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I/2021

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I/2021

Cover : Hailing the Tejas !
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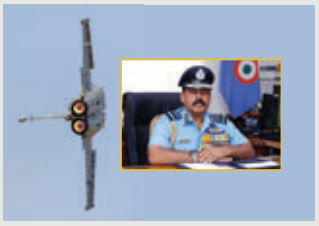

In *Vayu*'s interview with Air Chief Marshal RKS Bhadauria, CAS Indian Air Force, the Chief articulates upon the IAF's ongoing modernisation process, with timeframes for such activity running parallel to the induction and upgradation cycles. Focus is on induction of Tejas Mk.1As as also the HTT-40 and LCH while second half of the decade ahead should see selection of next generation platforms.

Admiral Arun Prakash, former CNS, urges that the Government must constitute a parliamentary committee with military advisers to oversee transformational reforms. This is in wake of the creation of a Department of Military Affairs (DMA) and a Chief of Defence Staff (CDS) a year ago.

13 January 2021 witnessed a landmark moment when the Cabinet Committee on Security (CCS) approved procurement of an additional 83 indigenous LCA fighter aircraft. In this article Sankalan Chattopadhyay reviews development of the light combat aircraft, from the Mk.1 (IOC/FOC) to the Mk.1A and beyond, the Mk.II or Medium Weight Fighter (MWF) leading to the Advanced Medium Combat Aircraft (AMCA), fifth generation fighter aircraft.

Two years on, revisiting the operation which targeted terrorist training camps at Balakot in 2019, Air Marshal Harish Masand (retd) analyses that event and the brief air actions the next morning to draw the right lessons. He rues the fact that against a Pakistani force of 24-26 fighters, the IAF launched a meagre force of 8-10 fighters and should have endeavoured to overwhelm the adversary. This distinguished former fighter pilot reiterates that the IAF needs to urgently revisit its doctrinal emphasis, rework future strategy and acquire the requisite combat support systems.

Lt Gen BS Pawar (retd) who was also head of the Army Aviation Corps rationalises why "Attack Helicopters must be organic with the Army". The case for inclusion of attack helicopters as part of the Army goes back to over half a century and despite an independent Army Aviation Corps being established in 1986, the Arm has continued to operate obsolescent light helicopters till augmented by the Dhruv ALH and its armed variant the Rudra. The shapes to come must include the AH-64E Apache as also the light combat helicopter (LCH) which would be a force multiplier in high mountains. (Ajai Shukla also writes on the LCH–the mountain fighter).

2021 AERO INDIA

As from the very first international Air Show organised and held in India, *Vayu Aerospace Review* continues to be at the forefront at this biennial event held at AFS Yelahanka, near Bangalore now in its 13th edition. The highlight this year is the Tejas light combat aircraft (LCA) and indeed the logo for Aero India is inspired by this "smallest and lightest multi-role fighter aircraft of its class, distinguished by its compound-delta-wing and tailless configuration". The world's leading aviation companies will again be taking part, showcasing their capabilities, many of which are highlighted in this special section.

Also: Shaheen IX; Growler, the Electronic Hornet; LM's AGM-158; Tomcats in farewell cruise; Kotroni Naval Air Station; Exercise Royal Blackhawk 2020; Air Policing in Romania.

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COMMENTARY

Don't bet on 2021

It is now conventional wisdom to say that 2021 will be better than the year gone by. Don't bet on it. The pandemic rages around the world and its aspect remains ferocious. Vaccinations have begun, somewhat fitfully though, in the country that is suffering its worst ravages – the United States. Just when vaccinations will actually alter the global trajectory of the pandemic is not clear, not only because it will take time to vaccinate enough people to create herd immunity, but because of the malevolence of this particular virus whose effects are even now not fully understood.

Beyond the course of the pandemic is the challenge of dealing with its consequences, as much social-psychological, economic and geopolitical. The global economy has been grievously hurt and the trendline of the future remains blurred. The immediate preoccupation of the incoming US President Joe Biden will not be China, Russia, climate change or the Indo-Pacific, but to heal the consequences of the pandemic in his own divided country.

For New Delhi, which has to bear, in addition to the pandemic, a political and military confrontation with Beijing, the United States is an irreplaceable element. No other country has the heft, and the ability, to intervene in the South Asia-Indian Ocean Region. Whether POTUS would be inclined to do so in light of the domestic problems he confronts, is another matter. Even though the gap between India and China's comprehensive national power has widened, India doesn't seek US military intervention. What it and many other countries want, is a greater clarity and sense of purpose from Washington in dealing with Beijing's wayward ways.

New Delhi needs to note, however, China's estrangement from the US is not as serious as the one with India. This is despite the tariffs and technology restrictions imposed in the Trump years, and the more active South China Sea stance of the US. In contrast to what India is seemingly attempting, decoupling is not an option for the US. The Biden administration is likely to retain the tariffs and technology restrictions and the forward posture in the South China Sea and then negotiate a rollback of tariffs in exchange for Chinese cooperation in a range of areas like climate change, pandemics and international trade.

Despite turning on the screws on domestic dissent and alienating a large part of the world, China is positioned to enter 2021 in better shape than its putative adversaries. It became a post-Covid economy in mid-2020 itself. Though there are signs of weakness in certain sectors of its economy, it cannot but gain from the creation of RCEP and its recent trade pact with the largest economy and trading bloc in the world, the EU.

As for India, headwinds will only increase in the coming years. The chance of becoming a $5 trillion economy by 2024 had receded before Covid hit. No amount of statistical jugglery or brave exhortations will change things. India has many things going for it – primarily, in the current context, being the "non-China".

Dr Manoj Joshi

Wait and watch

Amid existing tensions between India and China, reports have come in that New Delhi has informally asked airlines not to fly Chinese nationals into the country. Although airlines have said they haven't received any specific instruction to stop flying in Chinese nationals – many continue to board Chinese passengers – the issue is part of the larger frosty India-China dynamic.

There's no denying that ever since the Galwan Valley clashes in June, ties between the two sides have dipped sharply. China has been trying to capitalise on the Covid pandemic and unilaterally pushed its territorial and maritime claims. At the same time, it has been aggressively expanding its footprint in South Asia. Case in point, a high level Chinese team led by a vice-minister has been sent to Nepal to prevent a split in the ruling Nepal Communist Party – in what is overt political interference in another country.

Similarly, there are reports that Pakistan is fencing off a large part of Gwadar city to protect Chinese projects in the port area. This means that ordinary Pakistanis themselves will be kept out of Pakistani territory to please Beijing. China's $60 billion China-Pakistan Economic Corridor – a key part of Beijing's mega Belt and Road Initiative (BRI) – is increasingly unpopular in Pakistan, particularly in that country's Balochistan province where Gwadar is located. Recently, seven Pakistani soldiers were killed in Balochistan, highlighting local resentment against the Pakistani military and its cover for Chinese investments there.

Taken together, Beijing appears determined to ignore the lessons of history and engage in imperial overstretch. It perhaps feels that by increasing its influence in India's neighbourhood it can roll back New Delhi in what it sees as its natural strategic backyard. Here, a good Indian strategy would be to wait and watch, rather than to either work itself into a lather or try to imitate Chinese tactics. Let Beijing over-invest and impinge on Pakistani sovereignty, in which case it will face a natural pushback from Pakistanis (who may, in the goodness of time, even stop seeing India as their primary antagonist). Let Beijing buy up the Nepal Communist Party – which will come to be regarded by ordinary Nepalis as China's stooge. Moreover, given the power differential between India and the China-Pakistan axis, New Delhi has its work cut out defending its own borders. This is what the Centre should focus on now, along with rectifying the economy.

From *The Times of India*

"All-weather friends"

The Chinese defense minister, Wei Fenghe, visited Pakistan in December and met with the country's President Arif Alvi and Prime Minister Imran Khan, along with meeting Chairman of the Joint Chiefs of Staff Committee Nadeem Raza and Chief of Army Staff General Qamar Javed Bajwa. Earlier Wei had also visited Nepal. Writing on Wei's Islamabad trip, China Global Television Network (CGTN) quoted him as saying that "the China-Pakistan all-weather strategic cooperative partnership is unique in the world," language consistent with how China publicly describes Pakistan. During Wei's visit, both countries signed a memorandum of agreement around greater defence cooperation.

According to CGTN, during Wei's visit, Alvi promised Pakistan's support to China across issues including the South China Sea, Taiwan, and Tibet, and also to push ahead with the China-Pakistan Economic Corridor. Interestingly, according to CGTN, Wei also said China is "keen to jointly cope with risks and challenges with Pakistan, firmly safeguard the sovereignty and security interests of both countries and maintain regional peace and

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stability," language that would inevitably be interpreted in India as directed toward that country.

Over the year, as the Ladakh crisis continued unabated, Indian strategic experts pointed to the possibility of a two-front war where China and Pakistan on one side, and India on the other, find themselves in a shooting conflict. What has added salience to this fear is that India-Pakistan ceasefire violations show no sign of slowing down, with heavy artillery guns being used by both sides with alarming frequency over the past few years.

However, not all Pakistani analysts are convinced that China and Pakistan would be able, or willing, to jointly fight a war against India, fears of New Delhi's defense establishment notwithstanding. Speaking at a virtual event organized by a New Delhi think tank, Ayesha Siddiqa noted that there is limited interoperability between the militaries of the two countries, and that both would not prefer a large conventional war with India. Instead, Siddiqa suggested, for Pakistan, China's role is strategic as it manages to do what Pakistan hasn't been able to: keep India in check.

From *The Diplomat*

Maritime Command

China's aggressive posturing along the Line of Actual Control and its growing footprint in the Indian Ocean region have prompted India's armed forces to considerably raise their level of preparedness on land, sea and in the air. In November, the navies of the four Quad nations – the US, India, Japan and Australia – jointly conducted the Malabar military exercise in the Bay of Bengal and the Arabian Sea. The multilateral show of strength was intended to unnerve China, whose submarine fleet is three times bigger than that of India, and it did somewhat achieve its aim. Now, India is on course to set up an integrated maritime command that will have warships, fighter jets, helicopters, submarines, aircraft carriers and special amphibious brigades of the Army. The maritime theatre commander will be tasked with securing the sea lanes along the 7,500-km coastline.

The long-awaited move comes 19 years after India established its first unified command – the Andaman and Nicobar Command (ANC). Over the years, the ANC has been plagued by inadequate development of infrastructure, with a slew of environmental and coastal regulatory clearances being a major challenge. The unsavoury tug of war between the services is another stumbling block. The prolonged standoff in Ladakh apparently made the defence top brass look for ways to fast-track plans to strengthen the ANC. These projects should be executed without delay, even as the focus would eventually shift to the proposed maritime command, which is likely to be based in Karnataka. In view of the Andaman & Nicobar experience, infrastructural issues and mandatory clearances should be dealt with on priority so that the command becomes operational in a year or so, as envisaged.

The Chief of Defence Staff, Gen Bipin Rawat, has big plans to integrate the Army, Navy and Air Force while 'retaining the niche capabilities of each service'. Considering the current geostrategic scenario, it's clear that no single service can handle a conflict situation on its own. The key is to make the integration seamless so as to multiply the country's combat potential. The maritime command will serve its purpose only if various forces work as a cohesive unit.

From *The Tribune*

Beyond Air India

The government's proposed sale of Air India has finally, after several abortive attempts, begun to see some forward movement. Several expressions of interest have been reportedly received, including one from the Tata Group, which has long had an interest in the airline - which is, after all, a direct descendant of the Tata Airlines that was nationalised after independence. Any sale of Air India to the Tata group would be seriously complicated by Tata Sons' interest in two other airlines - the low-cost carrier AirAsia which it runs with a Malaysian partner, and the full-service Vistara, where its partner is Singapore Airlines. While over all some consolidation in the sector would be useful, the fact is that airline mergers have not typically done well in India, and Tata Sons' partners might have different views on the way forward. Also, if Air India and Vistara merge, that would leave India with only one full-service airline and give the merged entity a near-monopoly in India of long-haul international travel.

From the point of view of the government, however, the need is to get Air India off the books as soon as possible. In any case, it was unlikely to ever get a good price for an airline that is so encumbered and no longer even has goodwill with flyers. The pandemic, which has hurt the travel and leisure industry in particular – and from which, in spite of vaccine availability, there is no clear timeline for emergence when it comes to consumer behaviour – will further reduce the willingness to pay for an airline. So the government must clearly understand well in advance that the point of this sale is not revenue generation. It is to get an asset that drains away resources off the government's balance sheet. It is also important to use this repurposing of these assets to revitalise a troubled sector and to more efficiently deploy existing capital.

It is worth considering these facts in the larger light of the disinvestment programme. Too often disinvestment is seen by the government purely in terms Of the revenue that can be generated in order to plug fiscal holes. And certainly, in the current context - with the goods and services tax systematically under-performing in revenue generation and more and more calls on the fiscal, given the exigencies of the pandemic – extra non-tax revenue is especially welcome. But the broader argument for disinvestment is that the private sector would make more efficient use of assets, which t] re government may have run into the ground. At a time when growth and recovery is of paramount importance, this argument for complete privatisation can no longer be discounted. Air India must only be a beginning. The government must begin to look around to see what else is being under utilised by public sector participation or monopoly. Coal resources, for example, will now be better utilised given the opening up of private mining earlier this year. Even the profitable public sector can no longer be thought of only as a cash cow for the government. While the government will hopefully ensure that this time the Air India sale goes forward and is closed; it must also consider a longer-term outlook on privatisation at this point. In May 2020, Finance Minister Nirmala Sitharaman had talked about a public Sector Enterprises policy that will make sure there is a maximum of four PSEs in strategic sectors, while others are privatised. Eight months later, the policy is still in the works.

From *Business Standard*

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Admiral Arun Prakash asks as to

"Why Everyone Is Looking Seawards for Options"

Given the economic, technological and military asymmetry between China and India and the Sino-Pak axis, if hostilities were to break out, the best that India can hope for is a precarious stalemate on its northern and western borders. This seems to be the reason why everyone is now looking seawards for options other than 'boots on the ground,' which could reinforce India's negotiating position.

An obvious option is to use two closely related maritime templates: the naval exercise 'Malabar' and the 'Quadrilateral Security Dialogue' or Quad (both with common membership), for creating a more equitable balance of power vis-à-vis China.

The US Navy Chief, perhaps, went too far when he declared, during Malabar 2020, that operating with Quad partners was critical to "building a more lethal fighting force."

But India, as it prepares to fight its own battles, needs to rally this quartet of democracies, and create a consensus for

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ensuring that a 'rules-based order' prevails in Asia and the Indo-Pacific.

Other nations too must be mobilised and motivated to show solidarity in the common cause of reigning-in a hegemonic China.

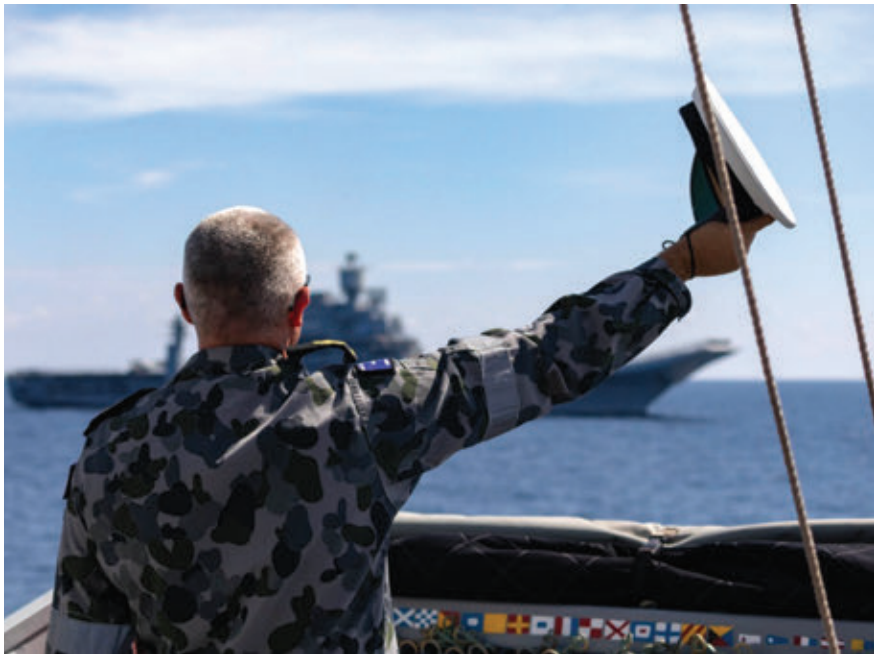
In terms of direct naval action, India's best option would be to employ conventional 'naval deterrence,' to dissuade China from pursuing its course(s) of action.

As the world's largest trading nation and energy importer, China's seaborne trade and energy constitute a vulnerable 'jugular vein'. While imposing blockades and waging trade-warfare are complex operations that call for naval superiority, there is a simpler form of compellence, termed, *maritime interception operations.* It involves the stopping, seizing or diversion of suspect ships.

Regardless of buffer stocks, any disruption or delay of shipping traffic could upset China's economy, with consequent effects on its industry and population.

The IN, in spite of fiscal constraints, has emerged as a compact but professional and competent force, and India's fortuitous maritime geography will enable it to dominate both the Bay of Bengal and the Arabian Sea. We must, however, bear in mind that China's PLA Navy (PLAN) – which now outnumbers the US Navy – is backed, not only by a prolific shipbuilding industry, but also the world's largest merchant fleet and a huge coast-guard, assisted by a maritime militia. It is possible, that we may, one day, see a Chinese *Indian Ocean carrier task-force*, based in Djibouti or Gwadar.

In the emerging maritime scenario, the IN will need more warships, submarines, helicopters, minesweepers and much else. Some of these are under construction, or on order. But given the dismal state of India's economy, warship retirements and a lethargic shipbuilding industry, the IN is unlikely to get a significant force-levels boost in the foreseeable future.



As we reflect on India's maritime security dilemmas, let us hark back to two historical events. In August 1971, in a major deviation from its policy of non-alignment, India signed the 20-year Indo-Soviet Treaty of Peace, Friendship and Cooperation, specifying "mutual strategic cooperation".

This alliance sent a strong signal to both Washington and Beijing, to remain "hands off," and was a crucial factor in India's 1971 victory. It served India's vital interests, at a crucial juncture, and did no harm to its image or standing.

In 1941, when the Allied nations – reeling under the German onslaught – sought US help, President Roosevelt signed the 'Lend-Lease Act,' under which the US 'lent' war materiel, including warships, tanks and aircraft to the UK, France, China and even the Soviet Union. In return, the US received leases on naval bases during the war.

Roosevelt explained it thus: "Suppose my neighbour's home catches fire, and I have a garden hose… if he can borrow my hose… it may help him put out the fire."

It would be a fitting demonstration of India's 'strategic autonomy,' in supreme national interest, if we could 'borrow a garden hose' to pre-empt any conflagrations in the Indo-Pacific. Especially if it buys us a breathing spell for attainment of '*Atma Nirbharta.*'

(All photos are from Malabar 2020)

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OPINION

Don't Mock It !

Air Marshal Brijesh Jayal on the Country's Honours System

The British honours system is one of the oldest in the world and has evolved over six centuries as the country found alternative means of recognising merit, gallantry and service. John Lidstone, a commentator on the honours system has noted that "every country needs to honour by exception people who have done outstanding things in bravery, civilian life or elsewhere". That India also opted to follow this tradition from its colonial rulers speaks of the sagacity of our founding fathers. Whilst military awards for gallantry, operations and distinguished service continued as per tradition after Independence, the institution of civilian awards only came into being in 1954 some years after India became a Republic.

Civilian awards are essentially graded by degrees of honour with the Bharat Ratna being the highest and most prestigious followed by the Padma series of Vibhushan, Bhushan and Shri. The decoration is conferred by the President by a Sanad under his hand and seal. Like military awards, these are Presidential awards announced in the annual Republic Day Honours list and conferred on those who have excelled in their field of work and made the nation proud. As per the awards' statutes, while there are no specific criteria for an award to be annulled or cancelled, this can only be done by the President of India. Three such cases are on record.

Whilst military personnel are eligible for a civilian award, the reverse is not normally the case. Again, whilst military awards can be suffixed to the recipient's name, in the case of civilian awards, the recipients are not entitled to use these as titles or suffix. This perhaps stems from Article 18 of the Constitution that forbids titles. Apart from particular awards for the police and acts of bravery, the National Award system has further been expanded by both central and state governments to include various literary, cultural, educational, sports, entertainment and other fields to recognise works of distinction and exceptional achievements where citizens distinguish themselves.

It stands to reason that disrespect to any award bestowed on an individual under the national honours and awards system, is a slight to the nation itself. This is the sanctity of a national award and those chosen for such an honour are expected to respect this sacred unwritten code. Unfortunately, we live in times where public discourse sometimes tends to verge on the uncivil and under the banner of freedom of speech and democratic right to protest, even national awards have now become a handy tool.

Commenting on the recent 'award wapsi' of a Padma Vibhushan by a senior political leader and erstwhile CM of Punjab, the current chief minister, himself a very distinguished military veteran and historian is reported to have wondered why the former was awarded the Padma Vibhushan in the first place and what sacrifice had he made for the community? Further, he compared this award to that of a senior Indian army Lt Gen who was awarded for his contribution to winning the 1965 war with Pakistan. Clearly, the veteran CM was attempting to score a political point and one wishes that he had not only left the military alone but also not dragged the Honours and Awards system into the political arena.

India perhaps has the dubious distinction of being the first country to have actually formalised the practice of a recipient of a national award returning the honour as a means of protest by coining the phrase 'award wapsi'. This has now become one more weapon in the armoury of those that wish to either lodge a democratic protest, express their displeasure on any issue of their choice or indeed just attempt stealing the limelight. However selfless or noble be the motive, such an unfortunate step is a direct slight to the National Honours and Award system and its very ethos.

With the British Honours System, there is also an ad-hoc 'Honours Forfeiture Committee.' This considers cases where an individual's action subsequent to their being awarded an honour either brings the honour system into disrepute or raises questions whether they should be allowed to continue to be a holder. One can only guess that whilst our founding fathers chose to follow the British tradition of the Honour System, in the euphoria of our hard-won independence and national pride in its achievement, they felt no need to consider a forfeiture option. This optimism now stands belied.

It is perhaps time for us in India to emulate the British example and institute a 'Reward Annulment Committee', whose task should be to consider cases brought to its notice of those awardees that have allegedly brought disrepute to their award under the National Honours and Award system and consider recommending its annulment to the awarding authority. No self-respecting nation should be seen to sit idly by whilst those it chooses to honour mock it's Honour System.

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SECURING THE FUTURE

Cabinet approves order for LCA Mk.1A

Under Chairmanship of the Prime Minister, on 13 January 2021 the Cabinet approved procurement of 73 LCA Mk.1A single seaters and 10 LCA Mk.1 two seaters at the cost of Rs 45,696 crore (US $ 6.3 billion) along with infrastructural cost of Rs 1,202 crore (US $ 165 million). The LCA Mk.1A variant will be equipped with Israeli-origin Active Electronically Scanned Array (AESA) radar, Beyond Visual Range (BVR) missiles, Electronic Warfare (EW) suite and Air to Air Refuelling (AAR) system. The power plant remains the GE F.404F2/J-IN20 turbofan of 90 kN with afterburner.

HAL is currently producing the LCA Mk.1 (FOC) to equip a second squadron, a first already operating the Mk.1 (IOC).

The 'Avro replacement' project

What has also been pursued for several years is the 'Avro Replcement Project' for 56 aircraft to supplant the present fleet of HAL-built Avro (HS/BAE Systems) 748 medium transport aircraft. Some 89 of these aircraft were built by HAL's Kanpur Division and essentially operated by the Indian Air Force apart from some 19 aircraft given to the erstwhile Indian Airlines. The

aircraft type had a controversial service life but the 56 aircraft remaining on the IAF's inventory are used for staff transportation, multi-engine conversion training, navigator/signal training as also for light logistics support.

The successor aircraft has been identified as the Airbus C-295 from Spain but is not to be built by the public sector undertaking HAL but Tatas, the private sector company which will assemble the subsequent 40 aircraft, the first 16 being imported from Spain. The total project cost is given is Rs 11,929 crore.

Airbus A320 selected platform for AEW&C Mk.II

Acceptance of Necessity (AoN) for procurement of six Airborne Early Warning & Control Mk.II aircraft for the IAF, with associated equipment was cleared by the DAC on 17 December 2020 under 'Buy (Indian-IDDM)' category. Platform for the system is likely to be pre-owned Airbus A 320 family aircraft ex-Air India *(artist's image above)*. The mission system design and development as well as maintenance of the system will be carried out in India by DRDO's Centre for Airborne Systems (CABS). It is also possible that Airbus will propose a variant of Saab's Erieye radar to be integrated in the A320, following its proposal on an A330-based AEW&C variant for the UK to replace its E-3D fleet.

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Maritime Theatre Command

Reports on the planned creation of a Maritime Theatre Command (MTC), headquartered at Karwar in Karnataka, have indicated that this will be headed by a senior Naval 3-star Vice Admiral and charged with responsibility for the country's 7,516-km coastline and 1,382 islands as well as the entire Indian Ocean Region (IOR) and beyond. With two sub-theatres for the west and east, "the MTC will bolster joint operations and application of force in the maritime domain," according to sources. This becomes crucial in face of China's ever-expanding naval footprint in the IOR, with China already having the world's largest fleet with 350 warships and submarines and plans to reach a force-level of 420 by the end of this decade.

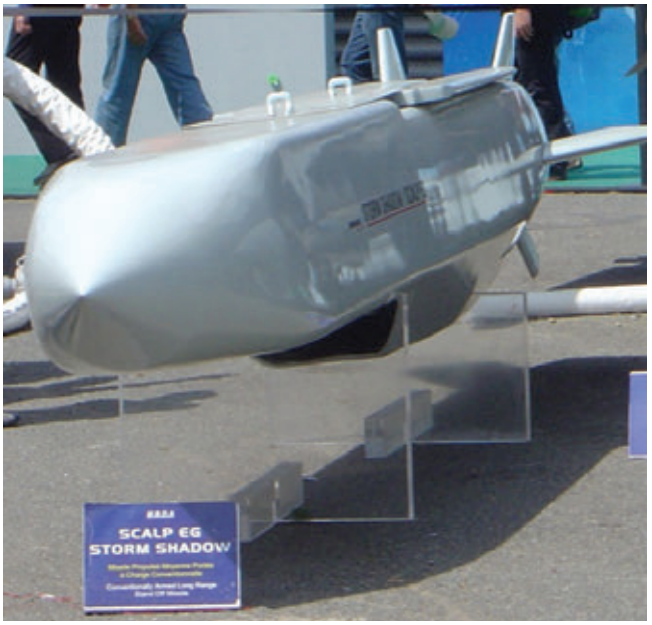
As per the plan prepared by a group led by the VCNS Vice Admiral G Ashok Kumar, the MTC will subsume the Western Naval Command (Mumbai), Eastern Naval Command (Vizag), the tri-service Andaman & Nicobar Command (Port Blair) and the Southern Air Command (Thiruvananthapuram). Various elements of the Coast Guard will be integrated in the MTC along with two Amphibious Brigades of the Army.

Indian-French Air Exercises

With more Dassault Rafales being ferried from France to India, three more aircraft arriving in January 2021 to augment the 8 Rafales already in service with the IAF's No.17 Squadron, joint air exercises between the two Air Forces were planned for mid-January 2021. For this, four Rafales along with an Airbus A330 MRTT of the Armée de l'Air, which had earlier carried out joint exercises with the Royal Australian Air Force were deployed to India for exercises over the Rajasthan desert ('Exercise Skyros'). According to an IAF spokesmen, the joint exercises are "another example of the deepening military ties between the two countries". It is pertinent that the Government of France has supported India on several occasions in context of the faceoff with China along the LAC, the French Defence Minister conveying their "steadfast and friendly support in these difficult circumstances".

Rafale at Garuda 2019

SCALP recalibrated for IAF Rafales



As part of the Indian Air Force Rafale's weaponry is the MBDA SCLAP *Système de Croisière Autonome à Longue Portée – Emploi Général*, or General Purpose Long Range Cruise Missile), also known as *Storm Shadow* in British service. This Anglo-French low-observable air-launched cruise missile was developed from 1994 by Matra and British Aerospace, and now manufactured by MBDA, According to media reports, MBDA have recalibrated software of SCALP so as to hit targets upto 4,000 metres above sea level which is considerably higher than that of the standard weapon.

S-400 programme 'advancing well'

Russian Ambassador to India Nikolay Kudashey has recently stated that India's contract for acquiring S-400 strategic surface-to-air missiles was "advancing well" despite the threat of potential US sanctions. His remarks were in context of the US imposing sanctions on Turkey over its $2.5 billion deal with Russia for the S-400 air defence systems under the *Countering America's Adversaries*

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Through Sanctions Act (CAATSA). The Governments of India and Russia had signed a $5.4 billion deal for the five S-400 systems in October 2018 and the first batch is expected to be delivered by the end of 2021, all deliveries to be completed in a five year period.

MoD to lease-purchase A330 MRTT?

It is reported that the Indian MoD are considering a French proposal to acquire six Airbus A330 multirole transport tankers (MRTT) to meet urgent requirements of the Indian Air Force which presently operates Russian-origin Il-78 MKIs. The Airbus A330 MRTT is a military derivative of the A330-200 commercial airliner, designed as a dual-role air-to-air refuelling and transport aircraft and has been ordered by Australia, France, United Kingdom, United Arab Emirates, Saudi Arabia, Singapore, South Korea and by NATO in a multi-Nation deal. Apart from refueling two fighters simultaneously through drogues or central refueling boom systems, the MRTT can accommodate 260 personnel in its cabin, which can also be converted for casevac tasks.

DAC approves proposals for Rs 28,000 crore

The Defence Acquisition Council (DAC) in its meeting on 17 December 2020 approved Capital Acquisition proposals of various weapons/platforms/equipment and systems required by the Indian Army, Indian Navy and Indian Air Force at an overall cost of some Rs 28,000 crore. This was first meeting of the DAC under the new regime of *Defence Acquisition Procedure 2020* and the first set of *Acceptance of Necessity* (AoNs) accorded in the categorisation of 'Buy Indian' (IDDM). Six of the 7 proposals will be sourced from Indian industry. Acquisition proposals approved include the DRDO-designed and developed AEW&C Systems for the Indian Air Force, Next Generation Offshore Patrol Vessels for the Indian Navy and Modular Bridges for the Indian Army.

More IAI Harops

Case for procurement of more IAI Harop (P-IV) and upgrade of other UAV systems "are at an advanced stage" with contracts likely to be signed in Q1 of 2021. As per reports, the IAF already has 110 of them and 54 more are likely to be ordered.

"India stood up to China": Defence Minister

Defence Minister Rajnath Singh has said that India stood up to China's "unprovoked aggression" on the Line of Actual Control (LAC), fought the People's Liberation Army (PLA) and

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forced its troops to retreat. These unusually blunt remarks were made by the Minister at an annual convention in New Delhi. He continued in that "India is at a point in its history when it needs to stand up itself and make it known that it can fight anyone". The Minister also said that "whenever there is situation at the LAC, the most obvious outcome is a comparison between India and China's military strengths. There can be a serious debate on who owns more military might but when it comes to soft power there is no scope of ambiguity".

Major re-deployment of Army

According to public sources, the Indian Army will deploy additional Divisions to the 'northern front' so as to reinforce the present forces facing the Chinese Army in north eastern Ladakh. The present XIV Corps with three Divisions will be reinforced by two Divisions from the present 1 Strike Corps, thus creating two Mountain Strike Corps, one each for the north western and north eastern frontiers with China, the recently raised XVII Mountain Strike Corps dedicated to the latter. The 1st Armoured Division of the Mathura-based 1 Corps will now reportedly become Army Headquarters Reserve, focussing on the Western Theatre. Reports have it that the Army is also planning to realign a Division from an existing Corps to focus exclusively on the central sector with China. This Division is likely to be under the Army's HQ Central Command and will focus on the central theatre, thereby strengthening offensive options in case of any protracted conflict with China. The western theatre is being re-organised in such a way that two Strike Corps continue to focus on that front with adequate support from the existing Pivot Corps (those deployed for defensive options) so as to retain the offensive options against Pakistan.

"Forces ready for any eventuality": CDS

Chief of Defence Staff (CDS) General Bipin Rawat has stated that the People's Liberation Army (PLA) continues to carry out development actyivities in Tibet Autonomous Region of China, amid the Sino-Indian standoff at Ladakh. He also said that Indian forces are well-equipped to deal with any eventuality, and similar activities are being undertaken in the country. "We are locked in a stand-off in Ladakh. There is some development activity which has been going on in Tibet Autonomous Region of China. I don't think there should be much concern, as we, on our side, are also carrying out similar activities".

"Ready to deal with any eventuality": COAS

At his annual Press Conference on eve of Army Day 2021, Chief of the Army Staff General MM Naravane was hopeful that India and China will be able to reach an agreement to resolve the eastern Ladakh standoff but at the same time asserted that Indian troops will maintain a high state of combat readiness to deal with any eventuality. Talking about increasing security challenges at the Line of Actual Control, the Chief of Army Staff said a need was felt about "rebalancing" of troops along the northern borders, adding "that is what we have put in place now." (*see news item*).

Nearly 50,000 troops of the Indian Army are currently deployed in a high state of combat readiness in various mountainous locations in eastern Ladakh in sub-zero temperatures even as multiple rounds of talks between the two sides have not yielded concrete outcome to resolve the standoff.

COAS visits LAC

Earlier General MM Naravane had visited forward areas of XIV Corps including at Rechin La and undertook a first-hand assessment of the situation along the LAC. He was briefed by the GOC XIV Corps and local commanders on operational preparedness of the forces, including armoured regiments positioned in Eastern Ladakh.

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CAS visits Ladakh

Air Chief Marshal RKS Bhadauria, Chief of the Air Staff visited Ladakh on 11 January, including Daulat Beg Oldie (DBO), Thoise and Nyoma ALGs where he reviewed ongoing logistic support operations for sustenance of troops in severe winter conditions. The Air Chief also met Chief of the Defence Staff General Bipin Rawat alongwith senior IAF and Army Commanders at the Air Force Station Leh.

36 new helipads for Ladakh

The Government has announced construction of 36 new helipads in Ladakh, to be completed by mid-2021. These are logically for strategic reasons but also "to give an impetus to the tourism sector". The helipads in Leh district are being constructed at Demchok, Hanle, Kharnak, Korzok, Chumur, Tangtse, Chushul, Shayok, Skympata, Dipling, Neryaks, Kanji, Markha, Panamik, Waris, Largyab, Agyam, Diskit and Sumor. Further, the helipads in Kargil district are being constructed at Kurbathang, Batalik, Sapi, Barsoo, Cheycheysna, Shephard Nala (Parkachik), Rangdum, Tangole, Padum, Longnak, Zangla, Tongri, Dras, Minamarag, Chiktan, Namkila and Hinaskote.

'The Great Game' Redux

In his incisive commentary, Professor Harsh Pant of the King's College London has said that China's footprint is at an all time high as has been evident for sometime now that States in South Asia and wider Indian Ocean Region cannot remain immune from the lure of Chinese political ane economic muscle, much like the rest of the world. "That China and Pakistan would collude in Afghanistan is not news, but what is important is the new reality confronting China today that as it becomes more proactive in shaping its regional environment, the facade of promoting peace and prosperity will quickly wear off".

China's footprint in Nepal has also been growing in recent years with billions of dollars of investments under its multi-billion dollar *Belt and Road Initiative* (BRI), including the Trans-Himalayan Multi-Dimensional Connectivity Network. As Professor Pant puts it "by standing up militarily to China on the Himalayan borders, India also made it possible for smaller nations at the reeiving end of Chinese aggression to envision the posibility that subserience to China is not the only option".

Japanese Air Chief in India

General Izutsu Shunji, Chief of Staff, Japan Air Self Defence Force (JASDF) visited India from 9 December 2020 on a formal invitation from the IAF Chief. According to an official statement "the CAS and CoS-JASDF recognised the progress made

in defence ties between India and Japan and discussed avenues to further enhance cooperation and interoperability and scope for enhancement of joint exercises and training between the two Air Forces. A broader cooperation for strengthening collective response to HADR contingencies was also discussed".

IAF Combined Graduation Parade

A Combined Graduation Parade (CGP) was held at the Air Force Academy, Dundigal on 19 December 2020, which marked successful culmination of training for 114 Flight Cadets of Flying and Ground Duty Branches in the Indian Air Force. This included 21 women, six from the Indian Navy, five from the Indian Coast Guard and three officers from "Friendly Foreign Countries" (Vietnam and Nigeria). Addressing the Parade, Defence Minister Rajnath Singh complimented the newly commissioned Flying Officers for their "immaculate turn out, precise drill movements and high standards of parade".

Third aircraft carrier an "operational necessity"

Chief of the Naval Staff Admiral Karambir Singh has again spoken on the importance of aircraft carriers, making this statement on the eve of Navy Day 2020. The CNS said that the Force "does not want to be a Navy tethered to the shore" and "air power at sea is absolutely required. The Navy is all about reach and sustenance, if you, as a nation, that is aspirational…. You will have to go outwards, seek the world you will have to move out… and for that you require air power, and you require it at longer range, aircraft carrier is absolutely necessary". Another senior Indian naval officer underlined the importance of air power at sea, stressing on the need for "persistent air power – it should be there, day and night…. how does America come, how can China come (close to Indian Ocean Region)? Because they are guarding their interests".

Three aircraft carriers are tactically needed as in the future "surge capability" will be needed which a third carrier will add, the admiral said. Another reason to build and have a third carrier is because of the experience gained by the Indian Navy and the country to run them. "We are very lucky that we have learned how to operationalise aircraft carriers and naval aviation over 60 years. We have mastered the art of maritime aviaiton. We have developed the skill over the years, it is not easy to operate an aircraft carrier. We should not let this skill go to waste".

Boeing F/A-18 Super Hornet demonstrates ski-jump launch

Boeing and the US Navy have confirmed that "the F/A-18 Super Hornet can operate from a 'ski jump' ramp," pointedly demonstrating the aircraft's suitability for India's aircraft carriers. The demonstrations, held at Naval Air Station Patuxent River, MD, "prove" that the Super Hornet would do well with the Indian Navy's Short Take-off but Arrested Recovery (STOBAR) system and validate earlier simulation studies by Boeing. "The F/A-18 Block III Super Hornet will offer the Indian Navy value in the form of advanced war fighter technologies at a low acquisition cost and affordable cost per flight hour because of its ease of maintainability, design and durability."

Navy to acquire Sea Guardians

Following the lease of two GA-ASI Sea Guardian RPAs from General Atomics by the Indian Navy, (see *Vayu Issue VI/2020*), the Service has moved a proposal to the MoD to procure ten MQ-

9B Sea Guardians in "fast-track mode," for an estimated Rs 1,300 crore. This would greatly enhance maritime surveillance capabilities in the seas around the Indian peninsula.

HMS *Himgiri* launched

On 14 December 2020 the Indian Navy's second Project 17A frigate INS *Himgiri* was launched at the Garden Reach Shipbuilders and Engineers Limited (GRSE) in Kolkata. General Bipin Rawat, CDS was the Chief Guest at the ceremony. INS *Himgiri*, which is expected to be commissioned by August 2023, is the second of the seven *Nilgiri*-class Project 17A stealth guided missile frigates being constructed for the Indian Navy. The Indian Naval Ship has taken its name and crest from the second frigate of the *Leander*-class of ships, which was launched 50 years back.

Refit of Maldivian Ship CGS 'Huravee'

Indian Naval Dockyard, Visakhapatnam has completed refit of the Maldivian Coast Guard Ship CGS *Huravee*. Rear Admiral Sreekumar Nair, Admiral Superintendent handed over the ship to the Commanding Officer Major Hussain Rasheed at Visakhapatnam on 25 November 2020. MNDF CGS *Huravee* (originally INS *Tillanchang*) is an Indian-built *Trinkat*-class patrol vessel constructed at GRSE, Kolkata and subsequently gifted to the Maldives.

Flight trials of Sahayak-NG

The Indian Navy have conducted test trials of the *Sahayak-NG* indigenously designed and developed Air Dropped Container from an Il-38SD aircraft off the coast of Goa. This aims to enhance operational logistics capabilities and provide critical engineering stores to ships which are deployed more than 2000 km at sea and reduces requirement for ships to come close to the coast to embark spares and stores.

India-Indonesia Coordinated Patrol

35th edition of the *India-Indonesia Coordinated Patrol (CORPAT)* was conducted 17-18 December 2020. INS *Kulish*, an indigenously built missile corvette along with P-8Is undertook coordinated patrols alongside Indonesian Naval Ship KRI *Cut Nyak Dien*, a *Kapitan Pattimura* (*Parchim* I)-class corvette and a MPA of the Indonesian Navy. The two navies have been carrying out CORPAT along their International Maritime Boundary Line since 2002, with the objective of ensuring safety and security of shipping and international trade in the region. "CORPATs build

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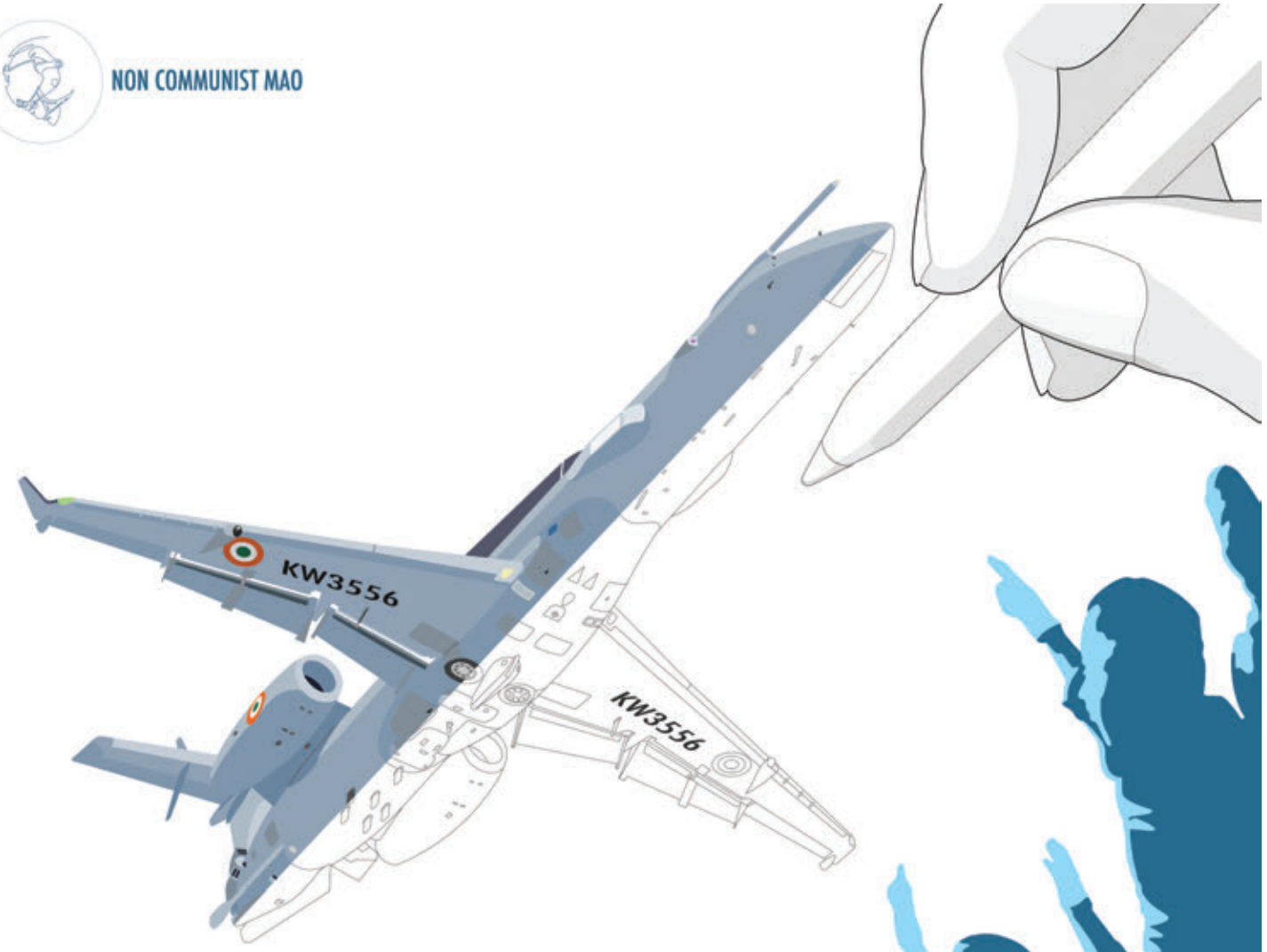

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up understanding and interoperability between navies and facilitate institution of measures to prevent and suppress Illegal Unreported Unregulated (IUU) fishing, drug trafficking, maritime terrorism, armed robbery and piracy".

PASSEX between Russian and Indian Navies

On 4-5 December 2020, the Indian Navy undertook *Passage Exercise* (PASSEX) with the Russian Federation Navy in the Eastern Indian Ocean Region. Involved were the RuFN guided missile cruiser *Varyag,* large anti-submarine ship *Admiral Panteleyev* and medium ocean tanker *Pechenga.* The Indian Navy was represented by the frigate INS *Shivalik* and anti-submarine corvette INS *Kadmatt* alongwith their integral helicopters. The exercise was aimed at "enhancing interoperability, improving understanding and imbibing best practices between both the friendly navies, and would involve advanced surface and anti-submarine warfare exercises, weapon firings, seamanship exercises and helicopter operations".

In end-December 2020, another Passage Exercise (PASSEX) was conducted between the Vietnamese and Indian Navies to "reinforce interoperability and jointness".

Passing out parade of Naval Officers

The 98th Integrated Officer Trainees Course passed out on 5 December 2020 on completion of their afloat training onboard ships of the *First Training Squadron*. The course consisted of 132 officer trainees, including 114 Naval, 13 Coast Guard and 5 foreign trainees from Myanmar, 1 each from the Maldives, Seychelles

and Tanzania. *The First Training Squadron* is based at Kochi and comprises INS *Tir*, *Magar*, *Shardul*, *Sujata*, Indian Coast Guard Ship *Sarathi* and Sail Training Ships *Tarangini* and *Sudarshini*.

CINCAN Unit 'Appreciations'

Lt Gen Manoj Pande, C-in-C Andaman & Nicobar Command (CINCAN) awarded Unit Appreciation 2019-20 for "outstanding performance" to 12th Bn the Jat Regiment, INAS *Utkrosh* and INHS *Dhanvantari*. He commended the personnel of the Naval Air Station at Port Blair for their 24x7 involvement in conduct of air operations, playing the role of a 'life-line' to the populace of Andaman & Nicobar Islands. INAS *Utkrosh* is the primary operating/staging area for the Indian Navy, Air Force and Coast Guard aircraft in the archipelago.

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PSLV-C50 launches CMS-01 from Sriharikota

India's communication satellite CMS-01 was successfully launched by PSLV-C50 on 17 December 2020 from Sriharikota. After 20 minutes 12 seconds, the vehicle injected the satellite into its intended orbit, the solar panels of CMS-01 automatically deployed and ISRO's Master Control Facility at Hassan assumed control of the satellite. Orbit raising manoeuveres were later executed to position the satellite in the Geostationary Orbit at its designated location. CMS-01 is a communication satellite envisaged for providing services in Extended-C Band of the frequency spectrum. The Extended-C Band coverage will include the Indian mainland, Andaman & Nicobar and the Lakshadweep chain of offshore islands. CMS-01 is the 42nd Communication Satellite of India.

HAL delivers largest Cryogenic propellant tank to ISRO

On 30 November 2020, HAL delivered the largest yet cryogenic propellant tank (C32 LH2) fabricated by the Company to ISRO much ahead of the contractual schedule. The C32-LH2 tank is a developmental cryogenic propellant tank of aluminium alloy designed for improving the payload capability of GSLV Mk.III launching vehicle. The four meter diametric tank is of eight meter length loading 5755 kg propellant in the 89 cubic meter volume. HAL as a strategic partner, has been associated with ISRO on space programmes over the past five decades, supplying critical structures, tankages, satellite structures for the PSLV, GSLV Mk.II and GSLV Mk.III launch vehicles. HAL has also supported ISRO right from the developmental phase of Crew Atmospheric Re-entry Experiment, PAD Abort test for Crew Escape for Human Space Mission and is currently building hardware for launch of the GSLV Mk.III in the *Gaganyaan* programme.

Vistara turns six years

Completing six years of operations, Vistara, announced '*The Grand 6th Anniversary Sale*' to celebrate. Vistara's Chief Commercial Officer Vinod Kannan said: "The last year was an unusually difficult one for people everywhere, compelling them to put travel plans on hold. But the New Year brings great hope in multiple ways, as evident from the increased passenger confidence in flying". Vistara presently have a total of some 45 aircraft in service, including the Boeing 787-9 Dreamliner.

IndiGo in strong recovery

Indicating their strong recovery post the lockdown period, IndiGo has achieved a remarkable milestone with operations of 1000 daily flights to and from 59 domestic and 6 international destinations.

IndiGo has already operated 100,000 flights between 25 May 2020 and 11 November 2020, both domestic and international. The airline is currently operating between 100-130 scheduled flights from three key metro cities Delhi, Bengaluru and Hyderabad, apart from CarGo charter flights across domestic and international markets.

Tata EoI for Air India

The Tata Group are greatly expanding their footprint in India's Civil Aviation market with all indications that they will be bidding for sole assumption of the national carrier Air India. According to reliable sources, "the opportunity to acquire Air India is too good to let go if the company wants to have scale and size in the business ofaviation. In all sectors Tata Sons operates, the focus has been to either be a market leader or No.2. Air India provides that opportunity".

At the same time, it is learnt that the Central Government may allow Air India's new owner to rationalise both the size of its current fleet and as also the total work force. Air India presently has a fleet of 121 airliners, with 133 employees per aircraft, considered very high by global standards.

However, Tatas already have major stakes in existing airlines in India, their stake in AirAsia India having increased to near 84 %, this "low cost" airline having begun scheduled services in 2014. The Malaysian partner, AirAsia group are quitting the JV, citing disruptions caused by the Covid-19 pandemic as a main reason. Besides, the Tata Group own 51% stake in the full service carrier Vistara, in partnership with Singapore Airlines.

All-women crew operate Air India's longest air service

Air India's all-women pilot crew "created history" when they operated a regular air service from San Francisco to Bangalore over the North Pole on 11 January 2021, covering 16,000 kilometers in some 17 hours. The women pilots were Captain Shivani Manhas,

Captain Zoya Aggarwal, Captain Papagari Thanmai and Captain Akansha Sonaware. The route was San Francisco-Seattle-Vancouver, then over the North Pole, over Russia and then south over the sub-continent and to Bangalore.

United Airlines nonstop service Chicago-Delhi

United Airlines inaugurated daily nonstop services between Delhi and Chicago on 12 December 2020, to be operated by a Boeing 787-9 Dreamliner aircraft. The airline additionally operates daily services from Mumbai and Delhi to New York/Newark and New Delhi to San Francisco. United also expects to introduce a new daily nonstop service between Bengaluru and San Francisco commencing 8 May 2021.

Singapore Airlines and Vistara "deepen" partnership

Singapore Airlines (SIA) and Vistara, a joint venture between Tata Sons Private Limited and SIA, have signed a Commercial Cooperation Framework Agreement which will further strengthen SIA's and Vistara's existing partnership and enable them "to offer seamless services to their customers by harmonising efforts in capacity planning, sales, marketing, joint fare products, customer services and operations". Mr Leslie Thng, CEO Vistara stated: "We are thrilled to further strengthen our partnership with Singapore Airlines. The intent is reflective of our deep-rooted commitment to providing our customers the finest and the most convenient way to fly across the world with the consistency of a five-star travel experience. This is in line with our long-term growth plan of expanding Vistara's global presence and presenting India's best airline to the world."

Reliance and BP in joint venture

Reliance Industries Limited (RIL) and BP are to carry out refueling operations at 30 airports across India. This will be by their new Indian fuels and mobility joint venture, *Reliance BP Mobility Limited* (RBML), which operates under the Jio-BP brand. The fast-growing Indian aviation fuel market is already the world's third largest in terms of passenger traffic, the joint venture aiming to increase its presence from 30 to 45 airports in India in the coming years. Kempegowda International Airport, Bengaluru (in image) is one of 11 new Air BP locations in India.

International airport at NOIDA

After their selection, Zurich Airport International has identified a consortium of Nordic, Grimshaw, Haptic and STUP as architects to design the passenger terminal of the planned Noida International Airport (DNIA) at Jewar through a three-phase, design competition. The winning design "best fits the defined project objectives: merging Swiss efficiency and Indian hospitality, creating a modern and seamless passenger experience, setting new benchmarks in sustainability for airport terminal buildings in India, envisioning green spaces inside and around the building, offering a concept for a future airport city, and providing flexible expansion options to serve 30 million passengers per year in the future".

Delhi-Dubai is 5th busiest global route

Delhi-Dubai and Mumbai-Dubai are now amongst the busiest international routes "in the pandemic world." According to the UK-based air consultancy firm OAG, Delhi-Dubai was the fifth and Mumbai-Dubai the 10th busiest air routes in December 2020 in terms of seat capacity deployment by airlines. These two have historically been the busiest international routes for India. The busiest international route is Dubai-London Heathrow (1.7 lakh seats) followed by Orlando-San Juan (1.6 lakh seats) and Cairo-Jeddah (1.4 lakh). Delhi-Dubai had 1.1 lakh and Mumbai-Dubai over a lakh seats in December, as per OAG.

Indian domestic air traffic down by 49.6%

On the other hand, the IATA stated that Indian domestic passenger air traffic was lower by 49.6% in 2020 compared with that in 2019. However, the Secretary Civil Aviation Pradeep Singh Kharola has expressed hope that this sector is expected to return to normal in the next few months. "The sector remained resilient during the pandemic, but I don't think that the bad period is over. It will take the next two to three months for the country's domestic civil aviation sector to return to normal. Big countries like India, which have huge domestic market, are where the future of aviation lies".

Covid Vaccine to be airlifted

Both the Indian Air Force and private airlines are on 'stand by' to airlift tonnes of Covid vaccine throughout the country. In early January 2021, the Drug Controller General of India issued authorisation to Pune-based Serum Institute of India, manufacturer of AstraZeneca Oxford vaccine Covishield. Hyderabad's Bharat Biotech got an emergency use nod . In the first phase, vaccine would be flown from Pune and Hyderabad to the metro cities, initially transported in scheduled passenger flights, while chartered flights could be used apart from Service aircraft.

DRDO's "phenomenal technological achievements"

The Defence Minister has applauded DRDO's "phenomenal technological achievements" and recent series of successful missions and technological achievements by various clusters of DRDO including Hypersonic Technology Demonstration Vehicle (HSTDV), Anti-Radiation Missile (RUDRAM), Quick Reaction Surface to Air Missile (QRSAM), Supersonic Missile Assisted Release Torpedo (SMART) and Quantum Key Distribution (QKD) technology during 2020. He lauded DRDOs contributions, despite pandemic conditions and congratulated Dr G Satheesh Reddy for DRDO's contribution to the development of technologies and products.

Hypersonic wind tunnel at DRDO Hyderabad

On 19 December 2020, Defence Minister Rajnath Singh was given an overview of DRDO's complex at Hyderabad, including various systems and technologies in areas concerning missiles, avionics systems, advanced materials, electronic warfare, quantum key distribution technology, directed energy weapons, Gallium Arsenide and Gallium Nitride technology capabilities. Two anti-drone technologies were also demonstrated by the DRDO "for neutralising ground targets and anti-drone applications to counter stationery as well as high-speed moving targets." During his visit, the Minister also inaugurated an advanced Hypersonic Wind Tunnel (HWT) test facility which is a pressure vacuum driven enclosed free jet facility having nozzle exit diameter of 1 meter to simulate speeds of Mach 5 to 12. "The facility has the capability to simulate hypersonic flow over a wide spectrum and will play a major role in the realisation of highly complex futuristic aerospace and defence systems."

ALH folding tail boom demonstrated

Design and development of the ALH's tail boom and horizontal stabilizer folding feature for meeting ship borne helicopter stowage requirements was demonstrated on 7 November 2020 with an ALH Mk.III DWDM prototype helicopter. In combination with the existing two blade folding, the achieved stowage dimension of ALH (13.5 m length, 3.5 m width and 4.1 m height) "meets the Navy's NUH specification". Qualification and certification of the tail boom scheme is expected to be completed by February 2021.

140th RD-33 Series-3 engine

HAL's Koraput Division has manufactured and delivered the cumulative 140th RD-33

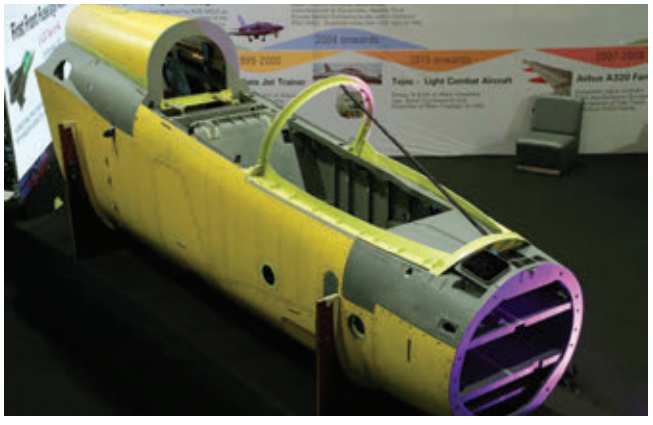
Series-3 Engine for the IAF's fleet of MiG-29s. 'Completion Certificate' was handed over by MJ Vinod Kumar ADG, AQA (Koraput) to Asutosh Mallick, GM (Engine Division).

Upgraded ALH Mk III Civil variant

HAL's Helicopter Division has initiated the process of building an upgraded ALH Mk.III (Civil) wheeled variant and integrating seven major modules including the glass cockpit, automatic flight control system, integrated dynamic system, crashworthy structure etc., in coordination with the DGCA. Maiden ground run of this helicopter was carried out on 16 November 2020 prior to start of test flights and DGCA Civil Certification.

Dynamatic builds LCA (FOC) front fuselage ....

Dynamatic Technologies have built and delivered the first front fuselage for the Tejas LCA (FOC), the first time such a complex fuselage section has been built by an Indian private sector



company. As HAL CMD Mr R Madhavan said, "Dynamatic has done it again by delivering the first front fuselage of LCA Tejas. The LCA programme has a requirement of 20 aircraft sets per year and will grow with Mk.II and AMCA. Dynamatic is a known and reliable supplier for HAL, and we will also look for opportunities on trainer and UAV platforms."

Included in the photograph above are Amitabh Bhatt, CEO-BC, HAL, Udayant Malhoutra, CEO & MD, Dynamatic Technologies Limited; R Madhavan, CMD, HAL; Velpari MS, Director - Operations, HAL; and Dr.Ajay Kumar, Defence Secretary (Live over video)

.... and Alpha Tocol delivers LCA rear fuselage

Alpha Tocol Pvt Ltd has rolled out the first LCA 'Rear Fuselage Assembly' complete with bracketary activities with the approvals from DGAQA in FOC configuration. The scope of work included fabrication of main jig, ICY tools, machining of components, special process and structural assembly of rear fuselage.

Cabinet approves export of Akash SAMs, creates 'Committee for Exports'

The *Akash* SAM with a range of 25 kilometres was inducted by the IAF in 2014 and in 2015 by the Indian Army. The Cabinet has now approved its export to "friendly countries",

the export version of the *Akash* being "different from the system currently deployed with Indian Armed Forces. There is also interest for other major platforms like Coastal Surveillance System, Radars and Air platforms. To provide faster approvals for export of such items, a Committee comprising of the Defence and External Affairs Ministers and National Security Advisor has been created". The GoI is to focus on exporting high value defence platforms to achieve target of $5 billion of defence exports and so "also improve strategic relations with friendly foreign countries".

Anti-ship test firing of BrahMos

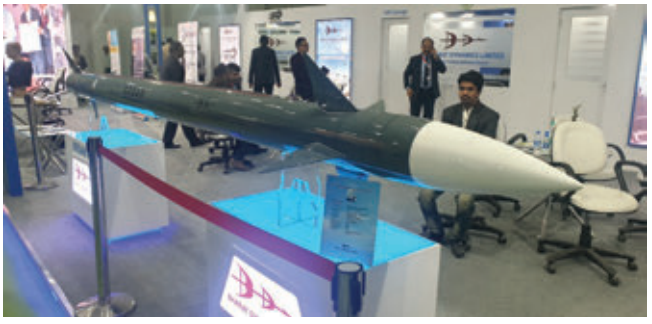
The BrahMos supersonic cruise missile in anti-ship mode was successfully test fired on 1 December 2020 against a decommissioned ship which, carried out by INS *Ranvijay*, accurately impacted the target.

Digitisation of Pechora SAMs

The IAF is in process of upgrading its legacy Pechora (SA-3) surface to air missile systems. Contract for the digitisation of firing units was signed late in 2020. "Post digitisation, performance of the system would be enhanced considerably".

Maiden launch of MRSAM (Army)

The Army Version of the *Medium Range Surface to Air Missile* (MRSAM), was launched by DRDO at the Integrated Test Range, Chandipur, off the Coast of Odisha. MRSAM (Army) weapon system comprises the Command post, Multi-Function Radar and Mobile Launcher system, the complete Fire Unit being in deliverable configuration.



Combined Guided Weapons Firing at AFS Suryalanka

Air Marshal HS Arora VCAS witnessed Surface to Air Guided Weapons firing at Air Force Station Suryalanka on 1 December 2020. The exercise, conducted from 23 November to 2 December 2020 had the indigenous Akash Missile System fired along with Russian-origin short range Igla missiles, engaging Manoeuverable Expendable Aerial Targets (MEAT). The VCAS commended the participating combat squadrons and urged "to be ready to apply all lessons learnt in the CGWF 2020 to any emerging operational scenario".

RR and Infosys in Strategic Partnership

Rolls-Royce and Infosys have signed a strategic partnership on sourcing engineering and R&D Services for Rolls-Royce's Civil Aerospace business, part of which Rolls-Royce will transition a significant part of its engineering centre capabilities for civil aerospace to Infosys in Bengaluru.

CVRDE-developed products

On 10 January 2021 retractable landing gear systems for the Tapas and SWiFT UAVs and 18 types of filters for P-75 Submarines were presented at the Combat Vehicles Research and Development Establishment (CVRDE) in Chennai. The three-ton retractable landing gear systems for the Tapas UAV have been designed in co-ordination with CEMILAC and DGAQA. CVRDE has also designed and developed one ton retractable landing gear system for the SWiFT UAV while 18 types of indigenously-developed hydraulic, lubrication, seawater and fuel filters for P-75 submarines were designed and developed by CVRDE.

L&T bridging system for Indian Army

The Indian Army has inducted three sets of 10-metre short span bridges, formally handed over on 29 December 2020 at the Talegaon facility of Larsen & Toubro Limited. The equipment will meet the important requirement of providing mobility to forces by speedy bridging of gaps during operations. The Bridge has been indigenously designed, developed and delivered as per schedule.

91st K9 Vajra-T from L&T

The 91st K9 Vajra-T 155mm/52 calibre tracked, self-propelled howitzer gun from L&T's Armoured System Complex (ASC) was flagged off at Hazira on 11 January 2021. The programme

involves delivery of 100 systems with associated Engineering Support Package (ESP) covering spares, documentation & training and maintenance transfer of technology (MToT) to Army Base Workshops. The company had established a green-field manufacturing cum integration cum testing facility, the 'Armoured Systems Complex' (ASC) at Hazira near Surat. The K9 VAJRA-T systems are being delivered with more than 80% indigenous work packages and above 50% indigenisation (by value) at the programme level. This involves local production of over 13,000 types of components per gun system through a supply chain of about 1000 industrial partners, mostly MSMEs, with about 150 of them being from the state of Gujarat.

DRDO 5.56 x 30 mm carbine trials

The DRDO-designed 5.56x30 mm Protective Carbine has successfully undergone final user trials meeting all the GSQR parameters "and is ready for induction into the services". User trials were carried out in extreme temperature conditions, and met stringent performance criteria of reliability and accuracy. JVPC is a gas operated semi bull-pup automatic weapon having more than 700 rpm rate of fire, with an effective range of more than 100 m. The carbine has been designed by the Armament Research and Development Establishment (ARDE), and manufactured at the Small Arms Factory, Kanpur with the ammunition manufactured at Kirkee (Pune).

Sea trials of 'Green Helicopters'

HAL's RWR&DC has carried out maritime trials of the ALH Mk.III ('green helicopter') from Coast Guard Air Station, Chennai as part of the CG contract for 32 ALHs. Flight testing was carried out over the Bay of Bengal with surveillance radar, EOIR payload with SWIR (Short Wave Infra Red), automatic identification system (AIS), and other systems including armament.

Three Coast Guard ships *Sujay*, *Abheek* and *Priyadarshini* participated in the trials providing vessels and divers for radar target deployment and demonstration of rescue operations at sea. The data generated through extensive flight testing at Chennai will be used for certification of 19 new systems fitted on the ALH Mk.III.

Clearance for AESA radar

HAL's Avionics division, Hyderabad has received clearance for the first AESA Radar (CBU phase) to be fitted on the Jaguar DARIN III UPG aircraft, the first to be fitted on any platform in India. HAL Hyderabad is production agency for a total of 54 AESA radars under ToT from IAI, Elta Systems, Israel.

'Uttam' AESA radar progresses

Development of the *Uttam* AESA radar was formally launched in 2020 by the Electronics & Radar Development Establishment (LRDE) and is to be a key system on the LCA Mk.1A, having completed over 100 flight hours on a test aircraft. Development of the *Uttam* commenced in 2008, slated to be successor of the EL/M-2032 a hybrid PESA (passive electronically scanned array radar) that currently equips the LCA Mk.1. New systems include the IFF, electronic and communication support measures, C-band line-of-sight and Ku-band SATCOM datalinks, etc.

New Army appointments

The Government of India has reportedly cleared the posts of two new three-star Generals, these being a Deputy Chief of the Army Staff (Strategy) with the objective of bringing about structural reforms in the army, about two years after the plan was envisaged. The present Director General Military Operations (DGMO) Lt Gen Paramjit Singh is likely to be the first DCOAS (Strategy). The government also announced another new post of Director General (Information Warfare) at Army Headquarters, which is being seen as recognition of the emerging trends in warfare. "Earlier there was just an ADGPI (Additional Directorate General of Public Information) who looked at things with the lens of the media". According to Lt Gen Deependra Singh Hooda, (retd) "this new officer will now work at how to deal with fake narratives and all kinds of current challenges that it poses".

Vice Admiral Sandeep Naithani is Controller Warship Production

Vice Admiral Sandeep Naithani has assumed charge as Controller Warship Production and Acquisition. A graduate of the National Defence Academy, Khadakwasla Pune, he was commissioned into the Electrical Branch of the Indian Navy on 1 January 1985. The Admiral is a Post Graduate in Radar and Communication Engineering from IIT Delhi, has held various appointments during

his naval career has served onboard the aircraft carrier INS *Viraat* in various capacities, has tenanted important appointments in Naval Dockyards at Mumbai and Visakhapatnam and in the Staff, Personnel and Materiel Branches of Naval Headquarters. He also commanded the premier electrical training establishment of the Navy, INS *Valsura*. As a Flag Officer, he was Assistant Chief of Materiel (Modernisation) in Naval Headquarters, Chief Staff Officer (Technical), HQ WNC, the Admiral Superintendent of Naval Dockyard Mumbai, Director General Naval Project at Mumbai and Programme Director, HQ ATVP.

Major changes at Army Commands

During the year 2021, five of the senior-most three-star Army Generals will be superannuating, with Lt Gen SK Saini, VCOAS retiring on 31 January followed by the GOC-in-Cs of Central Army Command and South Western Army Command, Lt Gen IS Ghuman and Lt Gen AS Kler respectively. On 31 May, Lt Gen AS Chauhan, GOC-in-C Eastern Army Command will superannuate followed by Lt Gen RP Singh, GOC-in-C Western Army Command. While the COAS retires at 62 years of age, the Lt Gen rank Army Commanders superannuate two years earlier.

LCA Mk.I (FOC) (SP-21) (Photo: Deb Rana)

Indigenous Punch

13 January 2021 witnessed a landmark moment when the CCS approved procurement of an additional 83 indigenous LCA fighter aircraft.

In late 1983, the Light Combat Aircraft programme was launched as an indigenous effort to develop a fourth generation combat aircraft to meet future requirements of the Indian Air Force. The programme was the responsibility of the newly formed Aeronautical Development Agency (ADA) in collaboration with HAL's Aircraft Research & Design Center (ARDC).

The LCA prototype made its maiden flight when TD 1 (KH2001) piloted by Wg Cdr Rajiv Kothiyal flew from Bangalore on 4 January 2001. The former Prime Minister of India Atal Bihari Vajpayee later named the LCA as *Tejas* (Radiance). A decade later, the LCA (LSP-4) achieved Initial Operating Clearance (IOC), making its maiden flight in June 2010.

The LCA programme has proceeded apace and currently there are two squadrons of the Tejas in service with the IAF No. 45 Squadron *(Flying Daggers)* at AFS Sulur was declared active on 1 July 2016, while No. 18 Squadron *(Flying Bullets)* got its first Tejas on 27 May 2020.

Of the initial order of 40 LCA, 16 each are of IOC and FOC standard while the rest are twin-seater.

Line up of LCA Mk.1 (IOC) at AFS Sular(Photo: Manorama/PTI)

LCA Mk.1 FOC (SP-21) conducted its first flight on 16 March 2020. The most easily observable additional feature of the FOC variant is its air-to-air refueling probe.

The FOC standard has additional fuel carrying capability. While the LCA IOC carries 2350 kg fuel carrying capability of IOC variant with its external drop tanks of 1200 and 800 liters capacity, Tejas FOC has an additional 725 litres center line drop tank with pressure refueling.

The LCA FOC will be equipped with one Derby or Astra BVRAAM as well as ASRAAM or R-73E for close range air combat, and the GSH 23 mm twin barreled cannon will be integral.

LCA Mk. 1A

Tejas Mk. 1A is a further modification of the basic Tejas and will have 43 'improvements' over the current platform. Some of these are:

Open Architecture Mission Systems for seamless net centric operation through software defined radio, 3D , vector , full colour satellite map modes

Active Electron Scanned Array (AESA) radar: Low Probability of Intercept (LPI), the AESA radar provides extended air to air track ranges for launching BVRAAMs even in interleaved modes on multiple targets which can be clearly identified, utilising advanced NCTR mode and integrated Interrogator/Transponder.

There is a new generation AESA-based jamming system with higher effective radiated power (ERP) through directional noise, directed deception and hybridized jamming techniques. According to public reports, some of the initial LCA Mk.1AS will be equipped with the Israeli-origin ELTA 2052 while later models will get the indigenously developed *Uttam*.

Digital Wideband Radar Warning Receiver: Multi-channel digital receivers with instantaneous tracking & identification of emitters in the entire frequency band, deeply integrated with passive modes of AESA radar and AESA jammer

New Generation Helmet Mounted Display System (HMDS): Wide envelope Helmet Mounted Display System with fully integrated air-to-air and air-to-ground modes; enhanced trackers with strap on Inertial sensors provide maintenance free, high accuracy operations.

First flight of the first Tejas Mk.1A is projected around 2023. The Cabinet Committee on Security headed by the Prime Minister approved procurement of 73 LCA Tejas Mk-1A fighter aircraft and 10 LCA Tejas Mk-1 trainer aircraft at the cost of Rs. 45,696 crore along with Design and Development of Infrastructure sanctions worth Rs.1,202 crore.

LCA Mk.2 or MWF (Medium Weight Fighter)

The LCA Mk. 2 is further development of the Mk.1 being an attempt to develop a platform of medium category with advanced features. The former CAS ACM Birender Singh Dhanoa said in 2018, "We're looking at 12 squadrons of the Light Combat Aircraft Mk.2". However, his successor ACM RKS Bhadauria has stated "In the long run, the IAF will have 40+83 Tejas Mk I/IA and around six squadrons of Tejas Mk II. Eventually, we aim to boost our capabilities with the fifth generation plus AMCA (Advanced Medium Combat Aircraft)". According to latest reports 170 Mk.2 version is being considered.

We now examine some features of the Mk.II on how this compares with the LCA Mk. 1A in terms of capability:

Addition of Canards: The most distinctive feature of the LCA Mk.2 is addition of close coupled canards, positioned below the avionics bay cover, just behind the cockpit, above the wing plane and below the avionics bay cover. These are set at a negative dihedral angle, the addition significantly increasing lift produced by the wing and augmenting lift act as air brakes to reduce landing roll, stabilise the wing LE vortices for medium to high angle of attack and to help achieve better area ruling for reduced wave drag.

Longer Fuselage: The Mk.II will have a longer fuselage than the Tejas Mk.1A, length of the fuselage increased to 14.6m. The increased internal volume is to facilitate carrying of additional systems with more internal fuel, this increase range, endurance and enhancing performances.

Leading Edge Root Extension: LERX will have a positive impact on the wing aerodynamics stability.

New AESA: Expected to be equipped with indigenous *Uttam* AESA.

Stealth: To decrease the radar cross section (RCS) several measures have been taken. Carbon composites of the airframe will decrease the RCS as also paint coating

LCA AF Mk.2 MWF (photo: Vayu)

with Radar Absorbing Material. The air intake ducts will feature a twisted design so that engine blades are shrouded within the intake duct.

Smart Large Area Display (LAD) and Head Up Display (HUD): The LCA Mk.II will be equipped with upgraded Fly by Wire (FBW) controls with advanced Digital Flight Control Computer (DFCC), indigenous actuators, a Smart Cockpit, Internal Unified Electronic Warfare Suite (UEWS), On Board Oxygen Generated System (OBOGS), Infrared Search and Track (IRST) and Missile Approach Warning System (MAWS).

More composites in the air frame will decrease its weight, with empty weight of 7000 kg, lighter than even the LCA Mk. 1, and able to carry 3300 kg of internal fuel with take-off clean weight of 11000 kg.

The maximum take-off weight will be increased to 17500 kg. Hard points will be increased to 11 thus despite of Self Protection Jammer and Targeting Pod being attached, the Mk.II can carry more weapons than the Mk.1.

The Mk.II will be powered by the GE F414-INS6 engine, with maximum thrust of 98 Kn. Ferry range is increased to 3500 km, a limit of -3.2 to 9 and MAX speed Increased to Mach 1.8. According to reports, ADA will unveil the Mk.II in 2022, the first flight to be conducted by 2023, entry into production by 2025-2026. However according to some other sources, "this is a very ambitious time line."

The AMCA

While the LCA Mk.1, Mk.1A and Mk. 2 (MWF) will bridge the gap needed to replenish much of the retiring fighter aircraft fleet currently in service, the IAF will need a futuristic platform to meet future requirements. Aerospace technology is progressing rapidly and so is nature of the threat. Instead of a specific platform that the IAF in future will face network-based high technology platforms ranging from advanced fourth generation to fifth generation aircraft, stealth unmanned platforms, long range surface to air missiles and future electronic warfare machines. To meet the fifth generation threat, the IAF will also need fifth generation fighters which is where the AMCA is going to play a very important role.

The Advanced Medium Combat Aircraft or AMCA is an indigenous attempt to develop a fifth generation fighter aircraft, the most ambitious indigenous project which will reshape IAF. An initial amount of Rs 90 crore was allocated for the feasibility study, then sanction for the design phase accorded in December 2018 with an allocation of more than Rs 400 crore.

It is reported the unmanned version also will be developed for the future. Five prototypes of AMCA will be developed in a proposed public-private joint venture.

Taxi trials of the AMCA are aimed for 2024-25 with the first flight expected to be conducted by 2025-2026, entering into production by 2029. Series production of AMCA Mk.2 version is expected to be by 2035.

According to various reports, ADA are working on three different projects: LCA Mk. II, AMCA and TEDBF for the Indian Navy. All prototypes are reported to be unveiled in 3-4 years and all will be airborne in 7-8 years.

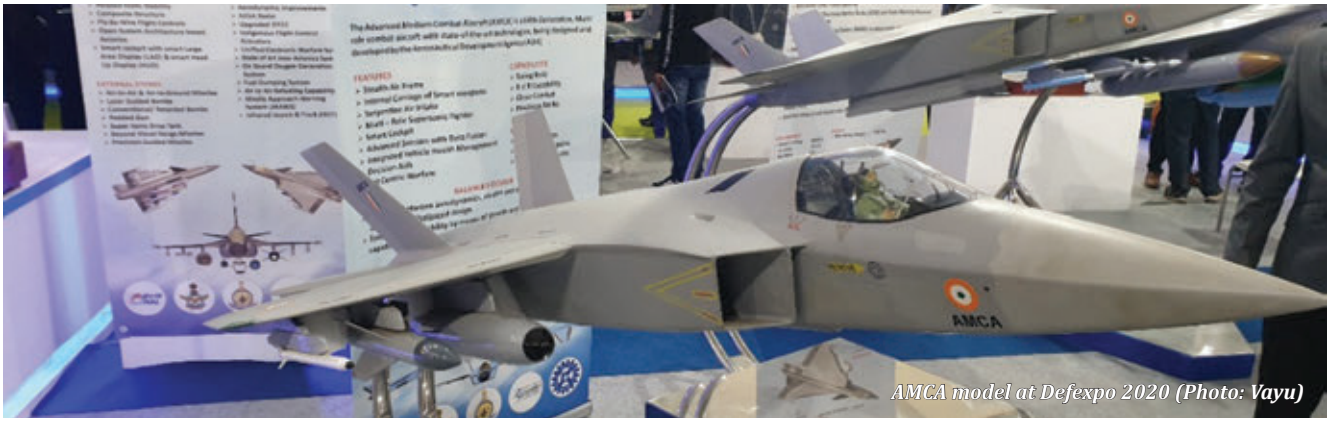
The fourth largest air force in the world sees multiple challenges ahead. It must take necessary steps to maintain the dominance without facing economic strain. Pakistan is no more India's primary concern and the focus must be shifted towards the largest advisory China. To combat the challenges procurement of foreign platforms can give India capability to conduct some crucial missions for some time, but it is only the indigenous platforms which can augment the strength needed for it. IAF to enter fifth generation era very soon.

All the specifications mentioned above are based on reports or articles published till 6 January 2021. Aero India 2021 is likely to unveil some new specifications as well as changes.

Sankalan Chattopadhyay (twitter@vinoddx9)
(Source & Courtesy: LiveFist, DDR & Onmanorama)

Proposed specifications of AMCA

- Body conformed antennas
- Flushed electro-optical sensors and stealth features
- Maximum Take Off Weight of 25 tonnes
- Internal fuel capability of 6.5 tonnes
- Specially designed detachable fuel tanks compatible with the internal weapons bay
- The internal bay will be able to carry four weapons.
- The non-stealth mode will feature 10 weapon stations.
- Diverterless supersonic intakes
- Advanced active and passive sensors integrated with electronic warfare suite.
- Vehicle Monitoring System (IVHM), Serpentine Air Intake, Infrared Search and Track (IRST) and Missile Approach Warning System (MAWS)
- Mk. 1 version will be equipped with two F-414-INS6 engines with 98 kN thrust, while Mk. 2 will be equipped with indigenous 110 kN engines developed with the help of a foreign collaborator.



AMCA model at Defexpo 2020 (Photo: Vayu)

'Full Speed Ahead'

Indian shipbuilders and yards in 2020

Of the 43 ships on order for the Indian Navy, 41 are being built indigenously and AoN exists for construction of another 44 ships and submarines to be built in India".
Photo above is of INS *Kolkata*, a *Kolkata*-class (Project 15A) stealth guided missile destroyer.

GRSE delivers 106th warship

Garden Reach Shipbuilders and Engineers Ltd., (GRSE), a leading warship building and Mini-Ratna Category 1 Company under administrative control of the Ministry of Defence, climaxed the year 2020 with delivery of the last of eight LCU project and start production of the first of eight ASWSWC ship.

GRSE has delivered IN LCU L-58 (Yard 2099), eighth and last in the series of Landing Craft Utility Ships to the Indian Navy. This is the 106th warship built and delivered by GRSE so far, since its inception in 1960 and represents the highest number of warships delivered by any Indian Shipyard till date.

This LCU was third ship delivered by GRSE in 2020, no mean feat considering operational constraints imposed by the global pandemic of COVID -19.

The Shipyard has delivered 14 ships in the last 42 months which means an average of 3 months. Comprehensive design of the LCU Mark IV has been in-house by GRSE as per requirements specified by the Indian Navy and is of unique design with no precedence worldwide. The 62.8 m long and

11 m wide LCU has a displacement of 830 tonnes and can achieve a speed of 15 knots. The LCU can accommodate 216 personnel and is equipped with two indigenous CRN 91 guns for artillery fire support during landing operations. The ship is fitted with state-of-the-art equipment and advanced systems such as the Integrated Bridge System (IBS) and Integrated Platform Management System (IPMS).

LCU L-58 delivered by GRSE to the Indian Navy will be part of the Andaman & Nicobar Command. The eight LCUs built by GRSE will provide backbone of the Maritime Security Cover and HADR activity in the A&N Archipelago.

GRSE is also currently executing three major projects for the Indian Navy pertaining to construction of 3 stealth frigates, 4 survey vessel (large) ships and 8 anti-submarine warfare shallow-water craft (ASWSWC), the last two projects won on competitive bidding. The double ceremony also marked the 'Start Production' Day for the first of eight ASWSWCs which is the first 'milestone' in shipbuilding and signifies commencement of vessel construction after the design engineering phase. The compact and complex stealth craft are designed by GRSE, the platforms equipped with state-of-the-art weapons and sensors such as hull-mounted sonar, towed sonar, torpedo launchers and rocket launcher to interdict and destroy sub-surface targets in coastal waters. The craft will be employed for 'Search & Rescue' and 'Low Intensity Maritime Operations', being propelled by water-jets capable of high speeds.

GSL specialised patrol boats for Indian Army

Goa Shipyard Limited (GSL) have signed a contract with Indian Army for supply of 12 high performance specialised patrol craft on 31 December 2020. Although GSL have earlier built over 170 GRP boats for the Ministry of Home Affairs and other customers, these craft for the Indian Army are of completely new design and fitted with specialised equipment to meet the requirement of Indian Army, reportedly for operations on the Pang Gong Lake in Ladakh.

GSL launches 5th OPV Project

The 5th and the last vessel of the indigenous Project for 5 Offshore Patrol Vessels for the Indian Coast Guard was launched on 14 December 2020 at Goa Shipyard Limited, the vessel named as ICGS *Saksham*.

Entirely designed in-house by GSL, these OPVs will form part of the Coast

Guard Fleet for protection of territorial waters in the EEZ. Fitted with most modern and technologically advanced machinery and computerised controls systems, these will be the most advanced Patrol Vessels in service with the Indian Coast Guard. The 2400-tonne vessels will be equipped with Quick Response Boats for rescue and anti-piracy, gunnery simulators and many other advanced features. The most efficient hull form is designed by GSL "to provide for fuel efficiency, crew comfort and excellent sea keeping qualities."

Commissioning and start of production during 2020

INS *Kavaratti*: the fourth and last ship of Project 28, this was commissioned on 22 October 2020 at Visakhapatnam.

***IN* LCU L57 (Yard 2098):** This was commissioned at Port Blair on 15 May 2020, the seventh of eight LCU MK IV ships being constructed by GRSE, Kolkata.

Yard 3023: Keel laying ceremony of Yard 3023 (Second ship of Project 17A at GRSE) was held on 24 January 2020 at GRSE, Kolkata.

Yard 12653: Keel laying ceremony of Yard 12653 (3rd ship of Project 17A at MDL) was held on 10 September 2020 at MDL, Mumbai.

Yard 12654: Production of Yard 12654 (4thship of Project 17A) commenced on 22 January 2020 at MDL, Mumbai.

Yard 3024: Production of Yard 3024 (3rdship of Project 17A at GRSE) commenced on 22 August 2020 at GRSE, Kolkata.

Commissioning of OPV ICGS 'Sujeet'

Indian Coast Guard Ship *Sujeet*, second in the series of 5 Off Shore Patrol Vessels, was commissioned at Goa on 15 December 2020. The OPV built by Goa Shipyard Limited (GSL) is fitted with state-of-the-art navigation and communication equipment, sensor and machinery. The 105 m. ship displaces approx 2350 tons and is propelled by two 9100 KW diesel engines designed to attain a maximum speed of 26 knots, with an endurance of 6000 nm. The ship is designed to carry twin-engined helicopter and four high speed boats plus one inflatable boat for swift boarding and search & rescue operations. The ship can also be equipped with pollution response equipment and undertake oil spill pollution response at sea.

Mr. Raj Kumar, IAS, Secretary (Defence Production), being briefed on state-of-the-art technology to meet maritime challenges in safeguarding national interests and to facilitate maritime trade & commerce

Launch of GRSE-built stealth frigate INS 'Himgiri'

On 14 December 2020, Garden Reach Shipbuilders and Engineers Limited (GRSE), Kolkata, launched the first of three stealth frigates, INS *Himgiri* as part of Project 17A. Construction of the three frigates is the largest ever order awarded to the shipyard by the Ministry of Defence, with a value of over Rs.19,293 crore.

The P17A ships are advanced state-of-the-art guided missile frigates, 149 m long, with a displacement of approximately 6670 tonnes and having an advanced CODOG Propulsion system, enabling speed of over 28 knots. These ships are equipped with a powerful weapon & sensor package for neutralising threats in all three dimesions, air, surface & sub-surface.

Fincantieri, Italy is the *Knowhow Provider for Technology Upgrade and Capability Enhancement* in this project. Project 17A is unique wherein, based on the basic design prepared by the Directorate of Naval Design, construction is concurrently being done at two locations, MDL and GRSE.

Courtesy: MoD

Dassault Rafale
(Photo: Angad Singh)

IAF's 'Vision 2030'

Air Chief Marshal RKS Bhadauria (Photo: IAF)

VAYU Interview with Air Chief Marshal RKS Bhadauria, CAS

VAYU: At a recent IAF Commanders' conference, IAF's 'Vision 2030' was articulated upon. Your concluding remarks were on the "need for rapid capacity building, increase in the serviceability of all assets and dedicated work towards effective integration of new technologies in the shortest time frame". Could you give us an overview on the time lines for these critical objectives to be met?

CAS: Modernisation is an ongoing process to enhance operational potential in keeping with the desired combat capability. This includes induction of state-of-the-art modern equipment as well as upgrading existing systems to boost their capabilities and ensure operational relevance. Timeframes for such activity and effort run parallel to the induction and upgradation cycles and are met to ensure an operational edge over the adversary at all times.

In the next five years we will induct the first of 83 Tejas Mk.1A and will put in place a rapid modernisation programme of our existing fighter fleets to integrate latest weapons, avionics and EW capabilities. We will also be inducting the HTT-40 and LCH to meet our training and attack helicopter needs. In the same timeframe we

MiG-29UPG of the IAF (Photo: Angad Singh)

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Tejas LCA Mk.1 (Photo: Angad Singh)

A model of the proposed advanced medium combat aircraft (AMCA) (Photo: Vayu)

VAYU: Congratulations on the induction of first Rafales in India! It will take some time for rest of these aircraft to arrive in-country and according to public information, these will operate from two widely distant airbases. Where would their 4th line maintenance facilities be established?

CAS: The Rafale squadrons at the Main Operating Bases of Ambala and Hashimara are likely to operate with full strength of 18 aircraft each by mid-2021 and 2022 respectively. We have our infrastructure in place for all necessary technical support of these aircraft. In tune with the flexible use of air power, we will be able to deploy these assets for extended periods to Forward Operating Bases and have the wherewithal in place to support them at their operational locations. The aircraft come with a warranty of two years followed by a performance based logistics (PBL) programme which will ensure availability of the assets at high serviceability rates.

VAYU: The IAF have placed an intent to order 83 LCA Mk1As on HAL but it is uncertain as to when this variant will be developed, tested and certified for series

also plan to digitise our older Air Defence systems and seamlessly integrate them along with our latest acquisitions. We have already achieved a major milestone in net centric operations through IACCS. Building on that, we are further upgrading and hardening our networks to ensure robust and redundant unified Command and Control of the air battle.

The second half of the decade ahead will see us leapfrog to the induction of next generation platforms, be it the AMCA or unmanned combat enablers. We should also be able to significantly boost our AWACS, ISR and aerial refuelling capability in this time.

Three Rafale two-seaters of the IAF (Photo: Vincent Genevay)

HAL HTT-40 basic turboprop trainer (Photo: Phil Camp)

HAL light combat helicopter LCH (Photo: Phil Camp)

LCA Mk.1 of No.45 Squadron at AFS Sulur (Photo: IAF)

production. Could you kindly give us the probable time lines for induction of the first LCA Mk1A into IAF service?

CAS: The contract for 83 LCA Mk.1A is likely to be signed in this calendar year. It is currently at the CFA stage. The deliveries are planned to commence three years from the date of signing the contract and HAL has assured us that they will meet this timeline. The complete delivery of 83 aircraft is likely to be completed by 2027-28 subject to signing of contract this FY. HAL will have to ramp up their current production rate in order to meet the target timelines.

VAYU : Meanwhile, there are some disparate reports on progress of the IAF's requirement for 114 multi role fighter aircraft, the process having begun some years back. Could you please update us on the status in context of the IAF's 'Vision 2030'?

CAS: Procurement of 114 MRFA will be under *Make in India* plan. The RFI has been issued and we are currently evaluating the response received and the way ahead.

VAYU: The IAF's transport and helicopter fleet have carried out Herculean efforts in flying reinforcements, equipment and supplies to the Ladakh region over the past three months. With the 'face off' against aggressive Chinese moves showing no sign of easing, the IAF's task for logistic air support will only increase. Are there any plans for short term leasing of additional transport aircraft/helicopters to meet the challenge?

SOME CONTENDERS FOR THE MRFA

Saab Gripen (Photo: Angad Singh)

Lockheed Martin F-16 (Photo: Angad Singh)

IAF Rafale (Photo: Angad Singh)

Boeing F/A-18 Super Hornet (Photo: Simon Watson)

MiG-35 (Photo: MiG)

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IAF C-17 Globemaster III coming into land at Leh (Photo: IAF)

will be the mainstay of the IAF fighter fleet in the coming decades. While we are supportive of DRDO and HAL's efforts, the numbers involved indicate that involvement of the private sector in manufacturing is essential to ensure timely delivery of indigenous platforms. We are already low in squadron numbers, and cannot afford to lose our operational potential if our numbers continue to fall. Involvement of the private sector in both design and development and manufacture of military aerospace platforms is critical for development of a sustainable, cost effective and efficient aerospace industry within the country.

IAF Lockheed Martin C-130J Super Hercules (Photo: Simon Watson)

Tejas Light Combat Aircraft (Photo: Phil Camp)

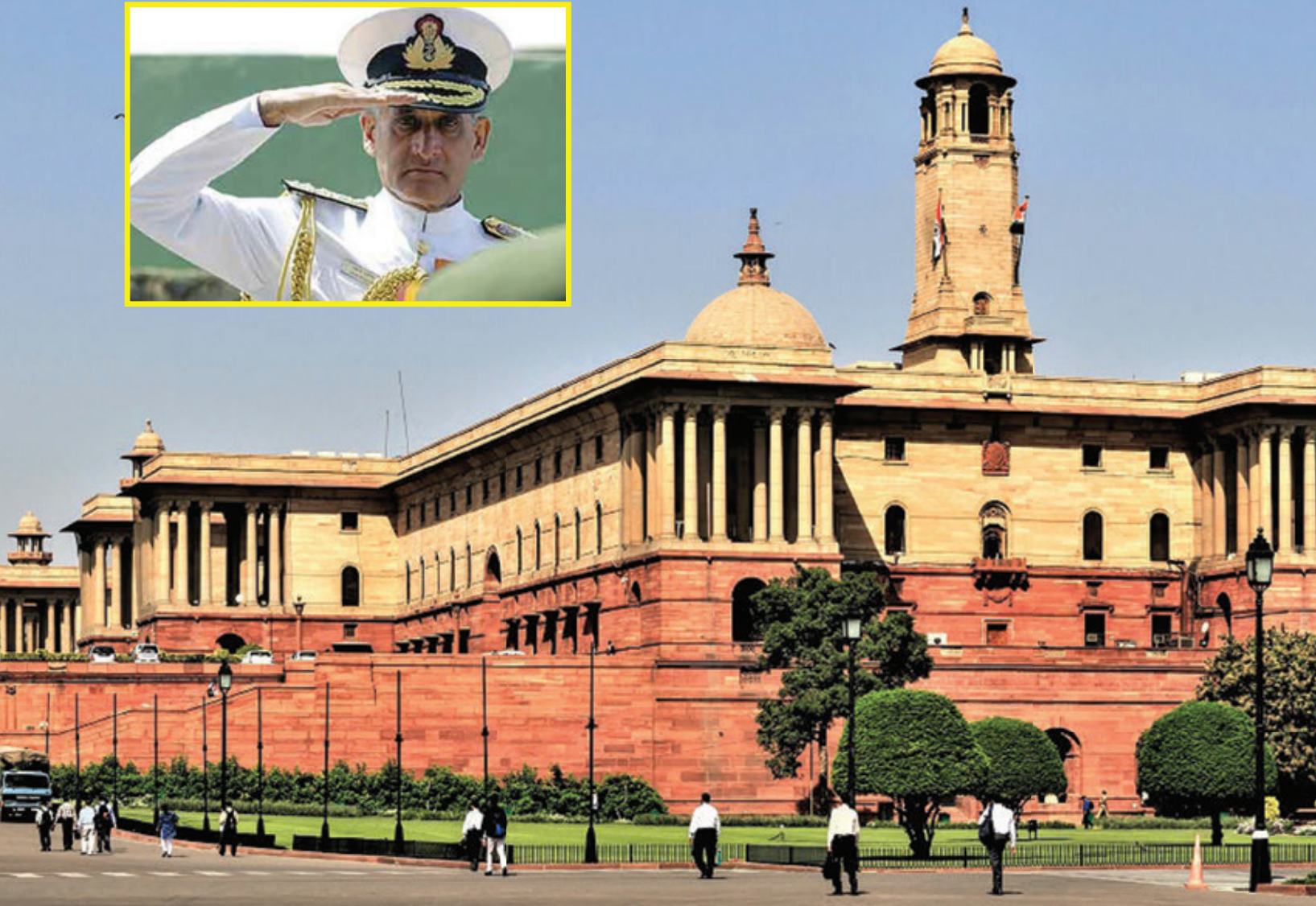
CAS: At this point the IAF transport fleet has adequate capacity and numbers to meet our strategic and tactical airlift requirements.

VAYU : The MoD have released a draft Defence Production and Export Promotion Policy 2020 (DPEPP2020) for public consultation and comments. The emphasis is to significantly enhance defence production capability which also requires India's aerospace/defence industry to more than double in size over the coming five years. With the IAF leaning on HAL to produce some 300 LCAs of all variants in the next decade, would this require major outsourcing of production to include the private sector?

CAS: We have placed our trust in the LCA project and are committed to development of the LCA versions in parallel to fifth generation AMCA which

Air Chief Marshal RKS Bhadauria after flight in Tejas LCA Mk.1 at AFS Sulur (Photo: IAF)

"Incipient schemes... with far-reaching



Admiral Arun Prakash, former CNS, urges that the Government must constitute a parliamentary committee with military advisers to oversee transformational reforms

(Image above of the Central Government Secretariat (North Block) in New Delhi and (inset) Admiral Arun Prakash when CNS)

It would be no exaggeration to say that, after decades of procrastination by successive governments, the creation of two new entities – a Department of Military Affairs (DMA) and a Chief of Defence Staff (CDS) – a year ago, was the most significant development in the national security domain since Independence. The crux of this development lay in two crucial and long-overdue reforms. One, the management of the armed forces, so far assigned to the civilian Defence Secretary, was brought under a military officer, the CDS. And two, the designation of CDS as Secretary DMA (although an incorrect equivalence for a four-star general) made him the first military officer to be recognised as a functionary of the Government of India (GoI) by its *Allocation of Business Rules*.

This radical restructuring has raised hopes that since the DMA is now a part of the GoI, the anomalies and imbalances – organisational, hierarchical and financial – unilaterally imposed on the armed forces over seven decades would be addressed and remedied at long last. While the DMA is, hopefully, considering these issues and coming to grips with its assigned charter, it has seen fit to share with the media some incipient schemes with far-reaching implications. This has brought certain important issues into the public domain, which bear discussion.

implications”

With the nation facing a “real and present” military threat from two adversaries, it is incumbent upon the GoI – notwithstanding the economic downturn – to find the means to bolster national security. Bizarre as it may sound, the onus for accruing savings to fund defence expenditure seems to have been placed on the DMA, which has floated two schemes aimed at reducing the defence pensions bill. One penalises officers seeking early release from service and another envisages a three-year ‘Tour of Duty’ for jawans. Both projects are based on unsound assumptions and, even if feasible, the first is likely to harm morale, while the second will degrade the military’s combat-capability in today’s technology-intensive battle-space. In the midst of a national crisis, it is the finance ministry or the Niti Aayog that should be devising ways of financing national defence, rather than the DMA, which must focus on military matters.

It is not clear whether the talk of ‘rolling out’ theatre commands is a trial balloon or the outcome of in-depth deliberation and consensus between the three service headquarters with certain clear objectives in sight. Ideally, these objectives should be: (a) To hand over the military’s warfighting functions to the Theatre Commanders, while retaining the support functions with service HQs; (b) to combine India’s 17 widely-dispersed, single-service Commands into four or five mission/threat-oriented, geographically contiguous ‘Joint’ or ‘Theatre Commands’; (c) to place the appropriate warfighting resources of all three services directly under the command of the designated Theatre Commanders; and (d) to achieve efficiency/economy by pooling of facilities and resources of the three services.

The creation of Theatre Commands, in response to a political diktat, must not become an end itself lest it merely add additional layers of military hierarchy to a reasonably functional existing organisation. The underlying, long-term premise of this exercise is that the Theatre Commanders and their staff will be so trained and groomed in jointness that they are able to plan operations and to employ land, maritime and air forces, regardless of the service to which they belong. For this to happen, radical changes are required in the content of our system of professional military education. Since the Theatre Commander will also have the benefit of advice from component commanders representing each service, this post (like that of the CDS) would be, at least in theory, tenable by an officer belonging to any of the three Services.

The system of Theatre Commands must, obviously, be tailored to meet country-specific requirements but two thorny issues that have emerged universally are the chain of command of the Theatre Commanders and the relationship of the CDS (or his equivalent) with the Service Chiefs.

Since democracies are averse to over-concentration of power in any single military functionary, the system followed by the US ensures that the chain of command runs from the President to the Secretary (Minister) of Defence and then, directly to the Theatre Commander. While the Chairman of the US Joint Chiefs of Staff (C-JCS) has no command authority over any combatant forces, he, as the principal military adviser to the President and Defence Secretary, assists them in providing strategic direction to the armed forces and in the force-planning and budgetary processes. When rendering advice, the C-JCS is required to consult the service Chiefs, who serve as subsidiary military advisers.

In India, while peacetime management of the armed forces is left to the MoD and the Chiefs of Staff Committee (COSC), strategic guidance to the military, during war, has always come from the PM. However, in the system of higher defence under implementation, ideally, the Raksha Mantri (RM) needs to be brought into the command/operational chain of the Theatre Commanders, with the CDS acting as his adviser.

Unfortunately, such is frequency of elections and intensity of politics in India that no RM has had the time or inclination to devote his/her undivided attention to complex national security issues. This is, possibly, one of the reasons why 70 years post-Independence India finds itself in a security dilemma. Therefore, unless the RM is an individual able to dedicate himself 24×7 to national security, it would be prudent to place the newly minted Theatre Commanders under the Chiefs of Staff Committee, rather than the CDS for operational tasking.

Finally, in the USA, politicians, soldiers, academicians and the media, country-wide, engaged in four years of informed debate before the US Congress passed the Goldwater-Nichols Defence Reorganisation Act of 1986. Since India’s military reforms are equally complex, the GoI needs to seriously consider the constitution of a Parliamentary Committee, with military advisers, to oversee and guide this transformational process.

This article first appeared under the title ‘Target in sight’.

Two years on, revisiting Balakot

Air Marshal Harish Masand feels that this is Not Really a Doctrinal Issue

The Air Situation as depicted by Sameer Joshi showing radar and ELINT data fused together to identify PAF aircraft operating on 27 February 2019

In an interview with Shekhar Gupta sometime back, it was heartening to observe the last air chief, Air Chief Marshal BS 'Tony' Dhanoa, stating that (if) "we had shot down four or five of their (meaning Pakistani) aircraft, the behavioural change would have taken place immediately". This interview was published in February, 2020 '*Pak's version a story, a façade*'. What was heartening to note was that the Air Force had obviously revisited the entire operation of the strike on the terrorist camp at Balakot on 26 February 2019 and subsequent engagement with the PAF the very next morning when the PAF launched their *Operation Swift Retort* in retaliation to the Balakot strike and so draw appropriate lessons from these for the future.

Without going into any controversies around the Balakot strike itself, it is undeniable that both these operations were the first of their kind nearly four decades after the 1971 Indo-Pak war, in terms of the IAF having crossed into Pakistani territory with an air-to-air engagement the next morning. It was immediately evident that the IAF had lost an opportunity in the aerial engagement of 27 February 2019 so as to assert its strength and send a clear message to the PAF on 'domination' of South Asian skies, the claims of an F-16 for the loss of a MiG-21 notwithstanding.

Such a revisit and the lessons drawn have been timely considering that within a few months of this admission from the former Air Chief, the IAF was to be deployed in strength in Ladakh to counter Chinese aggression. Now, after some ten months of such Chinese intrusion, the IAF remains very much on full alert all along the borders, from the North to the East and may well have to prove to the nation that it has truly drawn the right lessons from operations of the past. The IAF must assure the nation that the trust reposed on it, as the first responder to security threats to the nation, is not misplaced. Considering the current grave situation along our borders and the threat of a two-front conflict, it is imperative to examine some of the obvious lessons of the past once more without going into tactics and based purely on public domain information available.

Designing the battle-space

The art of war is to design the battle-space – and the battle – in such a manner that the enemy is lured to fight the way we want, where we can impose our superior strategy, technology, training and tactics to defeat him. In that respect, while Balakot 2019 was the perfect way to evoke a response from the

Dissimilar formation of IAF aircraft: MiG-27ML, Jaguar, MiG-21bison (photo: Simon Watson)

Pakistan Air Force, by all accounts we did not capitalise on the opportunity offered to inflict major losses on it which would have been a very sobering lesson, at least for a few years to come.

Having successfully hit Balakot on 26 February 2019, having crossed the Rubicon so to speak, it must be assumed that national security agencies, including all arms of the armed forces were ready for retaliation from Pakistan whenever and wherever that may have come. There should have been no doubt in anyone's mind that retaliation at a time and place choosing of Pakistan's was certain, particularly when the Pakistani PM himself, had immediately come on TV and so stated, leaving it open in terms of type, place and timing. Culturally, as well as politically, it would have been impossible for Pakistan not to retaliate in some way or another.

That the retaliation came the very next morning, and in the form most likely through the Pakistan Air Force considering the escalatory ladder, should really have been to our advantage.

Thus, taking alert status of the Indian Air Force as a given, the question which comes readily to mind was whether the IAF had foreseen the likely intrusion in force by the PAF resulting in an engagement and had trained itself for the desired end-state? If, as the Air Chief in charge of everything at that time now implies, the message would have gone strongly and the desired behavioral change in Pakistan come about immediately with a large number of Pakistani aircraft having been shot down, one wonders as to what prevented the IAF from achieving such an objective on that fateful morning?

Such a statement tends to confirm that this was not a doctrinal deficiency, which then leaves open questions on perhaps some shortcomings in our equipment, execution or training? Having lured the PAF, why did the IAF not respond to the Pakistani challenge of 27 February 2019 in greater numbers so as to ambush and overwhelm the intruders, shoot down most of them, if not all, as has been stated earlier? Certainly the IAF had the assets and capability to achieve that objective, particularly when viewed in the context of the statements from Air Chief Marshal Dhanoa that, despite its less than the full strength desired, the IAF had a 'Plan B' and the ability to fight a two-front war as demonstrated in Exercise *Gagan Shakti* of April 2018 which reportedly generated about 11,000 sorties in a limited time period. At that time, the CAS had also claimed that "both our adversaries had monitored this exercise and must have drawn appropriate lessons from it".

Considering all this, it thus seems somewhat strange that against a Pakistani force of 24-26 aircraft, the IAF launched a meagre force of four or six MiG-21Bisons to supplement two Su-30s and two Mirage 2000 aircraft that already were on combat air patrol. This becomes even more baffling when viewed in context of the statements that the BVR missiles carried by the Pakistani F-16s had a range superior to those missiles in our inventory at that time. However, this issue of the range of BVR missiles with the opponents and its effect on the engagement is actually in the realm of tactics and need not be discussed here except to state that an engagement based purely on comparative ranges of BVR missiles, reflects poorly on the execution and training of a professional Service.

The female officer, who was controller on the ground that time, later came on TV and stated that she "saw the (radar) scope filling up with blips all over and scrambled the MiG-21bisons which were on standby, apart from controlling the Su-30s/Mirages already in the air" or words to that effect. Without taking anything away from reaction of the controller that morning, and the subsequent award she received for her actions, the question which comes up then is as to why she did not order the launch of more aircraft from different air bases and thus position a larger number from different directions to confront the Pakistani fighter package?

It is difficult to believe that the IAF did not have more aircraft on readiness for such a contingency, a considerable number surely being on high alert after having conducted the Balakot strike just the day before. Also, if she did not order the launch of more aircraft to overwhelm the enemy, what were the actions of the sector director and others higher up in command who should have been monitoring the air situation, even in New Delhi with the Integrated Air Command & Control System (IACCS) in place, particularly when we have been touting our emphasis on net-centric warfare now for over a decade?

Doctrine of the IAF

Doctrine of the IAF very rightly – and clearly – emphasises the importance of air superiority and the various methods for achieving this. Therefore, any doctrinal deficiency can be ruled out. The next link in the chain is emphasis on the doctrine and the strategies employed to implement the chosen manner to achieve air superiority in varied situations. Emerging from such doctrinal emphasis would be identifying the assets required and the equipment on board to achieve the objective in such engagements. Once again, was it a lacuna in the Standard Operating Procedures (SOPs) or the orders on such situations or was this some lack of visualisation and training for situations such as this? Whichever way one looks at it, this certainly was a lost opportunity, as the former CAS had rued almost a year after the event.

Particularly strange is that the scrambled MiG-21bisons (from Srinagar) apparently did not carry the ECM pod that day and, perhaps, this is one of reasons for subsequently losing Abhinandan's MiG-21? A capable EW/ECM system is absolutely essential for any aircraft operating in the modern battlefield and even more so for a fighter aircraft in an aerial engagement in today's environment. Sending an aircraft into combat without an EW system is like sending a lamb to the slaughterhouse.

Visualising such an obvious environment in the future, as Director Aircraft Upgrade in charge of the MiG-21Bis upgrade programme at the time, I am personally aware that we had purchased adequate numbers of ECM pods for the Bison fleet in 1996 to equip almost every aircraft being prepared for such missions. Therefore, to keep an aircraft in readiness for a possible engagement without a functioning ECM and then to launch it into battle, also raises some questions on the concept of employment and tactics for engagements.

We were fortunate that despite the overwhelming numerical superiority that the PAF enjoyed on 27 February 2019, apart from their claims of fully integrated net-worked fighters with superior BVR missiles and years of training, the PAF did not press home their numerical advantage and inflict even larger losses on the IAF than just that single MiG-21bison flown by Abhinandan. It's almost certain that, despite all the claims being made by PAF's Gp Capt Kaiser Tufail, particularly on the number of aircraft that he indirectly implies were shot down that day, by clubbing *Swift Retort* with counter insurgency and their experience during the Afghan War, the PAF is perhaps also ruing their lost opportunities!

IAF Mirage 2000 at night ORP (Photo: Angad Singh)

The Sukhoi Su-30MKI now equips some 12 squadrons of the IAF (Photo: Simon Watson)

In this interview with Shekhar Gupta referred to earlier, the ex-CAS also stated "If we had…." referring to the planned induction of Rafales and S-400 SAMs, thus linking availability of such systems to any success of operations for air superiority or air dominance, as some have started terming the objective. Unfortunately, such a statement tends to deflect and divert the analysis and the lessons thereof, from what could or should have been done with available resources as against what may have been if we had "better assets". Mere induction of superior technology does not always result in success: it is actually how one uses such technology in conformity with the doctrine and formulated strategy alongside rigorous training for such operations. Just because the new Meteor missile has a larger claimed range, and a no-escape zone, compared with BVRs of the Pakistan Air Force, does not mean that the Rafale would always win against an F-16 carrying the AIM-120 AMRAAM or that the PAF would avoid combat, particularly against the Rafales. As a matter of fact, I am of the opinion that the PAF would definitely attempt to seek combat with the Rafales as and when the next aerial engagement takes place perhaps with some different tactics in an effort to down one or more of these and so boast about this to the entire world! This is what they seem to have attempted against the Su-30s in 2019 and, while they did not succeed in shooting down these, they certainly claimed a Su-30 along with that MiG-21bison.

IAF fighter pilots of a MiG-29UPG squadron (Photo: Phil Camp)

IAF MiG-21bison on full afterburner (photo by Simon Watson)

The MiG-21bison has four under wing hardpoints for a combination of weapons and ECM pods (Photo: Pushpindar Singh)

Is BVR Combat, be all, end all?

BVR combat is essentially a combination of electronics and manoeuvres combined with numbers and positioning in an integrated manner through secure data links in a net-centric environment. This writer had earlier also argued that BVR missile ranges were not the sole criterion in an aerial engagement. If the maximum range of BVR missiles was the main criterion, the emphasis of future developments in this area, following the Phoenix missile on the F-14 Tomcat in the 1970s with its 160 km range, would have been on longer range missiles with a higher kill probability and not on combat platforms with greater agility for close combat, which are designed at great effort, complexity and expense. Instead, at enormous cost, today's fighter aircraft designs emphasise stealth, super-cruise as well as super-maneuverability, the last only essential if final combat within visual ranges is envisaged.

At the same time, efforts have been to develop smaller shorter-range BVR missiles so that a larger number can be carried in the weapon bays of stealth aircraft. BVR combat is certainly the initial phase in today's air combat but it is hard to believe that this is the end all and after exchange of BVR missiles at long ranges, both opponents would retire to fight another day, again with just BVR missiles. One may also take note of the number of AMRAAMs fired on that fateful morning, all of which missed, with no losses except perhaps in the case of Abhinandan's MiG-21. At this rate, we could expect both sides to very quickly expend such missiles considering the limited number that Air Force's can afford to maintain in the inventory because of their high costs, limited shelf life and utilisation.

With all that said, one does need to take note in the article by the retired Air Commodore Kaiser Tufail of the PAF, and his views on the impact of Rafales in the skies of South Asia. Tufail claims that the upcoming PL-15 BVR missile carried by the PAF's JF-17 fighters, in combination with their new AESA radar, would actually beat the Meteor missile on the Rafale by "tens of kilometres". Apart from the PL-15 missile that he mentions, the US has already noted challenges of the improved PL-21 missile from China. Surely, the US is not just trying to build longer range air-to-air missiles to achieve air superiority. The IAF, thus, needs to consider how it wishes to fight the next such engagement for air superiority even with the Rafale, keeping in mind Tufail's comparison of the full net-centric integration of fighters on both sides.

Against the PLAAF, the IAF also needs to factor in the stealth factor sooner than later. Unfortunately, the article by Tufail also unnecessarily mocks PM Modi's statement on the lines of Dhanoa's "if we had". Ignoring the sarcasm, one does need to take note of Tufail's reference on "cost-effectiveness'" of four JF-17s against the price of one Rafale, although he does not elaborate on the importance of numbers in air combat. As they say, quantity has a quality of its own. Therefore, considering its depleted strength and the challenges of two to three fronts, the third being the maritime one as well as budgetary constraints, the Indian Air Force seriously needs to think of more cost-effective options for fighters in much larger numbers, as recommended earlier in an article on the depleted strength of the IAF in *Vayu Aerospace Review*.

By the way, Tufail's article admits that the PAF used F-16s with AMRAAMs while referring to the skirmish during Op *Swift Retort* on 27 February, 2019, something that the IAF has been saying all the while with recovered pieces of the AMRAAM. Going along the same lines, someday we may also get details of the PAF aircraft and pilot lost on 27 February, 2019. Was that an F-16 or a JF-17 and was it lost to Abhinandan's MiG-21bison or because of fratricide, just as the IAF downed its own Mi-17 helicopter in the fog of war that morning?

Another problem with statements of "if we had" is that even if we had the assets being mentioned, would they have been in such numbers to have been available in the concerned sector/place in time? With regard to the S-400 next generation surface to air missile system, it has been reported that the IAF is acquiring five units of this system at a cost of US$ 5.43 billion in addition to the NASAM, at some US$ 1.86 billion. As

IAF Su-30MKI firing its BVR missile (Photo: Wg Cdr RS Chauhan)

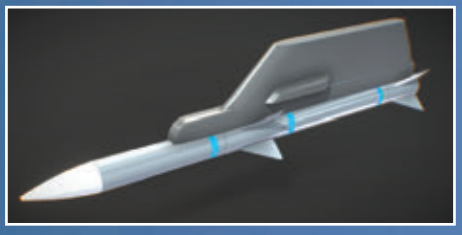


Image of AIM-120 AMRAAM BVR missile (image from the internet)

Artists depiction of Chinese BVR missile, the PL-15 (image from the internet)

Indian Air Force Rafale over Hindan at Air Force Day Parade (Photo by Angad Singh)

The MBDA meteor BVRAAM which equips the Rafale (image from the internet)

per this report, one of the S-400s is for the National Capital Region leaving the four others for rest of the extended western, northern and eastern borders. Considering the likely threats in the current scenario with China and Pakistan, even with the maximum reported range of 400 km at high altitudes for the S-400, five units of these would not nearly be enough to cover India's vulnerable areas thus leaving gaps which could be exploited by adversaries. Even though the systems are mobile, they move at surface speeds and cannot be shuffled about everywhere to immediately react to emerging airborne threats. All such defensive systems are also susceptible to concerted attacks and while resistant to jamming, it would be too optimistic to expect that a determined adversary would not find appropriate counter-measures against the S-400.

In this context, one recollects the 1973 *Yom Kippur* war and, more importantly air actions over the Bekaa valley in 1982, when the Israeli Air Force reportedly took out 19 Syrian SAM sites in two hours without losing an aircraft and then 82 Syrian fighters in less than two days without loss. These 19 missile systems were deployed in the Bekaa valley within a total length of approximately 120 km placing each missile site around 6 km from each other and offering much overlap and mutual support. The problem with SAM systems is their relative immobility, which makes them vulnerable against a determined enemy while also restricting one's own air operations.

The fratricide experienced by the Egyptians in the 1973 *Yom Kippur* War and also the IAF on 27 February, 2019 may also be considered in this context. More importantly, excessive reliance on SAMs tends to tie one down in a defensive strategy (and mindset) as air defence is best performed by fighters in an offensive-defensive strategy. The overall high cost of trying to secure every vital area or point with SAMs also devours resources that may be more cost-effectively employed in flexible fighter aircraft supported by appropriate combat support systems. All this comes down to the choice on how one wishes to fight the next air war or even a short and swift engagement like the one on 27 February 2019 with meticulous planning, equipping and training for the likely scenario.

In this connection, it may be of interest to note that most armed forces, being conservative in their approach and outlook particularly in peacetime, tend to fight the last war. Many examples of this tendency can be given. Some can even be found in the way the battles of 1965 and 1971 wars were fought. This is true even of the PAF. The Israeli approach in Bekaa valley was an exception and obviously derived from the lessons learnt in the 1973 *Yom Kippur* War. Bekaa valley was thus a precursor to the first Gulf War. However, in that Gulf War the US and its allies fought against a poorly

PAF JF-17 armed with combination of air-to-air-missiles (Photo from internet)

equipped enemy with a huge technological asymmetry in their favor.

Against a more equal opponent, the lessons from that war cannot truly be directly applied or replicated blindly without major modifications to the approach. It is also widely known that the PLAAF seems to have been heavily influenced by the first Gulf War. That should give us a clue on how they are going to try and fight if push comes to shove in the current standoff in Eastern Ladakh and elsewhere on the northern front.

Most cost effective options

Certainly, the IAF is seriously working on all these scenarios and debating the most cost-effective options to overcome deficiencies in its quest for air dominance in South Asian skies. This article would now attempt to highlight some of the essential steps that the IAF leadership may surely be considering.

As stated earlier, the first and most obvious step is to define exactly how the IAF wishes to fight the next battle for air dominance. In this context, it is felt that an all out conventional war seems most unlikely in today's geo-political scenario under a nuclear overhang though we have to be prepared for it should a low intensity conflict continue for a relatively longer period, particularly in terms of equipment and stockpiling of spares and munitions. In any event, such a conflict would be preceded by some sharp engagements in the preliminary confrontation period, the Galwan encounter of 15 June, 2020 being an example, while the aggressor attempts to build up a case in the international community for the planned aggression. The very first aerial engagement would be the opportunity to show our real worth and capabilities. Unlike skirmishes on land, the psychological impact of the first major engagement in the air is manifold, far more than the actual losses and the comparative strengths of the opponents particularly since the engagement is over in minutes if not seconds.

Having spent many years in this domain, I feel certain that the expertise of TACDE in devising appropriate strategies and tactics – as well as that of COBRA on such scenarios – have already been utilised in this effort. As a matter of fact, outlines of future air battles were submitted to Air HQ, as a classified paper, as early as mid-1994 while an article on the impact of AWACS on future air wars was published by Sqn Ldr Ajay Singh in 1995. Unfortunately, although I read this

J-10s of the PLAAF (Photo from internet)

Netra AEW&C aircraft flanked by pair of Su-30MKIs over Yelahanka (Photo: Phil Camp)

Advanced air combat scenarios can economically, realistically and effectively be conducted now via appropriate simulators (image from the internet for depiction purposes only)

article at that time, I have not been able to find a link or citation to it after all these years. Certainly, the authorities concerned must well have considered all of these while devising appropriate strategy and tactics to suit the current scenario and advances in technology.

The above exercise must certainly have examined deficiencies in certain assets and equipment which may include the need for more combat support systems as well as secure data links and communication sets on certain platforms as also current needs of EW suites. While the deficiencies in data links and communications could be rapidly made up, EW systems require a vast amount of data, painstakingly gathered over time through every possible means of intelligence gathering. Based on such high quality intelligence, EW suites may have to be developed or updated indigenously because of the classified nature of such data/information on systems to be countered and the requisite technology to effectively counter them. Such intelligence and technology is unlikely to be made available by foreign sources. Fortunately, some of our existing establishments, like DARE and ADE, have requisite expertise in this field and may be able to develop appropriate systems and software, particularly if we second specially selected IAF engineers and operators on such programmes.

Concurrently, the IAF must disseminate formulated tactics to all operators who will participate in such missions and then train them hard for it. Quite obviously, the amount of effort required for training such a large number of personnel involved in air dominance operations, which would include large-force engagements, could be prohibitive in terms of the available assets, their life and utilisation rates. There is also the problem of mounting requisite air effort regularly in a secure area outside the monitoring zones of our adversaries.

Pair of IAF Mirage 2000s (photo: IAF)

Air Combat Simulation

Fortunately, most training for BVR engagements can be more economically, realistically and effectively be conducted now via appropriate simulators, with multiple modules, with the added advantage of pause and replay in between when the actions of one or more members need to be reviewed. Once again, however, such simulators require programming with classified information and parameters, not realistically available from foreign sources, apart from their much higher costs when done by foreign vendors.

In this area too, indigenous agencies are available to put together the required simulator sets for various types of aircraft envisaged to be used in such engagements – provided we define the exact requirements and associate our own people with the development! Many of our retired officers had, when in service, made great strides in simulation and software development and the IAF could explore the possibility of engaging them for development of such simulators on a proprietary and confidential basis with some initial developmental funding, if required. Such an approach would be more cost-effective in the long-term when compared with the known costs of large international simulator companies – apart from the aspect of classified information.

Further, a number of such simulator sets would have to be built so as to place these at various locations to cover regular training of all operators. This would enable huge savings on the actual flying effort that would otherwise be required to keep all operators current on the latest systems and tactics. Such simulators could also be easily adapted to conduct other aspects of training, including air-to-surface missions, particularly in employment of standoff weapons. Additionally, such simulation automatically contributes in eliminating

accidents in such engagements, particularly for operators being initiated in such exercises with a large number of aircraft, thus significantly adding to the savings.

For the longer term, the IAF needs to define the kind of equipment it needs for the likely missions it would be required to undertake. Such definition should shape its re-equipment and modernisation drive. However, even here, hard choices have to be made in view of budgetary constraints that affect even the most affluent of nations. One just cannot fritter away precious resources on a bit of everything. If we talk of air superiority and even air dominance, we have to decide if we are going to aim for control of the air through ASFs and supporting systems or air denial strategy, on the lines of sea denial with submarines and mines, with largely static SAMs. One just needs to introspect on the amount of resources, both money and manpower, invested in SAMs in the context of the kind of wars we are likely to be involved in to arrive at the right choices in terms of assets or even the right mix of assets.

In conclusion, it is reiterated that the IAF needs to urgently revisit its doctrinal emphasis and to rework its future strategy and then its needs to acquire the requisite combat support systems and force-multipliers, apart from only acquiring combat aircraft. Our existing combat platforms must be properly equipped and regular training of all operators initiated for any future air dominance missions as also for standoff precision attacks to improve the success rate of all such missions.

Apart from cost-effective force multipliers, the IAF may also need to renew its focus on simulation for regular and repeated training of all operators in such missions to optimise utilisation of its already depleted assets and preserve these for the remaining essential training – and actual hostilities. Such large-force BVR engagements require simulator sets with tens of plugged-in modules to give realistic training to controllers as well as the pilots. To the best of this writer's knowledge, such simulators have not been built anywhere in the world so far and the IAF could take a lead in developing these systems indigenously. The doctrinal emphasis on air dominance of the IAF needs to be converted into an appropriate strategy with commensurate tactics and training. For basic combat training of all combat pilots while enhancing flight safety, measures earlier recommended may also be revisited.

References

In this Article, Air Marshal (R) Harish Masand has referred to his earlier writings

'*The Real Thing'* in *Vayu II/2019; 'The F-16 vs MiG-21 Bison: More Questions than Answers' 'Lessons Learnt: A year after Pulwama'; 'Stemming the Slide'* in the *Vayu;*

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IAF Su-30MKIs drop ordinance during fire power display (Photo: Angad Singh)

Air Warriors in Olive Green

Boeing AH-64E Apache of the IAF (Image from Boeing)

Lt Gen BS Pawar on why "Attack Helicopters must be organic with the Army"!

All major armies of the world, including those of our adversaries, have full fledged air wings of their own, comprising various types of helicopters, including attack as also fixed wing aircraft in their inventory. Both China and Pakistan have very potent attack helicopters in the aviation inventory of their respective armies. Pakistan Army Aviation already have Russian Mi-25/Mi-35 and US Huey Cobra attack helicopters and have recently acquired new Chinese Z-10 attack helicopters, recently inducted by the PLA. According to reports, the Pak Army is also in process of acquiring 30 new generation attack helicopters from Turkey, the A-129 ATAK, reportedly being a copy of the Italian 'Mangusta' attack helicopter but with far better high altitude capability.

It is therefore surprising that the Indian military mind is still stuck in the quagmire of unresolved command and control aspects, that of an aerial weapon platform which

Indian Army Commandos during exercise (image via author)

The Turkish A-129 ATAK (image from internet)

The Chinese Zhishengji-10 attack helicopter (from the internet)

is essentially designed for manoeuvre and attack against ground targets and which forms an essential component of land forces the world over. While over the past years, there has been some forward, but slow, movement on this matter, the continuing ambiguity and confusion at the Government and military levels fuels unwarranted suspicions, controversies and rivalries between the Army and Air Force with no light at end of the tunnel.

The logic

The case for inclusion of attack helicopters as part of the army goes back to 1963 when Gen JN Chaudhary, then COAS, stressed the requirement for a separate Army air wing. He emphasised that efforts at increasing fire power and mobility of the Army would be incomplete without an integral aviation element comprising light, medium, heavy as well as armed/ attack helicopters. This quest was partially fulfilled with formal establishment of the Army Aviation Corps on 1 November 1986, but this was nowhere near what had been envisioned in 1963, especially in respect to attack helicopters.

The Indian Army thereafter continued unabated efforts over the next three and a half decades to overcome bureaucratic barriers, inter-service rivalry and lack of political direction on the issue of ownership of attack helicopters. The Army's relentless pursuit of this need resulted in October 2012 when the then UPA Government, accepting logic of the Army's case and directed that, henceforth, all attack helicopters would be owned, operated and maintained by the Army.

Whilst the Government directive ruffled a lot of feathers, particularly those of the Air Force, the need for potent tactical airpower at immediate call of the ground force commander was finally recognised. Based on this decision, it was logically assumed by the Army that the formidable Boeing Apache AH-64E helicopters very recently procured from the US by India would now be part of the Army Aviation Corps inventory. It therefore came as a complete surprise to the Army when the UPA Government reneged on its earlier order and directed that the initial 22 Apaches being acquired would be with the Indian Air Force "because of the acquisition processes already in motion"! Such reasoning was totally devoid of logic and it was quite clear that Government-of-the-day had succumbed to Air Force and bureaucratic pressures.

In this regard, the statement of the then Air Force CAS NAK Browne that the Air Force could not allow "little air forces doing their own thing" is quoted, but he ignored the fact that both the Coast Guard and the BSF have air wings of their own. More than ever it still rankles the Air Force that India's Navy now boasts an inventory of over 300 sophisticated aircraft, of all types, including 4th generation fighters! It is beyond

HAL Chetak helicopter of the Indian Army (photo: MoD)

HAL Advanced Light Helicopter (ALH) of the Indian Army (photo: Angad Singh)

comprehension as to why the Air Force has a major problem with regards to the world's second largest Army having an air wing including attack helicopters under its command. It is high time the Air Force got off its fixated mindset of protecting its (air) turf at all costs and accepted the realities of present day high intensity, mobile warfare.

The Army's recommendation to the Government of that time to 'share' the 22 Apache helicopter assets on a 50:50 basis was also vehemently objected to. However, possibly to assuage feelings of the Army and keeping in mind operational requirements, the Government had given an in principle approval for 39 Apaches for the three Strike Corps. However, in May 2017 the NDA Government lowered this figure to 11 Apaches under the repeat option clause of 22 Apaches being procured by Air Force, and subsequently reduced this further to six Apaches in August 2018, possibly owing to financial constraints. While a unit of six Apaches makes little military sense, and is certainly not a rational combat organisation from the tactical employment point of view, some initial start has been made and the Army will no doubt subsequently pursue its case for greater numbers, based on its operational requirements. As per reports, all 22 Apaches for the Air Force have already been inducted and the induction of six Apaches for the Army is likely to commence next year.

But why attack helicopters for the Army?

The attack helicopter is one of the most versatile weapon systems currently available to the field force commander in militaries the world over. The primary mission of attack helicopters is to intrinsically participate in land battles, to support ground operations in the Tactical Battle Area (TBA) as a combined arms team, which immensely expands the ground commander's options in battlefield time and space. Battlefield leverage with attack helicopters is achieved through a combination of reconnaissance, mobility and fire power which is unprecedented in the evolution of land warfare. The greatest contribution to success in the battlefield is the accretion that this gives the commander to apply decisive combat power at critical times virtually anywhere, in the form of direct fire, facilitating 'Effects Based Operations'.


Boeing AH-64E Apache (image: Boeing)

The HAL Rudra attack helicopter (photo: Angad Singh)

It is imperative that attack and armed helicopters must be at the beck and call of the field force commander and also piloted by men in 'Olive Green' who are integral in fully understanding the ground situation and so ensuring optimum utilisation of this battle winning resource. This is the critical rationale on which the Army's case for ownership of these assets is based which has long been accepted in virtually all other modern armies of the world.

Unlike the Indian Air Force, Army Aviation units and helicopters need to be located very close to their operational areas, virtually alongside the formations they are affiliated to, especially at the Corps level. During war, these units will operate from 'Forward Composite Aviation Bases', having all requisite security, maintenance, fuelling and arming facilities. This employment philosophy dictates the need to develop organisations that enhance aviation capabilities to support the concept of operations of field commanders and tailored to meet the evolving operational requirements - hence the concept of an Aviation Brigade with each Strike Corps – and not being static at bases which are relatively distant away, as is the case with the Air Force.

Following the Indian Army's Doctrine of 'Cold Start' or 'Proactive Strategy' as the Government would like to call it, has meant major restructuring, with the Holding/Pivot Corps as 'first responder' to enable quick and immediate action within 48-72 hours, using integral assets at the Corps level. For this, all resources required (including attack helicopters) must be under command and control of the field force commander. The present arrangement that ownership of these vital assets is with the Air Force and operational control with the Army is not operationally sound: in no major Army of the world does such an absurd arrangement exist!

Army's Attack Helicopter Inventory: Present & Future

Despite the above hurdles, the Indian Army has already inducted in some quantity, armed version of the HAL advanced light helicopter (ALH), called the *Rudra*. While 50 *Rudras* are already in service and operationally deployed, including some in the current standoff area of Ladakh, another 20-30 are planned for induction in the next two years, thereby taking the total to some 70-80 of these armed helicopters, by no means a small number. The Air Force too has one helicopter unit equipped with ten *Rudras*. Although not a typical attack helicopter, the *Rudra* has an array of potent weapon systems including cannon, rockets, air-to-air and air-to-ground anti-tank missiles (ATGM). *Rudra* squadrons form part of the Holding/Pivot Corps, constituting a formidable offensive punch to the field force commander.

HAL light combat helicopter (image: Angad Singh)

The Light Combat Helicopter (LCH), also developed by HAL is a milestone achievement, hitherto exclusive club of such light attack helicopters, like Eurocopter's Tiger, Bell's AH 1Z Super Cobra, Turkey's A-129 ATAK and China's Z-10.

The LCH is derived from the ALH and designed for anti–personnel and anti–armour roles, with capability of operating at high altitudes (16,000 feet ASL), a distinct advantage over other attack helicopters. The LCH will be a major asset of the field force commander and operate both in the plains and mountains. During the Kargil conflict of 1999, the only attack helicopters with the IAF (Mi-25/Mi-35) could not operate at high altitudes, where the conflict was concentrated.

Army Aviation Dhruv ALH in Eastern Ladakh (image via author)

HAL Cheetah of the Indian Army at Siachen (image MoD)

As per reports, initial clearance for five LCH for the Army and ten for the Air Force has already been given by the Government while the overall requirement for the Army is much larger and induction is likely to commence in the year 2020-21.

Some myths – that need busting!

However, there remain efforts by "vested interests" to spread disinformation on capabilities of the Army to hold, operate and maintain aviation assets, orchestrated mainly through the print media both in leading newspapers and some defence journals. This has particularly been so after the Government's decision was announced on ownership issues of attack helicopters in the Army's favour.

Some of these are not only laughable but need dismissal with utter disdain! An article in *The Times of India*, a few years back,

Army Aviation Dhruv ALH with artillery gun under slung (image via author)

highlighted the fact that the Army does not have an "aviation culture" and hence was incapable of operating and maintaining modern day attack/heavy helicopters, while another article talked the Army's inability to absorb and maximise utility of these expensive military assets. There are very many other untruths spread around about Army Aviation pilots and engineers, on aspects related to flight safety, training, maintenance practices and so on. Most of the time these are ignored or brushed aside by the Indian Army, but the time has now come to end this hogwash!

The Indian Army's Aviation Corps came into being on 1 November 1986 and is well into its fourth decade. The Corps has earned many laurels both in conflict (during Op *Pawan* and Op *Vijay*) and is continuing to play a stellar role in counter insurgency operations. It has been in the forefront for search and rescue operations during numerous natural calamities and disasters faced by the country. Most importantly, Army Aviation helicopters are the life line of troops deployed in the extreme climatic environment and treacherous terrain of the Siachen Glacier, where pilots operate these machines to the extreme limits of their flight envelope.

The Army was the first to induct the HAL twin-engined Dhruv Advanced Light Helicopter and was appointed lead service for development of the armed version of the ALH the *Rudra*. The Army was once again in the lead for evolution and induction these gunships. The ALH has now matured into becoming one of the most modern utility helicopters in the world and is proving its superior high altitude capabilities during the present standoff in Ladakh.

Also for the uninformed, the basic training regime for both helicopter pilots and technicians is common for all the three Services and is conducted at their respective training institutes and establishments: however specialist and advance training is specific to each service's requirement. Therefore, let there be no doubt in anyone's mind that Army Aviation pilots and engineers are as good (if not better) than their counter parts in the Air Force and if the men in blue can fly and maintain the new Apaches and Chinooks, so can the men in olive green.

Another bogey raised from time and again is rationalisation of resources and cost benefits that accrue with a single service handling assets such as attack helicopters. I totally endorse this view! It is recommended that the entire helicopter fleet including attack as well as medium and heavy helicopters including the Chinook be transferred to the Army at the earliest for optimal utilisation of this critical resource as is the case with other advanced armies of the world including those in our neighbourhood.

Boeing CH-47F Chinook of the IAF (image: Angad Singh)

Prototype of HAL light utility helicopter (LUH) (image: HAL)

The Indian Air Force could retain what helicopters they require for supporting their own needs. In fact, this is an area that the CDS Gen Bipin Rawat could examine on priority and settle the bitter and controversial issue once and for all as this falls very much within the ambit of his mandate.

It would be appropriate to reiterate here that Army Aviation today has a permanent cadre of its own, which includes pilots, technicians and support/administrative staff. Officers are now directly commissioned into the Army Aviation Corps after completing their training and affiliated to different infantry battalions located in operational areas for the first two years of service, where they learn, imbibe and understand the essence of 'Army Culture', a pre-requisite for becoming an Army Aviation Aviator. This indeed is the fundamental of Army's Aviation Culture which unfortunately the Air Force and some of their fellow travellers do not - or cannot - understand.

Enhancements on the AH-64E Apache

IAF Apache

Improved Versatility: achieved with the newly designed Improved Drive System (IDS), Composite Main Rotor Blades (CMRB) and the more powerful 701D GE engines. These improvements provide better aircraft performance and support joint manoeuvre commander's need for multi-mission operations in high/hot environments (1,829 meters/35 degrees C).

Open Systems Architecture: enables the innovative and versatile ability to rapidly integrate new technology into the Apache without major reconfiguration of aircraft systems.

Joint Communications Capability: provides the Joint Combined Arms Team synchronisation with enhanced joint interoperable communications which enables shared situational awareness that builds situational understanding, with increased maritime capabilities.

Increased Responsiveness: provides capability for accurate target acquisition, identification, engagement and battle-damage assessment utilising the Modernised Target Acquisition Designation Sight (M-TADS), image enhancements, and Unmanned Aircraft Systems (UAS) control.

Increased Lethality: expands air-ground precision engagement capability for the joint commander through the use of longer-range sensors, unmanned aircraft system teaming and maritime capability.

Increased Payload Capability: provides scalable options and discriminating capabilities choices to the ground commander ensuring adaptability in a complex environment and operational overmatch when required.

Improved Survivability/Force Protection: supports the crews' readiness to fight in a complex and ever changing environment with Integrated Air Warrior, Common Missile Warning System, extended range radar and upgraded Radar Frequency Interferometer with enhanced ranging. The AH-64E design incorporates ballistic tolerances and systems redundancies that enhance survivability and successful mission completion in complex threat environments.

Enhanced Situational Awareness: supports the Joint and Unified Land Force Commanders with a better understanding of friendly and threat situation utilising unmanned aircraft systems capabilities. These enhancements increase effectiveness while improving battlefield situational understanding and minimising the chance of fratricide.

Courtesy: ***Boeing***

Raison d'etre

Primary role of attack helicopters the world over is to support and fight the land battle in the tactical domain. A key element of attack helicopter employment philosophy is that they must operate as part of the combined arms team–and not in isolation. Such a situation was dramatically demonstrated during the 2003 Iraq war when a deep strike raid attempt by a large number of US Apaches against an Iraqi Armoured Division near Karbala failed miserably, with consequential high losses. However, the same Apaches were successful in a similar mission four days later, when their operations were conducted in close coordination with the ground forces, artillery, as also ground attack aircraft.

The employment of attack helicopters, fully integrated with Army Aviation units and fighting alongside – and above – the Infantry also gives a new meaning to close air support in the TBA and which brings into focus the role of attack and armed helicopters. In Afghanistan, troops on the ground have been more comfortable with intimate support provided by attack helicopters in their operations, thanks to the visibility, proximity and short response time factors.

The shapes to come

In the near future, the Indian Army's Aviation Corps will have a formidable attack helicopter inventory, from the *Rudra* armed helicopter to the Apache and the LCH. The LCH particularly, because of its high altitude capability will be a force multiplier and major weapon of decision in any future conflict in the high mountains. Further, as per the recent reorganisation and concept of lean and mean *Integrated Battle Groups* (IBGs) whose operations have been validated both in the mountains and plains, these will need dedicated and organic fire support elements in terms of rapidly heli-lifted artillery as well as attack helicopters.

The Boeing AH-64E Apache is a game changer and will be a powerful and decisive factor for the Strike Corps Commander: in case of a future conflict, the 22 Apaches presently with the Air Force must also be immediately available to support land forces operations, which is the primary role of these attack helicopters (not as anti-drone interceptors as some men in blue proclaim!).

I quote a very relevant paragraph from the joint memorandum issued by the US

HAL light combat helicopter (image: HAL)

Army and US Air Force to the House Armed Services Committee in April 1976 to define the role of attack helicopters – this was at a time when the two Services were also going through similar ownership issues:

'The attack helicopter is a mobile weapon system capable of providing organic fire support to local Army units. Because of the limited range, speed and firepower of the attack helicopter, as compared with Air Force fixed wing close support capabilities, we do not consider the attack helicopter as duplicating Air force close air support'.

This should put to rest any further discussion on the ownership issue of attack helicopters: as with the US military, the same needs to be done for the Indian military without further procrastination or delay.

HAL light combat helicopter in Ladakh (photo: HAL)

Boeing AH-64E Apache (photo: Boeing)

Lt Gen BS Pawar is an alumnus of the RIMC at Dehra Dun, and has, during his career of over four decades, held a number of important command and staff appointments. He was head of the Army Aviation Corps and Commandant School of Artillery. Currently, he is President of the Northern Region of The Helicopter Society of India.

Ajai Shukla on

HAL's light combat helicopter: the mountain fighter

(photo: Angad Singh)

In a double assertion of its proficiency in building different kinds of helicopters, Hindustan Aeronautics Ltd achieved two significant landmarks in end-September 2020. The company rolled out its 300th Dhruv advanced light helicopter (ALH) for the military and also conducted inaugural ground run of the first Light Combat Helicopter (LCH) it is series-producing for the Indian Army and Air Force.

While the Dhruv, with over 280,000 flying hours logged, is already backbone of the Indian Army Aviation and also the Air Force, the LCH will be a crucial new induction that would play an important role

VCAS with LCH at Ladakh (photo: HAL)

LCH prototypes at Aero India 2019 (photo: Phil Camp)

in any armed confrontation between Indian and Chinese troops on the Ladakh border, or in the looming militarisation of the Line of Actual Control (LAC).

The LCH project was sanctioned after the 1999 Kargil War, when dire need was felt for a weapons platform that could provide dedicated fire support to army soldiers at high altitudes, which could carry a limited amount of weaponry. The Ministry of Defence accordingly sanctioned the LCH project in October 2006.

Fourteen years later, the LCH has become a reality. It is learnt that HAL will build the first 15 'limited series production' LCH for about Rs 125 crore per helicopter, or about one-third the cost of each of the 28 AH-64E Apaches attack helicopters the government is importing. True, the Apache is a bigger, more heavily armed gunship with more advanced avionics and battle-tested night fighting capabilities. But, for those reasons, it is expensive and the Army and IAF will be making up the numbers with LCHs.

The MoD is still to sign a contract for 15 LCHs, but HAL has begun building the helicopters with its own funds, HAL's board having sanctioned Rs 1,800 crore for this and production is well moving along. The armed forces have projected an eventual requirement of 65 LCH for the IAF and 97 for the Army.

A key attribute of the 5.8-tonne LCH is its ability to fly and fight at the high altitudes the army is deployed at. In tests conducted in the Siachen Glacier sector, the LCH has demonstrated its capability to land and take off at altitudes of 5,000 metres with sufficient fuel and weaponry for combat missions against even higher targets.

Driving this performance is the LCH's twin Shakti engines, especially designed by French firm Safran, to deliver extra power at high altitudes. That makes the LCH an ideal platform for providing infantry soldiers fire support in 15,000-16,000 feet-high contested areas such as Depsang, Galwan and the heights north and south of the Pangong Tso, where Indian troops are facing off against Chinese intruders.

For such a small, light helicopter, the LCH is a formidable fighting machine. Its two pilots, who are seated one behind the other in a slim tandem cockpit, can choose a range of weapons that they fire using a helmet pointing system that lets a pilot aim at a target by just looking at it.

The LCH's weapons options include a nose-mounted 20-millimetre turret gun or 70-millimetre rockets or air-to-air missiles that it carries on stub wings. The LCH is the first helicopter to fire air-to-air missiles against a flying target. The LCH is also designed to carry anti-tank guided missiles (ATGMs) that can target enemy tanks at ranges of up to seven kilometres.

Allowing it to survive on a battlefield where it will be a prized target, the LCH is protected by a range of devices. The pilots are shielded against ground fire by armoured panels around the cockpit and by a bulletproof windshield. The LCH has self-sealing fuel tanks that automatically seal bullet holes with a rubber compound. It has damage-tolerant rotor blades and a main gearbox that can run for 30 minutes even after a bullet hit drains out all its oil.

The LCH is also fitted with an electronic warfare (EW) system that detects enemy missiles and then scatters flares and chaff as decoys to lure the incoming missile away from the helicopter.

Showcasing HAL's prowess at Aero India 2021

VAYU Interview with Mr. R. Madhavan, CMD Hindustan Aeronautics Ltd.

VAYU : As we prepare for the forthcoming Aero India 2021, kindly give our readers an overview of HAL's participation at the Show and which aircraft types would be displayed and flight demonstrated.

CMD: The primary focus is to showcase HAL's prowess in the aerospace and defence arena to the world, with display of indigenously-designed and developed fixed and rotary wing platforms, technologies covering power plants, avionics, etc.

- With central theme of the **India Pavilion** being rotary wing capability in India, HAL's rotary platform Light Utility Helicopter (LUH) will be centrepiece of the display with scaled models of the IMRH, ALH, LUH, LCH and the Indian helicopter manufacturing ecosystem/supply chain partners arrayed around it.
- The HAL Stall in Hall 'E' will display our capability and contribution in line with HAL's central theme "Conceive-Indigenise-Collaborate". Future generation combat capable airborne solutions will be displayed here.
- The Outdoor display adjacent to HAL stall will feature rotary wing products namely the LCH, ALH Mk IV Rudra and ALH Civil variant.
- Display of the range of indigenous HAL platforms participating in static and flying display are included as part of *Aatmanirbhar Formation* flight. Both fixed-wing and rotary-wing aircraft including the Su-30, Do 228, Hawk-i, HTT-40, ALH, LCH, LUH will be in the flying display. In the static display are HTT-40, LUH, ALH Mk. III and Dornier 228. Customer demo flights will be offered to select customers, on need basis.
- HAL plans to sign MoUs/Agreements with global aerospace majors/associates both foreign and Indian looking for capacity and capability to address the requirements of Indian Defence and global markets. HAL has planned to sign various MoUs/Agreements.
- Product Launch/handing over/major announcements on reaching key milestones are also planned, including handing over of first hardware of Semi-Cryo development project of the ISRO.

VAYU : HAL's Helicopter Complex continues to develop variants of ALH, including the Mk. III wheeled version for the Coast Guard. Has the Service cleared its induction for deployment on board Coast Guard OPVs? What is status of the ALH variant offered to the Indian Navy, with folding rotor blades?

CMD: The newly-built ALH Mk.III wheeled variant for the Indian Coast Guard is integrated with nineteen additional equipment/sensors/systems for coastal security roles. All the trials needed towards certification of the new systems were completed during November 2020 at Goa. As required by the contract, final certification of the helicopters with 19 new systems by RCMA/ CEMILAC is at the final stages. After completing the certification by RCMA/CEMILAC and SOC by RDAQA, the helicopters will be cleared for deployment on board Coast Guard OPVs. By design, the helicopters are cleared for ship borne operations.

HAL has two orders for ALH Mk.III wheeled variant which includes 16 helicopters for Indian Coast Guard and 16 for the Indian Navy. The Navy and CG variants of ALH Mk.III are built with capability for manual folding of rotor blades, meeting the contract requirement of dimensions and time.

VAYU : Series production of the Tejas LCA Mk.I (FOC) commenced last year with the first such aircraft handed over to the Air Force on 27 May 2020. When would the balance aircraft of this series be handed over?

CMD: We have orders for delivering 16 FOC block fighters to the IAF, out of which, first FOC LCA aircraft has joined 18 Squadron of the IAF in May 2020. Flight testing has started for two more aircraft and another six aircraft are in the advanced stages of system integration and testing. The structural assembly manufacturing is underway for the remaining seven aircraft from the FOC batch. We are steering to conclude FOC fighter production by 2022.

VAYU : HAL is now responsible for development of the LCA Mk.1A and the Air Chief has reiterated that formal orders will be placed on HAL for this type during the current FY. What are the timelines for completing integration of the chosen new systems and by when would certification be received?


(Photo: Phil Camp)

CMD: LCA Mk.1A is an advanced variant of its predecessor variants. It comes fitted with AESA radar, Self-Protection Jammer (SPJ) pod, BVR (Beyond Visual Range) missile firing capabilities, advance EW (Electronic Warfare) suite as well as Radio Transmission with SDR link. The avionics of LCA Mk.1A is equipped with smart MFDs and thus will elevate the Human Machine Interface. It is a much more maintenance friendly aircraft developed to reduce the turn-around time (TAT) of LCA fleet and thus enhance the combat readiness of IAF squadrons. It has superior combat edge and enhanced aerodynamic capabilities over LCA Mk.1 aircraft, which are currently in operation. The certification of these systems call for rigorous flight testing and performance demonstration for all the newly integrated systems. All these systems are planned to be integrated progressively and LCA Mk.1A Certification is planned to be obtained within the stipulated time to ensure delivery as per the contract.

VAYU : HAL's Avionics Division at Hyderabad have received clearance for the first AESA Radar (CBU phase) to be fitted on the Jaguar DARIN III UPG aircraft. This is very creditable and would this success be reflected in the eventual fitment of such radar on the LCA Mk.1A?

CMD: AESA radar configuration finalised on LCA Mk.1A is different from the AESA radar fitted on Jaguar Darin III Aircraft. Both the radars will be manufactured at the Avionics Division Hyderabad under Transfer of Technology. However, the indigenous *Uttam* radar, developed by LRDE, DRDO is also under trials with the LCA.

VAYU : HAL have been producing the Sukhoi Su-30MKI at its Nashik Division for several decades and the licence manufacturing programme could be extended with the IAF's order for 12 more such aircraft. What is status of the type's upgrade programme?

CMD: HAL, with its rich experience and technology base is best capable of leading this indigenous upgrade. Indigenous upgrade will arm the nation with capability to carryout technology upgradation of the aircraft in future independently to address operational enhancements, obsolescence, reliability and maintainability to ensure a seamless life cycle support.

HAL has proposed an Indigenous Upgrade Programme for the Su-30MKI aircraft to the Indian Air Force and has been pursuing with Air HQ for the project 'Go-Ahead'.

Scope of Su-30MKI upgrade envisaged by HAL encompasses development of avionics architecture with integration of HAL Mission Computer, state-of-the-art sensors and systems like the AESA radar, advanced EW Suite, and improvement in maintainability, reliability, addressing obsolescence and integration of existing/modern weapon systems. This indigenous effort will align and synergise with the country's long term vision of Self Reliance through "Make in India" and *Aatmanirbhar Bharat.*

VAYU : The Air Chief has recently reviewed the Light Combat Helicopter (LCH) programme and you have stated that the Company is geared up for productionisation of the LCH to meet all requirements of the IAF. When are the first series production LCHs to be handed over?

CMD: Initial Operational Clearance (IOC) of LCH-LSP for Air Force and Army versions was accorded on 24 August 2017 and 15 February 2019 respectively. HAL has proactively taken up production of the LCH anticipating orders, in absence of firm orders.

However, we have pursued with Air Force and Army to give us a Letter of Intent (LoI) so that few helicopters can be offered to them for early exploitation pending contract finalisation. We have received LoI from both Air Force and Army for five helicopters each and in this financial year we have planned to signal out three LCH.

VAYU : HAL has embarked on configuration studies of a 13-tonne medium lift multi-role helicopter (IMRH). Assuming that the Armed Forces are closely involved with the concept and configuration studies, what is the timeline for finalisation of the specifications?

CMD: As per Minutes of the Review Meeting (dated 2 December 2020) on the IMRH chaired by Secretary DP, the IAF and Army are to issue a finalised JSQR


(Photo: Phil Camp)

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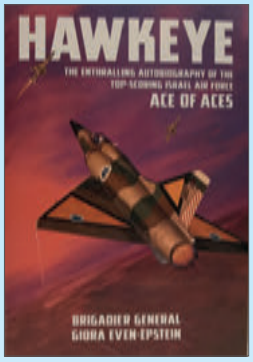

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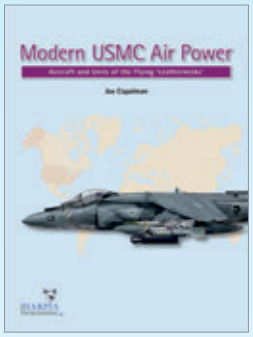

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by April 2021. Based on this, HAL will have to submit the DPR by June 2021. A preliminary version of the Operational Requirements have been issued by Air HQ on 15 December 2020. HAL will provide feedback on the ORs to IAF shortly.

VAYU: Please update us on status of the HTT-40 basic turboprop trainer and as to when certification is expected? Meanwhile, a modified HJT-36 intermediate jet trainer has commenced crucial phase of flight testing. Have the IAF indicated firm requirements for this IJT?

CMD: The HTT-40 meets all the systems and performance requirements as per the preliminary staff qualitative requirements. All systems certification flights including hot weather, sea level and cross wind trials have been completed. The aircraft has also cleared the technically challenging stall and spin trials. Six turn spin capability has been demonstrated on HTT-40 aircraft and the spin characteristic is consistent. The final certification will be against the frozen requirements contained in RFP. All inputs required by Air HQ for issuance of RFP has been provided.

The modified HJT-36 Sitara has commenced spin testing after the completion of all the prerequisites like spin recovery parachute system (SRPS) integration & streaming trials and stall testing. Presently two turn spin entry and recovery has been established. Further spin testing is in progress wherein the number of turns are progressively being increased in-coordination with the certification authorities. IAF will be approached for confirmation on delivery of HJT-36s after the demonstration of six-turn spins. Regular updates on the progress of HJT-36 flight testing are shared with the IAF.

VAYU: The MoD has formulated a draft Defence Production and Export Promotion Policy 2020 (DPEPP 2020), envisaged as "an overarching guiding document to provide a focused, structured and significant thrust to defence production capabilities of the country for self-reliance and exports". What are HAL's priorities in terms of exports of its products?

CMD: So far, HAL's exportable platforms have been the Advanced Light Helicopter (ALH) Dhruv Mk.III and Dornier 228 aircraft. Presently, in the rotary wing side ALH Mk.IV and Light Combat Helicopter (LCH) and in the fixed wing segment, Tejas Light Combat Aircraft have also been added to the basket of HAL's exportable aircraft platforms. In the near future, the Light Utility Helicopter (LUH) and Hindustan Turbo Trainer (HTT)-40 will also be pitched in the export market.

(Photo: Phil Camp)

With the introduction of above platforms to the export market, HAL envisages enhancement in exports in the coming years. HAL has been pursuing overseas opportunities in select markets and has responded to various RFIs received for its platforms. In addition HAL and other DPSUs have been entrusted with promotion of Indian Defence Industry Products abroad. Accordingly, HAL has taken the lead in eight countries allocated by MoD.

VAYU: Another area of great importance is HAL producing the biggest cryogenic propellant tank for the ISRO. The success of India's space programme is laudable and HAL shares the credit. Kindly give some details of HAL's involvement in futuristic space launch vehicles?

CMD: HAL as a strategic partner has been associating with the ISRO on the Indian prestigious space programmes for the past five decades. HAL has been supplying critical structures, tankages, satellite structures for the PSLV, GSLV-MkII and GSLV-MkIII launch vehicle.

Today, the Aerospace Division is the only facility in the country that brings under one roof activities ranging from methodising, high-tech tooling, precision machining, welding, complex riveted and welded assemblies, integration and quality assurance of aerospace systems.

The facilities have been augmented and modernised continuously over time to manufacture structures and propellant tankages of different types and sizes, different materials and varied complexities. The manufacturing excellence of the division is visible in production of space worthy large components and assemblies with stringent dimensional and quality requirements.

HAL has supported the ISRO for all its developmental programmess including *Chandrayaan-1*, Mars Orbiter Mission (MOM), *Chandrayaan-2*, Crew Atmospheric Re-entry Experiment (CARE), PAD Abort test for Crew Escape to the present stage of building a full-fledged launch vehicle for Human Space Mission-*Gaganyaan*. HAL will be supplying critical hardware for the *Gaganyaan* project for both the un-manned and subsequent manned missions planned by ISRO.

HAL-made structures and propellant tankages have performed impeccably mission after mission. As an initiative to expand business portfolio, facilities for productionisation of Cryogenic and Semicryogenic Engines are being established at HAL. Also, the civil construction and associated facilities are also in progress for taking up stage integration for PSLV project in-line with stage integration of GSLV.

Further, HAL is planning to support ISRO in its endeavour to involve Indian industry for total productionisation of the PSLV vehicle through its subsidiary unit *New Space India Limited* (NSIL). With this, HAL will be responsible for end-to-end realisation of the solid and liquid stages of the PSLV along with integration activities which are presently carried out by ISRO.

HAL's Aerospace Division envisages space programmes to increase manifold in the years to come for which the Division is gearing up in terms of modernisation of existing facilities and setting up of new facilities for ISRO. HAL will continue to participate and support the ambitious Indian Space Programme and is on track to become one stop destination for space hardware.

Rolls-Royce Adours power the Jaguars (photo: Simon Watson)

Rolls-Royce: "A natural partner in India's journey of self-reliance"

The world is recuperating from the devastating effects of a continuing pandemic and economies are slowly rising from this crisis, finding more resilient and innovative ways to survive and succeed. Amidst this, India is pursuing its 'Atmanirbhar Bharat' vision, which is also reflected strongly in its outlook for future of the defence sector.

Not surprisingly, India today has the third largest Army, the fourth largest Air Force and the seventh largest Navy in the world. India is fifth on the list of the world's biggest military spenders. Further, given changing geopolitical considerations, Defence remains a critical sector from the perspective of national security and the government is well aligned in its goal to develop a high degree of self-reliance in Defence, as in other sectors.

Currently, the country is at the right juncture to build a vibrant local defence industry ecosystem that could support both domestic and export demand. With a mix of defence public sector undertakings and private companies, as well as research capabilities and manufacturing set-ups, India has a huge defence industrial base. This provides an excellent opportunity to build and/or scale up an industrial base centred on indigenous manufacturing. Co-creation and subsequent manufacturing for India and for the world, is a goal we can aspire to achieve in this sector. However, if we need to accelerate the pace of indigenisation, we perhaps need a quantum leap in the way it is approached.

India today has the width and the weight to invest in co-creation programmes through collaboration with willing global players with the goal to co-develop relevant technologies and IP in critical areas. With a co-owned IP in areas of strategic importance, not only can India commercialise production locally, but also use its base to become a global supplier and exporter of defence technologies.

A co-development and co-creation led strategy would be attractive to global players at both Government to Government as well as Government to Global Private sector


Adour powered Hawk of the IAF (photo: Simon Watson)

Adour powered Jaguar at HAL

level. A shared research and development programme will distribute the risks among the parties, and if the outcome is breakthrough innovation, the rewards could be significant for all. There are several examples of such a model thriving in this part of the world, such as the UK-Japan co-development programme for air-to-air missiles, UK-Singapore collaboration to co-develop new technologies that will power the future of aircraft propulsion, better counter-terrorism measures and a more efficient military logistics system.

Rolls-Royce: India's Partner in Progress

Rolls-Royce has been India's military partner for nearly nine decades, with over 750 engines of 10 engine types powering aircraft of the Indian military. Our MTU brand of engines power India's indigenously-developed Arjun Main Battle Tanks as well as several Indian Coast Guard and Navy ships.

The company has been an early proponent of 'Make in India'. For the last 60 years, Rolls-Royce engines have been made in India, under license by Hindustan Aeronautics Ltd. (HAL), India's largest defence manufacturer. We have strong joint ventures for manufacturing and work closely with supply chain partners to deliver global quality standards from India. We have also nurtured engineering talent in India to work on global research and development (R&D) programmes.

With a legacy partnership that rests on many years of capability development and co-manufacturing, Rolls-Royce is committed to partnering India's progress. We believe the future will be all about 'Creating in India' in collaboration with willing global players, with India co-owning the Intellectual Property (IP) in areas of strategic importance. This will catapult India's vision to create a strong ecosystem and commercialise production locally, and eventually use this base to boost global supply chain and export capabilities.

Additionally, as India progresses towards 'Atmanirbharta', it must embrace technology at an increasing pace across all spheres of industry and society. Specifically, in the defence sector, the country's aspiration to evolve from a regional power to a global power will need to be coupled with the creation of well-defined initiatives focused on indigenisation and self-reliance, driven by technology at its core.

Rolls-Royce has a strong base of capabilities across technology development to supply chain and manufacturing, built over many years. Add to this our proven commitment to India through successful transfer of whole engine technology. We have also successfully participated in and led international combat engine collaborations in many markets. We believe, therefore, that Rolls-Royce is well positioned as natural partners in India's defence growth and 'Atmanirbhar Bharat' journey.

We believe the time is right for pursuing opportunities in partnership, co-creation and co-production to build a robust local manufacturing sector, which will also contribute significantly to economic growth in the future.

Kishore Jayaraman, President, Rolls-Royce India & South Asia

GAME-CHANGING WEAPONRY

MBDA Meteor and MICA on a Rafale (photo: Dassault)

MBDA: 'Make-in-India' commitments and Rafale weaponry at Aero India 2021

MBDA, the manufacturers of the Rafale's game-changing weaponry, is showcasing its *Make in India* commitments during Aero India 2021. Notably MBDA's stand in Hall B 3.4 features a display wall of missile system components 'Made in India' by the company's large Indian industrial ecosystem. Also exhibiting in Hall B is L&T MBDA Missile Systems Ltd, MBDA's joint venture with Larsen & Toubro, which will be displaying the systems offered to the Indian Armed Forces as well as its work on MICA missile launchers for the Indian Air Force's new Rafale fighters.

MBDA is not new to partnership with the Indian Armed Forces and Indian industry, indeed it has been delivering battle-winning capabilities to the Indian Air Force and collaborating with Indian industry for over 50 years. Throughout this history, there have been two guiding principles: to provide the very best technologies for the Indian Air Force, and to work in true partnership in support of the Indian Defence Industry. The company then is fully committed to the 'Make in India' programme, which aligns with MBDA's long-term strategy.

Aero India 2021 will also be a milestone year for MBDA, marking the first exhibition where Indian Air Force-operated Rafale fighter aircraft will be present. MBDA is well known as manufacturer of the weaponry that makes Rafale such a potent airborne force. Perhaps the best known is the ramjet-powered and network-enabled Meteor beyond visual range air-to-air missile from MBDA. This next generation missile is widely recognised as a game changer for air combat, and will provide the Indian Air Force with an unrivalled air dominance capability. Key to this is Meteor's throttleable ramjet engine, active radar seeker and datalink that combine to

Overwing ASRAAM on the Jaguar

The SCALP deep strike cruise missile with Rafale

provide unmatched end-game speed and manoeuvrability at greatly extended ranges, resulting in its all-important 'No-Escape Zone' which is more than three times greater than any other existing or planned BVR weapons.

Also arming India's Rafales is the SCALP deep strike cruise missile, which is no less game-changing than the Meteor. SCALP has proved itself unerring with its unmatched ability to combine very long range with devastating target effect on even the most hardened of military infrastructure during combat operations. Its long-range enables it to be fired at extended stand-off ranges, beyond the reach of hostile air defence systems or altogether even outside hostile airspace.

Other examples of technological edge weapons equipping the Indian Air Force are the MICA and ASRAAM within visual range (or dogfighting) missiles. MICA arms both the Rafale and Mirage 2000 and is the only missile in the world featuring two interoperable seekers (active radar and imaging infrared) to cover the spectrum from close-in dogfight to long beyond visual range.

ASRAAM is providing the IAF's Jaguar fleet with a step-change in air combat performance. With its large rocket motor and clean aerodynamic design, ASRAAM has unrivalled speed and resultant aerodynamic manoeuvrability and range. ASRAAM gives it a high kinematic capability that delivers superior end-game performance for within visual range air combat. MBDA's ASRAAM missiles are significantly enhancing the battle capability India's Jaguar strike aircraft giving them unrivalled self-protection ability and enhanced ability to penetrate hostile airspace.


Mistral ATAM

However, industrial partnership is of equal importance given the vitality of sovereign industrial defence capability. MBDA has been assisting the development of sovereign Indian missile industry, both public and private, for over 50 years. Partnerships the MBDA has formed with Indian industry have resulted in over 40,000 missiles of the MILAN family produced in India – a noteworthy and on-going success. Key components for both MICA and ASRAAM missile systems are made in India, and a selection of Indian-made components are on display in a special *Make in India* display area on the company's stand.

The Mistral ATAM system has been successfully integrated on the Advanced Light Helicopter (ALH) and final integration is being done on the Light Combat Helicopter (LCH). Utilisation of the Mistral missile on India's helicopter platforms also provides a bridge to their use in a ground based VSHORAD role, where the missile is fully compliant with India's requirements and outperforms the capabilities of its rivals.

MBDA has an excellent track record providing both operational and industrial capabilities in partnership with the Indian Air Force and India's Defence Industry. The strength of these two pillars make it a long-term true partnership, and one that should only continue to get stronger.


Boris Solomiac,
General Delegate, MBDA India

India's indigenous BVRAAM

Evolution of the Astra

Self-reliance in air launched missiles, particularly Beyond Visual Range Air-to-Air Missile (BVRAAM) systems is of strategic importance considering the new paradigm of air superiority warfare. With the service entry of an indigenous hypersonic (Mach 4 plus) Active-Radar Homing (ARH) Astra BVRAAM, India's Defence Research and Development Organisation (DRDO) seems to have produced a missile that is arguably capable of matching – or outmatching – similar class of missiles of United States, Russian and European origin.

As part of its development, this missile was first tested on 18 March 2015, launched from an Indian Air Force Su-30MKI fighter against a simulated live target to verify the control system and missile stability during flight. Prototype of the missile was first tested on 9 May 2003 from the Integrated Test Range (ITR) at Chandipur-on-Sea off the Odisha coast. On 27 March 2007, vertical launch of the missile was carried out, suggesting possible development of a Surface-to-Air Missile (SAM) variant as well. Following further tests, dual-mode guidance was proved during May 2009 followed by captive flight tests on a Sukhoi Su-30MKI, carried out from Pune in November 2019 when several sorties were conducted. The series of numerous tests initiated on 20 May 2011, also from the ITR at Chandipur focussed on evaluating performance of the smokeless non-metallised high specific impulse propulsion system, rocket motor, and configurations of the vehicle. Aero-dynamic evaluation with the missile incorporating significant changes and incorporating advanced technologies was also done in due course.

The project is led by the Hyderabad-based Defence Research and Development Laboratory (DRDL). The single stage, smokeless, solid fuelled Astra with a length

of 3570 mm, body diameter of 178 mm weighs 154 kg, is powered by high energy lithium thermal batteries, making it the lightest in its class and thus having a wide range of applications. The BVRAAM will be capable of destroying 9g manoeuvring enemy targets at high altitude in the head-on mode at a range of 80 km and in tail-chase mode at 20km, thanks to its redesigned cropped delta (replacing low drag low aspect ratio) wings and capability to pull a lateral acceleration of 40g in both yaw and pitch planes which means it should be able to engage non-manoeuvring targets well in excess of 100km and capable of operating in the altitude bracket from sea level to 20km.

The all-important seeker was initially provided by Russian's *Agat* (possibly more advanced than 9B-1348E integrated on R-77 variants) with an autonomous homing range of 25km plus, which enables off-bore sight launches up to an angle of 45 degrees and produced in India through a transfer-of-technology process. Prior ARH homing during terminal stage, Astra follows Fibre Optic Gyro (FOG)-based Inertial Navigation System (INS) during midcourse with high *g* accelerometers along with secure data link to allow midcourse re-tasking. While autopilot and guidance software uses Artificial Intelligence (AI) for accurate guidance and optimised trajectory, the on-board Electronic Counter Counter Measures (ECCM) capability allows it to stay on course in spite of enemy Electronic Counter Measures (ECM) procedures.

The 15kg high explosive warhead is pre-fragmented and radar proximity fuse armed plus directional to enhance lethality and Single Shot Kill Probability (SSKP). Additionally, the DRDO is currently working on a new laser fuse. The choice of an *Agat* seeker is interesting as this establishment is highly reputed for development of infra-red seekers and indicative of an Imaging Infra-Red (IIR) version of the Astra. As ARH is effective in one set of conditions and IIR in another, the open choice of different seeker heads complicates situation of the adversary.

In continuing development, on 15 September 2017 an Astra BVRAAM was test fired from a Su-30MKI from Kalaikunda Air Force Station with an indigenous Ku-band pulse Doppler radar seeker developed by Research Centre Imarat (RCI). With an antenna diameter of 140 mm and weight of 12.5kg, the lock on range is well in excess of 12km and gimbal angles of plus/minus 55 degrees. The same indigenous seeker is also set to arm the Akash-1S Surface-to-Air Missile (SAM) variant and also the QRSAM, with final development trials completed the same month. During user trials in 2019, the Astra BVRAAM decimated a manoeuvring target at a distance of 90km.

Projected to be a game changer at the tactical level, Astra BVRAAMs are reportedly to be integrated with all frontline Indian Air Force fighter aircraft including the Sukhoi Su-30MKI, MiG-29, Mirage 2000 and the indigenously developed Tejas LCA, and can be launched both in autonomous and buddy-mode operation. Reportedly, the Mk.2 version of Astra will have a maximum range in excess of 150km and tail chase range of up to 35km propelled by a dual-pulse rocket motor similar to the AIM-120D AMRAAM.

The DRDO is also looking at rocket/ramjet propulsion to provide greater range and enhanced kinematics performance to the BVRAAM. However adopting a rocket/ramjet approach has certain limitations as the need for controlled airflow to the ramjet ducts means that the 'skid-to-turn' manoeuvring of a conventional rocket-powered missile is not acceptable (because it will risk masking an intake) yet 'bank-to-turn' manoeuvring results in a reduced instantaneous turn rate.

Even more ambitious, the Astra Mk.3 is projected to be a Solid Fuel Ducted Ramjet (SFDR) powered missile with ranges in excess of 300 km. Under such circumstances, the primary concern of the IAF and the Astra development team will be of positive identification of enemy targets at those extended ranges since Identification Friend or Foe (IFF) remains a problem because of incorrect or absent returns and 'spoofing'. Hopefully in the long term, development of electro-optical seeker technology coupled with on-board threat database will let the missiles themselves determine legitimacy of the target!

Sayan Majumdar
(All photos: VAYU)

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"Long and trustworthy partner of India"

VAYU Interview with Pierre Dickeli, CEO, Safran India Pvt Ltd

VAYU : Please update us on Safran's 'Make in India' initiatives and collaborations with the DRDO and BEL.

Safran: Safran has been a long and trustworthy partner of India for more than 60 years in many aeronautical fields of activity such as space propulsion (Vikas engines), helicopter engines, military engines for the Jaguar, Hawk, Mirage 2000 and Rafale, as well as inertial navigation systems and optronics solutions, engines and equipment for civil aircraft. Currently employing more than 600 employees at eight companies and a maintenance training centre in Hyderabad for CFM engines, Safran has continuously expanded its footprint in India and will continue to offer design, production and support services in aerospace and defence space. We are the largest provider in India for turbo-shaft engines for helicopters and have the unique distinction of powering 100% of helicopters manufactured by Hindustan Aeronautics Limited (HAL). India is also the largest installed base worldwide for Safran with more than 1,200 INS (Sigma family) in use and being the reference of India's Armed Forces.

In line with Indian government's 'Make in India' initiative, Safran is building up an Indian supply chain for LEAP engines, through which it has already secured approximately 200 million euros of offset. Our current Indian supply base includes JV SHAe, Godrej & Boyce, Maini, Recaero India, Mach Aero India, SQUAD (JV with AEQUS and A&D), SESI (Safran Engineering Services India). We are also working on giving India access to air, land and sea applications through transfer of technologies that have been conducted with HAL for more than 30 years in various applications such as transfer of production for gyro mechanical navigation systems (ULISS) and Sigma-95N for fighters, AFCS (Automatic Flight Control System) and AHRS (Attitude Heading Reference System) for helicopters or co-development with DRDO/BEL of local inertial navigation systems (Land-INS and Air G3-INS).

We have also started developing a local supply chain in India, through Indian suppliers that have been qualified and integrated in our global supply chain and the creation of production centers such as the HAL/Safran JV based in Bangalore and Hyderabad cluster.

Under the Shakti engine cooperation with HAL, we have provided more that 70% transfer of technology for manufacturing and have set up a helicopter engine MRO JV. Once operational, this would help improve the turnaround time to repair and overhaul military helicopter engines. In addition to this, we have offered to collaborate with DRDO on the development of a military engines for their Indian fighter programmes including transfer of technology.

VAYU : Could you please elaborate on Safran's role in partnering India in achieving self-reliance

Safran: At Safran, we believe achieving self-reliance means dealing with design, development, production as well as support and that is why we are willing to address all these activities, when it comes to working in India.

The production concerning development of a supply chain in India has already started and we are aiming to develop an MRO shop in India to support the civil engines as well at the appropriate time. The objective is to entail a significant foreign investment, create numerous highly skilled jobs, promote local MSMEs to act as a supplier to MRO shop, while also improving logistics efficiency and overall turnaround time (TAT) of engines availability to the airline operators in India.

We are already working to achieve design and development through our current activity with HAL on helicopter turbines. Safran's relationship with HAL dates back to early 1960s with the transfer of licence for the Artouste engine to HAL. Since then, the engines for the Dhruv and Cheetal helicopters from HAL have been added to the portfolio. Initiated by HAL and powered with the support of Safran, the two extremely prestigious helicopter programmes: Light Combat Helicopter (LCH) and the Light Utility Helicopter (LUH) are close to entering service in the coming months.

Currently, Safran Helicopter Engines has about 1,700 engines in service within India, of which about 1,500 are flying with the military operators. Jointly with DRDO, we have proposed to build the capability to design, develop, certify and produce engines in India for all the Indian platforms in order to make India sovereign in the strategic domain of military aerospace engine and join the only 3 other countries in the world that have this capability.

Safran Electronics & Defense has strengthen its partnership with HAL on helicopter autopilots providing state-of-the-art development and integration capabilities to replace existing test benches and set up a software workshop to develop and validate control laws necessary for the use of AFCS on ALH Navy, LUH and the LCH.

Safran Electronics & Defense is also completing a ToT of Navigation Complex System with BEL for submarines which will become the reference and indigenous solution for all future Indian submarines programmes.

We can confidently state that we are in India for the long run and are seeking more local partnerships to build an entire ecosystem and contribute to Prime Minister's 'Aatmanirbhar Abhiyan'

VAYU : And an insight into your capabilities across defence and civil aerospace?

Safran: Over the past 60 years of Safran in India, we have contributed to the Indian aviation and defence sector. Safran has five core activities Aerospace propulsion, Aircraft equipment, Defense, Aerosystems and Aircraft interiors, all of which are serving Indian aerospace and defence activities. For each of these core businesses, Safran has developed a complete range of products and services addressing both civil as well as defence applications.

Currently deploying a workforce of 600 employees spread across eight different companies and a training centre, Safran believes in undertaking an assortment of activities ranging from design and production to services for our core businesses of aerospace and defense, thereby building and expanding our footprint and leadership in India.

With the M53 engine for the Mirage 2000 and M88 engine for the Rafale fighters, Safran is powering air superiority of the Indian Air Force.

In the defence sector, Safran is supporting the Indian Air Force with the M53 engine, integrated in the Mirage 2000. Recently added to the IAF fleet, the multirole Rafale fighter jets are integrated with the M88 engine. We are also working to support India in getting access to Helicopter Engine Sovereignty. The *Shakti* engine, co-developed by Safran and HAL, is currently in service on the Dhruv and has been selected on the Light Combat Helicopter (LCH). New repair facilities will be commissioned in the coming months for INS and Optronics solutions at various Air Force bases, Naval dockyards and Army workshops all over India and, Indigenous G3-INS (airborne application) and Land INS, based on Sigma inertial sensor block, will be the next generation of Indian designed and made INS

HAL LCH (photo: Phil Camp)

HAL LUH (photo: Phil Camp)

VAYU : Which programmes would be your priority in India this year?

Safran: Safran is committed to be a part of country's 'Make in India' objectives in the aviation and defence space. We will continue to extend our support by expanding our industrial activity in India, further develop our supply chain and continue to propose a military engine co-development project that would allow a full transfer of technologies and pave the way to a complete ecosystem and a total autonomy for India.

We had set up a harness facility in Hyderabad last year and now we are setting up a complete cluster there including an engine part manufacturing facility. We will also improve support to the IAF on their Mirage 2000 engine fleet and use Indian-trained technicians to provide proximity support for the Rafale engines. We will also focus in developing the MRO capabilities for civil aerospace.

VAYU : 2020 has been an unusual year. How did Safran adapt to new realities dictated by the Covid-19 Pandemic?

Safran: 2020 has been an unprecedented year of lockdowns, with adverse effects on all the sectors including aerospace and defence. Since the beginning of the worldwide pandemic, we have been taking every possible step to help slow the virus's spread and prioritise the well-being of our employees, families and customers. We also tried to ensure the ensure the business continuity for our customers, at the very best pace we could.

Currently each company has implemented the Group's Covid-19 protocol, along with the measures to adjust and reorganise the workplace, in accordance with strict health, safety and social distancing instructions and other essential health precautions, such as frequent cleaning and disinfecting, limited number of staff on site at any one time, staggered entries and exits, rotating work schedules and time between shifts to avoid overlap, distribution of masks for certain workstations and provision of hand sanitizer dispensers.

There was strong impact on both OE and services activities and therefore, we continue our efforts of costs optimisation and adaptation in the organisation to meet various health constraints.

Harness Inspection on the Rafale production line at Safran facility in Hyderabad, India. (photo: Christophe Viseux / CAPA Pictures / Safran)

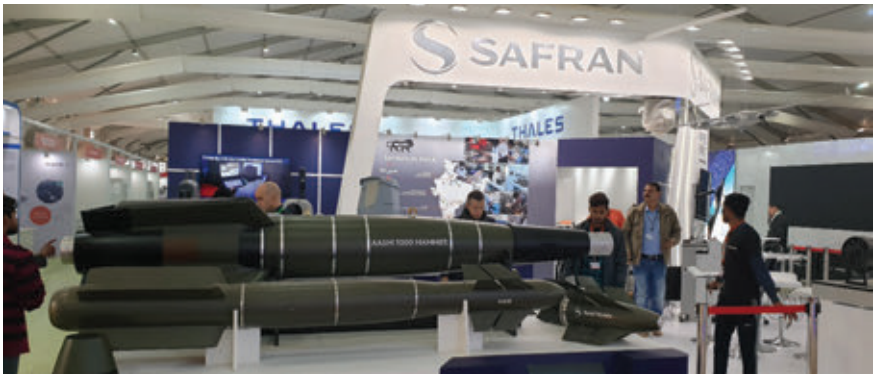
Safran's Hammer AASM

First separation tests of 1,000-kg AASM Hammer

The new 1000-kg version of the AASM Hammer air-to-ground modular weapon, designed and produced by Safran Electronics & Defense, has successfully completed its first two inert separation tests from a Rafale omnirole fighter. The separation dynamics observed during the two firings were in line with simulations. These industrial validation tests were designed to check the correct sequencing of all components of the wing hardpoints and the weapon, as well as the wing deployment mechanism on the range extension kit. Following these successful separation tests, the first live firing tests will be conducted in 2021 as part of the final development and qualification of the 1000-kg AASM.

The 1000-kg AASM features a guidance kit derived from the 250-kg version and a specific range extension kit. The 1,000-kg AASM has the same modular characteristics as the 250-kg version with the BLU109 penetrating bomb body and MK84 conventional body, as well as its close functional integration with the Rafale, especially for fire control system and configuration options. This new weapon will give the Rafale an enhanced strike capability, with payload configurations of up to three 1,000-kg AASMs per aircraft. Its standoff range is also extended, thanks to the integrated propulsion system.

Developed and produced by Safran Electronics & Defense based on existing bombs from 250 kg to 1,000 kg, the AASM Hammer family is the air-to-ground "weapon of choice for the Rafale".



Safran's EcoPulse hybrid aircraft demonstrator

The EcoPulse distributed propulsion hybrid aircraft demonstrator –which is being developed by Safran, Daher and Airbus-has successfully passed its Preliminary Design Review as a first key step toward validating the project's feasibility and firming up the architecture for a first flight scheduled in 2022.

Incorporating a distributed propulsion configuration, this shared hybrid aircraft project has the goal of helping to transform the aviation sector. By laying the framework for light aircraft by end of the decade, it will allow the development of technologies that reduce the environmental footprint of future commercial aircraft, thus contributing to the air transportation sector's decarbonization objectives by 2050.

VAYU Interview with

Michael Koch, VP,

Boeing Defence, Space & Security, India

VAYU : Boeing has strengthened its defence business in India with many of its iconic platforms servicing the Indian armed forces. How do you see the Indian market growing from your perspective?

Boeing: India's defence sector is poised for growth and Boeing is committed to supporting and enabling this progress. Boeing has had a presence in the country for over 75 years now, and we have had many firsts with India. India was the first international customer for the P-8, is the largest international operator of C-17s and P-8s, and the Harpoon missile was the first US weapon system on an Indian-built fighter.

The future looks promising and we continue to see several opportunities in India. We're engaged with our defence customers on their requirements for the Indian Air Force's Multi-Role Fighter Aircraft and the Indian Navy's Carrier-Borne Fighter programme. Early last year, the Ministry of Defence signed a contract for the acquisition of an additional six Apaches for the Indian Army.

Today, with 11 C-17s, 9 P-8Is plus three more on order, 22 AH-64 Apaches with six more on order with the Indian Army, and 15 CH-47 Chinooks, India is at the front and centre of Boeing's business plans.

We are also seeing the growth in our localisation of MRO services and training, and the value that Boeing Defence India, our local establishment in India, is able to provide through the lifecycle of Boeing products. We work with the Indian Air Force and the Indian Navy to provide exceptional operational capability and readiness to the P-8Is, C-17s, and 'Head of State' aircraft through local sustainment services in India. Boeing is also providing pilot training for the Indian Air Force fleet of C-17 aircraft and we are in the process of providing training to Indian Navy pilots on the P-8I.

We are contributing to the growth of India's aerospace industry; that is why we're investing in partnerships across the ecosystem in skilling, research & technology, and manufacturing. India's role in our global supply chain is big and getting bigger. Our commitment to India is deep and it is for the long term; our vision is to bring the best of Boeing to India and export the best of India to the world.

VAYU : Boeing recently announced results of ski jump trials of the F/A-18 Block III Super Hornet. Are there any updates on your talks with Indian Navy for their fighter requirements?

Boeing: Boeing and the US Navy have recently proved that the F/A-18 Super Hornet can operate from a ski jump ramp, thereby demonstrating the aircraft's ability to operate on Indian Navy carriers.

We are engaging with the Indian Navy and have responded to the Request for Information for the Multi-role Carrier Borne Fighter (MRCBF) programme. This is a very exciting opportunity to partner with

both the Indian Navy and the US Navy. The F/A-18 Super Hornet is the frontline carrier-based fighter of the US Navy, and will not only provide superior war fighting capability but also create opportunities for cooperation in naval security and aviation between the United States and India. The aircraft will be an incredible tool to ensure security and safety in the Indo Pacific region for decades to come.

VAYU : Why do you believe the Super Hornet will meet the Indian Navy's requirements for a carrier borne fighter?

Boeing: It is important to understand that, apart from being the most lethal, advanced and combat-proven aircraft, there would be benefits from the incredible know-how and technology investments made by the US Navy related to aircraft carriers and fighter operations at sea. As a strategic partner for security, US Navy is leaning in to provide the best solution available for Indian Navy. This includes the F/A-18 Block III Super Hornet, but it also includes deep capabilities in sustainment, logistics, flight ops, carrier and network integration, etc. These machines are powerful on their own, but they are far more potent when they are part of a fully integrated network of capabilities.

The Super Hornet was designed for the carrier deck and benefits from decades of experience which Boeing and US Navy have had operating classic Hornets. The Indian Navy would receive the benefit of US Navy's multi-billion dollar investments in Block III technologies, including advanced networks, longer-range detection with Infrared Search & Track, an all-new Advanced Cockpit System, improved signature reduction and a 10,000+ hour life. The F/A-18 Block III Super Hornet will be a game changer for the Indian Navy providing them several unique and differentiated capabilities.

Another important operationally relevant distinction is that the Super Hornet would prove a force multiplier for the Indian Navy through enhanced networked warfare with other US origin assets that the Indian Navy and the Indian Air Force have, or are in the process of acquiring. The F/A-18 Super Hornets can optimally interface with the P-8I, augmenting lethality of these platforms and enhancing India's force projection capabilities.

As part of Boeing's 'for India, by India' philosophy, the Block III Super Hornets can be serviced in partnership with the Indian

Navy, US Navy and industrial partners from India and the US throughout the lifecycle of the aircraft. This will further develop advanced expertise in aircraft MRO in India, resulting in higher availability of the aircraft at competitive pricing. All these together, with the fact that the Super Hornet is the most affordable tactical fighter in its class 'per flight hour' differentiates Boeing's F/A-18 Block III Super Hornet offer for the Indian Navy.

VAYU : The P-8I has always proven its capabilities and has been a strong pillar for Indian Navy when it comes to maritime security. There are three more to be delivered? What updates on the remaining P-8I delivery and your future plans for P-8I fleet?

Boeing: In November, last year, Boeing delivered the ninth P-8I to the Indian Navy. This was the first of the four options aircraft, with the remaining three scheduled for delivery this year. The Indian Navy was the first and is the largest international customer for the P-8. This aircraft is an integral part of the Indian Navy's fleet and is approaching an impressive milestone of 30,000 flight hours since its induction in 2013.

Our focus has been, and will continue to be on delivering the world's best maritime patrol aircraft to the Indian Navy. We have been supporting India's growing P-8I fleet by providing spares, ground support equipment and field service support. Boeing's logistics support has enabled the highest state of fleet-readiness at the best possible cost. Boeing is currently completing construction on a Training Support & Data Handling (TSDH) Centre at INS *Rajali*, Arakkonam, in Tamil Nadu and a secondary centre at Naval Institute of Aeronautical Technology at Kochi, as part of a training and support package contract signed in 2019. The localised, ground-based training will allow the Indian Navy crew to increase mission proficiency in a shorter time, while reducing the on-aircraft training time resulting in increased aircraft availability for mission tasking.

The P-8I's unmatched maritime surveillance and reconnaissance capabilities, versatility and operational readiness are uniquely qualified to perform India's range of missions across the Indian Ocean Region, and thus the aircraft has proven to be an important asset to the Indian Navy. We do believe that the Navy has requirement for more P-8Is as also more Harpoons and we stand ready to support them.

VAYU : When can the Indian Army expect its Apache helicopters?

Boeing: The AH-64 Apache helicopters will be a force multiplier for the Indian Army, just as they are today for the Indian Air Force. The Indian Army AH-64E Apaches are planned to be delivered in country 48-49 months after contract award. We are assessing any impacts owing to Covid-19 and communicating regularly with the Indian Army. Our Tata Boeing Aerospace Ltd (TBAL) joint venture in Hyderabad is a critical source of Apache manufacturing for the US Army and customers worldwide. Much of the contracted six Apaches for the Indian Army will be built at the state-of-the-art TBAL manufacturing facility, right here in India.

THE GRIPEN E

A WORKHORSE FOR THE IAF

A fighter in modern combat needs to spend as much time in the air as possible, keeping downtime to a minimum. The Gripen's small support footprint makes it combat-ready in minutes – even changing the entire engine takes less than an hour.

Gripen is a smart fighter with a 'minimal logistical footprint' which means it has been designed for maintenance and quick turnaround without the need for a large number of technicians on the ground to conduct checks and get the aircraft back in the air. Many of the necessary maintenance steps are easy to perform, can be done using simple tools and do not require a long time to complete.

"The Gripen E is the ideal workhorse for the IAF with very high availability and always ready to go. We see the aircraft meeting the requirement of the IAF for an aircraft that can be deployed in large numbers, has high fleet availability and can be deployed from forward bases, high altitudes as well as can multiply their operational impact by sharing information. In a sense, the Gripen E is the force multiplier and a workhorse that can work along with the existing aircraft to secure India's airspace 24x7," says Mats Palmberg, head of Gripen India campaign.

"The tools we use for maintenance between sorties are very basic. You need a flashlight to check the oil levels, and you need refueling equipment. You don't need any equipment to open any hatches, because there are quick hatches," according to Per Sverker, Maintenance Manager, Test Hangar, at Saab's facilities in Linköping, Sweden.

The ability to deploy swiftly with minimum resources was a basic requirement of the Swedish Armed Forces, as the first generation of the Gripen fighter was being initially conceived as a replacement for its existing fighter jets. Gripen was also designed to execute operations not only from small bases such as road strips, but from extremely short or battle-damaged runways.

Today, the Gripen has been further enhanced with features that ensure it retains the original concept of a minimal logistical footprint. For instance, replacing complex avionic equipment such as the radar or even changing the plane's engine can be accomplished in under an hour. "Changing the engine is one of the most impressive parts of the new Gripen generation. It's very easy. The fastest time we've had, from running the engine to changing the engine and completing everything we need to do to service it has been done in around 45 minutes," says Sverker.

The smart design of the Gripen means that no specific support equipment is needed to access the engine bay. The engine is mounted in three places, including the pipes and an electrical connection. Although it is very easy to change the engine, it is so good that you don't need to change it often," Sverker explains.

An air to air turnaround, including refueling and rearming weapons, can be done in less than ten minutes. This means that Gripen's air time is maximised, and downtime is kept to a minimum.

"In the rearming testing we do, the hatches are opened, but we use blanks not live ammunition. This process is very fast, and the refueling is done quickly as well. Basically, the Gripen is always combat ready," says Sverker.

Air-to-air refueling

Gripen is fully NATO compatible, using NATO-standard aircraft fuel and other replenishables. In addition, refueling of Gripen can be done while the fighter is in the air. "Nowadays, air-to-air refueling is a standard on Gripen. This capability was developed and tested on one of the early prototypes. To explore where to put the refueling probe we did ground testing and flight testing with a mockup probe mounted on the prototype Gripen. The flight tests were performed to verify the construction of the probe by flying behind a tanker aircraft and connect to the air-to-air refueling device," Per Sverker explains.

For technicians, this adaptability means that refueling isn't necessary to do on the ground, leaving more air time for sorties. "This feature means that when pilots are halfway through a sortie, they can get more fuel without having to land," says Sverker.

Short take-off and landing strips

Gripen was designed to be able to take off and land using designated areas of the existing Swedish road system, which were built for use as temporary runways and airbases if the country experienced a military invasion. These so-called road bases are often narrow and short, so the fighters using them need to be able to handle short take-offs and landings, as well as provide easy outdoor maintenance and service.

Gripen can take off and land on runways that are just 800 metres long and 16 metres wide, and the fighter has been designed for all different types of weather and runway conditions, including the harsh snow-covered runways in the Arctic climates found in northern Sweden.

The plane and the pilot

Being a test pilot for Gripen means playing a vital role in the making of a future proof fighter jet. It's the test pilot's job to master the challenges of a rapidly changing combat environment, and do so while dealing with the intense pressure of accelerating g-forces.

Gripen test pilots play an important role in evaluating the technology enhancements and upgrades in the fighter's air combat weapon systems. They must be critical thinkers who are able to adapt to different situations, to lead and conduct testing and to evaluate new and existing aerospace weapon systems. "As a Gripen test pilot my main task is to perform test flights where I evaluate the Gripen's performance and capabilities up in the sky," says Mikael Olsson, Test Pilot with Saab.

Before the test flights are conducted, Gripen test pilots spend many hours in the flight simulator evaluating the systems. Additional hours are spent at design meetings, where test pilots assist Saab engineers and offer pilot opinions on design solutions and decisions.

Modern warfare has seen evolution of the battlespace. Today fighter pilots need to be able to handle much more than before, and at a higher pace. Gripen achieves the optimal balance between the pilot and the fighter, by letting fighter intelligence take on a larger role in working autonomously on several areas simultaneously. The systems provides the pilot with cueing and suggestions ranging from weapon selection to full manoeuvring of the fighter in an emergency.

Test pilots have presentations on the system, the aircraft and the methodology used by Saab, in order to not only evaluate the fighter, but to instruct other pilots that will be flying the fighter. Part of their work includes observing and analysing how the aircraft operates as well as understanding the engineering that is behind the functionality. For test pilots this can mean understanding where any discrepancies lie in the functionality and offering suggestions on how to address these issues.

Courtesy: Saab

VAYU Interview with

Boaz Levy,

IAI President and CEO

VAYU : How is IAI expanding its collaboration with Indian firms in integrating strategic state-of-the-art systems for the Indian MOD?

IAI: IAI has always been one of the main pillars in supplying strategic and advanced equipment to India, providing cutting-edge technology for land, maritime, aerospace, and homeland security. IAI's systems, such as the unmanned aerial systems (UAS), radars, special-mission aircraft and air-defence systems, have been in use in India for many years and with high levels of satisfaction from our customers.

In the recent decade IAI entered to more and more strategic collaborations with local Indian firms, both PSU and private, in order to integrate strategic state-of-the-art systems for India's Ministry of Defence in various fields and in accordance with the 'Make in India' policy.

In 2021 IAI is expected to keep the same policy and expand our collaborations with local Indian Defence companies to be significant and important partners.

VAYU: What information can you share regarding the Heron TP?

IAI: The Heron TP is IAI's largest unmanned platform. The UAV can carry a wide range of payloads weighing up to a ton, fly at an altitude of up to 45,000 feet, boasts enhanced satellite communication capabilities and can undertake long range stand-off missions in difficult regions and under extreme weather conditions. The UAV has completely automatic, long runner takeoff and landing capabilities, which gives it additional flexibility and operational headroom beyond the long range at which it can operate. The system provides a solution for all types of missions-land and sea.

VAYU: What upgrades are being offered by IAI for existing UAVs?

IAI: IAI is home to the world's most advanced UAVs and keeps its systems updated with requirements of the modern battlefield. Presently we propose an improved propulsion system, advanced avionics, completely automatic remote takeoff and landing, a wide range of possible payloads weighing up to a ton, a maximum flight altitude of 45,000 feet, advanced satellite communications systems and

German Heron TP

capability to complete long range stand-off missions in difficult regions and under extreme weather conditions. In addition, we offer upgrades to the command and control centre, to an advanced control centre equipped with a user friendly touch screen and vocal notifications and commands. The system provides a solution for all types of missions – land and sea.

VAYU: Please provide an update on the MRSAM air defence system, in both its maritime and land-based versions?

IAI: MRSAM is an advanced, technology air – and missile-defence system, jointly developed by IAI and DRDO for the Indian Armed Forces. During development, IAI collaborated with Israeli and Indian industries, including Rafael, Tata, BEL, L&T, BDL and many private companies. The system provides the ultimate protection against a variety of aerial platforms, and is used by the Indian Air Force, the Indian Armed Forces, Indian Navy, Air force and the Israeli Defence Force. The system incorporates an advanced phased array radar (MF-STAR or digital MMR), a command and control centre, mobile launchers and interceptors and an advanced RF seeker.

IAI and the DRDO have recently concluded successful tests of the system at a test range in India. The flight test

MRSAM trials

demonstrated several extreme reference scenarios, validating the system's capabilities. As part of the test, the MRSAM interceptor was launched from a land-based mobile launcher and successfully hit its threats. The scenario began with the system's digital MMR radar zeroing in on the threat and then launching the MRSAM interceptor toward its operational trajectory. The interceptor acquired the target and successfully intercepted it. All the system's elements met their test goals successfully. Conducting the test under COVID-19 limitations was yet another testimony to the strong partnership between IAI and India. We are continually working with our Indian partners to bring the best operational outcome to meet the needs and requirements of the Indian Army, Navy, and Air Force. The MRSAM programme is progressing according to plan.

VAYU: Please elaborate on IAI's options in the loitering-munition category?

IAI: With more than 35 years' experience in developing combat-proven loitering munitions systems, IAI offers a wide range of these systems. Our solutions are uniquely capable of searching, identifying and neutralising targets effectively and with precision. Employing various guidance systems and capabilities, IAI's loitering

Mini-Harpy

Avionic Upgrade Simulator

systems provide solutions for a wide array of battle scenarios. In this category IAI offers the following systems:

HAROP: This is a remotely operated stand-in loitering attack weapons system designed to locate and precisely strike targets. The HAROP loitering munition (LM) is an electro-optically guided attack platform. HAROP LMs are launched from ground- or sea-based launchers and can be controlled via a two-way data link for full man-in-the-loop operation. HAROP is used to strike high-value targets and boasts full mission capabilities, from acquiring targets to striking them to conducting battle damage assessment. Combining the characteristics of a missile and a UAV, HAROP enables the effective execution of missions without relying on any additional external system for targeting and mission intelligence. HAROP is a fully combat-proven system and has demonstrated its capability around the world.

HARPY is an all-weather, day/night, 'fire and forget' autonomous weapon, launched from a ground vehicle away from the battle zone. Programmed before launch to fly autonomously to a pre-defined 'Loitering Area', the system then searches for targets with a radiation footprint. The HARPY loitering munition (LM) detects, strikes and destroys enemy radar emitters, hitting them with high precision ordnance. HARPY effectively suppresses hostile SAM and radar sites for long durations, loitering above enemy territory for hours.

The *Mini Harpy* is a unique tactical system designed for field or marine units. It can be launched from land, naval, and helicopter-borne platforms, providing complete independence in intelligence collection for an updated situational picture and for low-cost acquisition and annihilation of targets. Based on unique IAI developments and technology, the *Mini Harpy* combines the capabilities of IAI's two flagship loitering missiles, the Harop and the Harpy, offering the detection of radiation-emitting systems as well as having electro-optical capabilities. The system was introduced only few months ago and since then, IAI has seen interest in the system grow among existing customers as well as new ones. The *Mini Harpy* is an ideal weapon for armies looking for a cutting-edge tactical solution in the age of symmetrical or asymmetrical warfare.

The ROTEM Aerial System (AS) is a tactical, loitering munitions (LM) system based on a light, multi-rotor platform that delivers excellent capabilities against enemy systems in complex environments and with small footprints. This lightweight and compact LM can be assembled in seconds and operated by a single soldier. The LM is capable of lethal precision strikes on stationary and mobile targets with abort/safe capability and is recoverable. ROTEM is an extremely versatile platform. It can perform squad-level ISR and attack missions with minimal planning and operational focus from the operator. The system includes a tactical kit of two LMs with all peripherals packed in one backpack and allows operational units to use it organically as part of their standard gear. The system's exceptional capability to hover allows the VTOL platform to acquire targets and engage them within seconds, which makes the ROTEM a game-changer for its operators. ROTEM is also a full combat-proven system and has recently won a major global tender.

VAYU: Please give an update on some of IAI's important partnerships in India

IAI: IAI has $2 billion worth of business partnerships with Indian companies as part of India's 'Make in India' Policy. For years, IAI has developed and manufactured a range of technologies in India in collaboration with local vendors and implemented the 'Make in India' policy even before its official launch by the Indian government. In the recent decade IAI entered to more and more strategic collaborations with local Indian firms, both PSU and private. Two of them with BEL and HAL were signed last year.

VAYU: What products is IAI showcasing at Aero India 2021?

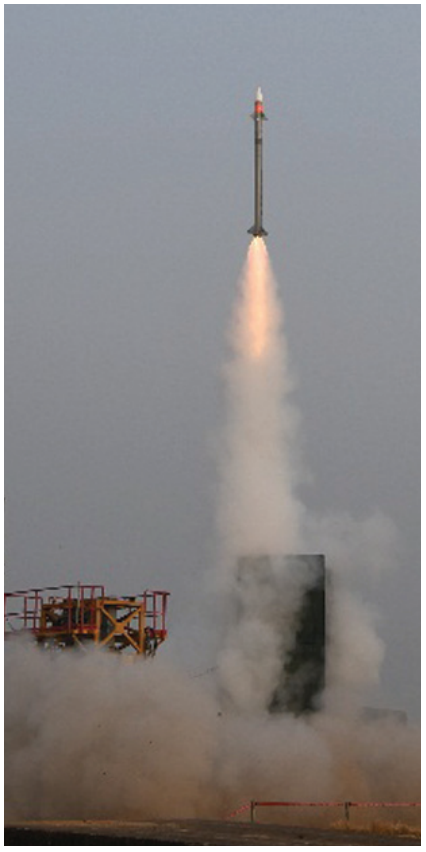
IAI: At AeroIndia 2021 IAI is presenting some of the latest and most advanced defence solutions, featuring the latest technologies in military aviation, air defence and missiles systems, unmanned systems, special mission aircraft, radars, and cyber technology. Among the systems on display are Heron TP, the largest platform IAI's family of advanced unmanned aerial systems (UAS), Maritime Heron and VTOL UAVs family by BlueBird. In addition, we are displaying satellites, radars, both strategic and tactical, loitering munitions systems, EO surveillance systems, advanced avionic upgrades and many more systems.

VAYU: What technologies is IAI working on to give it the cutting edge and how useful would these be in the Indian context?

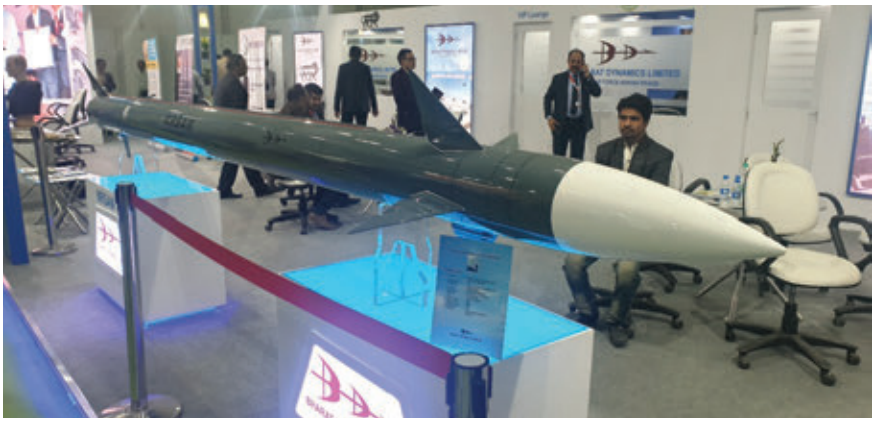
IAI: IAI offers its Indian partners advanced ground, air, and marine systems, including long-range air defence, the Heron TP UAV, loitering and precision ammunition, and is preparing for industrial collaborations with State-owned and private companies. In addition we are prepared with our Multi Mission Tanker Transport (refueling aircraft) to meet needs of our Indian partners.

(all photos: IAI)

IAI/DRDO test the MRSAM



MRSAM, Air & Missile Defence Systems jointly developed by Israel Aerospace Industries (IAI), Israel and the DRDO of India was successfully tested late December 2020 at a test range in India.



MRSAM is an advanced 'path breaking' air and missile defence system that provides 'ultimate protection' against a variety of aerial platforms and is to be used by the Indian Air Force, Army, Navy and the Israeli Defence Forces. The system includes an Advanced Phased Array Radar, Command and Control, Mobile Launchers and interceptors with advanced RF Seeker.

While MRSAM is jointly developed by IAI and DRDO for Indian forces, IAI is in collaboration with Israeli and Indian industries, including Rafael, Tata, BEL, L&T, BDL and number of private vendors.

"The current test, conducted at the Indian test range, validated all components of the weapon system to the customer's satisfaction. Israeli specialists and Indian scientists and officers participated in and witnessed the test", stated IAI.

More IAI Harops for India

According to the Indian MoD, the case for procurement of IAI Harop (P-IV) (Option Clause) and upgrade of UAV systems are at an advanced stage, with contracts likely to be signed in Q1 of 2021. As per various reports, India already has 110 of these and 54 more are likely to be ordered.

Flying Past the Pandemic

Dassault Aviation Group in 2020

In 2020, 13 Rafales were exported, in line with the policy, versus 26 in 2019. At the same time, in 2020, 34 Falcons were delivered, versus 40 in 2019. In 2020, 15 Falcons were ordered, compared to 40 in 2019. The Covid-19 outbreak, triggering an unprecedented global pandemic crisis, very restrictive travel restrictions and strong uncertainties about the worldwide economy, directly affected Dassault's order intakes.

As of 31 December 2020, the backlog includes 62 Rafales and 34 Falcons, compared to 75 Rafales and 53 Falcons as on 31 December 2019.

VAYU Interview with Mrs Anandi Ramalingam, Director Marketing, BEL

Mrs Anandi Ramalingam, Director Marketing

VAYU : What are your plans on increasing BEL's exports? How do you plan to increase your global presence?

BEL: BEL are fast expanding its global presence, putting its best foot forward to give a thrust to exports worldwide. All-out efforts are being made to tap new markets across the globe. In a bid to develop new markets in the Indian Ocean Region (IOR), BEL has operationalised overseas marketing offices in Oman, Vietnam, Sri Lanka and Myanmar. BEL has also expanded its Singapore and New York Regional Offices to handle marketing activities. BEL is also thinking of establishing similar offices in Nigeria, Brazil, Armenia and Kazakhstan.

The Government is encouraging defence exports through many policy initiatives and has set a target of Rs.35,000 Crs by 2024-25. BEL has identified Exports and Offsets as one of its thrust areas and has drawn up plans to offer its select products and systems to various export markets. The Company has put in efforts for increasing its business opportunities in South East Asia, Europe, Middle East, Africa and North America through constant engagement with customers and is also working closely with other Indian companies and local partners in the respective countries as part of maximising its geo-strategic reach and increase its global footprint.

VAYU: What are the products that you export and to which all countries do you export?

BEL: BEL has been exporting products such as Communication Systems, Coastal Surveillance System, Missile Systems, Radars, Electronic Warfare Systems, Electro Optic Systems and Electro Optic Fire Control Systems, Radar Finger Printing System, Naval Systems, Radar Warning Receivers, Electronic Voting Machines and various other equipment to USA, UK, Russia, Italy, Brazil, Germany, France, Israel, Indonesia, Honduras, Malaysia, Maldives, Mauritius, Myanmar, Namibia, Seychelles, South Africa and many other friendly countries. BEL achieved Export sales of US$ 48.59 million during FY 2019-20.

Some of the other products and systems which are being promoted for exports include Homeland Security solutions, Smart City solutions, Border Protection systems and Coastal Surveillance System. Having established a Coastal Surveillance System (CSS) for a few neighbouring countries, BEL is interacting with Ministry of External Affairs for supply of CSS to other friendly countries.

Recently, the Government approved the export of the indigenously developed Akash Missile System to friendly foreign countries.

VAYU: How do you plan to tap the Offset clause for exports?

BEL: BEL is also focusing on offsets as a potential avenue for revenue generation. BEL is interacting with many foreign OEMs to meet offset obligations in various RFPs of the MoD, on account of the offset policy incorporated in the Defence Procurement Procedure. BEL has identified contract manufacturing (*build to print and build to spec)* for foreign OEMs and partnerships in the form of Transfer of Technology of the latest systems and solutions as areas of emerging export opportunities. Efforts are also on to establish long term supply chain relationship with global players.

VAYU: How is your company gearing up to realise the Government's Atmanirbhar initiative?

BEL: Defence has been identified as a core sector to boost the *Make in India* vision of achieving $5 billion Exports. Major initiatives by BEL towards *Make in India/ Atmanirbhar Bharat* include strong thrust on R&D,_Collaborative R&D, Defence Innovation Organisation incorporated by BEL and HAL to create an ecosystem to foster innovation, and technology development in Defence by engaging R&D institutes, academia, industries, start-ups and individual innovators. To promote the Make in India initiative, BEL has established *Make in India* Display Cells, appointed Nodal Officers for Outsourcing & Vendor Development in all its Units and updated its policies and procedures. BEL has implemented the Make-II Policy of GoI and issued several EoIs to Indian vendors. The Company has been putting in efforts to create a strong vendor base in India and has currently more than 21,000 vendors

including domestic vendors and MSMEs. BEL is extending its Test facilities for use to private industries.

BEL is pursing development/ production opportunities with DRDO under DcPP model for various indigenous development/ production programmes. The Company has entered into partnerships / strategic alliances with foreign OEMs as well as major Indian industries to address large and strategic programme requirements, leveraging its complimentary capabilities and assuming the role of a Lead integrator / Tier-1 partner for indigenous manufacturing. BEL is constantly exploring possibilities of forging JV Partnerships.

BEL successfully rolled out 30,000 ICU ventilators within a record time for treating Covid-19 patients and make India self-reliant in high-end medical equipment. The project involved substantial import substitution within a short period of time. Post COVID, A separate vertical called Medical Electronics Division has been opened to focus on networked and remotely operated solutions with latest technologies like IoT, AI, Cloud-based services, e-diagnostics and online healthcare services.

VAYU: Can you throw some light on the key growth drivers for BEL going ahead?

BEL: Existing business segments such as Radar & Missile Systems, Communication & Network Centric Systems, Anti-Submarine Warfare & Sonar Systems, Tank Electronics, Gun Upgrades, Electro-Optics, Electro-Explosive and Electronic Warfare & Avionics systems will continue to drive BEL's growth in the coming years.

BEL has been putting in continual efforts to diversify into several new areas in both Defence and non-defence to sustain growth. Some of the areas BEL is focussing on in Defence are Next Generation Weapon Programmes, Electro-Optics, Airborne Radars, Arms & Ammunitions and Explosives, Unmanned Systems, Night Vision Devices, Inertial Navigation Systems solutions for various platforms, Helmet Mounted Display Systems, Counter Measures Systems for Airborne Platforms, Composites, etc.

In the last 5 years, BEL's turnover from non–defence business has been around 15% to 20% of the total turnover. Some of the areas being focused upon in non-defence are Air Traffic Control Radars, Space Electronics, Spacegrade Solar Cells, Satellite Assembly & Integration, Railway and Metro Solutions, Software, Electric Vehicles (Li-ion Battery Packs, Fuel Cells, Charging Stations), Homeland Security and Smart City businesses, Smart Metres and healthcare electronic equipment including ICU Ventilators to combat COVID-19.

VAYU: What is your current order book size? What is the growth in order book you expect in coming quarters?

BEL: BEL's order book as on 1 December 2020 is more than Rs. 52,000 crore. BEL has been consistent in order acquisition year-on-year. The Company has orders worth over Rs. 8,000 crore in the pipeline. All-out efforts are being made to tap new markets across the globe.

VAYU: What are BEL's latest products and systems planning for exhibition at Aero India 2021?

BEL: At Aero India 2021, BEL will showcase state-of-the-art products and systems spanning every domain of its business. The products and systems on display during the Aero India 2021 are clustered as Airborne & Space Application, Satellite and Space Application, Products and Systems for Self-Reliance (Aatmanirbhar Bharat), High Performance Computing & Artificial Intelligence Systems, Land and Naval Products and Systems, Communication and Laser based Products, Non-Defence/ Diversification and Outdoor Display Products.

In addition to the above, BEL will also showcase its R&D capabilities by launching/demonstrating some of its new products / technologies. The entire set of state-of-art equipment on offer will be a force multiplier for any Defence force.

Anti-Drone Guard System

SDR manpack

VAYU: How do you see the Government policy of 74% FDI through automatic route impacting the business?

BEL: The current FDI policy of 74% through automatic route is permitted for industries applying for fresh licence. Nevertheless, BEL considers it to be a positive step towards establishment of some niche technologies in the country. BEL with its long experience in the Defence sector has developed certain core strengths which is its USP to stay competitive in this sector.

Air Defence Fire Control Radar (ADFCR)

Saab updates

Definition of 'Future Options' for the Gripen C/D

Saab has received an order from the Swedish Defence Material Administration (FMV) to define what is needed to meet Sweden's requirements for the continued, effective operation and availability of Gripen C/D until 2035. The order value is 185 MSEK.

"Gripen C/D is the backbone of the Swedish Air Force and will be for many years to come. The result of the work will be that the customer has the ability to take different directions depending on their future needs. Saab's expertise in developing advanced fighter technology gives Sweden the means to decide how Gripen C/D remains a formidable frontline fighter in the 2030s," stated Jonas Hjelm, Senior Vice President and head of Saab business area Aeronautics.

The Gripen is in service with a number of air forces including Sweden, the Czech Republic, Hungary, South Africa and Thailand. The UK Empire Test Pilots' School (ETPS) is operating Gripens as its platform for test pilot training. Sweden and Brazil have respectively ordered 60 and 36 new Gripen E fighter aircraft.

Saab to upgrade French Giraffe AMB Radars

Saab has signed a contract with the French Armament General Directorate (DGA) for upgrade and life extension of the French Air and Space Force's mobile command and control systems, which feature Saab's Giraffe AMB radar and Command & Control shelter. This contract is part of the French Aerospace Operations Command and Control system programme, SCCOA. The upgrades include adaptations to further enhance the Air Force's NATO interoperability, information assurance and Identification Friend or Foe (IFF) capabilities. The lifespan of the French systems will be extended in order to allow its operational use up to at least 2033.

Follow-on contract for GlobalEye

Saab has received a follow on contract from the United Arab Emirates regarding sale of two GlobalEye systems, Saab's advanced airborne surveillance system. The order value is USD 1.018 billion and the contract period is 2020-2025. The original contract with the United Arab Emirates for GlobalEye was signed in 2015 and this contract is an amendment to that.

The work will be carried out in Gothenburg, Linköping, Arboga, Järfälla and Luleå in Sweden and in Centurion, South Africa. GlobalEye provides simultaneous air, maritime and ground surveillance, combining sophisticated radar technology with the ultra-long range Global 6000 aircraft from Bombardier.

Thales reinforces its 'Make in India' commitment


The STARStreak system

Led by its commitment to the 'Make in India' policy of the Government of India, Thales is participating at the 13th edition of Aero India, providing visitors a chance to witness the latest cutting-edge technologies across civil and defence aerospace as well as land and naval defence along with a special feature on its efforts towards 'Make in India'.

Thales is showcasing its airborne optronic capability the targeting and reconnaissance pod TALIOS that combines targeting and tactical reconnaissance capabilities in a single pod which will be able to embed artificial intelligence in the future, and also a range of rockets for fixed and rotary wing military aircraft.

Thales is also exhibiting the latest addition to its family of airborne surveillance radars, the AirMaster C, which is an optimised surveillance solution for a broader array of platform types and operators, ensuring they benefit from the highest levels of mission performance as they face the new challenges ahead.

Among other systems for the armed forces are SYNAPS software defined radios, armament, small arms, counter-UAV measures and air defence solutions such as STARStreak for which a teaming agreement has been recently signed between Thales and Bharat Dynamics limited is on centre stage.

Some other highlights at Aero India 2021 include military and civil avionics, Air Traffic Management Systems that support growing domestic and international travel requirements, among others.

"Driven by the purpose to build a future everyone can trust, we remain resolute in our commitment to the 'Make in India' vision of the Government of India. Since inception of our operations in the country, we are proudly supporting the modernisation efforts of the Indian armed forces and helping them to prepare, achieve and maintain tactical superiority over any form of threat. Aero India 2021 provides us with an opportunity to present our latest and advanced technologies that serve the needs of the country's defence forces, and strengthen our local partnerships. We are excited to be part of it," stated Emmanuel de Roquefeuil, Vice-President and Country Director, Thales in India.

Backed by the rich legacy of close to seven decades in India, Thales continues to innovate and accelerate digital transformation to serve the needs of the Indian market – as well as globally.

Updates from MBDA

First firing of a Medium-Range Missile (MMP)

MBDA has carried out the first firing of an MMP missile from an ARQUUS Sabre Special Forces vehicle, as part of a firing campaign implemented with the support of the French Army and of the *Direction Générale de l'Armement* (DGA - French Procurement Agency). The firing was carried out at the Canjuers military camp in the south of France, using 'lock-on-before-launch' mode against a tank 3,500 metres away, with a rapid switchover to 'fire-and-forget' mode, making the vehicle fully mobile after firing.

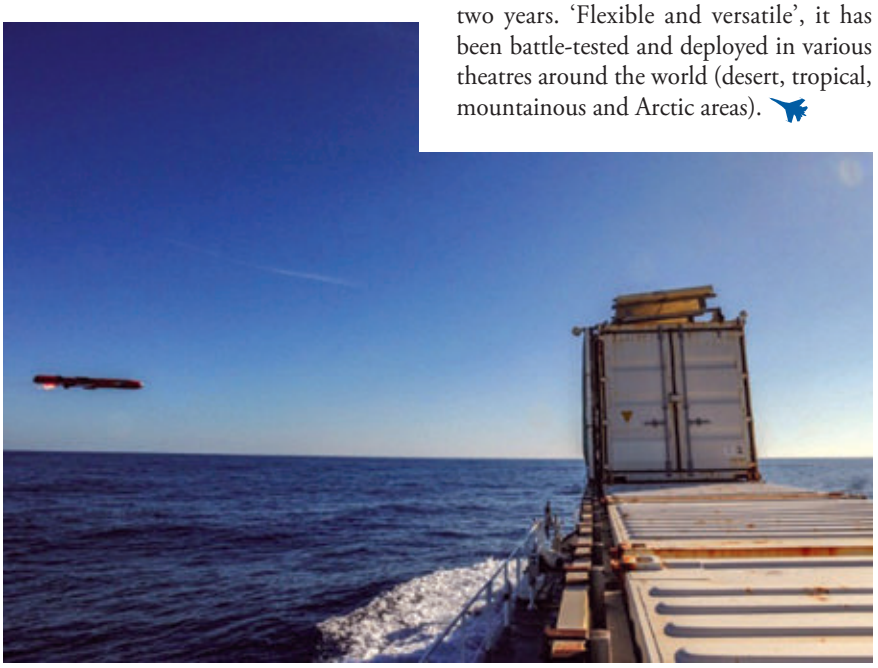
The MMP – the first fifth-generation missile to be deployed in combat – has been in service with the French Army for two years. 'Flexible and versatile', it has been battle-tested and deployed in various theatres around the world (desert, tropical, mountainous and Arctic areas).

UK orders production of SPEAR mini-cruise missile

MBDA has received a contract valued at £550 million for production of the SPEAR missile system from the UK Ministry of Defence. SPEAR (known in UK service as SPEAR3) is a first-of-class network enabled miniature cruise missile. SPEAR will be the main medium-to-long-range strike weapon of the UK F-35 combat aircraft, enabling them to defeat challenging targets such as mobile long-range air defence systems at over-the-horizon ranges in all weathers and in highly contested environments.

Guided firings of SPEAR will start within 18 months launched from a Eurofighter Typhoon fighter aircraft, with missile and launcher production beginning in 2023. The new contract follows successful implementation of the weapon development phase contract for SPEAR placed in 2016 and the contracting of integration of SPEAR onto F-35 in 2019.

The contract for SPEAR will employ a peak of 570 people at MBDA plus a further 200 in the Tier 1 supply chain. This will see the creation of 190 highly skilled technology jobs at MBDA in areas including system design, software engineering, seekers, and guidance control & navigation in Stevenage, Bristol and Bolton. It forms part of the Portfolio Management Agreement (PMA), a partnership initiated in 2010 between the UK MoD and MBDA on sovereign complex weapons design and production.



Qualification firing trials of the Sea Venom/ANL

The Sea Venom/ANL anti-ship missile has completed its qualification firings trials, with a successful final firing at the French Armament General Directorate test site at Ile du Levant. Soon to start equipping the Royal Navy's AW159 Wildcat and Marine Nationale's H160M Guépard shipborne helicopters, the Sea Venom/ANL anti-ship missile is a co-operation project developed under the Lancaster House treaty between France and the United Kingdom.

Indian Army test fires BrahMos in A&N

The BrahMos supersonic cruise missile was fired by an Indian Army unit from the Andaman and Nicobar Islands, "the objective of the missile was on another island, which then hit its target." The Indian Army has a number of regiments equipped with the BrahMos supersonic missile whose strike range has been enhanced to over 400 km.

BrahMos test fired from INS *Chennai*

On 18 October 2020, a BrahMos supersonic cruise missile was test fired from the Indian Navy's built stealth destroyer INS *Chennai*, accurately impacting a target in the Arabian Sea. BrahMos as 'prime strike weapon' will ensure the warship's invincibility by engaging naval surface targets at long ranges, thus making the destroyer another lethal platform of Indian Navy. The highly versatile BrahMos has been jointly designed, developed and produced by India and Russia.

BrahMos with indigenous booster flight tested

On 30 September 2020, a BrahMos supersonic cruise missile having an indigenous booster and with many 'Made in India' sub-systems was successfully flight tested from ITR, Balasore in Odisha.

"Lockheed Martin Reaffirms Commitment to Advancing India's Security and Industrial Capabilities at Aero India 2021"

Lockheed Martin is showcasing its diverse portfolio of defence capabilities and solutions at the 13th edition of Aero India 2021 at Yelahanka, Bengaluru. The company's exhibit this edition highlights its product portfolio across Aeronautics, Rotary and Mission Systems, and Missiles and Fire Control businesses. This includes a broad span of state-of-the-art capabilities, including the F-21 fighter, MH-60R 'Romeo' multi-mission helicopter, the S-76D helicopter and the C-130J Super Hercules transport aircraft.

"Aligned with the Indian government's *Atmanirbhar Bharat Abhiyaan* and the 'Make in India' initiative, we are participating in Aero India 2021 and reinforcing our commitment to supporting the growth of an indigenous defence manufacturing ecosystem while continuing to deliver our best capabilities to support the Indian MoD and Services," stated William (Bill) Blair, Vice President and Chief Executive, Lockheed Martin India. "We see tremendous strength and opportunity in India›s defence industry – both public and private – including start-ups and Micro, Small & Medium Enterprises (MSMEs). Aero India serves as an excellent platform for us to explore new partnerships and strengthen existing ones."

The prime attraction at the Lockheed Martin›s stand is the **F-21 fighter aircraft** which is on offer to the Indian Air Force. The company is leveraging both 4th and 5th generation technologies to offer the best solution to meet or exceed the IAF's capability needs, provide 'Make in India' industrial opportunities, and accelerate India-US cooperation on advanced technologies, including but not limited to fighter aircraft. The F-21 demonstrates Lockheed Martin's commitment in delivering an advanced, scalable single-engine fighter to the IAF: "For India, From India".

The Indian Navy's most recent rotary wing acquisition**, MH-60R 'Romeo' Seahawk helicopter,** also occupies a prominent place at Lockheed Martin's Aero India display. The MH-60R is the world's most advanced maritime helicopter and brings vital anti-submarine and anti-surface warfare capabilities to the Indo-Pacific region. The MH-60R is the latest thread in the stories of Lockheed Martin and US-India partnerships. In fact, it is the largest contract Lockheed Martin has ever signed with India. The first batch of the MH-60R helicopters will be delivered to India in 2021.

The **S-76D helicopter** has an unmatched record of safety and reliability, delivering the safety, reliability and efficiency customers have come to expect from the S-76 family of aircraft, but with faster cruise speed and more efficient fuel burn. In all roles, including the difficult Search and Rescue role, it has been incredibly well received providing a stable, low workload, reliable platform and speed, for when minutes matter. With S-76-class helicopters working for customers all over the world on a diverse set of operations, it›s well positioned to meet growing global customer needs.

On display at the show is India's workhorse, **C-130J Super Hercules** airlifter, represents a strong legacy of partnership between India and the US. The IAF has been extensively using its fleet of 12 Super Hercules for humanitarian efforts in wake of the Covid-19 pandemic, as well as to support the movement of troops and material to support regional military operations. All C-130Js now built and delivered around the world have major components manufactured in India through Tata Lockheed Martin Aerostructures Limited (TLMAL), a joint venture located in Hyderabad that has the distinction of being the single-global source of C-130J empennage assemblies.

As part of the Javelin Joint Venture, Lockheed Martin also produces the **Javelin** anti-tank guided missile system. This versatile and effective one-man-portable and platform-employed multi-target precision weapon system provides capability to defeat a broad spectrum of close combat threats on the modern battlefield. Using fire-and-forget technology, the weapon guides itself to the target without external commands, allowing soldiers to take cover or reposition. With a range of 65 meters to 4 kilometers in most operational conditions, as well as the ability to operate through adverse weather and battlefield obscurants, Javelin can be deployed in a variety of environments and conditions. Lockheed Martin has nearly 240 suppliers — including MSMEs that feed into its two joint ventures, TLMAL and Tata Sikorsky Aerospace Limited — that benefit from the vision of Lockheed Martin and Tata working together. Lockheed Martin has integrated more than 70 Indian suppliers, including MSMEs, into its global supply chain. At the show, the company representatives will discuss partnership opportunities with Tier 1 suppliers and prospective Indian industry partners that strengthen India-US defence industrial ties and 'Make in India' opportunities.

William L. Blair, Vice President and Chief Executive, Lockheed Martin India

Thales and Bharat Dynamics Limited bring STARStreak Air Defence System to India

Thales and Bharat Dynamics Limited (BDL) have signed a Teaming Agreement to work in partnership on the STARStreak Air Defence system with the support of both the Governments of India and the United Kingdom. The Teaming Agreement was signed by Thales and BDL in the presence of UK and Indian Government representatives in a virtual ceremony on 13 January 2021.

The representatives from the UK included Jeremy Quin (Minister for Defence Procurement) and Mark Goldsack (Head of UK Defence & Security Exports). From India, the Director General Army Air Defence and representative from Army Design Bureau, Indian Army, witnessed the ceremony.

NP Diwakar, Director (Technical), BDL, Alex Cresswell, CEO Thales in the UK and Emmanuel de Roquefeuil, VP and Country Director, Thales in India, signed the agreement in presence of Commodore Siddharth Mishra (Retd), Chairman and Managing Director, BDL.

Through the agreement, BDL will become part of the STARStreak global supply chain, providing the opportunity for export of Indian manufactured components to existing and future STARStreak Air Defence customers, including the UK Armed Forces.

BDL was established in Hyderabad in 1970 as a manufacturing base for guided missiles and allied defence equipment. In 2017, Thales and BDL signed a Memorandum of Understanding to assess the opportunity for transfer of technology for STARStreak. The signing of this teaming agreement confirms a positive outcome from that exploration process.

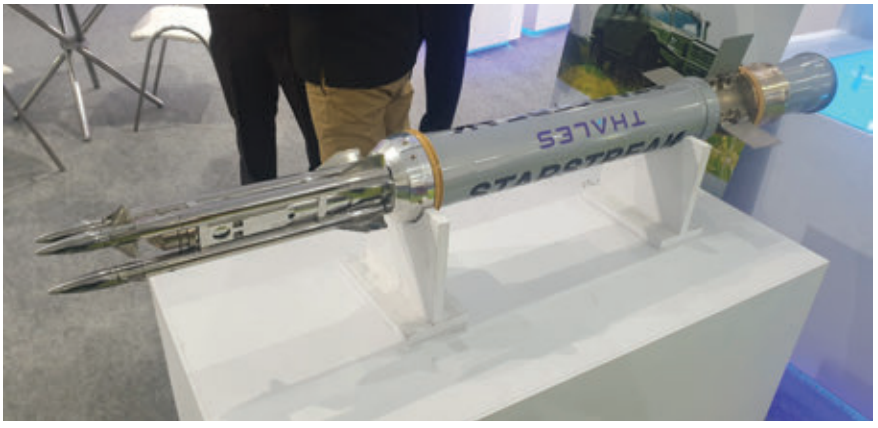
This agreement will also provide the opportunity for BDL to offer a 'Make in India' STARStreak solution to the Indian Government, with a capability that match as the immediate air defence needs of the Indian Army and Air force, and with 60% of the system manufactured in India.

It also represents an opportunity for further UK and Indian Industrial co-operation and will cement the ambition for closer collaboration and co-development between the two nations, supporting the ambitions of our governments› recently signed Defence Technology and Industrial Capability Cooperation MoU.

Alex Cresswell, CEO of Thales in the UK stated: "Today›s signing is a significant milestone for all parties concerned and I look forward to Thales and BDL developing a close working relationship. This is good news for our business in Belfast in Northern Ireland, for the strong supply chain of UK SMEs with whom we work and for our teams in India. The UK and India have a strong tradition of industrial partnership in defence, innovation and sharing technology and we are thankful to both the Governments for their strong support to this excellent initiative."

Commodore Siddharth Mishra (Retd), Chairman and Managing Director, Bharat Dynamics Limited, in his address stated that "partnership between Thales and BDL in this project with Transfer of Technology for the STARStreak will create a new business opportunity for BDL and its Supply Chain Partners in India. BDL will be able to enhance its footprints in the export market in addition to domestic market with this new business opportunity. The Government of India's 'Make in India' programme, the 'ease of doing business' and recent 'Atmanirbhar Bharat' initiatives have created a congenial ecosystem for the foreign OEMs to tie up with Indian Industries like BDL to establish the production facility in India," he added.

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



Big is Beautiful !

Rolls-Royce runs first engine on world's largest and smartest aerospace testbed

The R-R UltraFan

Rolls-Royce has successfully completed the first engine run on its state-of-the-art Testbed 80, which will be the largest and smartest indoor aerospace testbed in the world when it is officially opened in the coming months.

With an internal area of 7,500m^2, making it larger than a Premiership football pitch, the testbed has conducted its first run on a Rolls-Royce Trent XWB engine at the test facility in Derby, UK. This is a major milestone in the project which has been under construction for almost three years and represents a £90m investment.

Chris Cholerton, President Rolls-Royce Civil Aerospace, stated, "This is an important landmark in our journey towards a more sustainable future for aerospace and aviation. Testbed 80 will not only test engines such as the Trent XWB – the world's most efficient aero-engine in service – but also the engines and propulsion systems of the future, which will see us take another step towards decarbonisation. It's great that the first engine test has been a success and we are looking forward to the official opening of the facility in the coming months."

Testbed 80 has been designed to test a range of today's engines, including the Trent XWB and the Trent 1000, but will have the capability to test the UltraFan demonstrator, a blueprint for the next generation of even more efficient engines, as well as the hybrid or all-electric flight systems of the future.

The data systems inside Testbed 80 are more capable and complex than any of the existing testbeds, delivering data in the fastest time directly to secure storage, linked for the first time to RR's analytical models and engineers. "We can collect data from more than 10,000 different parameters on an engine, using an intricate web of sensors that detect even the tiniest vibrations at a rate of up to 200,000 samples per second. The data helps us understand our engines better, monitoring how every single component behaves in a range of conditions, and consequently providing crucial insights to inform future engine improvements for availability and efficiency."

The Testbed 80

The versatility of the testbed means it is able to accommodate engines of all sizes up to 155klbf thrust – that's enough power to launch a Boeing 747 with one (huge) engine.

As part of RR's decarbonisation strategy they are also committed to promoting the scaling up of Sustainable Aviation Fuels (SAFs), which can already be used as a "drop-in" fuel in the existing engines. To support this commitment, Testbed 80 is equipped with a 140,000 litre fuel tank (one could fill up the car almost 3,000 times with this amount of fuel) for different fuel types, including Sustainable Aviation Fuel.

The testbed is also home to a powerful x-ray machine that is able to capture 30 images per second and beam them directly to a secure cloud, where engineers around the world can analyse them along with the 10,000 other data parameters we can measure. "We are the only engine manufacturer in the world to x-ray our engines while they are running. This unique test allows us to inspect engines to minute levels of detail and obtain precise levels of data."

Part of the new technology development for Testbed 80, specifically for the UltraFan, has been supported by the ATI›s PACE project.

Courtesy: Rolls-Royce

P&W's Next-Gen engines for India's Defence modernisation

The Airbus C295 transport aircraft is powered by PW127G engines

As makers of the world's first operational fifth-generation engine, the F119 for the F-22 Raptor and the world's most advanced fighter engine, the F135 which powers the F-35, Pratt & Whitney's history and expertise with advanced propulsion systems is unmatched. With more than 7,000 military engines in service with 34 armed forces around the world, P&W understand that engine performance, reliability and versatility are critical components of advancing a nation's aerospace and warfighter ambitions.

Both the Indian Air Force and the Indian Navy are on a modernisation path with some key programmes in the running. For example, the Indian Air Force may acquire 56 Airbus C295 transport aircraft that are powered by PW127G engines. The PW100 family of engines represents a diverse set of customers, across regional, cargo, firefighting, emergency services and defence. It has delivered on reliability as well as versatility, flying in any environment, effectively and efficiently. The engine's latest materials, design and advanced engine control deliver impressive dispatch reliability, as well as easy operations and maintenance, making it uniquely suited to IAF's varied mission needs.

Meanwhile, the Indian Navy is looking to select a new Naval Utility Helicopter and the Sikorsky S-76D is one of the contenders. The S-76D is powered by the PW210 engine, which has been instrumental in shaping a new generation of helicopters worldwide. With its game-changing performance, improved fuel burn, power-to-weight ratio and operating economics, we are confident that if selected, the PW210 will deliver for the Indian Navy as it protects India's maritime borders.

When it comes to advanced fighters, there is the closely watched procurement of 114 Medium Multi-Role Combat Aircraft for the Air Force and Boeing's F-15EX is seen as one of the contenders. Pratt & Whitney's F100 engines have powered the United States Air Force's entire operational fleet of F-15s for more than the past 40 years, including its most current variants. The latest upgraded F100-PW-229 has a fully modular architecture that ensures ease of maintenance and incorporates leading edge technologies in materials, cooling, and health management including some advanced 5th generation technology. It is also fully capable of integrating with the F-15EX's fly-by-wire flight control system.

The F100's safety, reliability, and performance record with the F-15 is second-to-none. With more than 28 million hours flown, the F100 is an industry leader in fighter engine reliability and provides excellent value to its operators through low costs per flight hour. The engine currently powers frontline fighters for the USAF and air forces around the world, and is technologically fully capable of powering the most challenging missions against any adversary – now and in the future. These traits along with quality and value over the entire lifecycle, provide the Indian Air Force with a superior propulsion system for this critical aircraft and for their missions.

As India takes on a renewed 'Self-Reliant' approach towards defence modernisation, indigenous jet fighters in various stages of consideration and development like the Advanced Medium Combat Aircraft (AMCA) and the Tejas MKII are of significant importance. We believe that these are great steps forward in advancing India's defence and industrial capabilities, and that such platforms work best when augmented with next-gen propulsion systems.

In India, Pratt & Whitney is committed to building capabilities for high value services that will help operators get the best from their next-generation products, and creating an innovative aerospace and defence ecosystem that transforms the country's aviation aspirations into reality. We are confident that our engines are the best choice to power India's defence aircraft, and are pleased to engage with our customers on any opportunities that they see fit for us in the long term.

Courtesy: P&W

Ashmita Sethi, President and Country Head, Pratt & Whitney

Israel Aerospace Industries gives new life to veteran helicopters

As the most common aviation platform operated by military and government agencies, helicopters are utilised extensively, in large numbers and on different types of missions. Tens of thousands of helicopters, such as the American-made Sikorsky/Lockheed Martin Blackhawk UH-60, the Airbus 'Puma', and Russian Helicopters Mi-8/17/171 have proven to be robust, reliable and long-living platforms that have remained in service for decades. From an air worthiness perspective, these platforms are still completely functional, but their long life-span has led to a new problem. As the years pass and demand grows for new systems that can perform increasingly complex missions, the systems on these platforms no longer meet current demands . To give these helicopters a new lease on life, IAI has developed programmes that upgrade them into modern and potent platforms.

"We take these incredibly reliable helicopters and turn them into modern, combat-ready platforms suitable for the 2030s," stated Haim Shriki, helicopter upgrade programmes leader at IAI's Aviation Group. According to Shriki, such upgrades may include a complete overhauling of the platform, like the one carried out on the UH-60A/L for example. An avionics upgrade may also standardise helicopters fleets, and IAI also offers mission-specific conversion packages for helicopters.

"With the US Army replacing its Blackhawk UH-60 A/L models with the new UH-60M, plenty of helicopters are now available as US military surplus," Shriki noted. "Given proper modernisation and refurbishment, these helicopters can continue to operate for decades and will have mission capabilities similar to those of the new M model, at half the price."

Such a package includes an avionic upgrade that converts the analog instruments and avionics into a modern 'glass cockpit', with a moving map display, command, control, and communications management systems, full mission planning, and management capability. With these systems, the modernised helicopter operates better in both day and night, safely pursues formation flight at night, and tightens cooperation with other aircraft or ground forces through improved situational awareness. Additionally, the package may include integration of weapons management systems and self-defence measures, with optional weapons carriage, improving the Blackhawk's role in combat support.

IAI also offers avionic modernisation for other helicopters, such as the Mi-8 and 17, utilising its Integrated Avionic & Display System (IDAS). Based on an open system design and powerful Display and Mission Computers (DMCs), IDAS enables helicopter upgrade packages to be tailored to users' specific requirements. Designed with modern modular open architecture utilising Mil-Std 1553B and other commonly used interfaces, the system integrates multiple colour displays and moving map systems showing advanced tactical situation pictures along with essential instrument readings. The cockpit and displays are compatible with aviator night vision system (ANVIS) goggles.

According to Shriki, by modernising existing platforms instead of buying new ones, customers can now double the sizes of their combat-ready helicopter fleets. Furthermore, where mixed fleets are used, the project can standardise the avionics and interfaces in accordance with customers' preferences. "Unlike new, off-the-shelf platforms that are very expensive to adapt or change, our modernisation packages are flexible and suited to conveniently meeting specific customer demands," he added.

Equipping helicopters for naval operations is another line of activity for the IAI Aviation Group. These programmes focus on equipping helicopters with maritime operational systems and on integrating naval helicopters with modern systems. IAI has integrated a modular package for naval helicopters known as *Skimmer,* which has been utilised with Eastern bloc Ka-28 helicopters (the export version of the Russian Kamov-Ka-27) and with Western platforms.

Skimmer packs sensors, computers, and weapons in a full mission system such as maritime surveillance or anti-submarine warfare. Typical elements include a radar, EO/IR payload, sonar,

BlackHawk avionics

and torpedoes, that are all interfaced with onboard avionics, communications, and operator workstations.

IAI's Aviation Group has decades of experience in aircraft modernisation and upgrading, including helicopters of different types and makes. As an aircraft designer and manufacturer, IAI has the knowledge and expertise to develop, manage, and complete upgrade programmes while adhering to budgets and in a timely manner. "There are many suppliers offering avionic upgrades, but only a few can offer such a comprehensive package and customise it to the user like IAI," stated Shriki. The upgrade is often done at IAI, where experienced specialists, many of whom are former Israeli Air Force personnel, put together the technical package, integrate the avionic system and put the platform through flight tests. IAI also provides training and support, both technical and logistical, over the life cycle of the programme. Serial conversions and system support are often done by the customer or by a local subcontractor, thus enabling the customer to shift part of the programme's costs to domestic vendors, with full support from IAI. This technical and business cooperation allows IAI's helicopter modernisation and avionic upgrading programmes to be beneficial to all parties involved.

IAI's vast experience in diversified technological and operational areas has led to numerous successful programmes around the globe including in India. Several projects for the Indian defence forces are currently in different stages of implementation, both directly and through industrial cooperation with local partners. One example of such meaningful cooperation that we are very proud of involves the introduction of IAI's comprehensive avionics package for helicopters through cooperation with the reputable helicopters developer and producer, Hindustan Aeronautics Ltd. As part of this programme, hundreds of IAI's advanced avionics systems are already operational in India.

The Agni-V: India's Iron Fist

On 10 December 2018, India's Inter Continental Ballistic Missile (ICBM) Agni-V was successfully test-fired for the seventh time by Defence Research & Development Organisation (DRDO) from the Launch Complex 4 of the Integrated Test Range (ITR) off the coast of Odhisha in a lofted trajectory, thus completing the pre-induction trials.

The missile is usually programmed to attain an apogee of 600-km above prior descent, while the third stage firing the Re-entry Vehicle (RV) separates at 6-km/sec thereafter encountering the atmosphere at an altitude of 100 km. The RV subsequently attained further acceleration owing to gravity to record a speed of Mach 25+ and impacted the pre-designated target point at "pin-point accuracy", within a few (reportedly single digit) metres of the designated target point around 2,000-km away. Although the exact range of Agni-V is classified, the road mobile missile is comfortably expected to reach targets in excess of 7,000-km if armed with a single 200-kt nuclear warhead thereby obliterating any hostile targets in Asian landmass from secure launch points deep interior India. The missile was 'cold launched' from a hermetically sealed canister mounted on a Tractor-Erector-Launcher (TEL) ensuring rapid launch sequence, higher reliability, longer shelf life, less maintenance and enhanced mobility to ensure survival.

With a length of 17.5-metres, diameter of 2-metres and "launch mass" of around 50-tonnes, thanks to extensive use of composites to reduce weight, the Agni-V is a three stage solid fuelled missile with composite motor casing in the second and in the miniaturised third stage. Agni-V incorporates advanced technologies involving Ring Laser Gyroscope based Inertial Navigation System (RLG-INS) plus Micro Inertial Navigation System (MINS) and accelerometer for navigation and guidance further to be boosted by military grade precise signals from Indo-Russian GLONASS satellite navigation system. Agni-V will also carry at least three Multiple Independently targetable Re-entry Vehicles (MIRV) payloads within its 1.5 metre diameter all carbon composite RV (capable of withstanding temperatures of up to 5,000 degrees Celsius) to deliver multiple manoeuvring warheads at different targets or on a single target to execute saturated strike to overwhelm enemy Ballistic Missile Defences (BMD). In this context DRDO has successfully demonstrated the Hypersonic air-breathing scramjet technology with the flight test of Hypersonic Technology Demonstration Vehicle (HSTDV) (also capable of propelling manoeuvring nuclear warheads) on 7 September 2020 from the same location. Lofted to an altitude of 30 km by a proven solid rocket motor, the HSTDV working at high dynamic pressure and high temperature sustained a speed of Mach 6, for 20 seconds.

A sea launched variant with a length of less than 12-metres may be anticipated for ballistic missile-armed nuclear powered submarines (SSBN) that may in peacetime double as Satellite Launch Vehicle (SLV) fired from proximity of equator to put multiple satellites in geo-synchronous orbits with ease. The Agni-V is poised to emerge as India's standard ballistic missile to be put to mass production to ensure assured deterrence in foreseeable future. The stunning accuracy consistently displayed by the Agni-V prototypes, along with extensive mobility and indigenous BMD will enable India for the first time to adopt a "limited deterrence" posture by adopting both counter force and counter value stance.

Certainly the matured response of major global powers in response to India's ICBM tests has affirmed India's position as a responsible nuclear weapons State with self-imposed non-proliferation obligations. These tests also eliminated the Peoples Republic of China's (PRC) long-time dream to dominate the Asian landmass in due course. It is also perhaps time for the Indian scientific community to conduct a couple of round of nuclear weapons tests to fine tune the thermonuclear devices to be mounted on the Agni-V, and an undertaking of signing Comprehensive Test Ban Treaty (CTBT) thereafter will certainly ensure global acceptance.

Sayan Majumdar

Rafael at Aero India 2021

Rafael is deeply committed to India and is sending a significant delegation to Aero India 2021. The Company has demonstrated its ability to respond quickly and effectively to emerging needs, without making any quality compromises, as a result of its flexibility, its ability to make swift adjustments, and due to its vast experience in customer requirement analysis and tailor-made solutions.

Among its wide variety of solutions, at Aero India 2021, Rafael is showcasing the following systems and capabilities:

Rafael's air warfare systems are among the best in the world, stand-alone, or in combination, as an integrated suite that acts as part of a net-centric array that once installed on any platform, gives it advanced, 4.5 generation capabilities.

Its airborne missile systems include long range active-radar as well as full-sphere IIR air-to-air missiles for short-to-beyond visual range threats (Derby MkIII & Python-5). Its array of air-to-surface missiles (SPICE 250, 1000 & 2000) includes stand-off weapons and precision-guided ammunition kits for use against high-value ground targets, and ROCKS - a new generation extended stand-off range air to-surface missile designed for pin-point accuracy strike of high-value targets in a GPS-denied arena. Rafael's electro-optic targeting and navigation pod (Litening 5) is the most widely used pod in the world and its unique airborne reconnaissance pod (Reccelite XR) is known for its ability to shorten the sensor-to-shooter cycle. Rafael's airborne communication systems include the BNET SDR for full connectivity on all levels. Rafael also offers an advanced airborne electronic warfare set of solution.

Air Defence: Rafael offers a full range of multi-layered air defence to meet the imperative demand for air superiority and effective defence. Its multi-layered, mixed weapon systems, ensure decisive, efficient responses against all types of airborne threats including aircraft, helicopters, short to long-range missiles, and rockets. Rafael's multi-layered protection systems provide comprehensive protection for armed forces and population centers by delivering victory in the air and full protection on the ground. These solutions include the SPYDER, C-Dome and Drone Dome systems, supported by Sky Spotter, a passive Electro Optical Early Warning System with high probability of detection and very low false alarm rate, complementing the performance of legacy radars. Rafael's Integrated C^4I Air & Missile Defence System (MIC^4AD & Optimiser), provide command and control for the operation of both air and missile defence missions.

SDR Communication: Rafael's BNET SDR is a unique radio and network architecture that enables future digitised warfare by delivering ultra-wideband, low delay, data integrity and availability for reliable information interchange capabilities. BNET allows natural continuation of fighting since all forces are connected as they proceed to their new missions and objectives without the need to push forward relay equipment. All BNET radios share the same architecture and same baseband waveform implementation in different form factors and all radios of land, sea, and air units participate in one scalable MANET network.

Spike – a family of missiles: With sales of well over 34,000 missiles, Spike is in use by 35 nations, including India. Spike is an advanced 5th generation electro-optically-guided missile system family that has accumulated a substantial track record of target engagements including tanks, air defence targets, armoured vehicles, soft vehicles, marine vessels and structural targets. More than 6000 Spike missiles have been fired in training and combat, and more than 45 different platforms have been integrated, including vehicles, helicopters (more than 10 different types) and marine boats.

Also present at the show are two of Rafael's subsidiaries - CONTROP, which specialise in the development and production of Electro-Optical and Precision Motion Control Systems for Defence, Para-Military and Homeland Security (HLS) applications, providing some of the most innovative solutions for surveillance and reconnaissance activities used in the world today.

In addition, Rafael's subsidiary Aeronautics will display its integrated turnkey solutions based on unmanned systems platforms, payloads and communications for defence and civil applications. Designed as leading-edge UAS-based solutions, Aeronautics' systems offer operationally proven solutions for Intelligence, Surveillance and Reconnaissance (ISR) systems requirements.

Rafael Advanced Defense Systems Ltd. designs, develops, manufactures and supplies a wide range of high-tech defence systems for air, land, sea, and space applications for the Israel Defence Forces and the Israeli defense establishment, as well as for customers around the world. Rafael is one of Israel's three largest defence companies, and employs 8000 people and numerous subcontractors and service suppliers, including in the United States.

Controp launches SPEED-LR for long-range ground observation

Controp Precision Technologies Ltd., a company specialising in the field of electro-optics IR defence and homeland security solutions, has launched its newest long-range ground observation system known as the SPEED-LR, a fully-digital and stabilised multispectral system that represents a new standard in the land surveillance market.

This will significantly increase surveillance capabilities for defence and HLS Forces around the world, particularly when it comes to rapidly detecting and identifying potential threats from increased distances. The new system incorporates many features of its bigger brother, the top-of-the-range SPEED-ER, including cutting-edge sensor technologies for day, night and low visibility surveillance. The expanded SPEED family gives more choice for existing or potential customers and allows them to select a system that meets their requirements and budget.

"This SMART system has multi-tasking capabilities and there is nothing quite like it in the market right now," said Guy Oren, Vice President of International Marketing and Sales at Controp Precision Technologies. "Being part of the renowned SPEED family, our customers can expect a lot of the same great features that are already present on our other SPEED systems, including exceptional multispectral capability," he added.

The SPEED-LR incorporates a high definition (HD) cooled mid-wave infrared sensor and HD day camera, as well as a short-wave infrared camera. The latter sensor allows users to see effectively through obscurants such as mist humidity, fog, dust, or smoke, ensuring that threats are not missed. The new system also incorporates superb line-of-sight stabilisation to ensure a sharp image for operators, at the narrowest field of view even when fully zoomed in.

"We see this as a persistent surveillance tool, where the SPEED-LR will be able to act like a passive radar sensor, scanning the environment and automatically detecting multiple targets," further stated Oren. "We are very proud of the SPEED-LR and the fantastic work that the CONTROP team has done to make this available for our customers, particularly in these challenging times," said Oren.

Controp specialises in the development and production of Electro-Optical Infrared (EO/IR) and precision motion-control systems for surveillance, defence and homeland security. Controp's main product lines include: high-performance stabilised observation payloads used for day/night surveillance on-board UAS, small UAS and aerostats/balloons, helicopters, light aircraft, maritime patrol boats, remote weapon stations and ground vehicles; automatic intruder-detection systems for coastal and border surveillance, port/harbour security, the security of sensitive sites, ground-troop security and anti-drone applications; thermal imaging cameras with high-performance continuous zoom lens and state-of-the-art image enhancement features and more. Controp's products are in daily operational use in many of the most critical surveillance, homeland security and defence programmes worldwide.

Rafael's SPIKE SR

missile capabilities demonstrated

The EDF (Estonian Defence Forces) have completed firing of SPIKE SR (Short Range) missiles in a demonstration that took place late in 2020. EuroSpike's (a European Joint Venture between Rafael Advanced Defense Systems, Diehl Defence and Rheinmettal Defence) SPIKE SR is part of the wider, multi-platform, multi-purpose, multi-range SPIKE family of electro-optical missiles. It is an advanced, shoulder-launched, guided missile, designed for modern infantry warfare. SPIKE SR benefits include a light weight of only 10kg, operational simplicity, and an enhanced range of 2000 meters. SPIKE SR's ease-of-use allows the lower echelon infantry to qualify rapidly and to sustain a high level of operation with almost no continuous training.

In addition to the firing of live rounds, the EDF activated the different training means of the weapon system, including outdoor and indoor trainers. The EDF also evaluated the high level of portability of the SPIKE SR, and the highly-effective tandem HEAT (High Explosive Anti-Tank) warheads, which allow advanced modern armour penetration, and the critical stand-off range of 2000m.

These capabilities enhance infantry crew survivability when facing today›s modern tank threat that includes better armour, greater standoff ranges and advanced optics,

which place ATGM units at risk. With its very low signature and single-soldier operation, SPIKE SR enables forces to shoot-and-scoot without exposing their location. This is a crucial capability for both high intensity conflict, when facing an armoured invasion, as well as in hybrid warfare, when proxy armoured forces operate to hold ground.

The demo was attended by several European delegations, members of the SPIKE User Club, and was preceded by brief instruction of the EDF team on the operation of the weapon.

Packed in a 98 cm long canister, SPIKE SR is highly portable, allowing infantry to easily and rapidly deploy with the weapon in any ground infantry maneuver.

In September 2019, the Estonian MoD had signed a 40 million Euro Framework agreement with Eurospike for the supply of SPIKE LR ATGM›s, launchers and associated maintenance and training. The contract included ICLU (Integrated Control Launch Units) launchers and live SPIKE rounds.

Estonia is one of 35 user nations of the SPIKE missile, and one of 19 users in the EU and NATO. More than 33,000 SPIKE missiles have been supplied to-date around the world, with over 5,500 SPIKE missiles fired both in training and in combat.

LM delivers 123 F-35s in 2020

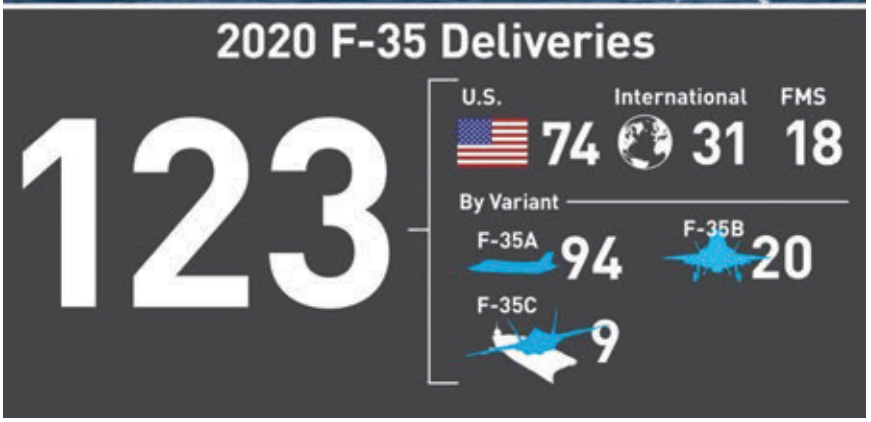
Lockheed Martin delivered the 123rd F-35 aircraft of the year in the last week of December 2020. The 123rd aircraft is an F-35A conventional takeoff and landing (CTOL) variant, built at the Cameri, Italy, Final Assembly and Checkout (FACO) facility and delivered to the Italian Air Force. In 2020, 74 F-35s were delivered to the United States military, 31 to international partner nations and 18 to Foreign Military Sales customers.

In response to COVID-19 related supplier delays, in May the initial annual delivery goal was revised from 141 to 117-123 aircraft to strategically avoid surging, which would increase production-related costs and create future delays and disruption. Though COVID-19 will have short-term impacts on production, the F-35 programme continues to work diligently and is on track to meet the joint government and industry recovery commitments over the coming years.

With more than 600 aircraft operating from 26 bases and ships around the globe, the F-35 plays a critical role in today's global security environment. More than 1,200 pilots and 10,000 maintainers have been trained, and the F-35 fleet has surpassed more than 350,000 cumulative flight hours. Nine nations have F-35s operating from a base on their home soil, nine services have declared Initial Operational Capability and six services have employed F-35s in combat operations. The United States Air Force deployed the F-35 for 18 consecutive months from April 2019 until October 2020 in the Central Command Area of Responsibility with hundreds of weapons employments in support of US service members and their allies.

The year also included initial fielding of the Operational Data Integrated Network (ODIN), the follow-on to the Autonomic Logistics Information System (ALIS), with excellent initial results. The system will be fully operational in 2022. Mission capable rates for the aircraft continued to improve in 2020 with rates greater than 70% across the fleet, and even higher for deployed units. The F-35 also proved its value in Joint All-Domain Operations with multiple exercises that highlighted the aircraft's ability to gather, interpret and share information with various platforms.

Courtesy: LM



IOC declared for Australia's RAAF F-35A

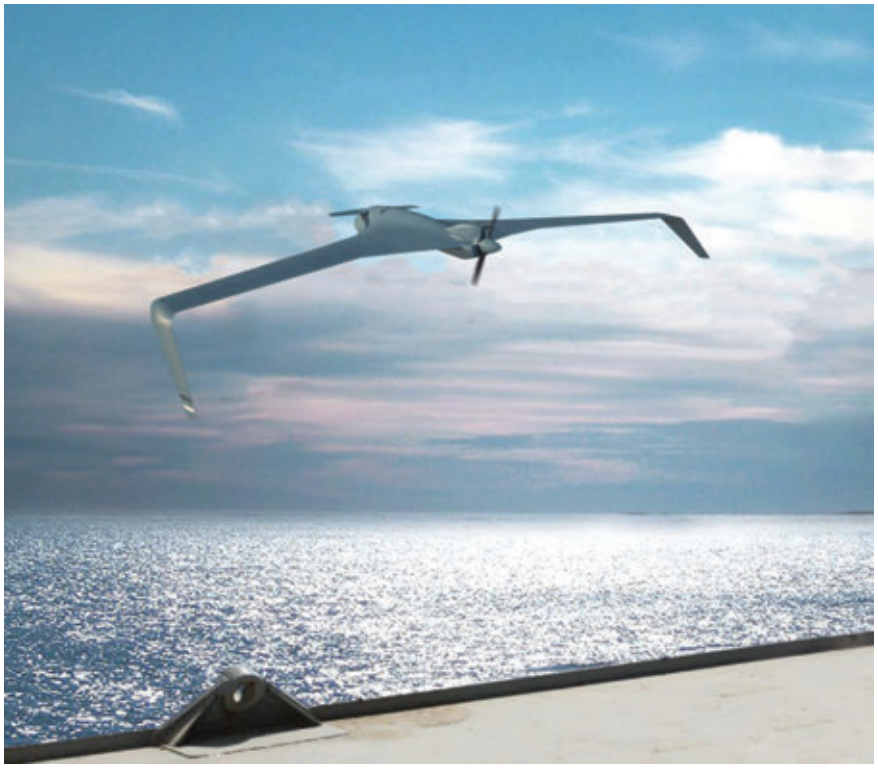
Minister for Defence, Senator Linda Reynolds, CSC, and Minister for Defence Industry, Melissa Price MP have on 30 December 2020, declared Initial Operational Capability (IOC) for Australia's F-35As, making Australia the seventh country to declare IOC for its F-35 fleet.

"The F-35 programme is a catalyst for evolving Australia's robust and resilient defence industry capability. With every F-35 manufactured containing Australian-made parts, more than 50 Australian companies have benefited from $2.7 billion Australian dollars ($2 billion) in contracts for the development, production and sustainment of the aircraft."

Australia currently has a fleet of 33 F-35As, and RAAF crews have surpassed more than 8,780 flight hours to date, with more than 45 pilots and 600 maintainers supporting the fleet.

Aeronautics highlights the Orbiter 4

"The most advanced small tactical UAS for ISTAR and maritime missions, with long endurance of up to 24 hours"



Aeronautics Ltd., a leading provider of integrated turnkey solutions, which are based on unmanned systems, payloads and communications for defence, HLS and civil applications.

for defence and HLS applications, is highlighting its Orbiter 4, the 'most advanced Small Tactical UAS available today' for ISTAR and maritime missions.

This lightweight UAV is capable of carrying multiple payloads, enabling ISTAR multitasking. Easy to operate, with a low logistical footprint and small crew of up to three personnel, Orbiter 4 suits all operational needs. Based on an open-architecture, fully-redundant platform, this highly-transportable vehicle-mounted system offers silent flight, making it ideal for covert operations.

The main applications of Orbiter 4 include land and maritime ISTAR, artillery fire management and BDA, target acquisition for precision-guided weapons, communications intelligence (COMINT), electronic intelligence (ELINT), electronic warfare (EW), communications relay, border patrol and reconnaissance, ISR envelope for strategic facilities security, search and rescue, and emergency response.

"Orbiter 4 is the most reliable and advanced platform on the market today," says Matan Perry, Vice President for Marketing & Sales at Aeronautics. "It delivers higher capabilities than other tactical platforms in operation today, with greater endurance, serviceability, operational flexibility and cost-effectiveness. Being part of Rafael Advanced Defense Systems, Aeronautics utilises the technological synergy between the two companies, Rafael brings its advanced air, land and naval defence capabilities and Aeronautics its proven ISTAR technologies for further strengthening Aeronautics status as a leading UAS solutions provider", Matan adds.

As a leading-edge provider in the field of unmanned aerial systems, Aeronautics identifies its customers' operational needs and responds with innovative technological solutions. The Group's broad product portfolio offers combat-proven solutions for Intelligence, Surveillance and Reconnaissance (ISR) missions, with demonstrated excellent performance and operability. Backed by continuous research and development, these systems are built on three decades of technological and operational experience.

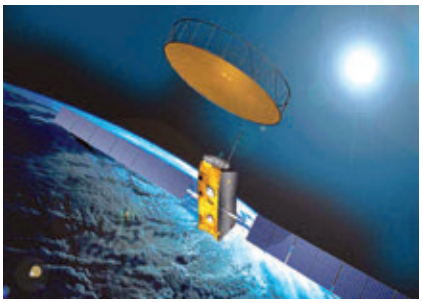
Prysmian Group: "A Leader in aerospace cable market"

Prysmian Group is the worldwide leader in energy and telecommunication cables, a position achieved through organic growth, innovation, targeted acquisitions, sustainability and integrity. In 2018, the Prysmian Group acquired General Cables, further reinforcing its leadership. With a turnover of €11 billion and a workforce of 30,000 personnel, Prysmian tackles most markets and business units. The Indian market is clearly identified as core strategy of the group, leveraging innovation on cables solutions, nurtured by the teams' diversity, even while respecting strong values that are recognised throughout the country.

The Prysmian Group has been leader in the aerospace cable industry since the 1960s when Fileca France provided first generations cables to the Concorde programme. Today, Prysmian continues to build on that prestigious heritage leveraging knowledge and expertise to provide for civil, military and space applications. Prysmian develops and manufactures cables following EN, US standard and abides with OEM's stringent programmes such as Airbus (ABSxxx) and Boeing (BMSxxx).

Its key current programmes and deliveries include those for the Airbus A300/A350, Dassault Mirage 2000 and Rafale, Sukhoi MC21, Ariane programmes 5 and 6, Comac C919 and ARJ21, Lockheed Martin F-35 as also and military applications for Boeing aircraft types.

Benoit Lecuyer, CEO Prysmian India: "Prysmian leverages its aerospace cables presence in India, backed by key accounts recognition, fueled by innovation, diversity and values"



Prysmian partner of satellite programmes

The Company's all–cable solutions follow the FAR 25 Compliance for flammability, smoke density and toxicity data, also bringing utmost importance to ArcTracking resistance that evaluates the cables resistance.

It has production facilities in France and Mexico coupled with an optimised integrated supply chain which allows the company to provide on time delivery and service excellence.

Thanks to its long-lasting expertise and reactivity recognised by the aerospace key accounts, Prysmian BU Aerospace is involved in most strategic client's processes. Major recent achievements are the Comac qualification to supply the ARJ21 and C919, Ariane 6, sole selection by Latecoere, a major OEM for optical fibres.

Prysmian, partner of Ariane programme

Prysmian cables for aerospace

Recent innovations and developments include high voltage cables for the futuristic aerospace electric hybrid run, optical fibres such as Lifi, Arian 6 projects, EWISS (aircraft electrical wiring interconnect system) for the COMAC projects, which are also great recognition by clients on Prysmian adaptability.

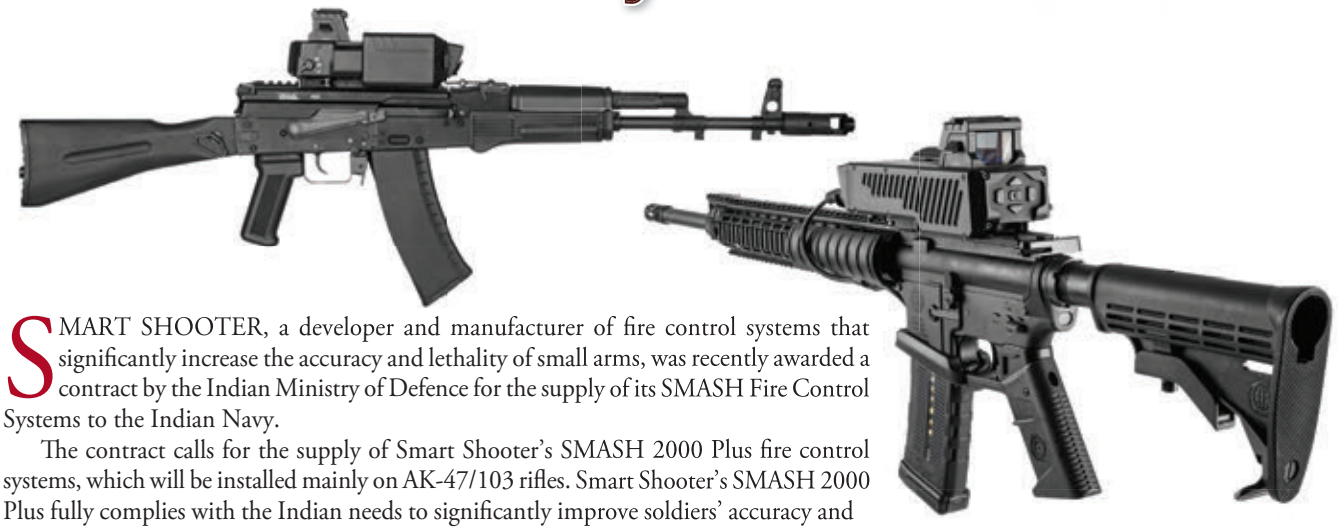
Prysmian India is currently selling HVAC, HVDC, cables for submarine, rolling stock, railways, cranes, mining, nuclear, wind, solar, marine, defence, aerospace, O&G, fire survival, accessories, partial discharge measurements, e-mobility etc.

In India, the company is finalising acquisition of one of its JVs Ravin Cables. From March 2021 onwards, its investment plans will strengthen the 'Make in India' initiative and will deliver more cables from India, including LV, MV, FR FS cables, localise some Prysmian R&D and innovation, in addition to Prysmian cables coming from their factories in the EU, Turkey, US and Asia.

"Prysmian innovates constantly, along with its partners"

SMART SHOOTER SMASH

Fire Control Systems for India



SMART SHOOTER, a developer and manufacturer of fire control systems that significantly increase the accuracy and lethality of small arms, was recently awarded a contract by the Indian Ministry of Defence for the supply of its SMASH Fire Control Systems to the Indian Navy.

The contract calls for the supply of Smart Shooter's SMASH 2000 Plus fire control systems, which will be installed mainly on AK-47/103 rifles. Smart Shooter's SMASH 2000 Plus fully complies with the Indian needs to significantly improve soldiers' accuracy and speed of hitting targets and shooting down threats, hence dramatically increasing each soldier's confidence in any combat scenario and maximizing operational effectiveness.

SMASH is a combat-proven Fire Control solution which ensures that each round finds its target. With a unique "One Shot – One Hit" capability, SMASH allows the operator to quickly and effectively neutralise any ground or airborne target, manned or unmanned. SMASH 2000 Plus includes the SMASH fire control solution's full feature set, with an additional advanced Counter-UAS mode which provides accurate Hard Kill capability against drones or any static or moving ground targets. Designed to give soldiers a decisive tactical edge in almost every operational scenario, SMASH 2000 Plus is ideal for border security, bases and strategic facilities protection. Smart Shooter's state-of-the-art technology allows each soldier to be smarter, effective, and professional and ultimately revolutionizes the world of small arms.

Michal Mor, SMART SHOOTER CEO, stated "SMASH 2000 Plus provides an inimitable hard-kill solution against the growing threats of drones, and delivers proven ability to hit any ground or airborne targets and eliminate the threat quickly and effectively. We are honored that the Indian Navy has chosen Smart Shooter's technology, and see this as a sign of proof for the unique value SMASH offers. We will be happy to keep offering the Indian military diverse cutting-edge solutions for protection against ground and aerial threats at land, air, and sea."

SMART SHOOTER's headquarters are at Yagur, Israel, and its American subsidiary, Smart shooter Inc., is located in Maryland. Smart Shooter also has an office in Düsseldorf, Germany.

Airbus Helicopters H145M: 'The Flying Command Post'

The Airbus H145M is a true multi-role helicopter as, in addition to tactical air transport of six fully equipped special-forces commandos, this light twin-engine helicopter can be deployed for fire support, armed reconnaissance, evacuation of wounded or for hostage rescue. But attention is shifting to ever greater extent to its use as a flying command post. In cooperation with industrial partners, Airbus Helicopters is working to further expand the command, control, communications, computer, collaboration and intelligence (C5I) capabilities of the H145M. Helicopters are able to manoeuvre in low-level airspace in a way that fixed-wing aircraft and UAVs simply cannot – all the while collecting and collating data for distribution to ground-based units on the battlefield.

To exploit these capabilities to the maximum, Airbus Helicopters is working to equip the H145M with jam-resistant Link 16 Variable Message Format (VMF) technology and a Battle Management System (BMS) for enhanced networking. BMS integration has already been successfully demonstrated on numerous occasions. With this connection, the long range and high speed of helicopters compared with ground-based systems represents a particular challenge. A demonstration of digitally aided close air support (DACAS) and digitally aided MEDEVAC with VMF and Link 16 is in preparation.

Courtesy: Airbus Helicopters

Strong presence of Airbus at Aero India 2021

Airbus is showcasing a wide selection of its advanced sustainable aerospace technologies and services Aero India 2021. "Airbus' participation at Aero India is a reaffirmation of our commitment to the rapid modernisation and indigenisation of the Indian aerospace and defence sector," states Rémi Maillard, President and Managing Director, Airbus India & South Asia. "The exhibition is a foremost platform to highlight innovations and technological advancements achieved in this sector, and we are proud to be able to showcase our best products and services to the show."

The display includes Airbus› innovative products along with its customer services and training capabilities. A section is dedicated to highlight the company›s strategic local industrial partnerships focused on developing a sustainable aerospace ecosystem in the country. On display are scale models of the C295 medium transport aircraft digital display of the A330 Multi-Role Tanker Transport (MRTT) aircraft.

As for helicopters, there are scale models of the H225M multi-role helicopter and the AS565MBe Panther, the all-weather, multi-role force multiplier. A special attraction is the S850 radar on a digital platform, a high-power satellite offering extensive SAR capabilities, including the monitoring of a high number of targets with frequent revisits and enhanced performance in a single pass.

Elbit Systems showcase array of capabilities and solutions


Elbit Systems BrightNite

Elbit Systems display at Aero India 2021 includes a range of solutions which are presented at the Company's stand and a variety of capabilities showcased at its Indian partner's stands, among them being munitions, Electronic Warfare (EW), Signal Intelligent (SIGINT), airborne self-protection systems, solutions for rotary and fixed wing aircraft, training and simulation systems as well as communication solutions.

Airborne munitions: The supersonic *Rampage* air-to-ground guided missile, the *Delilah* long-range air-to-ground loitering missile, the GATR laser guided rocket solutions for air-to-ground or ground-to-ground applications, the SLR 70mm 7 tubes helicopter rocket launcher, the LIZARD family of Laser/GPS Guidance Kits general purpose bombs, the MPR 500 multi-purpose rigid penetration and surface attack bomb and Fuses for aerial munitions compatible with modern precision guided bombs such as JDAM, Paveway, LIZARD and hard penetrator warheads.

Airborne self-protection capabilities: The Mini-MUSIC DIRCM system, IR spectral decoy flares, a mini-countermeasure dispenser system and mini-IR decoy flare, the All-in-SMALL EW suite, the UREP Unified Self-Protection Suite for fighter aircraft.


Hermes 900 in service with the Israeli Air Force

Rotary & Fixed Wing Solutions: Brightnite non-gimbaled enhanced vision system for helicopters, Large Area Panoramic HD Airborne Display, Head Mounted Display and Display and Sight Helmet (DASH).

Training & Simulation Mission Management System: Skybreaker networked multi-cockpit aircraft training centre, Special Mission Aircraft Suite.

Communication Solutions, Data-Links and Search and Rescue solutions: E-LynX Mobile Tactical Software Defined Radios, StarLite Data-Links, Elad-10 wideband data-link system, Personal Recovery Device (PRD), PRC-648 Personal Locator Beacon (PLB) series, ELT 648 variant of the PRC-648 PLB, PRC 434/CS Advanced dual mode long-endurance Personal Rescue Beacon (PRC), Mission Airborne Radio & Computer Software Defined Radio (MARC/SDR).

Elbit Systems, Hall C, Stand C.

Elbit Systems are also at the following stands

HAL at Hall E, Stand E 3.3:
- AES-212
- Head-Up-Display

Alpha Design Technologies (ADTL) Hall C
- Mi-17 smart glass cockpit demonstrator
- Skylark I-LEX
- Sky-Striker loitering munition in Canister
- Full drones portfolio
- AFV solutions
- Rattler GX
- Rattler H
- HattoriX PLDR
- Mini coral
- XACT th 70
- E-LynX Family

Bharat Electronics (BEL) Hall E.3
- Indigenous HMDS/HPS
- CoMPASS payload
- Spectro
- Mini-Music
- J-Music
- All-in-Small

PAF receives more JF-17 twin-seaters

Another batch of JF-17B twin-seat operational conversion trainers/lead in fighter trainers (LIFT) produced by the Pakistan Aeronautical Complex (PAC), were handed over to the PAF in the last week of December 2020 at a ceremony attended by PAF CAS Air Marshal Mujahid Anwar Khan and Chinese Ambassador Nong Rong and other invitees including the Nigerian Ambassador. Maiden flight of the JF-17B had taken place on 28 April 2017 at Chengdu while the first eight were delivered from PAC Kamra in December 2019. A total of 26 JF-17Bs are on order for the PAF.

JF-17 Block III for the PAF

The Pakistan Air Force has also formally announced production start of the JF-17 Thunder Block III which follows the completion of 50 JF-17A Block Is and 62 JF-17A Block IIs for the PAF, which now equip six fully operational squadrons. According to reports, the JF-17 Block III, prototype of which first flew in December 2019 at Chengdu will incorporate several advanced features including helmet-mounted display and sight (HMD/S) system, a new single panel multi-functional display (MFD), an active electronically-scanned array AESA radar, paired with an infrared search and track (IRST) systems, a cockpit with a flight-control stick on the side, more use of composites, new targeting and EW systems. It will also have an array of new weapons including PL-15 BVR missiles which would "surpass the F-16 Block 52/AMRAAM combination currently in service with the PAF".

First Su-57 FGFA into service

The Russian Aerospace Force has received its first production Su-57 fifth generation fighter aircraft (as it was known while India was seeking partnership in its development), to equip a Regiment in the Southern Military District. Earlier in December 2020, the Russian defence industry had announced that the first series production Su-57 would be delivered by end of 2020, with "a first stage engine". The aircraft with "a second-stage engine" would be available by 2022. Four more Su-57s would be delivered by the end of next year. Defense Minister Sergei Shoigu has informed the Ministerial Board that a total of 22 Su-57s would be delivered by 2024, with a total of 76 Su-57s ordered so far.

First Brazilian Gripen E

Designated as the F-39E Gripen by the Brazilian Air Force (FAB), the first of this new generation multirole combat aircraft in the Southern Hemisphere was officially displayed on 23 October 2020 which marked 'Aviators Day' and anniversary of the Brazilian Air Force.

The ceremony was attended by Brazilian President Jair Bolsonaro, Brazilian Defence Minister Fernando Azevedo e Silva; the Swedish Ambassador to Brazil, Johanna Brosmar-Skoogh; the Brazilian Air Force Commander, Air Lieutenant Brigadier Antonio Carlos Moretti Bermudez; Commander of the Swedish Air Force,Major General Carl-Johan Edström; Chairman of the Board of Directors of Saab, Marcus Wallenberg; and President and CEO of Saab, Micael Johansson, amongst others.

US planning Sixth-Gen Fighter

The United States continues its lead in the race for developing the most advanced fighters extant including the F-35 Lightning II and F-22 Raptor which are in frontline service along with the earlier generation F-16s and F-15s. Even as the US Air Force is working on its 'highly-secret' sixth-generation fighter under the *Next-Generation Air Dominance* (NGAD) programme, the US Navy has begun studies on a similar next-generation fighter that had the ability to operate from aircraft carriers. It is reportedly looking to replace its current fleet of Boeing F/A-18 Hornets to build a superior next-generation warplane that will complement the current serving Lockheed Martin F-35s. The process has begun analysing airframes, targeting systems, artificial-intelligence-enabled sensors, new weapons, plus engine technologies and it is believed that the Navy's next-generation fighter could be similar to the US Air Force's NGAD aircraft.

The fighters could be equipped with laser weapons, enhanced stealth technology and work hand-in-hand with subsonic drones which would enable the pilot to send his 'loyal wingman' to potentially dangerous areas. However, the US Navy reportedly prefers a 6th generation manned fighter jet as opposed to an advanced unmanned aerial vehicle, with 50 percent greater range for the new fighter as compared to the present fighters. The longer-range will enable it to fight farther from the aircraft carrier, which will, in turn, keep the warship out of enemy range who could launch anti-ship ballistic missiles.

The new aircraft would be would be twin-engined, a multi-role stealth fighter. Incorporating the latest radar-signature-reducing technology, the fighter should be able to evade most enemy radars. The Navy's need is a large aircraft that can accommodate a larger fuel tank as well as a larger internal weapons bay.

Iran's Qaher-313 ('Intense Anger')

Development of Iran's Qaher-313 'fifth generation' fighter which was initially greeted with much scepticism has been dismissed as a crude mock-up and a stunt to impress the country's citizens. Military aviation experts after taking a cursory look at recent images and videos released by Iran showing the fighter jet, said it was simply impossible for this 'prototype' to even fly. The single-engined aircraft was far too small to perform and had too many engineering flaws to even qualify as a fourth-generation jet. The Qaher (which translates as 'intense anger') has distinctive edges and angles of the US F-22 and the twin tail shape much similar to that of the F-35 Lightning II. The Q-313 has large, fixed canards, with the external section of the little wings canted downward. However, the nose section is very small and no known radar could fit in this.

The Islamic Republic of Iran Air Force is currently equipped with 20 MiG-29s, 23 Sukhoi Su-24s, 17 Chengdu F-7s, 50 F-4 Phantom IIs, 20 Northrop F-5s, 20 Grumman F-14 Tomcats and 9 (ex Iraqi) Mirage F1s, which are now heavily modified and indigenised after decades of US arms restrictions.

F-16 Depot Sustainment Programme

The US Air Force has awarded Lockheed Martin a $900 million contract to provide "sustainment support and depot-overflow" services for F-16 aircraft. The contract value is estimated over a total of 10 years and includes depot-level maintenance activities, predefined programmatic work, aircraft modification and unplanned drop-in maintenance.

BAE Systems missile seekers for LRASM

BAE Systems received a $60 million contract from Lockheed Martin to manufacture and deliver additional advanced missile seekers for the Long Range Anti-Ship Missile (LRASM). The seeker comprises long-range sensors and targeting technology that guide the stealthy missile to find and engage protected maritime targets in challenging electromagnetic environments.

Bundeswehr orders 31 NH90 helicopters

The German *Bundeswehr* has ordered 31 NH90 NFH helicopters, christened as the *Sea Tiger*, for the German Navy's shipborne operations. This was formalised on 26 November 2020, the new helicopters to replace the German Navy's present Sea Lynx Mk88A fleet which entered into service in 1981. The *Bundeswehr* has already ordered 18 NH90 *Sea Lion* naval transport helicopters, seven of which have already been delivered.

Embraer E-99 AEW&C aircraft for Brazilian Air Force

On 27 November 2020, during a ceremony held at the Embraer facility in Gavião Peixoto (São Paulo, Brazil), Embraer delivered the first modernised EMB 145 AEW&C (Airborne Early Warning and Control), designated as E-99, to the Brazilian Air Force (FAB). Four additional E-99 aircraft will be modernised as part of the contract.

Fourth Embraer C-390 Millennium

Embraer has delivered the fourth C-390 Millennium multi-mission medium airlifter of a total of 28 on order by the Brazilian Air Force (FAB). Like the three units already in operation, the fourth airlifter will be operated by the First Troop Transport Group (1st GTT). All 28 aircraft ordered by FAB are equipped to perform aerial refueling missions, carrying the designation KC-390 Millennium.

First A400M for Belgian Air Force

The Belgian Air Force has taken delivery of its first of seven Airbus A400M military transport aircraft. The aircraft was handed over at the A400M Final Assembly Line in Seville (Spain) and subsequently ferried to the 15th Wing Air Transport in Melsbroek (Belgium), where the aircraft will be based. This A400M will be operated within a bi-national unit composed of a total of eight aircraft, seven from the Belgian Air Force and one from the Luxembourg Armed Forces. The second A400M for Belgium will be delivered in early 2021.

M-345s for the Italian Air Force

Leonardo has delivered the first two M-345 jet trainers to the Italian Air Force, which has a total requirement for up to 45 aircraft. The new type, designated T-345A by the Italian Air Force, will gradually replace the 137 MB-339s which have been in service since 1982.

Afghan MD 530F Cayuse Warriors

MD Helicopters have an agreement with the US Army worth some $34 million to provide logistics support for the Afghanistan Air Force MD 530F Cayuse Warrior light attack and reconnaissance helicopter fleet. The deal is a continuation of MDHI's contractor logistics support (CLS) with the US Army and Multi-National Aviation Special Project Office (MASPO) for the fleet.

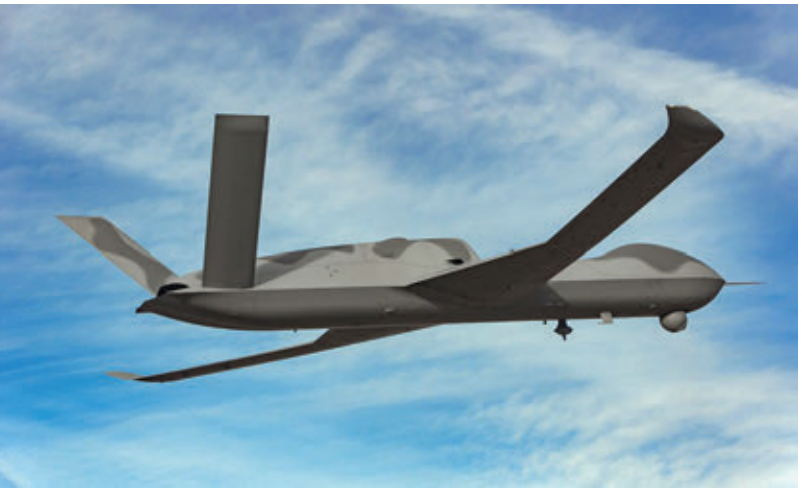
Dassault Aviation rolls out Falcon 6X

Dassault Aviation have revealed their newest and most advanced aircraft, the Falcon 6X. In Bordeaux-Merignac (France) with a 5,500 nm (10,186 km) range and top speed of Mach .90, the Falcon 6X can connect passengers non-stop to major business centres far and wide, as an example from London to Hong Kong or from Los Angeles to Moscow. The Falcon 6X can also perform safe approaches as low as only 109 knots, slower than other business jets, which allows the 6X, like other Falcons, to safely access smaller airports equipped with ultra-short and hard-to-reach runways.

Kratos receives Skyborg contract

Kratos Defense & Security Solutions have received an award from the AFLCMC/WA Advanced Aircraft Programme Executive Office for the Skyborg Delivery Order (DO) 2 contract to integrate, test and deliver XQ-58A Valkyrie aircraft. The contract includes three phases of design, integration, and flight testing of the Kratos XQ-58A Valkyrie system, integrating multiple customer-defined mission payloads and customer-defined autonomy in coordination/cooperation with the Skyborg System Design Agent company, Leidos.

GA-ASI conducts CODE flight



General Atomics Aeronautical Systems, Inc. (GA-ASI) have conducted an autonomous flight using a government-supplied Collaborative Operations in Denied Environment (CODE) autonomy engine to support air-to-air targeting missions. The CODE autonomy engine was installed on a GA-ASI Avenger Unmanned Aircraft System (UAS).

MQ-9B SkyGuardian wing structure testing

General Atomics have recently completed Full Scale Static (FSS) testing on the MQ-9B Remotely Piloted Aircraft (RPA) wing after three months of extensive testing. MQ-9B includes the SkyGuardian and SeaGuardian RPA produced by GA-ASI. The testing included multiple load cases to 150 percent of expected maximum flight loads. The wing was loaded using specially designed fixtures to apply a distributed load across the wingspan – simulating gust and manoeuvre flight conditions – with no failures.

Schiebel Camcopter S-100 for the French Navy

Naval Group, on behalf of the French Navy, has accepted for operational service two further Camcopter S-100 Unmanned Aerial Systems (UAS) from a total of four Unmanned Air Vehicles (UAVs). They will be deployed on the *Mistral*-class amphibious helicopter carriers (*Porte-Hélicoptères Amphibie* – PHA) *Tonnerre* and *Mistral*. The acquisition comes after the successful integration of the Camcopter S-100 on French Navy *Mistral*-class vessel *Dixmude*, which was finalised in 2019. This was the first time in Europe that a rotary wing UAS is integrated with the combat system of an amphibious helicopter carrier.

Boeing's autonomous MQ-25 in first test flight with ARS

Boeing and the US Navy have for the first time flown the MQ-25 T1 test asset with an aerial refueling store (ARS), a significant milestone on development of the unmanned aerial refueler. The 2.5-hour flight with the Cobham ARS – the same ARS currently used by F/A-18s for air-to-air refueling – was designed to test the aircraft's aerodynamics with the ARS mounted under wing. Earlier the Navy exercised an option for three additional MQ-25 air vehicles, bringing the total aircraft being produced to seven. The US Navy intends to procure more than 70 aircraft, which will assume the tanking role currently performed by F/A-18s.

Boeing *Loyal Wingman* in high-speed taxi trials

Boeing Australia and the Royal Australian Air Force have carried out high-speed taxi trials of the *Loyal Wingman* in preparation for its first flight. Boeing test personnel monitored the aircraft's performance and instrumentation from a ground control station to verify functionality while the vehicle reached accelerated speeds. The unmanned aircraft has been undergoing low, medium, and high-speed taxi testing at a remote test location in Australia.

Textron to build 36 new Shadows

Textron Systems Corporation have been contacted for sale of 36 Shadow aircraft in the latest Block III configuration for the US Army. The total contract award value of $66 million includes ongoing engineering services to continue fielding and supporting the new Block III system configuration.

Oshkosh JLTVs for the US Army

Oshkosh Defense have received an order from the US Army Contracting Command, Detroit Arsenal for 2,738 Joint Light Tactical Vehicles (JLTV), 1,001 companion trailers and associated kits. The Oshkosh Defense JLTVs will be supplied to the US Army, US Navy, US Marine Corps, and US Air Force along with a select group of NATO and non-NATO allies.

NASAMS for Hungary

Hungary has become the 6th NATO nation and the 12th country in the world to acquire NASAMS, a highly adaptable medium-range solution for a variety of operational air defence requirements. "Selecting NASAMS and becoming part of the greater NASAMS family allows Hungary to take advantage of the active production line - ensuring rapid delivery and competitive pricing for Hungary's armed forces".

ROK order MK 15 MOD 25 Phalanx

The Republic of Korea has requested procurement of two MK 15 MOD 25 Phalanx Close-In Weapons System (CIWS) Block 1B Baseline 2 (IB2) systems plus four thousand rounds, 20 mm cartridge API linked.

American Airlines resume Boeing 737 MAX flights

American Airlines has restarted passenger services with their Boeing 737 Max 8 airliners, the first flight being from Miami International Airport to New York's LaGuardia Airport.

The American flight follows the Federal Aviation Administration's decision to clear the aircraft for operations.

Ryanair orders 75 more Boeing 737 MAX airliners

Ryanair, Europe's largest airline, have placed a firm order for 75 additional 737 MAX airliners, increasing its order book to 210 jets. Ryanair have again selected the 737 8-200, a higher-capacity version of the 737-8, citing "the airplane's additional seats and improved fuel efficiency and environmental performance".

New China National Defence Law

With effect from 1 January 2021 China has revised its National Defence Law expanding the power of its armed forces headed by President Xi Jinping "to mobilise military and civilian resources

to defend its national interests both at home and abroad". This strengthens even more the President's formulation of military policy, handling decision-making powers to the Central Military Commission (CMC) and overall high-command of the two million strong People's Liberation Army (PLA). A few days later, Xi Jinping asked the military to "strengthen training to hone its combat skills and remain on high alert".

China warns against playing 'Tibet Card'

In an immediate reaction to the US's 'Tibetan Policy and Support Act of 2020', signed by Donald Trump in end-December 2020, the Chinese Embassy at New Delhi reacted with an unusually blunt statement that this was "advocating Indian interference in China's Tibet (Xizang) affairs". The US Act includes sanctioning of Chinese officials if they try to appoint the next Dalai Lama.

New Head of China's Western Theatre Command

General Zhang-Xudong has been appointed as Commander of the Western Theatre Command (WTC) according to state-run Xinhua news agency. Also promoted are three other senior military and armed police officers, including Guo Puxian, political commissar of the logistic support department of the CMC, Li Wei political commissar of the PLA strategic support force and Wang Chunning.

US Congress condemns China's LAC aggression

The National Defence Authorisation Act (NDAA) 2021, which became law on 1 January 2021 after Congress over-rode Trump's veto, included a resolution urging China to end its military

aggression towards India along the Line of Actual Control (LAC) in Ladakh. Expressing "significant concern" over the continued military aggression by China along the border with India, urging that China "should work with India toward de-escalating the situation along the LAC through existing diplomatic mechanisms and refrain from attempting to settle disputes through coercion of force". Attempts by China to advance baseless territorial claims, including those in the South China Sea, are inconsistent with international law, according to the Act.

China's C919 airliner "a costly pipe dream"

According to the Centre for Strategic and International Studies, a Washington-based think tank, the odds that the Chinese C919 airliner can be a success "are between slim and none". The report continued in that "Comac has received massive state funding and global attention, but it is not in the same league as the world's top commercial aircraft manufacturers – Boeing, Airbus, Embraer and Bombardier … Comac is not even as capable as its Russian counterparts, including Ilyushin, Sukhoi, and Tupolev, which have more advanced technology but have still struggled commercially".

Closer to Reality

Sino-Pak air exercise Shaheen IX

The Air Forces of Pakistan and China commenced their 3-week joint exercise *Shaheen IX* on 7 December 2020, this time around at the new PAF base at Bholari, 120 kilometers from Karachi in Sindh province. As reported by *Global Times*, a daily tabloid newspaper published under auspices of the Chinese Communist Party, "the recently concluded China-Pakistan air exercises benefited both sides, as Chinese pilots could learn manoeuveres and experiences from their Pakistani counterparts' while China's J-10C and J-11B fighters could be used to simulate India's Rafale and Su-30 fighters in mock air battles".

According to some observers, "many aspects of the J-10C mid-sized fighter jet, including its size, aerodynamic characteristics, aviation and weapon systems and overall combat capability, are comparable to the France-made Rafale, in service with the Indian Air Force. Defence analyst Fu Qianshao further noted that the J-11B heavy fighter has very similar appearance with India's Su-30 fighter – "but with superior avionics system". Closer to reality!

The exercise formally began in presence of PAF Deputy Chief of the Air Staff Air Vice Marshal Waqas Ahmed Sulehri alongside PLAAF Major General Sun Hong, the latter stating that "the joint exercise will improve the actual level of combat training and strengthen practical cooperation between the two air forces". Air Vice Marshal Sulehri said "the joint exercise will provide an opportunity to further enhance interoperability of both the air forces, thereby fortifying brotherly relations between the two countries."

PLAAF J-10C

The inaugural

PLAAF J-11Bs and J-10Cs on the Bholari flight line

Shaheen IX is the ninth in the series of Joint Air Exercises which have been conducted each year in both countries at alternate locations. The very first (*Shaheen I*) was held in March 2011 when for the very first time in history, PLAAF fighters operated from PAF bases. The *Shaheen* exercises thereafter continued annually, with *Shaheen VIII* conducted in August–September 2019 from the Chinese Air Base at Hotan, close to the Indian border in Ladakh (see article *'Falcons over the Karakorams'* in *Vayu* Issue IV/2020).

This time PLAAF sent a mix of warplanes including the Chengdu J-10C, Shenyang J-11B, Xi'an Y-20 heavy lift transport aircraft, Shaanxi KJ-500 AEW&C aircraft and Shaanxi Y-8 EW aircraft while the PAF deployed JF-17 Thunders and Dassault Mirage III/5s as also various force multipliers. Pointedly, the PAF did not operate F-16s from Bholari, ever mindful of US concerns but of course it was difficult for observers to monitor if this US-origin fighter actually took part, launched from other PAF bases.

It was reported that both Air Forces focused on large force engagements, carrying out BVR air combat, close air combat and ground attack, all in a dense EW environment. According to the Chinese spokesman, "more than 200 sorties were flown by both sides".

Later, the Chinese defence analyst Fu Qianshao said that "Unlike previous *Shaheen* series exercises, this time we comprehensively deployed aviation forces and paratroopers", while Ding Yuanfang, a Chinese Air Force deputy brigade commander stated that "real combat-oriented training courses like maritime training were included for the first time", which was "a great chance for the Chinese Naval Aviation to learn from Pakistan forces and improve its combat capabilities".

PAF Mirage 5 taxiing

PLAAF J-11B taxiing

However, in his analysis, a retired IAF officer felt that "these exercises are showcasing cooperation rather than capability. "We are concerned neighbours, must not look at this exercise as a threat, but use it for intelligence gathering. There is much to glean from what we 'see' happening in such exercises".

J-10C comes into land ...

... celebrating end of the Exercise

Growler, the 'Electronic' Hornet

An EA-18G Growler launches from flight deck of the aircraft carrier USS 'John C. Stennis' (photo: US Navy)

With new generations of large, electronically scanned array radars designed for sophisticated air defences proliferating across major aerospace powers, stealth aircraft designs will be compelled to weave through a narrowing number of gaps in coverage, requiring more reliance on electronic warfare and attack to disable, distract or "fool" the new generation of air defences with less emphasis on stealthy airframe designs.

Based at Naval Air Station (NAS) Whidbey Island, Washington State and capable of operating from either an aircraft carrier or from land-bases, the Boeing EA-18G Growler, itself a heavier derivative of the combat-proven two-seat F/A-18F Super Hornet (with a variant of Northrop Grumman's in-production Improved Capabilities (ICAP) - III Airborne Electronic Attack (AEA) system) is an airborne electronic attack aircraft designed and developed as replacement for the United States Navy (USN) EA-6B Prowler aircraft. One of the external visual differences are the AN/ALQ-218 wideband receiver pods on the EA-18 Growler in place of wingtip air-to-air missiles on the F/A-18F. Vital missions include Electronic Attack (EA) and Suppression of Enemy Air Defences (SEAD), particularly at the opening stages of hostilities. The first EA-18G for fleet use was officially accepted by VAQ-129 'Vikings' at NAS Whidbey Island on 3 June 2008, the aircraft's first test flight successfully completed in August 2006 followed by delivery of the first two test aircraft to the USN in September and November 2006.

The first production aircraft was delivered to the USN in September 2007. The first operational aircraft was delivered to NAS Whidbey Island in June 2008 and operational evaluation began in October 2008 onboard USS *John C. Stennis* (CVN 74). The SDD programme was scheduled to achieve initial operational capability in late 2009 when the first of ten electronic attack squadrons (VAQ) began EA-18G operations. The USN expects to acquire eighty-five EA-18G Growlers to be based at NAS Whidbey Island and equip twelve fleet squadrons plus a training squadron.

The Royal Australian Air Force operates eleven EA-18G platforms, entering service in 2017. The aircraft will carry out a range of missions including stand-off and escort jamming, surveillance and strike. The aircraft is powered by two General Electric F414-GE-400 afterburning turbofan engines, rated at 62kN or 98kN with afterburner alongside a titanium engine firewall incorporated into the aircraft structure.

The Growler is fitted with up to three EDO Corporation AN/ALQ-99 high & low-band tactical radar jamming pods; a maximum of five can be carried during exigencies. AN/ALQ-99 houses the exciters and the high radiated power jamming transmitters (additionally capable of firing sophisticated data streams into enemy emitters) together with AN/ALQ-218(V) 2 wideband receivers and a Raytheon AN/ALQ-227 communications countermeasures

system both of which are mounted in the bay previously designated as the F/A-18F gun bay plus ALE-47 countermeasures dispenser. Pentagon officials avoid defining the "full spectrum" phrase, but it includes the ability to create false targets, speeds, altitudes and locations, invade enemy communications networks to see what enemy sensors see, and perhaps mine intelligence and plant pass false information.

The Next-Generation Jammer is being designed for broader spectrum coverage, and will focus AEA effects better and operate over longer ranges. From the Block 2 standard, Growler is equipped with the Raytheon AN/APG-79 multi-mode radar with passive detection mode and active radar suppression. The AN/APG-79 Active Electronically Scanned Array (AESA) radar provides air-to-air and air-to-ground capability with detection, targeting, tracking and protection modes. The interleaved radar modes include real beam-mapping and Synthetic Aperture Radar (SAR) modes with air-to-air search, air-to-air tracking, sea surface search and Ground Moving Target Indication & Tracking (GMTI&T).

The radar has an advanced four-channel receiver-exciter which provides wide bandwidth capability and the ability to generate a wide range of waveforms for electronic warfare, air-to-air and air-to-ground operation alongside simultaneous ability to operate in multiple air-to-air and air-to-ground modes. For providing threat detection, identification and location the Northrop Grumman Electronic Systems passive countermeasures system AN/ALQ-218(V)2 provides improved electronic surveillance data and Electronic Warfare situational awareness is a variant of the Improved Capabilities (ICAP) III system deployed on the USN EA-6B Prowler aircraft. The system's antennas are located on the port and starboard sides of the nose, the engine bays, in the wingtip pods and to the aft of the cockpit, providing 360° azimuth cover. The data links in turn can push large target and imagery files around tactical and intelligence networks. The EA-18G will also use the Interference Cancellation System (INCANS) to allow voice communication while jamming enemy communications.

The Growler aircraft has eleven weapon stations for carrying electronic mission systems and weapons which can be used to carry out conventional strike missions when the requirements for EA and SEAD sorties

USN Boeing EA-18G Growler (photo: Bill Shemley)

are reduced. The aircraft is armed with AIM-120 Advanced Medium Range Air-to-Air Missiles (AMRAAM) and AGM-88 High-speed Anti-Radiation Missiles (HARM). In a surveillance-only configuration the EA-18G Growler will be armed with two AIM-120s for self-defence while for stand-off jamming and escort jamming missions the EA-18G will be armed with two AGM-88 plus two AIM-120 missiles.

In a strike configuration the EA-18G will carry a heavier load of two each of AGM-88, AGM-154 Joint Stand-Off Weapon (JSOW) and AIM-120. For close combat EA-18G is fitted with a combination of Hands on Throttle & Stick (HOTAS), full digital Fly-By-Wire (FBW) controls and Joint Helmet-Mounted Cueing System (JHMCS) to provide 'first look, first shot' high off-boresight weapons engagement capability, enabling the pilot to accurately direct or cue the weapons against enemy aircraft while performing high-g manoeuvres. While carrying out active transmitting jamming, the Block 2 aircraft has the capability of handing off target data to other airborne, land or surface attack platforms.

On smaller scale, yet from much closer range, the Growler will be capable of performing missions that were once "confined to" the secrecy-shrouded RC-135 Rivet Joint and the EC-130 Compass Call. The RC-135 can monitor enemy communications and other electronic emissions, while the EC-130 can jam and invade sensor and communication networks with sophisticated packages of exploitative algorithms albeit operating outside the range of enemy air defences, which are now pushing out to beyond 250-miles with the next generation of 'triple-digit' Surface-to-Air Missiles (SAM) like the Russian S-400.

The EA-18G's initial mission is to penetrate enemy airspace with high-speed strike aircraft and protect them with electronic jamming and after the AEA capability is refined, the physics of being closer to key targets such as sensors, computers and command-and-control centres will be exploited to compensate for the EA-18G's "limited power and smaller antennas".

Sayan Majumdar

Lockheed Martin's AGM-158 JASSM

Currently deployed on the United States Air Force B-1 Lancer, B-2 Spirit and B-52 Stratofortress bombers and F-15E Strike Eagle, F-16 multi-role fighters, the AGM-158 Joint Air-to-Surface Standoff Missile (JASSM) is a 14 foot long, 2,250 lb autonomous, stealthy, long range standoff missile designed to destroy high value, well defended fixed or relocateable targets, from ranges of over 200 nautical miles. The missile is also in service with the armed forces of Australia, Finland and Poland.

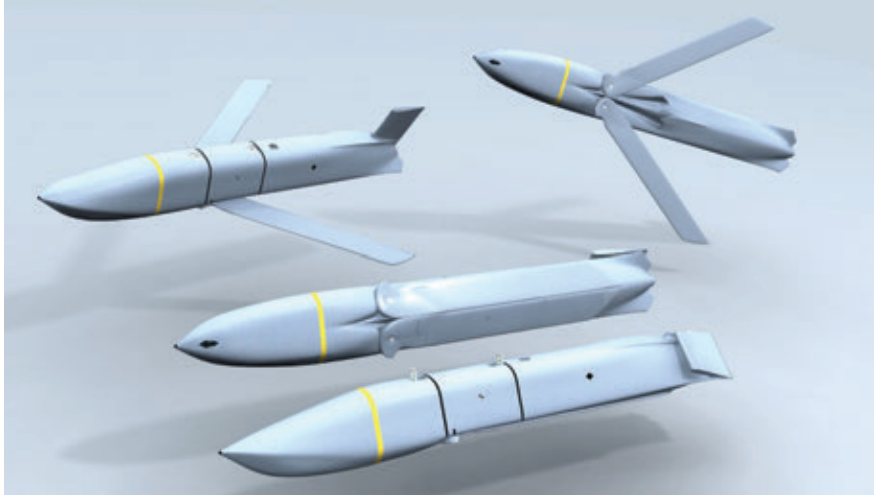
Powered by the Teledyne CAE J402-CA-100 turbojet, the autonomous navigation based on inertial and Global Positioning System (GPS) programmes, the missile follows a pre-planned low-level terrain following route to the target area. Once in predesignated location, the missile uses its Imaging Infra-Red (IIR) seeker of medium wavelength sensor using a 256 x 256 Focal Plane Array (FPA) and on-board, real-time Automatic Target Correlating (ATC) algorithms to precisely locate and strike the desired target aim point. The missile can also engage enemy jammers.

Lockheed Martin's ATC algorithms use an insensitive, redundant approach and real-time processors to provide a robust system that significantly reduces the missile's Circular Error Probability (CEP) impact any time of the day or night. This gives the missile ability to hit a precise spot, such as a specific point in a hardened bunker, cave entry or ventilation shaft, using a target model built months earlier. To make the missile more immune to GPS deception and jamming, JASSM Block 1A missiles are equipped with Selective Availability/Anti-Spoofing Module (SAASM) technology, which itself is an enhanced, digital anti-jam GPS receiver. This capability gives JASSM the ability to successfully complete its mission even in intense jamming environments. JASSM is equipped with a WDU-42/B (J-1000) 1000 lb dual mode blast-fragmentation penetration warhead with 240lb of AFX-757 for maximum effect against hard targets. A unique feature of the current model of JASSM is its capability to send back a sequence of pre-strike images of the target, just before impact, the process providing partial Battle Damage Assessment (BDA) capability.

Further improvements of AGM-158B JASSM-ER will include an improved engine and larger fuel capacity, with an improved two-way datalink which will provide flexible re-targeting of the missile, including tracked, moving maritime targets. The ER version maintains the same outer mould lines of the stealthy airframe, which makes JASSM extremely difficult for air defence systems to engage. It also retains the dual-

mode penetration and blast fragmentation warhead of the baseline JASSM missile. This capability will transform JASSM into a network-enabled system, providing in-flight re-routing, retargeting, or aim-point refinements and blue-force tracking, to eliminate fratricide risks.

The introduction of JASSM-ER will also provide limited loitering capability or further range extension beyond 500 nautical miles. Loitering will enable planners to more flexibly integrate JASSM with other means of attacks, such as decoys and defence suppression weapons etc. Flight testing for JASSM-ER began in May 2006 with tests at White Sands missile testing range in New Mexico and entered USAF service in April 2014 with B-1B squadrons. During one flight test, the missile was released from a B-1B aircraft and flew a pre-planned course to collect data, to fine-tune navigation algorithms, and then destroyed the designated target. The B-1B can carry a full load of 24 JASSM-ERs, the B-2 has 16



JASSM-ERs and the B-52 is able to carry 20 JASSM-ERs, eight internally and 12 on external pylons. The USAF plans a total procurement of 4900 JASSMs, both the 200 nautical miles basic weapon and 500 nautical miles JASSM-ERs.

During May 2015, the head of the Air Force Research Laboratory nominated the JASSM-ER as the optimal air vehicle to carry the Counter-electronics High Power Microwave Advanced Missile Project (CHAMP) payload designed to destroy hostile electronic equipment with bursts of high-power microwave energy, non-kinetically neutralising them. AGM-158C is the long range Anti-Ship Missile (AShM) variant.

Sayan Majumdar

Tomcats in farewell cruise

21 December 2020 marked exactly half a century after the Grumman F-14 Tomcat had made its first flight in the USA. This was the beginning of an impressive career of a twin-engined swing-wing fighter that operated for 34 years in the US Navy. During that period, the Tomcat was the primary US Navy multirole air defence fighter and a main asset with all the Carrier Air Wings (CVW) for aircraft carrier-based air operations. In paying tribute to this 50 years milestone, we go back to September 2005, the start of an USN aircraft carrier cruise for the last time with operational F-14s onboard.

Departure

On 1 September 2005, USS *Theodore Roosevelt* (CVN-71) departed from its homeport Naval Station Norfolk USA, for a scheduled deployment in support of the *Global War on Terrorism*. Its mission was to provide support to US and coalition forces in Iraq as part of *Operation Iraqi Freedom* (OIF) and *Maritime Security Operations* (MSO).

After two weeks of deployment, the *Theodore Roosevelt Carrier Strike Group* (TRCSG), comprising a total of 5 ships and a submarine, entered the Mediterranean Sea to conduct training with local allies and make port calls in Palma de Mallorca, Spain and Napels, Italy. By early October 2005, the *Roosevelt* with embarked Carrier Air Wing 8, arrived at the USN 5th Fleet area to relieve another carrier USS *Nimitz* and conducted missions out of the Persian Gulf and Arabian Sea.

TRCSG and CVW

Total complement of the TRCSG went up to 6970 men and women, of which the majority were on the command aircraft carrier with their 3200 ship's crew and 2480 Carrier Air Wing crew. CVW 8 consisted, besides the Tomcats, 2 squadrons of F/A-18C Hornets and one of Electronic Warfare EA-6B Prowlers. In addition, S-3B Vikings, E-2C

Hawkeyes, SH-60F and HH-60H Seahawks were deployed plus two C-2A Greyhounds for Carrier Onboard Deliveries (COD).

The F-14 Tomcat units

The embarked Tomcats were amongst the last of two USN front line fighter units operating the F-14D, being VF-31 *Tomcatters*, having 11 aircraft onboard and VF-213 *Black Lions* with 12 aircraft.

In late October 2005, while on station in the Persian Gulf. I met with VF-31 Commanding Officer (CO) Rick Labranche and VF-213 CO Dane Cave. CO Labranche, with more than 3000 flight hours of which 2000 were on F-14 B and D models, stated that planned withdrawal of USN F-14 operations was "an inevitable event and made from an efficiency perspective." Extensive hours of maintenance after each flight (crew worked 12-16 hours a day, 7 days a week to make the jets available for next flights), the pressure on the F-14 maintenance crews was enormous and was to be brought back to acceptable levels. Also, the strategic USN plan to reduce the number of different aircraft types in service at that time and an on course delivery scheme of F/A-18E and F Super Hornets, successor of the F-14, pushed forward the decision for early retirement of the F-14s. The *Tomcatters* (with Felix the Cat as their squadron logo) were to transit to the single seat F/A-18E in summer 2006. Consequently, the squadron would become VFA-31 *Fighting 31* achieving their operational status in about 5-6 months on the new type and available for new carrier deployment after another six months.

CO Dan Cave of VF-213 recalled that his unit would begin transit to the twin seat model F/A-18F Super Hornet immediately after finishing that cruise which was planned for March 2006. Dan Cave, with 3500 flight hours on the F-14, was "proud to lead the Tomcat unit in the aircraft's final months of service". His commanding role was rather new as he had assumed CO's responsibilities just 12 days earlier during an airborne change of command ceremony while two F-14Ds made a carrier flyby.

Operational Routine

A daily flight routine in the Persian Gulf normally included two launches, as CO Labranche explained, with the first executed around noon. F-14 missions were flown in

VF-31 Commanding Officer Rick Labranche

pairs of aircraft over Iraq and lasted about 6-7 hours, of which 3 hours were above the allied battle groups on the ground to provide support and protection. During a typical mission, the Tomcats were aerial refuelled several times to continue their mission time over Iraq and then return to USS *Roosevelt*. Just before arrival and recovery of the first aircraft another group of aircraft was launched around dawn for the 2nd wave which would fly similar 6 hours missions during the night.

Immediately upon arrival in the Persian Gulf, CVW 8 had its first sorties launched in support of *Operation Iraqi Freedom* (OIF). Tomcats of VF-31 had bombed targets north-east of Baghdad, a known Iraqi facility where insurgents manufactured improvised explosive devices (IEDs). During November 2005, the aircraft of CVW 8 participated in *Operation Steel Curtain* (OSC), carrying out strikes against terrorist targets in support of coalition troops in Iraq. OSC was an offensive aimed to prevent cells of Al Qaeda from entering Iraq through the Syrian border. The contribution of CVW 8 aircraft to OSC came to some 400 sorties. In early February 2006, USS *Theodore Roosevelt* had the last recovery of an F-14 Tomcat from a combat mission, in which the VF-31 Tomcat was recorded as the last USN drop a bomb in a combat mission.

USS *Roosevelt* then left the 5th Fleet area and after some 6th Fleet supported port visits in the Mediterranean, undertook its trans Atlantic return voyage to the USA. In the 6-month deployment of the *Roosevelt*, VF-31 and VF-213 had together carried out 1163 combat sorties totalling 6876 flight hours and dropped 9500 pounds of ordnance in reconnaissance, surveillance, and close air support missions. The CVW 8 aircraft flew a cumulative of more than 5500 sorties, logging 21000 flight hours during this specific CVN-71 cruise.

A few months later, in September 2006, had the F-14s performing their last flypast over NAS Norfolk marking the F-14's farewell in the US Navy.

Text and photos by Peter ten Berg

Kotroni, centre of the Hellenic Naval rotary force

In the north of Athens, one can easily locate the main helicopter base of the Greek Navy, Kotroni Naval Air Station, situated on a hilltop overlooking the town of Marathon and the nearby Aegean Sea.

In 1986, the Naval Aviation School was inaugurated to train crews for the new AB-212s. The unit, divided into two flights, also operated some Alouette IIIs. By 1996, the first S-70B-6 *Aegean Hawk* helicopters were delivered to Kotroni.

During 2013, the last Alouette IIIs were taken out of service, leaving the AB-212s and S-70Bs in two squadrons, namely 1 MEN *Mira Elikopteron Naftikou* (MEN), or 1st Navy Helicopter Squadron with their AB-212 and 2 MEN flying the Aegean Hawk. Additionally the base hosts a Coast Guard unit.

Vayu Aerospace & Defence Review spoke with the AB-212 pilot and Base Commander Lt. Col. Savvatis, shortly before he moved on a new posting in Brussels, Belgium.

1 MEN

Originally, the Hellenic Navy operated the AB-212 in two types; the former Electronic Warfare (EW) version and the current Anti-Submarine Warfare (ASW) variant.

Lt. Col. Savvatis explained that for sea-based operations, the AB-212 is equipped with variable depth sonar, a surface surveillance radar, an Automated Identify System (AIS) for detection and tracking of enemy surface targets and a Sapphire II Forward Looking Infrared (FLIR) system. Last three roles are mainly for Anti Surface Warfare (ASuW). The AB-212 fleet is further equipped with the OCTOPUS, a self-developed tactical system which combines a GPS moving map with signals from sonar, radar, AIS and FLIR into one overall view. The AB-212 can be armed with Mk.46 mod 3/5 ASW torpedoes and a MG-3 gun.

The AB-212 crew consists of a pilot, co-pilot and a radar operator positioned in the Combat Intelligence Center (CIC) in the cabin. This trio can is accompanied by a gunner or mechanic.

2 MEN

The other squadron, 2 MEN, was formed in 1995 prior to delivery of the S-70B-6s, as Lt. Col. Savvatis explained. Originally, eight helicopters were ordered, but by 2005, another three 'improved' Aegean

(VERTREP) and Special Operations Forces (SOF).

The S-70 crew includes a pilot, a co-pilot, added with a tactical coordinator/ operator and an acoustic sensor operator. Depending on the type of mission, the crew can be rearranged by inclusion of a hoist operator and a rescue swimmer, according to Lt. Col. Savvatis.

Hellenic Coast Guard

In 2005, the Hellenic Coast Guard based 6 Sud-Aerospatiale SA-365 N3 Dauphin helicopters at Kotroni NAS for training and maintenance. Coast Guard operations are flown from various detachment locations throughout the country to control and monitor the immense Greek coastal lines. The Helicopter Coast Guard is, although acting as

Hawks were delivered. The S-70s are fitted, besides the similar equipment and weapons of the AB-212s, with a Helicopter Long Range Active Sonar (HELRAS) and can further conduct passive EW. The three latest acquired S-70Bs (to be recognised on their serial PN-59 to PN-61) are installed with a Raytheon AN/AAS-44 FLIR system for Air-to-Surface attack of targets with Hellfire or Penguin guided missiles. Further upgrades also include LCD cockpit monitors (glass cockpit), which runs a Rockwell Collins Flight Management System (FMS), a BAE ALE-47 Countermeasure Dispensing System and improvements on GPS/INS navigation and Electronic Support Measures.

The main missions for S-70B helicopters of 2 MEN are ASuW and ASW. Secondary missions includes Search & Rescue (SAR), Medical Evacuation (MEDEVAC), Vertical Replenishment

an independent organisation, placed within the operational and administrative command structure of the Command Hellenic Naval Helicopters (COMHELNAVHEL), alongside 1 and 2 MEN.

Modernisation

Withdrawl of the Alouette III immediately impacted the capacity for liaison and training tasks. Although partially absorbed by the remaining helicopters, it was also obvious that the AB-212, serving since the 1980's, had to be taken into account for near future replacement. By summer 2019, the US State Department announced that it had approved a Greek request for seven Sikorsky-Lockheed Martin built MH-60R Seahawk maritime helicopters. The deal would also include equipment, spare parts, armament and personnel training and trainings equipment at an estimated value of $600 million. The helicopters are to be fitted with Airborne Low Frequency System (ALFS), Multi-Spectral Targeting Systems, embedded Global Positioning System (GPS) /Inertial Navigation Systems (INS) with Selective Availability/Anti-Spoofing Module (SAASM). Additional equipment and armaments were specified to include sonobuoys (AN/SSQ-36/53/62), a pair AGM-114 M36-E9 Captive Air Training Missiles (CATM), some AGM-114Q Hellfire Air-to-Surface training missiles, Advanced Precision Kill Weapons System (APKWS) rockets, MK 54 anti submarine torpedoes and 2 types of crew-served guns (type M-2400 and type GAU-21). Furthermore Communication Security (ComSec) radios, Night Vision Goggles (NVG) and an Identification Friend or Foe (IFF) system are mentioned to be included. The primary role of the MH-60R is Anti Submarine Warfare (ASW) and Anti Surface Warfare (ASuW). Secondary missions of the Romeo model include Search and Rescue (SAR), logistics support, personnel transport and medical evacuation.

In the summer of 2020, the Greek government formalised a package to purchase four new MH-60R helicopters and further included the modernisation programme of the older S-70B-6s helicopters with upgrades of electronic systems and sensors.

The introduction of the new MH-60R into Kotroni's 1 MEN around late 2021, will initiate a gradual phase out of the AB-212s. It is expected that a few AB-212s (to be selected with sufficient flight hours left for the helicopters air frame) will remain in service for passenger-liaison flights until 2025.

Text and photos: Peter ten Berg

Exercise 'Royal Blackhawk 2020'

The 1st Regiment of Artillery of Bourogne organised the 'Royal Black Hawk 2020' exercise where more than 400 soldiers and a dozen combat helicopters participated.

This marked its eighth edition and shares a very interesting background. A French Army cadet had met an American cadet at West Point in the USA and while they were together, were looking for some adventure and as a bet, decided to organise an exercise together in the future. This became reality in 2013 when the first *Royal Blackhawk* exercise was held.

Since 2013, the *Royal Blackhawk* exercise has been organised annually by the 1st Regiment of Artillery (RA) at Belfort and its surroundings for about two weeks. This edition, put together nationalities of more than 400 French, Belgian and British soldiers, engineers, artillery, infantry and also combat helicopters of the French and United States Army. The helicopters of the 1st Combat Helicopter Regiment operated alongside different helicopters of the 12th Combat Aviation Brigade (US Army).

Like every year the Exercise was realistic and faithful to its objectives, making it particularly possible to train the mortar sections. The teams of observers and the maneuvere troops participated in their specialised roles: Air assault, MEDEVAC, Close Combat Attack, Close Air Support via JTACs (Joint Terminal Attack Controllers), Forward Air Traffic Controllers.

For the French Army, it was also an opportunity to train with their allies according to standard NATO procedures. This exercise is now well established in the area with training carried out in the region between Belfort, Besancon and Valdahon.

The 1st Combat Helicopter Regiment participated with two NH90 Caïman and two EC665 Tiger helicopters. Besides helicopters of the French Army, the French Air Force participated in this exercise with some Dassault Mirage 2000Ds from BA133 Nancy and Dassault Rafales from BA113 Saint-Dizier. The French Navy provided an ATL2 from the 21F Flotille based at BAN Lorient/Lann-Bihoué for the *Royal Blackhawk* exercise. The US Army in Europe sent 4 AH-64D Apaches, 2 UH-60M Black Hawks and 2 CH-47F Chinooks of the 12th Combat Aviation Brigade. The Apaches and Chinooks are home based at Ansbach Army Airfield, the UH-60M Black Hawks based at Wiesbaden Army Airfield in Germany.

Scenario: On 14 October, the Citadel of Belfort was captured, although this was an exercise in peacetime with ground troops and helicopters. The Franco-American collaboration in this action gave French troops training in realistic conditions.

Still, it was difficult in such short time to integrate the objectives of the French Army (CEMAT) Chief's strategic vision on high intensity warfare. The capture of a village on 21 October was, moreover, carried out with a favorable ratio of 3 to 1 in terms of manpower, but it is the objective that counts: realism increases edition after edition, which is the interest of 1st RA, whose major equipment, the rocket launcher unit (LRU), is capable of striking regardless of weather conditions over a distance of 80 km and is one of the key elements for excellence in high intensity operations. US Army's helicopters are also more self-protected than their French equivalents, with a much better passenger carrying capacity of the Chinook than the NH90 Caïman.

During the exercise, one CH-47 also demonstrated its capability of a 120 mm mortar to be carried in its hold, with about fifteen soldiers and protective elements. The Caiman cannot do this as its floor is too weak and there is now a study being carried out for reinforcing that. Artillerymen of the 1st RA know that their LRU will take time, even if, as a remnant of the Cold War, there were few operational situations: in the Sahel, with only some ten rockets fired. Nevertheless, the Regiment maintains the Sahel for protection of Forward Operating Bases and in Lebanon, deployed the counter-battery radar Cobra: this equipment remains, more than ever, at the heart of operations.

Major Antonides flies the AH-64D Apache with the 12th CAB, having some 1600 flight hours on type which has been in service with the US Army since 2008. Major Antonides informed that the main task was to support NATO allies and help to facilitate their training. As he stated, "We did that through interoperability training, speaking with the JTACs from the UK, Belgium and France. Its really great for us to talk to someone on the ground and just work on those skills especially with our NATO allies".

For Apache pilots, it was great to have brought the third dimension to this exercise. As an Artillery Regiment, they normally work on the ground and know that they are good at working together with the other ground forces but they now had a third element, that of the air. Major Antonides stated, "Of course, they fire their artillery guns but with the Apaches we can add extra firepower in the event and can also add complexity in their training – they have to think about another asset out there"!

Capt. Guillaume of the 1st RA talked about future plans for the exercise. "Next year, I would like to improve a little bit. For me that would mean participation of the French Reaper UAV drone. They were unavailable this time, but I really hope that they will be available in 2021."

Photos & Article by Roelof-Jan Gort

I would like to thank Press Officer Gabriel, Major Antonides, Capt. Guillaume and the crews of the 12th Combat Aviation Brigade and the 1er RHC for their hospitality and help during my visit.

Air Policing in Romania

– and much more !

From the beginning of September till the end of December 2020, the Royal Canadian Air Force's 433 Tactical Fighter Squadron (TFS) deployed their CF-188 Hornets to *Mihail Kogalniceanu* airbase in Romania, the main objective being to perform NATO air policing missions – but there was much more!

This deployment was part of *Operation Reassurance*. Lieutenant Colonel David McLeod is commander of 433 TFS from Bagotville, Que and was also commander of the *Air Task Force, Romania*. Explaining the purpose of this deployment he stated, "We were deployed as the RCAF Air Task Force with some 150 personnel and six CF-188s for the *NATO Enhanced Air Policing Mission*. This was divided into two phases, the first part being the deterrent mission, that is the traditional Quick Reaction Alert (QRA), having armed fighters on the ground with alert was launched from MK [*Mihail Kogalniceau* airbase]. Second phase of the mission focussed on multinational joint training and integration between our forces and locally based forces such as the Romanian Air Force."

Because of Covid-19, the entire team was quarantined for two weeks and conducted testing in Canada before they even crossed the Atlantic Ocean and also during their stopover in Keflavik, Iceland, when the team was again in quarantine. McLeod explained the challenge of good communication, "Since we were working on strict guidelines owing to Covid-19, the biggest challenge that we faced while conducting these exercises was face-to-face interaction. In order to overcome this hurdle, we switched to electronic means of interaction by using the telephone or video conferencing, both secure and unclassified. We were using our own secure networks to coordinate and organise these events."

The Romanian Air Force flew their Lancers from MK, an upgraded version of the classic MiG-21 *Fishbed*. McLeod further explained, "They are looking forward to working with us and soak up as much knowledge and professional development from the interaction as they can. But our

side too, I mean my junior pilots, they are combat ready but some have not been deployed before. And now, we bring them out here and mix them up with real MiG-21s and do they get surprised! It's a small jet with a small profile, especially face on. We can try to simulate MiG-21s with Alpha Jets back home in Canada, but nothing beats the real thing. And my pilots learned that the Lancers have upgraded avionics, and they have very capable pilots. This really benefits both forces."

The QRA mission is not a continuous mission and the Canadian detachment shared the duty with other forces in the region as well. "We work out our schedule with CAOC at Torrejon (NATO*'s Southern Combined Air Operations Centre in Spain*). So as per our schedule, some days were focussing on training and some days were on QRA, holding alerts," McLeod clarified. "We are plugged in on the NATO secure systems so we stay connected to the CRC in Bucharest and the CAOC in Torrejon," he further stated.

For the QRA, the Hornets carried a mixed weapon load consisting of AIM-9 Sidewinder heat seeking missiles and AIM-120 AMRAAM radar guided missiles plus external fuel tailored to the situation. "It is a little different here whereas in Canada, we often fly longer ranges to conduct intercepts owing to the geographical differences. Here it's a smaller AOR [*Area Of Responsibility*] so we tailor the load a little more to the area of operation. The F-18 is fully capable of performing day and night operations and all of our crew members were equipped with the ANVIS 9 Night Vision Goggles to perform night operations smoothly," McLeod stated.

When there was a potential or actual violation of NATO air space, CAOC Torrejon sent a scramble alert to the Romanian NATO Command and Reporting Centre (CRC) with the call sign 'Chrystal' in Bucharest. Bucharest transmitted that to operations at MK and the scramble process was initiated. "Usually, we do our mission without any lateral airborne support, we just use native radar and communication coverage that Romania has. If a NATO AWACS is airborne, at the time, they contribute to that picture, but by default they are not controlling the Alpha scramble."

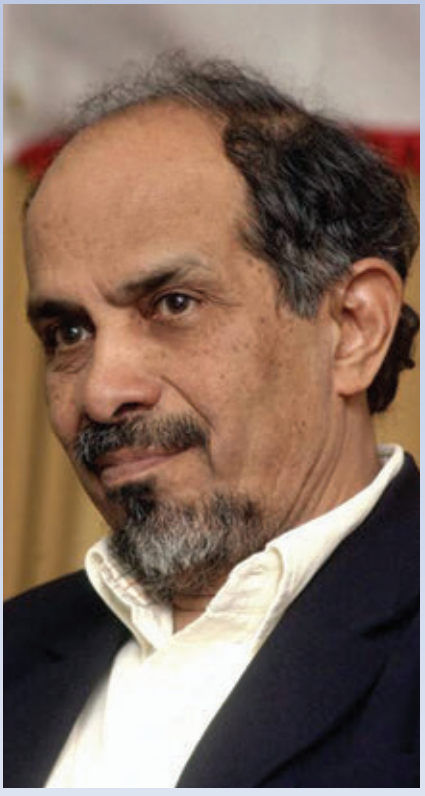
Formally, the area of operation was the entire Romanian flight information region. However, because of the various aspects of the mission, main focus was on eastern part of the country and especially the Black Sea region. Already at the beginning of the Task Force deployment, there was an amplified level of activities in that region owing to the ongoing large scale Russian exercise KAVKAZ-2020. After a few weeks, this culminated in an actual Alpha Scramble as a Russian jet got very close to Romanian airspace and two Hornets were scrambled. "We identified the aircraft as a Su-27 *Flanker* and monitored it closely until it left the Romanian flight information region," McLeod stated.

Apart from the "assurance and reassurance" parts of the mission, it has been a great learning experience for the personnel involved. "It is great to take my pilots out of their comfort zone. We are used to the Canadian and US air traffic systems. In Europe, they have to get used to the difference between general air traffic and operational air traffic. The difference goes all the way down to the accents on radios when they communicate. Any time we go on a multinational operation, we have to integrate with all these countries, with their different accents and capabilities. So the capability to work with all these forces, even if it's on a small scale such as here with the air policing mission, is a massive learning point for my guys. So this is an excellent preparation for any future multinational operation we are going to be a part of!" McLeod concluded.

Article by Patrick Dirksen & Frank Mink of Tristar Aviation
Photos: Canadian Air Force

The Dear Departed: Legends of Indian Aviation

Professor Roddam Narasimha



Roddam Narasimha was one of India's foremost aerospace scientists and a specialist in fluid dynamics. He was a professor of Aerospace Engineering at the Indian Institute of Science, Director of the National Aerospace Laboratories and Chairman of the Engineering Mechanics Unit at Jawaharlal Nehru Centre for Advanced Scientific Research.

Narasimha started his research career at Caltech, working on the problem of jet engine noise reduction. After the launch of the Russian Sputnik and the resulting interest in space programmes, he shifted focus to rarefied gas and fluid dynamics, working with Hans W. Liepmann. He continued this research at the NASA Jet Propulsion Laboratory, where he went on to study aerodynamics and supersonic flows toward better understanding of the structure of shockwaves. During this time, he worked on one of the space agency's first computers.

He returned to India in 1962, and joined the Indian Institute of Science at Bangalore as a professor in its aeronautical engineering department, where he continued his fluid dynamics research, studying turbulent flow and relaminarisation, including the study of fluid flow from turbulent (chaotic) to laminar (streamlined) forms.

During his time at the National Aerospace Laboratories, Narasimha led the research efforts into parallel computing as a means to solve fluid dynamics problems. He was also a contributing member of the team that designed the light combat aircraft (LCA) and the longest-serving member of the Indian Space Commission, a policy-making body for space exploration in India.

Air Vice Marshal Ajit Singh Lamba

Air Vice Marshal Ajit Lamba was commissioned into the Indian Air Force in April 1955, being awarded the Flying Trophy and Best Pilot of the Year Trophy at the Academy. As he grew in the Service, he shaped into an outstanding and distinguished fighter pilot and was honoured by the President of India with the Vir Chakra for gallantry displayed by him during the Indo-Pak war of 1965. He flew Hunters in action with No. 7 Squadron (*Battle Axes)*.

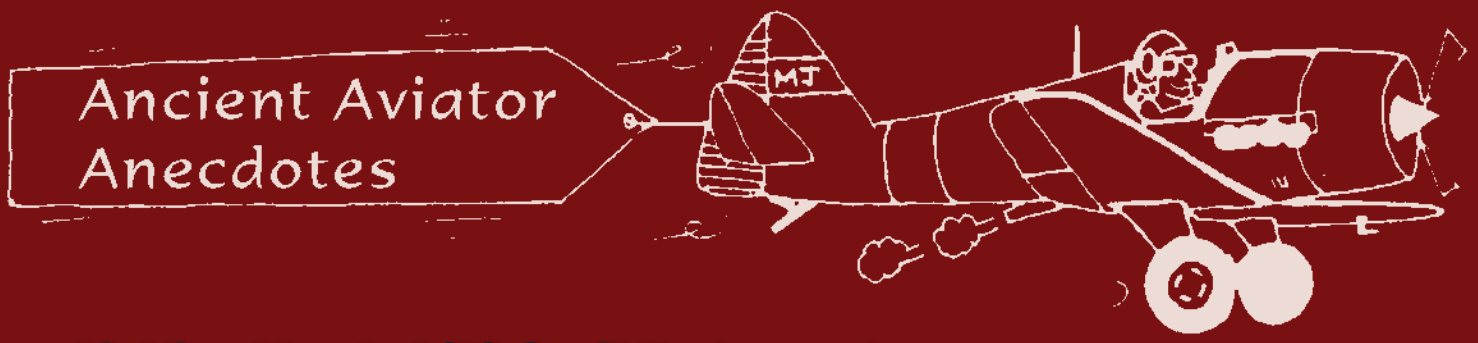
His incredible dedication to aviation, first as a fighter pilot, then an experimental test pilot and later with engagement in civil aviation, is evident from his impressive over half a century career, during which he logged over 8000 hours on nearly 100 different types of aircraft, ranging from trisonic fighters to ultra-light sports planes.

Ajit Lamba did his experimental test flying course in Farnborough, England in 1966 and later had the distinction of three tenures at the IAF'S A&ATU, later Aircraft & Systems Testing Establishment (ASTE), this unique establishment of the IAF, from where he retired as Commandant in April 1991. Earlier, he had commanded a Gnat light fighter squadron and served as Director of Plans at Air Headquarters.

In 1997, Ajit Lamba made the celebrated 'Freedom Flight' in a Pushpak light aircraft from Kanyakumari to Srinagar and back to mark the Golden Jubilee of India's independence.

He remained a consummate aviator, even in his 85th year, as the eldest in the country to hold a valid flying licence. Ajit Lamba continued on flying, giving air experience to students from the Indian Institute of Science, Scientists of the DRDO and ADA but most humanely, to physically impaired children.

On 2 December 2010 Ajit Singh Lamba was honoured by *The Society for Aerospace Studies* when celebrating the Centenary of Aviation in India.



Air Vice Marshal (R) Cecil Parker and.....

"LIGHTNING: ROLLING-ROLLING-NOW"

For air veterans of a certain vintage, the month of December will recall the 1971 Indo-Pak war. It was certainly the high point of my seven years with No.20 Squadron AF, four of which (1962-66) were as the flight commander on Hunter Mk.56 aircraft in Palam and three (1969-72) as the commanding officer on the Mk. 56A's in Hindan and Pathankot. The squadron which was formed in 1956 with Vampire Mk.52s, has a crest of three bars of lightning and a (translated) motto of 'Fast and Furious'. This has given the unit its name as the Lightning Squadron and its members are known as *Tribe Twenty*. During my two tenures, a fair number of personnel (pilots, technical/medical officers and airmen) passed through my hands and I, in turn, learnt a great deal from them both in the air and on the ground.

Recollection of identity–markers (rank, appointment, branch, service number, decorations) gradually fades with the passage of time. Better remembered is demonstrated performance and associated name. The collective performance of the *Lightning Squadron* in December 1971 is now recorded history during which my team comprised: JM Mistry: AA D'Rosario: KN Bajpai: GS Dhillon: BS Kailey: AL Deoskar: Arun Prakash (from the Navy, later CNS): Suraj Kumar: SS Gahlaut: AK Sharma: KP Murlidharan: S Balasubramaniam: T Chowfin: R Demonte: VK Heble: BC Karambaya: AAR Shirke: A Thapar: JPS Talwar: RS Pannu: augmented by the attachment of R Bharadwaj and Janak Kumar and supported so ably on the ground by Ajit Sahai: SR Sachdev: LK Kochar: KK Mukherjee: AK Sood: SV Ashok plus 335 air warriors of all trades.

Over the past near half-century, the 28 names listed above have been reduced by a few who have joined the two we lost during the war. *Tribe Twenty* members of 1971 vintage have had some Getogethers and a major Reunion at Navy House New Delhi in 2005 kind courtesy of the then CNS himself a distinguished ex-Tribesman *(see picture)*. Some members of the team met up at the presentation of the President's Colours to No.20 Squadron at Kalaikunda in 1992. For me personally it was a few nostalgic moments to climb into the cockpit of a parked Hunter after 20 years! The two other occasions some of us met up again were at the Squadron's Gold and Diamond Jubilee celebrations in 2006 and 2016 respectively in Pune where it is now equipped with Su-30 MKIs.

"Tribe twenty" led by Wg. Cdr. Cecil Parker during the December 1971 war, seen with a Hunter.

Thanks to the internet and the smart phone most of us continue to remain in touch periodically. But what this 88-year old great-grandfather finds difficult to picture is his (then) 20-something-year-old lively young officers as the septuagenarian grandfathers they must be now! One of their recent messages to me on my birthday, made my day. "Sir, among my abiding memories of my 20 Squadron days was the baritone voice of the boss on R/T calling 'Lightning: rolling-rolling-now' as we took off on yet another mission". Those were the days my friend.

Friends in uniform

Friendship stems from common interests, needs and proximity. If personal chemistry is also present, it makes for a stronger and longer relationship. To those of us who chose a career in the armed forces, a posting every two or three years had the potential for new friendships with colleagues from all corners of our country. In the air force it commences with our very first basic professional training course. In my own pilots course (1951-52) our comradeship and bonding as flight cadets led to friendships that have lasted many years.

As young pilots in squadrons, friendships with our peers grew out of our common need to learn new flying skills, acquire knowledge and gain experience both in the air and on the ground. As we reached our first supervisory appointments (Flight Commander/Instructor) the requirements of training and discipline called for a fine balance between leadership and friendship. As a very young QFI (1955) I was barely much older than my first pupils and was able to bond more easily with them. Most of them became personal friends, a relationship I myself enjoyed with my own flying instructor.

As a commanding officer (Sqn Cdr/Stn Cdr/ AOC/Commandant) the appointment called for some detachment and judgement to ensure that personal friendships are kept quite separate from professional relationships and is seen to be so. Three tenures at DSSC Wellington enlarged our circle of friends to include new ones from the army and navy. A years course abroad gave us many new friends from all three services from more than one country.

As a Station Commander in the 1970s, one of my wife's personal friends on the station had invited us to dinner. Unknown to either of the ladies, that same morning I had the unpleasant task of having to punish our hostess's husband. Yet we had a most pleasant evening together and our personal friendship was never affected. Some years later the officer died in a flying accident; his widow still remains in close touch. On another occasion my wife and daughter, returning to India and travelling unaccompanied by me, missed their flight at Heathrow and returned to 'The Keep' in Kingston where we had already vacated and handed back our apartment. One of our friendly neighbours, a serving colonel in the British army (and a tennis playing family) immediately invited them into their home to stay. The nature of the profession encourages friendships in the armed forces in most countries.

Covid-19 sanctions have of course eliminated travel and confined us to our home, cut off physically from our two children and their families. Yet there has been a spurt of communications from old friends enquiring about our welfare and recollecting experiences ranging from youthful escapades to attainment of great-grandfatherhood! One of my oldest friends and coursemates (two years my senior) happens to share a birthday with me and was 90 on 22 November 2020. Thinking aloud, I wondered what I could send him as a present? The advice from my best friend was that I should send a birthday message emphasising how greatly I value his friendship of near 70 years. And fortunate indeed is the man (in uniform or otherwise) whose wife is also his best friend!

25 Years Back

From Vayu Aerospace Review Issue I/1996

AI and IA Merger

Air India (AI) and Indian Airlines (IA) are moving ahead in a phased manner towards becoming a single corporation by gradually merging operational areas like training, engineering and human resource development (HRD). Approval for the merger has already been obtained from the Minister of Civil Aviation. AI and IA have formed a subcommittee which is going to submit the proposal for code sharing between the two airlines. The merger would also ensure that there is no overlapping on overseas routes.

ALH Naval Variant

The fourth prototype (naval variant) of the HAL Advanced Light Helicopter (ALH) was officially flight demonstrated for the CNS on 22 January 1996. The naval version has a retractable tricycle landing gear and provision for folding of the main rotors for easier stowage on ship deck.

Reliance-HAL partnership on Saras LTA

The Reliance Group and HAL are to participate in the NAL Saras light transport aircraft project which marks entry of the Reliance Group into the aviation sector. Reliance will undertake to market the 14-seater, twin-turboprop aircraft while HAL will manufacture the aircraft at its Bangalore Complex. The potential market for this pressurised LTA includes air taxi operators, light-cargo carriers and the Coast Guard. The aircraft will also be suitable for border patrol and air ambulance services.

Prithvi SS-250 test launched

The longer-range variant (250-km) Prithvi II, developed for the Indian Air Force, was successfully test fired for the first time from the interim test range at Chandipur-on-Sea in Orissa on 27 January. Further test launches of the SS-250 are planned before its clearance for induction into the IAF.

Nishant UAV

Work on India's first Unmanned Air Vehicle, the *Nishant*, has progressed with the completion of flight trails of three technology demonstrators. DRDO sources have confirmed that the three technology demonstrators developed and assembled by the Aeronautical Development Establishment (ADE) have undergone a series of flight trials and the construction of three more prototypes are planned.

Mi-35s for Army Aviation Corps?

According to Russian company Rostvertol, a proposal has been made to the MoD for the sale of Mi-35s (the export version of the Mi-24 'Hind') to the Indian Army. A defence delegation from Russia visited New Delhi recently for detailed discussions with senior Government and Indian Army officials. The earlier visit of Russian Deputy Prime Minister Yuri Yarov had virtually finalised the helicopter deal (India already operates two squadrons of the Mi-24/35).

"Indian aircraft purchases will exceed Rs 50,000 Cr"

Expenditure on Indian aircraft purchases will exceed Rs 50,000 crores ($14.7 billion) in the next 20 years, according to head of the structures division at NAL. Reference were made on the proposed acquisition by Air India of medium capacity long range aircraft, while private airlines have extensive plans for expansion and modernisation.

Indian Coast Guard Air Wing expands

The Indian Coast Guard's Air Wing has been steadily expanding with the induction of additional HAL-built fixed wing aircraft and helicopters. The third squadron equipped with HAL-Dornier 228-101s was established on 5 January 1996 when CGAS 745 was formed at Port Blair, capital of the Andaman & Nicobar Islands in the Bay of Bengal. The other two squadrons, CGAS 744 and CGAS 750 flying the specially-equipped Dornier 228 maritime patrol aircraft are based at Meenambakkam (Madras) and Daman respectively, covering India's eastern and western coastlines and the EEZ.

Himachal Pradesh air links

Chief Minister of Himachal Pradesh has evinced keen interest in the expansion and upgradation of existing airports in Himachal Pradesh to cope with the increasing need for air traffic to and within the mountain state. The state government has taken up the matter with the Civil Aviation Minister and work for the proposed expansion will commence as soon as more land is requisitioned.

Swedish Air Force Gripens

Four Swedish Air Force pilots and one pilot from the Defence Material Administration (FMV) are currently receiving conversion training on the JAS-39 Gripen. They have, so far, made ten flights each and training was to continue until the end of January 1996, when the tactical testing programme begins.

Tale Spin

May the Force be with you!

Contemporary advertisement inviting young Indians to join the IAF. The choice of fighters depicted has evoked some comments: the MiG-21bison at the top is on the brink of retirement while the Tejas below, development of which was conceived to supplant the MiG-21 has just received full operational clearance.

Whither the Rafale and Flanker?

Tales of sub-continental Airlines

Passengers bound for Nepal's Janakpur were in for a surprise after they ended up in Pokhara instead, 255km from the actual destination, after a rare flight mix-up by a leading private carrier. According to the spokesman, "such incidents may happen" (sic).

Meanwhile, Pakistan's Civil Aviation Authority has just cancelled the flying licences of 50 pilots for having 'fake' credentials. The licences of 850 commercial pilots were thoroughly scrutinised and action followed….

Don't fly for me …!

Brain or Brawn?

Sobering is the news from a village near Sonepat in Haryana. Campus of an erstwhile College of Engineering, which once taught aeronautical engineering, has now spawned a Wrestling Academy as earlier graduates could not find suitable employment. Paradoxical or a sign that the latter is unfettered by regulatory constraints (as unfortunately some of our hallowed institutions still remain).

Kushti kissi ke saath?

RAF in Ambala

Not *that* RAF (Royal Air Force) which established Ambala as their Air Station in the 1920s ! *This* RAF (Rapid Action Force) skirmished with protesting farmers on their 'Dilli Chalo' march in late 2020, a hundred years later.

Only the colours are different !

The final frontier

Chuck Yeager, the most famous test pilot of his generation who was the first to break the sound barrier in 1947, passed away in December 2020 in Los Angeles. He is also remembered in the sub-continent as having 'tilted' for the PAF during the December 1971 war.

Now, beyond the sonic boom!

Covid Times!

Please tick your definition (no cheating!)

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