2021
AERO INDIA
SHOW DAILY
04 February 2021
VAYU
Day 2

Atmanirbhar Bharat airborne

13th edition of the Aero India Show was formally inaugurated by Defence Minister Rajnath Singh at AFS Yelahanka on the morning of 3 February 2021. During his speech, the Minister commended the organisation of the biennial event "amidst challenges brought about by Covid-19" and added that owing to restrictions, this edition of Aero India would be a purely business event and there would be no public days.

The Minister continued in that, "Aero India 2021 will display the vast potential of India, and the multifarious opportunities that our country offers in the field of defence and aerospace sector. It also promises to be the world's first-ever hybrid aero and defence exhibition".

The Minister also spoke about the threats and challenges emanating from multiple fronts, urging that India remains "vigilant and prepared to counter and defeat any misadventure to defend its people and the territorial integrity at all costs".

The fly past was heralded by an *Atmanirbhar Formation Flight*, led by the Tejas LCA and including a pair of HTT-40s and single examples of the HJT-36 *Sitara* and Hawk-i. The aircraft static display had examples of HAL-built aircraft including the Jaguar, Sukhoi Su-30MKI, Dornier 228 as also IAF fighters such as the Rafale, Mirage 2000 and MiG-29UPG, apart from helicopter types including the Chinook, Apache and HAL Dhruvs.

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'Tejas, the Pride of India'

Defence Minister inaugurates second production line for LCA

On eve of Aero India 2021, Defence Minister Mr Rajnath Singh inaugurated the second production line at HAL's LCA Division at Bangalore on 2 February. "HAL's new LCA facility is example of how *Aatmanirbhar Bharat* is shaping and HAL deserves the largest indigenous order of 83 LCA Mk.IAs. LCA is the pride of India and sends the right message to others that India can make fighters of (this) class in-house. The fighter is superior in many ways when compared to other fighters in its category besides being cost effective".

The new facility will have CNC profilers, 5-axis machining centres, high pressure fluid cell press machines, test rigs, specialised facilities for heat treatment, special processing in the hangars for structural assembly of aircraft. Production tooling and productivity improvement initiatives have also been undertaken, adopting latest simulation software packages where structural assemblies of the LCA Mk.1A will be produced to meet the desired delivery rate of 16 aircraft per year.

"The programme will catalyse the aerospace ecosystem in India and would enable India to be an epitome in Prime Minister›s vision for *Aatmanirbhar Bharat*".

Chiefs of Air Staff Conclave

The Indian Air Force is hosting a *Chiefs of Air Staff (CAS) Conclave* on 3 and 4 February at Air Force Station Yelahanka where Chiefs of Air Staff from various countries "would brainstorm and synergise their thoughts on current issues related to aerospace power strategy and technological developments". In view of the COVID 19 situation, the Conclave has been planned in the hybrid form with extensive use of digital media, and is expected to be attended by about 75 countries.

According to the Air Force PRO, the Conclave will also be "a perfect example of India's defence cooperation with other countries working as a diplomatic instrument, giving an opportunity for building bridges of friendship, mutual trust and capacities on a global basis … promoting transparency in defence cooperation and building areas of common interests in military aviation".

Air Chief Marshal RK Bhadoria, CAS IAF

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The Tejas – and its loyal Warriors

Hinted at during Aero India 2019 and now publically revealed at Yelahanka two years later is a full scale model of the *Warrior* weaponised drone being developed by Hindustan Aeronautics Limited (HAL). This is part of the indigenous programme CATS (Combat Air Teaming System) which is "a composite amalgamation of manned and unmanned platforms which work together to penetrate heavily defended enemy airspace." This is India's equivalent of the 'Loyal Wingman' project which stealth unmanned aerial vehicle is in development by Boeing Australia to perform autonomous missions using artificial intelligence.

According to reports, there will be multiple Warriors controlled by the Tejas pilot, the drones also equipped with air-to-air and air-to-surface weaponry.

Also under development by HAL alongside the Bangalore based *Newspace Research & Technologies* is the Hunter cruise missile with a range of 200 kilometers and swarm drones known as ALFA-S with the objective of attacking multiple targets identified through artificial intelligence. The drones will be housed in a aerodynamically designed carrier mounted on a Jaguar strike fighter.

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SAAB

BEL delivers modules to Thales for Rafale RBE2 radar

As part of Thales' Offsets commitments under the Rafale India contract, and in line with the *Make in India* policy, Bharat Electronics Ltd (BEL) has manufactured T/R (transmit/receive) modules for RBE2 radars for the Dassault Aviation Rafale and delivered them to Thales.

Thales is an active stakeholder in the *Make in India* policy, and in the offsets conditions included in the Rafale India programme. In November 2020, the first RBE2 AESA (active electronic scanning array) radar with front-end manufactured by BEL in India was delivered by Thales to Dassault Aviation. BEL implemented a set of rigorous processes at its Bangalore facility in order to achieve this key milestone.

"We're delighted to see our collaboration with BEL delivering results, with the radar transmit/receive modules for the Rafale India programme being produced in Bangalore in line with the Make in India policy. The Thales teams are fully mobilised alongside our partners Dassault Aviation in France and BEL in India," stated Emmanuel De Roquefeuil, VP and Country director, Thales in India.

"We are happy to be associated with Thales in delivering the Transmit/Receive modules for the prestigious Rafale programme. The Thales and BEL teams ensured that the ToT happened seamlessly. We have augmented our facility in Bangalore to meet the requirements of manufacturing this state-of-the-art sub-system. We look forward to working together on many more such challenging assignments with Thales," stated Mr M V Gowtama, Chairman & Managing Director, BEL.

IAF's capital budget increased

In the country's budget 2021-22 announced by Finance Minister Nirmala Sitharaman on 1 February 2021, there is only a modest increase of 1.4% over the past FY but within this, the Air Force has been allocated the largest capital amount. This reflects the IAF's increasing commitment to pay for its new Rafale fighters, manufacture of additional Su-30MKIs and Tejas LCAs by HAL as also continued modernisation of the Mirage 2000 fleet. According to defence analysts, major expenditure is also anticipated in the case for 114 multirole fighter aircraft (MRFA) for which the IAF has issued a global RFI some years back.

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Fighter shapes in the making

Various fighter programmes under development by DRDO have been publically displayed for the first time in model form in Hall D. These include the single-engine LCA (Air Force) Mk.II also referred to as the medium weight fighter (MWF), with, alongside, model of the Navy's twin-engine deck based fighter (TEDBF).

The Indian Air Force has indicated its requirement for 5th generation fighters to be indigenously developed which is exemplified by scale model of the advanced medium combat aircraft (AMCA).

India's 'Stealth Works'

Publically revealed for the first time are an array of projects and programmes being undertaken by the India's Defence Research & Development Organisation (DRDO) alongside the Aeronautical Development Agency (ADA), the latter directly involved in the LCA Mk.II (medium weight fighter) and advanced medium combat aircraft (AMCA). In model form, these are the cynosure for all and are being referred to as work in progress in India's stealth works, a take of from the US 'Skunk Works' which has been working on Advanced Development programmes since the mid-20th century, some of its products being the F-117, F-22 Raptor and F-35 Lightning II stealth fighters.

However, the model above is that of the *SWIFT*, an autonomous stealthy unmanned combat air vehicle (UCAV), being developed by DRDO for the Indian Air Force. Details of the project are classified but according to public sources, this UCAV will be a stealthy flying-wing concept aircraft with internal weapons bay and a turbofan engine.

VAYU Interview with

Mr. R. Madhavan,

CMD Hindustan Aeronautics Ltd.

(Part-II)

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 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-36 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 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 import 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 do give some details of HAL's involvement in futuristic space launch vehicles?


(Photo: Phil Camp)

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.

Modified IJT commences spin flight testing

On 23 November, 2020, a modified HAL HJT-36 (*Sitara*) Intermediate Jet Trainer (IJT) designed and developed by HAL to replace the HJT-16 Kiran basic jet trainers of the IAF commenced spin flight testing in Bengaluru. The flight was piloted by HAL's test pilots Gp Capt HV Thakur (Retd) and Wg Cdr P Avasti (Retd). Spin testing of an aircraft is a crucial phase of flight testing, which will be gradually progressed to assess behaviour of the aircraft till six turn spins to either side to meet the targeted requirement. The test aircraft have been fitted with necessary safety devices (Anti-Spin Parachute Systems).

VAYU Interview with Mrs Anandi Ramalingam, Director Marketing, BEL (Part-II)

Mrs Anandi Ramalingam, Director Marketing

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.

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.

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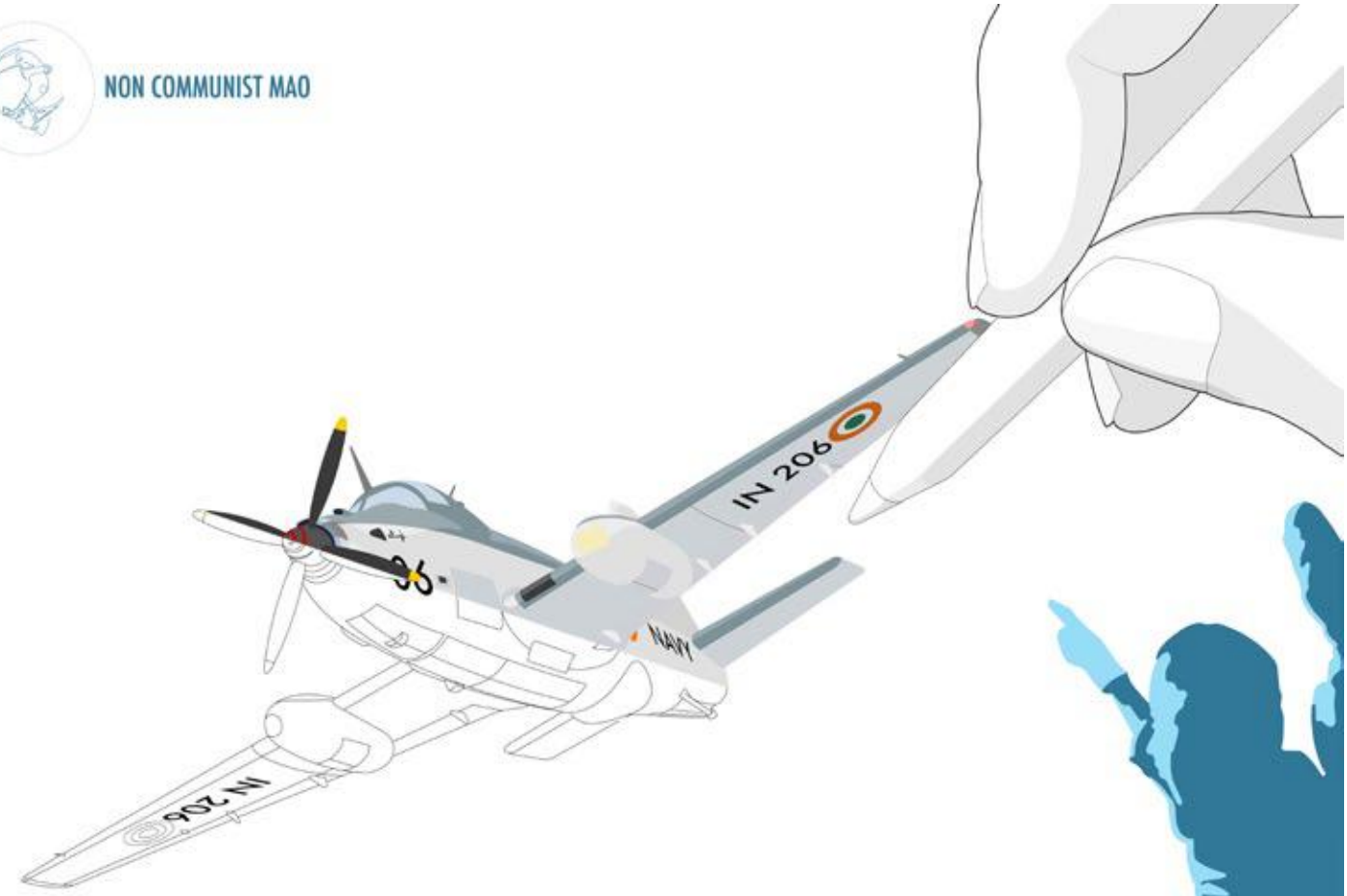

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Boeing offers Super Hornets for IN, F-15EX to IAF

VAYU Interview with

Ankur Kanaglekar,

Head India Fighter Sales, Boeing Defense, Space and Security

VAYU: Boeing recently announced the 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 successfully operate from a ski jump ramp, demonstrating the aircraft's suitability for Indian Navy's aircraft carriers.

We are engaging with the Indian Navy on their requirements and have responded to the Request for Information for the Multi-role Carrier Borne Fighter (MRCBF) programme. We are confident that the multi-role F/A-18 Super Hornet Block III will offer unrivalled value to the Indian Navy, that can be appreciated in the current economic environment, as it not only has a low acquisition cost, but also costs less per flight hour to operate than any other tactical aircraft in the US forces inventory, including single engine fighters.

VAYU: What makes the F/A-18 Super Hornet fit for this requirement?

Boeing: The F/A-18 Super Hornet Block III will offer the Indian Navy several unique and differentiated capabilities, with flexibility and best utilisation of precious air assets through carrier-compatible two seater variant (F-Variant) and single seater (E-Variant) for the Indian Navy. The two-seat variant (F/A-18F) shares the same mission scope as a single seat (F/A-18E) while allowing for carrier-capable training and the ability to fly advanced missions from the carrier to benefit from a second crew on-board. Most importantly, carrier-based naval aviation technologies related to manned-unmanned interface can also be effectively operationalised with a two-seater carrier compatible version.

An advanced, multi-role, frontline fighter of the US Navy, the Super Hornet Block III was designed alongside the US Navy to meet its mission requirements through the next decade and beyond. The Indian Navy will stand to gain from the multi-billion dollar investment that has gone into the platform resulting in a most lethal and highly networked naval fighter. The aircraft can interface with the P-8I and other US-origin assets that the Indian Navy and the Indian Air Force have, or are in the process of acquiring. This will further augment lethality of these platforms and enhance India's force projection capabilities.

Of no less importance is the fact that the Super Hornet logically lends itself to enhanced maritime cooperation between the US Navy and Indian Navy in several areas of naval aviation. The commonality and interoperability benefits that Indian

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Navy will get as a result of F/A-18 Super Hornet on Indian Navy carriers would be unmatched.

As part of Boeing's *For India, by India* aircraft sustainment strategy, we are exploring the possibilities of the Block III Super Hornets being serviced in partnership with the Indian Navy, US Navy and industrial partners from India and the US throughout lifecycle of the aircraft. This will further develop advanced expertise in aircraft MRO in India, resulting in higher availability of the aircraft.

All these together with the fact that the Super Hornet Block III has the ability to offer superior economics to the Indian Navy as it not only has low acquisition cost but also costs less to operate per hour of operation compared to any other tactical fighter in the US Forces inventory differentiates Boeing's F/A-18 Block III Super Hornet offer for the Indian Navy.

VAYU: What about Boeing's offer of the F-15 EX to the IAF for its requirement for 114 aircraft? How many F-15EX has the US Air Force ordered so far?

Boeing: The F-15EX is the latest and most advanced version of the combat-proven, multi-role, all-weather day/night F-15 aircraft family. The US Air Force recently placed an order for eight F-15EX with Boeing. The contract between Boeing and USAF includes an option for up to 200 jets, with the USAF projecting to buy at least 144 F-15EX aircraft.

More than $5 billion investment from the USAF and international customers has gone into the F-15EX which has resulted in several technology infusions such as advanced sensors including the highly reliable powerful radar, the world's fastest mission computer, advanced electronic warfare and other sensors and advanced cockpit system. The F-15EX can carry large payload and offers impressive performance in the form of range, speed and altitude. You may know that F-15 is the only aircraft that has 104 kills to its name in air to air combat!

We are happy to report that the United States government has recently approved our request to offer F-15EX to the Indian Air Force. We look forward to the requirements from the Indian Air Force being defined in the form of an RFP.

VAYU: Can you elaborate on the lifecycle cost and services approach that Boeing will take with the F/A-18? Are there any 'Make in India' plans for the 57 fighters that you are offering?

Boeing: The Super Hornet not only has an affordable acquisition cost, but also costs less per flight hour to operate than any other tactical aircraft in the US forces' inventory, including single-engine fighters.

This is not surprising since the maintenance needs for the platform are well understood owning to its substantial fleet size (more than 560 Super Hornets in operation) and the fact that the aircraft is designed for ease of maintainability.

Our 'Make in India' plans will depend on requirements of the Indian Navy as defined in the RFP. Since more than 80% of the value of the platform throughout its lifecycle is in sustainment, it is important that India develops local expertise to service and sustain the platform. As part of Boeing's "for India, by India" sustainment philosophy, the Block III Super Hornets can be potentially 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 specific advanced expertise in India resulting in higher availability of the aircraft at competitive pricing.

Boeing has the proven breadth and depth of experience in sustaining military aircraft for the Indian Navy and Indian Air Force in the country by utilising the local talent pool. We look forward to building on this expertise to offer the Indian Navy an opportunity to sustain F/A-18 Super Hornets throughout lifecycle of the aircraft.

VAYU: Has there been any interest in the F/A-18 Super Hornet from other countries?

Boeing: International interest in the Super Hornet remains high and includes Finland, Switzerland, Canada and Germany, who recently selected the Super Hornet over the competition. With orders of 106 additional Block III being built for the US Navy and Kuwait Air Force, the Super Hornet will be in service for decades across the world.

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The **Light Utility Helicopter** (LUH) is the third indigenous helicopter product from the stables of HAL after ALH and LCH. The helicopter is designed to carry out various utility roles such as reconnaissance, transport, cargo load and rescue operations. The helicopter is capable of flying at 220 kmph, with a service ceiling of 6.5 km and a range of 350 km with 400 kg payload.

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Gripen: Tailored for the IAF's Future Network Centric Warfare

Sharing the right information with the right person at the right time in the right form and ultimately for the right use is a tough challenge! According to Chief of the Indian Air Force, Air Chief Marshal RKS Bhadauria, challenges posed by rapid progression in technological innovations coupled with lower costs is leading to disruptions in how threats and warfare are now being perceived. India has 15,106.7 km of land border and a coastline of 7,516.6 km, including ahostile forces is critical to the country's security. The changing character of war is generally examined from the changes in weapon systems, technology and strategy employed. Advanced military technologies are changing the character of contemporary conflict and levying new demands on military's organisation, training and doctrine. Network form of organisations to take care of increasingly complex situations that the Indian military is often tasked with has become more prevalent. An aircraft's effectiveness is no longer determined mainly by how fast it can fly or how quickly it can turn. It is how effectively to interpret information from varied sources and present the data to pilots that they can comprehend and take instant action. And it is this ability to cooperate and communicate with other units during a mission in today's world of modern warfare is what Gripen excels in.

The Gripen is built with the most developed and secure data links systems that provide the pilot with total situational awareness. Packed with state of the art sensors and active jammers, Gripen is able to see the unseen, defeat advanced threats, and help the pilot be in control at all times. Smart fusion is a core focus in Gripen E to avoid over-loading pilots and instead assisting them in getting a real-time situational overview of the battlespace. This is done in order to make accurate decisions in the shortest possible time. The fighter intelligence and effective human-machine collaboration has a key role in making the most important data available to the pilot at the right moment. Gripen E's intelligent sensor and data fusion ensures that the pilot is always one step ahead. Sensor and data fusion forms a shared situational overview and decision support basis, as a result, the pilot gets real-time situational awareness from available sensors on the fighter, as well as sensors in its surrounding. The pilot is not required to decide which sensors are involved or know what information is being delivered by each system.

According to Gripen India Campaign Head, Mats Palmberg, "Gripen E is the most modern fighter in the ongoing MRFA acquisition and together with the weaponry, including Meteor, the BVR (Beyond Visual Range) missile, Gripen E will give India an edge against all its adversaries. The network centric capability is Gripen's unique ability to assemble all the information it obtains from its sensors and present it in a clean and prioritised manner so that the pilot can act and make a decision as fast and efficient as possible. The latest high performance sensors such as AESA radar, IRST system, advanced datalinks and AI-enabled decision support gives the pilot superior situational awareness and ability to see 'first-act first'. The low visual and electronic signatures and a fully integrated onboard self-defence and ECM suit with 360 degree spherical coverage, together with the suite of latest most advanced weapons available, secures mission success and brings the pilot home safe. With its combat performance and power projection capability, Gripen E will provide the IAF with a deterrence power in the region."

A quantitative information advantage is always worth seeking, but it is only in combination with intelligent fusion of gathered information that the advantage starts to become qualitative – and truly usable. The smart fusion is appreciably more intelligent than simply overlaying data from different sensors. It creates a unified view of the world by ensuring that the information from different sources such as fused objects from sensors, images and maps is coherent in both space and time. A combination of imaging (2D) and geospatial (3D) data improves the fusion and enhances decision-making.

Jonas Jakobsson, Test Pilot at Saab, explains the concept of network centric warfare by making a parallel to the internet. "It's basically like flying inside the internet where you share and use everyone's information. Adding all that information becomes better for me as a pilot," he says.

As a true network centric fighter, Gripen was designed make interoperability with other fighters and

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units easier and more efficient. Within this network, a threat detected by one of the members will not go unnoticed. The pilot, who is able to see everything that is happening around him through shared data and information, is able to make calculated decisions in a short period of time. This helps the pilot to focus more on the mission.

Another big advantage is that all fighters in the same mission are able to access the same superior and real-time situational overview. It also makes the collective situational overview robust: even if one or more is disrupted, the fused data will still be reliable.

In combat situations, it is a major advantage to protect your position or your very existence! Gripen can engage in passive 'listening' without transmitting via active sensors. This is done by using sensors such as radar, IR-seeking and the electronic support system in passive scanning modes to collect and fuse data from the existing network.

"It's like a puzzle. You add all the pieces together till you can make out what the big picture is," says Jonas. "Since we're all working in the same network, with the army and the navy, we can cooperate in really close loops in time," adds Jonas Jakobsson.

As technology advances rapidly, and in order to be one step ahead it is important to have the best technology today – but also tomorrow. Sensors on Gripen E can therefore be replaced without complex procedures. This is made possible by Gripen E's tactical agility, which enables hardware and software to be rapidly replaced and upgraded without any disruption to the flight critical functions. Situational awareness, freedom to manoeuvre, survivability, long ranging engagement and being able to operate in a network centric environment has become increasingly crucial. Tailored with its netcentric warfare capability, Gripen would be key in providing the IAF a superior edge in the challenging modern battlespace.

Courtesy: Saab

Gripen Es for Brazil

The Gripen E, named F-39E Gripen by the Brazilian Air Force (FAB), was officially presented on 23 October 2020, during the celebrations of Aviators' Day and the Brazilian Air Force Day, at Wing 1, in Brasília. The aircraft flew over the air base after an air display of the Brazilian Smoke Squadron.

The partnership with Brazil began in 2014, with the signing of contract for the development and production of 36 Gripen E/F aircraft for the Brazilian Air Force, including systems, support and equipment. An extensive technology transfer programme, which takes place over a ten year period, is already promoting the development of the local aviation industry through partner companies participating in the Brazilian Gripen Programme.

The Gripen E/F fighters that will be delivered to the Brazilian Air Force will be developed and produced in collaboration with the Brazilian technicians and engineers. From 2021 onwards, the complete assembly of 15 aircraft will begin locally. The development of the two-seat Gripen F is advancing with numerous activities at the GDDN.

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VAYU Interview with

Pierre Dickeli, CEO, Safran India Pvt Ltd (Part-II)

VAYU : Please give us 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 defense applications.

HAL LCH (photo: Phil Camp)

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 Airforce 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

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.

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

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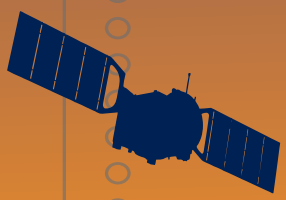


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We had set up a harness facility in Hyderabad last year and now we are setting up a complete cluster there including an engine part manufacturing facility.

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.

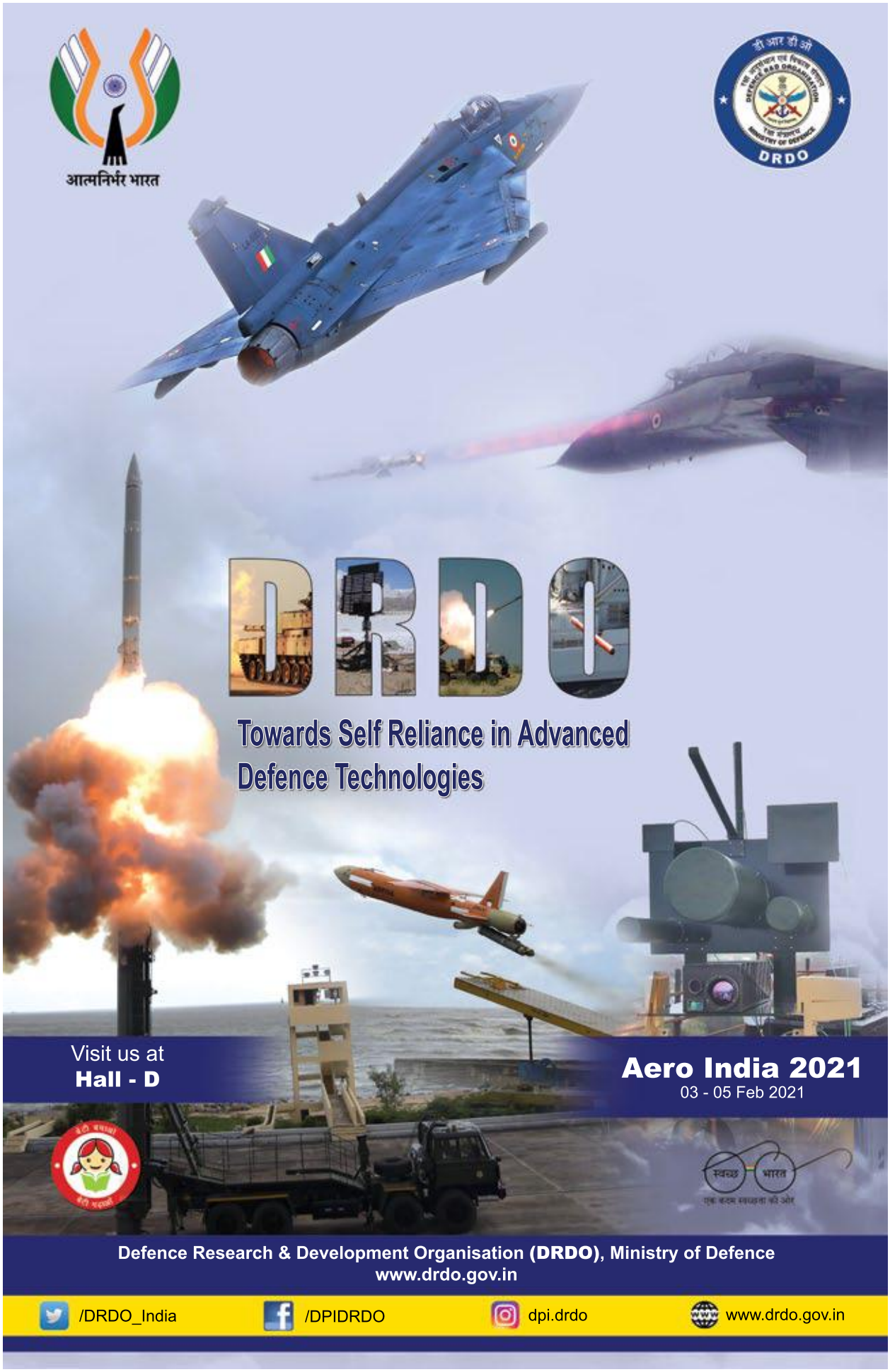
Currently each company has implemented the Group's Covid-19 protocol, along with the measures to adjust and reorganise the workplace, in accordance with strict health, safety and social distancing instructions and other essential health precautions, such as frequent cleaning and disinfecting, limited 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.

Safran Electronic & Power, Hyderabad

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.

First of four new P-8Is for IN

On 18 November 2020 the first of four new Boeing P-8I long range maritime patrol and ASW aircraft arrived at INS Hansa, Goa. The other three P-8Is, under the $ 1.1billion contract signed with the US in July 2016 are to be delivered in 2021 for eventual basing on the Western Coast of India. The earlier eight P-8Is equip INAS 312 at INS Dega in Arakonam (Tamil Nadu).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Rolls-Royce and the Indian Air Force
An association built on the shared vision

The Indian Air Force has been a source of pride for the entire nation. Since its inception in 1932, the IAF's is a remarkable history of achievements, currently the fourth largest in the world in terms of assets and personnel. 'Guardians of the Indian Skies' have a rich history of accomplishments over the last eight decades – and Rolls-Royce with an equally rich legacy – is proud to be associated with the IAF since its inception. Our relationship with the Indian Air Force goes back to the time when our Bristol Jupiter Engines powered their first Westland Wapitis. Since then, we have further strengthened this relationship and today, more than 750 Rolls-Royce engines of 10 engine types are powering different aircraft of the Indian military. Rolls-Royce engines equip a wide range of aircraft in inventory of the Indian Air Force – from combat and strike aircraft (the Jaguar, powered by the Adour Mk811) to trainers (Hawk Advanced Jet Trainer, powered by Adour Mk871) to strategic airlift aircraft (C-130J Hercules, powered by AE2100) and even VVIP and Surveillance aircraft (ERJ145, powered by AE3007).


IAF C-130J (photo: Angad Singh)


IAF Hawk AJT

The RR Defence Service Delivery Centre (SDC) in Bengaluru is the only one in Asia specifically in service of the Indian Armed Forces and Hindustan Aeronautics Limited. The centre is aimed at constantly improving Rolls-Royce's responsiveness to the customer, thus enabling the customer to further improve engine availability. Apart from this, RR field service representatives (FSRs) support IAF personnel to maximise the availability of engines on wings and provide on-ground technical advice directly to the operators, thereby drastically reducing maintenance and overhaul times. We continue to support today's fleets, including those that have been in service for many years. Our global experience and best practices from supporting 160 armed forces in 106 countries, give us the advantage of being a valued partner to the Indian armed forces.

Rolls-Royce identifies with India's potential and supports the government's *Atmanirbhar Bharat* vision even as we are determined to catalyse the goal of strengthening defence manufacturing capabilities in the country. We believe that we are well-positioned to participate in co-development programmes with India to support indigenisation, in line with the country's self-reliance vision. We are today already nurturing high capability engineering skills, developing local supplier base and building capabilities, and seek to embrace opportunities to co-develop and co-manufacture for the growing aerospace and defence sector with select Indian strategic partners. In this way we not only create value and contribute to local economies but also create an ecosystem that enables the sustainable growth of the sector. We have been manufacturing in India with Indian partners for nearly 60 years and are geared to support India's future needs.

Looking at the future, we remain committed to developing the Indian aerospace industry and supporting Indian self-reliance. An excellent example of this is the Adour Mk804/Mk811 (which powers the Jaguar) which was made and continues to be supported by HAL in India, with our support. Along with being active contributors to India's ever-growing defence capabilities, we have been fostering holistic partnerships with key corporate players like Bharat Forge, Godrej & Boyce, Force Motors, Tata Group, as well as various MSMEs and startups, to give a fillip to the nation's supply chain ecosystem. We are also focused on boosting STEM education and leveraging India's engineering talent-pool through our partnership with QuEST and TCS.

Last but not least, we applaud the valour and indomitable spirit of the Indian Armed Forces. Through innovation and a shared vision to co-create and co-manufacture in India, we have and will continue to push boundaries for building a future-ready and truly 'Atmanirbhar Bharat'.

Louise Donaghey, Sr. Vice President, Rolls-Royce

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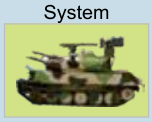
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Empowering the Nation's Defence Forces

MBDA showcases 'Make in India' commitment during Aero India 2021

MBDA, the maker of the Rafale's game-changing weaponry, is showcasing its *Make in India* commitments during Aero India 2021 at Stand B3.4 in Hall B. MBDA is exhibiting a full range of missiles and missile systems designed to provide next generation air combat capabilities, including air dominance, strike and maritime engagement for the Indian Air Force.

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 is displaying the systems it has offered to the Indian Armed Forces as well as its work on MICA missile launchers for the Indian Air Force's new Rafale fighter aircraft.

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 to 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.

Air dominance

Meteor is MBDA's ramjet powered and network-enabled beyond visual range air-to-air missile, which is widely recognised as a game changer for air combat.

At Aero India 2021, MBDA is displaying SCALP which is being delivered for the Indian Air Force's Rafale aircraft.

ASRAAM is being delivered to the IAF as its New Generation Close Combat Missile programme. ASRAAM will arm the IAF's upgraded Jaguar fleet and potentially other IAF platforms.

MICA is being delivered for the IAF's Mirage 2000 upgrade and for Rafale.

Mistral ATAM has been delivered to India to equip the HAL weaponised version of the Advanced Light Helicopter, the ALH Rudra. The same system has successfully undergone integration on the LCH platform also manufactured by HAL.

Battlefield engagement

MMP is the only fifth generation anti-tank missile available in the world, and it has been designed for dismounted infantry as well as for integration on combat vehicles. The technologies pioneered in MMP will be further developed by ATGM5 in India for the specific operational requirements of the Indian Armed Forces.

Maritime superiority

Exocet is well known in India where the submarine variant, SM39, has been delivered to the Indian Navy to arm its Scorpene submarines (Project 75). The AM39 version can be launched from Maritime Patrol Aircraft, strike fighters such as the Rafale as well as medium to heavyweight helicopters.


Marte-ER

Sea Ceptor is the next-generation, ship-based, all-weather, air defence weapon system. Sea Ceptor utilises the CAMM missile that will protect both the host ship and high value units in the local area.

Marte is a family of fixed and rotary wing and ship-launched anti-ship missile weapon systems designed to meet operational requirements in complex littoral environments and blue water scenarios. At Aero India 2021, MBDA is displaying Marte ER, the latest addition to the family.

MBDA - Hall B, Stand B3.4
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Safran's Hammer AASM

First separation tests of 1,000kg 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.

VAYU Interview with Boaz Levy

IAI President and CEO

(Part-II)

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.

Avionic Upgrade Simulator

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.

(Photo: IAI)

Year of the IAI Heron TP

The proliferation of drones in conflict areas highlights the role that large unmanned aircraft systems (UAS) have in modern conflict. The USA, China and Israel are currently the sole providers of large UAS platforms which offer long mission endurance and mission versatility. One of the largest, most advanced systems is the Heron TP from Israel Aerospace Industries (IAI).

Equipped with most advanced avionics, line of sight and satellite communications and multiple mission payloads, the Heron TP climbs up to 45,000 ft, high above commercial air traffic routes, where it can operate on missions spanning over 30 hours, carrying more than 1,000 kg of payload. Its robust structural design features double boom, twin-tail design which is most suitable for such missions, offering better antennae separation, optimal coverage and a stable platform necessary for precision signal measurements.

Israel Aerospace Industries (IAI) had signed a strategic collaboration MOU with focus on UAVs with Hindustan Aeronautics Limited (HAL) and Dynamatic Technologies Limited (DTL) at DefExpo 2020. The MOU reflected existing capabilities developed by IAI over the years and promoted the production of Indian UAVs, in line with the Indian Government's 'Make in India' and 'self-reliance' policy. Strategic partnership with the Indian corporations will allow the implementation of optimal solutions for the needs of the Indian forces based on their specific technologies and needs.

New Mission Capabilities

The Heron TP is configured to carry multiple payloads in a large internal payload bay, with universal payload attachments and underwing hardpoints. Such payloads include electro-optical systems, SAR and maritime search radars, COMINT and ELINT systems as also persistent surveillance systems designed for operation from standoff range.

In addition to the payloads integrated in the aircraft, Heron TP can also carry mission payloads in underwing pods. Such EO pods can deliver in real-time a 3D image of the ground scene, other sensors designed for persistent surveillance, provide continuous coverage of large areas, monitoring all movements over time, enabling analysts to follow objects of interests by specific parameters such as vehicles type, shape and colour, define life patterns and identify anomalies from such patterns.

A new capability provided by the Heron TP is maritime anti-submarine surveillance, integrating maritime surveillance radar, EO payload, magnetic anomaly detector (MAD) and sonobuoys that are dropped on water and transmit sonar data to the aircraft. With this equipment, the Heron can detect submarines underwater and track them at periscope depth. On such missions, Herons are launched from land bases but can be controlled from ships at sea. At twice the speed of other drones, and long mission endurance, the TP can cover larger areas, well out at sea. Flying higher than other drones and using EO payloads covering extremely long range, the Heron TP significantly enhances mission capabilities of maritime surveillance and ASW in its ability to move quickly to new positions and recognise targets without descending to a lower altitude, or from stand-off range.

"A Good Year for the Heron TP"

Operationally deployed with Israel's Air Force since 2010, the Heron-TP has performed countless missions, extended farther and longer than any other manned or unmanned aerial combat system. "90 percent of our activity covers the northern theatre, where we are required to provide persistent surveillance and real-time intelligence," stated Lt Colonel S of the 210th Squadron, "The Heron TP enables us to operate farther and extend our vision even longer". In 2018, the Indian Air Force took delivery of additional Heron TPs that significantly increases the UAV fleet size and increases operational flight hours by 70%.

Germany will soon become the second operator of Heron TP, following the award of €1 billion contract to Airbus in June 2018. The contract funds operational leasing of five Heron TP drones, for a period of nine years.

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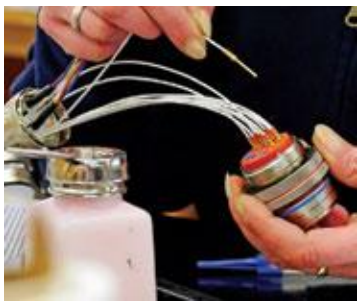

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The project will have a two-year set up phase, followed by an operational phase for a further seven years.

A month after the German announcement, the Indian government approved procurement of Heron-TP platforms to augment the fleet of Heron I's operated by the Indian Air Force. Similar to the German configuration, these platforms will offer enhanced mission capabilities, addressing an urgent Indian requirement for unmanned weapon-carrying platforms. The new Heron TP platform will further extend capabilities of the current Heron I, enable the Indian operators to fly missions higher, farther and with more versatile, heavier loads.

Courtesy: IAI

Airbus Helicopters resilient in 2020

In 2020, Airbus Helicopters logged 289 gross orders (net: 268) in a challenging market heavily impacted by the economic consequences of the COVID-19 pandemic, reinforcing the company's position on the civil and parapublic market. Additionally, the company delivered 300 rotorcraft worldwide despite the pandemic travel restrictions, resulting in a stable 48% share of the civil and parapublic market and thus allowing Airbus Helicopters to maintain its 'market-leading position'.

Order highlights for 2020 consisted of 84 helicopters for the 'best-selling' H145, including 17 UH-72B for the US Army, the first Fenestron and Helionix-equipped versions to be ordered. The H135 achieved sales with 33 units and also received the EASA certification of an alternate gross weight as well as a new single pilot IFR cockpit layout at the end of 2020. Milestone Aviation and Heli-Union both became new customers for the multi-mission H160, ordered to address a wide range of missions including offshore transportation.

The NH90 had a successful 2020 with the Bundeswehr placing an order for 31 naval helicopters. The French Armament General Directorate confirmed the development of a new Standard 2 version to equip the French Special Forces and the first NH90 for Qatar performed its maiden flight at the end of the year.

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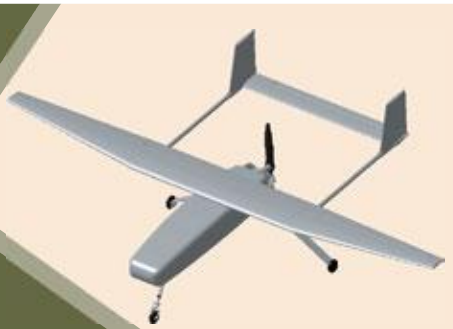

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(Part II)

The Dassault Rafale – for all Reasons!

French cooperation in creation of the IAF's manned airborne nuclear deterrent is a very little known, closely guarded both by French and Indian governments to prevent international criticism. During the 1980s, as the IAF "discovered" the Mirage 2000H/TH to be an excellent nuclear delivery platform, it began necessary modifications, an apparent feature being change of standard livery usually associated with air defence variants to 'camouflage' external body paint. Of course, far more radical changes were those internal, with generous assistance of the French government and aviation industry. It is rumoured that Dassault Electronique/Thomson-CSF Antilope V terrain-following radar (as on *Adl'A* Mirage 2000N nuclear strike platforms permitting automatic flight down to 61-metre and altitude-contrast updating of navigation system) had been installed on select IAF Mirage 2000H/THs along with reinforced radomes and twin INS. Optimum performance during nap-of-the-earth penetration of enemy airspace and strike is thus facilitated, the aircraft still powered by its single yet most reliable Snecma M53-P2 turbofan engine.

Similar cooperation from Dassault has perhaps been assured in "hardwiring" of the Rafale. This would include airframe reinforcements particularly near the appropriately shorter and thickened central pylon and the inboard wing pylons, with the pylon data bus being of a more complex nature with additional connecting pins well in conjunction of differently programmed attack computers, with restricted access.

In French Air Force service, the ASMP-A Land-Attack Cruise Missile (LACM) is tasked for airborne nuclear strike. Compactness of the ASMP-A can be judged by the fact that this formidable nuclear missile measures just over 5-metres in length with a weight of only about 850lb. The ASMP-A has a range of about 500 km at speeds of Mach 3, the extended range ensuring survivability of the launch platform from enemy air defences. The missile retains a speed of Mach 2 during low-level advanced and complex penetration mode with a high (yet undisclosed) degree of accuracy.

One of the IAF's first Rafales (BS 001) at AFS Ambala, on 10 September 2020 (Photo: Angad Singh)

A similar indigenous or joint-developed LACM integrated with the Rafale's centreline pylon would enable the IAF's Rafales, with air-to-air refuelling (AAR) and conformal fuel tanks (CFT) to conduct precision strikes against an array of enemy counter-force and counter-value targets ranging from airfields to overland communications, command and control centres in face of intensive air defence installations over land or the seas without penetrating enemy›s terrestrial or warship-based air defence systems.

Interestingly, the possible commonality of weaponry of the IAF's Sukhoi Su-30MKI and Dassault Rafale may well have served as a strong catalyst for selection of the French fighter. Looking ten years down the line, an emerging IAF multi-role fighter fleet of Sukhoi Su-30MKI, Dassault Rafale and upgraded Mirage 2000H/THs comprising a score of squadrons and further supported by at least two squadrons of Jaguar DARIN IIIs would certainly represent the most potent air power in the Asian continent.

It is important to note that assimilation of the French-origin Rafale in IAF service will be relatively smooth as the IAF has closely followed French combat tactics and procedures developed along with formulation of syllabus and Standard Operational Procedures (SOP) after the induction of Mirage 2000s in 1985.

Sayan Majumdar

The first batch of IAF Rafales at Dassault Aviation Facility Merignac, France (photo Dassault)

Greece contracts for 18 Dassault Rafales

Eric Trappier, Chairman and CEO of Dassault Aviation, and Theodoros Lagios, Director General of Armament and Investments of the Greek Ministry of Defence, signed in Athens, in the presence of Mrs. Florence Parly, French Minister of the Armed Forces, and Mr. Nikolaos Panagiotopoulos, Greek Minister of National Defense, two contracts respectively for the acquisition of 18 Rafale aircraft and for the associated logistic support.

The order for 18 Rafales includes 12 Rafales recently in service with the French Air Force and 6 new Rafales produced at Dassault Aviation plants. To meet the urgent need of the Greek authorities, the deliveries of aircraft will be begin in the summer of 2021 and will be spread over two years. The logistic support contract will support the Hellenic Air Force Rafale's air activity over four and a half years, maintaining the availability of equipment and systems at the highest level. The arrival of the Rafale in Greece highlights the quality of the strategic relationship between Greece and France and the continuation of more than forty-five years of solid partnership with Dassault Aviation and its industrial partners Thales and Safran.

As with the Mirage F1 in 1974, the Mirage 2000 in 1985 and finally the Mirage 2000-5 in 2000, the Rafale is an opportunity to launch new cooperation's with the Greek aerospace industry.

MBDA to arm Hellenic Air Force's Rafales

The new aircrafts' weapons will benefit from the strong commonality with those from the Mirage 2000s and Mirage 2000-5s currently in service in the Hellenic Air Force. Like these, the Rafales will be armed with SCALP cruise missiles, AM39 Exocet anti-ship missiles and MICA multi-mission air-to-air missiles. Additionally, MBDA will also supply Meteor beyond visual range air-to-air missiles.

MBDA's SCALP on the Rafale

Rafael's SPIKE Missiles – game changer for helicopters

In today's rapidly changing battlefield, the combat helicopter holds a central and important role. The combat helicopter is a valuable asset for the military commander both in defensive and offensive missions. In the modern battlefield, helicopters are required to operate under high threat that limits their ability to be effective. Currently, Combat helicopters mainly operate close to the enemy, within line of sight.

Rafael's Spike ER2 and Spike NLOS can be easily migrated and installed on different platforms. This complete commonality makes them an effective solution, allowing highly mobile operation and an unparalleled radius of up to 32 km. This allows great operational flexibility with low risk to the helicopter and its crew.

SPIKE helicopter integration

Spike weapon system is already operational on many helicopters: it is operational on Apache, Blackhawk, Tiger and many other helicopters. It provides these helicopters a game-changing capability of Standoff ranges with high accuracy, low threat to the helicopter and high effectiveness.

The SPIKE Missile Family

The SPIKE missiles are multi-purpose and multi-platform (air, ground, naval) weapons that have accumulated a substantial track record of target engagements including tanks, air defence targets, armored vehicles, soft vehicles, marine vessels and structural targets. Spike ER and Spike NLOS can be easily migrated and installed on different platforms. This complete commonality makes them an effective solution for coastal guard vehicles, allowing highly mobile operation and an unparalleled radius of up to 32 km. Such an application is in use by South Korea's Marine Corps on the Sand Cat vehicle.

The SPIKE Missile Family for helicopters includes Spike NLOS (Non Line Of Sight) – 32km range, 75 kg and Spike ER2 (Extended Range) – 16km (air launch), 34 kg.

SPIKE NLOS: 32 km

SPIKE NLOS Missile Weapon System is a true force multiplier enabling engagement of targets at ranges of up to 32 km during the day, night and adverse weather. The long range of the Spike NLOS Missile enables the helicopter to attack a target without exposing itself to enemy fire.

The system provides the helicopter with the unique ability to engage targets at significant stand-off range without line of sight. The Spike NLOS can be operated in either direct attack upon target detection using either Lock On Before Launch (LOBL) / Lock On After Launch (LOAL) Modes or firing from standoff in automatic navigation mode based on target coordinates (using the missile-embedded INS unit). A bi-directional advanced RF data link enables transmission of the missile seeker video image, enabling real-time updating or steering of the missile FOV.

SPIKE ER2 (Extended Range) to 10-16 km

The Spike ER2 Missile Weapon System is a light multi-purpose missile system for operation up to 10 km when ground launched (using a Fiber optic data link) and up to 16 km when fired from a helicopter (using a RF data link). Spike ER2 weighs only 34 kg, enabling it to be mounted on almost any light helicopters (such as Fennec AS550 scout, Bell 407, AW109 or the MD 530) as well as on heavier combat helicopters. Spike ER2 continuous the legacy of the Spike ER which has a standoff range of 8 km. The Spike ER2 includes an advanced electro-optical seeker with a robust multispectral target tracker (enabling sensor data fusion to track target in both day sensor & IR sensor simultaneously).

SPIKE ER2, like the rest of the SPIKE Family, includes as the basic mode "Fire & Forget" (F&F) capability, allowing the combat helicopter to "shoot and scoot" or engage multiple targets over a very short time. Its bi-directional data link includes two options: a unique fiber-optic-based technology or an encrypted RF data link, the two options provide a secure data link for real-time feed of seeker video image to the platform, allowing the operator to "Fire and Observe" (F&O) with no requirement for line of sight to target, and pinpoint the impact, controlling the required effect on the target (destroy, neutralise or disable). Spike ER2 includes a selection of warheads including anti-tank or anti-structure/anti-ship.

Rafael's BNET family

Rafael is a worldwide leading supplier of advanced defence systems with proven successful operational track record worldwide. Rafael is a major supplier of communication systems to the Israel Defence Forces (IDF) and the main communication supplier to the Israeli Air Force (IAF), particularly in the areas of broadband radio, wireless immune and secure jam-resistant networks, UAV communication and missile data-links.

The BNET SDR Family is the world's most advanced product family of its kind, integrating advanced wideband network capabilities with interoperability between all radio types for the tactical manoeuvring forces, battle group and below, and also as an option for mid-tier communications. All BNET radios family shares the same architecture and same baseband waveform implementation in different form factors. All BNET SDR family members support common Waveforms (WF).

BNET 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 radios of land, sea, and air units participate in one scalable MANET network. A single BNET MANET is used to connect all of the platoon, company command and battalion command platforms within a battalion. Multiple subnets are established to support the different voice and data communities-of-interest (e.g., battalion command net, company command nets, platoon nets). Real-time data flow by BNET allows better and faster decision making by commanders and integration of all systems through BNET radio, shortens dramatically the Sensor to Shooter cycle and enables combat units to react immediately.

The solution is fully interoperable with legacy as well as third party systems, and together with these, supports the modern digital battlefield by managing efficiently and effectively the information flow of high-speed broadband data, voice, and video from any reciever within all platforms simultaneously, on the move, and based on the ongoing stage of the operation.

Rafael specialises in the development, manufacture, and supply of SDR tactical radio solutions across a variety of spectrum bands, with an emphasis on advanced, immune, and secure network solutions. We provide our customers with the diverse, advanced services required by modern militaries employing the latest technology, focusing on network-centric operations including interoperability capabilities with other radio solutions.

Rafael is involved (during the last 15 years) in the development and supply of cutting-edge communication systems targeted for Network Centric Operations (NCO). Rafael first generation NCO system is the L-band radio, which was followed by two generations of the Ravnet system, which is a pioneer in airborne communication utilising the UHF band to provide simultaneous voice and data networks and hence much effectively utilise this air force valuable spectrum.

In anticipation of the worldwide new requirements for fully digital true Software Defined Radio (SDR) system, Rafael has assembled a comprehensive team of experts specialising in communication and advanced electronics. The goal of this team was to combine Rafael state-of-the-art capabilities in digital processing with its robust SDR architecture and its innovative suite of voice and data waveforms. This effort has been resulted with a family of new generation SDRs: the Global-Link / BNET family for air and ground communications. This family is based on wideband ultra fast sampling technology.

- Rafael has already delivered 1000s of Global link/Netcor V/UHF/L Band SDR systems.
- The Global Link system is in contract for 6 customers, including the IDF and worldwide customers. The SDR has already passed flight tests demonstrating live video transmission in L+ UHF band and is operational.
- The Global Link system won the Indian SDR tender of 1000 radios.

LM delivers 123 F-35s in 2020

Lockheed Martin delivered the 123rd F-35 aircraft of 2020 in the last week of December. 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.

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.

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.

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.

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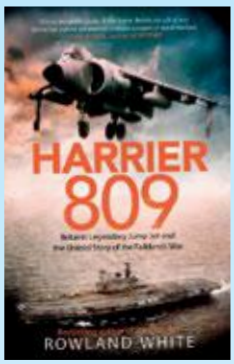

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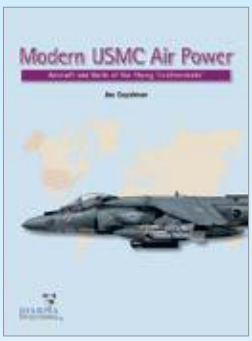

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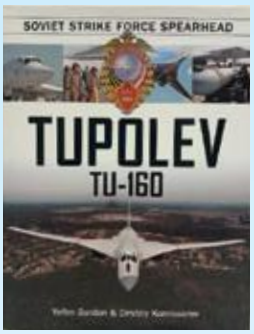

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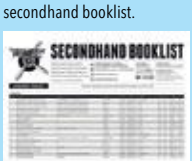

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(Part-I)

DRDO major achievements during 2020

Industry as Development-cum-Production Partner

The present industrial base for the DRDO consists of 1800 MSMEs along with DPSUs, Ordnance Factories and large scale industries. The DRDO has taken major initiatives through various policies to involve Indian industry as Development-cum-Production Partners (DcPP), offering its technology to industry at nominal cost and providing free access to its patents. This initiative is to support the fast growing Indian defence industrial ecosystem and help industry to contribute towards *'Atmanirbhar Bharat'* in a big way.

DRDO identifies 108 Systems & Subsystems towards achieving 'Atmanirbhar Bharat'

Responding to the call given by India's Prime Minister for *Atmanirbhar Bharat*, the DRDO has taken several initiatives to strengthen the indigenous defence ecosystem. A DRDO delegation appraised the Defence Minister Rajnath Singh on 108 systems and subsystems identified for design and development by Indian Industry.

LCA Navy operates from INS *Vikramaditya*

After completing extensive trials on the Shore Based Test Facility (SBTF), Naval version of Light Combat Aircraft (LCA) carried out a successful arrested landing onboard INS *Vikramaditya* on 11 January 2020.

DRDO at Republic Day parade

DRDO developed products including surface-to-air missile 'Akash', beyond visual range air-to-air missile 'Astra', anti-satellite (ASAT) missile, light combat aircraft 'Tejas', mobile bridging system 'Sarvatra' and air defence tactical control radar were displayed as part of different tableaux of the DRDO and the Armed Forces during the Republic Day Parade.

DRDO at DefExpo 2020

DRDO had displayed more than 500 indigenously-developed products during DefExpo 2020 held at Lucknow in February 2020. Included was the Light Combat Aircraft (LCA), Advanced Towed Artillery Gun System (ATAGS), Main Battle Tank (MBT) Arjun Mk-1A, Wheeled Armour Platform (WhAP), Counter Mine Flail (CMF) and Advanced Composite Modular Bridging System (ACMBS).

The 'Atulya' Air Defence Fire Control Radar (ADFCR)

Air Defence Fire Control Radar (ADFCR) in conjunction with Anti-Aircraft Guns form part of the Ground Based Air Defence System whose main purpose is effective point defence against air threats at short and very short ranges during day and night under all weather conditions, also in presence of enemy jamming. The radar has been developed as an indigenous solution after DAC approval for large quantity required for Indian Army. During February 2020, Phase-I of User Assisted Technical Trials (UATT) i.e. high-altitude low temperature tests were completed.

Advanced Light Weight Torpedo (ALWT)

The Advanced Light weight Torpedo (ALWT) is an anti-submarine torpedo launched from ship, helicopter or a fixed-wing aircraft. The presence of enemy target is detected by the sonar onboard a ship or an aircraft. Based on target parameters estimated by the sonar and Fire Control System, the torpedo is fired with a few preset parameters "to ensure that the weapon is in most favourable position to acquire the target, home in and destroy it". During March 2020, dynamic trials including homing and guidance logics were conducted. "The ALWT has consistently achieved good homing range including 3 steer away with increased target range and reduced target strength".

Software Defined Radio (Airborne)

The SDR secure indigenous system has legacy communication, and secure digital voice/data communication support secure digital voice/data communication for Naval applications with 3 channel, 4-channel for Tactical Communication and single channel operation in V/UHF and UHF band. During March 2020, two 4-channel CEMILAC SOFT certified SDR-AR system installation and integration were successfully carried out on two Indian Naval Dornier 228s with SDR-AR ground station at HAL.

***Dhruvastra* 3rd generation helicopter launch anti-tank guided missile**

The DRDO successfully conducted three flight tests of its indigenously-developed anti-tank guided missile (ATGM) *Dhruvastra* at the Integrated Test Range at Chandipur in Odisha, in July 2020. This is considered as one of the most advanced anti-tank weapons extant.

Anti-Drone System

During Prime Minister Narendra Modi's address to the nation on the 74th Independence Day, DRDO's anti-drone system was deployed at the Red Fort for ensuring security. This system capable of bringing can bring down micro drones through either jamming of command and control links or by damaging the drones through a laser-based Directed Energy Weapon.

Hypersonic Technology Demonstrator Vehicle flight-tested

The DRDO-developed the hypersonic air-breathing scramjet technology was flight tested with the Hypersonic Technology Demonstration Vehicle (HSTDV) at Wheeler Island, off the coast of Odisha in September 2020. The Vehicle was launched using a proven solid rocket motor, which took it to an altitude of 30 kms, where the aerodynamic heat shields were separated at hypersonic Mach number. The hypersonic combustion sustained and the cruise vehicle continued on its desired flight path at a velocity of six times the speed of sound for more than 20 seconds.

DRDO Young Scientist Laboratories (DYSLs)

The Prime Minister has dedicated to the Nation five DRDO *Young Scientists Laboratories* (DYSLs), located at Bengaluru, Mumbai, Chennai, Kolkata and Hyderabad. Each lab will work on a key advanced technology *viz.* artificial intelligence, quantum technologies, cognitive technologies, asymmetric technologies &smart materials respectively.

Russian Helicopters delivers first Ansat to operator in Europe

Russian Helicopters has delivered the first of three Ansat helicopters to a client in Europe. The operator of the rotorcraft, which is equipped for medical operations, is the Ministry of Interior of the Republika Srpska (Bosnia and Herzegovina). This is the first of three helicopters under the delivery contract. The Ansat for Republika Srpska comes with a medical module equipped with a stretcher and a medical shelf. Ansat is certified for use in the temperatures ranging between -45°C and +50°C, and in high mountains.

Russian Helicopters to supply two Mi-38s to RuMoD

Russian Helicopters has signed a contract with the Russian Ministry of Defence for two Mi-38 helicopters. The first serial produced Mi-38 helicopter was introduced to the general public at MAKS-2019 International Aviation and Space Salon, where it was demonstrated to the President of Russia Vladimir Putin and the President of Turkey Tayyip Recep Erdoğan. The design of Mi-38 is based on a single-rotor scheme and a twin-engine power plant.

Russian Helicopters to develop a modern shipborne helicopter

Russian Helicopters has signed a contract with the Russian Ministry of Defence for the development of a modern shipborne helicopter. "This marks a new stage in the development of a modern shipborne helicopter. Earlier, working together with the Russian Ministry of Defence, we established the terms of reference required for R&D side of this project. Now we have validated the project with the signing of relevant documents", stated the Director General of Russian Helicopters Andrey Boginsky.

Assembling the first Mi-171A3 'Offshore Helicopter'

Russian Helicopters holding company (part of Rostec State Corporation) has started assembling the first prototype of Mi-171A3 offshore helicopter. Equipment for assembling the fuselage was put into operation at the Ulan-Ude Aviation Plant. Mi-171A3 comes with several significant upgrades when compared to Mi-171A2: a new airframe that integrates a crash-resistant fuel system into the cargo bay floor and modernised avionics, upgraded for offshore operations and flights in the Arctic.

Rosoboronexport mobile radar to detect stealth aircraft

Rosoboronexport (part of the Rostec State Corporation) has started promoting the P-18-2 Prima high-mobility 2D surveillance and acquisition radar, developed and manufactured by PJSC NITEL and PJSC NPO Almaz, to the foreign market. The Prima solid-state radar is based on modern hardware components and digital signal processing and generation technology. It features high energy potential and increased immunity. The radar is designed to detect, track, locate and identify air targets of various classes and types as friend or foe in both jamming and clutter environments, take the bearing of jammers, and feed radar data to users' automated command-and-control systems.

The Prima radar operates in the VHF band and is capable of detecting any aircraft, including stealth ones. Its range coverage exceeds 320 km and elevation coverage is up to 45 deg. The minimum detection range is 500 meters. The manufacturers have introduced a number of technology solutions to ensure the radar's operation in a jamming environment, difficult terrain and in adverse weather conditions. The radar automatically detects and tracks low-speed and low-visibility targets in a clutter environment. The radar is equipped with advanced satellite navigation equipment exploiting GLONASS/GPS signals that provide automatic positioning. It has a built-in diesel power plant and a power take-off generator, and can also be connected to a three-phase general-purpose electrical network.

Rosoboronexport presents state-of-the-art radar, capable of detecting hypersonic targets

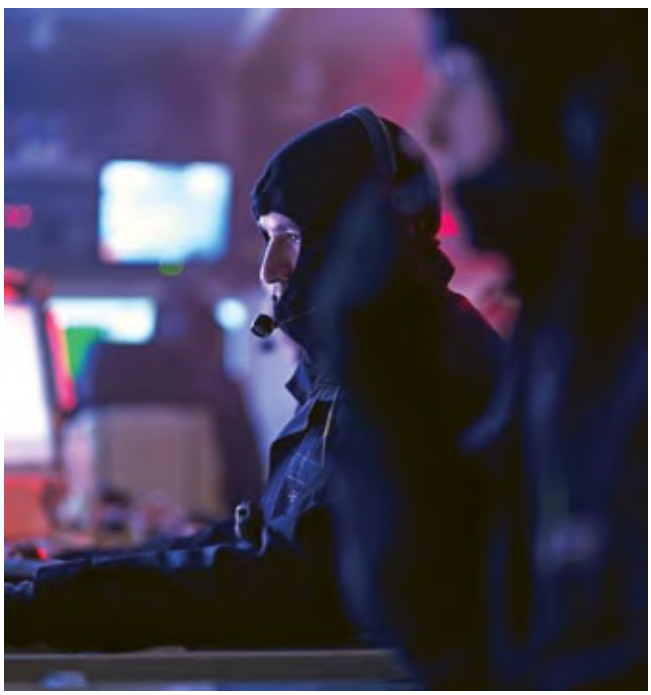
Rosoboronexport has started promoting the 59N6-TE mobile three-dimensional radar, developed and produced by the JSC "Federal Research and Production Center "Nizhniy Novgorod Research Institute of Radio Engineering" (NNIIRT).

The 59N6-TE radar provides for the measurement of the range, azimuth and altitude of aerial targets. It is capable of detecting objects, flying at a speed of up to 8000 km/h at a range of up to 450 kilometers and at an altitude of up to 200 kilometers. After detection, it exchanges radar information with C4I complexes. It operates in conditions of jamming and carries out direction finding of active noise jammers.

Saab Submarines and Air Defence Systems

Saab delivers upgraded 'Gotland'-class submarine

Saab has delivered the second submarine of *Gotland*-class to the Swedish Defence Materiel Administration (FMV) after a mid-life upgrade. Taking all necessary measures to ensure the submarine's operational availability, the upgrade includes new sensors and navigation systems, giving the vessel enhanced capabilities. The delivery of HMS *Uppland* was conducted at a ceremony in Karlskrona, Sweden, the second submarine in the *Gotland*-class to have gone through major upgradation.



Saab and Bulgarian Navy's new Patrol Vessels

Saab has signed a contract with the German shipbuilding company Lürssen to provide and integrate combat system for the Bulgarian Navy's new *Multipurpose Modular Patrol Vessels*, MMPV. Lürssen is the prime contractor to the Bulgarian Ministry of Defence, and will build the two new patrol vessels at the Bulgarian shipyard MTG Dolphin JSC. The vessels are scheduled to be delivered to the customer between 2025 and 2026.

Integrated ground based Air Defence System

Saab has signed a contract with the Swedish Defence Materiel Administration for an integrated sensor and command and control system for use with ground based air defence. The order value is approximately 2.1 billion SEK and the contract period is 2020-2025.

Elbit's Diverse Programmes

Elbit Systems has been awarded a $50 million follow-on contract from the Dutch Ministry of Defence to supply the Royal Netherlands Army with additional digital soldier and vehicular systems, expanding the soldier modernisation programme of the RNLA. Under the contract, Elbit Systems will supply digital soldier systems and vehicular integration of improved combat network capabilities including TORCH-X Dismounted Command and Control systems and E-LynX Software Defines Radio systems.

Elbit XACT *nv32* micro NVS for Netherlands

Elbit Systems has also been awarded an approximately $15 million initial contract from the Dutch Ministry of Defence to supply XACT *nv32* micro night vision monocular systems for the Armed Forces of the Netherlands. Compact and light weight, with a flip-up head/helmet adapter, XACT *nv32* provides high resolution images under adverse conditions while minimising Line-Of-Sight deviation and is suitable for mounted and dismounted soldiers, Special Forces and law-enforcement teams.

Elbit's E-LynX for the Swiss Armed Forces

Elbit has been awarded a $338 million contract by the Swiss Federal Department of Defence to provide the Swiss Armed Forces with an army-wide tactical mobile Software Defined Radio (SDR) network solution under the Telecommunications Armed Forces digitisation programme.

Elbit's Flight Training Programme of the Hellenic Air Force

Elbit has been selected to establish and operate the International Flight Training Centre of the Hellenic Air Force for an amount of $1.68 billion over a period of approximately 20 years. The programme calls for Elbit Systems to deliver a training aircraft fleet equipped with the Company's avionics and embedded training solutions, flight simulators/training aids and provide through-life logistical support.

Israel's T-6 and M346

Israel Aerospace Industries gives new life to veteran helicopters

BlackHawk avionics

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.

Avionic upgrade simulator

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, 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.

Successful maiden test of DRDO Akash-NG missile

DRDO conducted the successful maiden launch of Akash-NG (New Generation) Missile from Integrated Test Range off the coast of Odisha on 25 January 2021. Akash-NG is a new generation Surface to Air Missile meant for use by Indian Air Force with an aim of intercepting high maneuvering low RCS aerial threats.

The Akash-NG system has been developed with better deployability compared to other similar systems with canisterised launcher and much smaller ground system footprint. The test launch was carried out by a combined team of DRDO, BDL & BEL in the presence of the representatives of Indian Airforce.

Thales: "steadfast partner in India's growth story"

As India marches towards its goal of *Atmanirbharta* or self-reliance, it opens up immense opportunities for local and global organisations across the defence and aerospace sectors among others to work together and strengthen the industrial ecosystem in the country.

Backed by its strong presence in diverse verticals like defence, aerospace, transportation and digital identity and security, Thales has been an unwavering partner in India's ambitious plans and growth story by sharing its niche technologies and expertise. As a company driven by its purpose of building a future one can trust, Thales has been striving to closely work with its customers and cater to their requirements with the best possible solutions. Recently, Thales moved to a bigger and smarter India headquarters in Noida, Uttar Pradesh that also has a bigger engineering centre dedicated to its digital identity and security business. This new office is a key stake for Thales in India, symbolises the Group's long-term commitment to the country, and demonstrates how Thales is growing bigger and becoming more 'local'.

In its journey of close to 70 years in the country, Thales has built a mature industrial footprint backed by its joint ventures with Bharat Electronics Ltd (BEL) dedicated to radars, with Samtel dedicated to military avionics and Reliance Aerostructure Limited for electronic warfare and airborne radar as well as over 75 supply chain partners and other industrial partners. The company has also been closely working with Hindustan Aeronautics Limited (HAL) for over five decades.

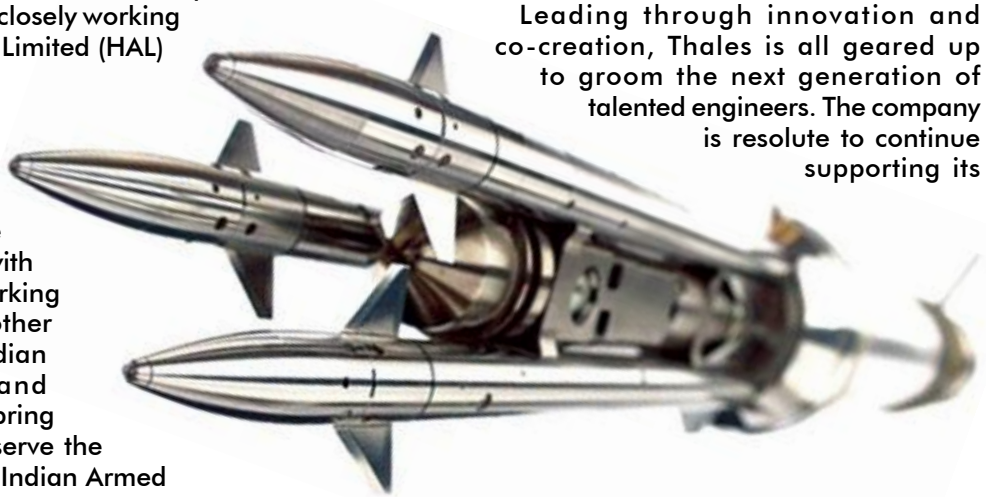
Thales is a proud member of the Rafale India team. It has also successfully undertaken the upgrade of the Mirage 2000 programme together with Dassault Aviation while working closely with HAL, among other key programmes of the Indian Air Force, Indian Navy and Indian Army. It continues to bring its latest technologies that serve the modernisation needs of the Indian Armed Forces.

Lightweight Multi-role Missile (Image: Thales)

Thales also understands the potential and the societal impact of the digital revolution that the world is witnessing. The company's investment of more than 7 billion euros globally in digital innovations such as connectivity, Big Data, artificial intelligence, and cybersecurity stands as a testament to this belief. These technologies have been supporting businesses and organisations across different sectors in which Thales operates and also governments in their decisive moments.

Innovation, fostered by research and development, is a key value for Thales. Its Engineering Competence Centres (ECC) in the National Capital Region and Bengaluru coupled with its tie-ups with Indian academia, embody this key value. The Bengaluru engineering competence centre specialises in defence, aerospace, and transportation, while the one in Noida and Gurugram is focused on Digital Identity and Security including cybersecurity, IoT, biometric as well as big data analytics solutions.

Leading through innovation and co-creation, Thales is all geared up to groom the next generation of talented engineers. The company is resolute to continue supporting its



STARStreak (Image: Thales)

customers' ambitions as they push towards the future, powering the India of tomorrow, today!

Going forward, Thales will continue to develop capabilities for local engineering, procurement from India and strengthen its local partnerships. Building collaborations with the Indian industry and transforming the country into a defence manufacturing hub shall remain a priority of Thales' focus for India.

Thales at Aero India 2021

Thales is enthusiastic about its participation at Aero India 2021, the Show providing an opportunity for Thales to present its flagship capabilities that support the modernisation plans of the country's defence forces. This year, the spotlight will be on Thales' 'Make in India' commitment and contribution towards building of *Atmanirbhar Bharat* by way of local partnerships and design and development. Visitors at the Thales stand will be able to experience cutting-edge technologies across civil and defence aerospace as well as land and naval defence including its latest airborne surveillance radar, the AirMaster C, for the first time in India.

Mr Emmanuel de Roquefeuil, VP & Country Director, Thales in India

Aequs Aerospace-Saab JV major milestone in Airbus A321 Programme

Aerostructures Assemblies (AAIPL), a joint venture between Aequs Aerospace and Saab AB, marked an important milestone with completion of the 100th shipset each of Over Wing Exit Doors (OWED), skeleton assemblies and Door 3 Plugs (D3P). The shipsets were completed "well on time" by AAIPL establishing the company's competencies in complex assembly of the D3P and a strikingly high build rate for the OWED.

Although initiated on different dates, both projects achieved this significant milestone in a matter of 29 months (for D3P) and 11 months (for OWED). The D3P assembly manifests an intricate build-to-print assembly, while the OWED skeleton is mapped for a steeper build rate requirement. Present on the occasion were Rémi Maillard, President & Managing Director at Airbus India & South Asia along with Thierry Cloutet, Head of Procurement, India & South Asia of Airbus.

AAIPL has established itself as a strong supply chain player and has been making door plugs for Airbus' A321neo Cabin Flex configuration since 2017 and producing wing panels and D-nose assemblies for the A380 programme since 2014. Besides end products, its capabilities also include development of assembly tools, jigs, and fixtures for domestic business. The AAIPL facility is located within the Aequs SEZ, the country's first *Notified Precision Engineering Special Economic Zone* (SEZ), at Belagavi in Karnataka.

Pratt & Whitney GTF Engines achieve 'World-class Reliability'

Pratt & Whitney's GTF engines powering the A320neo family have achieved a world-class engine dispatch reliability rate of 99.98%. The GTF engine powers more than 900 aircraft across nearly 50 airlines and three aircraft families: Airbus A320neo, Airbus A220 and Embraer E-Jets E2. GTF engines have saved more than 400 million gallons of fuel and over 3.8 million metric tonnes of carbon emissions since they entered service in 2016.

"Thanks to upgrades completed in close coordination with our customers in 2020, GTF engines for the A320neo family are now delivering industry-leading reliability," stated Carroll Lane, President of Commercial Engines at Pratt & Whitney. "When you combine this with our best-in-class fuel efficiency and low carbon emissions, it›s easy to see why GTF-powered fleets have seen high utilisation as the industry begins to recover."

The fleet has achieved an exceptional level of operational performance: A320neo family aircraft with GTF engines have averaged more flights and more hours per day than comparable aircraft. "The GTF-powered A320neo family is currently operating at about 90% of its pre-pandemic utilization levels," added Lane. "The A220, E190-E2 and E195-E2 have also proven their value with our customers, with airlines depending on them for the right mix of capacity, range and economics. These aircraft have been operating at about 80% of pre-COVID utilisation throughout much of the crisis."

Pratt & Whitney accomplished this by taking advantage of the downtime afforded by the crisis, during which the company developed "quick turn" shop visit capability to incorporate product upgrades across a rapidly growing service network. This year the company announced that four new facilities would join the GTF MRO network: Aircraft Maintenance and Engineering Corporation (Ameco) Beijing, MTU Maintenance Zhuhai, OGMA in Portugal and China Airlines in Taiwan. Air India Engineering Services Limited (AIESL) was announced as a provider of maintenance services in support of GTF operators in India and the surrounding region. Additionally, two network facilities completed their first engine overhauls: Delta TechOps in the US and EME AERO in Poland.

In 2020, the company welcomed new customers to the growing GTF family. These included Aegean Airlines, China Express Airlines, Middle East Airlines and SWISS, which each took delivery of their first GTF-powered A320neo family aircraft, while Air Canada entered service with its first A220 aircraft and Juneyao Air began operations with its first A320neo aircraft.

"Our customers IndiGo and GoAir were early adopters of the revolutionary GTF engine, and we are happy to say that these engines have crossed two million flight hours in India," stated **Ashmita Sethi, President and Country Head for India at Pratt & Whitney** (in photo). "With more than 180 GTF-powered aircraft in India and an extraordinary engine dispatch reliability rate of 99.98%, our customers are recognising the superior fuel efficiency that GTF engines deliver. Since cost savings are especially important in the current environment, we›ve seen airlines prioritise operating their GTF-powered aircraft before any others."

Courtesy: P&W

Dassault Systemes at Yelahanka


'Reinvent The Sky'

With the theme of 'Digitalisation to realise a thriving Aerospace, Defence & Space ecosystem' at Aero India 2021 (Booth no - A6.6 & A6.8): Dassault Systemes is showcasing key Industry Solution Experiences for the Aerospace & Defence sector:

Build to Operate based on the 3DEXPERIENCE platform, it accelerates meeting production targets and increases manufacturing capacity. The solution offers aerospace Original Equipment Manufacturers (OEMs) and suppliers the ability to implement lean practices, integrate new technologies and meet demand without sacrificing either quality or schedule.

Ready for Rate enables flexible production while delivering products with first-time quality, on budget, and on schedule. Aerospace manufacturers can take advantage of the 3DEXPERIENCE platform to implement lean practices that remove waste in critical areas of manufacturing.

Engineered to Fly allows small and medium suppliers to grow their business profitably from bid to delivery. By connecting the dots, the 3DEXPERIENCE platform reduces complexity to develop new bids, collaborate during product development and facilitate manufacturing ramp-up.

Reinvent The Sky supports startups, small and medium enterprises and OEMs in developing disruptive solutions: from small, light aircraft to electric vertical take-off and landing, as well as space launchers and satellite propulsion. Companies can accelerate the product lifecycle from concept to certification, and gain significant advantage by being the first on the market with their prototype.


Ravikiran Pothukuchi, Director & Industry lead for Aerospace & Defence in India, Dassault Systemes

Co-Design to Target allows Original Equipment Manufacturers (OEMs) to integrate disparate tools, organisations and processes into a single stream to optimise form, fit and function in an integrated System Digital Mock-up (DMU). This System DMU can avoid many of the integration issues that significantly impact the cost and schedule of a programme.

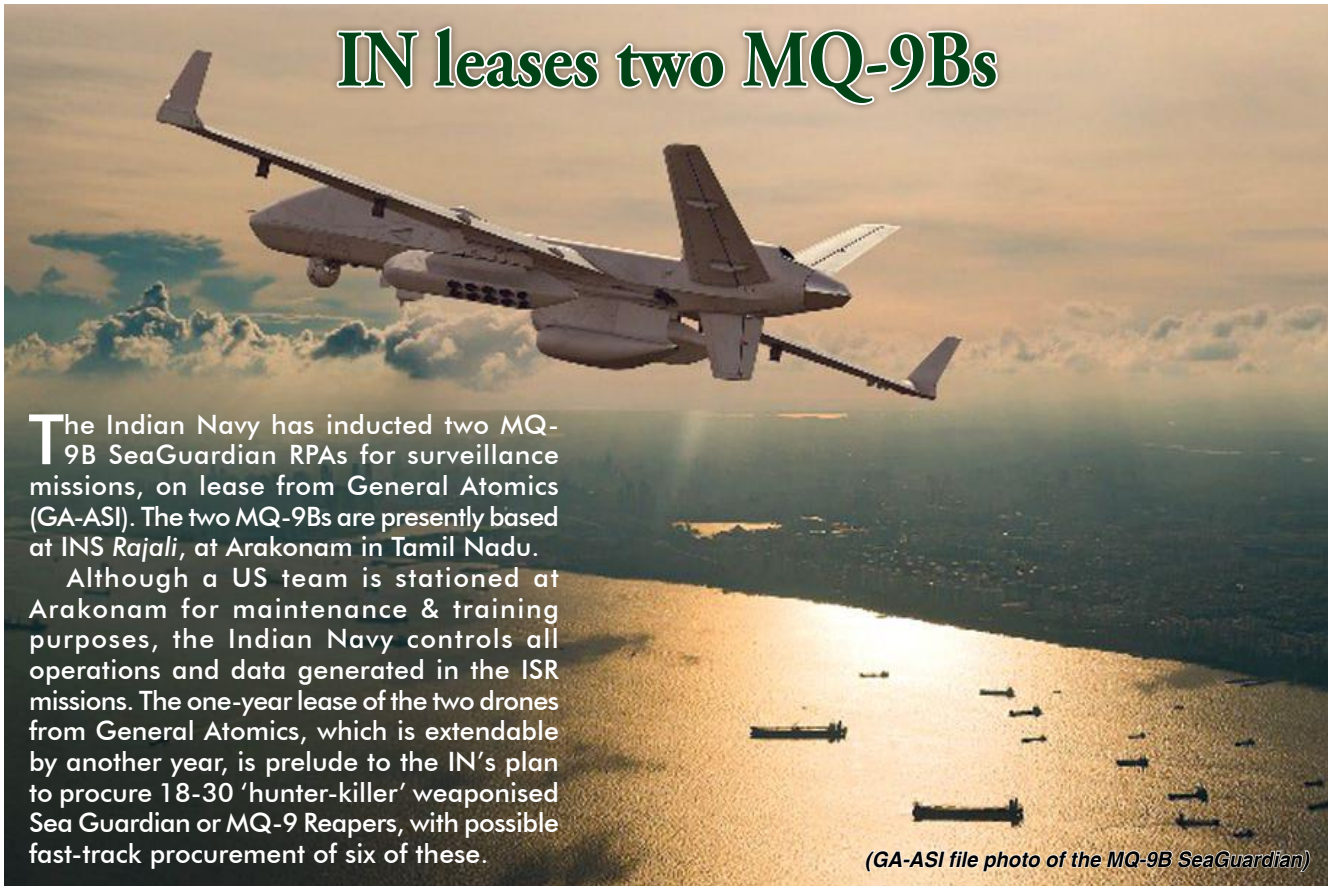
While the aviation industry faced the blunt of the pandemic; the Aerospace and Defence sector in India received a policy boost with the Government of India taking the vital decision to open up India›s aerospace industry and increase the Foreign Direct Investment (FDI) limit. It also put the Space sector reforms in a hyper-drive by allowing homegrown space companies to access ISRO's infrastructure.

While all of this will create new opportunities for the OEMs and suppliers in the ecosystem, they will also face certain challenges - increasing programme complexity, strong focus on affordability and innovation, zero tolerance for missed production schedules, faster product-development cycles and digital transformation. They will need to accelerate innovation, drive efficiencies and move to the factory of the future for greater agility on production rate. It requires new way to conceptualise, design, manufacture, test, certify and sustain new air and space vehicles.

Effective usage of 3D design and engineering technology will be key to the success of businesses in these sectors. It means, the full utilisation of the potential of virtual twins and application of model based systems engineering (MBSE) in the development of new aircraft, new defence systems or next generation of commercial and defence ready drones.

Dassault Systemes is enabling greater accessibility and availability of 3D design and engineering technology for upcoming defence corridors, MSMEs, and startups in India. It is working closely with various State Governments (Karnataka, Andhra Pradesh) to set up Centers of Excellence that can provide necessary training to the current and future generation of engineers, in the Aerospace and Defence industry.

IN leases two MQ-9Bs



The Indian Navy has inducted two MQ-9B SeaGuardian RPAs for surveillance missions, on lease from General Atomics (GA-ASI). The two MQ-9Bs are presently based at INS *Rajali*, at Arakonam in Tamil Nadu.

Although a US team is stationed at Arakonam for maintenance & training purposes, the Indian Navy controls all operations and data generated in the ISR missions. The one-year lease of the two drones from General Atomics, which is extendable by another year, is prelude to the IN's plan to procure 18-30 'hunter-killer' weaponised Sea Guardian or MQ-9 Reapers, with possible fast-track procurement of six of these.

(GA-ASI file photo of the MQ-9B SeaGuardian)

$90 million FMS deal for C-130J Super Hercules Support

The Government of India has requested to buy items and services to extend follow-on support for their fleet of C-130J Super Hercules aircraft, these items including aircraft consumables spares and repair/return parts; ground support and equipment; Cartridge Actuated Devices/Propellant Actuated Devices (CAD/PAD) fire extinguisher cartridges; flare cartridges; BBU-35/B cartridge impulse squibs; one spare AN/ALR-56M Advanced Radar Warning Receiver shipset; spare AN/ALE-47 Counter-Measures Dispenser System shipset; ten Lightweight Night Vision Binocular (F5032); ten AN/AVS-9 Night Vision Goggle (NVG) (F4949); GPS; Electronic Warfare; instruments and lab equipment support; Joint Mission Planning System; cryptographic device spares and loaders; software and software support; publications and technical documentation; personnel training and training and training equipment; US and contractor engineering, technical, and logistical support; and other related elements of programme support. The estimated total case value is $90 million.

PBS INDIA team at the DefExpo 2020

PBS INDIA: Solutions for Aerospace

PBS INDIA, is an Indian company and designer and manufacturer of aircraft engines, auxiliary power units (APU), environmental control systems (ECS), specific custom-made aircraft solutions, cryogenics and investment casting products. PBS INDIA is part of the PBS GROUP, a Czech engineering manufacturer that operates globally in aerospace, precision casting, precision engineering, cryogenics and energy. With more than 200 years of history, this is arguably one of the oldest engineering brands in the world.

The ability to design, construct, manufacture and test an entire product is a significant competitive advantage, as is the ability to adapt products to specific customer requirements. Thanks to in-house production, the highest quality and reliability of its products is guaranteed. PBS is a certified company and holder of design authorisation (DOA), manufacturing authorisation (POA) and maintenance authorisation (MOA) issued by the European Union Aviation Safety Agency (EASA). The PBS quality management system is ISO 9001, AS 9100, ISO 14001 and is Nadcap certified.

Learn more about our products and solutions on **www.pbsindia.com** and come to visit us in our Bengaluru office (No. 303, 'Pushpak, MES Ring Road, Jalahalli Village). We will be pleased to meet you at our booth at **Aero India 2021** exhibition to discuss our products and services for aerospace.

PBS has been developing and supplying small turbine drive units for the aerospace industry for half a century, the company celebrating the 20th anniversary of cooperation with manufacturers of MIL helicopters. PBS essentially supplies the Safir 5K/G MI auxiliary power unit (APU), for the main engines of a significant number of Mi-17 helicopters. PBS continually works on modifications of existing products, but the company also develops other devices for new types of helicopters as well as jet aircraft and UAVs.

20 years of cooperation with MIL

Over the decades, PBS has been involved with thousands of APUs and last year celebrated the 20th anniversary of cooperation with the manufacturers of MIL helicopters

PBS is a specialised manufacturer of castings made of superalloys based on nickel and cobalt for the power engineering, aerospace, marine, healthcare and transport industries worldwide

for which it developed the Safir 5K/G MI APU, designed for Russian Mi-8, Mi-17 and Mi-171 helicopters, which are considered as the most successful helicopters in the world in terms of both numbers sold and the number of countries in which they operate. Mi-17s have operated in more than 60 countries, including with the Indian Air Force.

Products for helicopters and jet aircraft

PBS APUs are especially suitable for civil and military helicopters, training and light combat aircraft and business jets. Applications in ground military forces or marine applications are also feasible, incorporated in several types of helicopters, but also in training and combat aircraft. PBS is currently following up on previous cooperation with the development and supply of several systems for new generation of this aircraft, for example the Czech L-39NG, L-159 and others. This includes the environmental control system, some fuel system instruments, the EMG-200 starter generator and other devices.

Turbine engines

PBS is a well-known supplier of turbojet engines, their high quality and reliability reflected in the fact that they are installed in over 1,300 aircraft worldwide. With certification from European Aviation Safety Agency (EASA) their quality makes them distinct in their category. The main advantage of PBS India's turbojet engines is their reliability and weight-to-thrust ratio and these engines are suitable for use in UAV and UCAS projects. The worldwide recognised turbojet engine PBS TJ100, is of the 4th generation and PBS India supplies of these engines in India.

Development and innovations

PBS continuously invests in development and has high-quality technical support and development plus testing capacities available. Latest addition to the PBS turbojet engine family is the TJ100P, an oil-free version of the well known PBS TJ100 engine. The company continually extends the time limits of overhauls for the Safir 5K/G MI, thus increasing its competitiveness. The company has also developed the relatively new EMG-200 starter generator for the Ansat helicopter, with several dozen units sold annually.

The MIL Mi-171A2 has received type certification in India for civilian use issued by the Civil Aviation Authority of India. The PBS CS-M1V environmental control system for the Mi-171A2 helicopter is another example of successful development, this system heating and cooling simultaneously, not only in the cockpit, but also in the cargo space of the helicopter.

The PBS investment casting foundry, with more than 50 years of experience, focuses mainly on blades and segments of stationary gas turbines, turbocharger wheels for automotive, impellers and guide wheels for aircraft engines, spinner discs for the glass industry and femoral components for the health sector. PBS is responsible for everything from the design, casting and machining to the final product to guarantee the highest quality at a reasonable price.

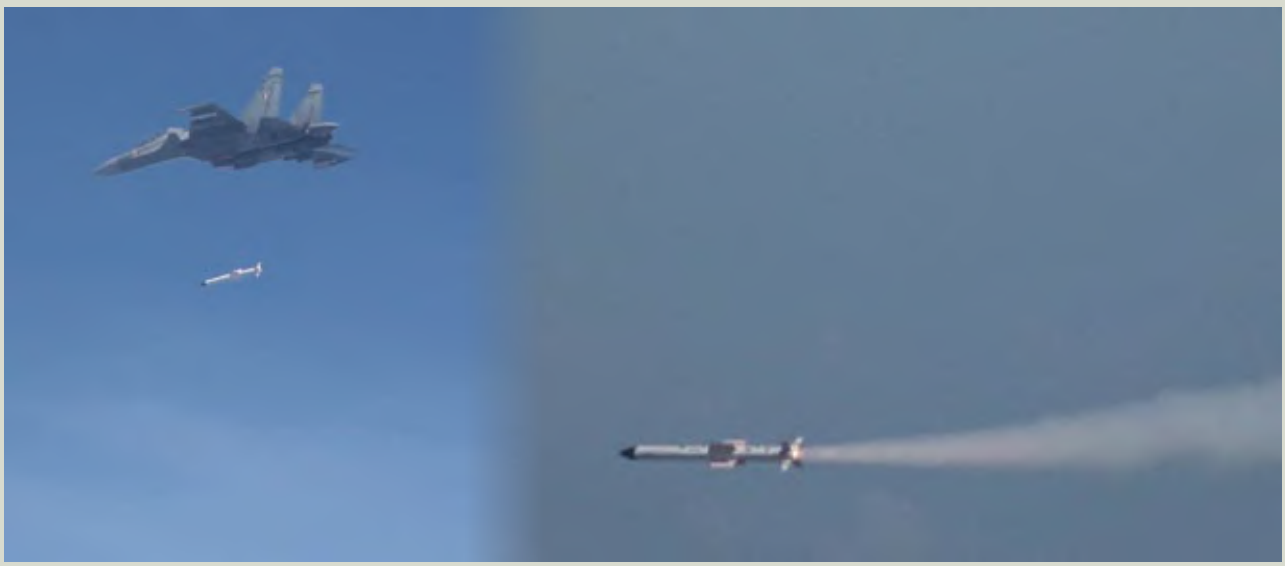
PBS is also a reliable supplier of compressors, pumps and helium expansion turbines for the cryogenic industry and very low temperatures from 4 to 150 K.

The latest addition to PBS turbojet engines family is PBS TJ100P. Oil-free version of the proven TJ100 brings many new interesting features and can be fitted into any modern UAV or UCAV system

IAF plans for 125 AMCAs

In his pre-Air Force Day Press Conference, Air Chief Marshal RKS Bhadauria stated that the Indian Air Force was considering an order for 125 next generation Advanced Medium Combat Aircraft (AMCA). He said that the first two AMCA squadrons would be powered the current General Electric F.414 engines of 90KN thrust while the follow-on five squadrons were likely to get an indigenous power plant with a higher thrust of 125KN. Under the current plans, first flight of the AMCA prototype would be in 2027, leading to full production by 2029.

DRDO's RUDRAM flight tested



On 9 October 2020, the new generation, indigenously developed RUDRAM (anti-radiation missile) was successfully flight tested after launch from a Su-30MKI onto a radiation target located on Wheeler Island off the coast of Odisha. The RUDRAM is first indigenous anti-radiation missile of the country being developed by DRDO. This has INS-GPS navigation with Passive Homing Head for the final attack. The passive homing head can detect, classify and engage targets over a wide band of frequencies as programmed, a potent weapon for *Suppression of Enemy Air Defences*.

DRDO curtain-raisers at Yelahanka

The Defence Research and Development Organisation (DRDO) is exhibiting an array of its latest defence technologies with more than 300 products, technologies and innovations presented at in indoor, outdoor, static and flying displays. The models and exhibits are in various technology categories, with the thrust being on digital display of data to highlight product details.

Major attractions of DRDO's participation is flight display of its AEW&C system, LCA variants, with the LCA Navy on static display. Highlights of the indoor exhibits include the combat free fall system, models of the Advanced Medium Combat Aircraft (AMCA), ABHYAS - High-speed Expendable Aerial Target,Twin Engine Deck Based Fighter (TEDBF), FCS System for the LCA and Aerostat Systems.

There are also displays of the Nirbhay missile, P-16 Heavy Drop System, AWACS India (in model form), Kaveri dry engine prototype, Gas turbine blade and Pilotless Target Aircraft Engine (PTAE) and others. In the area of materials, titanium sponge being developed for the aircraft carrier INS *Vikrant*, displayed along with other aeronautics products.

Among engineering products, the exhibits include Aircraft Mounted Accessory Gear Box (AMAGB), AWAGB bearing, MRSAM launcher and two-stroke single/ double/four-cylinder engines for UAVs. Armament-related products showcased are 250kg pre-fragmented bomb, 450Kg HSLD bomb, INS GPS guidance kit for 450kg HSLD bomb, missile warhead models of Astra, Helina, Canopy Severance System (CSS) for the LCA and IR flare for the PTA.

Among the missiles, full scale models of various surface to air missiles including the Astra, LRSAM, QRSAM, Astra, anti-radiation missile NGARM and Smart Anti Airfield Weapon SAAW are on display. Besides the missiles, technology sub-systems including the RF seeker, IIR seeker, PINAKA guidance kit, model of rail track rocket sled (RTRS) facility and exploder for naval warheads care on display.

As for electronics and communications, various mission and radar computers, laser warning sensors, AEW&CS data links, various SDR models, light weight portable laser target designator, radars and antennae are displayed. Integrated life support system, emergency survival rations, NBC Suit Mk.5, personal decontamination kit and other life sciences products are being shown as well.

The Indian Maritime Simulation System (IMSAS), Air Warfare Simulation System and Air Defence Simulation System are also demonstrated as working systems. Outdoor exhibits of DRDO include the ADFCR (radar vehicle), ADTCR (sensor and power systems), Anti Drone System, QRSAM, Rustom-1, Mobile Launcher Vehicle, MARS, Akash, and Rudram (NGARM) missile amongst others.

Within the *India Pavilion*, whose theme is Rotary Wing Platforms, some seventeen products applicable to helicopters are exhibited, Low Frequency Dunking Sonar (LFDS) for the ALH, torpedoes. Airborne Software Defined Radio, Radar for Naval Utility, Light-weight Electro Optical Payload (LEOP), Dual Colour Missile Approach Warning System (DCMAWS) and Digital RWR. The other systems applicable for rotary wing platforms include IFF Mk XII, Combat Search & Rescue (CSAR), Heli-Net, SANT Missile and NASM-SR Dummy Model.

MiGs in the skies over India

Part I

MiG-29UPG of the IAF (photo: Simon Watson)

Diplomatic relations between Russia and India, now for over 70 years, are unique because of openness and efficiency. They have similar views on the global world order, mutually beneficial cooperation in the fields of nuclear energy, industry and agriculture which has made possible to form a common creative view on world developments and well-being of their citizens. One of the key aspects in the long standing dialogue between the countries has been, and remains, military-technical cooperation between the two countries which is now reaching a new level of development.

Projects in combat aviation give reasons for real pride as it is in this domain that, over a long period of time, the brand 'MiG' has made, and continues to make, significant contribution to the air power of India's air forces.

More than 1000 'MiG' aircraft have been supplied to the Indian forces and also manufactured under licence by Indian industry. In fact, the first licence production of MiG-21 fighter, almost half a century back, was actually start of the 'Make in India' programme long before this became an established fact. Second, third and fourth generations of 'MiG' aircraft have been supplied within the framework of military-technical cooperation and Indian pilots got advanced MiG fighters much earlier than other foreign operators. As an example, in the 1980s, India was the first country to receive MiG-29s even before USSR allies of the Warsaw Pact did.

Manufacturing, maintenance and repair facilities for 'MiG' aircraft have long been localised in India, which supports the Indian Air Force and Navy to significantly reduce time and cost of all stages of after-

IAF MiG-21s (photo: Simon Watson)

sales support, from setting up of technical centres to scheduled maintenance and repair-restoration work.

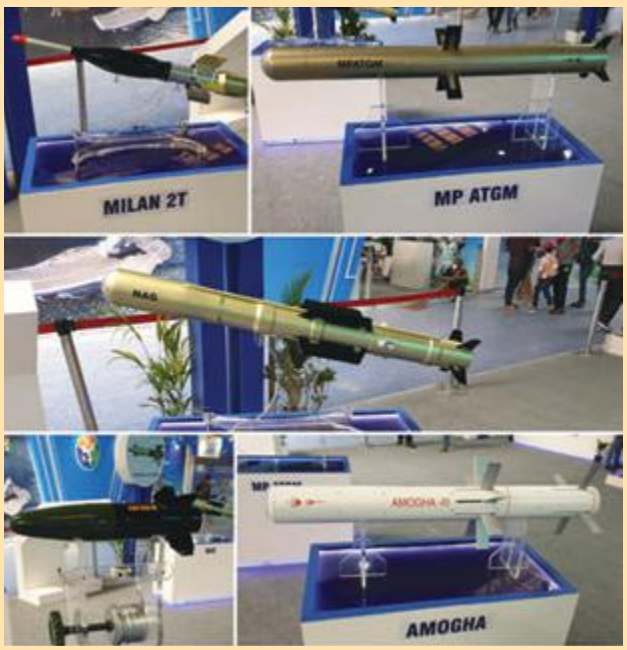
An important aspect in development of military-technical cooperation between the two countries is a potential decision of the Indian Government to purchase twenty one MiG-29s manufactured by the 'Russian Aircraft Corporation MiG' (as part of the United Aircraft Corporation). Sources in the Indian Ministry of Defence explain that this purchase is necessary for augmentation of the country's combat fleet at a time when the earlier generation MiG-21 aircraft are being replaced according to plan.

At the same time, in the current international situation, India is considering rapid upgradation of its MiG-29/MiG-29UB fleet as also upgrading MiG-29K/KUB fighters of the Indian Navy.

Article courtesy: MiG
Drawing: Amartya Mitra

The BDL range on display at Aero India 2021

Top Down:
BDL produced Varunastra ship-launched heavy weight electrically-propelled anti-submarine torpedo: light weight anti-submarine torpedo (TAL) and extended range anti-submarine rocket (ER-ASR)



Clockwise: Milan 2T light anti-tank infantry missile; MPATGM; Nag anti-tank missile; Amogha-III third generation anti-tank guided missile, designed and developed by BDL; INVAR is a laser beam rider anti-tank guided missile, capable of being fired from T-90 tanks.

Clockwise from top left: 9M113 Konkurs wire guided anti-tank missile (license from Russia); DRDO developed Smart Anti-Airfield Weapon (SAAW); short range man-portable air defence system Starstreak; Astra beyond visual range air-to-air missile; DRDO-developed MPATGM, or Man Portable Anti-Tank Guided Missile, third-generation fire-and-forget anti-tank guided missile derived from Nag ATGM

BEML at Aero India 2021

Showcasing capabilities in Defence and Aerospace Sectors

BEML is showcasing some of its prime products during Aero India 2021. The theme is *Atmanirbharta*; and the display includes, products such as the Transporter Landing System (TLS) and variants of Unmanned Aerial Vehicles (UAV), in its indoor Stall. BEML is also displaying various equipment and critical components in the aerospace sector.

The TLS displayed at BEML's outdoor stall is a ground-based precision landing system to improve access to airports where terrain or land constraints make instrument landing system (ILS) installation unfeasible or cost-prohibitive. TLS functions over any terrain using directional antennas and can be installed even on short runways ending with water / obstructions. This will be manufactured in India by BEML in collaboration with Advanced Navigation and Positioning Corporation of USA.

BEML's Primoco UAV '150' (photo above) is designed for both civilian and military use, can take off and land autonomously, having an endurance of 15 hours. This UAV can be used for surveillance, monitoring, border patrolling and law enforcement. Primaco UAVs will be built in India in collaboration with Primaco, Czech Republic.

BEML is also displaying its 25kg-class Tactical UAV being developed indigenously in collaboration with the Indian Institute of Technology, Kanpur. The UAV will carry payloads of 3.0 kg, including day & night cameras, fly continuously for 8 hours with 50 kms radio range.

MV Rajasekhar CMD, BEML

Vayu off to a flying start at Aero India 2021

In keeping with its track record, established since the very first international Air Show in India, the *Vayu Aerospace Review* has published Special Show Issues and Show Dailies for widespread distribution at the event. The *Vayu* team at Aero India 2021, pictured above, are continuing that tradition!

HAL's Helicopter prowess on display

Amongst the various HAL-designed, developed and produced helicopters on display at Aero India 2021 are the light combat helicopter (LCH) with an array of weaponry and the Coast Guard version of the Dhruv advanced light helicopter (ALH).

Thales launches AirMaster C ultra-compact airborne surveillance radar

Threat detection, identification and surveillance missions depend on a force's ability to operate in any type of environment and all weather conditions.

Drawing on its experience with the successful Master series of radars, Thales has developed a new, ultra-compact surveillance radar with enhanced target detection capabilities for fixed-wing aircraft, helicopters and UAVs. With its low integration and operating costs and high availability and performance, the AirMaster C sets a new standard for airborne radars.

The AirMaster C is a new surveillance radar with an ultra-compact, programmable 2D active antenna based on SiGe (silicon-germanium) technology. SiGe is much more energy efficient than other technologies used for AESA radars, and allows the radar to self-cool. Weighing less than 20 kilogrammes and housed in a single unit design, the radar has a 30% lower SWaP (size, weight and power) than the other radars in this class.

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Defence Minister at BrahMos Pavilion

Defence Minister Rajnath Singh visited the BrahMos Aerospace pavilion on inaugural day of Aero India 2021. Defence Minister was briefed by DS & DG, BrahMos (DRDO) and CEO & MD of BrahMos Aerospace Dr Sudhir Kumar Mishra about the progress and achievements made in various business activities under the ambitious *Aatmanirbhar Bharat* programme.

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M53- Mirage 2000 Engine

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