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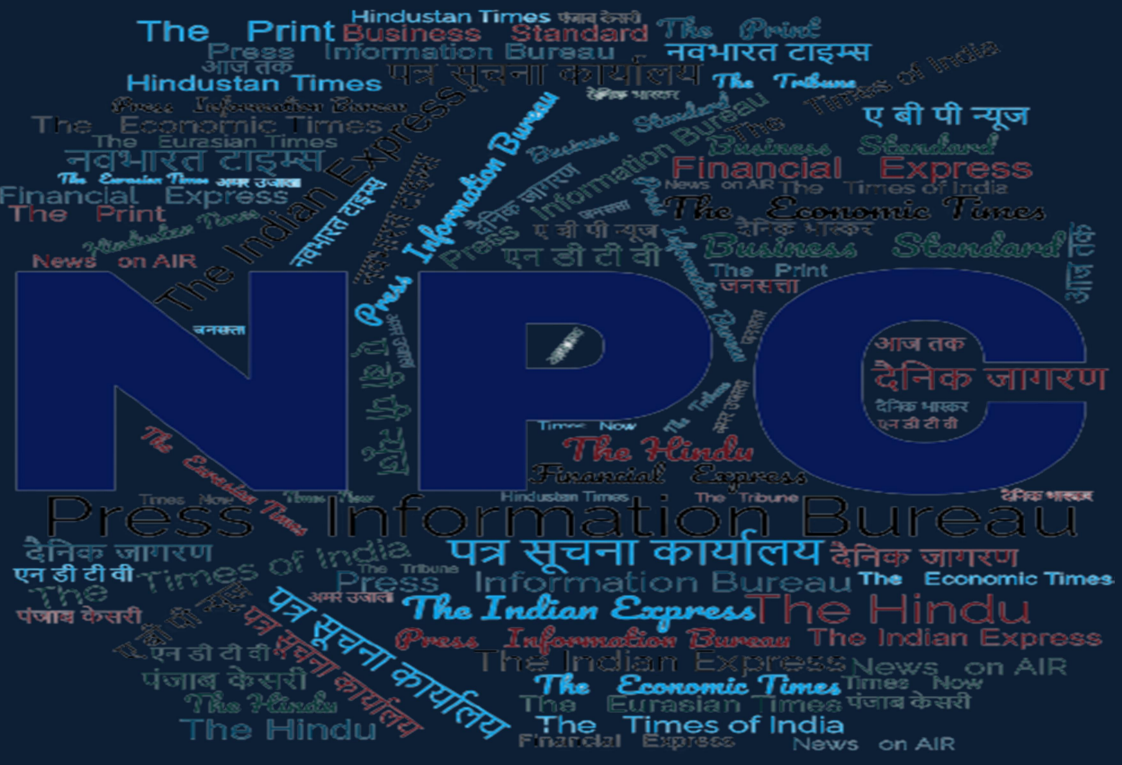
# समाचार पत्रों से चयित अंश

# Newspapers Clippings

**डीआरडीओ समुदाय को डीआरडीओ प्रौद्योगिकियों, रक्षा प्रौद्योगिकियों, रक्षा नीतियों, अंतर्राष्ट्रीय संबंधों और विज्ञान एवं प्रौद्योगिकी की नूतन जानकारी से अवगत कराने हेतु दैनिक सेवा**

**A Daily service to keep DRDO Fraternity abreast with DRDO Technologies, Defence Technologies, Defence Policies, International Relations and Science & Technology**

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भारत सरकार

**रक्षा मंत्रालय**

***Tue, 24 Jan 2023***

# गणतंत्र दिवस परेड 2023: रक्षा अनुसंधान एवं विकास संगठन निगरानी, संचार और खतरों को बेअसर करने की झांकी दिखाएगा; स्वदेशी रूप से विकसित बख़्तरबंद लड़ाकू वाहन भी प्रदर्शित किया जाएगा

रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) अत्याधुनिक रक्षा प्रणालियों के विकास के अपने लक्ष्य को पूरा करते हुए **26** जनवरी, **2023** को कर्तव्य पथ पर गणतंत्र दिवस परेड के दौरान एक झांकी तथा एक उपकरण का प्रदर्शन करेगा। डीआरडीओ की पहली झांकी की विषय-वस्तु 'प्रभावी निगरानी, संचार और खतरों को बेअसर करने के साथ राष्ट्र को सुरक्षित करना' है। इस झांकी को चार हिस्सों में विभाजित किया गया है। पहला भाग अंडरवाटर सर्विलांस प्लेटफॉर्म प्रदर्शित कर रहा है, जिसमें पनडुब्बियों के लिए यूशस - **2** जैसे सोनार, जहाजों के लिए हम्सा श्रृंखला के सोनार तथा हेलीकॉप्टर लॉन्च निगरानी के लिए कम आवृत्ति वाले डंकिंग सोनार शामिल हैं।

इस झांकी के दूसरे भाग में डी**4** काउंटर ड्रोन सिस्टम को प्रदर्शित करने वाले लैंड सर्विलांस, कम्युनिकेशन और न्यूट्रलाइजिंग प्लेटफॉर्म होंगे, जो रियल टाइम सर्च, डिटेक्शन, ट्रैकिंग तथा लक्ष्यों को पूरा करने की क्षमता रखते हैं। क्विक रिएक्शन सरफेस टू एयर मिसाइल (क्यूआरएसएएम) वेपन सिस्टम, बैटरी मल्टीफंक्शन रडार (बीएमएफआर) और मिसाइल लॉन्चर व्हीकल (एमएलवी) की दो इकाइयां भी प्रदर्शित की जा रही हैं। क्यूआरएसएएम हर मौसम में कामयाब वायु-रक्षा प्रणाली है, जो सामरिक युद्ध क्षेत्र में भारतीय सेना की मशीनीकृत संपत्ति को सचल हवाई रक्षा कवर प्रदान करती है। इसके अलावा, सॉफ्टवेयर डिफाइंड रेडियो के दो संस्करण- मैनपैक तथा हैंडहेल्ड इस झांकी का हिस्सा हैं। डीआरडीओ ने सुरक्षित संचार के लिए सॉफ्टवेयर डिफाइंड रेडियो विकसित किया है।

इस झांकी के तीसरे भाग में एरियल सर्विलांस एंड कम्युनिकेशन प्लेटफॉर्म एयरबोर्न अर्ली वार्निंग एंड कंट्रोल सिस्टम (एईडब्ल्यूएंडसी) और तपस बीएच मीडियम एल्टीट्यूड लॉन्ग एंड्योरेंस (एमएएलई) यूएवी को प्रदर्शित किया जा रहा है। एईडब्ल्यूएंडसी निगरानी, संचार और इलेक्ट्रॉनिक युद्ध क्षमताओं के साथ एक वास्तविक प्रक्रिया गुणक है। तपस बीएच रक्षा अनुसंधान एवं विकास संगठन द्वारा तीनों सेनाओं के लिए खुफिया, निगरानी, लक्ष्य प्राप्ति, ट्रैकिंग और टोही (आईएसटीएआर) आवश्यकताओं का समाधान प्रस्तुत करता है।

झांकी का चौथा भाग रियर है, जो डीआरडीओ की अनुसंधान गतिविधियों का विशेष प्रतिनिधित्व कर रहा है। इसमें सेमीकंडक्टर अनुसंधान और विकास सुविधा का प्रदर्शन किया गया है। रक्षा अनुसंधान एवं विकास संगठन ने इस भाग में सेमी-कंडक्टर, डिटेक्टर तथा नेक्स्टजेन सेंसर के क्षेत्र में भविष्य की तकनीकों को भी दर्शाया है।

स्वदेशी रूप से विकसित बख़्तरबंद लड़ाकू वाहन (डब्ल्यूएचएपी) एक मॉड्यूलर **8X8** व्हील्ड कॉम्बैट प्लेटफॉर्म है जिसे **70** टन के ट्रेलर पर ले जाया जाता है, इसका वास्तविक स्वरूप डीआरडीओ द्वारा झांकी में प्रदर्शित किया जाएगा। विभिन्न भूमिकाओं के लिए अनुकूलित, डब्ल्यूएचएपी का उपयोग पहिएदार इन्फैंट्री कॉम्बैट वाहन, सीबीआरएन वाहन, एटीजीएम वाहक और हल्के टैंक आदि के रूप में किया जा सकता है। प्रदर्शन के लिए बख़्तरबंद कार्मिक वाहक (एपीसी) संस्करण **30** मिमी बुर्ज, समग्र कवच और विस्फोट से बचने के नवीनतम स्वरूप के साथ एकीकृत है। यह बहुआयामी वाहन सड़क पर **100** किमी/घंटा की अधिकतम गति से पानी की बाधाओं को पार कर सकता है।

परेड के दौरान सशस्त्र बलों की टुकड़ियों द्वारा डीआरडीओ से विकसित कई और प्रणालियां भी प्रदर्शित की जाएंगी। इनमें अर्जुन एमबीटी, नाग मिसाइल सिस्टम, ब्रह्मोस मिसाइल, शॉर्ट स्पैन ब्रिज और आकाश एनजी शामिल हैं। डीआरडीओ द्वारा विकसित एईडब्ल्यूएंडसी परेड में फ्लाई पास्ट करेगा।

*https://pib.gov.in/PressReleasePage.aspx?PRID=1893368*

ThePrint

***Tue, 24 Jan 2023***

# Republic Day Parade 2023: DRDO to Showcase Tableau on Surveillance, Communication, Neutralizing Threats

Delivering on its mandate of developing state-of-the-art defence systems, the Defence Research and Development Organisation (DRDO) will showcase one tableau and one equipment during the Republic Day parade at Kartavya Path on January 26.

According to the Ministry of Defence, 'Securing Nation with Effective Surveillance, Communication and Neutralizing Threats' is the theme of the first tableau of DRDO.

This tableau has been categorised into four parts.

The first part is displaying Underwater Surveillance Platforms, which include sonars like Ushus-2 for submarines, the Humsa series of sonars for ships and the Low-Frequency Dunking Sonar for helicopter launch surveillance.

The second part of this tableau will have Land Surveillance, Communication and Neutralising platforms showcasing D4 counter-drone systems, which can perform a real-time search, detection, tracking and neutralize targets. Two units of Quick Reaction Surface to Air Missile (QRSAM) Weapon System, Battery Multifunction Radar (BMFR) and Missile Launcher Vehicle (MLV) are also being displayed. The QRSAM is an all-weather, air-defence system that provides mobile air defence cover to mechanized assets of the Indian Army in the Tactical Battle Area. Besides, two versions of Software Defined Radio – Manpack and Handheld are part of this tableau. DRDO has developed the Software Defined Radio for secured communication.

The third part of this tableau is showcasing Aerial Surveillance and Communication platforms Airborne Early Warning and Control System (AEW&C) and TAPAS BH Medium Altitude Long Endurance (MALE) UAV. AEW&C is a true force multiplier, with surveillance, communication, and electronic warfare capabilities. TAPAS BH is DRDO's solution to the tri-services Intelligence, Surveillance, Target Acquisition, Tracking & Reconnaissance (ISTAR) requirements.

The Rear, which is the fourth part, is representing DRDO' Research Activities wherein a Semiconductor R&D facility has been demonstrated. In this part, DRDO has also depicted futuristic technologies in the field of semi-conductors, detectors and nextgen sensors.

"Indigenously-developed Wheeled Armoured Platform (WhAP), a modular 8X8 wheeled combat platform carried on a 70-ton Trailer will be displayed by DRDO in the form of actual equipment. Customised for various roles, WhAP can be used as a Wheeled Infantry Combat Vehicle, CBRN Vehicle, ATGM carrier, Light Tank etc. The Armoured Personnel Carrier (APC) variant on display is integrated with 30 mm turret, composite armour and innovative blast protection. This amphibious vehicle can negotiate water obstacles with a max speed of 100 km/h on road," the ministry said.

Many more DRDO-developed systems will also be displayed by Armed Forces contingents during the parade. These include Arjun MBT, Nag Missile System, Brahmos Missile, Short Span Bridge, and Akash NG. DRDO-developed AEW&C will fly past at the parade.

*https://theprint.in/india/republic-day-parade-2023-drdo-to-showcase-tableau-on-surveillance-communication-neutralizing-threats/1333211/?amp*

THE TIMES OF INDIA

***Tue, 24 Jan 2023***

# Protecting Soldiers at Geo-Strategic Areas: DRDO Turns to Startups, Academia for Key Tech

The Defence Research and Development Organisation (DRDO), India's lead defence research agency tasked with equipping the armed forces is looking at a variety of new technologies to help prepare soldiers for multiple "geo-strategic" locations — ranging from high-humidity conditions to areas requiring anti-freeze equipment.

And for this, the premier agency has turned to startups and academia for at least 21 such technologies. Internally, its Defence Research Laboratory (DRL) will lead the development activity.

From apparel material that can prevent snake bites to formulations that can be used as alternatives to bathing or oral hygiene and from database on wild-edibles for emergency survival and real-time offline translation tools, startups and academia have been invited to

According to DRL, a DRDO lab specialising in R&D of products and technologies for soldier support, protection, and emergency survival, academia, startups, institutions "can team-up with

DRL for these cutting-edge targeted R&D in highly challenging areas of military research and be part of India's national self-reliance mission".

It adds that the list of 21 technologies/products is not "exhaustive" and that there would be "ample scope for dialogue on other novel ideas, products, technologies and knowledge" relevant to soldier support, protection and survival under emergency conditions.

Experts and former armed forces officers TOI spoke with said that while some of these products are currently being used by soldiers but are imported, while several others will be useful. They, however, reiterated that unless these technologies or products are delivered within a stringent timeline their benefits could be offset.

Former DGMO (director general of military operations) and 15 Corps commander Lt Gen (retd) AK Bhat told TOI: "I would differentiate some of these as "essential", some as "could be" some as aspirational technologies and products. For instance, technologies to protect soldiers at high-altitude and cold areas like Siachen are absolutely necessary as we will be working there more. It is a welcome move that the DRDO is working with startups and industries, which would help in achieving timelines and is in line with self-reliance."

Technologies or products in the list like specialised fabric with protection against various hematophagous animals/insects like snakes, leeches and mosquitoes, for use in tropical rainforests; safe formulations for maintaining general health and hygiene in high-humidity regions, for instance as an alternative to bathing or oral hygiene practices; odourless or signature-free, skin-friendly formulations for protection against various hematophagous animals and database of wild-edibles (WEs) in selected regions for use during emergency survival conditions, are all targeted for the northeastern region and desert.

Among technologies and products that would have uses along the Line of Actual Control (LAC) — where there are no signs of de-escalation in eastern Ladakh — and some parts of LOC are: Light-weight flexible fabric for extremely low temperature, high altitude regions; anti-freeze water storage systems or solutions; offline real-time translator system for select languages and human waste management in low temperature, high altitude, remote, resource-poor locations.

Some of them that have uses across locations are rapid blood coagulating formulation with antimicrobial properties for combat wounds; light-weight, mine-proof, anti-spike, anti-skid, abrasion-resistant, anti-static, ankle-protecting all-weather footwear; offline, secure, encrypted, untraceable audio-video communication system for closed group users and light-weight, reusable stoves with multiple fuel options.

Some other technologies or products DRL is exploring, include a database of vectors & vector-borne disease in selected regions; on-site, rapid differential diagnostics for vector-borne/ food/ water borne pathogens; emergency water purification device; light-weight, water-resistant fabric for multipurpose use; light-weight, highly breathable fabric for use as uniform in high humidity conditions, water-repellent gloves, ergonomic all-weather abrasion-resistant gloves, etc.

Further, it is also scouting for remotely operated devices for search & surveillance operations — to detect human-activity, weapons and landmines inside dense vegetation.

*https://timesofindia.indiatimes.com/india/protecting-soldiers-at-geo-strategic-areas-drdo-turns-to-startups-academia-for-key-tech/articleshow/97285829.cms?from=mdr*

# Defence News

## Defence Strategic : National/International

Press Information Bureau
Government of India

**Ministry of Defence**

***Tue, 24 Jan 2023***

# Raksha Mantri Shri Rajnath Singh Reviews Aero India 2023 Preparations during APEX Committee Meeting in New Delhi

### This 14th edition to be the largest ever aero show organised in a total area of around 35,000 sqm; 731 exhibitors register till date

Raksha Mantri Shri Rajnath Singh reviewed the preparations of the forthcoming Aero India during the apex committee meeting held in New Delhi on January 24, 2023. The Raksha Mantri was given a detailed account of the arrangements of the 14th edition of Asia's largest aero show, which will be held in Bengaluru, Karnataka between February 13-17, 2023. Shri Rajnath Singh exhorted all the stakeholders to ensure fool-proof arrangements for the participants. He said, Aero India 2023 will not just be an event, but a display of the growing prowess of the defence & aerospace sector and the rise of a strong & self-reliant 'New India'.

The five-day event, on the theme 'The runway to a billion opportunities', will be the largest-ever aero show organised at Air Force Station, Yelahanka in a total area of around 35,000 sqm. As on date, 731 exhibitors have registered for the event. Defence Ministers' Conclave, with the theme 'Shared Prosperity Through Enhanced Engagement in Defence (SPEED)', and a CEOs Roundtable are among the marquee events. The Manthan start-up event and Bandhan ceremony, which witnesses signing of MoUs, will also be part of the event, along with a fabulous air show on all the five days. It will showcase the paradigm shift the Government has brought in the aim of organising such events, that also include DefExpo. The events have been restructured with focus on increasing defence exports and forging partnerships rather than merely import of weapons/equipment.

The Raksha Mantri pointed out that the Indian defence industry is going through a transformational phase and the active participation of the private sector is the biggest catalyst to that change. "Not just the private sector, but R&D establishments and academia are also working together with the Government. Aero India is a medium to provide a platform to all the stakeholders to jointly strengthen the defence & aerospace sector and contribute to Nation Building," he added.

Shri Rajnath Singh emphasised that while Aero India is a business event, it also aims to strengthen India's relations with other countries. He also underlined the importance of these events for the business ecosystem of the states in which they are organised as well as available opportunities.

The Raksha Mantri commended Bengaluru for successfully organising several editions of AeroIndia, saying that the event is shaping Karnataka as an epicenter of aviation and aerospace industry. He described Karnataka as one of the leading states which contributes to the economic growth of the country. "The state is known for its skilled manpower and robust defence manufacturing ecosystem. It is a preferred center for manufacturing and R&D activities for domestic & multinational defence and aviation companies," he said. Shri Rajnath Singh noted the excellent coordination among the officials of MoD and the Karnataka Government to make the event a grand success.

Karnataka Chief Minister Shri Basavaraj Bommai and state government officials joined the meeting through video conferencing, while Chief of Defence Staff General Anil Chauhan, Chief of the Air Staff Air Chief Marshal VR Chaudhari, Chief of the Naval Staff Admiral R Hari Kumar, Chief of the Army Staff General Manoj Pande, Defence Secretary Shri Giridhar Aramane and other senior officials of Ministry of Defence attended the meeting physically.

*https://pib.gov.in/PressReleasePage.aspx?PRID=1893224*

THE HINDU

***Tue, 24 Jan 2023***

# 2023 Edition will be the Largest-Ever Aero India, Says Defence Minister

Defence Minister Rajnath Singh on Tuesday reviewed the preparations of the forthcoming Aero India during the apex committee meeting held in New Delhi and exhorted the stakeholders to ensure foolproof arrangements for the participants of the airshow, which is to be held between February 13 and 17 in Bengaluru.He said that Aero India 2023 will not just be an event, but a display of the growing prowess of the defence and aerospace sector and the rise of a strong and self-reliant New India.

The five-day event, on the theme 'The runway to a billion opportunities', will be the largest-ever aero show organised at Air Force Station, Yelahanka, in a total area of around 35,000 sq m.As on date, 731 exhibitors have registered for the event. Defence Ministers' Conclave, with the theme 'Shared Prosperity Through Enhanced Engagement in Defence (SPEED)', and a CEOs Roundtable are among the marquee events.

The Manthan start-up event and Bandhan ceremony, which witnesses signing of MoUs, will also be part of the event, along with an air show on all the five days."Not just the private sector, but R&D establishments and academia are also working together with the government. Aero India is a medium to provide a platform to all the stakeholders to jointly strengthen the defence and aerospace sector and contribute to nation building," Mr. Singh said.Mr. Singh commended

Bengaluru for successfully organising several editions of Aero India, saying that the event is shaping Karnataka as an epicenter of aviation and aerospace industry.

“The State is known for its skilled manpower and robust defence manufacturing ecosystem. It is a preferred center for manufacturing and R&D activities for domestic and multinational defence and aviation companies,” he saidChief Minister BasavarajBommai and State government officials joined the meeting through videoconferencing.

*https://www.thehindu.com/news/cities/bangalore/2023-edition-will-be-the-largest-ever-aero-india-says-defence-minister/article66428621.ece/amp/*

Press Information Bureau
Government of India

**Ministry of Defence**

***Tue, 24 Jan 2023***

# Tri-Services Amphibious Exercise, AMPHEX 2023 Concludes

The biennial Tri-Services Amphibious Exercise, AMPHEX 2023 was conducted at Kakinada, Andhra Pradesh from 17 to 22 January 23. AMPHEX is aimed at joint training of elements of all three services in various facets of amphibious operations to enhance interoperability and synergy. AMPHEX 23 is the first time that the exercise was undertaken at Kakinada, and was the largest ever AMPHEX conducted till date. The participating forces undertook complex exercises in all domains of amphibious operations over five days. The exercise culminated in a successful Amphibious Assault which was reviewed by Vice Adm Sanjay Vatsayan, AVSM, NM, Chief of Staff, Eastern Naval Command, in the presence of Force Commanders of the Indian Navy and Indian Army.

The exercise witnessed the participation of a number of amphibious ships consisting of Large Platform Dock (LPD), Landing Ships and Landing Crafts, Marine Commandos (MARCOS), helicopters and aircraft from the Indian Navy. Indian Army participated in the exercise with over 900 troops which included Special Forces, Artillery and Armoured vehicles. Jaguar fighters and C 130 aircraft from the IAF also participated in the exercise.

AMPHEX 2023 successfully demonstrated the amphibious capabilities and validated the excellent coordination that exists between the three Services to undertake the full spectrum of amphibious operations.

*https://pib.gov.in/PressReleasePage.aspx?PRID=1893205*

Press Information Bureau
Government of India

**Ministry of Defence**

***Tue, 24 Jan 2023***

# Theatre Level Operational Readiness Exercise (Tropex-23) Indian Navy's Largest War Game

The 2023 edition of Indian Navy's major maritime exercise TROPEX, is currently underway in the Indian Ocean Region. This operational level exercise is conducted biennially and witnesses participation not only by all Indian Navy units but also of Indian Army, Indian Air Force and Coast Guard assets.

TROPEX 23 is being conducted over a duration of three months from Jan - Mar 23. As part of the exercise, all surface combatants of the Indian Navy including Destroyers, Frigates, Corvettes as well as submarines and aircraft are put through complex maritime operational deployments to validate and refine the Navy's Concept of Operations including operational logistics and interoperability with other Services. The exercise is being conducted in different phases, both in harbour and at sea, encompassing various facets of combat operations, including live weapon firings.

Having grown in scope and complexity over the years, this exercise provides an opportunity to test the combat readiness of the combined Fleets of the Indian Navy to operate in a multi-threat environment. The maritime exercise also facilitates operational level interaction with the Indian Army, Indian Air Force and the Coast Guard, which will further strengthen interoperability and joint operations in a complex environment.

*https://pib.gov.in/PressReleasePage.aspx?PRID=1893232*

पंजाब केसरी

***Wed, 25 Jan 2023***

# नौसेना हिंद महासागर क्षेत्र में बड़ा युद्धाभ्यास कर रही

हिंद महासागर क्षेत्र में चीनी सेना की बढ़ती मौजूदगी के बीच भारतीय नौसेना हिंद महासागर क्षेत्र में युद्धक तैयारी की परख के लिए बड़ा युद्धाभ्यास कर रही है जिसमें युद्धपोत, पनडुब्बी और विमान जैसी उसकी लगभग सभी सामरिक संपत्तियां शामिल हैं। अधिकारियों ने मंगलवार को यह जानकारी दी।

उन्होंने कहा कि थिएटर स्तरीय सामरिक तैयारी अभ्यास (ट्रोपेक्स) के तहत नौसेना के विध्वंसक पोतों, युद्धपोतों, कार्वेट, पनडुब्बियों और विमानों सहित नौसेना की विभिन्न लड़ाकू इकाइयों को जटिल समुद्री परिचालन तैनाती से गुजारा जाता है।

ट्रोपेक्स जनवरी से लेकर मार्च तक की तीन महीने की अवधि के दौरान आयोजित किया जा रहा है। इसमें न सिर्फ नौसेना की सभी इकाइयों बल्कि थल सेना, वायु सेना और तटरक्षक बल से जुड़ी परिसंपत्तियों की भी भागीदारी होती है।

नौसेना के प्रवक्ता कमांडर विवेक मधवाल ने कहा कि अभ्यास के तहत नौसेना के विध्वंसक पोतों, युद्धपोतों, पनडुब्बियों और विमानों सहित नौसेना की सभी लड़ाकू इकाइयों की परख के लिए इन्हें जटिल समुद्री परिचालन तैनाती से गुजारा जाता है।

उन्होंने कहा कि यह अभ्यास हथियारों से प्रत्यक्ष फायरिंग सहित युद्ध संचालन के विभिन्न पहलुओं को शामिल करते हुए विभिन्न चरणों में बंदरगाह और समुद्र दोनों में आयोजित किया जा रहा है। अधिकारी ने कहा, ‘‘पिछले कुछ वर्षों में कार्यक्षेत्र और जटिलता में वृद्धि होने के बाद, यह अभ्यास बहु स्तरीय खतरे वाले वातावरण में काम करने के लिए भारतीय नौसेना के संयुक्त बेड़े की लड़ाकू तैयारी का परीक्षण करने का अवसर प्रदान करता है।’’

उन्होंने कहा, ‘‘यह समुद्री अभ्यास थल सेना, वायु सेना और तटरक्षक बल के साथ संचालन स्तर के आदान-प्रदान की सुविधा भी देता है, जोकि एक जटिल वातावरण में अंतर-संचालनात्मकता तथा संयुक्त अभियान को और मजबूती प्रदान करेगा।’’

इसी तरह, नौसेना ने **17** से **22** जनवरी तक आंध्र प्रदेश के काकीनाडा में तीनों सेवाओं के द्विवार्षिक अभ्यास **(**एम्फेक्स**) 2023** का भी आयोजन किया। एम्फेक्स का उद्देश्य आपसी तालमेल को बढ़ाने के लिए सहयोग सहित संचालन के विभिन्न पहलुओं में सेना के तीनों अंगों के विभिन्न घटकों को संयुक्त प्रशिक्षण प्रदान करना है।

कमांडर मधवाल ने कहा, ‘‘एम्फेक्स**-23** अभ्यास पहली बार काकीनाडा में आयोजित किया गया और यह अब तक का सबसे बड़ा समन्वित अभ्यास था। पांच दिन के प्रशिक्षण कार्यक्रम के दौरान कई संयुक्त अभियान संचालित किए गए जिसमें बड़ी संख्या में सैनिकों ने हिस्सा लिया।’’

इस अभ्यास में नौसेना के बड़े प्लेटफॉर्म वाले डॉक (एलपीडी), लैंडिंग शिप और लैंडिंग क्राफ्ट, मरीन कमांडो (मार्कोस), हेलीकॉप्टर तथा विमानों सहित तीनों सेनाओं के कई जहाजों की भागीदारी हुई।

थल सेना ने अपने **900** से अधिक सैनिकों के साथ इस अभ्यास में भाग लिया और इस दौरान उनके साथ विशेष बल, तोपखाने तथा बख्तरबंद वाहन भी शामिल थे। वायुसेना के जगुआर लड़ाकू विमानों और सी **130** विमानों ने भी अभ्यास में भाग लिया।

कमांडर मधवाल ने कहा, ‘‘एम्फेक्स **2023** ने भारत की जल-थल-नभ सैन्य कुशल क्षमताओं का सफलतापूर्वक प्रदर्शन किया और इस दौरान तीनों सेवाओं के संयुक्त संचालन के पूर्ण स्पेक्ट्रम को कवर करने के लिए तीनों सेनाओं के बीच स्थापित उत्कृष्ट समन्वय को प्रदर्शित किया गया।’’

*https://m.punjabkesari.in/state/news/pti-state-story-1758531?amp*

THE ECONOMIC TIMES

*Tue, 24 Jan 2023*

# Republic Day Parade 2023: Indian Army to Showcase Made in Indian Weapons

India Army on Tuesday announced that they will only showcase 'Made in India' Weapons systems during the Republic day parade on January 26."The weapons to be displayed include the K-9 Vajra howitzers, MBT Arjun, Nag anti-tank guided missiles, BrahMos supersonic cruise missiles, Akash air defence missiles, and the Quick Reaction Fighting Vehicles," a statement said.

Captain ShivashishSolanki told ANI that, "It is a matter of great pride and honour for being given this opportunity to represent my regiment and the Corps of Engineers in the Republic Day Parade. The Republic Day parade is a very big event for the entire nation which is watched across the globe."India is celebrating its 74th Republic day parade and this year's Republic Day Parade, Indian Army would showcase only Made in India Weapons systems, officials said.Akash Missile system is a newly inducted weapon system which is one of the most advanced weapon systems currently in use today indigenously manufactured and designed by Bharat Dynamics and DRDO. This system is entirely configured on mobile platforms, informed Lt Chetana Sharma.The rehearsal of the Republic Day Parade was held at Kartavya Path in Delhi, in which personnel from the Army, Air Force, Navy, and Paramilitary forces participated on Monday. Twenty-three tableaux from 17 states and various departments of the government took part in the rehearsal which started at 10.30 a.m.According to the Indian Air Force, 45 aircraft including 9 Rafale jets and four helicopters will be included in the fly-past at the celebrations.

The IL-38 plane of the Indian Air Force will take part in the Republic Day parade for the first and perhaps the last time. Formations of the flag, Rudra, eagle, Tiranga, Garuda, Bhima, Amrit, and Vijay among others will be made in the flypast.

*https://m.economictimes.com/news/defence/republic-day-parade-2023-indian-army-to-showcase-made-in-indian-weapons/amp_articleshow/97274599.cms*

The Tribune

*Tue, 24 Jan 2023*

# Indian Army to Get Robotic Mules, Jetpack Suits, Tethered Drones

The Ministry of Defence (MoD) today sought technical and commercial bids to add to the Army robotic mules, jetpack suits and tethered drones that will look across the Himalayas. The Army needs 100 robotic mules and has put out a request for proposal (RFP), which is the second step of the tendering process. An RFP is issued for commercial and technical bids. The Army is

looking at four-legged robotic mules capable of autonomous movement across various terrain, self-recovery and avoiding obstructions.

The robotic mule needs to be 1 metre in length, weigh not more than 60 kg and should be able to operate at altitudes over 10,000 feet carrying 10 kg weight. At present, a number of Army forward posts use mules to transport goods and rations. The robotic mule should be able to operate in autonomous mode and on pre-defined routes for over three hours.

The other high-technology item the Army is seeking is jetpack suits. These are powered by an engine. The jetpack can be worn like a backpack and soldiers wearing it can fly across varied terrain.

The Army is looking at 44 such jetpacks and is likely to use these for special operations. The weight of the jetpack must not exceed 40 kg. Carrying a 80-kg person, its maximum speed must not be less than 50 kmph.The third item sought is a tethered drone. Such drones are tethered to the ground using a cable that will be used to download data and give commands.

The Army is seeking a drone with an all-up weight of 15 kg. The drone will be tethered at some 60 metres from the surface and operate for six hours. It should be able to detect vehicles 5 km away and a person 2 km away.

**Modern equipment**

- The robotic mule needs to be 1 metre in length, weigh not more than 60 kg and should be able to operate at altitudes over 10,000 feet carrying 10 kg weight
- The weight of the jetpack must not exceed 40 kg. Carrying a 80-kg person, its maximum speed must not be less than 50 kmph
- The tethered drone being sought by the Army will be tethered at some 60 metres from the surface and can operate for six hours

*https://www.tribuneindia.com/news/nation/army-to-get-robotic-mules-jetpack-suits-tethered-drones-473384*

The Indian EXPRESS

***Wed, 25 Jan 2023***

# El-Sisi in New Delhi for Republic Day: Significance of his Visit, And India's Ties with Egypt

***By Shubhajit Roy***

Egypt's President Abdel Fattah El-Sisi, the chief guest for the Republic Day celebrations this year, landed in India on Tuesday (January 24). This is the first time that an Egyptian President has been invited as chief guest for the event.

**What is El-Sisi's schedule in India?**

Sisi will be accorded a ceremonial welcome at the RashtrapatiBhavan on January 25, and President DroupadiMurmu will host a State Banquet in his honour the same evening.

Sisi will have a meeting and delegation-level talks with Prime Minister NarendraModi on bilateral, regional and global issues of mutual interest. External Affairs Minister S Jaishankar will also call on President Sisi. The visiting dignitary will interact with the Indian business community at an event on the same day, according to the Ministry of External Affairs.

**What is the significance of a Republic Day invite?**

An invitation to be the Republic Day chief guest is highly symbolic from the Indian government's perspective. New Delhi has been weaving strategy with hospitality to decide its chief guest for the Republic Day. The choice of chief guest every year is dictated by a number of reasons — strategic and diplomatic, business interests, and international geo-politics.

**What is the history of India-Egypt relations?**

India and Egypt share close political understanding based on a long history of cooperation in bilateral, regional and global issues. The joint announcement of establishment of diplomatic relations at the Ambassadorial level was made on August 18, 1947.

India's first Prime Minister Jawaharlal Nehru and Egypt's President Gamal Abdel Nasser signed the Friendship Treaty between the two countries, and they were key to forming the Non-Aligned Movement (NAM) along with Yugoslav President Josip Broz Tito.

Since the 1980s, there have been four Prime Ministerial visits from India to Egypt: Rajiv Gandhi (1985); P V NarasimhaRao (1995); IK Gujral (1997); and Dr. Manmohan Singh (2009, NAM Summit).

From the Egyptian side, President Hosni Mubarak visited India in 1982, in 1983 (NAM Summit), and again in 2008.

High-level exchanges with Egypt continued after the 2011 Egyptian Revolution and then President Mohamed Morsi visited India in March 2013. India's External Affairs Minister (EAM) visited Cairo in March 2012 and the Egyptian Foreign Minister visited India in December 2013.

After the new government led by President Sisi took over in June 2014, then EAM SushmaSwaraj visited Cairo in August 2015. PM Modi met President Sisi on the sidelines of the United Nations General Assembly (UNGA), New York, in September 2015. President Pranab Mukherjee and PM Modi met Sisi during the Third India-Africa Forum Summit in New Delhi in October 2015.

President Sisi also paid a State visit to India in September 2016. A joint statement was issued, outlining the three pillars of political-security cooperation, economic engagement & scientific collaboration and cultural & people-people ties as the basis of a new partnership for a new era.

**What were the recent engagements?**

PM Modi held a phone conversation with Sisi on April 17, 2020 to discuss efforts to halt the spread of the coronavirus, and again on April 26, 2020 to exchange Eid-ul-Fitr greetings. The PM expressed appreciation for the support extended by Egyptian authorities for the safety and welfare of Indian nationals in Egypt during the Covid crisis.

President Sisi expressed sympathy and solidarity with India during the second wave of Covid-19, on April 30, 2021. Egypt dispatched three planes with medical supplies to India on May 9, 2021. In addition, the Embassy of India also signed an agreement to procure 300,000 doses of REMDESEVIR from M/s EVA Pharma, Egypt, which were provided well before schedule.

**What's the state of bilateral trade relations?**

Egypt has traditionally been one of India's most important trading partners in the African continent. The India-Egypt bilateral trade agreement has been in operation since March 1978 and is based on the most-favoured nation clause.

The bilateral trade has increased more than five times in the past 10 years. In 2018-19, it reached USD 4.55 billion. Despite the pandemic, the volume of trade declined only marginally to USD 4.5 billion in 2019-20 and to USD 4.15 billion in 2020-21. Bilateral trade has expanded rapidly in 21-22 — climbing to 7.26 billion, a 75 per cent increase from FY 2020-2021.

**What are the other areas of cooperation?**

Officials said that the two countries will be looking at a range of sectors, and agriculture will be one of the key areas of cooperation. Egypt, which is facing a shortage of food grains as its major sources were the warring Ukraine and Russia, wants to buy wheat from India. In May last year, India — which had put a ban on sale of wheat — allowed export of 61,000 tonnes to Egypt. But the country wants more grains, in view of the shortages.

Egypt's President is also coming at a time when the country is facing a massive economic crisis due to depleted forex reserves. While there has been no request for budgetary support, India is looking at increasing investments in the country, especially in major infrastructure projects in and around the Suez Canal, in terms of special economic zones in Alexandria and Cairo. Egypt is also keen to push for more tourism from India, and ease movement of people so that there is more forex inflow into their tourism-dependent economy.

With Sisi being a former Army chief, Egypt is interested in procuring defence equipment from India, which includes LCA Tejas, missiles like Akash, DRDO's Smart Anti-Airfield Weapon, and radars. This is being developed as part of defence industry cooperation, and one of the markers was that Defence minister Rajnath Singh visited Cairo last year when a defence pact was signed. Egypt has also been invited to participate in the Aero-India 2023 at Yelahanka Air Force Station, Bengaluru, next month.

A military contingent from the Egyptian Army will participate in the Republic Day parade. The two countries will also look at the education sector, where Indian higher educational institutions can set up campuses in Egypt: a proposal for establishing an IIT in Egypt is in the works.

An invitation to the Egyptian President is being considered significant, especially when India's ties with Muslim-majority countries were tested due to controversial remarks made by BJP spokesperson Nupur Sharma in June last year. That Egypt was one of the few countries from the Arab world which did not react officially to the remarks was not lost on New Delhi.

Top clerics — the Grand Mufti of Egypt and the Al Azhar university, the top seat of learning of Sunni Islam — had condemned those remarks. But New Delhi views Egypt as a moderate slamic voice, which has made an attempt over the years to play a nuanced and positive role in the 57-member Organisation of Islamic Cooperation, where Pakistan has managed to get some India-centric condemnatory resolutions.

*https://indianexpress.com/article/explained/explained-politics/el-sisi-republic-day-chief-guest-significance-8402505/*

The Indian EXPRESS

*Tue, 24 Jan 2023*

# India Picking Up Pace, May Emerge as World Leader as it Focuses on Niche Anti-Drone Technology Providers

With the 74th Republic Day round the corner and preparations in full swing, security has been beefed up across the national capital with police personnel intensifying patrolling and conducting anti-sabotage checks. Extra security forces have been deployed at all sensitive places, including Metro stations, railway stations, airports and prominent public places. Anti-drone systems have been deployed at critical locations and various other tech-based solutions have also been put in place to counter any breach.

In late June, 2021, two explosions shook the high security technical area of Air Force Station Jammu. Drones, carrying explosive payload, were suspected to be used in the operation that took place just one-and-a-half month before India celebrated Independence Day. Roughly a month later, security officials were placed on high alert over the possibility of drone attack in Delhi ahead of the Independence Day celebration on August 15.

Taking cognizance of such threats, India deployed four anti-drone systems at the Red Fort in 2021, as compared to the two anti-drone systems that were set up in 2020. However, the technical efficiencies of such solutions still require evolving upgrades and more portability &customisation for specific threat situations

With just days left for the 74th Republic Day celebrations, India is once again taking effective steps to secure India by installing counter drones to thwart any attempt to disrupt. India is also looking long-term in this direction by harnessing the potential of companies in niche technology.

As part of Make in India and the country's indisputable defensive as well as offensive requirements, India has started pushing government agencies and private companies to invest more in drone and anti-drone technologies. The three services have already been told to focus on acquiring anti-drone technologies to deal with attacks by unmanned aerial vehicles. It has also asked bodies running critical infrastructures across the country to induct and enhance its anti-drone capacity.

The Defence Research and Development Organisation (DRDO) has developed anti-drone technology to shoot down hostile drones in the range of two to three kilometres. It is conducting more research on extending the range.

ACSG Corp., a Delhi-based critical infrastructure protection company, has been doing research work on identifying and putting to use counter-drone solutions that could potentially offer critical installations a high degree of safety from rogue drones looking to steal information or cause damage.

Major Vijay (retd.), president ACSG Corp., says, "An effective counter drone solution should be portable, as it would normally be a temporary, event-based set-up to handle any looming threat that an event could draw. It should have, at least, a 3km radius. It should leave no blind spot. We are also working on integrating a number of other related technologies that should be a part of futuristic anti drone systems."

India is focusing more on being self-reliant. Defence Minister, Rajnath Singh, while addressing the audience at an industry event, revealed that the government is aiming to bring down defence imports by at least US$2 billion by next year. This means the onus would fall on Indian companies to design and deliver world-class drones and anti-drones for a variety of purposes.

The global anti-drone market is valued at $0.9 billion in 2022 and is expected to reach $3.8 billion by 2027, growing at a CAGR of 27.7% from 2022-2027. With India becoming technologically advanced, the country could potentially hold a major share in the fastest-growing industry. With shifting warfare and drones taking centre-stage, it's time for India to showcase and strengthen its technological capabilities as well as have a long-term policy for novel technologies.

*https://indianexpress.com/article/cities/india-picking-up-pace-may-emerge-as-world-leader-as-it-focuses-on-niche-anti-drone-technology-providers-8402570/*

***Wed, 25 Jan 2023***

# What India's New Defence Theaterisation Plan Looks Like

***By Ranjit Bhushan***

The country's most ambitious defence project, lying in limbo since December 2021, is now being kickstarted. The plan for theaterisation of armed forces, or creation of integrated theatre commands, which was spearheaded by the country's first Chief of Defence Staff (CDS), General BipinRawat, came to a creaking halt after his death in a helicopter crash, days before the 2022 New Year. Now, with a few changes, the plan is being fine-tuned for implementation.

Integrated theatre commands are war-fighting entities, containing army, navy and air force components, that would fight jointly to focus and synergise the combat power of all three services, a much-needed security adrenalin that pundits have demanded for a long time. The plan picked up the pace again after the current CDS, General Anil Chauhan, took over in September last year. A top official told Moneycontrol that the plan is expected to be finalised shortly, which would be discussed, examined, and accordingly fine-tuned further in consultation with the CDS. He stressed that the existing plan is still fluid and may undergo additional changes with more internal deliberations, and inputs from the government.

The need to swiftly implement this plan in light of tensions with China and Pakistan was aided in no small measure by the former Army chief, General ManojMukundNaravane, who told a Memorial Lecture in the last week of December 2022 that framing a national security strategy was a prerequisite for taking theaterisation forward to optimally utilise the military's resources for future wars and operations. Without such a well-defined strategy, pursuing the long-awaited reform would be akin to 'putting the cart before the horse', he said – a rare testy line from a former head of the military, which, unlike in many other countries, has opted to stay in the barracks.

A national security strategy essentially outlines the path that a country should take to realise its national objectives and interests. The lack of such a strategy has been a subject of discussion within the strategic community for years. Moneycontrol looks at the defencetheaterisation plan, how it proposes to implement wide-ranging reforms, mainly boosting the country's ability to tackle a two-front threat from China and Pakistan, at intra-defence tussles to control turf and the dynamics of how it is going to be implemented on the ground.

**What is the traditional command structure in the Indian defence forces?**

The Armed Forces currently have 17 single-service commands spread across the country. The Army and Air Force have seven commands each, while the Navy has three. The Army is divided into six operational commands (field armies) and one training command, each under the command of a Lieutenant General, who has an equal status to the Vice-Chief of Army Staff (VCOAS), working under the control of Army HQ in New Delhi. Of the Indian Air Force's (IAF) seven commands, five are operational commands and two are functional commands. The Indian Navy currently operates three commands — Western Naval Command located at Mumbai, Southern Naval Command located at Kochi and Eastern Naval Command located at Visakhapatnam.

**What was the structure proposed by former CDS, General Rawat?**

The theaterisation model being pursued under General Rawat sought to set up four integrated commands – two land-centric theatres, an air defence command and a maritime theatre command. The first joint theatre command would be responsible for the border against Pakistan in what the military refers to as the "western theatre"; while a second command — the northern theatre command — would be responsible for the border with China. A third, Navy-dominated theatre, called the "maritime command" will be responsible for the security of the Indian Ocean Region (IOR); and an island command, already functional and called the Andaman & Nicobar Command (ANC), would project power into the eastern Indian Ocean.

**What is the multiplicity of commands, and how has it prompted the theaterisation plan?**

Traditionally multiple commands have determined India's war strategy. For instance, today, four different Army commands look after Pakistan: Northern, West-ern, South-Western and South-ern commands. The Air Force has three commands looking after that frontier while the Navy has two. The frontier with China is managed by a similar multiplicity of commands. The Central Air Command, located in Allahabad, has a role in managing both the western and northern theatres, while the Eastern Air Command at Shillong is responsible for the northern theatre. The Army's Central and Eastern Commands look after the northern border while the Army's Northern Command is split between the western and the northern borders. In total, there are 17 commands responsible for guarding against India's traditional two-front borders.

**What are the changes being proposed by new CDS Gen Anil Chauhan?**

The Armed Forces are drawing up the final contours of theaterisation plans which seek to integrate the Army, Navy, and Indian Air Force and their resources into specific theatre commands. While late Gen Rawat's initial plan was to create four theatre commands, the services decided to take a fresh look at the proposed reform after Gen Chauhan asked them to do so. One of the top proposals being considered is to create joint theatre commands based on India's adversaries in the neighbourhood to begin with, as against the four defined theatre commands planned earlier. This involves initially carving out an integrated theatre command to

take care of the northern and eastern borders with China, another for the western borders with Pakistan and a third maritime command to tackle threats in the maritime domain, from the 17 service-specific military commands operating under the three services at present. Visakhapatnam, Jaipur, and Lucknow are among the possible locations being discussed for their headquarters. Also under discussion is the creation of a joint training command. Three joint logistics nodes had already been operationalised until 2021. India has two joint services commands at present – the Andaman and Nicobar Command (ANC) and the Strategic Forces Command (SFC). Threats emanating from China, Pakistan and via the sea routes are being factored into the plans for theatre commands.

**What were the Indian Air Force's objections to Gen Rawat's proposals?**

The IAF had raised objections to the previous theaterisation plans, stating that it would divide their fighting assets. Last year, IAF chief Air Chief Marshal V R Chaudhari had said that the IAF is not opposed to the theaterisation process if the doctrinal aspect of the force is not compromised by the creation of the new structures. He had also said that while the theatre commands should be future-ready to deal with the emerging forms of warfare in the space and cyber domains, they should not increase the decision-making chains from the existing levels.

**How is the new consensus being arrived at by the three services?**

Over the last two years, multiple studies were carried out by top officers of the three services to examine the theaterisation process, which lost pace after Gen Rawat's death. The services, however, continued their deliberations on the proposed reform with a few table-top exercises held to examine the employment of theatres in different operational scenarios. The plan picked up the pace again after the current CDS, Gen Anil Chauhan, took over in September last year. According to officials, the services were asked to individually study and check the feasibility of adopting a new and separate approach to the Indian military's theaterisation plans. In the last three months, multiple meetings have taken place within the three services – and between the three service chiefs and Gen Chauhan on the theaterisation plans.

**How will defencetheaterisation work on the ground?**

Defence officials say that with a national security strategy in place, it will also need a higher defenceorganisation (HDO), an interface between the government and the military leadership. HDO has to reflect the `whole-of-government, the-whole-of-nation' approach because it is nations that fight wars. The HDO will not be only of the defence ministry, it has to have the representatives of all ministries. Once decisions are arrived at, the Armed Forces are free to do their job, and all the other coordination must be carried out by this organisation.

*https://www.moneycontrol.com/news/india/how-indias-new-defence-theaterisation-plan-looks-like-9927331.html/amp*

MANOHAR PARRIKAR INSTITUTE FOR DEFENCE STUDIES AND ANALYSES
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*Tue, 24 Jan 2023*

# Integrated Rocket Force: A Timely Idea

***By Akshat Upadhyay***

The Chief of the Army Staff, General ManojPande, in his latest press conference held on 12 January 2023, as part of the annual Army Day celebrations, commented that "though unpredictable, the situation at the northern borders is stable and under control".1 The Army Chief was referring to the confrontational deployment of the Indian Army and the Chinese People's Liberation Army (PLA) along the LAC in Eastern Ladakh.

The challenge for India, along the 3400 kms LAC, is twofold: create options for deterrence by denial operations against the PLA, without invoking the use of heavier conventional forces and keep the conflict localised. The second is to have in reserve adequate long-range combat firepower which can be used for localised asymmetry.

An Integrated Rocket Force (IRF) serves both these purposes. The idea of IRF is timely since there is an increasing recognition within the Indian Armed Forces that the future of warfare will hinge on the effective utilisation of the tenets of non-contact warfare as part of shaping operations in any military campaign. For this, it is required that India, as stated by the late Gen BipinRawat while interacting with a select group of journalists in September 2021, operationalise a missile force.2 The command and control of the force can initially be vested within a single service, i.e., the Indian Army, and later can be made rotational.

A rotation system will require common professional military education (PME) system, an analysis of which is beyond the purview of the current text. There are many reasons for this. First of all, there is a need to establish the rationale behind consolidating a long range vector force, on the lines of the Chinese PLA Rocket Force (PLA RF). The strikes in Uri and Balakot, and the actions at Kailash range, have reinforced the dictum that an operational space exists between two nuclear armed adversaries for waging warfare, that does not cross into the nuclear domain. Such operations have shown that the stability–instability paradox3 , as it obtains today in the dyads of India–Pakistan and India–China,4 does not hold true. The so-called "window of opportunity" exists for accurate surgical strikes in a manner that strategic stability is maintained.

Missiles are one of the ways in which warfare can be waged by India against its adversaries, especially when it comes to shallow strikes against demonstrably military targets. The reasons are precision, speed of response, capability to evade detection with minimal loss to human lives. Compared with using manned aircraft, which if used, can be thought of as moving up the escalation ladder, missile strikes due to their accuracy and effectiveness may be used to either convey a message or achieve ascendancy in a localised conflict.

One also has to look at the cost-effectiveness of a missile vis-à-vis a fighter jet. An Air Force jet is a system-of-systems platforms, incurring costs of pilot training, EW suites, missiles, radars and other associated technologies. The production of aircraft is laborious and time-consuming, with only limited numbers being rolled out annually. Also, every increase in the aircraft numbers

also entails an exponential increase in the training costs and time of each additional pilot, increasing the marginal costs of training and administration manifold. Thus, in the same budget, more number of missiles can be produced and deployed.

Though unmanned aerial vehicles (UAVs) have been shown to provide some advantages in conflicts, their effective utilisation has been in the intelligence, surveillance, target acquisition and reconnaissance (ISTAR) domains.5 There have also been studies that state that the usage of UAVs only complements the side with a battlefield advantage.6 Drone swarms—supposed to be game-changers—are still in the experimental phase.7

There is also a question of indigenisation. India faces challenges with producing fighter aircrafts at scale. The LCA programme has just started getting off its feet in terms of production, with AMCA still at the conceptualisation stage. The key issue is lack of indigenous jet engine technology. On the other hand, India already has excellent expertise in producing both conventional and nuclear-tipped missiles. Agni, Prithvi, BrahMos, Nag, Pralay, Pradyumna, etc., are all examples of domestically made missiles in both the medium and long range category.

**Pralay: Likely Point of Origin for IRF**

The Pralay missile is a quasi-ballistic, surface-to-surface missile based on sub-systems from a host of already-tested DRDO missiles such as the exoatmospheric interceptor missile PrithviDefence Vehicle (PDV) and the Prahaar tactical missile. The composite propellant comes from the Sagarika family of missiles being developed for the Indian Navy.8 The range of Pralay is 150–500 km and its recent successful test launches and the induction of 120 missiles is likely to become the focal point for the creation of an Indian IRF. This is the only conventional tactical battlefield missile likely to be fielded by India, apart from the BrahMos supersonic cruise missile.

The creation of a Rocket/Missile force by India as separate from the Strategic Forces Command (SFC) is required for creating conventional deterrence and exploiting the windows of opportunity at the tactical and operational levels. Pralay is likely to be one of the major pivots for the still-to-be-formed force, which can create retaliatory as well as pre-emptive options for the Indian Army against China and ensure that the threshold for nuclear warfighting is neither reached nor crossed.

The range of the missile (150–500 km) along with the amount of payload per missile (350–700 kgs) and capabilities, i.e., high explosive pre-formed fragmentation warhead, Penetration-Cum-Blast (PCB) and Runway Denial Penetration Submunition (RDPS)9 ensure that the Army retains the flexibility to target hard targets such as bunkers, communication centres and runways at the operational ranges of up to 500 km, a distance which will yield maximum advantages due to the proximate deployment of the PLA in both Eastern Ladakh and Arunachal Pradesh.

The Pralay missile can also be thought of bridging the gap between the extreme ranges of the guns and rockets of the Indian artillery and conventional intercontinental ballistic missiles (ICBM) strikes. While the Artillery guns have a range between 20 and 50 km,10 the rocket systems of the Indian Army have a maximum range of 90 km.11 Pralay's operational range of 150–500 km will bring under threat significant PLA military infrastructure that was considered unreachable so far unless long range ballistic missiles were used. These had the disadvantage of belonging to the SFC which also has the mandate of preparing for nuclear warfighting operations. The Pralay missile, when deployed, can be seen to extend the range of the Indian

Armed Forces' strike capability beyond the 90 km range mark, providing it with critical deterrent capabilities by bringing into range a number of Chinese garrisons, communication centres, surface-to-air missile (SAM) sites and other critical infrastructure, while doggedly remaining within the conventional warfighting paradigm. In fact, as per an analysis by a veteran Indian Army officer, the IRF can be organised on the lines of six sector-based rocket missile forces with one focusing on Pakistan, four on China and one kept in reserve.12 The idea is to move beyond the traditional conceptualisation of artillery as supplementing infantry-predominant operations to a more central role with rockets and tactical missiles forming the vanguard of a new and potent Indian non-contact warfare capability. It is now important to see how a likely structure of IRF will emerge. The PLA RF's organisation, structure and objectives may serve as one of the templates.

Organisation and Deployment Posture of PLA RF Relevant to India

The PLA RF comprises nine bases which are either Corps or Corps Deputy Leader grade.13 While Bases numbering 61 to 66 are meant for ballistic missile operations, Bases 67–69 are meant for support operations. While Base 67 is responsible for overseeing the nuclear stockpile, Base 68 is charged with engineering and physical infrastructure. Base 69, which is the latest, is concerned with personnel training and missile tests.

Out of the operational missile bases, most face eastwards and most missiles are against Taiwan, with longer range missiles threatening American military bases in Guam. Base 64, headquartered in the western Chinese city of Lanzhou covers North West and North Central China.14 It consists of seven missile brigades, out of which at least four are road-mobile nuclear ICBM brigades, one a dual nuclear-conventional intermediate range ballistic missile (IRBM) brigade and two brigades of unknown missile type.15

The brigades are based at Korla, Xining, Yinchuan, Hancheng, Hanzhong and Tianshui. The missiles possibly include DF-26 IRBM (range 5000 km), DF-31 (range 7200–8000 km), DF-31 AG (likely range 11200 km), DF-41 (range 12000–13000 km) and some unknown missile types16 —all can cover the entire frontage of the LAC against India.

All of PLA's land-based tactical and strategic ballistic missiles are controlled by PLA RF. For nuclear-tipped missiles, the command and control is directly from the Central Military Commission (CMC) (currently headed by Chinese President Xi Jinping) to the PLA RF Headquarters at Qinghe, Beijing to the Rocket Bases, Brigades and finally to the launching units. In case of conventional missiles, the Bases seem to have more autonomy. However, as per a Jamestown Foundation analysis, for conventional operations, most rocket bases are supposed to be subsumed under the respective theatre commands, precluding the need for a theatre rocket force.17 All of PLA RF's short range ballistic missiles (SRBMs) and ground-launched cruise missiles (GLCMs) brigades are assumed to be under the direct control of the theatre commands,18 increasing its combat firepower and also providing an opportunity for conducting joint operations.

**Ideal Organisation of IRF**

There are likely forms of command and control of an emerging IRF in the Indian context. The structure of PLA RF can be considered as one of the templates where all conventional and nuclear missile forces are concentrated into a separate service. Another model is that of individual services having their respective missile forces but this model may not be viable when

theatre commands are created. The third model is the integration of the missile units within the theatre commands, with the rocket and missile forces clubbed together under a fourth component. Here, the operational command and control will reside with the respective service component to facilitate planning for joint operations within the theatre command.

Depending on the composition and tasks of the theatre commands, the respective platforms for launching the missiles may be decided. Personnel from the Corps of Artillery can initially form the core group for exercising initial command and control, operational training and exercises which will be made realistic and go a long way in inculcating long-range precision fires expertise within the remaining two services. Inclusion of state-of-the-art UAVs in the form of micro and mini drones can serve as force multipliers for ISTAR and post-strike damage assessment (PSDA). A similar use was made by the PLA during its exercises around the Taiwan strait.19 Artificial intelligence (AI) and machine learning (ML) based command and control (C2) systems can be used for effectively matching targets to delivery platforms.

The Corps of Artillery, which currently handles most of India's missile and rockets systems in terms of deployment and training, is well-poised to act as the core group of the new IRF. It has extensive training experience and has done countless firing tests and deployment exercises with these systems for a long time. With cross-pollination of personnel from the SFC and steered by the Corps of Artillery, the IRF can become India's answer to extend its conventional deterrence posture beyond the conventional range of its artillery.

Apart from operational command and control, it is necessary that there is a clear segregation between launch platforms for rockets and missile forces. Within the fourth vertical, while all ground-based launchers can be manned by Army units, air launched vectors should be exclusively with the Indian Air Force (IAF) while coastal defence and submarine launched missiles will be with the Indian Navy. This will accomplish two things: leverage the operational competence of each Service and ensure optimisation of operational logistics. Issues such as storage capacities and maintenance, repair and overhaul (MRO) will be streamlined.

A clear segregation of assets between the IRF and SFC will also address the paranoia generated by certain security studies scholars regarding India's "counterforce temptations".20 India's stated policy is still of no-first-use (NFU) envisioning nuclear weapons as political instruments and has steadfastly remained so. To preclude any actor from misidentifying any conventional strikes as nuclear or 'bolt-out-of-the-blue',21 it is critical that there is a marked and visible segregation of delivery platforms. The conventional theory of deterrence involves a judicious combination of the three Cs, i.e., capability, credibility and communication.22 Communication involves signalling especially to the adversary. There should be no grey zone in distinguishing the missiles that are kept for conventional strikes from the nuclear-tipped ones. The creation of the SFC was essentially for operationalising India's 'massive retaliation' nuclear strategy. It is therefore essential that the commissioning of Pralay coincide with the creation of IRF separate from SFC, followed by shifting of the rocket assets into the IRF.

**Conclusion**

The Chinese threat along the LAC necessitates a paradigm change in the Indian defence posture. While a start has been made with the deployment of unmanned systems and advanced sensors, there exists the challenge of creating a deterrent threat with two aims: create a window of opportunity for undertaking kinetic actions without climbing the escalation ladder and therefore putting the onus of escalation on the other side; and creating an indigenous solution which can be

scaled up rapidly without being limited to the foreign policy constraints of any country. The induction of Pralay may become the start of an Indian IRF which addresses both these aims.

*https://www.idsa.in/issuebrief/Integrated-Rocket-Force-AUpadhyay-240123#:~:text=An%20Integrated%20Rocket%20Force%20(IRF)%20serves%20both%20these%20purposes.,operations%20in%20any%20military%20campaign.*

THE HINDU

***Wed, 25 Jan 2023***

# India, Egypt Ties: From Fighter Jet Development in the 1960s to Collaborating on Defence Industry Today

***By Dinakar Peri***

During a two-day visit to Egypt in September 2022, Defence Minister Rajnath Singh visited the Egyptian Air Force Museum in Cairo and witnessed the Helwan 300 fighter jet, which was jointly developed by India and Egypt, an effort long before 'Aatmanirbhar Bharat' came into vogue.

This week, as Egyptian President Abdel Fattah El-Sisi is set to witness India's indigenous military hardware roll down Kartavya Path as part of the Republic Day parade, the two countries are looking to deepen defence industrial cooperation. Cairo is considering a range of Indian hardware for its forces.

During Mr. Singh's visit last year, India and Egypt had signed a Memorandum of Understanding (MoU) to further enhance bilateral defence cooperation. The two sides agreed to focus on "joint training, defence co-production and maintenance of equipment".

India's participation in Egypt's aircraft industry in the 1960s was the direct result of a close understanding between Prime Minister Jawaharlal Nehru and Egyptian President Gamal Abdel Nasser, wrote Group Captain KapilBhargava (retd), who as a Squadron Leader in June 1963 was deputed by the Indian Air Force to work as a test pilot in the Egyptian Aircraft Factory 36 at Helwan. He has the distinction of undertaking the first flight of the Helwan HA-300 fighter jet, designed by Willy Messerschmitt. The first flight of the HA-300 was undertaken on March 7, 1964 and lasted 12½ minutes, he wrote in a long account on bharat-rakshak.com.

India's interest was in developing the E-300 turbojet engine for its own indigenous HF-24 Marut fighter designed by another German — Kurt Tank. Extensive testing was done with two prototypes and the third prototype was just beginning taxi testing when the project was scrapped in 1969 for a variety of reasons: financial considerations, Egypt's defeat in the 1967 war and the Soviet Union offering its fighter jets to India.

According to information on globalsecurity.org, a contract between India and Egypt was signed in September 1964 for the engine and India helped fund development of the E-300 engine. The E-300 engine was eventually used in the Indian HF-24 Marut fighter. Two Egyptian pilots came to India in 1964 and attended the Indian Air Force test pilot school to prepare for the HA-300 flight development. India also provided a Marut fighter for the E-300 project.

Elaborating on the reasons for the project falling behind, Group Capt. Bhargava notes that Indian policymakers, including the Chief of Air Staff, were quite confused about collaboration with Egypt. According to them both countries would use the HF-24 fitted with the E-300 engine. "The Indian authorities had not realised that the Egyptians were not interested in the HF-24," he wrote. "When this became clear, official Indian enthusiasm for the E-300 also disappeared. This was the death knell of the HA-300 project. Foreign experts working at Helwan began to drift away. The Egyptians also ran out of patience and money, and closed the project in May 1969."

Fast forward to 2023, and Egypt is actively considering India's indigenous Light Combat Aircraft (LAC) Tejas, also being actively considered by Argentina and Malaysia. Both Indian and Egyptian Air Forces also operate the French-origin Rafale multi-role fighter.

Egypt has expressed interest in acquiring a range of military hardware including the Advanced Light Helicopter, Light Combat Helicopter and Akash surface to air missile systems, among others. To sweeten the offer on LCA, HAL is even considering a maintenance facility in Egypt which can also cater to its potential market in Africa and Middle East, it has been learnt.

India has offered assistance to Egypt in developing its own domestic defence manufacturing base, officials said, noting the close and historical ties between the two countries.

Interestingly, India, after making several failed attempts at developing an indigenous fighter engine, is now considering proposals from three global engine manufacturers — General Electric, Rolls Royce and Safran — for co-developing an engine for its future fighters.

*https://www.thehindu.com/news/national/india-egypt-ties-from-fighter-jet-development-in-the-1960s-to-collaborating-on-defence-industry-today/article66428318.ece/amp/*

WION

***Tue, 24 Jan 2023***

# Air Defence Systems Crop Up Near Putin's Forest Palace, Signalling Moscow Fears a Direct Ukrainian Strike

In what is being perceived as a clear sign that Russia President Vladimir Putin fears a direct strike from Ukraine, air defences have been set up near his forest palace in Yascherovo. Earlier, reports suggested that missiles were deployed near his Moscow residence as well.

Yascherovo is a village that lies halfway between Moscow and St Petersburg, and a Pantsir-S1 defence system has been established near the Valdai presidential palace here.

The area near Putin's official residence in Novo-Ogarevo has also seen the setting up of similar systems in the past week. These systems are reportedly supposed to protect Putin from Ukrainian drones or missiles.

The Pantsir-S1 and S-400 Triumf air defence systems have also been set up across Moscow to defend the city in case of a full-scale attack by Kyiv. The former is specifically tasked with

protecting government and industrial facilities against aircraft, helicopters, precision munitions, cruise missiles and military drones.

"These air defence systems protect President Vladimir Putin and his family from a possible Ukrainian strike," a report in Russian media outlet AgentstvoNovosti said.

"This conclusion can be drawn after the air defence system appeared near the Valdai presidential residence. There are simply no other sites for protection there, except for the residence," it said.

The developments have reportedly been sparked following suspected Ukrainian drone attacks on two Russian air bases deep inside the country in December. Two nuclear-capable bombers were destroyed in the strikes.

The Pantsir-S1 defence system near the Valdai place is supposed to "protect him and his family" from long-range Ukrainian attacks, according to AgentstvoNovosti. The report further said that three servicemen are near the system at all times. It is believed to have a rotating radar antenna.

Putin's 39-year-old rumured girlfriend AlinaKabaeva is known to frequent the palace quite a bit. Putin is believed to have young kids with her who have never been seen in public.

The roof of Russian defence ministry's National Defence Management Centre on Frunzenskaya Embankment, the command centre of Putin's invasion of Ukraine, has also been equipped with missile launchers.

*https://www.wionews.com/world/air-defence-systems-crop-up-near-putins-forest-palace-signalling-moscow-fears-a-direct-ukrainian-strike-555443/amp*

THE ECONOMIC TIMES

***Wed, 25 Jan 2023***

# U.S., Germany Poised to Send Tanks to Ukraine, Answering Kyiv's Pleas

The United States was expected to announce as soon as Wednesday that it will send heavy tanks to Ukraine, and Germany has decided to do the same, sources said, a reversal that Kyiv has said would reshape its war with Russia.Hours before Ukrainian President VolodymyrZelenskiy turned 45 on Wednesday, he pressed allies to move forward with providing his forces with more than five to 15 modern tanks.

"Discussions must be concluded with decisions," Zelenskiy said in his nightly video address. "Decisions on real strengthening of our defence against terrorists. Allies have the required number of tanks."Just days after arguing against granting Kyiv's requests, Washington was ready to start a process that would eventually send M1 Abrams battle tanks to Ukraine, two U.S. officials told Reuters on Tuesday. A third official said the U.S. commitment could total about 30 tanks delivered over the coming months.Meanwhile, German Chancellor Olaf Scholz had decided to send Leopard 2 battle tanks to Ukraine and allow other countries such as Poland to do so as well, two sources familiar with the matter told Reuters.

Spiegel magazine, which first reported the news, said Germany was planning to supply at least one company of Leopard 2 A6 tanks, which usually comprises 14 tanks. Other allies, in Scandinavia for example, intend to go along with Germany in supplying their Leopard tanks to Kyiv, the magazine reported.While there was no official confirmation from Berlin or Washington, officials in Kyiv hailed what they said was a potential gamechanger on the battlefield in a war that is now 11 months old - even if the rumoured tank numbers fell short of their hopes.

"A few hundred tanks for our tank crews .... This is what is going to become a real punching fist of democracy," AndriyYermak, the head of Zelenskiy's administration, wrote on Telegram.Kyiv has pleaded for months for Western tanks that it says would give its forces the firepower and mobility to break through Russian defensive lines and recapture occupied territory in the east and south. Germany has held back, wary of moves that could cause Moscow to escalate.

**Front Lines Frozen**

Front lines in the war, which stretch more than 1,000 kilometres (620 miles) through eastern and southern Ukraine, have been largely frozen for two months despite heavy losses on both sides. Russia and Ukraine are both widely believed to be planning new offensives.Zelenskiy said on Tuesday night that Russia was intensifying its push toward Bakhmut, an industrial town in eastern Ukraine that has been the focus of intense fighting. "They want to increase the pressure on a larger scale," he said.

Whether to supply Ukraine with significant numbers of heavy modern battle tanks has dominated discussions among Kyiv's Western allies in recent days.The Kremlin has said supplying tanks to Ukraine would not help and that the West would regret its "delusion" that Kyiv could win on the battlefield.

Berlin has been pivotal because the German-made Leopards, fielded by some 20 armies around the world, are widely seen as the best option. The tanks are available in large numbers and easy to deploy and maintain.

While the U.S. Abrams tank is considered less suitable due to its heavy fuel consumption and difficulty to maintain, a U.S. move to send them to Ukraine could make it easier for Germany - which has called for a united front among Ukraine's allies - to allow the supply of Leopards.

Russian President Vladimir Putin casts the "special military operation" that began when his troops invaded Ukraine on Feb. 24 last year as a defensive and existential battle against an aggressive and arrogant West.

Ukraine and the West call Russia's actions an unprovoked land grab to subdue a fellow former Soviet republic that Moscow regards as an artificial state.

**Leadership Purge**

Separately on Tuesday, Ukraine dismissed more than a dozen senior officials as part of an anti-corruption drive made more critical by the need to keep its Western backers onside.

The European Union, which offered Ukraine the status of candidate member last June, welcomed the development.

Among Ukrainian officials who resigned or were dismissed were the governors of the Kyiv, Sumy, Dnipropetrovsk, Kherson and Zaporizhzhia regions, the latter three frontline provinces. Kyiv and Sumy were major battlefields earlier in the war.

Some, though not all, of the officials who left had been linked to corruption allegations.

Ukraine has a history of graft and shaky governance, and is under international pressure to show it can be a reliable steward of billions of dollars in Western aid.

*https://m.economictimes.com/news/defence/in-reversal-us-poised-to-approve-abrams-tanks-for-ukraine/amp_articleshow/97294785.cms*

# Science & Technology News

Hindustan Times

***Wed, 25 Jan 2023***

## Big Plans for 2023 after a Mixed 2022: ISRO Chief

The landing demonstration of the Reusable Launch Vehicle-Technology Demonstrator (RLV-TD), one of the most challenging endeavors of the Indian Space Research Organisation (Isro) towards developing essential technologies for a fully reusable launch vehicle to enable low-cost access to space, is scheduled for Saturday, chairman S Somnath told HT in an interview, adding that several major missions are lined up for 2023. Edited excerpts:

RLV's landing demonstration is scheduled for this Saturday, if everything goes well. Then we have the Small Satellite Launch Vehicle's (SSLV) second development flight scheduled for the second week of February. It is going to be between February 10 and February 15, based on the information we get from the government. OneWeb India's launch of the next set of 36 satellites is also scheduled for the first week of March.

Another important mission planned for this year is the Aditya-L1 mission (a coronagraphy spacecraft to study solar atmosphere), which is likely to be scheduled around April-May. By February 1, we will also get the radar payload of the Nasa-Isro Synthetic Aperture Radar (NISAR) mission from US. We will be conducting a few tests after that and the launch can be expected around September.

Methane is identified as a potential future fuel. A big advantage of using methane as a fuel is that it is highly efficient and doesn't produce soot. Over the last few years, a lot of work has been happening around methane engines. We have also started. We tested a 120-tonne methane engine and have completed the design of a 100-tonne thrust methane engine. This will typically take four years of development time; and we are seeking funds from the government to scale up.

We had planned certain milestones for 2022; we achieved some and some we didn't. I don't think we did enough. I am not too enthused with what we achieved in 2022. The plans were

bigger. For instance, the SSLV launch was not successful. It was a narrow miss but it was a personal disappointment for me. We are working hard to make the second launch successful this year. There were some misses, but this is part of long-term missions. 2022 was good but 2023 should be better.

We are doing what is needed, and there was no problem with Isro input. The warning was that we should not give such information to the public before it is screened because this can create unnecessary panic, which can create a problem in any distress situation. We are continuing to give our data and analysis to the governments and the National Disaster Management Authority (NDMA). There is no restriction on data-sharing. It should not be misunderstood that data from Isro is being blocked. The report was taken out by us voluntarily so that the information was not misused.

*https://www.hindustantimes.com/india-news/big-plans-for-2023-after-a-mixed-2022-isro-chief-101674585363442.html*

ThePrint

***Wed, 25 Jan 2023***

# A Rocket Launcher You can Recycle — ISRO Chief Says RLV Landing Demo this Week

The Indian Space Research Organisation (ISRO) is all set to carry out the first landing demonstration of its Reusable Launch Vehicle (RLV) Saturday, its chairperson S. Somanath has said.

Somanath, who was speaking to ThePrint on the sidelines of the 8th India International Science Festival in Bhopal, said the demonstration will continue as planned provided climate and weather conditions are suitable.

An RLV is a launch vehicle that is designed to return to the Earth substantially intact and could, therefore, be reused.

ISRO's Reusable Launch Vehicle-Technology Demonstration (RLV-TD) Programme is a series of technology demonstration missions, seen as the first step towards realising a two-stage-to-orbit (TSTO) fully reusable vehicle. A TSTO, or a two-stage rocket, is a spacecraft in which two distinct stages provide propulsion consecutively in order to achieve orbital velocity.

This is the first time ISRO is conducting a landing demonstration for its RLV-TD Programme.

ISRO has also planned the launch of a Small Satellite Launch Vehicle (SSLV) with a payload capacity to deliver 500 kg to low Earth orbit (500 km), Somanath told ThePrint.

The SSLV launch, planned between 10-15 February, comes six months after ISRO's maiden SSLV-D1 failed to reach stable orbit because of a sensor fault in the separation stage.

Recalling that mission, which was launched on 7 August last year, Somanath said he was "not very enthused" about ISRO's achievement in 2022.

“For me, it was not enough. My goals were much higher,” he told ThePrint. “SSLV was not successful. It was narrowly missed and was a huge disappointment for me personally. But then we are working hard on the launch this year.”

He added that ISRO also wanted to conduct an abort test — that would check the system meant to help crew escape from a spacecraft in case of emergency — for its space mission Gaganyaan last year, but couldn’t do it.

In addition to the RLVs and SSLV, the space agency also has plans to launch a spacecraft to study the Sun this year, the scientist said.A NASA-ISRO mission & more this year

According to ISRO’s website, Saturday’s landing demonstration will involve a “landing experiment (LEX)” in which the RLV will be carried using a helicopter to an altitude of 3-5 km and released at approximately 4-5 km from the runway with a horizontal velocity.

After the release, the RLV glides and navigates toward the runway, and carries out a conventional autonomous landing. This is planned in a defence airfield near Chitradurga in Karnataka.

Somanath also spoke about ISRO’s other launches this year — including Aditya L1, a coronagraphy spacecraft that’s aimed at helping scientists study the Sun’s corona.

The scientist said that the spacecraft is on schedule, with ISRO planning to carry out the launch in April or May. “The important payload of this mission — the solar coronagraph — will be flagged off from the Indian Institute of Astrophysics (IIA) to ISRO Satellite Centre on Republic Day.”

The solar coronagraph is a telescope that is designed to block out direct light from the Sun to help study it better. The IIA has developed the coronagraph that will be used in ISRO’s space mission.

“Over the next two months, other payloads will also be brought and assembled in time for the launch,” Somnath said.

In addition, the NISAR (NASA-ISRO Synthetic Aperture Radar) will be brought from the US on 1 February to India, Somnath said, adding that he plans to travel to NASA’s Jet Propulsion Lab to oversee the flagging off. This is the first project jointly developed by NASA and ISRO.

A Synthetic Aperture Radar (SAR) refers to a technique for producing fine-resolution images from a resolution-limited radar system.

NISAR, which is being jointly developed by NASA and ISRO “will be the first radar of its kind in space to systematically map Earth”, according to the US federal space agency.

According to Somanath, there are two important payloads on this mission — the US-made radar L-Band and the Indian-made S-Band.

“We first prepared our payload and sent it to the US. The US payload is now integrated and testing was done over the last few months,” he said.

ISRO is scheduled to launch NISAR in September.

Joshimath and NDMA’s ‘gag order’

Somanath also spoke about ISRO’s report on land subsidence in Joshimath and why it was taken down last week.

On 14 January, the report was taken off ISRO's website, a day after the National Disaster Management Authority's gag order asking government agencies to refrain from interacting with media and sharing information on social media.

ISRO's chairperson told ThePrint that "there was no directive to the ISRO to take down the report", and that the decision to do so was voluntary.

"There has been no ban on us as such. The warning we got was that we should not reveal data without it going through different administrations levels who can take the required actions," Somnath said. "News and its analysis can create a scare and somebody might misuse it. The warning was not to give too much information to the public such that it creates panic."

The agency, he said, continued to provide information "to all the agencies, for example, the NDMA".

"We have only been told not to put info in the public domain," he said. "All scientists who need the data are getting it, we can assure (you) that. We've mechanisms to share this data with exerts."

The ISRO was working to develop a methane-fuelled rocket engine, Somanath said.

"Methane is identified as the fuel of the future. Its density is lower than kerosene. But its advantage is that it has high efficiency and does not produce soot, which is very dangerous for engines," he said.

ISRO, one of several science organisations in India trying to develop methane-based engines, has also tested a 20-tonne methane engine and has completed the design of the hundred-tonne one, the scientist said.

"It's a very simple reaction that can be carried out anywhere, and will be valuable for long-term space missions when enough fuel for the entire duration of the mission may not be feasible to carry," Somanath said, adding that it will take the agency four-odd years to fully develop the engine.

"We have recently done a successful demonstration of producing methane from carbon dioxide and water at the lab scale. We are now scaling up to implement it in space missions," he said.

*https://theprint.in/science/a-rocket-launcher-you-can-recycle-isro-chief-says-rlv-landing-demo-this-week/1332727/?amp*