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Tricolor Arrows - The Italian Air Force Aerobatic Display Team, Perform During the Opening Day of the Dubai Air Show

Image Source: gulfnews.com

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“Joint planning and integrated application of combat power will be the sine qua non of future wars. Developing unique tactics, carrying out realistic training, and incorporating relevant lessons learned will go a long way.”¹

- Air Chief Marshal VR Chaudhari PVSM AVSM VM ADC

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Opinions and Analysis

As Expensive as F-16, Large UAVs Like MQ-9 ‘Highly Vulnerable’ in Contested Airspace; India to Evolve Operational Roles

Air Marshal Anil Chopra (Retd)

*Director General, Centre for Air Power Studies |
22 November 2023*

Source: Eurasian Times | <https://www.eurasiantimes.com/highly-vulnerable-in-contested-airspace-india-to-evolve-operational-roles/?amp>



Reaper Drone

A US MQ-9 Reaper drone was shot down by Yemen's Houthi rebels' air defenses a few days back on November 8. The Houthis claimed it was in Yemeni air space, while the US official insisted the drone was over international waters when shot down.

Meanwhile, the Houthis have launched drones and missiles toward southern Israel on at least four occasions since the October 7 Hamas attack on Israel. A Russian S-22 surface-to-air missile nearly hit an American MQ-9 Reaper drone over Syria on November 27, 2022, as stated by the US Central Command.

In March 2023, a Russian Su-27 buzzed an MQ-9 Reaper Surveillance drone over the Black

Sea and doused it with jet fuel. The drone's propeller was so significantly damaged that the US forces chose to crash it into the water.

There has been an increasing number of such encounters between the US and Russian aircraft in Syria and the Black Sea, and this is despite deconfliction protocols being in place between the two superpowers. The Americans finally chose to bring in an A-10 'Warthog' Thunderbolt II to supplement the Predator drones. The A-10 can carry nearly three times the load for strike missions.

Earlier, on June 6, 2019, Houthis shot down a US MQ-9 Reaper over Yemen using an SA-6 surface-to-air missile (SAM) that was enabled with Iranian assistance. On August 21, 2019, another unarmed MQ-9 was shot down by Houthis over Dhamar, Yemen, using the Yemini-made Fater-1 missile, an improved SA-6.

On 23 November 2019, an MQ-9 was shot down by a Pantsir system operated by the Libyan National Army or Wagner Group over Tripoli, Libya.

Large Drones Viability in Contested Environment

The General Atomics MQ-1 (Predator) and later variant MQ-9 Reaper (Predator B) are unmanned aerial vehicles (UAV) that evolved after the end of the Cold War when the US did not expect a contested environment.

They were designed to maximize their ability to loiter while carrying a limited payload. They were not intended for evasive maneuvers. Large drones were initially used extensively for Intelligence, Surveillance, and Reconnaissance (ISR).

The November 8 incident has once again brought the drones of the MQ-9 Reaper class into a public debate about viability in the contested domain. These large drones are relatively expensive.

The 31 MQ-9 drones offered to India would cost slightly over US\$3 billion. These are nearly as costly as F-16 class fighters. Much less expensive countermeasures could down these drones.

The US Air Force (USAF) has been reviewing its additional purchases as it sees itself operating in a much less benign environment than that existed in Iraq and Afghanistan. Critics say that notwithstanding the capabilities, these large drones fly very slowly and are thus highly vulnerable to SAMs and fighter action.

Also, they are too expensive to lose. If a fighter jet was just to come near a large drone and release IR flares, it could damage it with the metal disks that fly out of some countermeasures dispensing systems. The propeller or even some sensors are highly vulnerable.

Predator MQ-9 Platform

The MQ-9 Reaper (Predator B) UAV is capable of remotely controlled or autonomous flight operations. It is a large drone with a maximum take-off weight of 4,760 kg, including a payload of 1,700 kg. There are seven hard points. The 11m length and 20m wingspan make its dimensions bigger than some fighter aircraft's.

The max speed is around 480 km an hour, and the maximum endurance is 27 hours. The service ceiling is 50,000 feet, though the operational altitude is 25,000 feet. The Reaper has a 950-shaft-horsepower (712 kW) turboprop engine.

The drone can carry up to eight AGM-114

Hellfire air-to-ground missiles or a combination of missiles and laser-guided bombs. Some models can carry air-to-air missiles. The drone has an airborne radar and a multi-spectral targeting system.

The SeaGuardian variant carries a marine search radar. The platform, sensors, and weapons are monitored and controlled by aircrew from a Ground Control Station (GCS), including weapons employment.

Once designed for intelligence, surveillance, and reconnaissance (ISR) roles, it now has a hunter-killer role. The USAF operated over 300 Reapers. 2035 is the projected end of the service life of the MQ-9 fleet.

The same is planned to be extended beyond 2040 after a proposed upgrade. While the Indian Air Force (IAF) and the Indian Army will likely acquire SkyGuardian, the Indian Navy will get the SeaGuardian.

Operational Use of MQ-9

On October 28, 2007, an MQ-9 achieved its first "kill," firing a Hellfire missile against Afghanistan insurgents. By March 6, 2008, the Reaper had attacked 16 targets in Afghanistan using 500 lb (230 kg) bombs and Hellfire missiles.

Since 2008, USAF has been flying Reaper missions in Iraq. Reapers also began anti-piracy patrols in the Indian Ocean. USAF has carried out tens of thousands of close air support missions with MQ-9s in Iraq and Afghanistan, where a significant number of drones were also used during combat operations. These drones saw actions in Ethiopia, Somalia, and Libya. In 18 years of operation, the MQ-1 and MQ-9 have completed over 2 million flight hours.

On 13 November 2015, an MQ-9 had killed ISIL member Mohammed Emwazi “Jihadi John.” In November 2017, the Reaper shot down a tiny, maneuvering aerial target for the first time.

On January 3, 2020, a US MQ-9 missile strike at Baghdad International Airport killed Qasem Soleimani, the commander of the Iranian Quds Force, and Abu Mahdi al-Muhandis, the deputy commander of Iraqi Popular Mobilization Forces. Many USAF drones crashed during training due to technical reasons such as starter-generator breakdowns.

Reworking the Large Drone Game

The Ukraine conflict has also shown that significant operational battle-zone effects can be achieved by using low-tech, cheaper kamikaze drones instead. These effects will multiply when a drone swarm is used.

A drone swarm would also saturate the enemy air defenses. Large loitering drones like Israel Aerospace Industries (IAI) Harpy and Harop have significant endurance and can make a Kamikaze attack, but they cost a lot. Some expensive drones can be recovered if not expended. But all these have technical and operational complexities.

Large drones have proved very well for ISR. Russia and China continue to develop drones of the same kind as the US. However, they must stay far away in contested domains to be safe.

Till now, the US has not made any design changes to MQ-9 despite the environment becoming more contested. Giving improved self-defense capability and high-G maneuverability would mean airframe design changes and compromises on endurance.

With many space-based constellations coming

up in low earth orbit, part of the ISR role can best be done from space. The US military has been telling lawmakers that in its present state, the MQ-9 will be at high risk in any operational deployment against Russia, China, or even Iran.

However, the Reaper boasts the lowest cost-per-flying-hour of any high-end combat platform. The US government feels the MQ-9 can be more survivable by adding more self-defense capability and countermeasures.

Modernizing the fleet of nearly 280 MQ-9s currently with the USAF could mean an investment of around US\$12 billion, which is modest by US budget standards. The proposal is to deploy them in lesser contested zones such as Africa or parts of Asia. The dilemma remains between cheap drones and those like the MQ-9.

There is a need to re-design and produce more survivable large drones. They must be stealthy, like the proposed Indian “Ghatak” drone. Also, there is a need to redefine the operational employability and roles of existing ones.

More stand-off sensors and weapons, perhaps. Improved AESA radar, self-defense electronic suite, and air-to-air weapons. Survivability can be increased by using self-protection pods against infrared and radio frequency-guided threats in contested environments.

The MQ-9 Block 5 Ghost Reaper concept of USAF rebrands the platform to be part of the Advanced Battle Management System (ABMS) as a node to connect fourth and fifth-generation aircraft with modern communication pods and secure data links.

Unmanned systems empowered by artificial intelligence will be very potent members of teaming with manned aircraft. The large drones

could also act as a mothership for smaller kamikaze drones.

Large drones could support secure airborne communications to very long ranges. Drones are being modified with systems for “Joint Multi-Domain Operations.” They remain an essential asset for ‘Grey Zone’ operations. It could mean more onboard power generation. All future drones would be stealthier and support Manned-Unmanned Teaming.

The USAF has published a Request for Information (RFI) seeking insight from industry for a future Next-Generation Multi-Role Unmanned Aerial System Family-of-Systems. The desire is to get the MQ-9’s functionality into a broader concept called the “MQ-Next.”

Many are questioning the idea, and no funding has yet been considered. The USAF has much higher funding priorities, such as the Next-Generation Air Dominance family-of-systems, the B-21 bomber, F-35 fighters, and the KC-46 tanker, among many others.

The MQ-9 could be adapted to carry air-to-air interceptors or directed energy weapons to counter air and missile threats to remote and forward U.S. bases, including during out-of-area contingencies. Meanwhile, the Reaper is reasonably well suited to the USAF and NATO’s Agile Combat Employment (ACE) because of its automatic take-off and landing capability, which allows operations from highway launch pads with minimal ground support and crew.

Large Drones Remain Significant For India

China already operates the Chengdu GJ series of drones, also called Wing Loong. These are in Medium and High Altitude Long Endurance (HALE) variants. They have armed combat

variants (UCAV). China continues to develop more advanced variants.

Wing Loong II, which provided up to twelve air-to-surface missiles, entered the PLA Air Force (PLAAF) service in 2018. As per media reports, a new generation of high-speed, long-endurance drones powered by low-cost jet engines has entered military service in China.

Pakistan acquired the CH-4 UCAVs from China. They have used them to conduct strikes in Balochistan. They have the maritime variants also. The indigenous Burraq UCAV has been jointly developed and built by the National Engineering and Scientific Commission (NESCOM) and the Pakistan Air Force (PAF).

Shahpar-2 is another indigenous UAV. They also acquired significant numbers of the Turkish Bayraktar TB-2 UAVs. They have ordered the Bayraktar Akıncı HALE UCAV, deliveries that have just begun.

For a long time, India has been using the IAI Heron and Searcher UAVs for ISR roles. Once UCAVs are acquired, the IAF could use the armed drone to not only look across the mountain in the Himalayas for surveillance and attack ground targets but also use them to intercept cruise missiles.

A few large drones can create an airborne radar chain for sectorial radar cover. IAF could use these drones for ELINT, SAR, and electronic warfare roles.

Large drones will continue to play a significant role in maritime surveillance. The new extended-wing Reaper has an increased loiter time from 27 to 40 hours. They are much cheaper to operate than the P-8 Poseidon aircraft and can supplement the air effort.

They could also support creating an extended air picture and situational awareness in India's Bay of Bengal and Arabian Sea. Lastly, large drones can significantly help civil administration in emergency response to detect and mitigate the effects of natural disasters.

For some time, large drones will continue to play a significant role in the Indian sub-continent. India must accelerate the development and production of the indigenous Tactical Airborne Platform for Aerial Surveillance-Beyond Horizon-201 (TAPAS BH-201) and the Ghatak UCAV.

India must encourage more private players to enter more significant UAV development. There is a need to work more aggressively on Manned Unmanned Teaming.

'Drone Squad' for India? How can Delhi Deflate Threats Emanating from Terror Groups Armed with Chinese UAVs?

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18 November 2023

Source: Eurasian Times | <https://www.eurasiantimes.com/chinese-drones-with-pak-terror-groups-biggest-security/?amp>



Pakistani drone captured by India's border force. (BSF)

Cross-border terrorism from Pakistan has been a scourge for India for many decades now. After Article 370 abrogation and greater control in Jammu and Kashmir, the incidents have been, albeit, on the decline.

However, the new phenomenon is the use of drones for cross-border intrusions. In the last three years, drone sightings across the international border have increased considerably.

Of the nearly 500 sightings, over 300 were in the year 2022 itself, an exponential increase from previous years. About 75 percent were in the Punjab sector, 15 percent were in Jammu, and 10 percent were in Rajasthan and Gujarat.

India's Line of Control (LoC) and International Border (IB) with Pakistan are well-fenced, surveyed, and manned. Yet Pakistani state and non-state players are upping the ante and using technology to smuggle illegal arms, ammunition, drugs, currency, propaganda pamphlets, and other items to their supporters and operatives.

Drones are cheap and available commercially off-the-shelf and have replaced human smugglers and even terrorists in some cases, as was the case in the Jammu airfield attack a few years ago.

The US has been extensively using drone strikes against targets as part of the 'War on Terror.' Drones have even been used for assassination. Ayman al-Zawahiri, al-Qaeda leader, was killed in a US drone strike in early August 2022. On January 3, 2020, Qasem Soleimani, an Iranian major general, was killed by a US drone strike at Baghdad International Airport.

A significant terror plot by Pakistan's ISI was averted by the Special Operations Group (SOG) and Jammu police after they recovered a consignment of arms and ammunition dropped by a Pakistani drone along the IB in the RS Pura Sector in Jammu district in February 2022. The future is unmanned on many counts, including use for terrorism.

An unmanned combat aerial vehicle (UCAV) can carry ordnance such as rockets, missiles, and bombs. Small bomb-laden drones can make a Kamikaze attack.

Till recently, most drones were usually under real-time human control. However, Artificial Intelligence (AI) technology now supports more significant flight and decision-making autonomy levels.

Jammu Airfield Attack

Pakistan-based Lashkar-e-Taiba (LeT) made a drone attack on IAF's Jammu airbase on June 27, 2021. This was the first reported use of drones to attack military facilities in India.

There were twin blasts, five minutes apart, around 1:35 a.m. The first drone dropped a bomb that damaged a building when it went through the roof, while the second exploded on the open tarmac at a little distance from a parked helicopter.

There was no damage to any operational asset or loss of life. It was later understood that the target was Air Traffic Control (ATC) tower and parked IAF helicopters. The two Improvised Explosive Devices (IED) weighed five to six kilograms, with RDX as the main explosive charge. The drop was made through stored location coordinates.

The two drones had flown from across the border, a mere 14.5 kilometers away. Drones have continued to be used in Punjab, Rajasthan, and Jammu & Kashmir sectors for Intelligence, Surveillance, and Reconnaissance (ISR). They are also used for smuggling drugs and small arms. The drones were assembled from Chinese-origin kits and thus increased deniability.

Drones, New Dimension To Border Security

For long unmanned aerial vehicles (UAV) have been used for border surveillance and often through incursions into adversary's territory. Drones are also used for intelligence gathering, especially for military and BSF installations near the border.

Drones are small and have low visual, noise, smoke, and infrared (IR) signatures. They can fly ultra-low or at high altitudes, making it difficult to detect, intercept and neutralize.

Most conventional air defense radars cannot detect them. A few dedicated bird detection avian radars at airports monitor bird activity within the airfield zone and near the approach and take-off path.

Such radars will pick up drones, but it is not affordable to position such radars across the entire border. Sensitive IR sensors are required in large numbers at a considerable cost to detect the heat signature of drones. Small size and nearly no smoke signature means late visual detection. Even the drone sound can be heard very late.

Drones could be autonomous or remotely controlled and, because these are sourced from the open market, enable deniability. Drones could travel a few 100 kilometers deep, carrying a significant quantity of contraband payload. The types of cargo captured from the downed drones included substantial amounts of heroin, opium, pistols and revolvers, ammunition, detonators, and other explosives. More recently, they have been bringing even currency.

Pakistani Drone Production Ecosystem

For years, Pakistan had been pushing the US to allow it to acquire the MQ-1 Predator, the primary UCAV system the US used as a strike platform. However, such requests were denied amid fear of technology proliferation.

Pakistan's National Engineering and Scientific Commission (NESCOM) and the Pakistan Air Force (PAF) jointly began developing its own Burraq UCAV. The initial variants were for surveillance and intelligence gathering.

In 2015, they had the first UCAV variant. Pakistan borrowed ideas from the Chinese CASC Rainbow CH-3A UCAV and may have received assistance, too. The Shahpar II is a UCAV

built by Global Industrial Defence Solutions of Pakistan. It is currently in production following the completion of a test and qualification phase. It reportedly can fire missiles at both stationary and moving targets.

Pakistan is working closely with Turkey on Bayraktar TB2, medium altitude long endurance (MALE) drones for offensive and air defense use. They showcased these at the Pakistan Air Force (PAF) day event. Satellite images revealed the presence of one Bayraktar TB2 at PAF's Murid Airbase. Pakistan has thus raced ahead of India in indigenous MALE and UCAVs.

Pakistan also signed a contract with Turkey for the co-production of ANKA UCAV. Pakistan also acquired CH-4 and Wing Long UCAVs from China. The Pakistan Navy already operates several UAVs, such as Scan Eagle and Uqab, for surveillance.

The SATUMA Jasoos II is another indigenous drone in the PAF inventory, fulfilling dual purposes of ISR and training. The Pakistan military has claimed to have eliminated three high-profile Tehrik-i-Taliban Pakistan (TTP) terrorists using its indigenous Burraq combat drone during an operation in North Waziristan's Shawal Valley.

Pakistan's Drone Infiltration Mechanism

Pakistan is following an all-of-the-nation approach with many government agencies, the armed forces, and Inter-Services Intelligence (ISI) supporting the covert operations. Their border security force, Pakistani Rangers, has reportedly set up drone centers to help drone crossings by smugglers and terrorists to send arms and drugs into India.

Pakistan's focus has been much higher in Ferozepur and Amritsar sectors. The BSF has

seized about 1,150 kg of drugs at the Punjab border in the last three years. Also found on the intercepted drones were some AK series assault rifles, pistols, MP4 carbines, carbine magazines, high explosive grenades, as well as narcotics.

Pakistan's Chinese Off-The-Shelf Drones

Most Pakistani drones are of Chinese origin. Da-Jiang Innovations (DJI), Shenzhen, is one of the major drone manufacturers. Several Chinese state-owned entities back it.

DJI manufactures commercial drones for aerial photography and videography. DJI accounts for around 70 percent of the world's consumer drone market. The company's products have also been used by militaries and police forces, as well as terrorist groups.

DJI drones have been extensively used in Ukraine. These drones could be of different sizes and have significant payload capacities. Some of those caught on the Indian border include the DJI Matrice 300 Quadcopter with RTK (Real-Time Kinematic) drone.

It can have a maximum take-off weight of nine kg, fly at 80 km/h, and have an endurance of 55 minutes on fully charged batteries. It can fly autonomously on pre-fed waypoints and transmit live mission recordings. It costs nearly INR 1,500,000.

The payload could be three to four kilograms. The operator in Pakistan could control the payload drop based on video feed from the drone. Alternatively, it could fly autonomously. The US government has prohibited DJI products because the drone is known to transmit all data to parent organizations in China.

Forensic Analysis Of Downed Pakistani Drones

Most Pakistani downed drones give tell-tale signs. Knowing the flight path, the number of flights done recently, the quality of onboard equipment and sensors, and assessing their vulnerabilities is possible.

Also, it is possible to determine the communication equipment and frequencies, which could be jammed later. Sometimes, it is possible to burst into the recipient terrorist networks and find terror-related hardware, arms and ammunition, narcotics, and foreign currency. India's National Investigation Agency (NIA) has monitored and investigated all incidents.

Anti-Drone Measures

Large UAVs and Kamikaze drones have been extensively used in the Ukraine War and earlier in the Azerbaijan-Armenia conflicts. These have become more sophisticated, accurate, and lethal. Security establishments worldwide are working on anti-drone measures and systems that include hard and soft kill.

The large UAVs will be tackled by the air defense units of the armed forces using missiles and air defense guns. The larger drones can also be shot down by fighter aircraft or UAVs with air-to-air ability. Attack helicopters like the recently inducted Light Combat Helicopter (LCH) 'Prachand' also have air combat missiles.

BSF or other border guarding force sniper rifles can shoot the smaller drones. Special nets can be fired from hand-held guns that will entangle the drone rotors and bring them down. The GPS signal of the drone can be jammed and send it off track or astray.

Also, drone communication links can be jammed. Special laser-beam firing guns can

burn the drone electronics or dazzle the optical systems. There are cyber means to take control of the drone and bring it down at a place of own choosing, as was done by the Russians in Syria.

It is a good achievement even if the drone is forced to drop its load through counter-drone action. Even the drone warhead could be exploded in the air. With more drones being flown in a swarm, the complexity of neutralizing would increase.

Drone Ecosystem In India

Indian armed forces are already flying Israeli Heron and Searcher UAVs and Harpy and Harop UCAVs. India will soon have MQ-9 Reaper or Predator B UCAVs from General Atomics of the USA.

For a long time, DRDO's Aeronautical Development Establishment (ADE) was responsible for UAV development in India. Lakshya and Nishant had little success. Indian DRDO's Stealth UCAV Ghatak project is being accelerated. The first flight of a scaled-down test-bed flying wing was carried out in July 2022. It may be inducted by 2026.

Tapas MALE is also progressing well. DRDO must find private production partners for UAVs. The Adani Group is making the Israeli Hermes UAVs in India through a joint venture with Elbit Systems at Hyderabad.

Meanwhile, the private sector has been rightly galvanized for mid-sized drones. Over 100 drone start-ups are operating, and many have started getting significant orders from armed forces and other security agencies. Indian Air Force's 'Mehar Baba' competition helped identify drone and drone swarm start-ups.

Bengaluru-based start-up NewSpace Research

and Tech is working with Hindustan Aeronautics Limited (HAL) to develop a futuristic air-launched swarm drone system as part of the Manned-Unmanned-Teaming project called the Combat Air Teaming System.

As per the Drone Federation of India, the manufacturing of drones and related systems is happening in India, but critical components like batteries, motors, sensors, semiconductors, GPS, and cameras are still being outsourced. Select countries have developed mass production capabilities against aggregated demand for such components. India needs to get into such mass production.

Anti-Drone Actions In India

Notwithstanding the sporadic successes of shooting down a few intruding Pakistani drones, it must be understood that the initiative of timing and place is with the aggressor.

Considering that India's border with Pakistan and China is large, we have to be selective in providing anti-drone means to the border guarding forces.

Also, human intelligence (HUMINT) and other means must support anti-drone actions. Indian Army and BSF are acquiring large numbers of drones, some of which could be used for surveillance of borders to identify incursions timely. It all requires inter-agency coordination in India.

The BSF conducts round-the-clock surveillance through patrolling, checkpoints, and observation posts. Floodlighting of the fence enhances visibility during the night. India has invested in radars for detection.

Indian security forces also use drones for anti-drone operations. BSF has installed anti-drone

systems using integrated surveillance technology equipped with cameras, sensors, and alarms with a command-and-control system at more sensitive points on the Punjab border.

They have also created ‘drone hunting teams’ to shoot down enemy UAVs. The success rate in downing drones is going up. BSF conducts awareness campaigns among the public in border areas to sensitize them about UAVs/drones. With many drone start-ups in India, anti-drone systems can be acquired easily in more significant numbers.

Way Ahead For India

Pakistan’s support of radical Islamic elements and the technological backing of China enhances the terror threat pan-India that sees the risk of drones being used for more lethal chemical or biological forms of terrorism.

The Indian government is giving the drone ecosystem in India a very high priority. India must promote more research and development in drones and unmanned systems to remain globally relevant.

As India becomes drone-friendly, there is a need to strengthen regulation and control over drones. Air defense procedures have to be evolved. More no-fly zones may be designated to make vital installations safer.

Sensors and weapons against drones would one day be integrated like the IAF’s Integrated Air Command and Control System (IACCS). Inter-ministerial coordination would be significant with the proliferation of drones within the country.

Local police and the Intelligence Bureau (IB) must monitor drones more closely. The police and security personnel should be educated and trained

to respond to drone transgressions.

India has to prepare to take on drone swarms. An anti-drone force may be created one day. The national drone policy would need continuous evolution, using global interactions and inputs. To counter the risk of embedded malware in drone electronic sensors, there is a need for greater indigenization of both platforms and sensors.

Drones are the future, and India must follow a facilitative proactive approach yet be conscious of security implications and prepare for it.

Air Power

Plan to Rename IAF as Air and Space Force in Right Direction: Ex-Air Chief

Man Aman Singh Chhina | 25 November 2023

Source: *Indian Express* | <https://indianexpress.com/article/cities/chandigarh/iafs-redesignation-air-space-force-will-air-chief-marshal-bhadauria-9041011/>



The IAF is learnt to have made a proposal to the government to formally designate it as an air and space force given the increasing need of combat integration of the two domains and the needs of future warfare. (PTI Photo)

Air Chief Marshal RKS Bhadauria, former chief of air staff, said Friday that the proposed redesignation of the Indian Air Force (IAF) as the Indian Air and Space Force would be a step

in the right direction even as he described the move as a “work in progress”.

Interacting with the media on the sidelines of the platinum jubilee celebrations of the IAF’s No. 5 Squadron at Ambala in Haryana, Air Chief Marshal Bhadauria was answering a question on whether the force should be redesignated as a space force or a separate space force should be raised as in the US.

“It is a work in progress, I would say. But overall requirements of space and integration of space in air power is a natural integration. If you see the French they have an air and space force. The US has employed a different combination. Every country has its own approach,” said Air Chief Marshal Bhadauria.

He went on to add that ideally an air and space force made a lot of sense. “If you look from the point of synergy and core strength, then air and space force will be a step in the right direction. But like I said, it is a work in progress. It is something which is being discussed. It is an evolution which will take place as things move forward and the right decisions will be taken,” he said.

The IAF is learnt to have made a proposal to the government to formally designate it as an air and space force given the increasing need of combat integration of the two domains and the needs of future warfare.

Air Marshal Bhadauria also expressed confidence in the abilities of the IAF in meeting future challenges. He said he commanded the No.5 Squadron in Ambala from May 1999 to July 2001 and he hoped that the squadron would perform all its tasks to perfection in the future as was its history.

At the age of 92, Air Commodore KK Badhwar, Vir Chakra (retd), was the oldest veteran to participate in the platinum jubilee celebrations. He served in the squadron during the 1965 war.

“I am as old as the IAF as it too is 92 years old,” quipped the alert and agile Air Commodore Badhwar. Commissioned in 1954, he took part in the air raids on Peshawar, Sargodha, Chaklala (near Rawalpindi) and Risalewala in Pakistan in the war. He was awarded a Vir Chakra in the 1971 war while commanding the No.35 Squadron.

The No. 5 Squadron, also known as the Tuskers, is equipped with Jaguar deep-penetration strike fighters. The ceremony was attended by serving personnel and veterans who had served in the squadron throughout its history.

On the occasion, a special postal cover was released by Air Marshal Tejinder Singh, commodore commandant of the squadron. He said that it was a tribute to all those who had contributed to building the rich legacy of the squadron. On the occasion, Group Captain MP Verma, commanding officer of the squadron, greeted the dignitaries, veterans and their families.

An air display was put up by the Suryakiran Aerobatics Team, the Aakash Ganga para-diving team and Rafale and Jaguar aircraft formations.

Elaborating the history of the No. 5 Squadron, Air Marshal Tejinder Singh said that November 2, 1948, saw the birth of the Tuskers under the leadership of Wing Commander JRS ‘Danny’ Dantra at Kanpur, equipped with B-24 Liberator heavy bomber aircraft. The squadron has been pivotal in safeguarding the skies and upholding

the honour of the nation, be it in the operations in Congo, the 1965 war with Pakistan or the 1971 war for the liberation of Bangladesh.

During the 1965 war, 5 Squadron raided Sargodha and Peshawar airfields in Pakistan with Canberra aircraft at least six times. For their outstanding services during the war, personnel of the squadron were awarded one Mahavir Chakra and four Vir Chakras. The squadron was employed in war for a third time in 1971 and took its strikes deep into enemy territory, attacking Pakistan Air Force bases at Sargodha, Chander and Risalewala.

LCA Ideal to Replace MiG-Series Fighter Jets: IAF Chief After Centre's Nod to Buy 97 Tejas

30 November 2023

Source: Businessworld | <https://www.businessworld.in/article/LCA-Ideal-To-Replace-MiG-series-Fighter-Jets-IAF-Chief-After-Centre-s-Nod-To-Buy-97-Tejas/30-11-2023-500643/>



Air Chief Marshal VR Chaudhari on Thursday said the nod given by the Defence Ministry to procure 97 more LCA mark 1A fighter jets marks a 'landmark event' and demonstrates the force's commitment towards 'Atmanirbhar Bharat'.

Speaking to ANI, Chief of Air Staff and Air

Chief Marshal Chaudhari said, "It is indeed a landmark event that the approval has been given for procurement of 97 additional LCA mark 1A. You are aware that we had signed a contract for 83 LCA mark 1As, the deliveries for which are to start shortly in the next few months. We already had 40 LCAs of the original IOC and FOC version."

Stating that LCA mark 1As is an ideal fit to replace the depleting strength in the Air Force, the Air Chief Marshal said, "So with this, in the long run, the strength of the Indian Air Force will grow to 220 LCA mark 1As, which will equip almost ten squadrons of the Air Force. With the winding down of the MiG 21 and the MiG 27 and 23 fleets in the past, this is an ideal fit to replace the depleting strength."

"It's a very capable and potent aircraft and it gives our trust in the Indian defence industry capabilities. It shows that we firmly are committed towards Atmanirbhar Bharat and ensuring that a large number of our items on our inventory are made in India," he added.

Earlier, on Thursday, the Defence Ministry cleared the proposal for the acquisition of 97 LCA mark 1A fighter jets for the Indian Air Force at a cost of around Rs 65,000 crores.

According to defence officials, a proposal for buying 156 LCH Prachand choppers has also been approved by the Defence Acquisition Council while an upgrade plan for 84 Su-30MKI fighters has also been cleared. The proposals are worth Rs 1.6 lakh crore and, all, are indigenous projects.

On the acquisition of LCH Prachand choppers, Chief of Air Staff, Air Chief Marshal VR Chaudhari said, "The requirement for having a very agile combat helicopter was felt immediately

after the Kargil conflict and this indigenous development of the LCH or the Prachand has given a tremendous boost to our capability in war fighting in this domain of helicopter combat operations."

"We had procured 10 of them initially, for the Indian Air Force, the light combat helicopters, and they have proven their worth. They are indeed very agile, they are capable of carrying out multiple tasks even at high altitudes and these will enhance the capability of the armed forces and the Air Force in particular," he added.

IAF chief added that after the acquisition of 156 LCH, it is most likely that the Air Force will stop importing attack helicopters.

"This huge tranche of 156 LCH should suffice to meet our requirements of both the Army and the Air Force," he said.

Calling Prime Minister Narendra Modi's recent sortie in Tejas Aircraft a 'landmark event', the Air Force chief said that this gives confidence to the Indian domestic manufacturing ecosystem as it has received endorsement from the highest office of the country.

"The output of the effort of so many people in the industry, in the defence industry, has borne fruit and we are now capable of even exporting this aircraft to other countries. You've seen the follow on order which will come from the Air Force for 97 additional LCA. All this is a huge step towards Atmanirbharta. It was a tremendous message not only to the Indian Air Force, and Indian Armed Forces but also to the Indian defence industry," he said. (ANI)

Russia's Huge Air Force is Still Mostly Intact, but it hasn't been Building the Jets it Needs to Win on the Ground in Ukraine

Michael Peck | 29 November 2023

Source: [Businessinsider](https://www.businessinsider.com/russian-air-force-lacks-jets-to-destroy-ukraines-air-defenses-2023-11?IR=T) | <https://www.businessinsider.com/russian-air-force-lacks-jets-to-destroy-ukraines-air-defenses-2023-11?IR=T>



A Russian Su-35 downed in Ukraine's Kharkiv region in April 2022. Press service of the Ukrainian Armed Forces General Staff/Handout via REUTERS

With Despite its losses in the Ukraine, Russia's air force is still quite robust. It began the war with about 900 fighters and other combat aircraft and is estimated to have lost only about 90 jets between February 2022 and September.

What Russia doesn't have is the support aircraft needed to find and attack enemies on the ground. Even though Russian airpower was expected to be a dominant factor in this war — just as it has been for the US in its wars since 1945 — Russian jets have provided limited support to Russian troops, contributing to the failure of what the Kremlin expected to be an easy conquest.

That shortcoming has allowed Ukrainian anti-aircraft missiles, bolstered by Western-made air defenses, to take a toll on Russian aircraft, forcing the remainder to stay back and lob missiles and bombs at Ukrainian targets in less precise attacks.

For NATO air forces, the solution would be obvious: conducting suppression of enemy air defenses, or SEAD, and destruction of enemy air defenses, or DEAD, missions to disrupt and destroy surface-to-air missile batteries and air-defense radars.

But that requires adequate numbers of aircraft for intelligence, surveillance, and reconnaissance, or ISR, and for electronic warfare.

"Russia's own military experts may not believe Russia has put its money or focus on the right technology," Cmdr. Matthew Galamison, the executive officer of a US Navy electronic-attack squadron, and Michael Petersen, a professor and expert on the Russian military at the US Naval War College, wrote in a recent article for the US Air Force's Air and Space Operations Review.

"Airpower observers have noted the defense industry has failed to develop capability and capacity, especially in ISR and electronic attack, for the purpose of SEAD and DEAD," Galamison and Petersen wrote.

The Russian Air Force — known as the VKS — was still focused on the Russian military's traditional mission of protecting "the Motherland," according to Galamison and Petersen.

"Russian military strategy has generally prioritized the defense of critical infrastructure and close air support of ground troops rather than power projection in defended airspace," they wrote. "Because of this, the development of operational concepts and doctrine for air dominance operations, including SEAD/DEAD, has suffered."

Ideally, strike aircraft entering enemy territory would be escorted by high-performance electronic-attack aircraft — such as the US Navy's

EA-18G Growlers — to jam or deceive enemy air defenses.

But the VKS uses converted airliners that can't survive in contested airspace and various models of Sukhoi fighters with wing-mounted electronic-warfare pods that provide limited support.

If airborne jamming isn't an option, that leaves anti-radiation missiles, such as Russia's Kh-31, to home in on and destroy enemy radars. Those missiles can be effective if used properly.

"Yet based on videos appearing on social media, the employment altitude, flight profile, and ranges observed are unlikely to maximize the desired effects," Galamison and Petersen wrote in reference to Russia's Kh-31 attacks. Ukrainian troops also defend against these attacks by briefly shutting down their radars when they detect an incoming anti-radiation missile, causing it to miss.

As long as Ukraine's air defenses aren't suppressed, the Russian Air Force can't provide meaningful support to ground troops. Without air support, the Russian Army has a problem.

Many Russian units in Ukraine are composed of ill-trained, poorly armed, and unmotivated conscripts and paroled criminals. Conducting complex operations with such troops is a challenge, even when not facing highly motivated defenders like the Ukrainians. Airpower could and should have been an equalizer, helping Russian ground forces make up for other weaknesses.

Russia's military is taking some steps to compensate for its lack of aerial coverage, according to recent assessments by the British Defence Ministry.

The ministry said this month that Russia had begun using A-50 early-warning-and-control

aircraft to find targets for its S-400 air-defense systems at longer ranges, a change made in part because of Russian concern "about the prospect of Ukraine deploying Western-provided combat aircraft."

In a separate update, the ministry said a recent sighting of Russia's Soviet-era M-55 reconnaissance plane carrying a military reconnaissance pod developed for fighter jets was a sign that Moscow was considering putting the M-55 into use for ISR and target-acquisition missions in Ukraine.

With a ceiling of more than 70,000 feet, the M-55's sensors could work "at considerable stand-off range" to spot Ukrainian troops and air-defense sites from the safety of Russian airspace, the ministry said.

Given Russia's formidable electronic-warfare capabilities and its deep arsenal, Moscow's apparent interest in finding Ukraine's air defenses means Kyiv may soon have to contend with a more effective campaign to suppress them.

5 Russian Aircraft 'Shot Down' in 5 Minutes by Patriot Missiles Over 5 Months Ago: Ukrainian Air Force

Sakshi Tiwari | 29 November 2023

Source: Eurasian Times | https://www.eurasiantimes.com/5-russian-aircraft-shot-down-in-5-minutes-by-patriot-missiles/#google_vignette



File Image: Patriot missile defense systems.

Indian Back in May, the Ukrainian air defense troops managed to shoot down five Russian aircraft inside Russian territory, sending a chilling message to the Kremlin. The Ukrainian Air Force has revealed that the US-made Patriot missile defense system achieved the unprecedented feat.

The spokesperson for the Ukrainian Air Force, Yuriy Ihnat, recently revealed that during a furious counterattack in May this year, the Armed Forces of Ukraine shot down five Russian planes in five minutes. The barrage, he asserted, was carried out using the Patriot missile defense system, Ukrainian media outlet Novynarnia reported.

The official further elaborated that among the five aircraft meticulously brought down were a Su-34, a Su-35, two rare Mi-8MTPR-1 electronic warfare helicopters, and a regular Mi-8 helicopter. All of these aircraft were shot down in Bryansk Oblast, bordering Ukraine.

Inhat told the publication on November 27 that it was a genius operation led by the

Commander of the Ukrainian Air Force. Speaking in his native language, Inhat said, “The [Ukrainian] Patriot SAM units, with their unorthodox and decisive actions, destroyed five aircraft in five minutes in the Bryansk direction from where they launched guided missiles against our northern territories.”

This is significant given that Su-35 Flanker-E has been one of the most extensively deployed aircraft of the Russian Air Force in the ongoing conflict. And also the most feared. Ukrainian fighter pilots flying dangerous missions on their Soviet-legacy warplanes admitted that their biggest challenge was the formidable Russian Su-35 fighter jet.

Shortly before the Patriot shot down five Russian aircraft, some Ukrainian air defense operators who had completed training on the new PAC-3 Patriot missile defense systems also stated that the Su-35 was their “dream target.”

As EurAsian Times had discussed extensively in a previous report, advanced Russian fighters, like the Su-35, had been deployed together with the Su-34 Fullback along the frontlines to fire guided aerial bombs on Ukraine, for which the latter has little defense.

This allowed the Russian jets to man the frontlines, carry out attacks, and shoot down hostile jets without entering the Ukrainian air space, which has been saturated by air defense.

However, the shootdown by the Patriots on the fateful date of May 13 is likely to have taken the Russians by surprise and forced them to change Russia’s security calculations.

The Killers Of Russia’s Mighty Su-35

The Patriot missile defense went on to achieve some more victories shortly. For instance, Inhat

said that foreign-donated Patriot systems downed other Russian aircraft after the events of May 13, which caused Russia to change its aerial tactics.

“Over the Black Sea, another Su-35 was shot down [by a Patriot system]. It occurred at some point following the events of May 13 in the Bryansk region. And after that, they [Russian aircraft] understood it was risky there and that they may be shot down, so they temporarily ceased flying there.”

After the May 13 incident, Ukrainian officials had also claimed that the Patriot missile defense acquired from the West had shot down Russia’s Kinzhal hypersonic missile, which has essentially been projected as invincible by Moscow. In response to these claims, the Russian Ministry of Defense said that the Kinzhal had destroyed a Patriot defense battery.

Recounting this, Inhat said, “We [have downed] 15... ‘Daggers’ [Kh-47M2 Kinzhal hypersonic air-launched ballistic missiles altogether]... plus dozens of... ballistic missiles flying towards Kyiv.”

The Patriot missile defense system, supplied to Ukraine after an extended reluctance by the West, has occupied the center stage in the war-torn country. A typical Patriot battery consists of an AN/MPQ-65 or AN/MPQ-53 radar, the necessary fire control, communications, and other support components, and up to eight launchers mounted on trailers. Ukraine has reportedly received two Patriot batteries from Germany and the US.

Although the Ukrainian Air Force admitted to Patriot downing the five mighty Russian aircraft only recently, a video released by the service in early July suggested that the heroic shoot-down was the work of a Patriot, as reported by EurAsian

Times. In the released footage, a Patriot battery was seen with depictions of two Russian fighter jets and three Russian helicopters adorned with inscriptions of “May 13.”

Meanwhile, the latest admissions come at a time when Ukraine has been battered by massive Russian aerial strikes and drone attacks as the two countries enter yet another winter with the hostilities seeing no signs of abating.

Ukrainian officials announced that Russia launched its biggest Shahed drone strike on the capital, Kyiv, on November 25 since the beginning of its invasion. According to reports, the bulk of the Iranian-made drones were reportedly caught in the Kyiv region. However, 71 of the drones were captured by air defenses in six other areas of Ukraine.

Ukraine, for its part, has been begging allies in NATO to provide the nation with additional air defenses to prevent another winter like the one that ended with widespread power outages due to ongoing Russian attacks on Ukraine’s energy infrastructure.

Germany and France are spearheading the formation of a new 20-nation coalition centered on ground-based air defense to fortify Ukraine’s defenses against Russian drone and missile threats. Therefore, additional Patriot batteries could eventually be outbound for Kyiv.

China's Hypersonic Missiles could Take Down the US Air Force's New B-21 Raider: Study

27 November 2023

Source: *Times of India* | <https://timesofindia.indiatimes.com/world/china/chinas-hypersonic-missiles-could-take-down-us-air-forces-new-b-21-raider-study/articleshow/105531581.cms?from=mdr>



The B-21 Raider stealth bomber was unveiled at Northrop Grum .

NEW DELHI: Just two weeks after the US Air Force's super-secret B-21 Raider stealth bomber quietly made its first flight in California, Chinese researchers have said the aircraft can be taken down by PLA's hypersonic missiles.

The Chinese research team staged a virtual duel between the two rivals to see what it would take to win a future air battle, according to a report by South China Morning Post (SCMP). The result suggested that, with a combination of advanced hardware and new tactics, China could detect the opponents first.

In one simulated war game, a B-21-like stealth platform and its companion drone were both shot down by China's air-to-air hypersonic missiles, which can reach a top speed of Mach 6.

Eye on China

The B-21 Raider is only capable of cruising at about 1,000km/h (less than Mach 1), but it will play a central role in the US Air Force's Penetrating Counter Air (PCA) strategy that is tailored towards potential battles with the Chinese military.

The PCA strategy could pose a severe threat to China's air defence that has relied heavily on radar warning systems based on land, sea or airborne platforms.

The next-gen nuclear stealth bomber reportedly has a radar signature as small as a mosquito. In a conflict, it could get deep behind enemy lines and dump a large number of missiles or bombs on China's coast, crippling the People's Liberation Army's core defence infrastructure, said the report by SCMP.

The new bomber will take up its role in the nuclear deterrence triad in the 2030s, just as China builds up its nuclear arsenal.

China Develops Countermeasures

The development of the B-21 has forced China to place countermeasures with new technology.

China's hypersonic missiles are built with special features to track and kill stealth aircraft. Using new solid fuel "pulse engine" that can adjust power output at will throughout the flight, the missile can first go up to near space and come down on the enemy aircraft at an extremely high speed, said the research team.

This unusual approach, which is considerably harder to predict and can cover a much longer distance than traditional trajectories.

According to the SCMP report, the Chinese military has revealed numerous types of

hypersonic missiles but the version for air combat remains classified. The Chinese Air Force has confirmed that a large and advanced stealth aircraft is also under development but the time of first flight remains uncertain.

The number of J-20 aircraft – China's workhorse stealth fighter – is expected to be larger than the number of America's F-22 Raptors but considerably lower than the number of their F-35 combat aircraft. The Chinese military is reportedly also testing a two-seat version of the J-20 that can fly in formation with a number of drones.

Air Force Scrambled Rafales After a 'UFO' Sighting Near Imphal Airport

Manjeet Negi | 20 November 2023

Source: [India Today](https://www.indiatoday.in/india/story/indian-air-force-scrambles-rafale-fighters-to-look-for-ufo-sighted-near-imphal-2465188-2023-11-20) | <https://www.indiatoday.in/india/story/indian-air-force-scrambles-rafale-fighters-to-look-for-ufo-sighted-near-imphal-2465188-2023-11-20>



An unidentified flying object was sighted by some people near Imphal airport.

BEIJING – The Indian Air Force scrambled two Rafale fighter jets after getting information about the sighting of an 'unidentified flying object' (UFO) near Imphal airport in Manipur on Sunday.

The Rafales, launched from Hasimara air base, could not spot anything, top sources told India Today.

The first aircraft returned to the base and the second was deployed towards the area to check again, but it could not ascertain anything.

The Eastern Command of the Indian Air Force said that it had activated its Air Defence response mechanism.

"IAF activated its Air Defence response mechanism based on visual inputs from Imphal airport. The small object was not seen thereafter," it tweeted on Sunday.

"The UFO was visible with bare eyes moving westwards of the airfield till 4 pm," a CISF official said.

Flight operations at Bir Tikendrajit International Airport in Manipur's Imphal were halted for several hours after an unidentified flying object was sighted above the airport.

The diverted flights included an IndiGo flight from Kolkata which was initially instructed 'to hold overhead'. It was diverted to Guwahati after 25 minutes.

The delayed flights left Imphal airport after receiving clearance after around three hours. The Indian Air Force Eastern Command at Shillong was also informed of the development.

Space

China is Working on a Design for a Reusable Air-Launched Orbital Rocket

Andrew Jones | 30 November 2023

Source: *Space News* | <https://spacenews.com/china-is-working-on-a-design-for-a-reusable-air-launched-orbital-rocket/>



A view of the Jiuquan launch center from the Sentinel-2 satellite. China's reusable experimental spacecraft launched from the facility Sept. 4, 2020. Credit: Modified Copernicus Sentinel data 2020

HELSINKI — A Chinese launch vehicle maker is working on designs for an air-launched rocket for sending small satellites to orbit.

The system is being designed by the China Academy of Launch Vehicle Technology (CALT) to deliver a payload of up to 300 kilograms to a 500-km-altitude sun-synchronous orbit (SSO).

The three-stage air-launched rocket would weigh approximately 20,000 kilograms. It would fly on a carrier aircraft to an altitude of about 11.9 kilometers, reaching speeds of Mach 0.8 before being released.

The system is designed to provide “flexible, affordable and dedicated launch” for small satellites, according to an abstract submitted to Lyu Yan of CALT at the 74th International Astronautical Congress in Baku, Azerbaijan in October.

CALT is a major rocket developer under China's state-owned main space contractor, CASC. It is one of two entities, along with the Shanghai Academy of Spaceflight Technology (SAST), which make Long March rockets.

Such a system would potentially provide China with a flexible and economical option for launching small satellites. It would be able to take off horizontally from runways and not require access to China's spaceports. The latter are currently a bottleneck for Chinese access to space and growing demand for launch.

CALT earlier stated it is working on an air-launched rocket. It was reported to be working with Ukrainian companies on the project. Plans from 2017 note that a Y-20 strategic transport plane would be used in the system. The rocket which would have a payload capacity of 100 kg. A larger, 200 kg rocket was also mooted. Both would be solid-fuelled rockets.

The new design rocket offers a higher payload capacity and first stage reusability using an air rudder. "The air rudder recovery technology does not require the first-stage engine to have re-lighting and thrust adjustment functions, making it easier to design and manufacture," according to the abstract.

"Based on a 10 times recovery, the recovery of the first stage booster sacrifices a payload capacity of 1kg to 2kg while reducing the economic cost by approximately 62% for each launch mission."

Virgin Orbit notably developed an air-launch system, using its Cosmic Girl to deploy the small LauncherOne rocket. Virgin Orbit filed for bankruptcy earlier in 2023.

China's state-owned rocket makers and emerging Chinese commercial companies

have been exploring a broad range of launch technologies. The developments are part of a wider effort to increase the country's options and overall access to space.

These include the development of new solid rockets, new-generation human-rated launchers for lunar crewed missions and an evolving Long March 9 super heavy-lift launcher. There are also numerous potentially reusable commercial kerosene and methane-fueled launchers.

Commercial entities have also experimented with forms of propulsion including pulse detonation and monopropellants. CASC is also developing a two-stage spaceplane concept. It uses a reusable VTHL suborbital first stage and a reusable spacecraft second stage.

GAO Report Warns Artemis 3 Landing may be Delayed to 2027

Jeff Foust | 01 December 2023

Source: *Space News* | <https://spacenews.com/gao-report-warns-artemis-3-landing-may-be-delayed-to-2027/>



Illustration of a SpaceX Starship lunar lander on the moon. Credit: SpaceX

WASHINGTON — The first crewed landing of NASA's Artemis lunar exploration effort is unlikely to happen before 2027, a report by the Government Accountability Office concluded.

The GAO report, released Nov. 30, found that slow progress on both the Human Landing System (HLS) lunar lander being developed by SpaceX and new lunar spacesuits from Axiom Space would prevent NASA from achieving its currently goal of a late 2025 landing on the Artemis 3 mission.

Much of the report's emphasis was on HLS development. SpaceX, the GAO concluded, "is facing multiple issues that limit this progress and jeopardize its ability to support an Artemis III mission in 2025." Those issues include an "ambitious" schedule, delayed progress on its development to date, and significant technical work.

The GAO effectively argued that it was unlikely from the beginning of the HLS program that a Starship lunar lander would be ready by late 2025 given the time typically needed to complete any major project at NASA.

"We found that if the HLS development takes as many months as NASA major projects do, on average, the Artemis III mission would likely occur in early 2027," the report stated. "The complexity of human spaceflight suggests that it is unrealistic to expect the HLS program to complete development more than a year faster than the average for NASA major projects, the majority of which are not human spaceflight projects."

The report also noted that SpaceX's work on HLS was going at a slower pace than projected, taking more than half the overall schedule to reach the preliminary design review milestone, versus an average of 35% for major NASA projects. SpaceX has delayed "multiple key events," not specified in the report, from 2023 to 2024, compressing the remaining schedule.

The GAO report also flagged the "incomplete" first integrated test flight of Starship/Super Heavy in April. (The report noted, but did not assess, the second launch on Nov. 18, which fell outside the scope of the study.) Key technical milestones that remain outstanding are confirmation of the performance of the Raptor engine that powers Starship/Super Heavy and demonstration of in-space cryogenic propellant transfer. NASA officials told the GAO that the latter must be completed before the critical design review of the Starship lander.

NASA officials said in August that they received an updated schedule for Starship HLS development from SpaceX but the agency has not disclosed details about that schedule.

"Our overall schedule with them continues to be worked as they work off their technical milestones," Jim Free, NASA associate administrator for exploration systems development, said of SpaceX's HLS development at a Nov. 17 meeting of the NASA Advisory Council's human exploration and operations committee. "We look at how the lander integrates with the rest of the program."

At that meeting, he noted that the Starship lander was not the only new item being developed for Artemis 3. "Yes, the lander is absolutely important. We can't go anywhere without it. But, we also can't go anywhere without the suits."

The GAO report also suggested potential delays in development of those suits by Axiom. The company is still in early stages of suit development, with a preliminary design review scheduled for November. As of Nov. 30, neither NASA nor Axiom had reported the completion of

that review.

The report stated that Axiom planned to redesign portions of the suit, based on a design previously developed by NASA, to meet agency requirements that the suit provide 60 minutes of emergency life support capabilities. That could delay overall development of the spacesuit, it warned.

“Axiom’s remaining work to develop and procure suit components risks potential delays,” the GAO stated. That includes supply chain challenges, such as critical components from suppliers that have lead times of 12 to 18 months..

NASA Acknowledges Possibility of Short-Term Post-ISS Gap

Jeff Foust | 22 November 2023

[Source: Space News | https://spacenews.com/nasa-acknowledges-possibility-of-short-term-post-iss-gap/](https://spacenews.com/nasa-acknowledges-possibility-of-short-term-post-iss-gap/)



The International Space Station as seen from a Crew Dragon spacecraft in 2021. Credit: NASA

WASHINGTON — While NASA seeks to maintain an uninterrupted human presence in low Earth orbit, an agency official said a short-term gap between the International Space Station and commercial successors would not be “the end of the world.”

NASA’s current approach to its future in LEO counts on supporting development of commercial space stations with the goal of having at least one such station ready to support NASA astronauts and research by 2030, when the ISS is scheduled for retirement. A key question, though, will be whether any of the several companies working on such concepts will be ready by the end of the decade.

Speaking at a Nov. 20 meeting of the NASA Advisory Council’s human exploration and operations committee, Phil McAlister, director of NASA’s commercial space division, said the agency would not jeopardize safety to meet a schedule, following the lessons from the commercial crew program. “I do not feel like this is a safety risk at all,” he said. “It is a schedule risk and we are doing several things to mitigate that risk.”

One risk mitigation step is working with several companies, three of which — Axiom Space, Blue Origin and Voyager Space — have funded contracts or agreements with NASA to support initial work on their stations. Several others have unfunded Space Act Agreements to assist their own station plans, known by NASA as commercial LEO destinations or CLDs, or are working independently of NASA.

“Having more than one company in this stage of development, so you’re not relying on a single provider, really increases the probability that somebody’s going to be ready on time,” he said.

There is also some schedule flexibility in the transition between the ISS and commercial stations. McAlister noted there is a two-year overlap currently projected between the start of commercial space station operations around 2028

and the retirement of the ISS in 2030. “Less than that is certainly feasible,” he said of that overlap period. “This gives us a little bit of schedule margin.”

A third option is to extend the ISS beyond 2030, which would depend on the status of the ISS and willingness of ISS partners to continue station operations. Ken Bowersox, NASA associate administrator for space operations, said in a Nov. 2 speech that ISS retirement was “not mandatory” in 2030 and that there may some flexibility in that date should commercial stations not be ready.

In a later statement, Bowersox reiterated that NASA’s current policy is to retire the ISS in 2030 but that the agency “also prepares for a variety of scenarios” to ensure it can continue research in LEO. “The agency intends to maintain our continuous human presence in space for the benefit of humanity as we become one of many customers in a thriving commercial marketplace in low Earth orbit.”

But McAlister said even that goal of a “continuous human presence” could be reviewed. “If all of those mitigations fail, we would have a temporary gap in LEO presence,” he said. “That would be bad and I don’t want one, but if CLDs were not ready, we might have to accept a gap. And, personally, I don’t think that would be the end of the world.”

“A gap would not be great,” he said later in the meeting, “but I also don’t think it would be unrecoverable, either, especially if it was relatively short term.”

He added that flights by commercial crew vehicles, like SpaceX’s Crew Dragon and Boeing’s Starliner, “could lessen the impact of a

gap.” Those vehicles, he said, could be equipped with research equipment and extra consumables to enable 10-day missions for “meaningful research.”

Other vehicles in development, including SpaceX’s Starship, a crewed version of Sierra Space’s Dream Chaser and a proposed Blue Origin crewed spacecraft known only as Space Vehicle, would also help fill any gap, he added.

Other agency officials at the meeting said it may be a few years before they know how likely it is a commercial station will be ready by the end of the decade. “It’s really hard to rate it” now, said Angela Hart, NASA manager of the CLD program.

She said NASA wouldn’t have better insight into commercial space station development schedules until after the agency awards what it calls Phase 2 contracts to certify those stations and purchase services. NASA currently expects Phase 2 contracts to begin in 2026.

“That first six months to a year, once that contract is awarded, is where I think we’ll have the best understanding of what our schedule is,” she said.

She added her program was working closely with the ISS program “to put some meat on that transition plan” from the ISS, including fallback options if commercial stations are not likely to be ready by the end of the decade. “Some of those key decision points are in ’26 and ’27.”

In another presentation at the meeting, Robyn Gatens, ISS director at NASA Headquarters, said there is some “timeline flexibility” for the transition, which will depend on both the readiness of commercial space stations and availability of a deorbit

vehicle for the ISS. NASA is currently reviewing proposals for a U.S. Deorbit Vehicle, with a contract award expected in April 2024.

“In order to have no gap, it may require some flexibility in that timeline,” she said. That’s “tricky,” she added, because of the lead time of three years to procure additional cargo and crew transportation services for the ISS. “That introduces some challenges in that timeline flexibility.”

STARCOM Releases Space Domain Awareness Doctrine Publication

16 November 2023

Source: Starcom | <https://www.starcom.spaceforce.mil/News/Article-Display/Article/3589828/starcom-releases-space-domain-awareness-doctrine-publication/>

COLORADO SPRINGS, Colo. -- Space Training and Readiness Command (STARCOM) recently released its latest Space Doctrine Publication (SDP), SDP 3-100, Space Domain Awareness – the first operational level doctrine publication developed by STARCOM for the U.S. Space Force.

Space Delta 10’s doctrine team worked with Guardians from across the service to capture extant best practices, and authoritative guidance regarding space domain awareness or SDA.

SDP 3-100, Space Domain Awareness, presents the U.S. Space Force’s approach to establishing and maintaining SDA as part of unified action to support the freedom to operate in, from, and to space. The publication articulates the importance of SDA for operations in all domains; characterizes the space environment,

to include the natural operating environment, space debris, threats, adversary use of space, and commercial space; discusses space capabilities and the orbital, terrestrial, and link segments of space systems; and addresses roles and responsibilities of organizations that conduct SDA.

“Effective SDA is foundational for space forces to conduct prompt and sustained operations that fulfill the cornerstone responsibilities of the Space Force, preserving freedom of action in the space domain, enabling joint lethality and effectiveness, and providing independent options capable of achieving national objectives. Space Force commanders and their staffs rely on timely and actionable SDA to satisfy these responsibilities,” stated U.S. Space Force Brig. Gen. Timothy Sejba, Commander of STARCOM, in SDP 3-100’s foreword.

In addition to SDP 3-100, Space Domain Awareness, STARCOM previously released five keystone-level SDPs: SDP 1-0, Personnel; SDP 2-0, Intelligence; SDP 3-0, Operations; SDP 4-0, Sustainment; and SDP 5-0, Planning. Several other doctrine documents are currently in various stages of and can be accessed on the Space Wiki and from the Space Training and Readiness Command (STARCOM) Digital Library..

As India Mulls Renaming IAF to 'Air And Space Force,' Tata Forays into Manufacturing High-Resolution Military Satellites

Ujjwal Shrotryia | 30 November 2023

Source: [Swarajyamag](https://swarajyamag.com/defence/as-india-mulls-renaming-iaf-to-air-and-space-force-tata-forays-into-manufacturing-high-resolution-military-satellites) | <https://swarajyamag.com/defence/as-india-mulls-renaming-iaf-to-air-and-space-force-tata-forays-into-manufacturing-high-resolution-military-satellites>



Earth Observation Satellite (EOS). (Representative Image)

The Indian Government is mulling to rename the Indian Air Force (IAF) to Indian Air and Space Force.

Former IAF Chief, Air Chief Marshal RKS Bhadauri described this as a positive development, stating that this is a 'work in progress,' and makes a lot of sense.

He said, "If you look from the point of synergy and core strength, then air and space force will be a step in the right direction. But like I said, it is a work in progress. It is something which is being discussed. It is an evolution which will take place as things move forward and the right decisions will be taken."

Amid these talks Tata Advanced Systems Ltd (TASL) has decided to establish a facility in Bengaluru for manufacturing high-resolution

imagery satellites, betting big on the military space sector, reported Economic Times.

This marks a significant investment in the military space sector.

The facility will manufacture satellites capable of sub-metre resolution, including a ground station for satellite control and image processing, crucial for armed forces operations in monitoring infrastructure and identifying military targets.

According to the report, the Defence Ministry has recently challenged the Indian industry to develop satellites with metre and sub-metre resolutions for military applications.

Leveraging TASL's extensive defence expertise, the facility plans to produce up to 24 low earth orbit (LEO) satellites annually.

This venture is in collaboration with Satellogic, a Latin American firm specialising in earth observation satellites. The first satellite, offering 0.5-metre spatial resolution imagery, is anticipated to be launch-ready within six months.

Responding to an inquiry, TASL confirmed the establishment of an assembly, integration, and testing (AIT) facility.

According to the report, TASL expressed the critical need for advanced resolution imagery satellites for Indian military. It emphasised that TASL's partnership with Satellogic, which has a strong background in satellite technology, forms the core of their strategy.

Currently, the Indian armed forces rely on satellite imagery from the Indian Space Research Organisation (ISRO) and, when necessary, procure commercial images from international sources.

The heightened need for surveillance, particularly after recent incidents along the Line of Actual Control (LAC) with China, has led to increased dependency on foreign imagery sources.

Using foreign services for satellite imagery requires sharing coordinates of targeted areas, which poses security concerns. A domestically operated ground station would significantly enhance the security and efficiency of surveillance operations.

TASL aims to utilise its expertise in system integration, electronics, and software development to innovate satellites with varying payloads to meet defence needs. The company plans to increasingly localise production and develop indigenous payloads.

TASL already supplies a variety of products to the armed forces, including loitering munitions, UAV control centres, artillery systems, and aerostructures. It is also collaborating with Airbus to manufacture C-295 military transport aircraft.

Indian Astronaut will Fly to Space Station in American Vehicle: ISRO Chief

29 November 2023

Source: India Today | <https://www.indiatoday.in/science/story/indian-astronauts-will-fly-to-space-station-in-american-vehicle-isro-chief-2469034-2023-11-29>



Nasa uses Falcon-9 to launch astronauts to space.

(Photo: SpaceX)

In a significant development for India's space ambitions, Isro Chief S Somanath has confirmed that Nasa is working towards sending an Indian astronaut to the International Space Station (ISS).

This announcement follows the comments made by Nasa chief Bill Nelson, who is in India on an official visit. The idea was first floated in high-level discussions between Prime Minister Narendra Modi and US President Joe Biden.

Nasa is currently using the Elon Musk-led SpaceX's Falcon-9 rocket and Dragon spacecraft to send astronauts to the ISS.

"We are taking it forward; that's what the Nasa chief said—that Indian astronauts will be flying to the international space station in an American vehicle," stated Somanath. The collaboration marks a milestone in Indo-US space relations and underscores the growing partnership between the two nations in the realm of space exploration.

The Isro Chief emphasized the importance of the program being beneficial for India. He expressed the desire for comprehensive training of Indian astronauts at US facilities, which would not only include the astronauts themselves but also the teams responsible for handling, medical support, and control operations.

Such training would provide invaluable exposure and experience, enhancing India's capabilities in manned space missions.

This move comes as part of a broader initiative to bolster cooperation between Nasa and Isro. It is expected that by the end of 2024, the selected Indian astronaut, whose selection process will be conducted by ISRO, will be trained and ready to embark on a mission to the ISS.

This event will mark the first time an Indian has traveled to space since Wing Commander Rakesh Sharma's historic journey in 1984.

In addition to the astronaut program, both space agencies are gearing up for the launch of the Nasa-Isro Synthetic Aperture Radar (NISAR) satellite in the first quarter of 2024. NISAR aims to provide an unprecedented view of Earth by observing its dynamic surface and interior, which will contribute significantly to the understanding of climate change and natural resource management.

Global Aerospace Industry

US Approves Major Long-Range Missile Deal for Japan

17 November 2023

Source: *Spasewar* | https://www.spacewar.com/reports/US_approves_major_long-range_missile_deal_for_Japan_999.html



The United States on Friday approved Japan's request to buy 400 Tomahawk missiles, part of Tokyo's bid to bolster defenses despite fresh dialogue with China.

The State Department said it was approving the \$2.35 billion sale that includes two types of the Tomahawk missiles, which have a 1,600-kilometer (995-mile) range.

The State Department said the sale was aimed at "improving the security of a major ally that is a force for political stability and economic progress in the Indo-Pacific region."

The sale "will improve Japan's capability to meet current and future threats by providing a long-range, conventional surface-to-surface missile with significant standoff range that can neutralize growing threats," it said in a statement.

Prime Minister Fumio Kishida told a parliamentary committee in February that his government was seeking 400 Tomahawk missiles as part of a major defense push.

Japan has been alarmed by China's growing military clout, including its exercises around Taiwan, as well as by nuclear-armed North Korea's missile tests.

The missile deal is going ahead despite dialogue with China aimed at easing tensions.

Chinese President Xi Jinping met separately in recent days on the sidelines of an Asia-Pacific summit in San Francisco with Kishida and US President Joe Biden.

IAI Signs Agreements Valued At \$145m to Deliver Long-Range Loitering Munitions

20 November 2023

Source: SP's Aviation | [https://www.sps-aviation.com/news/?id=1396&catId=1&h=IAI-signs-agreements-valued-at-\\$145M-to-deliver-long-range-loitering-munitions](https://www.sps-aviation.com/news/?id=1396&catId=1&h=IAI-signs-agreements-valued-at-$145M-to-deliver-long-range-loitering-munitions)



Israel Aerospace Industries (IAI) signed two separate agreements with two countries to deliver long range loitering munitions. The contracts' combined value is \$145M. These two significant orders follow a previous contract signed earlier this year, that has also declared the purchase of

IAI's long range loitering munitions. This series of orders represent the growing global demand for IAI's long range loitering munition family and demonstrates IAI's unique capability in this market segment.

IAI's President and CEO Boaz Levy: "Loitering munitions have proven critical to achieving operational success on the battlefield worldwide. The flexibility in strikes that can be achieved with a loitering munition is a major advantage in combat and the type of precision reached is of strategic and national importance. The latest orders emphasize the trust in IAI's loitering munitions family in bringing the required advantages to each country respectively".

IAI's family of long range loitering munitions includes the Harpy NG, Harop, and Mini Harpy.

In the 1980s, IAI invented the loitering munitions weapons class when it introduced the HARPY. Equipped with an Anti-Radiation (AR) seeker, the Harpy was designed for the Autonomous Suppression of Enemy Air Defence (SEAD) missions. Today, IAI offers the Next Generation, the HARPY NG – a more advanced loitering munition used against a diverse range of radiating targets.

The HAROP, a derivative of the Harpy, is a combat proven loitering munition with a naval and land versions. The Harop is used against a variety of combat scenarios including against terror threats. Using a day and night Electro Optical seeker, the HAROP scans, detects, identifies, and attacks stationary and moving targets with exceptional precision and at any angle.

The MINI HARPY is the only loitering munition in the world to carry a triple seeker – Electrooptical day, night, and AR. The combined seeker allows detection and attack in severe weather conditions and makes it very difficult for the target to avoid detection and destruction. The Mini Harpy has electrical propulsion and is equipped with an anti-tank warhead. Like the other long range LMs, Mini Harpy is canister-launched.

IAI is proud to pave the way in air defence, precision strikes, missiles, space, radars, UAVs, civil aviation, and cyber defence. IAI's land, air, naval, and space systems are currently proving critical to security forces during Israel's Iron Swords War, and other defense organizations around the world.

Boeing Bonanza Leaves Rival Airbus in the Dust at the 2023 Dubai Air Show with Three Times more Aircraft Orders

Natasha Turak | 16 November 2023

Source: CNBC | <https://www.cnbc.com/2023/11/16/dubai-airshow-2023-boeing-order-bonanza-leaves-airbus-in-the-dust.html>



Aermacchi MB-339 trainer aircraft of the Fursan al-Emarat (UAE Knights) aerobatics team release smoke as they fly over with an Emirates Airbus A380-861 jetliner aircraft during the 2023 Dubai Airshow at Dubai World Central - Al-Maktoum International Airport in Dubai on November 13, 2023.

Giuseppe Cacace | Afp | Getty Images

DUBAI, United Arab Emirates — American aerospace giant Boeing eclipsed its French rival Airbus after four days of deals at the 2023 Dubai Air Show, underlining strong demand for wide-body jets in particular and making a strong comeback after several years of underperformance following major safety scandals.

Boeing chalked up 295 aircraft orders in comparison to Airbus' 86 orders by Day 4 of the Middle East's largest aviation event, according to company updates and tallies from industry experts. The French manufacturer grappled with publicly aired concerns over the cost and performance of the Rolls-Royce engines on its planes.

Boeing kicked off the first day of the show with a massive order for 90 of its 777 wide-

body jets from Dubai's flagship carrier Emirates Airline at list prices of \$52 billion, followed by an \$11 billion order from Emirates subsidiary and low-cost carrier FlyDubai for 30 of its first-ever-ordered 787 Boeing Dreamliners.

The robust appetite for wide-body jets highlighted both Dubai's optimistic outlook for long-haul air travel as well as the importance of the Middle East market to the aircraft model's demand. The purchases showed Dubai flexing its muscles as a leading East-West transit hub, looking keen to defend and increase its market share amid rising competition or expansion from carriers in Turkey, India and Saudi Arabia.

The Emirates order was made up of 55 additional Boeing 777-9s and 35 of its 777-8s, bringing the airline's total orders for the 777X wide-body jets to 205 units. Emirates also updated its order of Boeing 787 Dreamliners from 30 to 35.

The significant proportion of wide-body jets at the Dubai show "reflects the surge in international travel in 2023; and it favors BA (Boeing), which is stronger than Airbus in widebodies and has snared ~50% of the Dubai dollar order value," analysts at TD Cowen wrote in a note Wednesday.

Turkish-German airline SunExpress made the second-largest Boeing order after Emirates, comprised of 56 of its narrow-body 737-8s and 34 737-10s. Ethiopian Airlines followed with up to 41 737-8s and 26 787-9s, then FlyDubai with 30 787-9s, Kazakhstan's SCAT Airlines with seven 737-8s, and Royal Jordanian and Royal Air Maroc with orders of four and two 787-9s, respectively.

Airbus Faces Ongoing Deal Talks, Engine Criticism

Airbus, which had firmly dominated at the last few Dubai shows, trailed behind with 86 aircraft orders, the largest from AirBaltic which bought 30 narrow-body A220-300s with an option for a further 20. Ethiopian Airlines ordered 11 of Airbus' wide-body A350-900s, while EgyptAir purchased 10 of the same jet.

Emirates on Thursday ordered 15 of the French plane maker's A350-900 jets, a purchase the airline said is worth \$6 billion — a much smaller order than previously anticipated, after the carrier's president, Tim Clark, openly criticized the cost and maintenance required for the Rolls-Royce engines on the Airbus A350.

"If the engine was doing what we want it to do ... then it would reenter the mix of assessment for our fleet plan," Clark told journalists at the air show. He said that Emirates would have ordered 35-50 of the jets otherwise.

In a statement replying to the comments, Rolls-Royce said that the A350-900's XWB-84 engine "is the best engine out there when you look at efficiency, durability and reliability."

Industry watchers also anticipated a blockbuster sale for Airbus of 355 planes to Turkish Airlines. But instead of a signing, the two said they reached an "agreement in principle for a significant commercial aircraft order," with the Turkish flag carrier saying in an Istanbul stock exchange filing that its "discussions with Airbus" are "ongoing."

Boeing Orders 'Exceeded Investor Expectations'

Boeing's orders are already nearly three times as high as its total orders from the Dubai

Air Show in 2021, and approaching the 356 orders in clinched at the 2023 Paris Air Show in June. Airbus' order figure of 86 aircraft is meanwhile significantly behind its 2023 Paris Air Show haul of 846 orders and 2021 Dubai Air Show total of 408.

Before this week, the iconic American manufacturer hadn't enjoyed a winning performance at a Dubai Air Show since 2017. In 2019, Boeing's sales were badly hit after two catastrophic crashes of its popular 737 Max jet in less than five months. Roughly 400 737 Max jets around the world were grounded for nearly two years.

"We believe the Dubai order flows have exceeded investor expectations thus far for Boeing," analysts at RBC Capital Markets wrote in a note after the second day of the air show.

The analysts still saw potential future orders for Airbus. "Despite Airbus not yet solidifying its deal with Turkish Airlines, we believe the order activity could be increasing across other airlines," RBC wrote on Tuesday.

"Saudi Arabia's newest airline, Riyadh Air, said it could be looking to make a narrowbody purchase, along with [low-cost Saudi carrier] Flyadeal, who could be planning to order about ~150 more" narrow-body jets, it said.

The Middle East's largest aviation event, the Dubai Air Show takes place every two years and this year hosted some 1,400 commercial and military exhibitors from 95 countries, according to its website.

Indian Aerospace Industry

Govt Nod to buy 97 more Tejas LCAs, 156 Choppers Worth Rs 2.23 Lakh Cr

30 November 2023

Source: Refiff.com | <https://www.rediff.com/news/report/govt-nod-to-buy-97-more-tejas-lcas-156-choppers-worth-rs-223-lakh-cr/20231130.htm>



IMAGE: A Tejas light combat aircraft during a sortie.

Photograph: ANI Photo

India on Thursday accorded an initial approval to defence acquisition projects worth Rs 2.23 lakh crore that included procurement of 97 Tejas light combat aircraft and 156 Prachand combat helicopters, in a major move to significantly enhance the combat capabilities of the armed forces.

The Defence Acquisition Council, chaired by Defence Minister Rajnath Singh, cleared the projects, at a time India is locked in a bitter military standoff with China at a number of friction points in eastern Ladakh for over three years.

The defence ministry said 98 per cent of the total procurement worth Rs 2.23 lakh crore will be sourced from the domestic industries and that the move will give a substantial boost to the Indian defence industry in achieving the goal of 'Aatmanirbharta' (self-reliance) in defence

industry.

The DAC also approved a proposal of the Indian Air Force to upgrade its Su-30 fighter fleet by state-run aerospace major Hindustan Aeronautics Ltd.

The DAC further accorded Acceptance of Necessity or initial approval for procurement of two types of anti-tank munitions namely area denial munition type-2 and type-3.

The top body on procurement of military hardware also cleared acquisition and integration of automatic target tracker and digital basaltic computer for T-90 tanks besides approving another proposal to buy medium range anti-ship missiles for the Indian Navy.

The MRAShM is a lightweight surface-to-surface missile which will be a primary offensive weapon onboard various Indian naval ships.

"The DAC accorded AoNs for procurement of Light Combat Helicopter for Indian Air Force and Indian Army and Light Combat Aircraft Mk-1A for IAF from Hindustan Aeronautics Limited under Buy (Indian-IDDm) category," the ministry said.

Though it did not mention the specific numbers, official sources said 97 Tejas Light Combat Aircraft (Mark 1A) are being procured for the IAF and 156 Light Combat Helicopters are being procured for the Army and the Air Force.

In February 2021, the defence ministry sealed a Rs 48,000 crore deal with the Hindustan Aeronautics Ltd for procurement of 83 Tejas MK-1A jets for the IAF.

With the additional fleet, the number of indigenously-developed Tejas aircraft being procured by the IAF would go up to 180.

"The AoNs have also been accorded by the DAC for upgradation of Su-30 MKI aircraft

indigenously from HAL.

How PM Modi's Sortie in Tejas Signifies India's Confidence in Defence Indigenisation

Air Marshal Anil Chopra (Retd)

*Director General, Centre for Air Power Studies |
26 November 2023*

Source: First Post | https://www.firstpost.com/opinion/how-pm-modis-sortie-in-tejas-signifies-indias-confidence-in-defence-indigenisation-13432572.html?utm_source=twitter&utm_medium=social



Image Source: X/ @narendramodi.

Air . Prime Minister Narendra Modi made a 30 minute flight on the Light Combat Aircraft (LCA) 'Tejas' on November 25, and became the first and the only Indian PM to fly an indigenous designed and produced fighter aircraft. Dressed like a combat pilot and wearing a G-suit, he flew the sortie with Group Captain Debanjan Mandal. Having operated from Indian Air Force's (IAF), flight test centre, the Aircraft and Systems Testing Establishment (ASTE), Bengaluru, he was received and felicitated by the Air Chief, ACM VR Chaudhuri. It was all more significant, because he was flying a single-engine aircraft, when traditionally the VVIPs make flights in twin-engine aircraft like the Su-30MKI. As head of the family (government) the PM has led from the front.

PM Modi tweeted that his successfully completed sortie on the Tejas was an incredibly enriching experience, and significantly bolstering his confidence in the country's indigenous capabilities, and left him with a renewed sense of pride and optimism about India's national potential. He further said that it was a flight to remember. Tejas is India's pride, a manifestation of the strength and skills of 140 crore Indians.

The flight underscored the PM's and the nation's commitment to indigenisation. He congratulated the IAF, Defence Research and Development Organisation (DRDO), Hindustan Aeronautics Ltd (HAL), and all Indians for the great aircraft developed through a whole of nation approach. The PM also visited the world class production facilities where the 'Tejas' is produced, and it was of great encouragement to the engineers and technicians.

LCA: Great Design and Operational Asset

The HAL Tejas is a single engine, delta wing, light multirole fighter designed by the DRDO's Aeronautical Development Agency (ADA) and HAL. It is the smallest and lightest in its class of contemporary supersonic combat aircraft in the world. It has an indigenous fly-by-wire system, and makes extensive use of home-developed composite materials. The 4.5 generation aircraft made its first flight in 2001. The first Tejas squadron "Flying Daggers" became operational in 2016.

The IAF has ordered 32 LCA Mark 1s, 73 Mark 1As and 18 Mark 1 two-seater aircraft. It has been decided to order 97 additional Mk1As. IAF has projected a requirement of nearly 200 LCA Mk2.

The LCA Mk1A made its first-flight in May 2022. It can fly at Mach 1.6. It has 9 external hard-points with a capacity of 5300 kg, and provisions to carry combinations of state-of-the-art rockets; short-range and beyond-visual range (BVR) missiles; and various gravity bombs and precision guided munitions (PGM) from stand-off ranges. The initial batches have the Elta EL/M-2052 AESA fire control radar which will soon be replaced by the indigenous LRDE Uttam AESA radar. There are nearly 40 improvements over the Mk1 variant. It will have a potent electronic warfare suite. It will have an expanded weapon suite consisting of Astra BVR air-to-air missile (AAM) and Advanced Short Range AAM (ASRAAM). Many of these weapons will be of indigenous origin. The aircraft will start inducting in 2024.

The Tejas Mk2 or the Medium Weight Fighter will be a larger aircraft, with more payload, and will be powered by the more powerful General Electric GE F414 INS6 engine. These American engines will be produced in India. The engines will also initially power India's indigenous fifth-generation fighters Advanced Medium Combat Aircraft (AMCA).

The first flight is expected in 2024, and the aircraft ready for series production by 2026. The Mk2 will feature a modern glass-cockpit, have an advanced AESA radar, and an integrated infrared search and track (IRST). It will have an on-board oxygen generation system and a built-in electronic warfare suite among other improvements to avionics. More internal fuel will increase the combat range. The aircraft will eventually replace the Mirage-2000, Jaguar and MiG-29s.

A naval variant is also being developed. In

January 2020, The Naval LCA made a successful arrested landing on INS Vikramaditya and subsequently, 18 take-offs and landings were conducted in five days. In a major milestone, the LCA naval variant made a maiden landing onboard the country's first Indigenous Aircraft Carrier (IAC) INS Vikrant in February 2023. This was also the maiden landing of any fixed wing aircraft on the carrier as part of its operationalisation. Indian Navy's twin-engine MiG-29K landed and take-off subsequently.

As of 2022, indigenous content in the Tejas Mark 1 is 59.7% by value and 75.5% by number of line replaceable units. The indigenous content of the Tejas Mk 1A is expected to be 50% and rise to 60% by the end of the program.

LCA Combat Employment

LCA is a multi-role aircraft that is designed to undertake air defence, strike and maritime roles. It will be significantly used for offensive air support and provide close combat support for ground operations. Five IAF Tejas participated in its first outside India exercise Desert Flag VIII in UAE in February-March 2023. The fact that IAF deployed the aircraft in multinational exercises abroad reflects its confidence in the single-engine fighter. The LCA has been taking part in all military exercises within the country for a few years. The aircraft has had an excellent flight safety track record of accident-free flying till date.

Sulur in southern Indian Peninsula has been the home base for LCA Mk1 till now. A few months back it was decided to permanently move an LCA Mk1s squadron to a forward base in Gujarat. Further it has been decided to place the first LCA Mk1A unit in a forward airbase in Rajasthan. This not only shows aircraft's

technical maturity, but also its operational capability.

Enhanced Aircraft Production

HAL has a capacity to build 16 LCA Mk-1As every year in Bengaluru and a new production line has been activated in Nashik. This will help ramp up production to a total of 24 jets. This will enable HAL to deliver the 83 fighters by 2027-28, a year ahead of the contracted delivery schedule. The IAF needs faster aircraft inductions to cater for retiring MiG 21 squadrons.

LCA Export Potential

LCA capabilities have been showcased through static and flying displays at India's Aero India airshows for many years. It performed some daring manoeuvres to display its capability as a formidable fighter aircraft. HAL has also been developing a Lead in Fighter Trainer (LIFT) variant of the LCA two-seater.

The aircraft had also participated in many international events, such as LIMA-2019 at Malaysia, Dubai Air Show-2021, Sri Lanka Air Force anniversary celebrations in 2021, and Singapore Air Show 2022.

HAL has been in talks with many countries for possible export of the LCA. HAL was willing to set up logistic facilities in Indonesia, Malaysia, Sri Lanka and Vietnam as part of exporting the Tejas. Among the prospective customers are Botswana to replace its Canadair CF-5s with the Tejas. Egypt had once expressed interest in procuring 70 LCA Tejas to replace their 100 Chinese-made Hongdu JL-8 trainers. During Aero India 2023, it was reported that Egypt is seeking around 20 Tejas. LCA was a good contender for the Argentine Air Force, but

the British sanctions affected the sale as there were some British aircraft parts including the ejection seat. Even the Royal Australian Air Force (RAAF) had shown interest, but finally no progress could be made as they decided to upgrade their existing Hawk two-seaters. Even the Malaysian deal could not succeed as finally they procured the KAI FA-50 Block 20 aircraft. Even Philippines dropped the LCA as a contender. But with an increase in production, LCA could continue to make efforts to find new export customers.

Way Ahead

The highest dividend for the “atmanirbharta” in defence is in aviation sector. Aircraft require the leading edge technologies. No country shares technology easily, and India must build its own intellectual property. Also obsolescence sets in early. IAF’s leadership firmly backs the LCA program. In a recent review, Air Chief V R Chaudhari described the fighter aircraft as the flag-bearer of IAF’s efforts towards the indigenisation of its combat fleet. Technology for many parts and sub-sections of the aircraft has been transferred by DRDO and HAL to private sector firms, and are being manufactured by MSMEs. Over the years a defence production ecosystem has been created. It is hoped that PM Modi’s confidence exuding flight will further raise the morale of India’s aircraft designers and engineers and accelerate the design and further development. It is also hoped that it will hasten the clearances and funding of further phases of LCA and AMCA development.

Indian Air Force Advances: Su-30 MKI Upgrade with Indigenous Technologies and Strategic Partnerships

Huma Siddiqui | 30 November 2023

Source: Financial Express | <https://www.financialexpress.com/business/defence-indian-air-force-advances-su-30-mki-upgrade-with-indigenous-technologies-and-strategic-partnerships-3322038/>



Indigenous additions to Su-30MKI weaponry include BrahMos and Astra air-to-air missiles. (image: Andaman and Nicobar Command)

The Defence Acquisition Council (DAC), led by Defence Minister Rajnath Singh, granted Acceptance of Necessity (AoN) for the indigenous upgrade of Su-30 MKI Aircraft by state-owned Hindustan Aeronautics Limited (HAL).

The Air Chief, in one of the earlier interactions with the media, indicated plans to upgrade 84 Sukhoi-30MKI fighter jets at a cost slightly exceeding Rs 60,000 crore. The HAL facility, in collaboration with the Indian Air Force and other partners, will handle the upgrades, excluding modifications to the airframe and engines.

Reports in the public domain indicate that the first batch of 100 SU-30s will undergo upgrades, including electronic warfare suite enhancements, avionics, and radar improvements.

The design and development phase is expected to span four to five years, followed by

the initiation of fleet modernization. The Su-30MKI fleet has been undergoing a continuous “spiral upgrade” for over a decade, integrating new weapons and sensors.

Indigenous additions to Su-30MKI weaponry include BrahMos and Astra air-to-air missiles. Further integration is anticipated, involving Rudram-1 new generation anti-radiation missiles (NGARMs), Rudram-2, Rudram-3, and Astra-2. Rudram missiles are designed to neutralize various enemy surveillance, communication, and radar targets on the ground from stand-off distances.

The successful flight test of Rudram-1 NGARM on October 9, 2020, marked a milestone, striking a radiating target off the coast of Odisha. Subsequent developments include the DRDO’s plans to develop Rudram-2 (350 km range) and Rudram-3 (550 km) air-to-ground missiles.

A schematic for an electronic warfare suite, presented during Aero India 2023, hinted at ongoing efforts to replace current Russian SAP-51 pods on IAF’s Su-30 MKI fleet.

Will Russia be Part of the Upgrade?

Yes. Talks with Russia since 2017 have focused on upgrading the existing SU-30 MKI fleet, aligning with India’s goal of maximizing indigenous systems. Following the 19th IRIGC-M&MTC meeting in Moscow on November 6, 2019, Russia committed to supporting the development of a prototype for an upgraded Su-30MKI at HAL.

Contrary to engine upgrades, reports suggest a deliberate effort to minimize costs. The Indian Air Force’s preference for beyond-visual-range (BVR) combat diminishes the significance of super manoeuvrability. The planned upgrade

features a new radar, potentially the Tikhomirov NIIP N035 Irbis E, comparable to an AESA radar.

Director General – Electronics & Communication Systems (ECS) at DRDO BK Das outlined plans to integrate the Uttam Radar with fighter jets like Sukhoi-30MKI and Mig-29 by 2025, following successful integration with Tejas Mk-1.

Considering the design and development timeline for the Su-30MKI upgrade variant, it remains a possibility that DRDO will have a suitable Uttam variant for the upgraded fighters. However, inherent challenges in new development projects may lead to timeline uncertainties.

Dubai Airshow: India’s LCA Tejas to ‘Edge Out’ Competitors with New, Long-Range, Precision-Guided Munitions

Ritu Sharma | 15 November 2023

Source: Eurasian Times | <https://www.eurasiantimes.com/lca-tejas-to-edge-out-competitors-with-new-long-range/>

The world’s smallest and lightest supersonic fighter jet, LCA ‘Tejas’ (Brilliance), is all set to become deadlier. The feasibility studies have been completed to integrate the Al-Tariq long-range precision-guided munitions (LR-PGMs) on the Indian-made fighter jet.

Al Tariq-LR is a long-range (LR) precision-guided munition (PGM) manufactured by Al Tariq, part of the Weapons and Missiles business of EDGE Group, a state-owned defense conglomerate based in the United Arab Emirates (UAE).

Al Tariq-LR is part of the Al Tariq family

of precision munition kits designed to convert unguided aerial munitions into high-precision, smart, longer-range, focused munitions using guidance and propulsion technologies. The Al Tariq family of precision munition kits also includes the standard range precision-guided munition.

The announcement was made on the sidelines of the Dubai Air Show and follows a Memorandum of Understanding (MoU) signed earlier this year between Al-Tariq (a Joint Venture between EDGE and South African Denel) and Indian aerospace major Hindustan Aeronautics Limited (HAL).

The MoU aimed to integrate the AL TARIQ LR-PGM onto the HAL Tejas LCA and other platforms as part of their campaign to offer a long-range precision weapon solution to the region.

Theunis Botha, CEO of Al Tariq, said: “We are proud to be associated with HAL in this strategic campaign to offer high technology solutions to the Tejas customers in the region. We look forward to presenting the range of AL TARIQ’s mission-proven long-range precision-guided munitions to HAL Tejas customers around the globe.”

The AL TARIQ family of modular, all-weather, day/night LR-PGMs are designed to fit onto the Mark 80 series and the Indian-designed High-Speed Low Drag (HSLD) series of aerial munitions. Adding a wing kit converts the AL TARIQ-S (Standard Range) to the AL TARIQ-LR (Long Range), extending the stand-off range from 45km to 120km.

Full integration and qualification of AL TARIQ’s LR-PGMs on HAL’s Tejas LCA is expected to be completed in the third quarter of 2024.

From Design Board To India’s Frontline Fighter Jet

As the curtains draw on the Indian Air Force’s (IAF) fleet of MiG-21s, the LCA Tejas will be more prominent in defending the Indian air space. The IAF has deployed LCA Mk-1 at the Sullur air base in South India. However, in 2023, the IAF deployed one squadron of its indigenous combat jets in the Kashmir Valley, a base responsible for defending the border along Pakistan.

Moving LCA Tejas to forward bases aims to help it gain experience in flying in the valley and other operations. The deployment to forward bases indicates the growing confidence of the IAF in the aircraft. It allows the units to test their maintenance procedures, turnaround rate, and aircraft availability, which will be helpful in case of conflict.

An official told the EurAsian Times: “These detachments are happening nationwide, particularly in the forward air bases. These detachments are to familiarise pilots and the ground staff about operations from these air bases and to provide them experience operating from these locations, with an eye on likely future permanent deployment.”

Recent media reports indicated that an LCA-Mk 1 squadron based at Sullur in Tamil Nadu will be relocated to a frontline fighter base in Gujarat. The first LCA Mk-1A squadron will be raised at an air base in Rajasthan. LCA Mk-1A is an advanced variant of LCA Mk-1.

In 2021, the IAF signed a US\$ 6.5 billion deal for 83 Tejas MK1A. In 2023, the force has indicated that it will soon place an order for additional LCA MK1A. The IAF’s Tejas fighters have a variety of strike weapons and air-to-air

weaponry, including Russia R-73, Israeli Python, and Derby missiles. Future integrations will allow the Tejas to carry weapons like the ASRAAM, Indian Astra beyond visual range missile, and the Russian R-77.

India's air force is all set to begin induction of the 83 LCA Mk1A variant, produced by the state-run lone aircraft maker HAL, in the first quarter of 2024. HAL is expected to complete the deliveries of the 83 LCA Mk1A variants, including ten trainers, by 2029. In 2024, HAL will deliver three aircraft and follow them up with 16 aircraft deliveries from 2025 through two production lines.

Ultimately, HAL plans to produce 24 LCA Mk1s annually from its facility in Bengaluru, for which a third production line that can manufacture eight aircraft a year is being set up at the facility.

The IAF is expected to order more than 100 Mk-2s, and the aircraft will be ready for production in five years. American engine maker GE's F-414 engines will power them. F-414 has evolved from the F-404 engine that powers the existing LCA variants. The deal was signed in early 2023 during Prime Minister Narendra Modi's visit to the US.

The production of the engines in India will result in the new fighter jet having an indigenous content of around 75 percent compared to 55-60% in LCA Mk-1A and 50% in the existing Mk-1 variant.

Technology Development

Airbus Advances Autonomous Aerial Refuelling with Auto'Mate

Robert Schreiber | 28 November 2023

Source: Space War | https://www.spacewar.com/reports/Airbus_advances_autonomous_aerial_refuelling_with_AutoMate_999.html



The second flight test of Auto'Mate.

Airbus, a pioneer in aerospace technology, is taking significant strides in the realm of aerial refuelling, a critical capability for military operations. The company's latest innovation, the Auto'Mate technology, is set to transform the in-flight refuelling process, offering substantial benefits to both defence and civil aviation sectors.

Developed by Airbus Defence and Space in collaboration with Airbus UpNext, the company's innovation-focused subsidiary, Auto'Mate represents a leap in autonomous in-flight refuelling. This disruptive technology aims to automate the entire refuelling process, eliminating the need for human intervention, which is a substantial advancement in the field of aviation technology.

A testament to the capabilities of Auto'Mate

was demonstrated last March and more recently in November 2023. In these demonstrations, an Airbus testbed tanker aircraft, along with unmanned drones including the Airbus DT-25, performed simulated refuelling operations. This involved advanced AI-based navigation and cooperative control technologies, a significant milestone for the autonomous in-flight refuelling domain.

The traditional method of in-flight refuelling requires close coordination between the tanker crew and the receiving aircraft's pilot. Auto'Mate technology, by automating this process, promises to enhance safety, reliability, and efficiency.

The system can autonomously guide and control the receiver aircraft into position for refuelling, even in challenging conditions like low visibility, and then execute the fuel transfer and safe separation manoeuvre. This not only makes the process more effective but also reduces the training costs for flight crews.

Moreover, Auto'Mate opens avenues for refuelling unmanned combat air vehicles and drones, critical for Europe's Future Combat Air System (FCAS). This technology can also be applied to remote carriers and "loyal wingman" operations, underscoring its versatility.

Airbus is focusing on three key technological aspects to develop this autonomous in-flight refuelling capability:

- + Navigation: The system leverages various technologies such as cameras, satellite positioning, and LiDAR sensors, combined with AI and sensor fusion algorithms, to achieve unparalleled position accuracy.

- + Communications: The technology includes covert, secure, and multi-node communication

systems capable of guiding several receiver aircraft simultaneously.

- + Control: Autonomous control systems are employed to manage critical flight parameters, ensuring coordinated, safe, and efficient operations with built-in collision avoidance functionalities.

Building on its extensive experience in aerial refuelling, notably with the A310 MRTT since 2004 and the subsequent A330 MRTT, Airbus is well-positioned to lead this new frontier in aviation technology. The Auto'Mate technology not only represents a significant advancement in aerial refuelling but also demonstrates Airbus' commitment to pioneering innovative solutions in the aerospace industry.

With these developments, Airbus continues to shape the future of aviation, emphasizing efficiency, safety, and the growing role of autonomous technology in both military and civil aviation sectors.

Airbus Achieves Milestone with Tablet-Controlled Autonomous Helicopter Flight

Hugo Ritmico | 28 November 2023

Source: *Space War* | https://www.spacewar.com/reports/Airbus_achieves_milestone_with_Tablet_Controlled_Autonomous_Helicopter_Flight_999.html



Urban Air Mobility (UAM) is an emerging sector in aerospace, focusing on developing air vehicles for urban environments. The mention of CityAirbus NextGen in relation to this test signifies Airbus' ongoing efforts in this area. The application of these advanced technologies in urban air transportation solutions could revolutionize how we approach short-distance urban travel.

Airbus has recently marked a significant advancement in aviation technology with the successful testing of a new, simplified human-machine interface (HMI), a part of its ambitious project code-named Vertex. Developed by Airbus UpNext, a subsidiary dedicated to pioneering future aerospace technologies, these novel features are controlled through a touchscreen tablet, significantly simplifying mission preparation and management. This development not only aims to reduce the workload of helicopter pilots but also to enhance overall flight safety.

The groundbreaking test was conducted using the Airbus Helicopters' FlightLab, which executed a fully automated flight, encompassing all phases from lift-off to landing. This included taxi, takeoff, cruise, approach, and final landing, all achieved over the span of a one-hour test flight along a predefined route. The pilot's role during this flight was primarily to monitor the system, which is adept at detecting unforeseen obstacles and recalculating safe flight paths autonomously. The pilot maintained the ability to override the controls via the tablet and resume the mission as needed.

This flight test, conducted at the Airbus Helicopters' facility in Marignane, France, ran from October 27th to November 22nd and represented a significant leap in autonomous aviation technology. According to Michael Augello, CEO of Airbus UpNext, "This successful demonstration of a fully autonomous flight from takeoff to landing is a great step towards the reduced pilot workload and simplified HMI that the Airbus Urban Air Mobility team intends to implement on CityAirbus NextGen. It could also have immediate applications for helicopters in low-level flights close to obstacles thanks to the information provided by the lidars on board."

The Vertex project involves integrating various cutting-edge technologies, including vision-based sensors for enhanced situational awareness and obstacle detection, advanced fly-by-wire systems for improved auto-pilot, and an innovative human-machine-interface consisting of a touchscreen and head-worn display for in-flight monitoring and control. These technologies represent Airbus' commitment to advancing the safety and efficiency of helicopter operations.

The concept of autonomous helicopters and

advanced HMIs in aviation is not entirely new. However, the integration of touchscreen controls and sophisticated sensor systems for obstacle detection, as demonstrated by Airbus, shows significant progress in this domain. The FlightLab platform has been pivotal in testing and validating these new technologies, which could soon be implemented in future helicopter models.

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The utilization of lidar technology, which measures distances by illuminating targets with laser light and measuring reflections, is key to the enhanced obstacle detection capabilities of this system. This technology, commonly used in various applications, including autonomous vehicles, plays a crucial role in ensuring the safety and navigability of autonomous air vehicles.

Airbus Helicopters plans to continue refining the technologies encompassed in the Vertex project, further enhancing the capabilities of their helicopters. This recent demonstration is not only a testament to Airbus' innovative spirit but also a glimpse into the future of aviation, where enhanced safety, efficiency, and simplified operation are at the forefront.

Commentary

1. 'Flying Wing' Design: Led By B-21 Raider, US, Russia & China Bet Big On 'Tail-Less' Aircraft. Here's Why - <https://www.eurasiantimes.com/flying-wing-design-led-by-b-21-raider-us-russia-china-bet-big/?amp>

Further Reading

1. Roadrunner Reusable Anti-Air Interceptor Breaks Cover - <https://www.thedrive.com/the-war-zone/roadrunner-reusable-anti-air-interceptor-breaks-cover>

“The term ‘Aerospace’ was introduced in 1958 by the USAF Chief of Staff, General Thomas D White, as a new construct that depicted air and space as a seamless continuum stretching from the Earth’s surface to infinity.”



The Centre for Air Power Studies (CAPS) is an independent, non-profit think tank that undertakes and promotes policy-related research, study and discussion on defence and military issues, trends and developments in air power and space for civil and military purposes, as also related issues of national security. The Centre is headed by Air Marshal Anil Chopra, PVSM AVSM VM VSM (Retd).

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