiveness to our customers and drive higher levels of engine readiness and availability.”

VEM Technologies delivers fully indigenous BrahMos component



Hyderabad-based defence and aerospace firm VEM Technologies formally handed over a fully indigenous critical component for the BrahMos weapon system on 30 January 2017. In the photograph is seen VEM Technologies Chairman/MD V Venkata Raju presenting the first

complex Pneumatic-Hydraulic Fuel Feed system to Dr Sudhir K Mishra, CEO and MD of BrahMos Aerospace, who noted that VEM has already set up infrastructure facilities for series production of the Pneumatic-Hydraulic system.

Dr Mishra congratulated VEM Technologies “for realising the critical sub-system in a short span of time” and complimented the company and its partners for the milestone achievement. VEM Technologies is one of BrahMos Aerospace’s major production partners, and has already supplied electronics, power systems and stores separation articles for air- and ground-launched versions of the BrahMos.

Airbus BizLab selects seven start-ups

Airbus BizLab launched the second season of its start-up Accelerator programme in Bangalore in the presence of the visiting French Minister for Foreign Affairs and International Development, HE Jean-Marc Ayrault, HE Alexandre Ziegler, Ambassador of France to India and Mr Francois Gautier, Consul General of France in Bengaluru.

Airbus BizLab is a global aerospace business accelerator with facilities in Toulouse (France) and Hamburg (Germany) besides Bengaluru, where start-ups and Airbus ‘intrapreneurs’ (internal



The Airbus team with the French Minister of Foreign Affairs and International Development HE Jean-Marc Ayrault. (L - R) Camille Durand, Siddharth Balachandran, HE Jean-Marc Ayrault, Nicolas Chamussy, Srinivasan Dwarakanath, HE Alexandre Ziegler, Francois Gautier

entrepreneurs) can work together to speed up transforming their innovative ideas into valuable businesses.

The programme is designed for aerospace start-ups as well as any start-up that has a product/solution that can be adapted for the aerospace sector such as Robotics, Internet of Things, Data Analytics, Virtual Reality/Augmented Reality, Supply Chain, FinTech, Gaming, Manufacturing and Image Processing.

Airbus BizLab offers wide-ranging support to early-stage selected projects in the form of a six-month acceleration programme. Start-ups have access to a large number of Airbus coaches, technical and business experts and mentors in various domains, free hosting, and a Demo Day with Airbus decision makers, venture capitalists, Airbus customers and partners

Airbus signs MoU for setting up ‘Centre of Excellence’

Airbus has signed a Memorandum of Understanding (MoU) for establishing a Centre of Excellence for aerospace skill development in Hyderabad, together with the Government of Telangana, National Skill Development Corporation India and AEROCAMPUS France. The signing was witnessed by Rajiv Pratap Rudy, Union Minister of State for Skill Development & Entrepreneurship and K. Taraka Rama Rao, Minister for Industries & Commerce, Government of Telangana. “This first of its kind Centre of Excellence aims to enhance the employability of young aspirants by imparting the required skills to them”, said Rajiv Pratap Rudy. “The Centre will not only provide training on aircraft maintenance but also on aerospace manufacturing and assembling”.

“We are sensitive to India’s ambition to have a thriving indigenous aerospace industry. This Centre of Excellence will play a role in translating this ambition into reality by feeding the industry with a trained talent pool,” said Ashish Saraf, V-P and ‘Make in India’ officer for Airbus.



BMD missile successfully tested

The indigenous its Advanced Air Defence (AAD) interceptor missile was successfully test launched against an incoming ballistic missile at its terminal stage at endo-atmospheric altitude. The test was held on 1 March 2017 and was the second within a month. Earlier on 11 February 2017, an incoming hostile ballistic missile target was also intercepted at high altitude by an exo-atmospheric interceptor missile some 50km above the earth's atmosphere. The target was a Prithvi missile launched from the test range at Chandipur in Odisha, while the AAD interceptor was launched four minutes later from Wheeler Island in the Bay of Bengal. The AAD interceptor, fired from a mobile launcher, was a single-stage missile with a navigation system, a high-tech computer, an electro-mechanical activator and independent tracking and homing capabilities.



MR-SAM is a mobile system and the missile has a range of 50 km to 70 km for shooting down a variety of aerial targets. The system configuration includes Advanced Phased Array Radar, Command and Control vehicle, Mobile Launchers and Missiles with advanced RF Seeker. The Indian Army will induct over five regiments of MR-SAM which will have 40 missile launchers with about 200 missiles. The Army plans to deploy MR-SAM with its mechanised formations operating in the plains, semi-desert and desert terrain. The delivery of the first system will commence in 2023.

IAF to deploy Spyder surface-to-air missiles



According to reports, the Indian Air Force will shortly be deploying Israeli Spyder surface to air missiles (SAMs) at its front line bases in the western sector. The contract for Spyder missiles was signed with Rafael in 2008 and deliveries were due to begin in three to four years but these have been delayed owing to unavailability of Czech-origin Tatra trucks on which the missiles were to be transported. The missile system has now been mounted on Tata 6x6 trucks 'Made in India'. Spyder is a mobile low level quick reaction missile (LLQRM) designed to destroy aerial targets like fighter aircraft, helicopters, cruise missiles, UAVs and stand-off weapons.

Acquisition of S-400 'Triumf' missiles sans offset clause ?

The Government of India may well procure the Russian S-400 missiles without the offset clause, so as to speed up deliveries. India and Russia had signed a deal for five regiments of the S-400 long range surface-to-air missiles at a cost of \$5.5 billion (Rs 39,000 crores). The S-400 'Triumf' in Russia (NATO SA-21 'Growler'), is considered as amongst the most lethal, long range surface-to-air





missile systems in the world. S-400 has a tracking range of 600 km and can engage targets up to a range of 400 km at a scorching speed of 13.8 Mach (17000km/h). Deliveries of the S-400 to India are not likely to start before 2019-2020 as production in Russia is concentrating on domestic requirements as also orders from China.

India is the world's "largest arms importer"

India has the dubious distinction of being the largest arms importer in the world and accounts for 13 per cent of international arms imports. India is followed by Saudi Arabia, United Arab Emirates, China and Algeria according to a report 'Trends in International Arms Transfers, 2016,' released by Swedish think tank, Stockholm International Peace Research Institute (SIPRI) on 20 February 2017. "India's imports increased by 43 per cent. India's imports in the most recent period were far greater than those of its regional rivals, China and Pakistan." Analysing this large dependence on imported arms the report concludes, "India's arms industry has largely failed to produce competitive indigenously designed weapons."

Restrictions on civil flights to military airfields

From 2018 onward, scheduled airline flights will be allowed from military airfields after certification from the Directorate General of Civil Aviation (DGCA). With certain issues still to be



sorted out between the civil aviation and defence ministries, the deadline has been extended to 31 December 2017. For certification, DGCA will check and ensure the safety of airstrips and related facilities, including air traffic control (ATC), at military airfields. Besides, the regulator should have access to areas and aspects related to scheduled carrier services.



In this connection, the Indian Navy has reportedly requested the Airport Authority of India (AAI) to reduce the number of civil flights at Goa International Airport at Dabolim, which is being contested. The airfield at Dabolim is controlled by the Indian Navy, and is part of its INS *Hansa* naval air station. INS *Hansa* houses a number naval air assets including the MiG-29K fighter aircraft, Dornier Do 228 maritime patrol aircraft (*seen in photographs*) and various types of helicopters. There are some 80 civil flights to Goa everyday which amounts to some six million passengers annually, making it one of the busiest airports in the country.

Army to fast track anti-tank missiles for Rudra armed helicopter



The Indian Army awaits decision on anti-tank missiles for its indigenous Rudra armed helicopters. The Rudra has been manufactured by Hindustan Aeronautics Limited (HAL) and is the Weapon System Integrated (WSI) Dhruv Mark-4 armed version of the Advanced Light Helicopter (ALH). Currently, Rudra has been equipped with French Nexter THL-20 chin mounted gun turret housing 20 mm M621 cannon and Belgian 70 mm rockets.

To meet the critical requirement of helicopter launched anti-tank guided missiles (ATGMs), the army plans to procure a limited number from global vendors at a cost of about Rs 1300 crores, and plans to issue a fresh tender to buy ATGMs on fast track. The Army and IAF plan to acquire 76 Rudra helicopters armed with guns, rockets and missiles.

DG Army Aviation flies LCH

Lt Gen Kanwal Kumar, DG Army Aviation Corps flew the Light Combat Helicopter (LCH) during Aero India Show on 15 February 2017. The LCH has been ordered in quantity by the Indian Army and will complement the Rudra in frontline service. The LCH is light, manoeuvrable and armed with considerable devastating fire power. With its ability of manoeuvring through narrow valleys and mountains in high altitude areas, the LCH is to provide effective support to troops engaged in mountain warfare. The LCH will be armed with turret mounted gun, rockets, air to air missiles and air to ground missiles and is considered “a potent force multiplier”.



Poona Horse marks Bicentenary

Bicentenary celebrations of the Indian Army's highly decorated 17th (Poona Horse) Regiment was marked at Meerut on 12 February 2017. A Poona Horse stamp of Rs 5 was released along with a regimental history book. The highlight was a mounted parade by the regiments T-90 main battle tanks, 32 of them moving in



synchronised manner. The Regiment, which earned two Param Vir Chakras in the 1965 and 1971 conflicts, is composed of Rajputs, Jats and Sikhs in various squadrons.

Indo-Nepal Exercise Surya Kiran XI



An infantry battalion level joint counter insurgency exercise between the Indian and Nepalese Armies, named *Surya Kiran XI*, was conducted at Pithoragarh from 7 to 20 March 2017. *Surya Kiran* is conducted every year, alternately in India and Nepal, with an aim to promote military relations while increasing interoperability in conducting joint counter insurgency operations in mountainous terrain. Both armies hope to benefit mutually from each other's experience in fighting insurgency, environmental conservation, humanitarian assistance and disaster relief (HADR), etc.

HAL CMD flies HAL trainers

At Aero India 2017, HAL CMD T Suvarna Raju flew in an upgraded Hawk-i, which he described as “a lifetime experience.” HAL has indigenously upgraded the Hawk Mk.132 and the CMD experienced the upgraded systems first hand as he sat behind HAL test pilot Wg Cdr Pratyush Awasthi. Later on the same day, Mr Suvarna Raju also flew the indigenous HTT-40 basic trainer, and opined thereafter: “It is a wonderful machine and my flying it is intended to enthuse youngsters to look for careers in flying



or aerospace and take-up challenging assignments.” In the photo above is seen HAL CMD in the Hawk-i, and below with HAL test pilot Gp Capt (retd) C Subramaniam after flight in the HTT-40.



IAI selects HAL for supply of Boeing main deck cargo door

HAL has been selected by Israel Aerospace Industries (IAI) for further supply of Boeing 737 main deck cargo doors as T Suvarna Raju, CMD, HAL stated, “This reflects the confidence reposed by our valued customer.” HAL has already manufactured and supplied more than 30 Main Deck Cargo Doors to IAI.



In the photo are seen R Kaveri Renganathan, CEO (Bangalore Complex), HAL signing the contract with Eli Alfassi, Executive Vice President, Sales and Marketing, IAI during Aero India 2017

Airbus training facility established at New Delhi

Airbus is setting up a greenfield training facility at Aerocity near the International Airport of New Delhi “to support India’s growing need for Airbus aircraft pilots and maintenance engineers”. The ground-breaking for the Airbus India Training Centre was performed by P Ashok Gajapathi Raju, Union Minister of Civil Aviation and Tom Enders, CEO, Airbus in the presence of Jayant Sinha, Minister of State for Civil Aviation on 17 March.

India is the fastest growing domestic aviation market in the world and is expected to continue to grow at an annualised 9.3 per cent over the next 20 years. To support this huge demand, Airbus forecasts a requirement for at least 1,600 new passenger and freighter



aircraft by 2035, the consequent increase in Indian in-service aircraft fleet requiring over 24,000 new pilots and maintenance engineers. The 7000 m² Airbus India Training Centre will be operational by end-2018 with two A320 full flight simulators, increasing to four and potentially to six simulators as required. It will start with an initial capacity to train over 800 pilots and 200 maintenance engineers annually, and will cater primarily to Airbus operators in India and the region. Airbus has more than 250 aircraft in service in India and over 570 more are on order by Indian airlines.

In photo above are seen P Ashok Gajapathi Raju, Union Minister of Civil Aviation and Tom Enders, CEO, Airbus unveiling the Airbus India Training Centre model.

India’s first heliport inaugurated in Delhi

India’s first heliport was inaugurated on 28 February 2017 by Union Civil Aviation Minister Ashok Gajapathi Raju, in Rohini, North Delhi. Owned by Pawan Hans Helicopters Ltd (PHHL), the



Rs 100 crore heliport has a terminal building having capacity of 150 passengers, four hangars with parking capacity of 16 helicopters and nine parking bays. It also has an integrated maintenance, repair and overhaul (MRO) facility. The heliport will be used for providing services for disaster management, emergency medical services, and law & order surveillance. It will reduce the pressure on the heavily congested IGI Delhi airport.

Pawan Hans and Airbus Helicopters in maintenance partnership

Airbus Helicopters has signed a Memorandum of Understanding with Pawan Hans Limited (PHL) appointing the Indian helicopter operator as Airbus Helicopters' approved maintenance centre for the Dauphin and Ecureuil rotorcraft. The MoU has the provision to enlarge Pawan Hans' scope of maintenance services in the future to include other Airbus helicopter types. Pawan Hans' maintenance base for the Dauphin is located in Mumbai.



"We are proud to be the world's largest civil operator of Dauphin fleet and to be its leading maintenance services provider in India. Over the years we have enjoyed a great partnership with Airbus Helicopters," said Dr BP Sharma, Chairman & MD, Pawan Hans Limited. "We would like to take our partnership a notch higher by extending our maintenance services portfolio to more Airbus helicopter types and increase our geographical coverage to SAARC countries." Pawan Hans, the world's largest operator of the civil Dauphin fleet, has 34 Airbus helicopters of which 32 are Dauphins and 2 are Ecureuils.

Russian Helicopters developing new service framework in India



Russian Helicopters (part of State Corporation Rostec) is working to improve its aftersales services and introduce a 'single-window' system of cooperation with foreign clients. A pilot project is currently being implemented in India. This framework entails centralisation of all after sales-related processes and represents the first step in providing operators with an after sales services package and the transitioning of the organisation of after sales service under the life cycle contract. As a rotorcraft designer and manufacturer, "Russian Helicopters intends to utilise its existing co-operation with other Russian companies engaged in helicopter building to ensure operation of the machines throughout the full term of their life cycle".

Saab partners with HAL for ToT

Saab's subsidiary company, Saab Grintek Defence (SGD), and Hindustan Aeronautics Limited's (HAL) Avionics Division have signed a contract to deliver transfer of technology (ToT) between South Africa and India. Announced at Aero India 2017, the contract, valued at \$8.5 million, concerns transfer of technology for



in-country maintenance of Saab's Integrated Defensive Aids Suite (IDAS) system in India. IDAS has been selected as the electronic warfare (EW) self-protection system for Indian Air Force and Indian Army variants of the HAL Dhruv Advanced Light Helicopter, including the Rudra (*photo on previous page*). Meanwhile it is reported that the Indian Army has since deployed two operational Rudra units, one in the west and the other in the north east, and is raising a third at Bangalore.

The maintenance ToT provides for the supply and commissioning of test infrastructure at HAL Hyderabad along with documentation and training of HAL personnel in both Centurion, South Africa, and Hyderabad. The ToT programme will qualify HAL Hyderabad as a Saab-approved IDAS repair facility. HAL will focus on maintenance and repair of IDAS equipment for the Indian end-users. Saab will continue to support HAL Hyderabad with critical spares and proprietary components for the entire service life of IDAS.

"Air India needs more funds"

According to the CAG report tabled in Parliament on 10 March 2017, Air India has understated its losses: "Though AI reported a positive EBITDA of Rs 166 crore (April-December 2014) from a negative Rs 191 crore (April-December 2013), both the statutory auditor and the CAG had expressed qualified opinion on AI's accounts for all the three years (2012-13 to 2014-15), pointing out significant understatement of losses in (its) financial statements".



In 2005-06 during UPA-I, the Government had ordered 50 wide body aircraft from Boeing worth Rs 33,197 crore for Air India and 43 narrow body A320s from Airbus worth Rs 8,400 crore for the erstwhile Indian airlines. "The airline had over-provisioned wide body aircraft... while it had an acute shortage of narrow body aircraft. Even though the company was aware of the shortage and had initiated the process of leasing Airbus A320 aircraft as early as July 2010, only five aircraft could be inducted by 31 March 2015, against the requirement of 19, the CAG report stated."

Government plans to sell majority stake in Air India ?

According to reports, the Government of India is planning to sell a majority stake in Air India to a 'strategic partner' with the aim to turn around the loss making national carrier. The proposal

reportedly, includes reviving Air India within five years of selling a 51 per cent stake. The talks are at an initial stage and presentations have been made to the finance ministry and the prime minister's office. The airline has a debt burden of \$ 7 billion and has been unprofitable since 2007 despite a bailout allotment of \$ 3.6 billion by the government in the past six years. Air India's share in the domestic market has reduced from 35 per cent ten years ago to 14 per cent.

Air India becomes latest A320neo operator



Air India has become the latest Airbus A320neo operator after taking delivery of the first of 14 aircraft leased from Kuwait headquartered Aviation Lease and Finance Company (ALAFCO), on 14 February 2017, thus becoming the first CFM-powered Neo operator in India. The delivery is also the first Neo for ALAFCO from an order for 85 A320neo Family. The A320neo will join Air India's existing fleet of 66 A320 family aircraft. The A320neo family incorporates latest technologies including new generation engines and wing tip devices, which together deliver more than 15 percent in fuel savings.

SpiceJet is "second most valued Indian airline"

With a market capitalisation of Rs 5,599 crore as of 24 March 2017, SpiceJet has risen ahead of Jet Airways to slot in behind IndiGo as India's second highest valued airline. SpiceJet has effected a remarkable turnaround since late 2015, at which point it was on the verge of closure, and in February recorded a passenger load factor of 93.6 per cent and an industry-leading on time performance of 81 per cent. As reported in *Vayu Issue II/2017*, SpiceJet announced a deal on 13 January 2017 for the purchase of upto 205 Boeing 737-8 MAX airliners, valued at \$ 22 billion.



Qatar Airways moot new Indian airline



Qatar Airways CEO Akbar Al Baker has revealed that along with Qatar government's investment arm, he plans to start a domestic airline in India, since the government allows 100 per cent FDI. Qatar Airways is "joining hands" with Qatar Investment Authority and an application to launch the domestic airline in India "will be made soon."

In June 2016, the Indian government had cleared full ownership of Indian carriers by foreign entities. While foreign carriers will be restricted to a maximum stake of 49 per cent, they are allowed to collaborate with a foreign partner, such as a sovereign wealth fund or an institutional investor, and not necessarily join up with an Indian partner for the remaining 51 per cent. Civil Aviation Secretary RN Choubey described Qatar's move as "excellent" but added that foreign stake of over 49 per cent in a proposed airline would require government approval.

Singapore Airlines and Etihad have already invested in airlines in India (Vistara and Jet Airways respectively) with the region acknowledged as the world's fastest growing aviation market globally for past 22 months in a row. International traffic to and from India has grown at a steady 10 per cent for many years.

Russian Navy Chief visits India

Admiral Vladimir Korolev, Commander-in-Chief of the Russian Federation Navy made an official visit to India from 15 to 18 March 2017, leading a four member Russian Navy delegation. The visit intended to "consolidate bilateral naval relations between India and Russia, as also to explore new avenues for naval cooperation." The Russian Navy Chief held bilateral discussions with Admiral Sunil Lanba, Chief of the Naval Staff and other senior officials of the Indian Navy and also met with the Minister of Defence, the Chief of the Air Staff, the Chief of the Army Staff and the Defence Secretary as part of his official engagements in New Delhi. Admiral Korolev also visited Mumbai, where he met with Vice Admiral



Garish Luthra, FOC-in-C Western Naval Command, and visited the indigenously-built destroyer INS *Mysore*, the Naval Dockyard and Mazagon Dock Limited.

The Indian Navy cooperates with the Russian Navy in many areas, including operational interactions, training, hydrographic cooperation, information technology and personnel exchanges in various fields through the medium of Navy-to-Navy Staff Talks. In addition, the Indian Navy and the Russian Federation Navy have been conducting the bilateral maritime exercise *Indra Navy* since 2003. Eight editions have been held so far, the last being held off Visakhapatnam in December 2016.

MBDA SM39 Exocet missile fired from INS Kalvari

On 2 March 2017, the Indian Navy test-fired an MBDA SM39 Exocet anti-ship missile for the first time from an indigenously built *Kalvari*-class (*Scorpena*) submarine. The weapon was fired from INS *Kalvari*, the first of India's six submarines being built under the Navy's Project 75, and it "successfully hit" a surface target during the trial in the Arabian Sea. All the six diesel-electric attack submarines will be equipped with the anti-ship missile, which has a proven record in combat. These missiles will provide the vessels the ability to neutralise surface threats at extended ranges.



Commissioning of 20th FPV ICGS *Ayush*



Indian Coast Guard Ship *Ayush*, last in the series of twenty Fast Patrol Vessels (FPVs) designed and built by Cochin Shipyard Limited, was commissioned on 18 February 2017 at Kochi by Vice Admiral Abhay Raghunath Karve, Flag Officer Commanding-in-Chief (South). The 50-m FPV displaces 421 tonnes and is propelled by three Rolls Royce waterjets to achieve a maximum speed of 33 knots and an endurance of 1500 nautical miles. ICGS *Ayush* will be based at Krishnapatnam, under the administrative and operational control of the Commander, Coast Guard Region (East), Chennai.

ICGS *Shaunak* commissioned

Indian Coast Guard Ship *Shaunak*, fourth in a series of six Offshore Patrol Vessels (OPVs), was commissioned at Goa by Suresh Prabhu, Minister for Railways on 21 February 2017 in the presence of Coast Guard Director General Rajendra Singh. The 105-metre OPV is fitted with state-of-the-art navigation and communication equipment, sensors and machinery, including a 30mm CRN 91 gun, Integrated Bridge System (IBS), Integrated Machinery Control System (IMCS), Power Management System (PMS) and High Power External Fire Fighting System. The ship is designed to carry one twin engine Light Helicopter and five high speed boats including two Quick Reaction Inflatable Boats for swift boarding operations, search and rescue, law enforcement and maritime patrol. The ship is also capable of carrying pollution response equipment to contain oil spill at sea and will be based at Visakhapatnam to be deployed extensively for EEZ surveillance and other duties to safeguard the maritime interests of India.



NOVA Integrated Systems Surface Surveillance Radar for Indian Navy

On 22 February 2017, the Indian MoD signed a contract with NOVA Integrated Systems Limited (NISL), a subsidiary of Tata Advanced Systems Limited (TASL) to execute the Indian Navy's Surface Surveillance Radar (SSR) project. The SSR programme is the first procurement by MoD under the 'Buy and Make (Indian)' category of the Defence Procurement Procedure (DPP). The project involves delivery, installation and commissioning of the radar systems on Indian Navy vessels, as well as delivery of simulators, establishing depot level facilities, and integrated logistics support with deliveries spread over 10 years. The proposed radar is based on the latest solid-state technology and also suited for coastal surveillance applications.

Enhancing coastal surveillance

On 21 February 2017, the Defence Acquisition Council cleared the project for second phase of radars for coastal surveillance to augment surveillance along the country's western, southern and eastern coast, and integrate its coastlines under a single radar system. "This involves the setting up of 38 additional radar stations and four mobile surveillance stations, ensuring gapless surveillance of vessels up to 25 nautical miles". The first phase of the surveillance project comprising 46 radar stations, 36 along the mainland coasts and 10 on the islands, was undertaken soon after the 26/11 Mumbai attacks in 2008. The radar system would enable detection and widespread dissemination of information leading to a far more coordinated action between the Navy, the Indian Coast Guard, marine police, state police forces, customs, CISF, IB, R&AW and various ports.

DCNS Energies to collaborate with Andhra Pradesh for OTEC



DCNS Energies along with DCNS India has proposed collaboration with the Andhra Pradesh Economic Development Board (APEDB) to collaborate on industrialisation of a future Ocean Thermal Energy Conversion (OTEC) plant for Andaman & Nicobar Islands and its related systems. In presence of Civil Aviation

Minister PA Gajapathi Raju, Dr GS Reddy - Scientific Advisor to Defence Minister, AK Gupta - Secretary Defence Production and other dignitaries from the Ministry of Defence and Government of Andhra Pradesh, it was agreed that DCNS and APEDB will put together their complementary expertise to implement such a project in India and ensure the industrialisation of the same at Andhra Pradesh in line with Indian Government's 'Make in India' policy.

In photo on previous page are seen Bernard Buisson, MD, DCNS India presenting letter of intent to J Krishna Kishore, CEO, Andhra Pradesh Economic Development Board.

Jindal Stainless (Hisar) enters Defence sector

Jindal Stainless (Hisar) Limited, India's largest integrated stainless steel producer have signed the License agreement with Defence Research & Development Organisation (DRDO), which entails transfer of technology for manufacturing High Nitrogen Steel (HNS) for armour applications. The agreement was signed in the presence of Union Minister of State for Defence, Dr Subhash Bhamre, and Abhyuday Jindal, Vice Chairman, Jindal Stainless (Hisar) Limited. With this, Jindal Stainless (Hisar) Limited (JSHL) now becomes India's first company to commercially manufacture High Nitrogen Steel for the defence sector. The use of HNS will replace the existing import of Rolled Homogenous Armour (RHA), thereby resulting in improved cost efficiency in material acquisition for armour applications by some 50 per cent.

Raytheon, Tata Advanced Systems to co-produce Stinger missile components

Raytheon has signed a MoU with Tata Advanced Systems Limited to engage in co-production of Stinger air defence missile components. As part of the new agreement, TASL would produce components of the Stinger missile in India, with both surface-to-air and air-to-air applications. "This collaboration with Raytheon is in keeping with other partnerships that TASL has with global leaders in the defence and aerospace sector. We will seek to expand our relationship to other missile systems and technologies, and contribute to the progressive implementation of the 'Make in India' initiative to address multiple objectives of the government, such as value addition, employment, and control over key technologies," said Sukaran Singh, chief executive officer and managing director of TASL. In 2016, India was one of three international customers to order Stinger missiles



which will also equip its AH-64 Apache helicopters soon to enter service with the Indian Air Force.

In the picture are seen Ratan Tata, Interim Chairman, Tata Sons, along with Mark Noyes, Director of International Business Development for Raytheon Missile Systems.

Tata Elxsi partners with DiSTI

The DiSTI Corporation, a leading provider of graphical user interface software and customised 3D virtual maintenance training solutions, has announced a strategic partnership with Tata Elxsi to deliver DiSTI's GL Studio UI products with Tata Elxsi software services. Tata Elxsi developed their e-Cockpit demonstrator using DiSTI's GL Studio UI Designer for development of Infotainment, Cluster and HUD. The hardware used for the demonstrator is the Renesas R-Car H3 Salvatore-X board. The demonstrator highlights both how GL Studio can seamlessly handle high performance graphics across multiple displays on a single embedded target, as well as the quality design and software implementation capabilities of Tata Elxsi.

Tata Trusts, Lockheed and DST in innovation partnership

Tata Trusts have engaged with Lockheed Martin and the Department of Science and Technology (DST) for an initiative to "help start-ups and innovation." This public-private partnership will invest in social and industrial innovations, train innovators in world-class commercialisation strategies, offer support for incubation and assist in business development.

The three entities are likely to invest \$2 million annually, which may include seed money for the entrepreneurs to develop technology-based solutions which helps the society. Other new programme partners include the Massachusetts Institute of Technology (MIT), Indian Institute of Technology, Bombay and the Indian Institute of Management, Ahmedabad.

Alpha Design partners with Elbit Systems



Alpha Design Technologies announced a \$30 million contract with Elbit Systems for the IAF's Mi-17 helicopter upgrade programme, which involves upgrading of 90 such helicopters and

Alpha Design, as the major offset partner, will be manufacturing all key sub-units at its Bangalore factory. Alpha Design's scope of work will involve manufacturing of key sub-units such as smart displays, new cockpit, transponder, Digital Voice Recorder (DVR), Missile Launch Detection Systems (MILDS), cables, brackets, etc.

Alpha Design's MILDS is being indigenously manufactured by the company in technical collaboration with Airbus as part of a DARE (DRDO) project for upgradation of helicopters. Alpha Design has already produced and supplied 469 MILDS as part of Cheetah Helicopter Upgrade for Army Aviation Corps, through BEL, during 2015-16.

BEL launches BELCOMNET communication network



On 15 February 2017, Defence PSU Bharat Electronics Ltd (BEL) unveiled its new communication network, BELCOMNET, for Indian military and paramilitary forces and the export market. BELCOMNET is a VHF/UHF secure voice communication network with user specific encryption algorithm. The network facilitates exchange of secure voice through repeaters that are dispersed geographically. This enables connecting two or more dispersed locations for day-to-day communications. With this, brigades in the field and headquarters can be connected using IPv6 features. It also facilitates broadcasting to all sites, in case of an emergency or a crisis.

In the photo above are seen Dr Ajit T Kalghatgi, Director (R&D), Nataraj Krishnappa, Director (Other Units), and other senior officers of BEL at the unveiling of BELCOMNET at Aero India 2017.

BEL receives Offset Contract for CoMPASS from Elbit

Elbit Systems Electro-Optics Ltd (ELOP) has awarded Bharat Electronics Limited (BEL) an offset contract for the supply of 10 CoMPASS systems for use in the Light Combat Helicopter (LCH) being manufactured by Hindustan Aeronautics Limited (HAL). BEL has entered into a Technical Collaboration Agreement with ELOP for joint production and D-Level maintenance of the Compact Multi-Purpose Advanced Stabilised System (CoMPASS)



electro-optical sensor turret. BEL has absorbed transfer of technology (ToT) for production and maintenance, and not only supplies but also provides maintenance support for CoMPASS.

In the photo above are seen Bezahel Nachlis, President & CEO, ELBIT Systems and MV Gowtama, CMD, BEL, exchange documents after signing the offset contract for CoMPASS

HAL helicopter production to be ramped up



The Indian Armed Forces have stated requirements for well over 700 helicopters of various categories including light utility, armed and medium multi-role types. According to sources in New Delhi, the Ministry of Defence (MoD) have asked the public sector undertaking Hindustan Aeronautics Limited (HAL) to ramp up production, speed up existing under-development projects and start out-sourcing work. HAL's Helicopter Complex at Bangalore currently produces 22-24 Dhruv ALHs per annum but production of light utility helicopters (LUH) is assuming priority considering that the Army and Air Force urgently need to supplant their inventory of ageing HAL-built Cheetahs and Chetaks. HAL would have to produce up to 85-90 helicopters a year in three types-the ALH, LUH and LCH – with out-sourcing of some work being suggested on the lines of global manufacturing practices.

India's three armed services need some 485 light utility helicopters, the Army requiring 259, IAF 125 and Navy around 100 such helicopters, the latter also for embarking on warships. In addition, the Army and the Air Force have requirements for some 180 light attack helicopters. In addition, the Coast Guard and other paramilitary forces have requirements for 100 helicopters. Meanwhile, HAL has planned to establish a new helicopter production facility at Tumkur, 100 km from Bengaluru, which will start production in 2018.

APPOINTMENTS

Air Marshal S Harpal Singh is Director General (Inspection & Safety)

Air Marshal S Harpal Singh AVSM VM assumed office of Director General (Inspection and Safety) on 21 March 2017. The Air Marshal was commissioned into the fighter stream of the IAF on 15 June 1980, and has over 2,400 hours of flying on various aircraft and has commanded a fighter squadron, was Chief Operations Officer of a major base in the western sector, commanded a radar base and was AOC of a major fighter station in the Eastern sector. He is a Fighter Combat Leader, a graduate of the Defence Services Staff College, and has undergone the General Course for Senior Officers at the National Institute of Defence Studies in Japan. Air Marshal Harpal Singh has served in various staff appointments at Air Headquarters, Tri-Services Organisations and was the Senior Air Staff Officer of South Western Air Command prior to assuming his present post.



Emmanuel de Roquefeuil is Thales' Country Director in India

Thales has appointed Emmanuel de Roquefeuil as the new VP and Country Director for India, succeeding Antoine Caput. In his new role, Emmanuel will lead and drive Thales' growth in the country and also realise the Group's overall goal of 'Make in India and export from India.' "India is a key country for Thales. The company is strongly committed to expanding its presence in the country by continuing to collaborate with the local industry and customers." Prior to this appointment, Emmanuel served as the Vice-President, Sales and Marketing for Optronics and Missile Electronics at Thales. In this role, he was responsible for the setting up of OPTROLEAD, a joint venture between Thales and Sagem.



Neelu Khatri is India President for Honeywell Aerospace

Honeywell has appointed Neelu Khatri as the new India President for its aerospace business group. In this role, Khatri will provide strategic direction and focus on further growing the company across the country in commercial aviation and defence. As part of the pioneering group of women



officers commissioned into the Indian Air Force, Khatri served for 15 years and obtained the rank of Wing Commander. During her military career she developed strong management and leadership expertise as well as an applied and practical awareness of the defense and aerospace sectors. During her Air Force career and after, she worked extensively on various capital and revenue programmes with India's Ministry of Defence.

Khatri joined Honeywell in 2014, bringing extensive experience in business operations and project and programme management to the company. As senior director of strategy and business development, she worked with Honeywell's India-based business groups to create and execute initiatives to grow organic and new business across the company's market segments.

Nik Khanna is BAE Systems' MD for India

Nik Khanna took over as Managing Director for India at BAE Systems with effect from 1 February 2017. He joined the Company from Raytheon, where he has led business development, marketing and strategy in India for the last four years, as Country President. Prior to that he was Associate Vice-President at The Cohen Group. Khanna has also served as Aerospace and Defence Director at the US-India Business Council. Based in New Delhi, Khanna will join the BAE Systems India Board, chaired by Deepak Parekh, Chairman of HDFC Ltd, and will lead the Company's growth strategy anchored in a focus on 'Make in India.'



Air Marshal Raghunath Nambiar takes over as Deputy Chief of the Air Staff

Air Marshal Raghunath Nambiar AVSM AVM & Bar has taken over as Deputy Chief of the Air Staff. An alumnus of the National Defence Academy, he was commissioned in the IAF in 1981 as a Fighter Pilot. He is an Experimental Test Pilot and has the distinction of having the highest flying hours on the Mirage 2000 aircraft in the IAF, besides undertaking the decisive precision attack on Tiger Hill during the Kargil conflicts in 1999 and had also been the Project Test Pilot for the Light Combat Aircraft.

The Air Officer has held various Command and staff appointments such as Principal Director Offensive Operations, Director of Space Application and Commandant Aircraft Systems Testing Establishment. He has also been Defence Attaché to Israel, AOC of AFS Jamnagar, Air Defence Commander of Western Air Command, Senior Air Staff Officer of Southern Air Command, Training Command and Senior Air Staff officer of HQ EAC prior to assuming the present assignment.



ISRO makes history: launches 104 satellites in one go!

On 15 February, the Indian Space Research Organisation's PSLV-C37 successfully launched its Cartosat-2D primary payload, along with a record-breaking 103 co-passenger satellites. The mission was the thirty-ninth flight of the Polar Satellite Launch Vehicle (PSLV) and the sixteenth PSLV flight in 'XL' configuration, with strap-on solid motors. Primary payload mass was 714 kg and total mass of the 103 co-passenger satellites was around 663 kg, for a total payload mass of about 1,377 kg. The satellites were placed into a 505-km polar Sun Synchronous Orbit (SSO).



Fully integrated PSLV-C37 seen with mobile service tower



The co-passenger satellites comprised 101 nano-satellites, one each from Kazakhstan, Israel, The Netherlands, Switzerland, United Arab Emirates (UAE), 96 from the United States of America, as well as two from India. PSLV-C37 also carried two additional ISRO nano-satellites (INS-1A and INS-1B), with four different scientific payloads from ISRO's Space Applications Centre (SAC) and Laboratory for Electro Optics Systems (LEOS).

The 101 international customer satellites were launched as part of the commercial arrangement between Antrix Corporation, a Government of India company under the Department of Space, the commercial arm of ISRO, and the various international customers.

INS *Viraat* decommissioned



INS *Viraat* and *Vikramaditya* steaming side by side with decks full of aircraft
(photo: Indian Navy/ Cdr Navtej Singh)

Laid down as a *Centaur*-class carrier during WWII, launched in the year 1953, commissioned into the Royal Navy as HMS *Hermes* in 1959, sold to India in 1986 and re-commissioned as the Indian Navy flagship in 1987, INS *Viraat*'s long and storied career finally came to close on 6 March 2017, when she was decommissioned at sunset at the Naval Dockyard in Mumbai. The ceremony not only marked the carrier's 30 years of service with the Indian Navy, but also the 27 years she spent with the Royal Navy – Admiral Sir Philip Jones, First Sea Lord and Chief of Naval Staff of the Royal Navy, and Vice Admiral Vinod Pasricha, commissioning CO of INS *Viraat* were guests of honour, while Admiral Sunil Lanba, Chief of the Naval Staff, was chief guest. Some 1,300 personnel who had served on board *Viraat* were also in attendance.

In her 27-year Royal Navy career, *Hermes* was converted from her original CATOBAR configuration to a helicopter and troop carrier, and then in 1980 to a STOVL carrier with a ski-jump. It was in this final configuration that the carrier saw action as flagship of the British forces during the 1982 Falklands War, with RAF Harriers and RN Sea Harriers and Sea King helicopters operating from her decks through the historic campaign.

Under the Indian ensign, *Viraat* was referred to as 'Mother' and was home to the Sea Harriers of INAS 300 'White Tigers,' Sea Kings of INAS 330 'Harpoons,' and SAR Chetaks of INAS 321 'Angels.' Her air wing amassed 22,622 flying hours across all aircraft types over three decades, and she spent

nearly 2,252 days at sea sailing a distance of 588,287 nautical miles (1,094,215 km), roughly equivalent to 27 circumnavigations of the globe! *Viraat* has had 22 Captains since she began Indian Navy service, and some 40 flag officers, including five Chiefs of Naval Staff, served aboard the vessel.

INS *Viraat* played a major role in *Operation Jupiter* during the 1989 Sri Lankan peacekeeping operation, after which she was affiliated with the Garhwal Rifles and Scouts of the Indian Army in 1990. She was also a key part of *Operation Parakram* in 2001-2002, after the terrorist attack on the Indian Parliament. Above all, *Viraat* is credited with honing the art of carrier flying in the Navy, which enabled the seamless induction of INS *Vikramaditya* and its integration with the fleet, despite differences in carrier configuration and air wing. She participated in numerous international and domestic exercises, including the Indo-US *Malabar* series, the Indo-

French *Varuna* exercises, *Naseem Al Bahr* with Oman, and the annual Theatre-level Readiness and Operational Exercise (*TROPEX*) with the Indian Army and Air Force. *Viraat*'s last operational deployment was for the International Fleet Review off Vishakhapatnam in February 2016 (see *Vayu II/2016*).

With the decommissioning, the Indian Navy returns for the moment to being a single-carrier force, with INS *Vikramaditya* taking up aviation operations at sea as the completion and induction of INS *Vikrant* (IAC-1), currently under construction at Cochin, is awaited.



INS *Viraat* underway with Sea Harriers, Sea Kings and Chetaks visible on deck (photo: Indian Navy/ Cdr Navtej Singh)

Road Map for Future IAF Fighters

VAYU Exclusive Interview with

Air Chief Marshal BS Dhanoa, Chief of the Air Staff

VAYU: *Congratulations on having taken over as Chief of the Air Staff of one of the world's largest and most committed Air Forces. Could you kindly articulate on your major thrust areas for the IAF over the next few years?*

CAS: Strengthening the air defence of our Vital Areas and Vital Points (VAs and VPs) and maintaining a deterrent offensive capability are the IAF's key thrust areas. While the aim is to maintain a combat ready professional Air Force to meet any external threat, enhancing the security of Air Bases, VAs and VPs is also at the apex of our thrust area. Having assessed our vulnerabilities and shortcomings, post the terrorist attack on AF Station Pathankot, we have embarked on a two-pronged approach to further our security against a possible Fidayeen attack on our VAs and VPs. On the one hand we are upgrading Air Field security at all bases by installing high technology Integrated Perimeter Security Systems, while simultaneously commencing specialised training of IAF personnel to counter terrorist attacks. Our aim is to embrace technology and both equip and train existing Air Warriors to effectively detect and thwart any kind of sub-conventional attack on our assets.



VAYU: *The IAF has a proliferation in inventory of its fighters, transport aircraft and helicopter types, which surely creates massive maintenance difficulties. What are the broad plans for reduction of such diversity so as to make their management more effective and cost effective?*

CAS: Though IAF operates diverse aerial and ground assets we have an organised maintenance cadre, from field units to Air HQs, which is responsible for ensuring the

serviceability of all combat and technical support equipment. Our maintenance organisation is robust, time tested, battle hardened, technologically advanced and professionally competent to deal with the diverse platforms operated by IAF. Apart from the maintenance and logistic personnel that directly support combat operations of our five operational commands, the Maintenance Command of IAF plays a significant role in indigenously upgrading and co-producing war fighting equipment. IAF plans to bring more than 95% of our mandatory spares under 'Make in India' by 2027. The Maintenance Directorate at Air HQ ensures the best industry standards and operational logistics philosophies are followed by the IAF.

VAYU: *With the combat aircraft strength of the IAF steadily decreasing owing to obsolescence and attrition, while induction of new aircraft is still some time away, does the IAF plan to keep its MiG-21 variants and MiG-27s in squadron service for much longer?*

CAS: MiG-21 variants of Type 75 (MiG-21bis) and Type 96 (MiG-21M) are slated to be phased out by 2019 and the MiG-27 fleet by 2020. The MiG-21 Bison



By 2019, all MiG-21 variants but the upgraded Bison (seen leading this formation) and the MiG-21UM trainer (bottom left) will be phased out (photo: Angad Singh)



The Air Chief in a two-seat LCA trainer at Yelahanka AFS (photo: IAF)

and Type 69 (MiG-21UM trainer) would continue in service up to 2025. All aircraft in IAF remain in service until completion of their Total Calendar Life (TCL) or Total Technical Life (TTL). The MiG-21 and MiG-27 aircraft currently in service with IAF still have residual TTL/TCL. These aircraft play a supporting role in our operational capability and will continue to be of relevance until completion of their Technical or Calendar life. As per the current plan some of the upgraded MiG-21 aircraft will remain in service till 2024-25.

VAYU: *The Dassault Rafale was selected as MMRCAs of choice but the numbers originally required have been pared down drastically and the equivalent of only two squadrons worth are on order. Recent reports have it that even these limited numbers of aircraft will be based at two geographically distant air bases. Would*

this not impact on infrastructural costs and pose logistic challenges?

CAS: The Rafale is a latest generation maintenance friendly aircraft. The support and maintenance philosophy caters for the necessary infrastructure and support required to sustain operations of the squadrons at distant geographical locations. Necessary planning has been done at various levels, with the dispersed location in view, to ensure that all logistic challenges are addressed. Rafale, once inducted in the IAF will be the most advanced fighter aircraft with capabilities to dominate any air battle, thus the plan to utilise the aircraft optimally. Operational considerations are the key factors that dictate basing of fighter aircraft in IAF. Hence, the basing plan of the aircraft has been narrowed down post deliberations on all operational, maintenance, and logistics

aspects. The requirement of operating the Rafale from dispersed locations was factored in its procurement. Infrastructure and logistics issues based on two-base operations have been included in all negotiations from the very beginning and addressed in the contract.

VAYU: *The Government is moving to select yet another single-engine fighter, to be produced in India in parallel with the Tejas LCA. What are the key capabilities the IAF is looking for in such an aircraft and how would this impact on future orders for more LCAs?*

CAS: The Government has made a roadmap for induction of fighter aircraft to ensure that IAF reaches its authorised strength at the earliest. This has been done with emphasis on 'Make in India.' The number of LCAs to be inducted into the IAF has been proposed considering production capabilities and other operational factors. A suitable fourth-generation-plus fighter aircraft is being shortlisted by IAF, which will not affect the induction of LCA. Further, the technological advancements and 'spin-offs' from the 'Make in India' aircraft will also assist in future fighter development programmes.

VAYU: *The IAF's requirement for Fifth Generation Fighter Aircraft (FGFA) has been projected for some years and one is aware of the on-going Indo-Russian collaboration in this regard. However, with this programme facing several hurdles in terms of technology, costs and evolution of new systems, could there be other options that the IAF could consider?*

CAS: At present, the Research and Development (R&D) contract is under negotiation and the proposal is being reviewed by a Joint Committee.

VAYU: *Preliminary aspects of the indigenous Advanced Medium Combat Aircraft (AMCA) project are in the public domain but it is essentially the IAF that must decide on its key performance parameters before the final configuration is frozen. What is the timeline for this programme to receive a format set of Air Staff Requirements, and when should this next generation fighter assume service status?*

CAS: Aeronautical Development Agency (ADA), DRDO has been working



Dassault Rafale B displaying at Aero India 2017 (photo: Angad Singh)



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The IAF inducted its first EMB-145 AEW&C aircraft on 14 February during Aero India 2017 (photo: Angad Singh)

capability? Also, what are the IAF's plans for space based networking particularly beyond GSAT-7A?

CAS: The networking of airborne assets is related to the Software Defined Radio (SDR)/Operational Data Link (ODL) Project. The procurement case for SDR is at a very advanced stage. Simultaneously, the specifications of Network Centric Operation Applications (NCO Applications) are being worked out based on IAF requirements. The delay in procurement of SDRs was due to issues of interoperability between stakeholders/operators. Meetings have

on the development of Advanced Medium Combat Aircraft (AMCA). The project feasibility study has been completed by ADA and the PSQRs for AMCA are in the process of finalisation. Though it is premature to comment on timelines for induction of AMCA in IAF, we expect the aircraft to be operationalised by 2031-32.

VAYU: *The IAF's current AWACS/AEW capability is limited to only three Phalcon AWACS (plus two more in the pipeline) while there are delays in the indigenous Embraer 145-based AEW&C programme. This key capability gap must be addressed on priority and could you please give an overview of the options?*

CAS: In order to establish the required degree of air dominance, IAF has a strategic requirement of a large number of AWACS. As rightly brought out, three AWACS are already in service. Two indigenous AEW&C are under evaluation and would be inducted shortly. We are planning to acquire additional AWACS under the AWACS (India) Project. Requirement of AWACS has been projected in its Long Term Integrated Perspective Plan 2012-27. AWACS (India) are being acquired through indigenous route from DRDO.

(Editorial Note: The first indigenous EMB-145 AEW &C aircraft was inducted in IOC configuration during Aero India 2017, with a second to follow shortly. See item in this issue)

VAYU: *The IAF has achieved considerable success in networking its ground stations with the inductions of IACCS. However, the networking of airborne of airborne assets is still lagging. What are the major reasons for delays in this project and what is the timeframe to achieve such*

HAL Tejas LSP-3 (KH2013) seen shortly after take off (photo: Angad Singh)

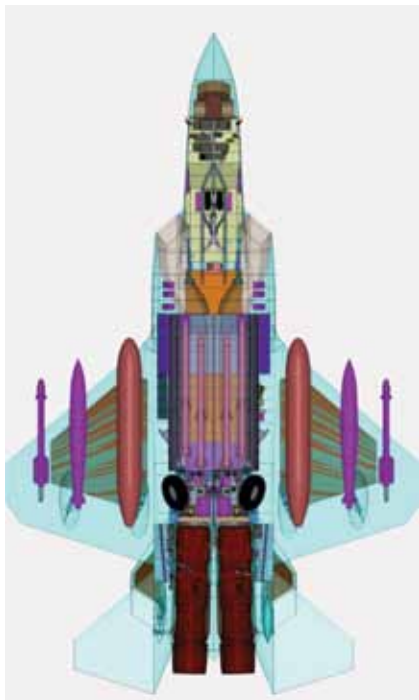


The MoD has indicated that at least 70 HAL HTT-40 trainers will be ordered for the Air Force (photo: Angad Singh)



been held under the chairmanship of DG Acquisition with various organisations under DRDO and DPSUs to discuss the issues of interoperability and security of communication through SDRs. The contract would be signed once cleared by the Acquisition Wing of MoD.

VAYU: *Flying Training: Are the present pilot numbers adequate to sustain the planned aircraft-to-pilot ratio? The present inventory of PC-7 Mk.II BTAs is to be augmented by the HTT-40 which is still under development and could take some years before its clearance for service.*



A proposed configuration of the AMCA being developed by ADA

Meanwhile, the HJT-36 intermediate jet trainer programme is reportedly stalled and the Kirans will be phased out in the near future. All this will clearly impact on the IAF's flying training scheme. Are there any plans to augment the number of Hawk AJTs to go in for a two-stage training sequence, as a possible option?

CAS: IAF conducts a three stage ab-initio pilot training on PC-7 Mk.II, Kiran Mk.I/IA and Hawk Mk.132 aircraft for induction in the fighter stream. With the phasing out of Kiran Mk.I/IA, the second stage of pilot training would also be conducted on PC-7 Mk.II as an interim measure until the induction of an intermediate jet trainer. Additional Pilatus

and Hawk aircraft are being procured under option clauses, and the IAF plans to induct the indigenous HTT-40 basic trainer aircraft after completion of its design and development.

VAYU: *What are the IAF's views on the pace of indigenisation as concerns weapons systems such as MR-SAM, air-to-air missiles and radars. With an emphasis on 'Make in India,' could the IAF well consider having its own design and development directorate, similar to that of the Navy? Could the IAF consider assuming ownership of an existing organisation such*

CAS: Indigenisation is one of the main priorities of the IAF. The Air Force has been fully supportive of indigenisation efforts and has contributed towards design, development and induction of various weapon systems. The IAF actively undertakes trials on all aerial platforms, weapons and systems developed by DPSUs and other Indian agencies, and also contributes to the funding of projects undertaken by DRDO. In order to harness and direct indigenisation and R&D efforts, the IAF is in the process of forming a Directorate of Research & Development, which will be the nodal agency for directing



HAL has recently completed licence-production of the 99th and final Hawk Mk.132 for the IAF, and a number of upgrade and new-build programmes are proposed

as the Aeronautical Development Agency (ADA), which was set up as a 'Society' in the mid-1980s, essentially for the Light Combat Aircraft programme, but now tasked for futuristic programmes?

R&D activities of breakthrough technologies and state-of-the-art equipment. This is essential for transforming the capabilities of the IAF and to achieve a technological edge over its adversaries.



Indigenous Akash SAM systems have been inducted into the IAF, but additional surface-to-air weapon types, such as the MR-SAM and S-400 are still required



Aero India 2017 – The way we were (are)!

The 11th edition of India's biennial Air Show, traditionally preceded by the International Technology Seminar, with the theme this time of 'Aerospace Technology Collaboration and Self Reliance' took place at Bangalore, India's aerospace capital, in mid-February 2017. Organised by the DRDO, the former attracted scores of excellent papers (*see separately*), some of which were presented live by the authors at parallel sessions at the Royal Orchid Convention Centre, not very far from the Air Force Station Yelahanka, which was hosting the industrial exhibition, static and flying displays.

As for the latter, clearly, some form of exhaustion has crept in, both in terms of organisation and participation. There were fewer exhibitors around and not all international companies which returned to this edition of Aero India, were actually exhibiting, with many of their senior executives choosing instead to 'walk the halls', meet with important (Indian) personalities, political, bureaucratic and military, so as to achieve their objectives without spending an arm and a leg!



HAL's Hawk-i comes into land at Yelahanka
(photo : Angad Singh)

Hawk Mk.132s of the Surya Kiran team performing at Aero India 2017 (photo : Angad Singh)

Defence Minister Manohar Parrikar had the Goa Chief Minister Laxmikant Parsekar in tow throughout which led to much talk about as to where he was headed : in fact Parrikar continuously alluded to the forthcoming elections in his native state and the speculations about his return there as Chief Minister abounded. (*Ed : Manohar Parrikar resigned as Defence Minister on 12 March and headed back to Panaji to be sworn in as Chief Minister of Goa, with Arun Jaitley announced as Interim Defence Minister the next day*).

Back to Aero India 2017 : there were many leaders of industry who were at Yelahanka with drums beating and flags flying. Amongst these certainly were the Israelis and Swedes, while there was a welcome return by the British industry. In fact the BAE Systems Hawk advanced jet trainer was much in evidence both in the air and on the ground. Whilst HAL-built Hawk Mk.132s of the *Surya Kiran Aerobatic Team* (SKAT) performed over Yelahanka every day, HAL's recently rolled out Hawk-i, the 100th such aircraft produced at Bangalore, was also shown off in its new blue-white livery. Cynosure of all eyes, however, was the

'Advanced Hawk', transported from the UK and strategically displayed at the entrance to Hall E, which housed the huge HAL exhibition (*see separate item*).

This 'prototype' Advanced Hawk with its new 'combat wing' was smartly painted in British and Indian colours and is the subject of discussions between the two companies to meet the Indian Air Forces' projected need for potent light attack aircraft.

The Inaugural itself

The inaugural took place at sharp 0900 hours on 14 February, off the main taxi track of Air Force Station Yelahanka when Defence Minister Manohar Parrikar arrived to be greeted by Organisers of this Edition of Aero India. Accompanying him was Civil Aviation Minister Ashok Gajapathi Raju, whose presence could well signal a return to Indian aviation "synergy", this being repeatedly stressed by both the Cabinet ministers. There will be much cheer amongst the industry,

In Retrospect



India". With reference to and in support of the Regional Air Connectivity (RCS) scheme, Parrikar later said that HAL has been cleared to build ten civilian Dornier 228s, which "sturdy aircraft" will be suitable for such applications. Parrikar also predicted a "boom" in the aviation sector, taking into account both civilian and military needs.

However, almost all the aircraft at Aero India 2017, on static or flying display were unabashedly military types and many felt that the Civil Aviation Minister's presence could well have been complemented by at least some civil airliners at the Show. In fact, considering Air India's growing fleet of A320neos, one such aircraft could have been 'spared' to adorn the apron at AFS Yelahanka and perhaps even an Air India B-787 Dreamliner doing a flyby after the inaugural would have stressed the point !

Defence Minister Manohar Parrikar escorted to the dias by Air Chief Marshal BS Dhanoa and other senior officials



Four of the five aircraft types in the 'Might formation' are, left to right, Su-30MKI, Tejas LCA, Dornier Do-228 and Hawk-i (photo : Angad Singh)

if indeed there is ONE airshow in India with the purportedly 'civil-oriented' India Aviation Show in Hyderabad attracting fewer and fewer participants ; another sign of 'exhaustion' mentioned earlier! However, alert *Vayu* readers will recollect that during Aero India 2013, then Defence Minister AK Anthony had shared his vision for the future of aviation in India with the then Civil Aviation Minister Ajit Singh, who "appeared to agree to move ahead jointly for such expositions." This has still not happened !

Now, in his inaugural address, Mr Parrikar stated that the government

was committed to creating an enabling environment for a domestic ecosystem in defence production. "The defence public sector undertakings are being revitalised and encouraged. Government has also taken several initiatives for ease of doing business for private firms and additional initiatives are underway to support the role of private sector in defence manufacturing." This was echoed by the Civil Aviation Minister in his speech, who added that "India's airspace is well defended by the armed forces, which has enabled civil aviation to grow and connect an increasing number of destinations in

The speeches over, the invitees were then treated to the customary flying displays, traditionally starting with a trio of Mi-17 helicopters trailing national flags, followed by a most unusual mixed formation of five HAL-built aircraft, which comprised the Tejas LCA, Dornier 228, HTT-40, Hawk-i, and Su-30MKI ('Might Formation'). Individual flying displays were then carried out by single examples of the Tejas, Gripen, Rafale, Falcon and Su-30MKI, followed by Hawks of the IAF's *Surya Kiran Formation Aerobatic Team* (SKAT) and the traditional finale by four HAL Dhruv helicopters of the *Sarang* team.



Dassault Rafales and Saab Gripens at the Yelahanka flight line in February 2017

M-MRCA Contest Redux

There was a whiff of déjà vu at Aero India 2017 with three of the original six M-MRCA contenders back on the flight line and in the air above Yelahanka. During the run-up to a decision for selecting the Indian Air Force's future fighter, euphemistically referred to as the *Medium-Multi Role Combat Aircraft*, which had kicked off in 2004 and ended in 2012 when the Dassault Rafale was selected, six of the contending aircraft types had participated in every successive Aero India show, encompassing a decade or so of time. With the Rafale declared the IAF's M-MRCA of choice, the other five types were now seen as 'also ran' and so, just the Rafale came to Yelahanka in 2013. Still, perhaps in a spirit of 'never-say-die', Lockheed Martin still brought in a pair of F-16s 'borrowed' from the USAF in Japan. The other four aircraft types (F-18, Typhoon, Gripen and MiG-35) were understandably absent. And this remained the pattern again two years later at Aero India 2015; even though three years had elapsed since the Rafale selection had been announced, in February 2015 the



Nestled between HAL Hawk-i, HTT-40 and the Netra AEW&C aircraft are the pair of Lockheed Martin F-16s of the USAF

contract had yet to be signed. Flying their flag with sangfroid, Rafale International, the consortium of Dassault, Thales and Snecma showcased three Rafales at Aero India 2015, a single-seat Rafale C and two twin-seat Rafale Bs.

Then at his Press Conference during Aero India 2015, a visibly anxious Air Chief voiced his concerns about the state of the IAF's combat fleet, worries on obsolescence

and phase-out of legacy fighter types, in context of delays in the acquisition of newer platforms. He was candid in his assessment of the M-MRCA, LCA and FGFA programmes, and clearly stated that the M-MRCA, as a requirement "is essential to the IAF", but was not necessarily any specific aircraft type, alluding to the delayed finalisation of the Rafale contract. He later admitted that the Air Force had no alternate plan to meet the M-MRCA requirement, should negotiations continue to remain deadlocked. On the suggestion that more Su-30MKIs could be inducted to 'fill the gap,' then Air Chief Marshal Arup Raha stressed that the two types "complement rather than replace" each other.

Obviously, the Air Force's anxiety was acutely felt by the Prime Minister when, two months later, at the very start of his state visit to France in April 2015, Narendra Modi announced that he had requested the French government to make available 36 Dassault Rafales to meet the urgent requirements of the Indian Air Force, thus sweeping aside the bureaucratic impasses which continued to dog finalisation of the M-MRCA programme. However, it still took another eighteen months for the formal agreement to be signed, this finally taking place on 23



September 2016. The agreement, valued at approximately €7.8 billion (Rs 60,000 crore) comprises 36 aircraft (28 single-seat and 8 twin-seat), weapons, spares, maintenance and support, as well as a number of IAF-specific customisations. Deliveries would commence 36 months after the contract coming into force, with all 36 aircraft to be delivered within a period of another 36 months.

These drastically reduced numbers (from 126 to 36) obviously gave heart to the other losing contenders. The US government quickly expressed their full support to marketing efforts by Lockheed Martin and Boeing to, respectively, sell their F-16 Block 70 and F/A-18 E/F Super Hornets to the Indian Air Force, the former offering to shift its entire F-16 fighter production line from Fort Worth in Texas to India. The resilient Swedes too renewed their offer to make the Saab Gripen E in India. Further, the Swedes also suggested partnership in the design and development of India's next-gen fighter, the Advanced Medium Combat Aircraft (AMCA) as a follow-on to the LCA developed by ADA, something that would be logical and ensure that ADA's three decade efforts on design & development of the LCA were not lost in the sands of time much like the HF-24 programme was.

Thus, the decks were cleared for a redux (albeit more focused) of the M-MRCA contest at Aero India 2017. Mr Parrikar had for some time been re-iterating the Government's desire to select a new 'single-engine fighter' for which there would be "a new production line for single-engine fighters" in India and that this would be parallel to existing HAL Tejas LCA production facilities. However, such a move awaited identification of a "strategic partner" referred to in the Defence Procurement Procedures (DPP) 2016. As the Minister has said, "...during the current year the decision should be tentatively over...maybe a few of them will come in ready-made status (as 'flyaways') but the rest will be made in India."

While the Indian strategic partner for the single engine fighter would need be identified through the Aatre Committee model, selection of the western partner would depend on the Transfer of Technology (ToT) offered and the financial proposal of the OEM. "Competitive process will be followed," stated the Defence Minister, although the deal would be finalised under

a Government-to-Government (G2G) process.

Two Lockheed Martin F-16s were also on the flight line and were vigorously flight demonstrated at Aero India 2017 while in Hall E, the Company had an impressive display of various aircraft and systems in model form. The USAF also deployed a C-130 Super Hercules to Yelahanka and this was augmented by Boeing's C-17 Globemaster III and a P-8A Poseidon from the US Navy.

Now to Defence Minister Parrikar's press conference at Aero India 2017, on 14 February when he answered specific queries. He again referred to the need for a new single-engine fighter for the Indian Air Force, the process being at an "advanced stage" with the decision to be announced "in the third quarter of the current calendar year." Reacting to questions on dichotomy between the 'America First' rhetoric of newly-inaugurated US President Donald Trump, and Indian PM Narendra Modi's 'Make in India' initiative, the Defence Minister stated that any foreign OEM seeking to provide their platforms to Indian operators would have to secure all approvals from their respective governments. "I want it to be made in India," stressed Parrikar, while any export opportunities "would be a bonus."

On the Indo-Russian Fifth Generation Fighter programme, the Defence Minister was somewhat evasive, stating that there are "several questions yet to be answered" before the next steps are taken. These include the Indian workshare and possible export markets.

HAL is King

Hindustan Aeronautics Limited clearly dominated this Show, with perhaps the largest indoor exhibition in Hall E, a dedicated open air area where key announcements were made, including launch of the book 'Harlow to Hawk', authored by Pushpinder Singh of *Vayu* encapsulating the history of HAL's Aircraft Division at Bangalore from the very first aircraft type built there (Harlow PC-5A) in the early 1940s till the present, when HAL have completed manufacture of several tranches of the BAE Systems Hawk advanced jet trainer.

HAL-designed and built aircraft dominated the Show, with several fixed wing and rotary types parked in the static display area. In the air, Tejas LCAs carried out regular aerobatic displays as also 'customer flights', the most notable being that by Air Chief Marshal BS Dhanoa, Chief of the Air Staff, who flew a LCA trainer on the afternoon of 14 February along with Air Vice Marshal AP Singh, Principal Director of the National Flight Test Centre (NFTC), and experienced the LCA's manoeuvrability and advanced avionics. The sortie included general handling, air-to-air and ground attack profiles. Air Chief Marshal Dhanoa was reportedly "impressed by its capability" and expressed his faith in the programme. The Tejas has achieved Initial Operational Clearance (IOC) and has been inducted into the Indian Air Force with No.45 Squadron, which is still based at HAL's Bangalore airport.



'Top Guns': T Survarna Raju, Chairman/MD HAL after his flight in the Hawk-i at Aero India 2017 (photo: Angad Singh)



Tejas LCA Mk.1 taxis past the spectators at Aero India 2017 (photo : Angad Singh)



(photo: Vishnu Som)



Air Chief Marshal BS Dhanoa and Air Vice Marshal AP Singh in Tejas trainer (photo: PRO IAF)

There were many others who were flown in the Tejas trainer including the well known TV personality Vishnu Som, who took this picture of the other Tejas trainer in formation.

During his Press Conference on 15 February, HAL CMD T Suvarna Raju confirmed that design work has commenced on the Tejas LCA Mk.1A, and following selection of the radar and sensors, trials are planned to commence in 2018, with production to begin the following year. 83 LCA Mk.1As have been cleared for procurement by the Defence Acquisition Council (DAC).

In clearing the procurement of 83 LCA Mk.1As at the Defence Acquisition Council meeting chaired by Defence Minister Manohar Parrikar in November 2016, this



HAL light combat helicopters (LCH) at Aero India 2017 (photo: Angad Singh)

programme was formally announced, and is confirmed by the formal global tender issued by HAL's Aircraft Research & design Centre, (ARDC) in December for the supply of key sensors and systems. This comprises an AESA radar and EW Suite that can be integrated with other onboard avionics of LCA which includes a Digital RWR and podded jammer, Combined Interrogator and Transponder (CIT), short range air to air missiles and BVR missiles. Companies listed for the AESA radar include Elta, Saab, Raytheon, Thales and Rosboronexport.

HAL's World of Helicopters

At his Press Conference on 14 February, Manohar Parrikar talked about the requirement for "a thousand" helicopters for the Indian military, and in this context stated that the indigenous HAL Light Combat Helicopter programme "is proceeding well," with an initial order for 15 aircraft having been recently cleared. The LCH, which has been christened 'Dhanush', has proven itself well in extreme conditions such as the high operating altitudes at the Siachen Glacier.

However, it was the Indian Multi-Role Helicopter (IMRH) which dominated HAL's Show, albeit in a full scale mockup form. The Defence Minister officially unveiled this on 14 February, in the presence of HAL CMD T Suvarna Raju and many of his senior board members.

HAL aims to indigenously develop such a 12-tonne-class multirole helicopter to serve with all three branches of the

military. With a service ceiling of around 6,500 m, sea level payload capacity of 3,500 kg, and a seating capacity of 24 troops or 8 VVIPs, "the helicopter is being uniquely tailored to the needs of Indian military operators." Primary roles will be tactical troop transport, casualty evacuation, under-slung load carrying, combat search and rescue, anti-surface operations, offshore operations, and VIP/VVIP transport. The Army/IAF variant will have a significant hovering and payload capability, especially at high altitude, while the Naval variant will trade approximately one tonne of maximum take-off-weight for additional sensors and

maritime modifications, as well as having torpedo and anti-ship missile capability.

The IMRH is proposed to be powered by two 3,000 shp class turboshaft engines (yet to be selected), and will be equipped with an automatic flight control system, state-of-the-art mission systems, advanced cockpit display and avionic systems and so on.

Besides domestic orders, HAL is targeting export markets for the IMRH. Despite not working toward any set QRs, the DPSU is open to working with any of the three Services, or all of them! HAL has also signaled a willingness to collaborate with technology partners on key areas.



HAL's IMRH full-scale mock up



IMRH mock up

HAL's Su-30MKI and other programmes

"HAL will be the lead agency for the Sukhoi Su-30MKI upgrade programme, involving back-to-back contracts with Russian partners," stated HAL CMD T Suvarna Raju at his press conference on 15 February 2017. The programme will be carried out in two phases, the first to be finalised "within 90 days". The Chairman also gave detailed statistics on aircraft production, with 183 Su-30MKIs produced as of January 2017, and the



Prototype of the HTT-40 (nicknamed 'Phoenix') at Aero India 2017 (photo : Angad Singh)



Sukhoi Su-30MKI performs over Yelahanka (photo : Angad Singh)

balance to be manufactured by 2020 at the rate of 12 aircraft per year, with all 222 such fighters delivered to the IAF by 2019-2020.

The CMD should be particularly pleased with the steady progress of the HAL HTT-40 basic turboprop trainer, the first prototype flying over Yelahanka during the inaugural and the second prototype on static display through the Show. Looking beyond the first tranche of HTT-40s to be ordered by the IAF, the CMD was confident that the orders would reach 106 aircraft.

Being candid on the vexed intermediate jet trainer (IJT) programme, Mr Suvarna Raju felt that this would "get out of the grave" this year but the Indo-Russian

multi-role transport aircraft (MTA) programme "is not progressing."

Russia's United Aircraft Corporation had their delegation at Aero India 2017 headed by Yuri Slyusar, President Chairman of the Executive Board who also talked about the twin-engine MC-21 will be delivered in three basic versions, with passenger capacity ranging from 150 to 180 seats. The aircraft is being produced with extensive use of composite materials and alloys of aluminum and titanium, making it considerably lighter than its predecessors. "We will use Pratt & Whitney's engines which are fuel efficient".

Significantly, there were no Russian aircraft on display this time around although there are a score or more Antonov An-32s based at Yelahanka for multi-engine conversion training, alongside a handful of HAL/Avro 748s (see separate article).

Saab, Saab, Saab

At Saab's massive exhibition area in Hall C, the Company announced that it had offered a fighter sensor package for India's Tejas LCA Mk.1A fighter aircraft. The package consists of a state-of-the-art Saab Airborne Electronically Scanned Array (AESA) fighter

out scintillating aerobatic displays over Yelahanka but flew several Air Force, Navy and ADA pilots to give a feel of the type's superb handling qualities. A number of select media were also given the privilege of sorties in the Gripen, including *Vayu's* Angad Singh (*see separate article*).

The Dassault delegation included the legendary M.Serge Dassault himself and many of his senior colleagues. In fact, *Vayu* was privileged to sit next to them during the inaugural ceremony on 14 February. According to a spokesman, Mr Serge Dassault has attended every Aero India



Pair of Saab Gripen Ds landing at Yelahanka (photo : Angad Singh)

radar closely integrated with a compact Electronic Warfare (EW) suite using Gallium Nitride based-AESA technology. Saab, in partnership with Indian industry, will offer a solution that will bring the required radar and EW capability to India and the Indian Air Force. Following extensive technology development Saab is offering "this latest technology for the LCA Mk.1A on time, and with low risk".

Saab was clearly at full throttle with its extensive range of its products and systems on display at Aero India 2017. Pride of place was obviously the Gripen E and its weapon systems, a full scale mockup parked just outside the entrance to Hall C. Within the Hall, also on display was a model of the Gripen M the naval variant of the Gripen E. Other products were Electronic Warfare & Early Warning Systems, Next-Generation Radar Systems, Saab's Integrated Avionics Demonstrator, Ground Combat Indoor Trainer, Signature Management Systems, the mobile camouflage system, Air Defence Systems including the RBS 70 NG VSHORAD and BAMSE SRSAM, as also the well known but new generation Carl Gustaf M4, man-portable multi-role weapon system and the RBS 15 Mk.3 naval surface to surface missile.

Saab brought three Gripens to Aero India 2017, a single-seat C and two twin-seat Ds which not only carried

Rafales at Yelahanka

Taking nothing for granted, three Dassault Rafales were at Aero India 2017, and were flown with customary excellence, their pilots obviously now 'familiar' with the Yelahanka environs. There were several 'customer' flights as well, with a relatively large number of these devoted to naval aviators which is understandable considering the Indian Navy's recent RFI for 57 carrier borne fighters. The Rafale M is a strong contender to meet this requirement even as the design of IAC-2 approaches finalisation.

Show since its inception. As stated by Chairman and CEO of Dassault Aviation, Eric Trappier, "Dassault Aviation has contributed to India's defence preparedness for more than 60 years".

"Demonstrating Rafale's capabilities in Aero India reaffirms our total commitment to India's sovereignty. We have had a long standing relationship with the Indian Air Force and industry and, thanks to the unmatched capabilities of the Rafale and to our full involvement in the innovative approach of the 'Make in India' Initiative,



Rafale B at Aero India 2017 (photo : Angad Singh)

The Technology Seminar

The Aero India 2017 International Seminar (on Aerospace Technology) was this time around organised by the GTRE, with the Advisory Committee headed by Dr S Christopher, Chairman DRDO and Secretary Defence R&D. The inaugural on 12 February had Dr VK Saraswat, former SA to RM and now member of the National Institution for Transforming India – NITI Aayog, giving the inaugural speech. The good Doctor was in his element, not surprisingly as this was his ‘scene’ in the recent past, although some of his off the cuff remarks raised several eyebrows, especially his counter-views to the Navy’s on the LCA’s Naval variant.

Following him was Mark Pearson of GE Aviation, whose message at the Plenary Session was loud and clear : the Company is “ready to support future indigeneous fighter requirements”, their F404-IN20 engine already in service powering the LCA Mk.1 while some examples of the F414-INS6 have been delivered for the LCA Mk.2 project, which however is yet to ‘get off the ground’. Interestingly, GE is hedging its bets (on the potential business for new IAF fighters) with their F110 engines powering the F-16 and F414 family on the Gripen E and F-18E/F.

Post lunch on 12 February and continuing for the next day and half, were presented a staggering 68 papers from experts in India and internationally, sessions taking place simultaneously in three halls and interested listeners were spoilt for choice. While Dr Sudhir Mishra of BrahMos Aerospace spoke on the challenges in realising the air launched version of the BrahMos supersonic cruise missile, next door Captain Shivnath Dahiya and Dr Amitabh Saraf of ADA gave an impressive review of ‘Ski-jumping the light combat aircraft’. Jonas Jakobsson from Saab talked about Gripen : the smart fighter with future-proof technology’.

On Day 2, the theme was on power plants and propulsion. The legendary Dr Victor I Mileschin, of CIAM Russia, give a highly impressive review on improving gasdynamic efficiency, followed by Gary Way of Eurojet who spoke on future technologies for combat engines, his expertise obviously stemming from the Eurojet EJ200 turbofan engine. Next door was Conrad Banks, of Rolls Royce, speaking on a similar theme but querying whether it was “evolution or revolution?” The AMCA is obviously uppermost in their minds!

Post lunch, various professors from DIAT presented *Robust Consensus for Swarm of UAVs* but perhaps the most pertinent was that on Concurrent certification in the design & development of the HTT-40 basic turboprop trainer aircraft’ which programme’s return ‘from the cold’ is certainly a case study on how the indigenous aircraft company HAL took on all odds to persist with development of this aircraft which, informally christened ‘Phoenix’ by its enthusiastic designers is now flying.

But thereafter the scene shifted to Yelahanka, where the real HTT-40 took part in the flying display, leading the incredible mixed formation as Aero India 2017 was formally inaugurated.



we are entirely dedicated to partner India in meeting its strategic defence and economic needs.”

According to a clearance application filed before Competition Commission of India (CCI), the Dassault Aviation-Reliance Group joint venture that was announced in October 2016 to execute significant offsets for the Rs 58,000 crore Rafale fighter jet deal, plans to manufacture and supply military combat aircraft on a “worldwide basis”. The application also revealed that Reliance Aero, which was incorporated in April 2015 by the Anil Ambani-controlled Reliance Group, will hold 51 per cent of the JV, with Dassault holding the remainder.

Shalom, Shalom !

Israel’s industry has always participated in a big way at Aero India Shows and 2017 was no exception. Clustered in Hall A were Israeli companies under the broad umbrella of SIBAT, which is the International Defence Cooperation Directorate within Israel’s Ministry of Defence, and organisers of the Israel National Pavilion at Aero India 2017, where a wide variety of advanced, locally-developed defence technologies are being presented. Eleven companies exhibited their cutting-edge solutions in the fields of cyber, avionics, EW, unmanned systems, missiles – and much more.

According to SIBAT’s Director, Brig Gen (Ret) Mishel Ben Baruch, “In recent years, we have witnessed the strengthening of the cooperation between India and Israel in many fields, the most prominent being defence technology. Israeli companies are increasingly utilising the unique manufacturing and development capabilities that exist in India, establishing local entities, and collaborating with local companies, in order to comply with ‘Make in India’ requirements. “Interest in Cyber defence, in particular, is on the rise in India and the region as a whole. Israeli companies have developed innovative solutions in this field and are already exporting them to countries in the region. SIBAT are working to connect the needs of the countries in the region, cyber or otherwise, with Israeli technologies, for mutual benefit”.

Amongst the biggest displays at the Israeli pavilion was that of IAI, Israel Aerospace Industries Ltd. “We look at India as one of the most dominant markets for IAI,” Eli Elfassi, VP Marketing of IAI told *Vayu*. “A significant per cent of our export is attributed to our Indian operations and,

our goal is to continue and establish this dominant position in the future, despite the growing competition. The excellent reputation won by IAI and the gains by its Indian customers are instrumental for continued success”.

At Aero India 2017, IAI and Kalyani Strategic Systems Ltd signed a MoU to

incorporate a JVC in India while another MoU was signed between IAI and Taneja Aerospace & Aviation. Continuing their charge, IAI and Dynamatic Technologies announced corporation to jointly address needs of the Indian UAV market.

There were other Israeli ‘majors’ at Aero India 2017, including Rafael, Controp,

Elbit System, and IAI Elta. Their showing, as also that of US including, Boeing, Raytheon, Lockheed Martin, and General Atomics will be covered in *Vayu*’s next Issue, preceding the Paris Air Show 2017, which *Vayu* will cover in its usual comprehensive manner. The Show(s) go on!

Vayu Editorial Team

Advanced Hawk “for India and the World”



The Advanced Hawk demonstrator bears a striking Indian tricolour and Union Jack paint scheme with BAE and HAL Company logos as well as the Make in India lion logo (photo: BAE Systems)

The Advanced Hawk demonstrator, developed and proposed in collaboration with Hindustan Aeronautics, which recently completed licence production of the Hawk Mk.132 at its Bangalore complex, has also been referred to as ‘Combat Hawk’ in the past, is being pitched as a cost-effective update of the Hawk AJT, intended to serve as a Lead-In Fighter Trainer (LIFT) aircraft at the Operational Conversion Unit (OCU) level.

The joint BAE-HAL development includes a new, more powerful engine (Adour Mk.951), and a completely redesigned wing with leading edge slats and updated ‘combat flaps,’ which significantly expands the aircraft’s envelope. The cockpit has seen a similar redesign, and now incorporates an all-new large area touchscreen display, digital HUD and improved sensor simulation and training aids. Other changes include a full defensive aids suite, expanded weapons capability (including MBDA’s ASRAAM on the wingtip rails), a fixed air-to-air refueling probe, and on-board oxygen generation. BAE executives at the show were keen to point out that these modifications not only make the Advanced Hawk a capable fighter trainer, but also endow it with significant combat capability in its own right. The new wing and increased thrust endow the Advanced

Hawk with fighter-like agility, useful for training and combat alike, while the new cockpit layout is not only conducive for better simulation and training, it is also the layout of choice for most future fighters, such as the Saab Gripen E and Lockheed Martin F-35.

The key advantage to the programme is introduction of new features into a proven airframe, and one that is already “made in India”. This is reflected in the short (24-month) development cycle of the new variant, with first flight planned soon. The improved capabilities of the Advanced Hawk will enable training activities currently performed on frontline fighters to be pushed back to the OCU phase of training, thereby freeing up flying hours on operational

platforms and either extending their service lives or increasing their availability for operational tasks instead of training. Conducting air-to-air refueling training, for example, can be done at much lower cost and in a much safer training environment with the Advanced Hawk.

While BAE Systems is confident that the Advanced Hawk offers a compelling training platform to the Indian Air Force, Company officials stressed that the aircraft would also be available for export from HAL’s Indian facilities. The advanced training and combat abilities of the aircraft, they feel, expand the type’s potential market. Of course, India is where BAE and HAL are focusing efforts for the moment, with production facilities available at HAL’s Aircraft and Engine Divisions, and comprehensive maintenance capability already in place at AFS Bidar and INS Dega, in addition to 3rd and 4th line support provided by HAL’s Overhaul Division. Commonality with the Hawk Mk.132 production and support infrastructure in India should enable Advanced Hawk to be manufactured and supported effectively, with greatest re-use of facilities, equipment and skills, and the aircraft’s established ‘Make in India’ footprint across the public and private sectors is equally likely to boost its political standing.

Angad Singh

Some highlights of

AERO INDIA 2017



Rafales at Yelahanka, 2017



The Rafale omni-role fighter aircraft was showcased at Aero India 2017. Three Rafale fighters, one single-seat Rafale C, and two twin seat Rafale B fighters participated at the show after the acquisition by Indian of 36 Rafales in September 2016, consistent with Rafale International's endeavour to illustrate its commitment to India and to Indian interests.

This programme exemplifies the strategic relationship and the 'exemplary partnership' maintained between India and France and is a 'natural culmination' of the relationship of trust initiated in 1953 when India became Dassault Aviation's first export customer.

"Dassault Aviation, the Rafale manufacturer, has contributed proudly to India's defence preparedness for more than 60 years. Demonstrating the Rafale capabilities in Aero India, is reaffirming our total commitment to India's sovereignty. We have had a long standing relationship with Indian Air Force and industry and, thanks to the unmatched capabilities of the Rafale and to our full involvement in the innovative approach of the 'Make in India' initiative, we are entirely dedicated to partner India in meeting its strategic defence and economic needs" stated Eric Trappier, Chairman and Chief Executive Officer of Dassault Aviation.

Serge Dassault with Dassault Systèmes co-founder Charles Edelstenne, and current Dassault Aviation Chairman and CEO Éric Trappier. Serge Dassault has attended every Aero India show since 1996!

Saab offers “World’s Most Modern Fighter Aircraft Facility in India”

Saab is offering to set up the ‘world’s most modern ecosystem’ and facility in India to manufacture the Gripen E for India and the global market. From this ‘unique industrial base,’ India will accelerate its ability to design, develop, manufacture, modify and enhance new fighters for the future. The state-of-the-art facilities for India would include a dedicated Gripen Design Centre, a major production facility equipped with the latest manufacturing technologies and robotics systems, a radar and sensor centre, final assembly plus test and verification centres.

“In close cooperation with Saab, engineers and technicians from Indian partner and supplier companies will live and work in Sweden and at global partners’ sites. They will be trained at today’s production facilities, to gain the knowledge and experience needed for transfer to Indian-made Gripens once India’s own facilities are operational. Saab’s R&D collaborations in India will see a rapid expansion. Saab would incubate partnerships between its global supply chain and Indian suppliers. Saab would also foster R&D partnerships for next-generation platform, system and sub-

system design and development across the industry. To support the Gripen facilities and the wider aerospace industry, Saab will set up a training academy for pilots, technicians and aerospace engineers. Saab has started to identify and evaluate Tier 2 and Tier 3 partners from all over India. Saab’s partnership and procurement teams have met many Indian companies to assess capabilities and areas of cooperation. In addition, Saab has evaluated potential sites in a number of states and has entered into discussions with several state governments. India’s indigenous aerospace capabilities will be built up to establish, operate and secure a national support network, through ‘true’ technology transfer to Indian industry. This will ensure that the Indian Air Force is completely self-reliant, and need look only within India for all required support.”

Mats Palmberg, Vice President, Industrial Partnerships, Aeronautics, Saab AB described the benefits of Saab’s proposal saying, “Saab’s offer of Made-in-India Gripen fighters includes the setting up of a completely new industrial ecosystem in India, with the capabilities to produce and upgrade the world’s most advanced fighter aircraft, for India and for export. The offer involves transfer of critical technology to India, and close cooperation with Indian partner companies and suppliers, for long-term fighter capability development in India.”

The facilities to be set up would also deliver depot-level maintenance, repair and overhaul and design services. This fighter technology ecosystem would support the full spectrum of production capabilities for India, including parts manufacturing and sub-assembly.

“Saab is offering an industrial facility that will be the centre-of-gravity for the Made-in-India Gripen. It is an unrivalled offer that will set new standards in aeronautical engineering excellence for decades to come, should India procure Gripen,” stated Saab India Chairman Jan Widerström.



[Photos: Angad Singh]

Russia expands Su-30SM fleet



Acquisition of the Su-30SM multirole fighter has become a main priority of the Russian MoD, even in the current fiscal situation that has impacted aircraft modernisation and recapitalisation plans. The Centre for Analysis of Strategies and Technologies (CAST), a Moscow-based think tank, estimated that Irkut supplied 17 Su-30SMs to the Russian military in 2016, while all other Russian military aircraft, such as the Su-35S, MiG-29SMT, and Su-34, were acquired in smaller numbers. In addition, the Russian MoD signed new Su-30SM contracts with Irkut in 2016, which CAST experts say have taken Irkut's order book for the type to 116 aircraft. More than half this number are already delivered and operational. Once deliveries under current contracts are completed, the Su-30SM will become the most numerous modern fighter of the Russian armed forces, where it is operated by both the Russian Aerospace Forces as well as Russian Naval Aviation.

Judging by 2016 deliveries, Russian Naval Aviation has elected to make Su-30SM its primary land-based fighter, with these being delivered to three of four regional commands of the Russian Navy. One of reasons for this increased Su-30SM procurement has been assessment of the type's performance during combat operations in Syria. General Sergey Shoygu, the Russian Defence Minister, said in December 2016 that the Su-30SM was among a number of Russian military systems that "have demonstrated high efficacy in combat operations in Syria."

Su-30SM fighters are being delivered not just to regular units, but to some of Russia's premier aerobatic teams, namely the 'Russian Knights' and 'Falcons of Russia.' The two teams traded legacy Su-27s for all-new Su-30SMs in 2016. Display pilots from these teams have explained their choice in favour of the Su-30SM, saying that the new aircraft benefits from being a modern fighter with contemporary avionics systems. The Su-30SM has a better nav-attack system than the Su-27, which allows it to make long-range flights without a 'pathfinding' aircraft, while an increase in internal fuel capacity and an in-flight refueling probe make its flight range essentially unlimited, dictated only by the physical limitations of the aircrew.

The Su-30SM is a localised development of the Indo-Russian Su-30MKI, which forms the majority of the IAF's combat fleet. Deliveries to the Russian Air Force commenced in 2012, after which

it was decided to allow exports to Russian allies under regional military-political organisations. Kazakhstan became the first foreign customer of the Su-30SM, and Belarus has also repeatedly expressed interest in the fighter a number of times in the past year.

Despite the fact that the Su-30SM is a relatively new aircraft with first deliveries only five years ago, there are already discussions in Russia concerning future upgrades for the aircraft. Experts note that some Su-30SMs are equipped with pylons for future 'RVV-SD' missiles, while Yuri Bely, CEO of the Tikhomirov Instrument-making Institute, which is developing the radar for the Su-35 as well as the PAK-FA (Sukhoi T-50), has stated that the Su-30SM's radar could benefit from an upgrade.

"The Su-30SM fighter has huge upgrade potential," stated Sergey Chemezov, CEO of Rostec Corporation, one of the most leading Russian defence companies, as he spoke on Russian MoD plans to pursue a serious upgrade programme for the Su-30SM.



Crystal Clear



KT201 taxiing in to the show loaded with five MICA (three on wingroot stations, two on outboard wing stations), a single Popeye (centreline), two RPL 501/502 1,700-litre drop tanks, and a Litening pod (photo: Angad Singh)

IAF Mirage 2000 upgraded to 'FOC' spec, displayed for the first time with Popeye ASM ('Crystal Maze')

After several years of discussion and negotiation, the Indian Government signed a \$2.5 bn contract to upgrade the IAF's fleet of 51 Mirage 2000H/TH on 29 July 2011. The programme, involving Dassault Aviation and Thales in France and HAL in India, was based on the Mirage 2000-5 Mk.2 standard, but with certain India-specific customisations. Among the changes planned for the IAF's Mirages were a night vision goggle-compatible 5-screen glass cockpit, new navigational systems, advanced Identification Friend or Foe (IFF) system, on-board oxygen generation system (OBOGS), new Thales RDY-2 multi-mode radar, fully integrated electronic warfare/self-protection suite and new weapons and datalinks. The principal avionics improvement is the Modular Data Processing Unit (MDPU) as designed for the Rafale, which outperforms the Mirage 2000-5's 2084 XRI mission computer by orders of magnitude, to say nothing of the legacy system on the IAF Mirages. The MDPU serves as a mission

computer, sensor and data fusion system, and manages the nav-attack system and cockpit displays along with virtually all operational functions.

The first French-upgraded (IOC) aircraft, KT201 (the first twin-seat Mirage 2000TH built for the IAF) made its maiden flight at Istres-Le Tube on 5 October 2013. KF107, a single-seater, flew shortly thereafter and the two aircraft were then comprehensively flight-tested in a campaign lasting over 250 flying hours (*see Vayu Issue III/2015*).

Following the upgrades of KT201 and KF107 in France, the remainder of the IAF's Mirage 2000 fleet (47 aircraft) is being upgraded in India by HAL, to the definitive FOC standard, which involves integration of India-specific weapons and systems, such as the Rafael Popeye standoff strike missile (referred to as 'Crystal Maze' by the IAF) and Elbit's Display And Sight Helmet (DASH). The Israeli additions require use of the MIL-STD-1553B data bus, while the Mirage internally employs

the legacy Digibus data transfer system (a similar transmission concept to 1553, but using a different implementation), so HAL has independently added and certified the 1553B bus to the Mirage 2000I/TI, interfacing with the legacy Digibus via Ethernet. According to a source close to the programme, this 1553B implementation will enable easier integration of non-French weapons and sensors to the aircraft in the future, given the ubiquity of the standard. In addition, the upgrade programme has been used as an opportunity to involve new as well as established Indian private sector industrial partners, such as Axis Aerospace & Technologies, Avio India, Centum, Rangsons Electronics and Samtel.

KT201 was the first IOC-upgraded Mirage to be modified to the FOC configuration by HAL, and made its first flight as an FOC Mirage 2000TI on 28 July 2016. The same aircraft was displayed on the ground at Aero India 2017, showcasing its new weapons fit of MICA AAMs and Popeye ASM in public for the first time.

MBDA's MICA (EM) RF/MICA IR for India



Rafale firing a MICA RF

MICA is the reference multi-mission air-to-air missile system for the Rafale and latest versions of the Mirage 2000 combat aircraft. Developed by MBDA, MICA provides a high level of tactical flexibility. MICA stands for *Missile d'Interception, de Combat et d'Autodéfense*, which is a clear statement that this single missile system covers all facets of the air-to-air battle: BVR (Beyond Visual Range) interception, close air combat and self-defence. The MICA system has 2 versions: MICA (EM) RF with an active radio frequency seeker and MICA IR with a passive dual waveband imaging infrared seeker. Both missiles are fully qualified and in series production, being currently flown by numerous air forces worldwide.

A "full MICA" configuration on an aircraft such as Rafale gives very flexible and high BVR fire power for air superiority during various missions: combat air patrol, sweep, deep strike, recce, and maritime operations. The MICA missile in BVR mode introduces a new way of waging air combat by offering multi-target capability at extended ranges with the two interoperable guidance systems to hamper enemy counter measures. All (EM) RF or IR MICA missiles are fully BVR, being operable with or without data link target designation updating. In short range (SR) combat, a MICA configuration on an aircraft offers a full "new generation" capability thanks to the outstanding performance of the missile (extreme agility and manoeuvrability).

An additional advantage lies in the possibility of launching MICA with its seeker (namely IR) either locked-on to the target or not, while still featuring all BVR qualities. The same MICA missile provides a dual use (air-launched or surface-launched). The surface-launched variant, named "VL MICA", is launched vertically either from naval- or ground-based air defence systems.

Storm Shadow/Scalp

The Storm Shadow/Scalp is a conventionally armed, stealthy, long-range stand-off precision weapon designed to neutralise high value targets. This precision, day or night, all-weather missile system is optimised for pre-planned attacks on static targets whose

positions are accurately known before the mission. Mission data, including target reference scene and aim point, are programmed into Storm Shadow/Scalp on the ground (whilst loaded or in storage preparation areas), thus demands on aircrew are kept to a minimum. The fire and forget missile once launched will find its way to the intended target autonomously which, combined with the missile's range, allows the launch aircraft to keep well clear of enemy air defences.



Boeing accelerates defence engagement with India



Boeing has announced the establishment of Boeing Defence India (BDI), a local operating entity that will support the company's future growth objectives in the country in the areas of services and support, sales and marketing, sourcing, manufacturing and engineering. Pratyush Kumar, President, Boeing India, will lead BDI while continuing his responsibilities as President of Boeing India.

With BDI, Boeing will expand its engagement with India's Ministry of Defence to deliver advanced capability and readiness to India's military customers and to develop a competitive supplier base in country that is integrated into Boeing's global supply chain.

Further, BDI will set up a local sustainment support footprint in India that will enhance its responsiveness on local sustainment and training contracts. This, coupled with the efforts of "last-mile" services execution teams based in India, will ensure the high availability of platforms to Boeing customers for missions at a competitive cost structure.

"India is among the fastest growing economies in the world, and Boeing has made accelerated investments to grow the manufacturing, skill development and engineering scale in the country," said Kumar. "Going forward, our strategy will be to continue leveraging India's strengths to maximise growth and productivity for Boeing and help create a robust and self-sufficient aerospace ecosystem in the country."



Israel Aerospace Industries MOUs at Aero India 2017

With Taneja Aerospace & Aviation (TAAL)



From left to right: Shaul Shahar, IAI Executive Vice President and General Manager of the Military Aircraft Group, Salil Taneja, Chairman, Taneja Aerospace and Aviation Ltd.

Israel Aerospace Industries, Ltd. (IAI), through its Golan Industries Division, and Taneja Aerospace & Aviation Ltd. (TAAL) of India, have signed a Memorandum of Understanding (MOU) to cooperate in the development, production, marketing and/or sale of civil and military aircraft crashworthy-seats. The MOU was signed at the Aero India 2017 in Bangalore, by Shaul Shahar, IAI's Executive Vice President and General Manager of the Military Aircraft Group, and Salil Taneja, Chairman of TAAL.

With the Kalyani Group in JV

Israel Aerospace Industries, Ltd. (IAI) and Kalyani Strategic Systems Ltd. (KSSL), the defence arm of Kalyani Group, signed a Memorandum of Understanding (MOU) to incorporate a Joint Venture Company (JVC) in India. As part of the MOU, IAI and KSSL are aiming to expand their presence in the Indian defence market and to build, market and manufacture specific air defence systems and ground to ground & ground to sea munitions. The MOU was signed in Bangalore at the Aero India exhibition, by Joseph Weiss, IAI's President and CEO and Baba Kalyani, Chairman Kalyani Group. The MOU is the first step of a process to establish a JVC between the two companies to integrate strategic state-of-the-art defence systems for the Indian MOD in accordance with the Indian Government's 'Make in India' policy.



At the MOU signing ceremony: Joseph Weiss, President and CEO of IAI and Baba Kalyani, Chairman Kalyani Group

With Dynamatics on Mini UAVs

Israel Aerospace Industries (IAI) and Dynamic Technologies Ltd (DTL) have announced their cooperation to jointly address the needs of the Indian UAV market. Both companies signed a cooperation agreement regarding the production, assembly and support of mini UAVs in India at Aero India 2017 in Bangalore, which encompasses the transfer of technology and production capabilities from IAI to DTL to enable the indigenous capability for mini UAV systems for the benefit of Indian end-users and in support of the Indian government's 'Make in India' initiative. This agreement can serve as a solid foothold for much broader collaboration between the parties in the field of UAVs in India, while retaining the continuity of existing programmes and enabling the implementation of new ones.



From left to right: Joseph Weiss, President and CEO of IAI, Shaul Shahar, IAI EVP and General Manager of IAI's Military Aircraft Group, Udayant Malhoutra, CEO & Managing Director Dynamatic Technologies Ltd, Eli Alfassi IAI's Executive VP Marketing

IAI unveils Heron TP-XP

IAI introduced the long-range long-endurance Heron TP-XP multi-mission, multi-payload strategic UAS at Aero India 2017. The Heron TP-XP is a special export version of the Heron TP, which has been in service with the Israel Air Force since 2010, integrating the most advanced IAI technologies.

The Heron TP-XP is the latest member of the Heron family, a significant advantage to many Heron customers worldwide, following the same operational concepts. These

operational concepts are based on over 40 years of IAI accumulated knowledge and experience in UAV systems, with 1,500,000 cumulative UAV flight hours and more than 50 operational clients.

Characterised by safety and reliability standards that are among the highest in the world, and capable of operating in extreme weather conditions, this UAV also meets accepted world standards and complies with STANAG 4671.

Shaul Shahar, IAI EVP and General Manager of the Military Aircraft Group, said: "We are proud to introduce the latest IAI development in the UAV field in India, which is an IAI strategic customer. The Heron TP-XP introduces air supremacy at a higher level than



currently exists in India, with an emphasis on doubled flight speed, high altitude and enhanced payload capability. This system is the latest derivative of the Heron TP, considered to be one of the world's leading UAVs. The possibility of offering the Heron TP-XP opens up additional opportunities by allowing us to expand the range of solutions we can offer to our customers."

On Show: Rafael's Python-5 and i-Derby AAMs



At Aero India 2017, Rafael Advanced Defence Systems exhibited its Python-5 and i-Derby advanced air-to-air missiles. The former is a fifth generation air-to-air missile that provides the pilot engaging an enemy aircraft with a full sphere launch capability. The missile can be launched from very short to beyond-visual ranges with greater kill probability, excellent resistance to countermeasures, irrespective of evasive target manoeuvres or deployment of countermeasures.

Python-5 combines advanced new technologies with operationally proven

Python-4 components. The missile incorporates a new dual waveband imaging seeker, advanced computer architecture, Inertial Navigation System (INS), sophisticated Infra-red counter-counter-measures (IRCCM) and sophisticated flight control algorithms. Python-5 maintains Python-4's unique aerodynamic airframe, INS, powerful rocket motor, warhead and proximity fuze.

The missile provides revolutionary full sphere competence, achieved by a combination of Lock-On-After-Launch (LOAL) and 'excellent' acquisition and tracking capabilities. Its dual waveband Focal Plane Array (FPA) seeker and sophisticated algorithms enable acquisition of even small, low signature targets in Look-Down, adverse background and cloudy environments.

The i-Derby is an active radar air-to-air missile that provides fighter aircraft with outstanding and effective performance in both short ranges and Beyond Visual

Range (BVR) intercepts. The missile enables operational flexibility and multi-shot capability, and can be launched at an enemy aircraft day or night and in all-weather conditions. Additional i-Derby capabilities include look-down/shoot-down, sophisticated fire-and-forget mode and an advanced ECCM tailored to the customer's operational requirements. I-Derby's light weight allows it to be adapted to various modern fighter aircraft, including light aircraft, such as the F-5, Mirage and F-16.

Rafael now presents the i-Derby ER, a multi-range (short, medium and long-range) BVR air-to-air and air defence missile, based on the legacy of the Derby family. The i-Derby ER is an active radar air-to-air missile providing aircraft with effective performance in short range up to long BVR intercepts and incorporates the innovative i-Derby RF seeker combined with a dramatic increase of kinematic performance (up to 100km). I-Derby ER is designed for simplified integration on leading fighters, including light aircraft, such as the F-5, Mirage-2000, F-16, LCA, JAS-39 Gripen and F/A-50.

Thales showcases

Defence Aerospace Capabilities at Aero India 2017

French aerospace and defence firm Thales, a supplier to the Indian armed forces since 1953, participated in the 11th edition of Aero India, where the company highlighted its goal of 'Make in India and export from India.' Thales showcased its "ability to meet demanding customer requirements through innovation, mastery of advanced technology and industrial prowess" by displaying a wide range of products, capabilities and developments, with particular focus on:

Thales in India: Thales is enthusiastic about the 'Make in India' policy of the Indian government and developing the industrial defence base of the country. At Aero India 2017, the Thales stand is highlighting the firm's relationship with India, its co-operation with local industry, and capabilities that can optimally serve the modernisation needs of the Indian armed forces. The capabilities on display included

rocket systems, underwater systems (sonars), surveillance and fire control radars, and surface warfare systems (missiles), among others.

Thales on Rafale: Thales is a member of the Rafale programme alongside Dassault Aviation, and provides a number of key systems aboard the fighter. Chief among these are the RBE2 AESA radar, Spectra electronic warfare system, optronics, communication navigation and identification system (CNI), a majority of the cockpit display systems, power generation systems and a logistics support component. At Aero India 2017, Thales displayed these key systems as well as the new generation multi-function targeting pod (Talios) and the airborne reconnaissance observation system (Areos).

New Innovations: Thales showcased some of its new and innovative products and equipment at Yelahanka, such as the Stratobus, an autonomous stratospheric



Thales' RBE2 AESA radar

airship that can be positioned at an altitude of 20 km over its theatre of operations and can perform a variety of missions including surveillance of borders or high-value sites, on land or at sea, security, environmental monitoring and telecommunications; SYNAPS, a new broadband tactical software-defined radio; and Spy'Ranger, a mini surveillance and reconnaissance Unmanned Aerial Vehicle (UAV).

The Thales STARStreak

Military commanders around the world are increasingly concerned about the serious threats being posed to their forces and civilians by low level combat aircraft, Unmanned Air Vehicles (UAVs) and attack helicopters. Thales' STARStreak High Velocity Missile (HVM) has been designed to defeat these threats quickly and effectively and provide a vital capability in force protection. STARStreak was designed to provide close air defence against conventional air threats such as fixed wing fighters and late unmasking helicopter targets. Since the system's introduction, Thales has addressed the needs of military users around the world, introducing major improvements to provide increased range beyond 7 km, increased coverage and altitude and improved guidance precision against small targets.

The STARStreak configuration remains based on the proven STARStreak principles of utilising high velocity to defeat targets with short unmasking times. The three-dart payload maximises lethality and accurate line of sight laser beam riding guidance enables engagement of the smallest signature targets, which are extremely difficult to defeat and lock onto by traditional fire and forget missiles.

The STARStreak missile is capable of being launched from lightweight land, sea and air platforms, from either automatic fire control systems such as the RAPIDRanger or the STARStreak Lightweight Multiple Launcher (LML). STARStreak can therefore be deployed quickly into operations and is easy to integrate into a force structure, besides being a versatile missile that is most effective when dealing with targets with short exposure times. As soon as a target is detected the operator presses the trigger and launches the missile – there is no waiting for lock on. The rocket motor system accelerates the missile to greater than Mach 3 in a fraction of a second, and the missile then releases the three laser-guided 'hittiles' towards the target. The laser guidance, which enables precision engagement of the smallest of targets, is immune to all known countermeasures, and the hittiles cannot be decoyed in flight.



Glenn Kelly, Vice President Rolls-Royce Customer Business India - Defence

VAYU: Which are RR's on-going defence programmes in India?

We have a long standing relationship with India's armed forces, which goes back to the time when our engine powered the first aircraft of the Indian Air Force. Since then, we have continuously built and strengthened this relationship, turning this to one that will extend far into the future. Today, more than 750 engines of 10 different types power various Indian military aircraft, from combat and strike aircraft (the Jaguar, powered by the Adour Mk811) to trainers (Hawk Advanced Jet Trainer, powered by Adour Mk871) to strategic airlift aircraft (C-130J Hercules, powered by AE2100) and even VVIP and Surveillance aircraft (ERJ145, powered by AE3007), our engines power the whole gamut of aircraft with the Indian military. Apart from this, we have a broad range of service support capabilities and have already established highly effective service partnerships in India.

VAYU: How do you support mission-readiness of the Indian Armed Forces?

We deliver the best possible support to today's aircraft fleets, including those that have been in service for many years. We are providing our most advanced service support right up to MissionCare on some fleets, drawing upon on our experience of best global civil and military practices. Our Field Service Representatives (FSR) work in close coordination with IAF personnel to maximise the availability of engines on wings and provide on-ground technical advice directly to our customers, thereby dramatically reducing maintenance and overhaul times.

VAYU: How are you positioned to support India's future indigenous programmes?

India has great indigenous capacity and capability to design, develop and manufacture leading-edge combat aircraft engines. This can be further accelerated by technology transfer and close collaboration



with international partners. We are uniquely placed to support India's future requirements as we are the only whole engine company to have transferred full capability outside our home market and have executed successful international combat engine programmes.

Further, our collaboration with HAL for over 60 years proves that we have the technology and capability to support the government's 'Make in India' initiative. We are proud to be a leading provider of power to the Indian Armed Forces, and our commitment to support India to achieve its goals of indigenisation and self-reliance remains as strong as ever.

VAYU: What are RR's future proposals for the Indian Military?

These include the powerplant for the Shinmaywa US-2i, which amphibious aircraft can play an important role in India's maritime security. The aircraft's four AE2100 engines are the same as those that power the C130J, and there is also a boundary layer control system using the Rolls-Royce CTS800 engine to assist with take-off and landing. We are also keenly anticipating conclusion of the AWACS contract negotiations, a vital capability which will be based on the Airbus A330 aircraft powered by Rolls-Royce Trent 700 engines. We are naturally also monitoring developments in the Advanced Medium Combat Aircraft programme. With our capability and successful track record in international combat programmes, I believe we are well placed to support the Indian desire for an indigenously designed and built future fighter programme.



VAYU Interview with MV Gowtama, Chairman/MD Bharat Electronics Limited



Akash SAM system

VAYU: On BEL's participation at Aero India 2017.

MVG: BEL showcased capabilities spanning every domain of its business – electronic warfare and avionics, C4I systems, communication systems, electro optics, radars, C4I solutions, energy Shelters and missile systems. BEL is also displaying its R&D capabilities by demonstrating some of its new products and technologies.

Electronic Warfare and airborne products on display included avionics for the Light Combat Aircraft (LCA), light weight ESM System for helicopters and LRUs for the Rustom Unmanned Aerial Vehicle (UAV).

Communication systems on display were the Software Defined Radio – Airborne and AFV versions (with live display), Radio On The Move (ROTM), Stars V Mk-III, CNR Mk-II, SATCOM terminal manpack and handheld, and advanced landing ground communication terminal, besides BEL's complete range of electro optics, which were demonstrated live.

BEL also showcased a host of new radars – ground penetrating radar, through wall radar, Schilka weapon system, weapon locating radar and mine field recording system. A C4I systems capability

demonstration was showcased in a live 'Customer Experience Centre' during the exhibition. Naval systems capability is being displayed through our advanced composite communication System.

The highlight of BEL's outdoor display is the Army version of the Akash Surface-to-Air Missile system, including the Troop level radar, troop control centre, and troop power supply vehicle.

VAYU: Please review BEL's recent deliveries to the Indian armed forces.

MVG: BEL has successfully executed many notable orders for the Indian armed forces. These include Akash SAM systems for the Indian Army and Air Force, 3D tactical radar for the Army, passive night vision devices, low level light weight radar for the Air Force, fire control systems, ship data network and new generation sonars for the Navy.

Significant orders received by BEL in the recent past include Integrated Air Command Control System (IACCS), weapon locating radar, hand held thermal imager with laser range finder, ground based mobile ELINT, integrated communication system, submarine sonars, electronic ammunition fuses, armoured engineer reconnaissance vehicle and EW system for IAC.

VAYU: Please give an update on the Akash and other BEL missile programmes.

MVG: Akash is a great success story and the best example of the Indigenous Design Development and Manufacturing (IDDM) drive. Almost 92 per cent of the total inputs are sourced from within India. Akash is the first indigenously developed air defence missile system in our country, realised by DRDO with support from BEL, BDL and private industry. Akash is a role model for Public-Private Partnership, as a massive, state-of-the-art missile system, which has been realised through professional project management spearheaded by BEL. While the radars, control centres, simulators, associated maintenance vehicles and the integrated software for the system are supplied by BEL, the missiles are from BDL, squadron control centre is from ECIL and the launchers are supplied by Tata Power SED and L&T. There are around 500 vendors in the programme, of which 108 are MSMEs.

With the Weapon System expertise gained in Akash, BEL is ready for futuristic programmes like the Quick Response Surface to Air Missile (QRSAM), Medium Range SAM (MRSAM), Long Range SAM, Akash-NG, etc and can execute them as 'turn-key' projects. BEL is already nominated as Lead System Integrator for the QR SAM programme, and the supply chain created for Akash will also benefit through these programmes.

Defsys Solutions: “Turning ‘Make in India’ into reality”



Defsys Solutions Pvt Ltd (Defsys) is a private Indian company, manufacturing complex and sophisticated defence electronic systems for Indian military customers one of the greatest success stories of the ‘Make in India’ initiative in the defence sector. The company has not only created a modern manufacturing infrastructure but also developed and achieved indigenous capabilities enabling it to deliver world class products to Indian Armed Forces.

Vayu spoke with **Mr. Dmitry Bernadiner, Executive Director of Defsys** (in photograph) on the success of his company and the changing business environment in the country.

VAYU : ‘Make in India’ is the new ‘mantra’. What are critical aspects in the creation of a favorable ecosystem in defence manufacturing?

DB: The Government of India has given very clear and refreshingly unambiguous positive indications. There is now a discernible shift in the mindset of MoD which is a laudable achievement. Enthused by this, an increasing number of Indian private sector companies are looking to enter

defence production and the local ecosystem is ripe for foreign partnerships.

In order to invigorate the manufacturing sector, the Government of India launched the ‘Make in India’ initiative in September 2014. The investment climate in the country since then has undergone a sea change which is evident in a 46 per cent growth in the defence FDI. The seriousness of the Government can also be gauged from the fact that almost 90 per cent of the new capital acquisition programmes sanctioned thereafter have been under the ‘Make in India’ categories, thus ensuring a high level of indigenous content. It is clear from these two facts that both, the foreign investors as well as the Government of India, are very confident and optimistic about the future of defence production in India.

VAYU : Which areas did you focus on the most in your journey towards self-reliance under ‘Make in India’ ?

DB: Human resources development was one aspect we concentrated the most and we continue to do so. As you are aware, we are located in high-tech zone of Gurugram, where Defsys competes on its talent with the most reputed best

global companies like Google, Microsoft, IBM, Samsung, Honda, Maruti, etc. Our skill development and training includes: basic and highly skilled competences, certification courses, job related technical trainings within the country, and specialised training in foreign countries. Second area of focus is development and optimisation of our production processes and PLM systems, which mainly include: warehouse automation, computerised assembly systems, automated test equipment in our production lines, quality assurance and configuration management.

VAYU : Which are your defining partnerships under the initiative of ‘Make in India’?

DB: We are in collaboration with leading global defence manufacturers for various high technology mission critical systems. Our partnership with Controp Precision Technologies Ltd (Controp) of Israel for manufacturing of Electro-Optical systems is one amongst the few very important partnerships of Defsys. Controp is a world renowned privately owned company that specialises in design, development and production of electro-optical and precision motion control systems for defence and homeland security applications. Controp product range include high performance gyro stabilised E/O payloads and sensors used for day and night surveillance onboard UAVs, small UAVs, VTOLs, helicopters, light aircraft, maritime boats, ships, hovercraft and all ground based applications including mobile applications. Controp also provides some of the most innovative solutions for surveillance and reconnaissance applications used in the world today and their products are operationally proven in many of the most challenging security and defence programmes worldwide. There are other foreign partnerships for manufacture of cutting edge technology electro-optical airborne systems for Indian defence forces, which we shall unveil at an appropriate time.

HAL Book 'Harlow to Hawk' released

At a special ceremony on 15 February, HAL Chairman T Suvarna Raju formally released the book *Harlow to Hawk* which encapsulates history of HAL's Aircraft Division at Bangalore from the very first aircraft type built there (Harlow PC-5A) in the early 1940s till the present, when Hindustan Aeronautics Limited have completed manufacture



of several tranches of the BAE Systems Hawk advanced jet trainers. Over the past eight decades, HAL's Aircraft Division have produced a range of primary trainers, fighter-bombers, light fighters, basic jet trainers and strike fighters, nearly 1500 of which have served with the Indian Air Force. HAL's Aircraft Division remains repository of the country's accumulated experience and expertise in manufacturing a veritable range of aircraft types

which makes it the logical centre for production of next generation combat aircraft.

The author, Pushpindar Singh, is well-known internationally for his research and writing on Indian aviation matters for over four decades, being regarded as virtual chronicler of India's aviation history, and founder editor of the *Vayu Aerospace & Defence Review*, now in its 43rd year of publication.

'Brahmand World Defence Update 2017' released



Defence Minister Manohar Parrikar released the sixth edition of *Brahmand World Defence Update 2017*

Defence Minister Manohar Parrikar released the sixth edition of global military yearbook *Brahmand World Defence Update 2017* at the BrahMos Aerospace pavilion on the inaugural day of Aero India 2017 in Bangalore.

Also present on the occasion were Minister of State for Defence Subhash Bhamre, who has penned the foreword for the yearbook, Chief Minister of Goa, Laxmikant Parsekar and Dr. Sudhir K Mishra, CEO & MD of BrahMos Aerospace.

An initiative of BrahMos Aerospace, *Brahmand World Defence Update 2017* "provides incisive, comprehensive and up-to-date facts, figures and data on the armed forces of 113 countries worldwide with the objective to give a comprehensive assessment of the present-day global military order." BrahMos Aerospace is a Joint Venture between DRDO of India and NPOM of Russia.

VAYU

First – as always !

Since Yelahanka 1993 - and so in 2017



The *Vayu Aerospace Review* has been intrinsically involved with every Air Show at AFS Yelahanka since the very first one that took place in 1993 (then known as *Avia India*). The maiden *Show Dailies* were produced and distributed by *Vayu*, which entity thereafter remained exclusive media partner for the biennial Air Shows from 1996 onwards (now officially *Aero India*).

Inevitably, competition came about in the years thereafter and, in 2017, there were no less than half a dozen 'Show Dailies' not counting 'Special Supplements' by a number of national newspapers ! Those attending the Air Show, both exhibitors and industrial professionals, as also aviators



both Defence and Civil and thereafter the thousands of visitors, were 'spoilt for choice' and could collect Show Dailies from the stands in various Halls.

However, *Vayu* was arguably the much sought after *Show Daily*, not only for its content and presentation, but was always the first at Yelahanka as copies fresh off

the press were rushed from downtown Bangalore, consolidated at *Vayu's* stand in Hall AB and then distributed throughout the length and breadth of the Show. The relentless pace began at the inaugural ceremony itself and continued till Day Three of the Show.

And so to Aero India 2019 !

Pulling G at Aero India 2017



Vayu's Angad Singh strapped into a Saab Gripen at Aero India 2017, for a 'hands on' experience of a lifetime!

“Arm seat,” says a voice in my ear. This is the point of no return, as I head to Yelahanka’s 3-kilometre runway in the rear seat of a Saab Gripen D (tail number 830). I depress the catch that secures the ejection seat arming mechanism and push the switch from the ‘safe’ position to ‘armed.’ This simple action, more than anything in the past ninety-odd minutes of briefings drives home the reality of what is about to happen.

“Seat armed,” I reply, trying my darndest to sound like a fighter pilot. I am not certain I succeeded.

Waves of heat radiate off the asphalt runway, baked by the midday sun. Holding short to the north side of the runway as we line up are two Tejas LCA trainers, readying to depart after us. Behind us and lined up to the right of the centreline is another two-seat Gripen D. We wait for what seems like an

eternity, made worse by the nerves that seem to amplify the discomfort of my g-suit. In reality it was probably only a few seconds from line up to ATC clearance for take-off. My pilot, Saab’s Wing Commander Flying Hans Einerth, doesn’t waste time or words – he releases the brakes as soon as ATC gives him the word.

This is not so bad, I think to myself. My anxiety begins to subside as we gather speed in much the same way as an airliner.

Then suddenly I’m slammed back into my seat by a force that can only be described as ‘a kick in the pants.’ *Oh. That’ll be the afterburner then.* Having experienced a catapult launch from the deck of a US Navy aircraft carrier in the recent past (see *Vayu VII/2015*), I have to admit the take-off was only the *second* most visceral acceleration I have ever felt, but the deceptive nature of the afterburner engagement versus the

complete and utter sensory overload of a ‘cat shot’ makes this a much more enjoyable experience!

We are airborne in moments, pulling smoothly upward along the runway before banking into a sharp right turn heading south and away from Yelahanka. For a few seconds Aero India 2017 is visible in its entirety from on high – the crowds, hangars, outdoor displays and dozens of parked aircraft – until we level out and head out to our designated ‘play area’ far from the base.

The Gripen Experience

Shortly after take-off, Gripen 837, piloted by Swedish Air Force Captain Fredrik Barske with *Times Now* Senior Editor Srinjoy Chowdhury in the back seat formed up on our wing. We climbed together as Fredrik flew his aircraft around ours, giving me a series of incredible views of the Gripen



Gripen 830 seen taking off for a demonstration flight on a different day at Aero India

in flight. When we reached our play area, Hans and Fredrik carried out a spectacular display of precision flying, conducting aerobatics in formation. My g-suit caught me by surprise the first time it inflated – I was not expecting anything near as rapid, and the pressure was quite uncomfortable! Within a few minutes, however, I learned to anticipate which manoeuvres would lead to suit inflation and to his credit, Hans seemed to know exactly what I was, and was not, ready for. The ‘sick bag’ that had thoughtfully been placed in a pocket on the right leg of my flight suit remained unused!

After the formation aerobatics, the two aircraft split up to head to separate sections of airspace near Yelahanka, specially designated for demonstration flights during Aero India 2017. There, Hans showcased some of the ‘head down’ capabilities of the Gripen, cycling through various displays on the three multifunction displays and demonstrating the radar in air-to-air and-to-ground modes. Albeit without any first-hand points of comparison, the air-to-air radar range was singularly impressive. In look-up mode we were able to detect and track airliners flying off India’s east coast – a range comfortably in excess of 300 km! Hans showed me how to use the throttle grip to slew the cursor on the radar display to select a target and engage it with a mock BVRAAM. He pointed out that the PS-

05 Mk3 radar (current standard fit on all Swedish Air Force Gripens) is already able to take advantage of the MBDA Meteor’s formidable range. Sweden’s fighters were upgraded last year to incorporate the latest MS20 operating software standard, making the Gripen the first combat platform to operationalise the Meteor BVRAAM (*see Vayu III/2016*).

Hans then switched the radar to Ground Moving Target Indicator (GMTI) air-to-surface mode, which immediately displayed the heavy traffic on National Highway 44, the primary north-south highway in the state of Karnataka. Again, Hans then guided me through a mock air-to-ground strike with a simulated GPS-guided bomb. Upon selecting a target, a green circle was displayed on the map, enclosing both the target and the launch aircraft (us). The circle denoted the area in space from which the bomb could be released and still relied upon to hit the target, and was calculated based on the launch platform’s speed and altitude. I clicked the trigger saw a JDAM disappear from the weapon status screen on the left hand MFD.

After the sensor and weapons demonstration, Hans asked if I was up for some aerobatics. I answered in the affirmative, and he immediately put the aircraft through some breathtaking (if utterly gut wrenching) moves. The

formation aerobatics from earlier in the flight were obviously an order of magnitude gentler! Civilians generally tend to be slightly in awe of fighter pilots, but this took my respect for the men and women in the profession to new heights (pun intended). I was not at any point unable to handle the aerobatics, but essentially was no more than a passenger in the back seat without any real ‘responsibilities.’ The idea that combat pilots are required to not only endure these incredible forces in three dimensions, but also simultaneously operate sensors and weapons, is mind-boggling.

Just as I was coming to grips with the kind of abilities the good gentleman in the seat in front of me possessed, he returned us to level flight and asked “Do you want to take the stick now?”

I didn’t bother trying to sound like a fighter pilot as I let out a shaky “Yes.”

Stick Time

Hans first put the aircraft into autopilot and showed me how to steer using the rudder pedals. The Gripen autopilot only disconnects if it detects manual input to the stick or throttle. Using the pedals allows a pilot to steer the aircraft in the horizontal plane (i.e. heading only) while maintaining altitude. This is apparently a useful feature for long ferry flights, allowing minor course changes while still flying ‘hands off.’

After I had demonstrated that I could adequately follow Hans' instructions from the front seat, he called "your controls" and I put my hands around the stick and throttle for the first time.

Initially, I simply followed his directions to roll and turn, easing or increasing control inputs as instructed. I was quite comfortable in the horizontal plane, and while constantly communicating my intentions to Hans, pulled progressively tighter turns and faster rolls. The g-suit that had initially been uncomfortable felt more and more natural, and the pressure on my legs barely registered as I manoeuvred the aircraft.

At one point Hans called "my controls" and pulled the aircraft around, explaining that I had been about to exit our 'play area.' He gained some height and asked if I felt up to some loops. "I'll show you first," he said, and without warning pushed the throttle forward and snapped the nose up. A gasp was all I managed before my arms were pinned against my body. I tried to place my hands on my thighs but my body was in no position to respond to my intentions! *How in hell am I supposed to do this if my hands don't even work*, I thought to myself in a mild panic.

Once we returned to level flight, Hans pulled the throttle back and called "your controls." I took a breath, gingerly nudged the throttle forward and pulled back on the

stick. It turned out that having something to grip – the stick and throttle – helped keep one's arms in place. My right forearm was more or less stuck to my thigh, but that didn't matter much because my hand and wrist were doing most of the heavy lifting. On the left, my arm was certainly being pushed down and away from the throttle, but again, simply hanging on to the handle was enough to keep everything where it was supposed to be. The loop itself was exhilarating, although the incredible view did momentarily distract me, prompting Hans to remind me to "keep pulling!" Once I returned to level flight again, I did a few more turns and rolls before asking Hans if I could try an *Immelmann* (roll off the top). "Sure," came the reply, and I duly pushed the throttle forward, held the stick back for a few seconds and then snapped the aircraft into a roll to the left once we were inverted. It wouldn't have won any awards, but I ended up more or less level at the top of the loop, with the nose pointing slightly up and a little more to the left than a seasoned pilot might have managed.

That's when I made my first 'mistake' – I simply pushed the stick forward to regain the horizon. Negative G is a thoroughly unnatural, unsettling feeling, and that one attempted correction was enough to ensure that my stick did not move forward for the rest of the flight!

Having enjoyed looping in the upward direction, I was considering requesting Hans if I could try a Split-S, but then he came on the radio to ask if we should re-join the other Gripen and head back to Yelahanka. I would have been happy to stay up in the air all afternoon, but I understood it was more a statement of intent than a question!

In the other Gripen, Fredrik and Srinjoy formed up on our left as I flew at 6,000 feet to a waypoint called 'Mike' just short of Yelahanka. There, Hans called "my controls" for the final time and brought our formation thundering over the runway for a sharp right hand break above the airfield, before flying a curved approach down to the threshold. Since a lot of aircraft were starting up and taxiing for the afternoon show display block, we coasted to the eastern end of the runway instead of carrying out the Gripen's trademark short landing and vacating the runway at the flightline itself.

We turned off the runway near the ATC tower and joined a queue of aircraft on the apron, bringing to an end one of the most exhilarating hours of my life. With the aircraft idling gently on the tarmac, Hans gave his last instruction of the day: "Disarm seat."

I depressed the catch and pulled the switch up. "Seat disarmed," I said, through a wide grin. I didn't care whether I sounded like a fighter pilot or not.



Angad Singh and Hans Einerth heading to their aircraft...



... airborne over Bangalore...



... and back on terra firma!



But The Ground Realities....!

Misogyny shows itself in many ways. In public places, it shows in the way women are denied even the most basic facilities like toilets.

The Indian Ministry of Defence has just concluded the 11th edition of the biennial aerospace show Aero India in Bengaluru. Government officials have frequently used superlatives over the years to describe Aero India, which indeed is India's biggest defence and aerospace event, attracting the who's who of the global defence industry, including presidents and CEOs.

In 2017, over 250 foreign and some 270 Indian companies exhibited in Aero India, which was jointly inaugurated by ministers of defence and civil aviation. As is the trend worldwide, even in the defence industry, the number of women in the workforce has increased over the years. So too at Aero India 2017, there appeared to be as many women at Air Force Station Yelahanka, which has been the permanent location of the show for the last two decades, as there were men. Even at extremely conservative estimates, there were at least 2,500-3,000 women at the show every day.

Yet, it didn't occur to the organisers that these women would need access to clean toilets. There were just under a dozen toilets for women at the show, each afflicted with its own unique problem. Some had no water,

toilet paper rolls or soaps; some had too much water on the floor, forcing the users to roll up their trousers or hitch up their sarees before entering, while some demanded a cross-country trek over unpaved ground, difficult to negotiate in heels.

One thing united them all: the absolute lack of hygiene! For a show of this level, the organisers had hired local cleaning women to attend to the toilets, instead of professional housekeepers.

This makes a mockery of everything we claim and aspire for at so many levels. Let's take each level one by one. We claim to be a leading power in Asia; our prime minister asserts that our time has come and the world must take notice; and he is exhorting global industry to come and 'Make in India'. Yet, at this biggest showcase event, the infrastructure is so abysmal that foreign participants make sympathetic noises while putting India back in the third or the fourth world.

"Aero India is basically a national show for us unlike the Dubai or the Singapore Air Shows, which are more regional in nature," an exhibitor told this writer, explaining why they neither expect nor get delegations from other Asian countries to Aero India. To look at the latest trends in defence and aerospace technology, customers from those countries prefer to visit Dubai or Singapore.

"To attract international customers, you will really need to work on the infrastructure," she said. After all, it stands to reason that if you cannot get something as basic as the toilets right, how can you be trusted with high technology?

But we do get a lot of technology right. ISRO has just launched 104 satellites in a single flight. So what is this disdain towards providing toilets for women, if not a veiled attempt at keeping them out of public places? And if this is the state at a premier show crawling with so-called VIPs, one can only shudder to think of the state of toilets in lesser places.

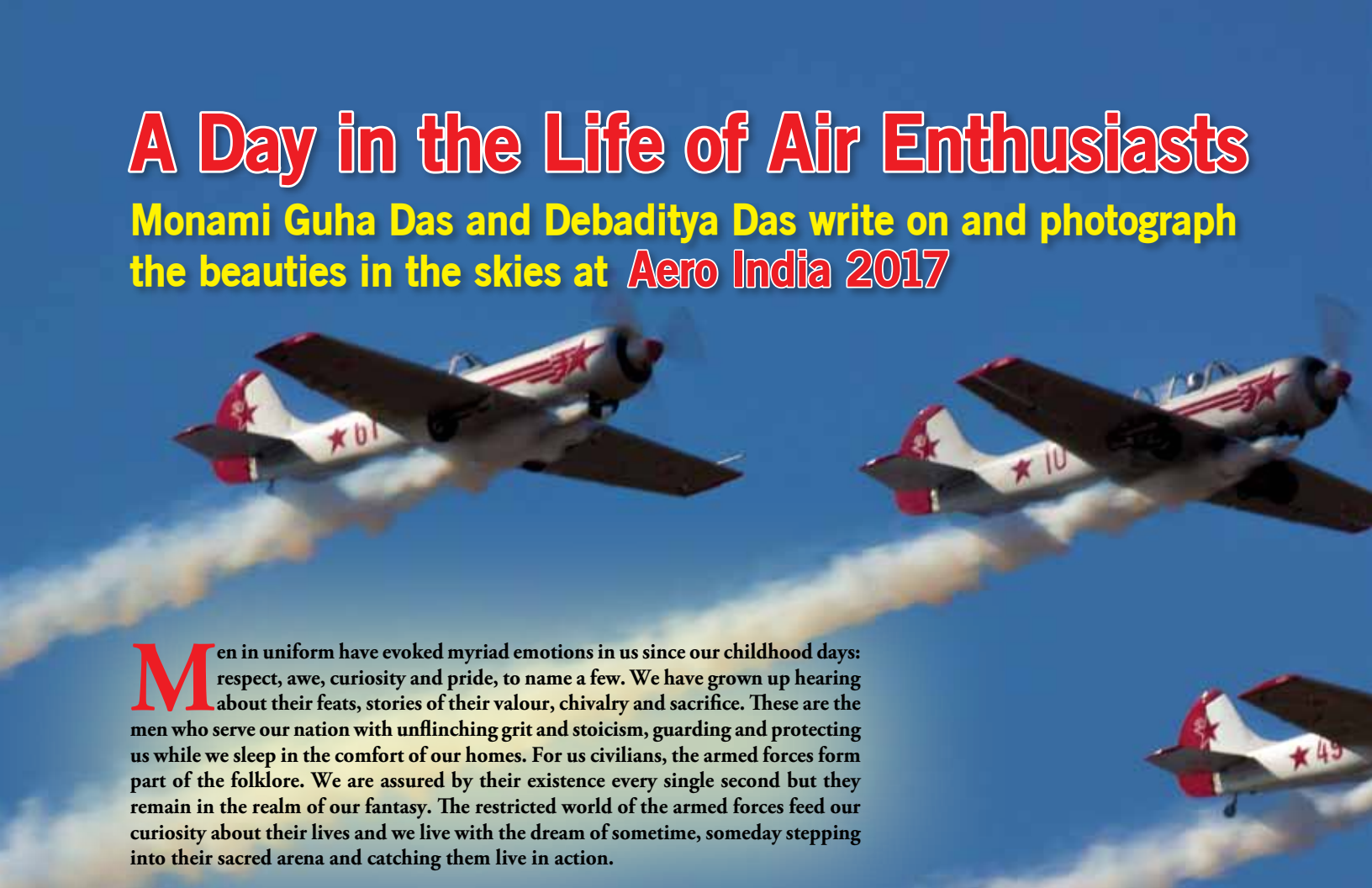
At the second level, what does it say about the government's *Swachh Bharat Mission* (SBM)? Clearly, if usable toilets cannot be provided for women at even high profile events, the fate of the millions of these being built under SBM is not difficult to imagine. In most urban areas, the problem is not of a toilet structure, but its condition.

Finally, the government is committed to giving greater opportunities to women in the armed forces. But by not providing them civilised facilities at their places of work, isn't the government telling them that we may have opened our doors, but our minds remain absolutely shut?!

*Courtesy: Ghazala Wahab,
(Executive Editor, FORCE magazine)*

A Day in the Life of Air Enthusiasts

Monami Guha Das and Debaditya Das write on and photograph the beauties in the skies at **Aero India 2017**



Men in uniform have evoked myriad emotions in us since our childhood days: respect, awe, curiosity and pride, to name a few. We have grown up hearing about their feats, stories of their valour, chivalry and sacrifice. These are the men who serve our nation with unflinching grit and stoicism, guarding and protecting us while we sleep in the comfort of our homes. For us civilians, the armed forces form part of the folklore. We are assured by their existence every single second but they remain in the realm of our fantasy. The restricted world of the armed forces feed our curiosity about their lives and we live with the dream of sometime, someday stepping into their sacred arena and catching them live in action.



Aero India thus is an event that once in two years throws open the doors of a restricted military zone to the common man. Military and civil aircraft are unveiled and displayed, fighter jets do flypasts while aerobatic teams from different countries perform with their aircraft, leaving spectators mesmerised.

We made our maiden visit to Air Force Station Yelahanka on the very last day of the exhibition, after days of anticipation. Expecting a huge turnout on the final day, which happened to be a Saturday, we started early. We reached in time expecting to catch the morning display, but that was not to be! Absence of proper markings and signboards leading to the entry gates meant that we missed the gate for parking and pass collection. It took us three hours to turn back! With sinking hearts we saw many jets fly over us, as we remained trapped inside our car. Having driven for more than 5 hours, we became frustrated and decided to return home. But by a stroke of luck we found a private parking space, where we parked, grabbed a quick lunch and walked some 2 kilometres to reach the venue in time for the afternoon display.



Yakovlev Aerobatic Team from the UK performing at Aero India 2017



Smoke art in the sky created by the Yakovlev team

And what a performance that was! The pilots lit up the sky with their gorgeous displays, which lifted our dampened spirits which was totally worth the pain of wading through traffic for hours! We found our very own *desi* HAL-manufactured Tejas, zooming past in all its glory. A proud moment for us all!

The Yakovlev Aerobatic Team from the UK performed brilliant stunts leaving people gaping in awe. And then it was time for our own Indian Air Force *Surya Kiran* team to take control of the skies with their orange and white beauties, the Hawks. Cutting through the air at lightning speed, the planes disappeared in the blink of an eye. We put away the cameras as it was futile to even attempt capturing them on lens. 'Brilliance' is a small word for their performance. Sarangs the helicopter aerobatic team of the Indian Air Force was similarly impressive with their four HAL-manufactured Dhruv helicopters.

Unfortunately we were short on time and could not visit the exhibition, and so missed out on a rare opportunity of interacting with some of them who stole our hearts with their performance—and a

miss that will be regretted for a long time to come.

But the display was an experience of a lifetime and will be cherished. Seeing our pilots create magic in the sky, our own manufactured aircraft soaring high,

was a moment of immense pride and left us choked with emotion. These were moments that will always remain etched in our memories.

For us, the countdown for Aero India 2019 has begun!



HAL's 'Hawk-i' demonstrator gave a superb performance

The Historical Perspective

The Air at Yelahanka



Various aircraft types seen at AFS Yelahanka, including the Mi-8, Chetak and Antonov An-32

AFS Yelahanka, where the biennial Aero India international air shows have been held since the 1990s, is nearing its Platinum Jubilee since its establishment in the 1940s. Joseph Antony recalls its chequered history.

Air Force Station Yelahanka (AFSY) is located on the NH-7 from Bangalore to Bellary/Hyderabad. The airfield has had an association of over 75 years with military Aviation in India since its inception in the 1940s to the present time. It is the alma mater through whose portals most transport and helicopter pilots of the IAF have graduated over the past fifty years. Having first visited the airfield almost 52 years ago (when my father was an instructor pilot based there) and thereafter during various Aero India shows, I thought it fit to compile some of its aviation related history.

During World War II, the Italian Tenth Army under the command of Marshal Rodolfo Graziani had made inroads from Libya into Egypt in September 1940, only to be beaten back by a much smaller Allied force under General Sir Archibald Wavell, British Commander-in-Chief, Middle Eastern forces in February 1941. Over 130,000 Italians were taken Prisoners of War (POWs) after five Italian Divisions were mauled in two days of fighting. Later, more Italians became POWs as their forces were comprehensively defeated in North



File picture of de Havilland Mosquito



File picture of Spitfire Mk.VIII

and East Africa. A large number of these POWs were sent to India for internment in 29 camps forming 6 Groups between the years 1941 to 1946. Of these, Group I with 8 camps were in Bangalore and were located at Jakkur, Hebbal and Jalahalli. The remaining Groups were located at Bhopal, Ramgarh, Clement Town (Dehra Dun) and Yol (near Dharamshala).

The POWs at Bangalore (numbering over 20,000) were put on the job of constructing three airfields, at Jalahalli (present AF Station but the airfield is no longer in use), Jakkur (presently in limited civilian use) and Yelahanka. The POWs walked from either Jalahalli or Jakkur to Yelahanka in the mornings and returned to their camps in the evenings.

The airfield was initially designated as RAF Station Yelahanka when it commenced operations in July 1942. A search on the Internet revealed that a number of Royal Air Force (RAF) and later Indian Air Force/ Royal Indian Air Force (RIAF) squadrons were either based for short terms at the airfield or used its facilities, which was a beehive of flying activity. These included :

- No. 1302 (Meteorological) Flight, RAF, from July 1943 till it was disbanded in June 1946 which operated the Bristol Blenheim, Vickers Wellington and Hawker Hurricane at different times.
- No. 684 Squadron RAF, a photo-reconnaissance squadron from 1943-1946 had a detachment here, operating the de Havilland Mosquito and later converted to the Bristol Beaufighter.
- No. 60 Squadron, RAF between May to September 1943 with the Bristol Blenheim and later the Hawker Hurricane IIC Fighter.
- No. 30 Squadron, RAF, between April to September 1944 flying the Hawker Hurricane IIC and the P-47 Republic Thunderbolt.
- No. 1672 (Mosquito) Conversion Unit between February-June 1944 and again from October 1944 to August 1945.
- No. 211 Squadron, RAF around June-July 1945 operating the Mosquito aircraft.

Author's Note: There were some fourteen Mosquito aircraft related incidents during the period October 1944 to July 1945 which testifies to the high levels of intense/accelerated



Nur Khan as Sqn Ldr with the RIAF

training imparted on this base. The causes were overshoot landing, undercarriage(ulc) collapse on landing, swing on landing and ulc collapse (four instances), swing on take-off and ulc collapse, engine cut-out on overshoot followed by stall, bounced on landing and ulc collapse, overshoot on landing and hit vehicle, collision after bird hit, etc.

- No. 4 Squadron, Royal Indian Air Force (Oorials), between December 1943 and February 1944 and again from April 1945 to March 1946, flying the Spitfire Mk VIII. One of its daredevil pilots was one Flt Lt Malik Nur Khan, a Pathan. He had earlier perfected the technique of making landing approaches in a Hurricane aircraft while inverted, lowering the undercarriage (which would open upwards), carrying out a last minute roll to normal level flight, before touching down. Twenty years later as Air Marshal, he was Chief of the Pakistan AF during the 1965 Indo-Pak War. He later became Chairman of Pakistan International Airlines and Governor of Punjab after retirement. As Chairman, he overpowered a hijacker on the PIA airliner at Karachi but was hit by a bullet in the process. Incidentally, No. 4 Squadron RIAF was assigned to Japan at end of the War and pilots flew their aircraft from this base to Cochin where they were loaded on to an aircraft carrier for transportation to Japan.

- No 84 Squadron RAF, between October 1944 to April 1945, Vultee Vengeance and Mosquito.

- One RAF Sergeant Pilot from Palestine, Ezer Weizman, underwent flying training here for six months in 1944-45. Later he went on to become the Commander of the Israeli Air Force, subsequently the Defence Minister and finally became the seventh President of Israel. His wife and the wife of the legendary General Moshe Dayan were sisters. As president he returned to AFS Yelahanka in 1997 and planted a tree during his visit.



Ezer Weizman in his early Air Force days

Corporal Arthur Goodinson, an RAF Flight Mechanic and Warrant Officer Eric Watts a RAF Volunteer Reserve pilot penned their experiences and the following extracts from their diaries/web-pages pertain to the eventful period of two months in Yelahanka during June-July 1945 when with No. 211 Squadron, RAF.

There used to be a Camp cinema in the base (the ruins of which one could see until the late sixties) which screened films like 'They Live Dangerously', 'Sqn Leader X', 'Design For Scandal', 'Seven Miles from Alcatraz', 'Fallen Sparrows', 'The Cross of Lorraine', 'Heaven Can Wait', 'Nick Carter Master Detective', etc. Draught beer was available in the canteen and playing or watching soccer (usually between different squadrons or formations on the base), was a favourite pastime. Otherwise, like most other RAF airfields in WW II, the facilities were primitive and most personnel did not even have permanent toilets, having to use dugouts. The sound of jackals in chorus during the night was common occurrence.

RAF technicians service a P-47 Thunderbolt fighter bomber, the type that Ezer Weizman flew at Yelahanka



On 29 June 1945, Warrant Officer Lowcock (Jeff) & Flight Sgt Wilkes while flying a Mosquito aircraft (HR554) employing evasive tactic manoeuvres (practice) against a Spitfire lost control and dived vertically into a village but killing about 40 local villagers (and cattle) who were either attending a weekly fair or a wedding (at Kogilu village, S-E of AFSY). Only three days later on 2 July 1945, there was a formation dive bombing display and another Mosquito (RF779) failed to pull out, killing Warrant Officer Webster & Flight Sergeant Hopes (Corky & Jackie). The loss of Webster and Hopes, just three days after that of Lowcock and Wilkes, was deeply felt by the men of 211 Squadron—perhaps the more so during a non-operational period. The funerals

were held in Bangalore on 30 June and 3 July 1945 respectively. However, the funerals did not stop the game of soccer later on each day!

The nearest escape to unwind was Bangalore city, which was reached after negotiating the narrow road piled with bullock carts and crossing at-least four manned railway crossings. The Standard Brick & Tile Co. Pvt. Ltd. at Yelahanka (1930) and the Parsee Tower of Silence at Hebbal (1940), major landmarks enroute to the city. The Tower of Silence exists even today, however only the Chimney of the tile factory located amidst real estate development, remains.

After end of the War, the airfield had No. 2 (Indian) Group Communication

Flt as its last flying element when it was transferred to the Royal Indian Air Force (RIAF) in June 1947. The airfield fell into disuse after World War II and Indian Independence in 1947 when the open spaces became grazing areas for cattle from the neighbouring villages. Thereafter, it was used occasionally for holding Motor racing events some times in a year (like Sholavaram and Sullur, other World War II airfields near Madras and Coimbatore respectively), or sometimes by pilots of the nearby Government Flying Training School in Jakkur who could not resist stealing touch and go landings of their Tiger Moth aircraft on the long and wide runway of this deserted airfield.



Indian Air Force C-47 Dakotas

Resurrection

The Sino-Indian border war in 1962 contributed to re-kindling life at the airfield in its military role in order to cater to the expanding needs of pilots for the IAF's transport squadrons. The Indian Air Force established No. 2 TTW (Transport Training Wing) at the re-commissioned airfield in August 1963 under the command of a World War II veteran and Dakota king-pin, Gp Capt PL Dhawan, VrC (Dakota supply and night bombing operations under enemy fire during the J&K Operations in 1948) and Bar to VrC (Dakota supply operations in Daulat Beg Oldi area in 1962). As a young officer, Flt. Lt. Dhawan would carry out stall turns on the Dakota transport aircraft.

In 1964, C-47 Dakotas carried out numerous supply dropping and casualty evacuation sorties in the disaster-hit areas around Dhanushkodi and Rameshwaram. A Dakota of this Wing participated in the scattering the ashes of the late Prime Minister Jawaharlal Nehru, as per his last will. Aircraft from this base participated in numerous missions of mercy over the years.

During the Indo-Pak war in September 1965, around ten C-47 Dakotas of this Wing were hastily converted for operational tasks and played a supply role in the war. Gp Capt John Francis Lazaro, VSM (later Air Vice Marshal), the then Station Commander, around thirty officers (including the author's father then Sqn Ldr VJ Antony) and over a hundred airmen were part of the task force. Supply sorties were carried out for movement of troops and transportation of arms, ammunition and spares in support of the war effort. One of these aircraft on a supply mission carrying naval munitions from the Naval Air Station at Willingdon Island (Cochin) to Jamnagar was lost over the Baba Budan range area near Mangalore on 7 September 1965. Sqn Ldr Asit Kumar Ghosh and all members of the Dakota C-47 perished in the accident. In fact, the wreckage of the aircraft was located only after the cessation of hostilities and search operations were mounted by the remaining aircraft from this Wing after return to home base.

In January 1968 the previously existing No. 1 TTW in Begumpet was also moved to AFS Yelahanka and merged with No. 2 TTW to form a single TTW and renamed as AF Station Yelahanka.

C-47 Dakotas were still the backbone of the IAF Transport fleet during the 1971 operations and TTW contributed



IAF Mi-8 lifts off at AFS Yelahanka

once again to the war effort operations in airlifting supplies, troop movement and refugee evacuation which commenced with airlift of refugees from East Pakistan to Agartala much before the actual war commenced. They also formed a major part of the airborne fleet that carried out the famous Tangail airdrop in Bangladesh. In addition maritime reconnaissance duties were carried out over the East and West Coasts of India to detect enemy ship movements to and from East Pakistan. Flt Lt Arunesh Prasad and crew flying Dakota (J975) from this Wing located one such ship *MV Toronto* in the Arabian Sea and guided the destroyer *INS Godavari*, which shepherded the ship into Cochin harbour.

During the Sri Lankan Civil War, on 4 June 1987, Operation *Poomalai* ('Flower Garland'), also known as Eagle Mission 4, was undertaken by the Indian Air Force to

air-drop supplies over the besieged town of Jaffna in Sri Lanka. Five An-32s from Agra staged through Yelahanka loaded with relief supplies, the An-32s escorted by Mirage 2000s.

No.112 Helicopter Unit '*Throughbreds*' is a Mi-8 Conversion and Training Unit based at Yelahanka for many years which carries out the operational conversion of pilots, flight engineers and flight gunners. It also operates a small sub-flight of these helicopters for VIP tasks in the region. No.151 Helicopter Unit (*Sarang Display Team*), was set up in 2005 operating the HAL Advanced Light Helicopter Dhruv and was based here for some years before moving to Sullur AFS.

The Station was renamed the *Air Lift Forces Training Establishment* in the 1990s but the name reverted back to AFS Yelahanka after a short time.



The Sarang Helicopter Display team perform over Yelahanka

HAL-Dornier 228 lifts off at AFS Yelahanka. The Indian Air Force employs this light transport aircraft for multi-engine conversion training ...



... before pilots move on to the Antonov An-32 or the Avro HS-748



Nostalgia : IAF C-47 Dakota as gate guardian at the entrance of AFS Yelahanka



During the Andhra Pradesh floods in August 2000, 127 adults and 15 infants who were marooned atop a building were winched to safety by the crew on to a Mi-8 helicopter piloted by Sqn Ldr GS Padda (awarded VSM) from this base. The rescue was completed in eight shuttles without refuelling.

Hindustan Aeronautics Ltd (HAL) has also had a long association of over fifty years with AFS Yelahanka since flying operations re-commenced in the nineteen sixties. The HAL detachment at AFSY used to initially support the repair and maintenance of C-47 Dakota aircraft which was later followed by similar support for the HAL built HS-748 and Dornier 228 and An-32 aircraft. HAL has been the major participant at the biennial Aero India Airshows since 1996.

The present Air Officer Commanding AFSY is Air Cmde Tejbir Singh, VM and the main role of the airbase remains multi-engine conversion training of pilots to fly transport aircraft like the An-32, HS-748 and Do228 or helicopter pilots to fly the Mi-8. There are Flight Simulators for imparting training on the An-32 and Dornier 228. It also conducts type-conversion of navigators on the Antonov An-32. There are three aircraft types as gate guardians at AFSY: the Iskra jet trainer (W-1759), a Mi-8 helicopter (Z-1372) and the C-47 Dakota (BJ-1045) ex-USAAF and later with the IAF which has been recently relocated from AFS Belgaum.

Thus, apart from hosting the Aero India Shows, Yelahanka has contributed in both war and peace time relief operations over several decades, with exceptions being the Kashmir Operations of 1948 and the Goa Operations in 1961, when the base was not active. In addition, it has attained two unique achievements as an Indian airbase remains having handled the most diverse types of military aircraft platforms (considering WW II and the various Aero India airshows) and also of having the most number of cumulative flying hours recorded by the fleet based at any IAF airbase over the past half century.

Joseph Antony
(Deputy General Manager –
Marketing, HAL)

Nipped in the Bud!

India's Aviation Industry



HAL HF-24 Maruts at Bangalore

Dr Sanjay Badri Maharaj explores India's aviation industry with special focus on how a clear and systematic development programme for combat aircraft and trainers was destroyed before it could bear fruit. This has had serious consequences for the industry, which was reduced to becoming a serf for licence-production, with consequential loss of design capability.

India's defence industry is perhaps one of the most unfairly maligned extant. From Defence Public Sector Undertakings (DPSUs) to the Ordnance Factories Board (OFB) and Defence Research and Development Organisation (DRDO), there is a litany of complaints, insinuations and insults – some undoubtedly justified, but

others incited either by malafide intentions or out of pure ignorance.

As the country has embarked upon the 'Make in India' initiative in defence production, which is still winding its way towards delivering usable products, it is worth examining the period in India's defence industry between 1948 and 1980

in which much progress was made, but such strong foundation betrayed by a fatal combination of military exigencies, fiscal constraints but mostly political and military myopia.

It should be noted that 'indigenisation' is a much used and abused word. It is not entirely clear whether the Indian Navy has

any higher level of indigenisation by value than either the Indian Army or the Indian Air Force, as in the latter cases, licence-produced equipment has increasingly high indigenous content by value and by component (the Su-30MKI for example is 51 per cent indigenous by value and 73 per cent indigenous by component). What the Navy has however consistently done, is to support indigenous ship designs and improve the product accordingly. This was not the case with the other two services.

Aviation – Opportunity Missed

In 1948, India tasked its nascent aircraft industry – in the form of Hindustan Aircraft Limited (HAL) – to begin work on a basic piston-engine trainer to supplement and then supplant the Tiger Moths and Percival Prentice aircraft in service. The result was

trainer (HT-10), which would have replaced the T-6 Harvard in the training roles.

However, even at this early stage, short-sightedness combined with budgetary constraints conspired to stymie these plans. Neither of the aircraft progressed beyond the mock-up stage, and a valuable learning process was ended prematurely. HAL then initiated some work on civil aircraft with the HUL-26 Pushpak trainer becoming a staple of Indian civil flying clubs following its first flight in 1958. An enlarged version, the HAOP-27 Krishak, formed the basis of Army Air Observation flights until being replaced by Cheetah helicopters from the mid-1970s.

The HAL HA-31 Basant agricultural aircraft had a limited production run (31 aircraft) but proved successful in service. For transport duties, the Avro (HS.)748

HAL to branch into combat aircraft manufacturing at an early stage.

The first jet combat aircraft to be manufactured in India was the de Havilland Vampire in its FB.52 and T.55 variants. Under a licence granted in 1950, which included the Goblin 2 turbojet, India was able to replace its piston-engine fighters with jet aircraft in systematic and low-risk manner while simultaneously building its aviation industry.

Although India had to opt for purchase of Hawker Hunters (1954) Dassault Ouragans (1957) and Mysteres (1956) to bolster its fighter strength, the intent to create an indigenous fighter manufacturing base was pursued with determination. The years from 1956 to 1959 were critical for the Indian aviation industry. In 1959, HAL received permission to proceed with the



The Ajeet was a domestic development of the Folland Gnat, but embodied only modest improvements over the original

the Hindustan HT-2, which served with distinction from 1953 until its retirement in 1980. Over 170 were built, with a dozen being used to form the Ghanaian Air Force in 1959. By starting with a basic trainer, HAL had embarked upon its learning process in sensible manner and intended to develop this core competency into an advanced trainer (the HT-11) and an armed

trainer entered production in the 1960s and became progressively 'Indianised' with numerous examples still soldiering on in IAF and BSF service.

Till this point, HAL's work had been unpretentious but essential. Building the foundation for a viable industry necessitates starting from the simplest of aircraft. However, the needs of the IAF required

development of a basic jet trainer to replace the Vampire T.55s and the T-6 Harvard. As one of HAL's unqualified successes, the resultant aircraft – the HJT-16 Kiran – first flew in 1964 and in a modified version continues in service to this day. To be sure, the Kiran did have a somewhat protracted development period before entering service and its Mk.2 variant was late in coming.



India has licence-built and upgraded aircraft such as the SEPECAT Jaguar, but has not developed and fielded a new fighter type since the Marut (photo: Angad Singh)

Nevertheless, the Kiran has been a success. It entered series production and serves the IAF competently.

Simultaneously, HAL had laid the foundations for further fighter production with a licence agreement for the Folland Gnat being signed in 1956 while Dr Kurt Tank was engaged to begin work on designing the HF-24 Marut.

The Gnat, despite its British origins, became an 'Indian fighter'. At its peak, HAL could build four Gnats per month

Kiran trainer. It was hoped that HAL's experience with the Gnat would have led to the development of a more advanced version but here, as was the case with the Marut, inherent limitations with the Orpheus B.OR.2 Mk.701 engine rated at 4,520 lbf (20.11 kN), rendered such efforts futile.

The HAL Ajeet, while intended to improve on the Gnat's performance, was only marginally successful as by 1975, the desired performance could only be achieved with some more powerful engine and more

coupled with the loss of a prototype ended this effort and the IAF remained without an AJT until 2008, when the first BAE Hawks entered service.

It was India's short-sightedness in engine development that wrecked not only the prospects for a high-performance Gnat but also the potentially superb HF-24 Marut. The HF-24 was designed around the Orpheus B.Or.12 engine rated at 6,810 lbf (30.29 kN) dry and 8,170 lbf (36.34 kN) with afterburning, which was being developed for the proposed Gnat Mk.2 interceptor and a NATO light-weight strike fighter. Unfortunately, the British authorities cancelled their requirement for the type and India, being unwilling to provide the modest sum required to complete development, was stuck with the non-afterburning Orpheus B.OR.2 Mk.703 rated at 4,850 lbf (21.57 kN), which ended up being used on the Marut. An Indian effort to fit afterburners to this engine resulted in between 18 per cent and 27 per cent increase in thrust, but the loss of the test aircraft with Group Captain Suranjan Das in 1970, ended this effort. An attempt to re-power the Marut using Brandner E-300 turbojets being developed for the Egyptian Helwan HA-300 fighter (an aircraft which in many ways was a supersonic Gnat-type light interceptor), each rated at 6,275 lbf (32.4kN) dry and 10,582 lbf (47.2 kN) with afterburning was potentially promising. However, form drag was considerable and while testing was satisfactory, the 1967 six-day war ended this avenue of development.

To say this lack of a suitable engine had a deleterious effect on performance would be an understatement. The Marut's airframe



The Tejas LCA programme has suffered owing to a lack of continuity in aerospace design and manufacturing capabilities in India (photo: Angad Singh)

and this diminutive fighter transformed the IAF's combat arm. HAL also received licence to produce the Bristol Orpheus engine. This engine, despite its limitations, provided the Gnat with a then unheard of thrust-to-weight ratio of 0.75:1 (in contrast the F-86F-40-NA supplied to Pakistan had a thrust to weight ratio of 0.42) and a de-rated version continues to power the

advanced avionics. While four squadrons of Ajeets served between 1975 and 1991, the type never achieved its potential. The Ajeet was also considered for conversion into an advanced jet trainer (AJT), which should have been encouraged as no fewer than 105 Gnat T.1s served the RAF with distinction as an AJT. However, lack of support, lack of reference to the Gnat T.1,

Although India has struggled to field fighters, helicopters have been an encouraging success story for HAL (photo: Angad Singh)



was designed for speeds exceeding Mach 2, but with the anemic Mk.703 engine, the aircraft barely went supersonic. The Marut first flew in 1961 and initially entered IAF service by 1964. In the 1971 war, the type served with some distinction but its lack of engine power led to it being overshadowed by the more powerful Su-7 and, most of all, more capable variants of the MiG-21. It should be noted that while underpowered, the Marut was an excellent weapons platform and though somewhat short on range, its performance characteristics – even with the Mk.70 – were not dissimilar to contemporary types like the French Dassault Etendard IVM (which served until 1987) or even the Dassault Super Mystere B.2 (which continued in service until 1996 with Honduras). In contrast, the last Maruts left squadron service in 1985.

Despite some half-hearted efforts to find a suitable engine for the Marut, the IAF was never entirely supportive of the project. An attempt to integrate Adour turbofans (used in the Jaguars and Hawks) was confounded by an IAF demand that the thrust of the Adour be increased by 20 per cent. This decidedly unhelpful attitude was caused, at least in part, because the IAF's immediate requirements were being catered for by a substantial infusion of

Soviet aircraft – the Su-7 for tactical strike and the MiG-21FL/M and MF variants. A very realistic and cost-effective proposal to create a strike-fighter based around the Marut airframe and the R-25 engine (the HF-25) received no sanction and while efforts to procure RB.199 turbofans were seriously considered for a Marut Mk.3 – the HF-73 – the project failed to materialise.

Ferdinand Brandner, designer of the E-300 was far more blunt and firmly believed that the failure of India to develop an E-300 powered Marut, and of Egypt to complete development of the HA-300, was due to Soviet pressure and the desire of the latter to sell MiG-21s and the licence to manufacture them. Whether this is true or not is hard to say, but what is clear is that the availability of licence-produced MiG-21s sounded the death knell for any further development of the Marut.

As MiG-21s were augmented by MiG-23s, and later MiG-27s and Jaguars, the IAF was not supportive of continuing the development of the Marut. Successive governments failed to seize the initiative, and in so doing, design expertise, infrastructure and experience were frittered away. Thus, when India restarted a project for an indigenous fighter – what would eventually

become the Tejas LCA – it had to begin from scratch.

As for HAL, its design expertise atrophied and initiative was discouraged. Its HPT-32 Deepak trainer was until recently its last success and even then HAL's upgrade of the type into the HTT-34 received no encouragement. Its efforts to replace the type with the HTT-35 also met with no support. It must have been particularly galling for HAL to then see the IAF go in for the purchase of 75 PC-7 Mk.II trainers which were very similar to their proposed HTT-35.

[The HTT-40 programme will hopefully reverse the tide: Ed]

In a real sense, the Marut power plant saga was the beginning of the end for HAL as a designer and developer of aircraft. While licence-manufacture of MiGs, Jaguars and Alouette helicopters continued (some projects with greater indigenous content by value than others) to meet the requirements of the IAF, HAL's potential was squandered. It would not be unfair to say that for want of an engine, an industry was lost.

The writer is a lawyer practicing in Trinidad and Tobago, and has a PhD from King's College, London, on India's nuclear weapons programme and is the author of 'The Armageddon Factor – Nuclear Weapons in the India-Pakistan Context.'

Russia supplies Su-35s to China



The PLA Air Force took delivery of the first batch of Sukhoi Su-35 'Flanker-E' fighters from Russia in late December 2016, having a year earlier signed a \$2 billion contract with Russia for the acquisition of 24 Su-35s, following more than five years of on-again, off-again negotiations for the aircraft. This recent agreement amounts to the lifting of a 2006 moratorium on high-tech weapons exports to Beijing, implemented amid accusations that China had "reverse-engineered" Russian equipment such as the Su-27 fighter.

It is opined by experts on Chinese military aviation and industry that one of the reasons China is keen on acquiring the Su-35 is to access modern Russian engine technology in the form of the Saturn AL-41F1S (117S) afterburning turbofan engine and the associated thrust-vectoring capability of the super-maneuverable Su-35. China has been trying to develop its own indigenous fighter jet engine for several years, but the programme has been dogged by technical problems. China's stealthy Chengdu J-20, single-engine Chengdu J-10 and Shenyang J-15 carrierborne fighters are still powered by Russia's Saturn AL-31 engine.

It is felt by US analysts that such Russian arms sales to China are threatening US air superiority. "In Chinese hands, Russian weapons such as the S-400 surface-to-air missile system, thought to be among the world's best, and the fourth generation Su-35 fighter jet could have significant consequences for the United States", said the study by the US-China Economic and Security Review Commission, which is appointed by Congress.

China to produce Ballistic Missiles with Pakistan?

During his 16 March 2017 visit to China, Pakistan's COAS was received not just by military leaders but by Zhang Gaoli, a member of the Communist Party's Politburo Standing Committee member, who is regarded as the seventh ranked leader in China. Gen Bajwa also met Vice Chairman of the Central Military Commission General Fan Changlong, General Fang Fenghui, chief of the Joint Staff Department, and Army Commander General Li Zuocheng.

Consolidating its already considerable relationship with Pakistan's armed forces, the Chinese government instructed industry "to jointly produce ballistic, cruise and anti-aircraft missiles along



with Pakistan". Song Zhongping, a former officer of the PLA Second Artillery Corps (which has now been renamed as PLA Rocket Force), stated that joint production with Pakistan will not only cover missiles but also extend to other weapons. This includes the "mass production of FC-1 Xiaolong, a lightweight and multi-role combat aircraft developed jointly by the two countries" (*known in Pakistan as the JF-17 Thunder*). The report about joint missile production has come shortly after China criticised India's development of ballistic missiles, questioning the recent test of Agni V "as a violation of UN Security Council resolutions."

16 more JF-17 Thunders for PAF

At a ceremony held on 16 February at Kamra, a new batch of 16 JF-17 Block II multi-role fighters was formally handed over by the Pakistan Aeronautical Complex (PAC) to the Pakistan Air Force (PAF) for re-equipping No. 14 Squadron, earlier equipped with F-7Ps. With this, some 70 JF-17s (both Block I and Block II) have been delivered to the PAF, which now equip four squadrons plus a flight of the CCS.



A total of 150 JF-17 are on order, over three production blocks, (I,II,III), the Block III envisaged to incorporate an active electronically-scanned array radar, helmet-mounted display and sight system, and updated electronic warfare and countermeasure systems.

MiG-35 “formally” launched



Although the Russian MiG-35 had been offered to meet the IAF’s AM-MRCA requirement over ten years back, this was in effect a “repainted” MiG-29M. Now, on 27 January 2017, there is an announcement that the Russian Air Force plans to replace its current ‘light’ fighter fleet with the newly unveiled MiG-35, when the first two pre-production examples of the MiG-35 fighter configured for the Russian Air Force were presented to military officials and media in a ceremony at Russian Aircraft Corporation MiG’s Lukhovitsy facility, southeast of Moscow. Russian Aerospace Forces (VKS) commander-in-chief Colonel General Viktor Bondarev has said that all of the service’s present light fighters would eventually be replaced by the new MiG-35. The MiG-29M/M2 designations are for similar aircraft offered for export, for which Egypt is reportedly the launch customer, with a contract for 46 aircraft.

USAF considers ‘light attack fighters’

Interestingly, the US Air Force are also now considering the acquisition of ‘light fighters’. US Air Force chief of staff General David Goldfein has revealed plans to acquire up to 300 of such “low-cost light-attack fighters” to be used primarily for “counter-terrorism missions.” Such a proposal was first mooted by Senator John McCain, chairman of the Senate Armed Services Committee, who had said the USAF could procure the first 200 by 2022. Types to be evaluated include current fighters (speculatively including the Saab Gripen seen below at *Red Flag* Exercises in the USA)?



More MiG-29s for Serbia

Six MiG-29s have been donated to the *Ratno Vazduhoplovstvo I Protivvazduhoplovna Odbrana* (RV I PVO – Serbian Air Force and Air Defence) by Russia in December 2016 and the Serbian Government has since announced its negotiations for a similar deal with Belarus. It was stated that Belarus would donate eight MiG-29 fighters to Serbia, without cost, after overhaul and modernisation in Belarus. Belarus currently operates some 34 MiG-29s at the 61st Fighter Air Base in Baranovichi. These aircraft will reportedly undergo overhaul and upgradation at the 558th Aircraft Repair Plant.

More Reapers for France

The French Ministry of Defence plan to acquire a fourth MQ-9 Reaper unmanned aerial vehicle system for the *Armée de l’Air*, which service has already taken delivery of three Reaper systems, some of which have been deployed in West Africa. Two MQ-9s were delivered to Base Aérienne (BA) 101 in Niamey, Niger, on 31 December, to support *Opération Barkhane*.

Mi-35Ms and Su-30SMs for Kazakhstan



A batch of four more Mi-35M attack helicopters and two additional Su-30SM multi-role fighters have reportedly been delivered to the Kazakh Air Force. The batch of four Mi-35Ms had been airfreighted from the factory at Rostov-on-Don during November 2016 and delivered to the 405th Aircraft Factory at Almaty International Airport for reassembly and flight testing. Although Kazakhstan has previously taken delivery of older Mi-24 variants, these are the first Mi-35s to enter service in Kazakhstan, which government has signed for a further four Mi-35Ms for delivery in 2018. Meanwhile, the Kazakh MoD announced delivery of the two Su-30SMs from Irkutsk Corporation on 27 December, being the fifth and sixth of the type to be delivered to this country, following the first four in 2015: the initial two arrived on 7 April. It is reported there are plans to eventually acquire 36 Su-30SMs with deliveries expected to extend through to 2020.

More Naval helicopters for South Korea

The South Korean Government has plans to deploy additional maritime helicopters by 2022, with the AW159, MH-60R

Seahawk and NH90 being shortlisted. Selection is due by the end of 2018, with deliveries beginning in 2020. The Republic of Korea Navy currently deploys eight AW159s and plans for 20 additional maritime helicopters.

Airbus H120s for Myanmar



Four Airbus Helicopters H120s (EC120B Colibris) and four Beechcraft 1900D transport aircraft have been formally inducted by the Myanmar AF. This was recently at Meiktila Air Base, which has acquired several second-hand Beechcraft 1900Ds in recent years (picture of H120 for representational purposes).

Y-9 for PLA Army Aviation

The Chinese People's Liberation Army Aviation has taken delivery of its first Y-9 tactical transport, reportedly assigned to the 4th Army Aviation Brigade (65th Group Army) at Tongxian. Several army aviation brigades are now being formed, and each will be equipped with their own fixed-wing aircraft types.



A400M ordered by Indonesia

The Indonesian Government has reportedly ordered five Airbus military A400M heavy transport aircraft. The plan is to assemble the last three at PT Dirgantara in Bandung. In May 2016, the Indonesian Ministry of Defence had announced it would acquire 'a small number' of these aircraft, which was re-iterated when Airbus executives met Indonesian ministers at Jakarta in August 2016.

Former 'Indian' AW101 for Indonesia



An Agusta Westland AW101 helicopter, originally built for the Indian Air Force (as ZU-4306) has now been delivered to the *Tentara Nasional Indonesia – Angkatan Udara* (TNI-AU – Indonesian Air Force), for VIP transportation. The Government of Indonesia has plans to acquire three such helicopters for their Presidential fleet, but there have been some political controversies because of which a single example could be operated for military transportation and SAR tasks.

Eighth Russian Navy Il-38N

The Russian Navy has received its eighth Ilyushin Il-38N ASW aircraft after service life extension and equipment modernisation. Attending the ceremony on 31 January 2017 at the Ramenskoye aerodrome south of Moscow, Russian Naval Aviation Commander Gen Igor Kozhin declared plans for eventual modernisation of "about thirty" of the 54 aircraft currently in the inventory, stating that work on the fleet would run through 2025. Gen Kozhin said that the Il-38 and Tu-142 would continue as the primary ASW types in Russian service. "These are old platforms, but we expect a substantial increase in their capabilities through equipment modernisation." Nikolai Stolyarov of United Aircraft Corporation said Ilyushin and its industrial partners – Myasishchev and Aircraft Repair Plant No. 20 would continue to work on service life extensions and modernisation of other versions of the baseline Il-18 in service with the Russia Aerospace Forces. "This platform has proved very reliable, durable and robust. We hope the Il-38N modernisation programme will continue... after successful completion of special flight trials that will commence shortly."



(The Indian Navy continues to operate five Il-38 'Sea Dragons', but the remaining eight Tu-142Ms are being phased out end-March 2017: special Vayu-on-the-Spot coverage in next Issue).

200th Lockheed-Martin F-35s for Japan

10 January 2017 was a historical milestone for the F-35 Lightning II programme when the 200th operational jet, the second delivery for the Japan Air Self-Defence Force, departed Lockheed Martin's Fort Worth production facility and arrived at Luke Air Force Base, Ariz. This joined Luke's F-35 fleet of 46 jets to train Japan's pilots. The F-35 programme continues to grow and accelerate as it now operates in 12 locations worldwide including Israel and Italy. The programme has also logged 75,000 flight hours while training more than 380 pilots and 3,700 maintainers.



USMC F-35Bs at Iwakuni

Lockheed Martin F-35B Lightning II aircraft, belonging to Marine Fighter Attack Squadron 121 (VMFA-121 'Green Knights'), Marine Aircraft Group 12, arrived at Marine Corps Air Station at Iwakuni on 18 January 2017, beginning the squadron's permanent basing at the air station, and marking the first major overseas deployment of the type.



*The first USMC F-35B touching down at Iwakuni
(photo: USMC/LCpl Joseph Abrego)*

The F-35B is the future of Marine Corps fighter aviation and incorporates into a single airframe the mission capabilities of a range of current Marine Corps platforms that it will eventually replace. These include the AV-8B Harrier, F/A-18 Hornet, and EA-6B Prowler. In addition to its Short Take-Off and Vertical Landing (STOVL) capability, the F-35B's combination of stealth, cutting-edge radar,

sensor technology, and electronic warfare systems bring together all of the access and lethality capabilities of a fifth-generation fighter, a modern bomber, and an adverse-weather, all-threat environment air support platform.

IAI's ADA, against GPS jamming

Israel Aerospace Industries (IAI) has unveiled ADA, a new advanced system that protects avionics systems from GPS jamming, ensures the availability and functionality of GPS systems in a contested, EW-saturated battle-space. ADA has already been integrated into several systems and platforms operating both in Israel and abroad. The ADA system recently won a tender from Israel's Ministry of



Defence, "for integration into one of the main platforms of the Israeli Air Force." ADA was developed by IAI's MALAM Division, a national centre of excellence for anti-jamming protection of Global Navigation Satellite Systems (GNSS) receivers.

MH-60R delivery milestones

2016 was a successful year for the MH-60R programme, with Denmark becoming the first European nation to join the global operator base of MH-60R helicopters. The Royal Australian Navy (RAN) received their 24th and final MH-60R, and earlier, the Kingdom of Saudi Arabia became the third Foreign Military Sales (FMS) customer, procuring 10 MH-60R Seahawk helicopters, following the Royal Australian Navy and the Royal Danish Air Force.

*An MH-60R Seahawk helicopter
seen firing a Hellfire missile*



The Danish aircraft are configured for search and rescue or anti-surface warfare operations, including defending Danish interests in the North Atlantic, executing anti-piracy operations, and conducting other missions during international deployments. The first four aircraft are currently in Denmark. Two aircraft are in the Lockheed Martin's Owego, New York production hangar being fitted with their mission equipment.

Lockheed Martin has delivered more than 225 aircraft to the US Navy on or ahead of schedule, and the US Navy has operated more than 400,000 flying hours with the MH-60R, which they have found "to be operationally effective and reliable." The MH-60R's highly integrated suite of weapons and sensors enhances situational awareness, expands the operational area of influence and elevates operators and commanders' decision making ability.

Azerbaijan starts producing Aeronautics Orbiter 1K

Media reports in Azerbaijan have revealed that local firm Azad Systems has begun manufacturing the Aeronautics Orbiter 1K armed loitering UAV under licence with the local name 'Zarba.' The production facilities for the Orbiter 1K at Azad Systems were established in 2011 with assistance from Aeronautics.

The Orbiter 1K is Aeronautics first loitering weapon system, and is catapult-launched with endurance of 2-3 hours. It is equipped with a warhead and an electro-optical/infrared sensor for target identification and engagement. The Company claims that the UAV's low acoustic signature means the Orbiter 1K is not detectable until seconds before starting its attack dive. Attacks can also be modified as needed or aborted altogether, in which case the aircraft can be recovered and prepared for its next mission.



South Korea deploys Taurus KEPD 350

The Republic of South Korea Air Force (ROKAF) formally deployed the Taurus KEPD 350K air-launched cruise missile in December 2016. The missiles, produced under an MBDA and Saab joint venture, are integrated with the ROKAF's F-15K Slam



ROKAF airmen mounting a Taurus KEPD 350 to an F-15K Slam Eagle

Eagle fighter fleet, and intended to target and destroy North Korea's nuclear and missile infrastructure from stand-off range. The KEPD 350 has a disclosed range of around 500 km, and South Korea received its first batch of an order of 170 missiles in October 2016. The South Korean variant of the missile is identical to the missiles currently in service with Spanish F/A-18s and German Tornados, except that it is equipped with a Rockwell Collins GPS receiver with a Selective Availability Anti-Spoofing Module (SAASM).

Kamov Ka-52 production in 2017

The first batch of Kamov Ka-52 Alligator reconnaissance and attack helicopters to be supplied to the Ministry of Defence of the Russian Federation in 2017 were handed over in December 2016, well ahead of the contract schedule. Meanwhile, several fuselages for the new helicopters are currently undergoing final



A Russian Air Force Ka-52 Alligator at Torzhok Air Base (photo: Alex Beltyukov)

assembly, with another batch of Ka-52s to be handed over to the Russian MoD shortly. In 2017, Russian Helicopters, owned by Rostec State Corporation, plans to double the production volume of the Ka-52, primarily owing to commencement of construction of the first export helicopters. The first export Ka-52 has already been assembled and is now undergoing pre-delivery tests.

Raytheon's next-gen Standard Missile-3 in intercept test

The US Navy and Missile Defence Agency (MDA) have completed the first successful intercept flight test of a Raytheon Standard Missile-3 (SM-3) Block IIA, a defensive weapon designed to defeat short- to intermediate-range ballistic missile threats. Crew members on board the USS *John Paul Jones* (DDG-53) launched a SM-3 Block IIA, which successfully engaged and destroyed a land-launched target resembling an advanced ballistic missile threat.



The SM-3 interceptor, shown in this illustration, is the world's only ballistic missile killer deployable on land or at sea

The interceptor's kinetic warhead has been enhanced to best address advanced and emerging threats, with improvements to the search, discrimination, acquisition and tracking functions. The kinetic warhead, along with larger rocket motors, allows SM-3 Block IIA to engage more sophisticated threats and protect larger regions from short- to intermediate-range ballistic missile threats, providing greater operational flexibility.

Raytheon and US Navy Tomahawk Blk 4 flight tests

Raytheon and the US Navy recently completed two flight tests with the Tomahawk Block IV cruise missile. According to the company, the tests were conducted to demonstrate the missile's ability to engage time-sensitive targets.

During the first test, a Tomahawk missile was fired by US Navy personnel from the *Arleigh Burke*-class guided missile destroyer USS *Pinckney*, using the Launch Platform Mission Planning capability. The weapon followed a pre-planned route throughout the trial. For the second test, crew members fired the weapon for a longer duration, and also conducted a terminal dive manoeuvre to strike the intended target. Raytheon said the performance confirms the Tomahawk's ability to attack heavily defended targets.



RADA MHR High Energy Laser programme

RADA Electronic Industries, an Israeli company specialising in tactical land radars for force and border protection, had announced in January an order for its Multi-mission Hemispheric Radar-based (MHR) RPS-42 radar system, "to be used by a Far-East Country, for the development and testing of a High-Energy Laser (HEL) ground-based tactical weapon system."



Rosoboronexport sales increase to \$13 bn



Russian state arms export agency Rosoboronexport's sales are likely to have risen to about \$13 billion stated Sergei Chemezov, CEO of Rostec state corporation, in December 2016. Rosoboronexport is part of Rostec, which owns a number of defence firms in Russia. The total backlog of orders is presently valued at some \$45 billion. Meanwhile, Rostec State Corporation, has appointed Alexander Mikheev as CEO of JSC Rosoboronexport (*in photograph*).



Elbit in Mi-17 upgrade

Elbit Systems have announced an approximately \$110 million contract from an "undisclosed Asia-Pacific country" for upgrade and maintenance of "dozens" of Mi-17 helicopters. The project will be conducted over a five-year period.

Elbit Systems has extensive operational experience in rotary-wing modernisation activities, including conversion of utility and assault helicopters into multi-role platforms, upgrading existing utility and attack platforms, supplying cutting-edge systems for latest-generation aircraft and providing comprehensive maintenance



and support packages. Elbit Systems has the flexibility to serve as prime contractor, systems integrator, component supplier or service contractor in order to meet the specific needs of a customer, and can tailor solutions to meet customer requirements, whether they are for a single system, large-scale systems, structural upgrades or maintenance and support.

Singapore Airlines select Trent 1000s

Rolls-Royce has won a \$1.7bn order from Singapore Airlines for Trent 1000 engines to power 19 Boeing 787 Dreamliner aircraft. The engines will be covered by Rolls-Royce's flagship engine service, TotalCare, "which improves engine reliability, increases time on wing, and maximises the engine's contribution to business performance." This builds on a previous SIA Group order for Trent 1000 engines to power 50 787s, made in 2013. Twelve of those aircraft are now in service with SIA subsidiary Scoot and are also covered by TotalCare. In addition to the Trent 1000, operated by its subsidiary Scoot, Singapore Airlines also operates the Trent XWB, Trent 900, Trent 800 and Trent 700.

2,600 CFM engines ordered in 2016

CFM International achieved near record orders in 2016, with the company booking a total of 2,677 engines, including 876 CFM56 engines (commercial, military and spares) and 1,801 LEAP engines (including commitments and spares). 2017 is already off to a good start, with more than 580 engine orders received in January. At the same time, the LEAP engine has now garnered more than 12,200 total engine orders and commitments (excluding options) at a value of more than \$170 billion US at list price.

Italy's participation in Aster 30 Block 1 NT programme

OSCAR (Organisation for Joint Armament Cooperation) has notified to EUROSAM, a consortium formed by MBDA and Thales, the amendment 1 of the contract for the 'BINT' programme. The Aster 30 Block 1 NT missile development takes



into account the key dual requirement (same missile for ground and naval Aster systems), including thus the necessary adjustments to allow the missile to be fired from warships. Italy has in fact expressed its desire to use the Aster 30 Block 1 NT from its future class of PPA (*Pattugliatori Polivalenti d'Altura*) offshore patrol vessels.

Bell 407GXP for Nepal

Bell Helicopter delivered the first Bell 407GXP to Nepal to be operated by Simrik Air. This is the customer's first Bell helicopter and is outfitted for multi-mission capabilities, including



travel and tourism and search and rescue. Bell Helicopter and Simrik Air commemorated the delivery at a special ceremony in Kathmandu, Nepal. Last November, Bell Helicopter successfully completed a demonstration tour of the Bell 407GXP throughout Nepal which included flights to Kathmandu, Nepal and into the Mount Everest Base Camp area, where the Bell 407GXP successfully climbed to an altitude of 20,000 feet. The demonstration flight was executed from Lukla airfield and demonstrated several landings from 13,500 ft. to 19,600 ft. near the Everest Base Camp.

Flynas orders 60 A320neos

Flynas, Saudi Arabia's leading low-cost carrier, has signed an agreement with Airbus for 60 A320neo Family aircraft. In addition to the 60 aircraft, Flynas has converted 20 A320ceo from a previous order to A320neo bringing the airline's total firm order to 80 A320neo. The deliveries are scheduled to take place during 2018-2026. Flynas, an all Airbus operator, currently has 26 A320ceo in service.

ATR consolidates leading position

ATR further consolidated its position in 2016 as the "preferred choice of regional airlines". The ATR -600s ranked first among all regional aircraft sales of the year, with orders for 36 aircraft (34 ATR 72-600s and 2 ATR 42-600s). ATR confirmed its leading position in the segment of 50-to-90-seat aircraft with a market share above 35 per cent since 2010. As it celebrated its 35th anniversary, the world's leading turboprop manufacturer consolidated historical levels of turnover and deliveries despite a challenging market environment.

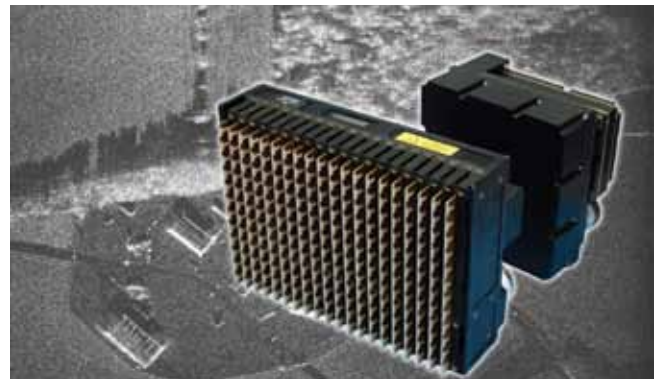
Leonardo AW609 progresses

The AW609 TiltRotor programme is expected to start icing trials soon following recent ground and flight testing activities. These advances have been made in support of FAA certification, which



remains on track for 2018. The third prototype, based at Leonardo's facility in Philadelphia, performed several weeks of unrestrained ground testing and, more recently, flight trials that allowed avionics and all systems to be fully tested. During initial flights, the aircraft performed basic hovering and maneuvering and patterns around the airport, concluding with hover landing.

Leonardo AESA radar for Patroller UAV Programme



Leonardo has been selected by Safran Electronics & Defence to provide the PicoSAR AESA radar for its Patroller UAV. The radars will be used by the French Forces, which selected the Patroller in April 2016. The multi-million Euro contract will see Leonardo provide a number of radars and spares, which will be used for long-range, over-land surveillance missions. First deliveries are expected in 2017 and Leonardo is working closely with Safran for the satisfaction of the French Forces. PicoSAR features an advanced AESA capability and is ideally suited for UAVs.

Marte anti-ship missiles for UAE

MBDA has been awarded a contract by the UAE Navy to supply additional Marte MK2/N anti-ship missiles, a follow on to



the contract signed in February 2009. Each high speed multi-role combat vessel will be equipped with four box launchers for MBDA Marte Mk 2/N guided missiles, able to strike targets at ranges in excess of 30 km, flying a fire-and-forget sea-skimming profile using mid-course inertial guidance and active radar homing.

Pakistan expands its AW139 fleet



Pakistan has placed orders for “an undisclosed number” of additional AgustaWestland AW139 intermediate twin engine helicopters, the aircraft to be used for utility and transport operations across the nation. Deliveries are expected to start in mid-2017. This further expands the presence and success of the AW139 and other Leonardo models in Pakistan and confirms the AW139 as the “preferred new generation helicopter choice for replacement of older types currently in service”. The new helicopters will add to the fleet of AW139 previously ordered to carry out search and rescue (SAR) and emergency medical service (EMS) duties in the country.

SriLankan Airlines receives first A320neo

SriLankan Airlines has taken delivery of its first A320neo on lease from Air Lease Corporation, making the airline the latest operator of the type. The delivery from Airbus’ facilities in Hamburg is the first of a fleet that’ll grow to six A320neo Family. SriLankan’s A320neo is configured for 150 passengers in a two-class cabin layout with 12 business class seats and 138 economy class seats. It is powered by CFM Leap1A engines.



Airbus to retrofit 26 Bundeswehr CH-53 helicopters



Airbus Helicopters has received an order from the Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw) to retrofit 26 CH-53 heavy transport helicopters, to cover obsolescence management for components that are no longer available and will replace them with new parts. This retrofit will guarantee the helicopters’ operation until at least 2030. The process will start in 2017 and should be completed by 2022. Work will be carried out in Donauwörth at Airbus Helicopters’ Military Support Centre Germany.

GA-ASI Launches ‘Team Reaper Australia’



General Atomics Aeronautical Systems, Inc, a leading manufacturer of Remotely Piloted Aircraft (RPA) systems, radars, and electro-optic and related mission systems solutions, has formally launched its Team Reaper Australia solution to the Project Air 7003 requirement, together with Australian partners Cobham, CAE Australia, Raytheon Australia, and Flight Data Systems. Air 7003 will provide the Australian Defence Force with a medium-altitude long-endurance RPAS, and will include aircraft and GCS.

Leonardo and UK MoD launch Phase 2 of RWUAS

The UK's Defence Equipment and Support (DE&S) Technology Office has placed a two year, jointly funded, Research and Development contract for a Rotary Wing Unmanned Air System, Capability Concept Demonstrator – "RWUAS CCD Phase 2", with Leonardo. The contract aims to identify, develop and exploit the opportunities offered by emerging technologies, to reduce costs and increase the agility, flexibility, resilience and persistence of national military equipment and capability in the rotary wing arena.



NHV's H175 fleet reaches 10,000 flight hours



NHV Group and Airbus Helicopters H175 fleet have now surpassed 10,000 flight hours. This significant milestone "proves this super-medium-sized rotorcraft's capabilities and reliability in highly demanding operations, especially the transportation of personnel and supplies to offshore oil and gas platforms". The 10,000 hours have been accumulated by NHV's fleet of eight H175s, the first two aircraft introduced in December 2014 with NHV being the launch operator. The rotorcraft have since completed more than 4750 flights; with certain missions conducted in challenging North Sea weather conditions, and non-stop flights performed to distances of 180 NM with passengers and cargo.

A321neo type certified with CFM LEAP-1A

Following a comprehensive flight test programme, the A321neo powered by CFM International's LEAP-1A engines has been granted joint Type Certification from the European Aviation Safety



Agency (EASA) and the Federal Aviation Administration (FAA). The A321neo powered by CFM engines, successfully completed a certification programme accumulating over 400 flight hours in more than 160 flights. The tests validated the aircraft airframe and systems well beyond their design limits to meet all airworthiness criteria.

Boeing launches MH-139



Boeing has unveiled its MH-139 helicopter in the competition to replace the US Air Force's UH-1N 'Huey' fleet. Boeing's response to the Air Force, revealed at the Air Force Association Air Warfare Symposium, is based on Leonardo Helicopters AW139. The US Air Force UH-1N Replacement Programme plans to replace the current Huey fleet, which entered service in the 1970s, with up to 84 new helicopters. Almost 900 AW139s are in service with more than 250 governments, militaries and companies across the world. More than 250 of the helicopters have been assembled and delivered from Philadelphia.

Missile firing from Protector USV

Rafael Advanced Defense Systems Ltd. recently completed the development of an additional mission module for its *Protector* Unmanned Surface Vehicle (USV), in use by a number of naval fleets around the world, including the Israeli Navy. The development was completed as part of a series of successful tests performed by

Naval Aviation

Publications by The Society for Aerospace Studies



On The Wings of Gold

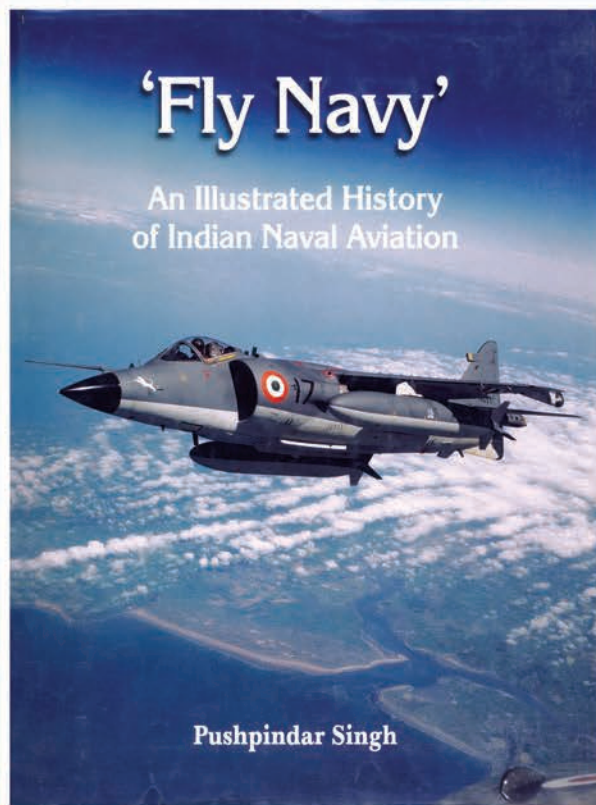
Golden Jubilee of INS Hansa
by Pushpindar Singh

This book explores in comprehensive detail the history of the Indian Navy's largest and most active Naval Air Station, INS Hansa, at Dabolim in Goa. From the Station's beginnings as the Naval Contingent, Coimbatore in September 1961, to the move to its present day home in Goa in 1964, and right up to contemporary times, this richly illustrated book details the growth and evolution of the Station as well as all Naval Air Squadrons associated with it.

'Fly Navy'

An Illustrated History of Indian Naval Aviation
by Pushpindar Singh

The first dedicated history of Indian Naval Aviation, published in 2006, this book contains hundreds of rare photographs a treasure trove of painstakingly collected information on India's Naval Air Arm, making it a tremendous resource for enthusiasts and analysts alike.



Pushpindar Singh



Enquiries to:

The Society for Aerospace Studies
D-43, Sujan Singh Park, New Delhi 110003, India
Phone: +91-11-24626183, Fax: +91-11-24628615
Email: vayu@vayuaerospace.in

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Rafael, in which a number of missiles were launched from the *Protector* and hit simulated enemy targets. This was the first-ever missile firing from an operational, remote-controlled USV. During the test, Rafael fired a number of Spike missiles, a family of precise, electro-optical, missiles that can be launched from aerial, land and naval platforms. This new capability allows pin-point attack of land or naval targets, enabling safe vessel operation from , with no risk to the operating force, from a remote command and control room or from aboard other naval platforms.

Irkut's plant producing Su-30SMs, Yak-130s, Yak-152s

On 9 March, Deputy Defence Minister of the Russian Federation Yuri Borisov visited Irkutsk Aviation Plant—subsidiary of Irkut Corporation (UAC member). Yuri Borisov viewed the production progress of Su-30SM multirole fighters and Yak-130 combat trainers, as well as the manufacturing process of the new Yak-152 primary trainer aircraft. “Under the long-term contracts with Irkut Corporation, the Ministry of Defence will receive 17 Su-30SM and 10 Yak-130 aircraft this year”, stated Yuri Borisov the Deputy Defence Minister who also attended test flight of the Yak-152 aircraft. “The impressions from the flight are most



Yuri Borisov in assembly shop



Yuri Borisov next to a Yak-152

favourable,” said Yuri Borisov. He also mentioned that after the tests are completed, the Defence Ministry will sign a contract on this primary training aircraft for cadet flight schools. “In general we are satisfied with the fulfillment of the state defence order and with the quality of the enterprise’s products,” noted the Deputy Defence Minister, summing up the visit to the plant of Irkut Corporation.

Pakistan Army inducts Chinese-built ADS

Pakistan’s Army has inducted Chinese-built Low to Medium Altitude Air Defence System (LOMADS) LY-80 in its air defence system when Army Chief General Qamar Javed Bajwa was chief guest at the induction ceremony. LY-80 is a Chinese mobile air defence system capable of tracking and destroying variety of aerial targets at longer ranges flying at low and medium altitude, the ISPR statement read. The army chief said, “LY-80 LOMADS increases our response capability to current and emerging air defence threats.”





“Bye Bye Lynx, Welcome Wildcat”

After forty years of operation with the Royal Navy, the Westland Lynx is now set to be replaced in frontline operational service by the AgustaWestland AW 159 Wildcat. Joan le Poole and Sander Meijering visited the last operational Royal Navy Lynx unit before the type was retired.

It is cold on the tarmac of 815 Naval Air Squadron (NAS) at Royal Naval Air Station (RNAS) Yeovilton in Somerset. Flight crews and engineers are working together to get their helicopters airborne. On left of the tarmac, two Wildcats are running while a third is starting up. On the right are two Lynx helicopters being prepared for flight. Operating two helicopters types at the same time is quite a challenge for the 250 men and women from 815 NAS. As CO Cdr Philip Richardson explains: “We’ve got seven Lynx aircraft and seven Wildcat aircraft at the moment. With the end of Lynx in sight we are replacing Lynx aircraft with Wildcat aircraft and transition at the same time. We are changing the qualifications of our Lynx maintainers into



Wildcat engineers and that is a long process with all the procedures they need to learn. But the challenge at the moment is to run those two aircraft types simultaneously next to each other. As you can see in the hanger, the Lynx goes to this side and the Wildcat to the other and never do the two engineering procedures meet because there are different greases, oils and procedures for both types of aircraft. We kept them completely separated but run them concurrently."

It is possible for such transition in different ways but the Royal Navy has chosen a slower conversion without stopping flying. "We looked really carefully at how we wanted to do the transition," says Richardson. "Did we want it to be a steep loss of capability, were we just stop everything for a year and retrain? No, we meet all our operational commitments and also retrain on the Wildcat. The whole transition process has taken three years." Even though the Lynx retired officially on 23 March 2017, this was not the end of the transition period. "It takes another year after we finish flying Lynx together before we all walk out trained."

The History

Commander of the Lynx-Wildcat Maritime Force, Cdr Gus Carnie, explains: "The Lynx is a very impressive piece of machinery, it has been our proven weapon carrier in the last forty years."

But the Lynx story started more than forty years ago, dating back to the mid-sixties. British manufacturer Westland Helicopters began with the development of the WG13, a helicopter intended for civil and maritime use. Early in the development project both the Army and Navy showed interest for replacing the Westland Scout and Westland Wasp. In 1967, France and Britain agreed on a package deal. Westland would team up with the French company Aerospatiale to design three new helicopters. Aerospatiale would design the Gazelle and Puma, while Westland worked on the WG13, now called Lynx. The first Lynx prototype made its maiden flight in March 1971. The test flight revealed a fast and highly manoeuvrable aircraft. Powered by two Rolls-Royce Gem engines driving a four-blade rotor, the Lynx was a compact and modern aircraft. The design of the rotor head and gearbox was revolutionary, and the powerful engines and lean airframe enabled the Lynx to fly extremely fast. The Lynx set

its first world helicopter speed record in 1972 followed by a second one in 1986. The latter saw the Lynx achieve a speed of 400.87 km/h, which is the absolute speed record for helicopters that still holds today.

In the development stage both army and navy variants were developed. The naval version has a folding tail, foldable main rotor, and a 'harpoon' for flight deck landings. Another difference is that the army version was equipped with skids while the naval helicopters have wheels. Only the latest AH9 army variant, in service since 1990, also has a wheeled undercarriage. After development, production of the Lynx started with an order of 60 aircraft for the Royal Navy and 113 aircraft for the British Army. The first aircraft entered service with the Royal Navy in 1976, followed by the Army in 1979. Many countries shortly followed the British example and acquired the Lynx, with the naval variant becoming particularly popular worldwide. Over 400 Lynx helicopters served with some sixteen countries around the globe, including France, Germany, the Netherlands, Oman, Brazil, and South Korea.

Lynx with the Royal Navy

The first squadron to operate the Lynx was 700L Naval Air Squadron (NAS) at RNAS Yeovilton. This Anglo-Dutch unit was an Intensive Flying Training Unit (IFTU) for the Lynx HAS Mk.2. After an intensive period of training and testing the Dutch Navy returned to the Netherlands and 700L NAS was decommissioned at the end of 1977. The balance of 700L squadron was re-commissioned at RNAS Yeovilton as 702 NAS in January 1978. The second squadron to operate the Lynx was 815 NAS, which was commissioned at RNAS

Yeovilton in 1981. Both squadrons moved to RNAS Portland during the summer of 1982 with the upgraded Lynx HAS Mk.3. It was not long before the Lynx had an opportunity to prove itself in combat. The first Lynx helicopters went into action in the South Atlantic during the Falklands war in 1982. After that, the 1980s saw the Lynx in action on several occasions, including the evacuation of British citizens from Beirut, and protecting British interests during the Iran/Iraq war. This made 815 NAS so busy that some of the unit's flights were transferred to 829 NAS in 1986.

The nineties were similarly busy for the Lynx. The Lynx saw much action during the Gulf War, and Lynx crews even sank two Iraqi vessels with Sea Skua missiles. In March 1993, 829 NAS disbanded and handed over its duties to 815 NAS. In the same year the final Lynx upgrade programme started which had most of the helicopters upgraded to the HMA Mk.8 standard. This programme was a major upgrade that fitted the Lynx with a new tail rotor, repositioned the Seaspray radar and replaced the nose structure to fit the Sea Owl Passive Identification Device. During course of the upgrade both 702 NAS and 815 NAS moved back to RNAS Yeovilton in 1999. The 21st century saw the Lynx in even more action in countries like Sierra Leone, Northern Ireland and Somalia, but also revealed the age of the Lynx and the need for its replacement.

Enter the Wildcat

The MoD had already announced that it wanted to replace the Lynx helicopter in 1995, but it took until 2002 before the MoD asked AgustaWestland to do a study for possible re-manufacture of the Lynx as



a new variant called the 'Future Lynx.' By 2006, the MoD awarded AgustaWestland a contract to build 70 Future Lynx helicopters. It took years of designing and testing before AgustaWestland came up with a prototype, now known as the AW159 Wildcat. This prototype made its maiden flight on 12 November 2009. The prolonged design and development period resulted in a nearly all-new helicopter with little in common with the legacy Lynx. To prepare the Royal Navy for Wildcat operations, 700W NAS was formed. This squadron was the operational test and evaluation unit for the Wildcat. However it was not until 2013 that 700W NAS received its first five Wildcat HMA 2 helicopters.

After a year of training, the Wildcat was ready to enter operational service, and a decision was made to merge both 700W NAS and 702 NAS into 825 NAS making it the first operational Wildcat squadron. In April 2016, 815 NAS received its first Wildcats, and began operating them alongside the older Lynx.

From one workhorse to another

The main role of the Lynx is that of a shipboard helicopter. The Lynx operates independently from Royal Navy vessels, and is integrated with both frigates and destroyers. "We have sixteen flights under 815 NAS now that are going to different corners of the world and operate completely independently," says Cdr Richardson. To make this practical a Lynx flight comprises more than just the aircrew. Lt Max Cosby, the final Lynx pilot trainee, explains: "A Lynx flight will always have two aircrew. One will be the pilot and the other one the observer. The senior of the two will be known as the flight commander while the other will be respectively the flight observer or the flight pilot. The aircraft is looked after and maintained by the SMR (Senior Maintenance Rating). The SMR is supported by six persons equally split into two different trades, mechanical and avionics. And finally the aircraft controller, or the AC, is the person who keeps the helicopter integrated with the ship while it is in the air." The current method of operating a Wildcat will not differ much from the Lynx. The only difference is addition of a fourth avionics engineer because the Wildcat incorporates more electronics than its predecessor.

On the other hand, the transition course will still take six months. Cdr Richardson



explains: "The actual flying syllabus of the sticks and poles will take six months. If you drive a car you can drive another car but you need to know how to start it [*the Wildcat –Ed*], you need to know how to operate it, and crucially, you need to know how to fight with it." Fighting with the Wildcat in particular is a bit different from the Lynx. "The role of the Lynx versus the Wildcat is very different," says Richardson. "In a Lynx you are at low level, you have a weapon system on the side of the aircraft, a Sea Skua for example, and you would be used as a probe asset to go around to collect a recognised maritime picture. Yet, with the Wildcat you are collating that picture and then you are sending that to another unit, which can prosecute it. For example the observer's role within a Lynx is exactly the same in a Wildcat but he has a whole new suite of next generation sensors. The observer becomes a system manager."

The Future

The future will bring even more changes to the Wildcat. Richardson explains: "When the FASGW (Future Air-to-Surface Guided Weapon) comes into service, the Wildcat will have this weapon system, so it can find, fix, strike all in itself." The Wildcat will also have a role aboard the new *Queen Elizabeth*-class carriers: "With the reconnaissance and ISTAR (Information, Surveillance, Target Acquisition and Reconnaissance) capabilities that it has, we are working to integrate that into the carrier strike group. The Wildcat is a giant leap forward compared to the Lynx. Capability-wise, with all the sensors that the Wildcat has, it can do the same job as four or five Lynx at the same time. So it is a hugely capable aircraft. It is just, how do we best employ it, that's our challenge. And that will go on and on for the next forty years that it is in service."



Winds of Change at Güvercinlik



Carlo Kuit and Paul Kievit of Bronco Aviation visit Turkish Army Aviation

“Train today as you fight and win tomorrow” is the doctrine taught at the Turkish Army base Güvercinlik to students and Turkish Army (*Türk Kara Kuvvetleri*, TKK) aviators alike. This Army Aviation School was established in 1957 with re-deployment from Polatli to Güvercinlik. In 2003, the Turkish Aviation Command was reorganised as an independent command directly reporting to Turkish Army Headquarters. Since 1 September 2014 the Army Aviation School is subordinate to the Army Aviation Command and is composed of Headquarters, Aviation Training School, 1st Army Aviation Regiment and Air Transportation Group (Güvercinlik), 2nd Army Aviation Regiment (Malatya) 3rd Army Aviation Regiment (Gazimur), 4th Army Aviation Regiment (Istanbul) and the Training and Exercise Centre (Bodrum).

In mid-2016 over 184 army aviators were under training at the Army Aviation School, participating in various courses. The first T-129 ATAK helicopter student to be trained in Turkey by the Army Aviation Training School graduated in

end-May 2016; all prior T-129 pilots were experienced Army Aviators trained in Italy with AgustaWestland itself (now Leonardo Helicopters). Lt Col Ahmet Okur is currently the most experienced instructor pilot on the T-129, and was among the twenty-seven pilots that received T-129

training at the Italian Army Training Centre in Viterbo, Italy.

“It has been very helpful to have dedicated training to adapt to the new T-129 platform,” said Lt Col Okur. “Our three-month training course focused on the instructor/test pilot part the longest. We had



HEWS upgrade on a Sikorsky S-70



about eighty hours of training, compared to sixty hours for a regular combat pilot. Upon return to Güvercinlik we had an additional twenty hours of familiarisation flying organised by Turkish Aerospace Industries (TAI). New students will have forty hours of training on the T-129 during the Combat Battle Readiness phase which is similar to the 32.5 hours of training for the AH-1P/W Cobra students, as flying these helicopters is not too different.”

“A major advantage of the T-129 over the AH-1 is the Target Sighting Unit (TSU), the ASELFLIR 300T,” points out Lt Col Okur. “As a result we have now more focus on night training. Based on experiences in operational circumstances, training will be altered as we are still shaping the training syllabus for our students. The first goal for our training is to qualify expert-level Weapon Systems Officers (WSOs). The next step will then be training as a pilot on the T-129.”

At the time of the authors’ visit, five instructor pilots and thirty-nine operational pilots were available for the T-129, and an additional fifteen were undergoing training. A total of 5 training classes were running in parallel, ranging from Basic Flying up to the Combat Readiness phase. Before joining the Army Aviation School, pilot candidates first have to complete a computer-based selection test as part of the Pilot Selection System (PSS). The demand for new Army Aviators is high and as a result Güvercinlik is one of the busiest bases within the Turkish Armed Forces today.

Turkish Army Aviation operates over 240 helicopters with approximately 3,100 personnel. Over eighty helicopters, mainly S-70s, AB-205/UH-1s and AB-206Rs, are located at Güvercinlik. The UH-1 fleet commemorated 50 years of service in 2016, with no replacement planned yet, and the TKK is the largest operator of the type in Europe.

“We are currently running a new eighteen-month training programme,” stated Brigade General Ünsal Coskun, Commander of the Aviation Training School. He has been with Turkish Army Aviation for eleven years, and has commended the Aviation Training School for over a year. “The new programme consists of three periods of six months. Students start with Basic Training (Cessna 182T and AB-206R), followed by an advanced phase (UH-1H/AB-205) and completed with a Combat Battle Readiness phase training either on the S-70A-28D or the fixed wing Cessna T-42A, Cessna-421C, the latter for fixed-wing aviators. Students go solo after around 20-30 flying hours, and after the Combat Readiness phase are able to join operational units.”

“Before we started the new programme our students went to 1st Battalion at Güvercinlik operating the UH-1H. However we came to the conclusion that this was not the best solution to prepare the students for daily operations. Nowadays the Combat Battle Readiness phase is part of the Aviation Training School. We send combat ready pilots directly to the units after their training. Then they are capable in night flying, mountain flying and operations over water. It is a really tough programme to get through. As a result of our new training approach there is no need for a transition phase for a graduate pilot when assigned to a specific operational unit, and this works most efficiently for all of us,” explained Brigade General Coskun.





The Brigade General continued: “The Turkish Army on an average has a demand for about 110 new pilots each year. In order to be able to execute all our tasks we have a group of 84 instructor pilots who are involved in basic training or are tasked as maintenance test pilots. We also conduct training for the Navy (*Türk Deniz Kuvvetleri*), Military Police (*Türk Jandarma Havaçılık Komutanlığı*) and police units (*Turkish Ministry of the Interior*). Because of the refugee crisis there is an additional demand for police and Coast Guard (*Sahil Güvenlik Komutanlığı*) pilots.”

“The first two phases (basic and advanced) of pilot training will be conducted at a new base in Isparta. The move to this new airfield is planned for 2017. We will have an area of 30 square miles with mountains and lakes at our disposal for various training scenarios and the infrastructure is ready for the forthcoming move,” revealed Brigade General Coskun, whose primary job is now to prepare for the re-location to Isparta. The primary reason for the move is the amount of training sorties that must be accommodated alongside daily operations of other co-located units at Güvercinlik. Complicating factors are the nearby Air Force base at Etismesgut, only 4 km to the

west, and the densely populated capital city of Ankara some 10 km to the east.

Between 1998 and 2015, a total of 119 pilots and 304 technicians from seventeen different countries, such as Albania, Azerbaijan, China, Saudi Arabia, Jordan, Ukraine and Uzbekistan, have been trained at Güvercinlik. Based on positive feedback gained an application was made to become a Helicopter Training Centre under NATO’s ‘Smart Defence’ initiative, resulting in establishment of a Multinational Military Flight Crew Training School (MMFCTS) in 2015. MMFCTS opens Turkish Army training capabilities to NATO and other partner countries, and the programme includes basic and advanced rotary-wing training, and flight crew and ground crew training similar to the syllabus for Turkish pilots. Brigade General Coskun adds: “Advantages of this concept are lower costs by operating from one central location, and increased interoperability among countries for future operations. The flight training tactics are in line with NATO’s operational requirements and with FAA/ ICAO standards.”

In mid-2016, three Albanian and two Cypriot mechanics were conducting a twelve-month training course, but Brigade General Coskun is quick to point out

that “primary focus remains the training of our own Army pilots and crews.” A co-operation agreement with the Royal Jordanian Air Force (RJAF) and the Turkish Army has also been implemented, including a new exchange programme. Focus of this programme will be Combat Search and Rescue (CSAR) missions, and pilot exchanges will typically last for a period of six months, in which three months will be spent at Güvercinlik and three months in Istanbul.

At present, the main focus with both the Aviation Training School and 1st regiment are the introduction of the T-129 ATAK and six newly acquired CH-47F Chinook helicopters. On 16 November, three CH-47Fs were delivered to the Army Aviation Command at Güvercinlik, bringing the total in service to six. To support the heavy lift capabilities new maintenance infrastructure and hangars have been built and more personnel trained. The initial batch consists of 6 CH-47Fs: five for the Special Air Group Command (*Özel Hava Grup*) and one for the *Genelkurmay* (General Staff).

On 14 October 2016, TAI delivered the seventeenth T-129 ATAK helicopter to the 1st *Taarruz Helicopter Taburu* (Assault Helicopter Battalion) of the 2nci Kara



A TKK Cobra with rocket pods during training mission

Havacilik Alay Komutanlığı (Army Aviation Regiment Command) based in Malatya. The ATAK was selected nine years ago for the TKK with development and production under the 'ATAK Team,' a partnership of Turkish Aerospace Industries (TAI) and AgustaWestland. The first TAI-built T-129 was delivered to the Turkish Army on 22 April 2014. The T-129 fleet has mainly operating out of Malatya in southeast Turkey and is expected to be permanently located at this airbase.

Developed from the Agusta Westland A-129CBT the main differences compared to the ATAK are a new system philosophy with new engines (LHTEC CTS 800-4A) to support mountain operations, new avionics and weapons, a modified airframe, upgraded drive train and a new tail rotor. The first three T-129As to be based at Güvercinlik were delivered in July 2016, and a representative of TAI was positioned at the Maintenance Battalion in June to support the induction. The 'Phase-1' configuration of the T-129, which is currently in service, is armed with a combination of 2x4 UMTAS ATGMs (or Hellfire/Spike), 4x19 70 mm unguided rockets, 4x24 70 mm Guided CİRİT rockets, and 2x2 Stinger ATAM. Phase-2 will mainly add electronic warfare capabilities to the platform.

In anticipation of T-129 deliveries to the Attack Battalion (*Taarruz Helikopter Taburu*) in 2015, the first four AH-1Ps have been taken out of service. "The maintenance of the AH-1P/W fleet is becoming more challenging, especially the gun system," stated Lt Col Murat Bolat, the Maintenance Battalion Commander. "Acquisition of spare parts is not easy

through the FMS programme and it is too costly to start production of old parts." On an average the AH-1 fleet goes through 200-hour maintenance cycles in which O (Operational) and I (Intermediate) level maintenance is performed. Depot level maintenance is performed by the 5th Maintenance Centre Command located at Güvercinlik.

In addition to the Army Aviation School, a number of other units are located at Güvercinlik. The *Hava Ulatırma Grup Komutanlığı* (Air Transport Group), which can trace its origins back to a Liaison Flight formed in 1951 in Polatlı, is tasked with Command and Liaison flights (VIP), personnel and material transport, courier service, medevac, etc. It operates a mix of fixed-wing aircraft and helicopters. The Group has four AS.532UL Cougars on strength with two in VIP configuration, and another in AS.532USAR configuration, along with five Beech 200 Super King Airls. The 5th Maintenance Centre Command conducts depot level maintenance on all helicopter and fixed wing aircraft of the Turkish Army Aviation Command except for the CH-47Fs, which will undergo D-level maintenance in the US.

Another long-term resident is the *Helikopter Taburu* (Attack Helicopter Battalion), which has the distinction of being the first helicopter unit in Turkish Army Aviation, formed in 1966 operating OH-13 helicopters. Its personnel and aircraft regularly rotate to southeastern Turkey, and the unit also supplies helicopters for the rotary-wing training activities in the School. It is capable of operating by day and night, and the pilots

are qualified for all weather operations. The first two Textron AH-1W Super Cobras were delivered to the Battalion in September 1990. In March 1991, the first two AH-1Ws were deployed to Diyarbakir in support of security forces. The Attack Helicopter Battalion comprises of three *Filos* (Squadrons), one with nine AH-1Ws, and two *Filos* each with AH-1P/S Cobras. The fleet has recently undergone an upgrade programme by ASELSAN, implementing a self-defence package consisting of an EADS missile launch detection system and chaff and flare dispensers (MILDS).

The 1st Regiment, also based at Güvercinlik, operates a mixture of S-70A-28D Blackhawk and UH-1 Huey helicopters. During the authors' visit a number of S-70A-28Ds were seen in various stages of upgrade, receiving the Helicopter Electronic Warfare System (HEWS) package. This self-protection kit consist of 12 sensors including radar warning and jamming and laser detection with a RIAS-ANT-4 laser guided missile detector located in the tail, LIAS-S3 laser detector, FIS-S2 IR sensor, RFKS-Göndermec-1 for Radar Jamming (ECM), a jammer in the nose, and an 'Özisik' countermeasure dispensing system. In order to be able to operate the HEWS systems pilots have a short familiarisation course. There is no need for any additional sensor operator, as all sensors are autonomous. Besides the implementation of HEWS, ASELSAN is supporting a general cockpit upgrade programme that will see all S-70A-28Ds equipped with four MFDs.

Going through a wind of change, the Turkish Army Aviation has high hopes for the future.

The Indian Air Force - 'We Dare, We Care'

The IAF has recently issued an image-intensive coffee table book entitled 'We Dare, We Care', depicting the 'technology-intensive force with real time response capability and strategic global reach.' In his Foreword to the book, Marshal of the Indian Air Force Arjan Singh elucidates: 'This is the most propitious period for the IAF, as we resolutely define the security spectrum as a strategic aerospace power. Undoubtedly, the aerospace technologies provide exciting possibilities, but it is definitely the men-behind-the-machine and the leadership they espouse which will usher in a new era for the IAF...'

No doubt, the men behind the machines play a vital role in driving any formidable force to attain the peak of professionalism but a detailed perusal of the book reveals how the leadership role played by Air Chief Marshal Arup Raha, Chief of the Air Staff, has been very strongly lauded and heralded so much so, that it almost appears to be an ode to him! The photographs and production quality of the book are superlative and the stunning images obviously deserve a strong mention. For those aspiring to become a part of the Indian Air Force's tradition, 'We Dare, We Care' offers a glimpse into the training and everyday life of the officers of the IAF and also inspires women to join the force and add to its esteem and history.

Commencing with the motto and core values of the Indian Air Force, the book dwells upon some important aircraft types such as the C-130J Super Hercules, C-17 Globemaster III, Pilatus PC-7 MkII, Tejas Light Combat Aircraft, which has just gone into service and many others which form an integral part of the Indian Air Force.

Lavishly illustrated, the book lauds some heroes of the Indian Air Force including Flying Officer Nirmal Jit Singh Sekhon, the first Param Vir Chakra awardee of the IAF for his gallantry in the 1971 war, besides

the legendary (then Sqn Ldr) Arjan Singh, Sqn Ldr 'Jumbo' Majumdar, Sqn Ldr 'Baba' Mehar Singh, Sqn Ldr Surjit Singh, and generations later, Wg Cdr Rakesh Sharma, who was the first Indian in space, besides others.

The coffee table book recounts the Indian Air Force's memorable feats during *Operation Pawan* in Sri Lanka in August 1987; *Operation Cactus* in Maldives in November 1988, *Operation Safed Sagar* at Siachen in May 1999 as well as *Operation Black Thunder* when the IAF's Mi-17 helicopters assisted in combating terrorists during the ghastly attack at Mumbai's

However, and surprisingly, the IAF's major contribution in support of UN Forces in the Congo during 1961, when its Canberra bombers decimated the enemy Air Force does not feature at all, although recent helicopter operations get a page.

The book also showcases the biennial International Aero Space and Defence Exhibition Aero-India held at Yelahanka Air Force Station at Bangalore, whose 11th edition has just concluded.

This gorgeously produced, mammoth coffee table book has been conceived, to quote the Afterword, so as to: "encapsulate the IAF's operational capabilities, milestones



iconic Taj Mahal Hotel in November 2008.

The fact that the Indian Air Force has a distinguished history of being an integral part of the UN peacekeeping forces as well as an active participant in international exercises namely *Ex Red Flag Alaska 2016*; *Ex Desert Eagle – II 2016*; *Ex Jupiter Victor 2016*; *Ex Iron Fist 2016*; *Ex Live Wire 2015*; *Ex Indradhanush 2015*; *Ex Avia Indra 2014* and these have been included in the book.

and journey since inception" through vivid imagery. But it is not understood as to why the book is so 'exclusive'? After countless phone calls and pulling the vital 'strings' right to the top, *Vayu* finally managed to 'borrow' an elusive copy of the book. Surely, the Indian Air Force needs to share its glories with the *aam aadmi* and not confine its greatness within its own exclusive sphere...

Monica Arora

Ancient Aviator Anecdotes



Air Vice Marshal Cecil Parker recollects

The Ties That Bind

The youth of my generation who were educated at public schools in the Raj era, will still recall their school motto and tie which was integral to the school uniform. The former, in my case was Latin: *Non Nascor Mihi Solum* i.e., Live Not For Self Alone. I must confess we did not always live up to it, but that is another story! The introduction of the school tie however was the forerunner of many more over the years, some for sartorial effect and others for identification.

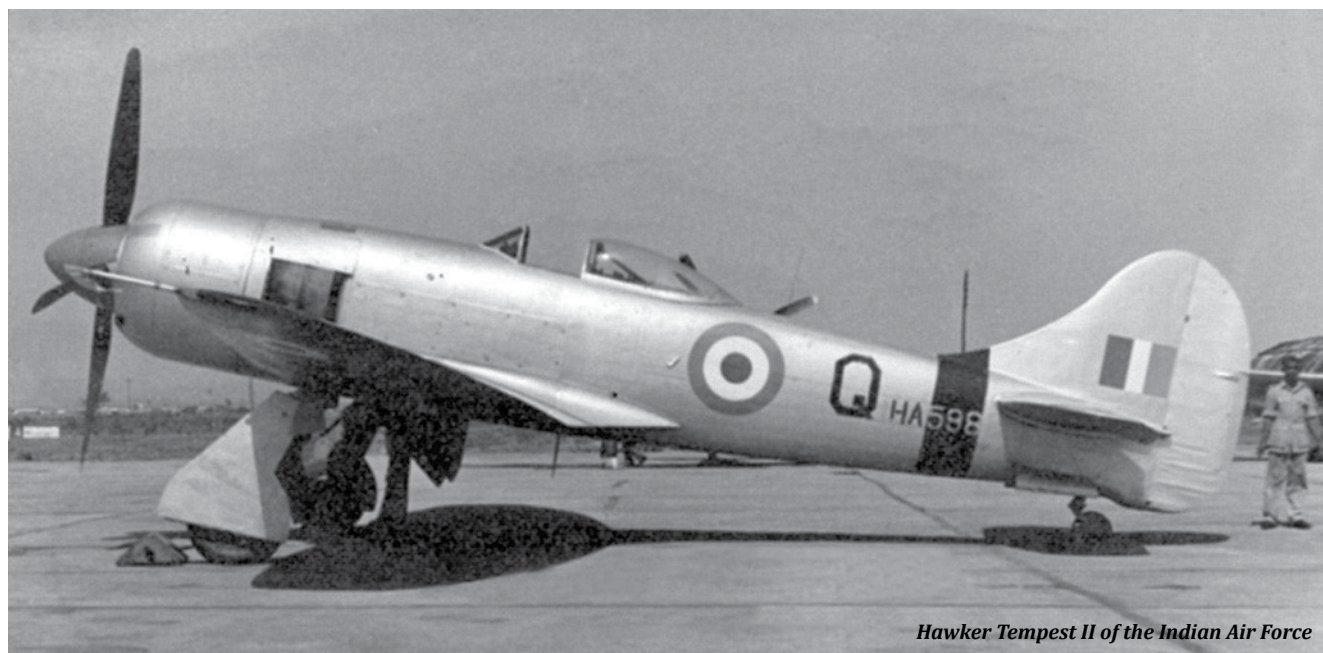
One practical use of the tie was demonstrated to me by my paternal grandfather, an agriculturist in a tiny village in what is today Chhattisgarh. He was the village *sarpanch* and I had never seen him dressed in anything other than kurta, pyjama and *chappals*. During World War II my school in Namkum (Bihar) had been taken over by the Army to serve as a military hospital, with the school temporarily relocated to Allahabad (UP). We no longer had the privilege of a special school train and all boarders were required to be personally escorted by parents/guardians to the new

location. I had just entered my teens and spent my summer vacation with my grandparents in the village. My father in Kolkata had requested my grandfather to escort me to Allahabad and, in view of the prevailing sartorial culture, had suggested that he wear western attire, including a tie, which he mailed to him by post and which I was required to knot for him. On arrival at our destination, we went to the railway waiting room where grandfather freshened up and emerged looking very smart and spruce in shirt, trousers and shoes. When I looked for the tie to knot, I found it looped neatly around his waist substituting for a belt he had forgotten to bring!

From school to college to the Air Force my wardrobe included a growing number of ties from academics, reunions, anniversaries, and by way of gifts. In 1980, while attending the Royal College of Defence Studies in London, the dress code was invariably a suit and therefore a tie was *de rigueur*. One day on the London tube, an older gentleman in front glanced frequently in my direction. When I disembarked at Earl's Court, he followed me and very politely asked if I

was wearing the Caterpillar Club tie? I complimented him on his keen eyesight and confirmed that I was. He then removed his scarf and I saw that he was wearing the same tie. In the station coffee shop we introduced ourselves and shared our experiences leading to membership of the club. I explained that I was from India and had bailed out from a Tempest fighter on fire in 1952. He was a Canadian and was the captain of a Lancaster RAF bomber during World War II and had also to bail out from his aircraft on fire over France in 1944. We exchanged names, addresses, and numbers and promised to keep in touch. From this chance encounter some years later, the story of my club membership appeared in a Canadian publication, 'Bless You Brother Irwin (The Caterpillar Club Story)' by John A Neal and titled by him as 'Bailout Over India.'

On retirement I disposed of most of my fancy ties but today, in my 85th year, I find I still have 30 hanging in my wardrobe, half of which are 'regimental' in nature and kept only for sentimental reasons. I am now very rarely required to wear a tie, so



Hawker Tempest II of the Indian Air Force

much so that I have almost forgotten how to knot one. But also in retirement, I have made the delightful discovery that any brand of whisky invariably tastes better in kurta, pyjama and *chappals*!

Republic Day Flypasts

This piece, being written in January, brings to mind the Republic Day flypasts in which I had actively participated in the first two decades after we became a republic. The spectators, thronging both sides of Rajpath in New Delhi, saw only the impeccable position-keeping of up to 64 aircraft flying in 16 boxes of 4 aircraft each. We fliers heard no applause nor saw anything other than the aircraft we were forming on and remained almost 'frozen' in position until far out of sight past India Gate.

The preparations for the R-Day flypast commence immediately in the new year and involves a great deal of planning, co-ordination, and rehearsals, all controlled by HQ WAC in Palam. The composition of the flypast grew rapidly into a mix of rotary, fixed-wing, piston, jet, single and twin-engine types, and transport/fighter blocks from a number of squadrons operating from several bases. These blocks were required to join up at the RV point and, orbiting like an airborne snake, uncoil into a mile-long straight line by the run-in point marked by

smoke candles to align the flypast with the dome of Rashtrapati Bhawan.

My very first R-Day flypast was in a Vampire in 1954 followed by one in a Toofani. In 1956, as a young QFI in Jodhpur, I was part of a detachment of 15 Harvard trainers that provided three boxes that year. The rest of my flypasts were all on the Hunter as Flt Cdr and then CO of a Palam/Hindon-based squadron. In the early 1960s a certain Group Captain commanding an air force station (who shall remain nameless), decided to lead the block himself in a Hunter T66 trainer with the other seat occupied by a navigator. On the first rehearsal, the visibility west of Delhi was poor and he missed both the smoke candles and Rajpath! The embarrassing debrief that followed was not in any way helped by some humourist, who claimed that the station commander concerned had received a message from the station master of Sonepat railway station thanking him for the flypast!

The presence of birds was a continuing flight safety hazard. It took its toll the next year when a MiG-21 flying just behind us in the supersonic block ingested a bird, causing its engine to flame out. The pilot, a young Flying Officer, very smartly pulled clear and ejected safely a bare minute before Rashtrapati Bhawan. The flypast went

through as planned and we only learnt about the ejection after we landed back at base.

Weather forecasting by its very nature is an inexact science, and the January weather in and around the flypast area was often uncertain. In 1970, I had taken 10 Hunters to Halwara to fly the Hunter block from that base. The final decision to cancel the entire flypast reached us as we were in the cockpit about to start engines. Two hours later we were cleared to return to base, flying almost the planned flypast route! With my squadron relocating to Pathankot in 1971, my participation in the R-Day flypasts ceased.

Then, in the mid-1970s, I was instructed to join five other gallantry awardees from the other two services as the MoD had decided to 'showcase' some of the Indian war heroes as part of the R-Day parade. It was my first opportunity to actually observe the function, seated 'to attention' in an open jeep. On one rehearsal, just after passing the saluting base, our jeep broke down. Fortunately, the media personnel present were slow to spot and report on three middle-aged senior officers pushing the vehicle to one side and then hot-footing it across the lawns to the CV Mess in search of (liquid) refreshment! For the next rehearsal we found that a standby jeep was now added to our tiny convoy of two!



Hunters over India Gate rehearsing for the R-Day flypast, now part of the IAF's lore

25 Years Back

The Advanced Jet Trainer

There has been continuous debate in Indian (and foreign) media on the Light Combat Aircraft (LCA) and even now no one quite knows the fate of that project. However, even with best estimates the LCA is targeted for service only from the year 2001. What has been relegated into relative obscurity in the dust and haze of the LCA situation, however, is the pressing requirement of the Indian Air Force for an Advanced Jet Trainer (AJT). One has been hearing for the last few years that the AJT is a *Priority Number One* requirement and that the lack of such an aircraft would start to critically affect the output of new combat pilots by the year 1992. We are already into 1992 and very little has been heard about the AJT over the past few years !

HAL focus on Civil Aircraft

HAL is now deliberately shifting focus to the design, development, manufacture and marketing of civil aircraft. According to HAL's Chairman, collaboration with foreign aircraft companies is being examined and "negotiations are on. We hope to strike a deal with one of the Companies." HAL had plans to co-produce turboprop airliners with capacity of 50-70 seats and are participating in the development of a 100 to 120-seat jetliner as also an executive aircraft with 10-seat capacity. Negotiations for joint collaborations would reportedly take place this year. Meanwhile, sub-contracts have been placed on HAL by some of the world's major airliner manufacturers including Boeing, Airbus Industrie, British Aerospace, Fokker and Dornier.

ALH Progress

The prototype of HAL's Advanced Light Helicopter will be test flown "positively" by September 1992 according to Chairman HAL. The development programme of the ALH has suffered a year's delay owing to "some technical discrepancies in the gear box" but these are now sorted out. The prototype was in the final stages of integration and all system tests had been carried out. The 5-ton ALH is being developed for the Indian Air Force Army and Navy while a Civil version (with a seating capacity of 14 pax) would be developed after deliveries to the Services are underway, slated for 1995-96. The detailed project report had been submitted to the government for production but the investment sanction was yet to be cleared.

Russians suspend Rocket Technology transfer

The Russians have suspended transfer of rocket technology to India, following pressure from the United States, Russian President Boris

From Vayu Aerospace Review Issue II/1992

Yeltsin has therefore ordered "a pause" in fulfilling the \$200 million contract between the Russian Space Agency 'Glavkosmos' and the Indian Space Research Organisation (ISRO).

HAL/BAe Software JV

The pilot scheme for a Joint Venture Software Company between Hindustan Aeronautics Limited and British Aerospace of the UK has passed the first earnings milestone for the last financial year. Both companies have made significant investment in facilities and high technology equipment to ensure that the scheme is successful. The pilot activity is housed in a separate Software Enclave adjacent to the HAL Complex in Bangalore. A dedicated satellite link provides voice, data and facsimile communications directly between the offices of the UK and Indian staff, and allows direct access from Bangalore into BAe Computer Complexes in the UK.

Indo-Malaysian Defence Co-Operation

During the Malaysian Defence Minister's visit to India, detailed discussions were held on various matters of mutual interest with the Indian Government. There is considerable scope for co-operation between the two countries in the fields of science and technology, industrial production and trade. On Defence co-operation, various on-going programmes were reviewed and new initiatives taken. It is learnt from reliable sources that India will assist Malaysia in its diversification plans for the modernisation of its armed forces, perhaps also influenced by the collapse of the Soviet Union.

US Assistance on LCA

The United States is continuing high-tech assistance for development of India's light combat aircraft (LCA), as confirmed by Dr VS Arunachalam, Secretary DR&DO. He said that the LCA project was going very well and the aircraft would be ready by 1995. He explained that even in Europe, only the French Rafale was equipped with this type of technology. Meanwhile, the Defence Minister had directed that the aircraft should be flying by 1995-96 and defended the time being taken to put the aircraft together, saying that even in the US it "takes years to design and manufacture such a prototype".

New Aircraft and Weapon Systems for CIS

Leaders of the Commonwealth of Independent States (CIS) were recently invited to examine new combat aircraft and missile systems developed by various bureau of the former Soviet Union. On display was the Sukhoi Su-27IB, a new two-crew, side-seating variant of the interceptor. Produced at a Sukhoi plant at Novosibirsk, however future of the Su-27 Flanker is uncertain and it is doubtful if the Su-27IB will survive the proposed defence cut-backs.

Another aircraft on display was the MiG-29M (*NATO Fulcrum Plus*) prototype, with glass cockpit, incorporating two multi-function displays and fly-by-wire controls. The MiG-29M has a new infra red search-and-track (IRST) system, similar to that on the navalised MiG-29K.

THE IAF's HISTORY ENSHRINED

HIMALAYAN EAGLES

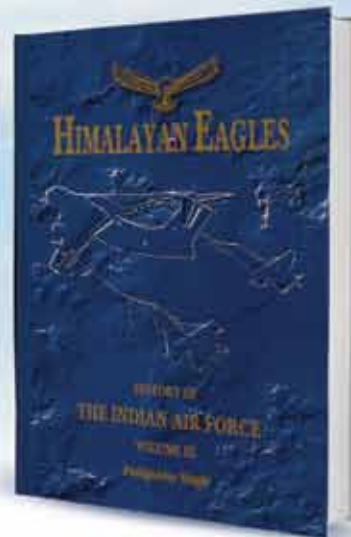
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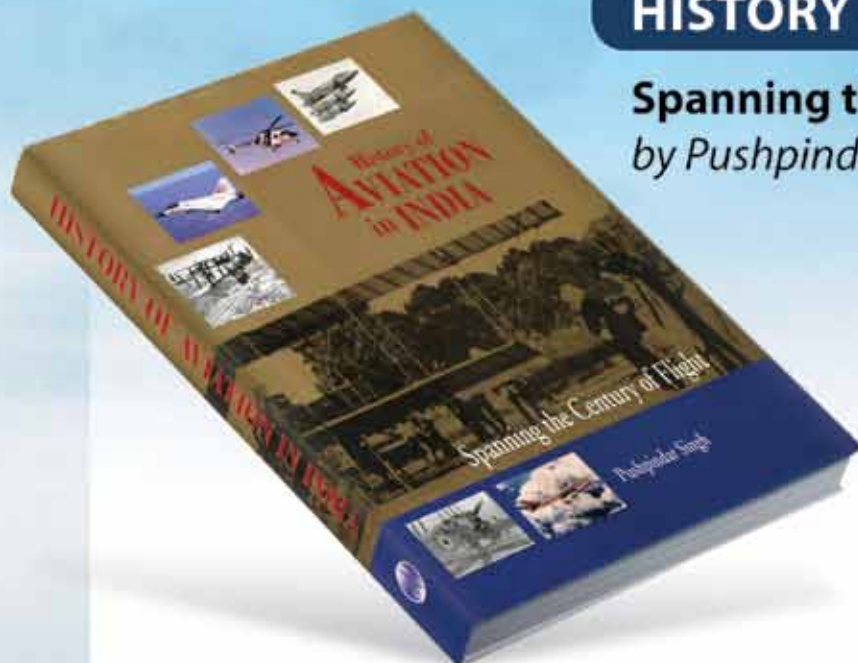
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Tale Spin

Thunder-heart



Since this Issue is Yelahanka-centric, it is appropriate to record the presence of some historic personalities at this Air Force Station. So, here too, was this RAF Sergeant Pilot from Palestine, during World War II, who converted to fly the Republic P-47 Thunderbolt at this Station and recalled with much nostalgia his time at RAF Yelahanka. Apart from flying training, he had developed a certain fondness for the daughter of an owner of a nearby bakery. When this gentleman re-visited Yelahanka half a century later, a red carpet was laid out by the Government of India, but his wish to locate that young lady was not fulfilled. Alas, the bakery had long closed and so eventually did this chapter of his life.

He was none other than Ezer Weizman, the seventh President of Israel, before which he was Commander of the Israeli Air Force and Minister of Defence, making a state visit to India in 1994.

Amigos Novamente

Nothing remains permanent ! For decades after 'Operation Vijay', the liberation of Portuguese Goa by India's Armed Forces in December 1961, the two countries ostensibly remained at a 'state of war' but



this finally only faded away some decades later. Interesting then that the Governments of India and Portugal have just signed an MoU on Defence Cooperation during the recent visit to India of Portugal's Goa-origin PM Antonio Costa. *Vida Cie!*

An aside : India's erstwhile Defence Minister Manohar Parrikar, who was then young boy in 1961, recalls that his father's lorry had been 'commandeered' by the Indian Army during that brief Operation. Hope it was eventually returned to the owner !

Extra-terrestrials and Sir Winston



Britain's Prime Minister during World War II, Sir Winston Churchill, is certainly known for his resolute leadership in the face of daunting odds during the 'Battle for Britain'. Less known is his conviction that there was life on other planets. Over 50 years before the discovery of exoplanets, Churchill considered likelihood that other stars would host planets concluding that a large fraction of these distant worlds "will be the right size to keep on their surface water and possibly an atmosphere of some sort".

Battles well beyond Britain ?

Standing room only !



That the sector Karachi-Medina is highly overbooked, is no exaggeration ! On one of PIA's recent flights (PK-743), this was so and thus on this Boeing 777, half a dozen passengers were given hand-written passes for standing in the aisle during the three hour flight. PIA's Boeing 777 has a seating capacity of 409 including jump seats for the staff, but PK-743 actually carried 416 passengers. Although the harassed senior cabin attendant informed the Commander of "chaos" in the cabin, she was advised to "adjust" them in any which way.

That the aeroplane (and its passengers) landed safely is tribute to both the aircraft manufacturer and the intrepid crew that (wo)man it !

Taking no chances !



From the internet, following the altercation on an Air India Airbus flight.

Afterburner



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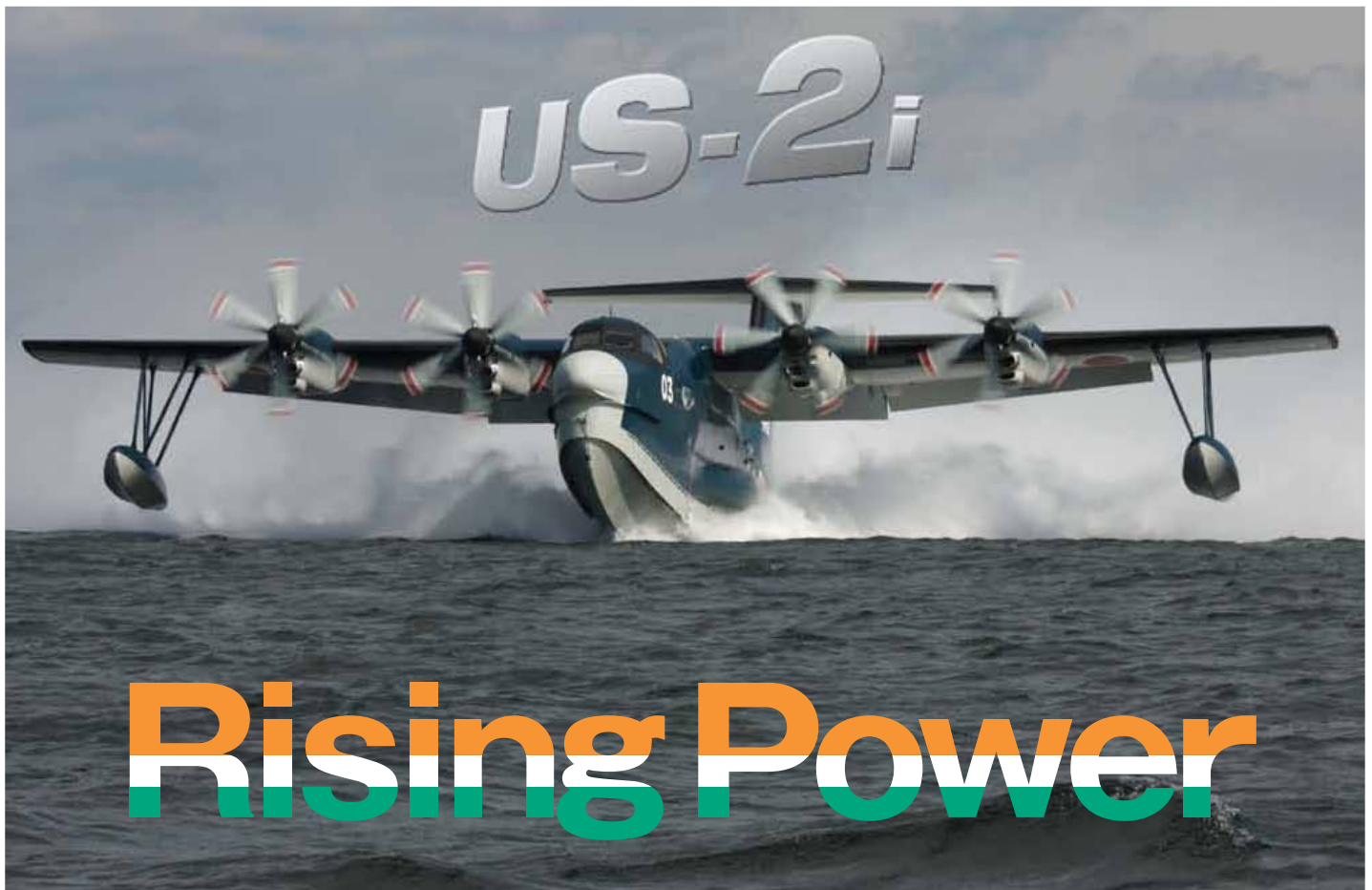


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