

मई
May
2026

खंड/Vol. : 51

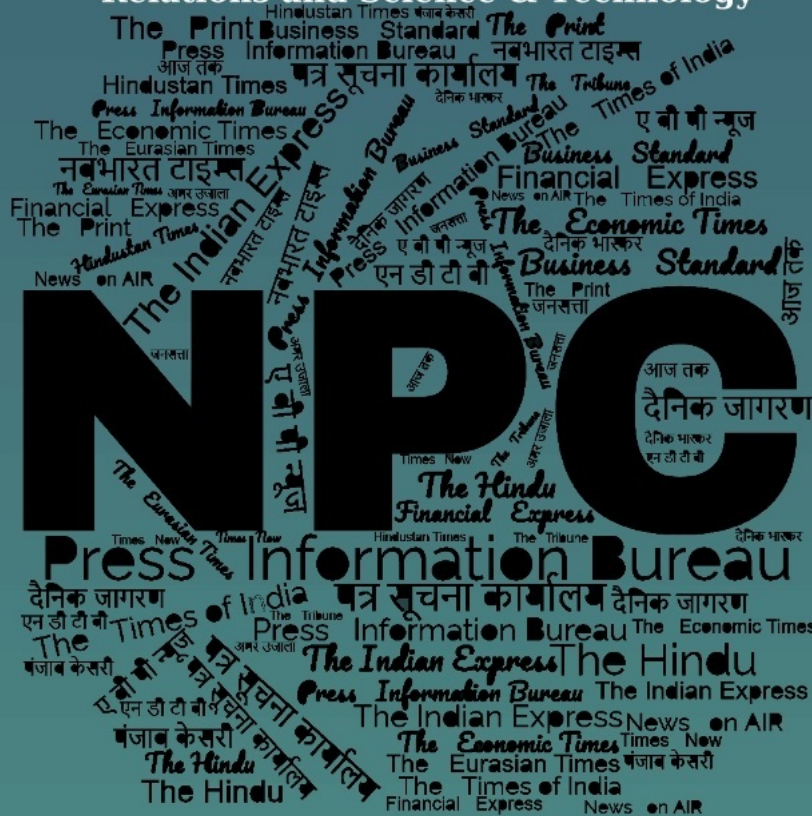
अंक/Issue : 098

27/05/2026

समाचार पत्रों से चयनित 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



रक्षा विज्ञान पुस्तकालय

Defence Science Library

रक्षा वैज्ञानिक सूचना एवं प्रलेखन केंद्र

Defence Scientific Information & Documentation Centre

मेटकॉफ हाउस, दिल्ली - 110 054

Metcalf House, Delhi - 110 054

CONTENTS

| S. No. | Title | Source | Page No. |
|--------------------------------------|--|---------------------------------|-------------|
| Defence News | | | 1-8 |
| 1 | Delhi in talks with Moscow to buy additional batch of S-400 systems: Russian media | <i>The Times of India</i> | 1 |
| 2 | हिंद-प्रशांत क्षेत्र की सुरक्षा, समुद्री अभ्यास और होर्मुज संकट पर चारो देशो की अहम चर्चा | <i>NavBharat Times</i> | 1 |
| 3 | Quad unveils 4 key initiatives; expands energy, maritime ties | <i>The Asian Age</i> | 2 |
| 4 | K9 warriors steal the show at Exercise PRAGATI 2026 | <i>The Pioneer</i> | 4 |
| 5 | Anti-drone systems along border within six months: Amit Shah in Bikaner | <i>The Indian Express</i> | 5 |
| 6 | India's strategic autonomy needs a reset | <i>The Pioneer</i> | 5 |
| 7 | Our defence future lies in Asia | <i>The Tribune</i> | 7 |
| Science & Technology News | | | 8-12 |
| 8 | "CLEAR" technology can revolutionize protein imaging & facilitate detection of Cancer and Neurobiological Diseases | <i>Press Information Bureau</i> | 8 |
| 9 | India acquires capacity to operate a commercial-scale fast breeder nuclear reactor | <i>The Pioneer</i> | 10 |

Defence News

Delhi in talks with Moscow to buy additional batch of S-400 systems: Russian media

Source: The Times of India, Dt. 27 May 2026

India is in negotiations with Russia to purchase additional batches of S-400 long-range air defence systems, Russia's Federal Service for Military-Technical Cooperation (FSVTS) confirmed on Tuesday.

"Russia and India are negotiating the delivery of an additional batch of S-400 Triumph air defence systems, according to Russia's Federal Service for Military-Technical Cooperation. Moscow said the S-400 'proved itself' during Operation Sindoor, with India now expressing interest in expanding its inventory beyond the five regimental sets ordered under the 2018 deal," Russian state-controlled news network RT India said on X. TOI had earlier reported that India's Defence Acquisition Council (DAC) had approved plans to purchase five additional regimental systems.

The Indo-Russian talks come as Moscow works to wrap up a \$5.4 billion (approx Rs 40,000 crore) contract signed in 2018. While Russia successfully delivered the first three S-400 systems by 2023 that India had successfully deployed along the western and northern borders, the remaining two units have faced delays due to Russia's ongoing war with Ukraine. FSVTS chief Dmitry Shugayev said last week that the outstanding deliveries are now back "on schedule", with the final two units expected to arrive in India any time this month and the last one in Nov.

S-400 Triumph, also called 'Sudarshan Chakra' in India, served as a critical game-changer during Op Sindoor, successfully neutralising hostile aerial assets and creating a protective umbrella over vital Indian air bases and cities.

India has deployed these mobile systems in strategic sectors to create a multi-layered aerial defence shield against threats from Pakistan and China. The defence ministry and DRDO are now working on integrating S-400 units with the indigenous Project Kusha (extended range air defence system or ERADS) through the Indian Air Command and Control System (IACCS) to create a pan-India missile shield. This network-centric framework allows both systems to share data and coordinate "buddy firing" without compromising India's strategic autonomy.

<https://timesofindia.indiatimes.com/defence/delhi-in-talks-with-moscow-to-buy-additional-batch-of-s400-systems-russian-media/articleshow/131337255.cms>

*

हिंद-प्रशांत क्षेत्र की सुरक्षा, समुद्री अभ्यास और होर्मुज संकट पर चारो देशो की अहम चर्चा

Source: NavBharat Times (Pages 01&14), Dt. 27 May 2026

भारत, अमेरिका, जापान देशों को अपनी सुरक्षा के बीच और ऑस्ट्रेलिया के समूह QUAD ने हिंद-प्रशांत क्षेत्र की सुरक्षा और आर्थिक के लिए कई नई पहल शुरू करने का लिया है। क्वाड के विदेश मंत्रियों की मंगलवार

को हुई बैठक में रेयर अर्थ और क्रिटिकल मिनरल्स की स्थिर और भरोसेमंद सप्लाई के लिए नया फ्रेमवर्क शुरू किया गया। मकसद इस क्षेत्र में चीन के तोड़ना है। इलेक्ट्रॉनिक्स ओर हाई-टेक प्रोडक्ट्स के लिए जरूरी रेयर अर्थ मिनरल्स की 90% सप्लाई अभी चीन से होती है।

साझा बयान में 'मुक्त और खुले हिंद-प्रशांत' की बात दोहराई और इस क्षेत्र में समुद्री निगरानी के लिए तकनीक और क्षमताएं, साझा करने की पहल शुरू की है। इसे इंडो-पैसिफिक मैरिटाइम सर्विलांस को ऑपरेशन इनिशिएटिव नाम दिया गया है। इसके तहत क्षेत्र में जहाजों की आवाजाही और समुद्री सुरक्षा पर नजर रखी जाएगी। बैठक में होर्मुज की स्थिति पर भी चिंता जताई गई।

दिल्ली में मंगलवार को क्वाड देशों की अहम बैठक में हिंद-प्रशांत क्षेत्र की सुरक्षा, समुद्री निगरानी, ऊर्जा सप्लाई और आतंकवाद जैसे मुद्दों पर बड़ा फोकस रहा। बैठक की मेजबानी विदेश मंत्री एस जयशंकर ने की। इसमें ऑस्ट्रेलिया की विदेश मंत्री पेनी वॉंग जापान के विदेश मंत्री तोशिमित्सु मोतेगी और अमेरिकी विदेश मंत्री मार्को रुबियो शामिल हुए। जयशंकर ने बैठक को बेहद सार्थक और उत्पादक बताया।

क्वाड ने इंडो-पैसिफिक मैरिटाइम सर्विलांस को ऑपरेशन इनिशिएटिव शुरू करने का ऐलान किया। इसके तहत चारों देश अपनी समुद्री निगरानी क्षमताओं को साझा करेंगे, ताकि क्षेत्र में रियल टाइम जानकारी उपलब्ध कराई जा सके। साथ ही इंडो-पैसिफिक मैरिटाइम डोमेन अवेयरनेस पहल का भी विस्तार किया 'री है। मार्को रुबियो ने कहा कि दुनिया के लगभग 60 प्रतिशत समुद्री व्यापार का रास्ता हिंद-प्रशांत क्षेत्र से गुजरता है, इसलिए इसकी सुरक्षा सिर्फ क्वाड ही नहीं बल्कि दुनिया के कई देशों के लिए जरूरी है।

आतंक पर एकजुट हुए

बैठक में आतंकवाद के खिलाफ "जीरो टॉलरेंस" की नीति दोहराई गई। जयशंकर ने कहा कि आतंकवादी हमलों का सामना कर रहे देशों को अपनी रक्षा का पूरा अधिकार है। वहीं जापान के विदेश मंत्री तोशिमित्सु मोतेगी ने कहा कि क्वाड ने क्षेत्र में बल या दबाव के जरिए यथास्थिति बदलने की कोशिशों का विरोध करने पर सहमति जताई है। उत्तर कोरिया के परमाणु कार्यक्रम और अपहरण मुद्दे पर भी चर्चा हुई।

*

Quad unveils 4 key initiatives; expands energy, maritime ties

Source: *The Asian Age (Pages 01&04), Dt. 27 May 2026*

The Quad on Tuesday announced four important initiatives, including the first-ever Indo-Pacific maritime surveillance cooperation, expanded cooperation in critical minerals and energy, and unveiled new measures to boost maritime surveillance and port infrastructure across the IndoPacific, against the backdrop of China's growing military posturing in the region. The new measures were announced following a meeting of the Quad foreign ministers in the national capital, chaired by external affairs minister S. Jaishankar and attended by US secretary of state Marco Rubio, foreign ministers of Australia and Japan Penny Wong and 'Toshimitsu Motegi, respectively.

The Quad foreign ministers said in a joint statement that the four initiatives — the Indo-Pacific maritime surveillance cooperation, the critical minerals framework, the fuel and energy security framework, and the ports of the future partnership are designed to improve teamwork and create real benefits for the region. The Quad joint statement, in a strong message to China without naming it, said, “We remain seriously concerned about the situation in the East China Sea and the South China Sea. We reiterate our strong opposition to any destabilising or unilateral actions, including by force or coercion, that threaten peace and stability in the region.”

“We (Quad) express our serious concerns regarding dangerous and coercive actions, including interference with offshore resource development, the repeated obstruction of freedom of navigation and overflight, and the dangerous manoeuvres by military aircraft and coast guard and maritime militia vessels, especially the unsafe use of water cannons and flares and ramming or blocking actions in the South China Sea. We are seriously concerned by the militarisation of disputed features,” the joint statement further added.

Rejecting China’s apprehensions over the meeting, New Delhi, at a special ministry of external affairs briefing, said “(the Quad’s maritime) surveillance should not be seen as mild mounting suspense on when India will host the next Quad summit, the external affairs ministry said that the Quad foreign ministers are in touch on the (holding of the next) summit. The four ministers said they look forward to the convening of the Quad leaders’ summit and the next Quad foreign ministers’ meeting.

On the maritime security initiative announced on Tuesday, Mr Rubio said, “The launch of the Indo-Pacific maritime surveillance cooperation initiative is going to leverage each of our countries’ maritime surveillance capabilities in the Indo-Pacific to enhance information sharing.”

“The reason why maritime security is so important, beyond the fact that current events remind us of what can happen when maritime security is impeded, is the fact that 60 percent of global maritime trade passes through the Indo-Pacific,” the US secretary of state said and thanked India for committing to hosting the next iteration of the Quad at sea mission, which brings together the respective coast guards in one place on one ship. The Australian foreign minister said in her remarks, “We will be coordinating our maritime surveillance efforts initially in the Indian Ocean and at (the Indian Navy-hosted) Exercise Malabar through the Indo-Pacific maritime surveillance collaboration initiative. And we are also expanding the domain awareness initiative to the Indian Ocean. This will enable partners to access near real-time unclassified satellite tracking data to combat illegal fishing, trafficking and also enable us to better support humanitarian disaster response.”

In his remarks, Mr Jaishankar pointed out that the “maritime domain has seen a steady expansion of collaboration, including surveillance and domain awareness, logistics networks, undersea cables, training, capacity building, and HADR activities”. Asserting that “because we are four maritime democracies located at different ends of the Indo-Pacific, the exchange of perspectives was an exercise of considerable value”, Mr Jaishankar added that the four ministers “spent some time on the question of safe and unimpeded maritime commerce and reaffirmed the significance of scrupulously observing international law”.

According to the joint statement: “We welcome India’s operationalisation of the Indian Ocean Region programme of the Quad Indo-Pacific partnership for maritime domain awareness (IPMDA)... We will work to develop a common operational picture (COP) across the Indo-Pacific by drawing upon the existing IPMDA efforts...” On the critical minerals initiative, which is seen to be a response to China’s dominance over the global critical minerals and rare earths trade, the Quad

said, "To advance our vision for fair and diversified critical minerals markets, we are pleased to announce the Quad critical minerals framework, which will guide how Quad partners can leverage economic policy tools and coordinate, including in concert with the private sector, investment to strengthen critical minerals supply chains, including in mining, processing, and recycling."

Pointing out that the "Quad partners intend to mobilise up to \$20 billion" for this investment and project development, it said the four nations "intend to support the development of secure critical minerals supply chains, which are essential for advanced technologies, economic growth, and the resilience of our industrial bases". On the Quad initiative on Indo-Pacific energy security, the grouping said it will work to identify areas of cooperation for energy security in technology, management, policy, international market analysis, and emergency response exercises through an engagement plan.

"This group effort would aim to recognise and leverage the unique resources and capabilities of each country's energy sector, including to strengthen their respective strategic petroleum systems. We will work with our partners in the Indo-Pacific to help strengthen regional energy resilience," the joint statement said, acknowledging that "Quad partners will work together to ensure open, well-functioning and stable energy markets and resilient and diversified supply chains" and that "maintaining open trade flows in essential goods is critical for the security and prosperity of the Indo-Pacific region." On port infrastructure, the grouping stated, "...The Quad countries will work, in coordination with the Government of Fiji, to advance port infrastructure and associated activities in the country."

*

K9 warriors steal the show at Exercise PRAGATI 2026

Source: The Pioneer (Page 14), Dt. 27 May 2026

Amid tactical drills and multinational training at Exercise PRAGATI 2026, the Indian Army's four-legged warriors added a distinctive and powerful dimension to the exercise. Army dogs trained alongside troops from friendly foreign countries, showcasing their role in modern military operations and enhancing interoperability in a multinational environment.

From IED detection and tracking to intervention operations, the K9 teams demonstrated how trained military dogs remain an invaluable asset in high-risk operational scenarios. The display included Alan, a Belgian Malinois assault dog; Victor, a Rampur Hound tracker dog; and Deo, a Labrador explosive detection dog. Each showcased a specialised skill set, reflecting the versatility, discipline and mission readiness of Indian Army K9 teams. A key highlight was the participation of India's indigenous breeds, reflecting their adaptability, resilience and disease resistance, indigenous breeds are increasingly being integrated into operational roles, strengthening the Indian Army's move towards self-reliance under Atmanirbhar Bharat.

The K9 warriors also demonstrated their operational relevance across varied terrains, from deserts to glaciers, underlining their adaptability and effectiveness. Reporting interyeon teams, these dogs bring speed, instinct, courage and loyalty to the battlefield. The exercise also featured robotic dogs, highlighting the evolving interface between trained animals and emerging technology in future military operations.

*

Anti-drone systems along border within six months: Amit Shah in Bikaner

Source: The Indian Express, Dt. 27 May 2026

Union Home Minister Amit Shah on Tuesday said anti-drone systems will be deployed along the international border within the next six months, underlining the need to view the BSF's traditional role "from a new dimension".

Speaking at an event near the international border in Rajasthan's Bikaner, Shah said that the BSF must strengthen its preparedness by maintaining constant vigilance against illegal smuggling, infiltration, and cross-border activities, highlighting the Centre's decision to expand BSF's jurisdiction from 15 kilometres to 50 kilometres from the border.

He said, "It is our responsibility to inform the civil administration if any illegal construction takes place within villages located inside this 50-kilometre zone," adding that if any artificial demographic change takes place, the BSF must remain alert and inform the state government.

He said it is also the responsibility of the force to take all necessary measures to strictly stop the smuggling of narcotics and weapons through drones and other means. In this regard, the government will begin installing anti-drone systems within the next six months, he said, stressing that it is equally important to identify who receives the drones once they land on Indian soil and who uses the materials brought by them for anti-national activities.

<https://indianexpress.com/article/india/amit-shah-anti-drone-systems-bsf-border-security-10709658/lite/>

*

India's strategic autonomy needs a reset

-by Ashok K Mehta, retired Major General

Source: The Pioneer, Dt. 27 May 2026

Speaking on the anniversary of the nuclear tests conducted in defiance of US warnings, Prime Minister Narendra Modi said: "India will not bow down to anyone", heralding the successful execution of its strategic autonomy, though its evolution has seen more downs than ups, especially during the turbulent Trumpian era. Punitive tariffs and multiple sanctions, along with waivers on Russian military platforms, Russian oil, and Chabahar Port, have taken their toll. During the recent BRICS Foreign Ministers' meeting in New Delhi, External Affairs Minister S Jaishankar criticised unilateral non-UN sanctions on India, calling them "unjustified", even as Delhi awaited waivers on Chabahar and Russian oil. Later at the conference, he noted the unnecessary resort to unilateral coercive measures and sanctions, which are inconsistent with international law and the UN Charter. These measures "disproportionately affect developing countries". This is perhaps the first time such comments have been made - akin to closing the stable door after the horse has bolted.

Strategic autonomy has been bruised notwithstanding the slew of deals with the EU and France. The purchase of 36 Rafale fighters in 2016, subsequent contracts for 18 naval versions, and the rejection of US, Russian, European, and Swedish offers were seen as a combination of high technology and, more importantly, trust. Trump's coercive tariffs and warnings over de-dollarisation in BRICS have made India compliant. But the narrative worsens. A US submarine sinking an

Iranian naval ship, IRIS Dena, in the Indian Ocean after it returned from the Indian Fleet Review 2026 dented India's image as a net security provider.

“Strategic” is perhaps the most overused adjective in the diplomatic lexicon. It is attached to “restraint”, “patience”, “sovereignty”, and “national interest”. The word “partnership” is variable, dynamic, and transactional. But “strategic autonomy” — hedging or balancing relationships through sovereign choices — has endured. It originates from non-alignment adopted after independence, when New Delhi punched far above its weight. With adversarial relations with the US intensifying, India was gradually pulled towards the Soviet Union. Confronted with simultaneous threats from Pakistan, China, and the US in 1971, India was compelled to sign the first formal Treaty of Peace and Friendship with the USSR. Then Prime Minister Indira Gandhi insisted that the phrase “India is a non-aligned country” be inserted into the treaty, although it functioned de facto as an alliance.

India has evolved from non-alignment to multi-alignment, multi-engagement, and multipolarity, culminating in strategic autonomy, whose utility appears to be diminishing in a disrupted global order. Since no formal national security policy or strategy documents have been produced, strategic autonomy remains an immaculate conception, despite six drafts reportedly gathering dust. With India's oldest ally, Russia, the relationship is described as “Special, Privileged and Strategic”. The partnership with the US has evolved from an “Estranged Democracy” into a “Comprehensive, Global and Strategic” partnership. Relations with China have fluctuated between war and border skirmishes, signifying deep mistrust. The EU is a more recent entrant into the strategic club, though largely in trade and commerce. Relations with Vietnam were elevated to an “Enhanced Comprehensive Strategic Partnership” during the recent visit of President To Lam.

Lately, there has been intense debate regarding strategic autonomy and India's graded strategic relations with other nations, many of which have undergone qualitative upgrades. Strategic autonomy is a dynamic policy that requires periodic recalibration in line with contemporary geopolitics and geo-economics. The recent summit between Xi Jinping and Donald Trump in Beijing confirmed a shift in the US strategic approach towards China — from rivalry and competition towards “stable and respectful relations”. Diplomatic vocabulary acquired a new phrase from Xi: “constructive strategic stability”, replacing the Biden-era term “strategic competition”. Trump went further in a Fox News interview, describing the meeting as resembling a “G2”, recalling earlier remarks made by President Obama that had caused consternation. Trump displayed unusual restraint and respect towards Xi, praising his leadership extensively. The subsequent Xi-Putin summit was described as a meeting between “dear friends” in an “everlasting strategic partnership”. In both cases, Xi conceded little to either Trump or Putin. These developments call for a reassessment of India's strategic autonomy.

At the recent Chennai conference, the majority opinion supported the establishment's approach, calling it “pragmatic”. The opposing view argued that the government had deferred excessively to Trump, beginning with Modi's February 2025 visit. Regarding the two kinetic assaults on Iran, critics argued that India had effectively taken sides even before the conflict began. It appeared aligned with the US and Israel, particularly after Modi addressed the Knesset 48 hours before the Iranian Supreme Leader was assassinated in an Israeli precision strike. Apparently, both US and Indian intelligence agencies believed the conflict would end swiftly. Delhi remained silent, despite Modi's earlier repeated assertion that “this is not an era of war” and that only a political solution could resolve conflicts. India's attempt to balance strategic relations with the US, Russia, China,

Israel, the EU, and Vietnam has resulted in too many competing priorities, with its relationship with Israel increasingly becoming a liability among Global South nations.

Some of India's recent diplomatic difficulties might have been avoided with more skilful handling of Trump's claim that the US facilitated the ceasefire during Operation Sindoor, which was not entirely untrue. Acknowledging this would not necessarily have undermined strategic autonomy. India's insistence that there was no third-party mediation appears difficult to sustain, given that in nearly every crisis since 1971 the US has played a role. Pakistan, meanwhile, managed its diplomacy skilfully, transforming its image from a state sponsor of terrorism into that of a responsible mediator in conflict resolution.

Pakistan can now claim to have helped facilitate the impending ceasefire between the US and Iran, in which Israel is conspicuously absent. Its international profile has consequently risen, and rather than being re-hyphenated with India, it now occupies a different diplomatic category.

At another seminar, Ambassador Jawed Ashraf remarked emphatically: "Silence is not strategic autonomy", hinting at India's silence regarding what many consider illegitimate actions by the US and Israel against Iran and others. To become a Viksit Bharat, India must play a more proactive role and truly avoid bowing to anyone, as Modi frequently states. Its credibility among the Global South and within its neighbourhood is at stake. Strategic autonomy is indeed in need of a reset.

<https://dailypioneer.com/news/indias-strategic-autonomy-needs-a-reset>

*

Our defence future lies in Asia

-by Lt Gen Anil Ahuja (Retd)

Source: The Tribune (Page 06), Dt. 27 May 2026

For nearly three decades, India's defence partnerships have centred on four countries: Russia, Israel, the US and France. The cooperation extends well beyond military-to-military engagement. It encompasses technology, trade and industrial collaboration. Today, amidst major geopolitical disruptions, India's defence partners, except for France, are facing headwinds. This turbulence reinforces the need to diversify partnerships, as has been done for supply chains, energy and trade.

Against this backdrop, two of Asia's most capable industrialised democracies — the Republic of Korea (ROK) and Japan — present viable options for defence partnership, particularly because they share similar national security concerns. ROK's security calculus has shifted under Trump 2.0. The US Defence Strategy 2026 places primary responsibility for countering North Korea's conventional threat on Seoul itself. US forces stationed in Korea have been earmarked for a Taiwan contingency. Of concern to the ROK, both Patriot PAC-3 and THAAD anti-missile systems were redeployed from the Korean Peninsula to West Asia-at the outbreak of the Iran conflict — a signal of Seoul's relegation in Washington's strategic priorities. Confidence in the US nuclear umbrella is also eroding.

Meeting these challenges, the ROK is also likely to be in search of additional defence partners. From an Indian perspective, the ROK possesses strong defence industrial capabilities. It is the world's ninth-largest arms exporter. It produces the K9 self-propelled Howitzer, the K2 Black Panther main battle tank, the KF-21 advanced multirole fighter, the FA-50 light combat aircraft and

the KSS-III ballistic missile-capable submarines. The ROK, like India, remains dependent on the GE-414 engines for its fighter programme. To mitigate this limitation, it is pursuing indigenous aeroengine development — a shared aspiration with India.

The April visit of ROK President Lee Jae Myung to India and the multi-domain Special Strategic Partnership envisioned for 2026-2030, including the launch of the Korea-India Defence Accelerator (KIND-X) innovation platform, provides the institutional underpinning for deeper cooperation.

Another potential Asian defence partner, Japan, recently amended its 'Three Principles on Transfer of Defence Equipment and Technology' in April, removing the restriction that limited overseas transfers to only five categories. India is among the 17 countries for which the scope of defence exports, including lethal systems, has been significantly expanded. This is a deliberate effort by Tokyo to revitalise its defence industry and strengthen its own national security posture.

There are, however, structural challenges in furthering this relationship: a nascent defence export culture, complex defence acquisition procedures and lingering constitutional and public sensitivities in Japan. It would be pragmatic to commence with bilateral technology cooperation, which could evolve into defence-industrial cooperation, trade and operational coordination.

There exists a compelling strategic logic to develop a trilateral defence partnership between India, the ROK and Japan. All three face pressure from an assertive China, uncertainty about US security commitments, and the imperative to build indigenous defence capabilities.

A workable template also exists in various India-US defence technology cooperation initiatives. A way ahead could be to start Track 2 and Track 1.5 dialogues structured around think tanks to arrive at some pathfinder programmes.

*

Science & Technology News

“CLEAR” technology can revolutionize protein imaging & facilitate detection of Cancer and Neurobiological Diseases

Source: Press Information Bureau, Dt. 26 May 2026

A novel imaging platform called Cleavable Light-Erased Antibody Reporter (CLEAR) could help researchers visualize an unprecedented number of proteins within the same biological sample using just a single fluorescent marker. This could unveil new possibilities for high-resolution, multiplexed imaging across cells and tissues, with important implications for disease diagnosis and biological research.

Proteins are the primary orchestrators of biological function and remain the principal targets for therapeutic intervention, as well as key markers for disease diagnosis. A comprehensive proteomic map of a tissue sample—capturing the identity and precise spatial organisation of every protein within its native context could help pathologists in diagnosing cancers or understanding complex neurological disorders. However, mapping a large number of proteins within their native spatial context has remained a major challenge.

In order to overcome this challenge, researchers at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, an autonomous institute of the Department of Science and Technology (DST) developed the imaging platform CLEAR that can enable scientists to visualize a large number of proteins within the same biological sample using a single fluorophore.

It could make comprehensive protein mapping possible at high resolution with the potential of transforming diagnosis in areas such as cancer biology, immunology, and neurological disorders, where understanding spatial protein organization is critical.

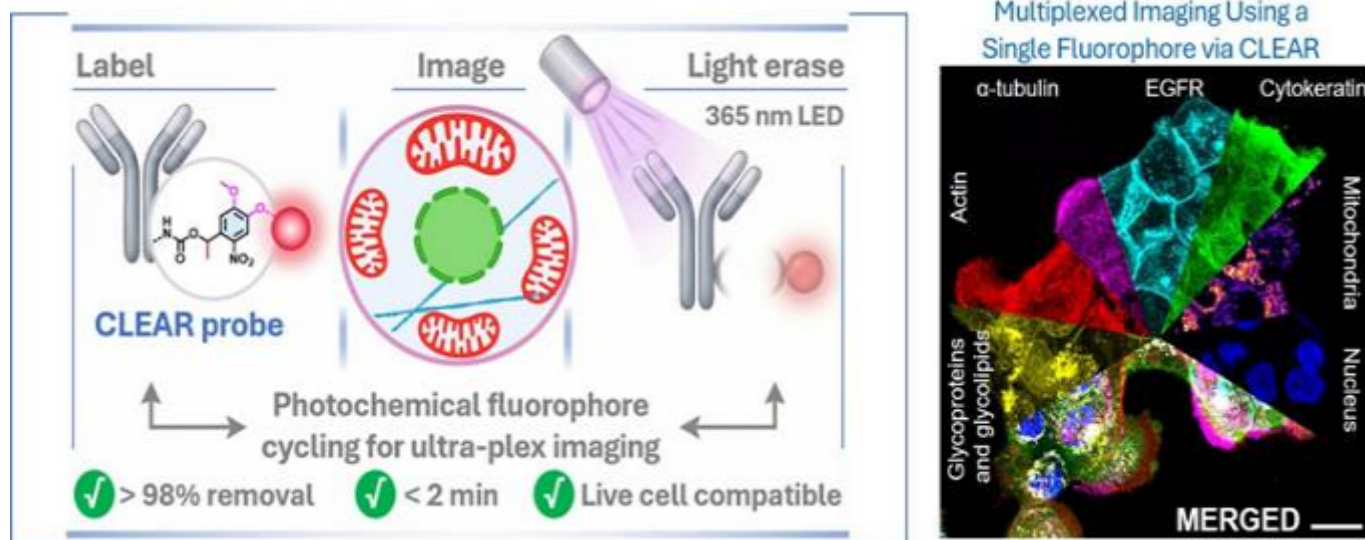


Fig: Illustration of the CLEAR imaging workflow and resulting high-plex images generated using a single fluorophore

The team led by Prof. Sarit S. Agasti designed and synthesized the CLEAR probes, developed the imaging workflow, and validated the platform across different biological systems. Experimental design, probe chemistry, and imaging analysis were carried out within the group. Collaborative efforts with researchers at the Indian Institute of Science (IISc) helped demonstration of the platform in complex biological settings, particularly in immune cell systems.

They introduced a light-cleavable probe system that enables repeated cycles of labelling and imaging within the same spectral window. Unlike existing multiplexing techniques, CLEAR combines high multiplexing capability with speed, high spatial resolution, and compatibility with delicate biological samples, including live cells. This approach fundamentally redefines multiplexed imaging by enabling virtually unlimited protein visualization without requiring multiple fluorophores.

The newly developed method published in the journal *Chemical Science* (Royal Society of Chemistry), works like a chalkboard – the things written can be erased to make room for new writing. The method, enables scientists to label proteins of interest within cells using cleavable fluorescent tags. After acquiring the images of a set of proteins under a microscope, a gentle pulse of 365 nm LED light is applied to erase the fluorescent signal, allowing a new set of proteins to be labelled in the same cell and to be imaged in the same optical window. By iteratively repeating this cycle, increasingly detailed and information-rich maps of multiple proteins can be generated across specimens, ranging from single cells to complex tissue sections.

CLEAR has the potential to transform biomedical research and clinical diagnostics by enabling detailed mapping of proteins in cells and tissues. This can improve early disease detection, especially in cancer and neurological disorders, and aid in understanding immune responses. In the long term, the technology could contribute to precision medicine by providing comprehensive

molecular insights that guide targeted therapies. The technology aligns with global efforts toward spatial proteomics and precision medicine.

Publication Link: [10.1039/D5SC08599C](https://www.pib.gov.in/PressReleasePage.aspx?PRID=2265421®=3&lang=1)

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2265421®=3&lang=1>

*

India acquires capacity to operate a commercial-scale fast breeder nuclear reactor

-by Anil Bhat, VSM (Retd)

Source: The Pioneer, Dt. 27 May 2026

On April 6, 2026, India's 500 MWe (Megawatt electric) Prototype Fast Breeder Reactor (PFBR) at Kalpakkam, Tamil Nadu, reached "first criticality" — the initiation of a self-sustaining, controlled nuclear chain reaction. This monumental achievement pushes India into the second stage of its pioneering three-stage nuclear energy programme and positions the country as a global leader in advanced breeder reactor technology. Completed and commissioned in March 2024, the reactor successfully achieved first criticality just thirteen months later — the initiation of a sustained, self-sustaining nuclear chain reaction.

Designed by the Indira Gandhi Centre for Atomic Research and built by BHAVINI, a Government of India enterprise established to construct and operate the country's advanced nuclear power reactors, the PFBR is central to Stage Two of India's Three-Stage Nuclear Power Programme. It is designed to use mixed oxide (MOX) fuel - plutonium and uranium — and produces more fissile material than it consumes, paving the way for the utilisation of India's vast thorium reserves.

India holds only about 1-2 per cent of global uranium reserves but possesses one of the world's largest thorium reserves, estimated at 25-30 per cent of the global total. Thorium cannot be used directly as a nuclear fuel; it must first be irradiated in a reactor to convert it into the fissile isotope Uranium-233. To harness these reserves, the Department of Atomic Energy established an innovative closed-loop Three-Stage Nuclear Power Programme aimed at achieving long-term energy independence:

Stage 1: Pressurised Heavy Water Reactors

Natural uranium is used as fuel to generate power. The spent fuel produces plutonium, which acts as the primary input for the next stage.

Stage 2: Fast Breeder Reactors

The plutonium from Stage 1 is used to fuel reactors that generate more fissile material than they consume. These reactors are also used to irradiate thorium and convert it into Uranium-233.

Stage 3: Thorium-Based Reactors

These reactors will use the Uranium-233 bred in Stage 2 to power the nation using the country's abundant coastal thorium reserves.

The PFBR at Kalpakkam, Tamil Nadu, marks a major milestone towards transitioning into the second and ultimately the third stages of this roadmap. India's Department of Atomic Energy

designed a unique phased roadmap to bypass its limited domestic uranium reserves and unlock its massive coastal monazite sand deposits, found extensively in Kerala, Tamil Nadu, and Odisha.

Unlike conventional reactors that consume more fuel than they produce, the 500 MWe PFBR is a “breeder” reactor. Using a uranium-plutonium mixed oxide (MOX) fuel core, it is designed to transmute surrounding non-fissile uranium into more plutonium than it burns.

This entirely indigenous innovation has been achieved after overcoming decades of complex engineering challenges and geopolitical technology denial regimes. The plant was completely designed by the Indira Gandhi Centre for Atomic Research and built by BHAVINI, validating India’s culture of scientific self-reliance. India’s ambition to sustain its power grid for up to 60,000 years relies on its vast world-leading thorium reserves, estimated to exceed 500,000 tonnes. Thorium-based nuclear reactors use a closed fuel-cycle process that transforms this abundant element into fissile Uranium-233, creating a practically limitless energy source capable of achieving genuine national energy independence.

Power generated at the Kalpakkam nuclear complex is delivered across India through the National Grid. The delivery process operates as follows:

(a) Generation and Step-Up: The Madras Atomic Power Station (MAPS) and the PFBR generate electricity at medium voltages, around 15-33 kV. Generator Step-Up (GSU) transformers immediately boost this to extra-high voltages, such as 400 kV or 220 kV, to minimise energy loss over long distances.

(b) Grid Interconnection: The stepped-up power is fed into the Southern Regional Grid. It is integrated through switchyards at Kalpakkam into high-voltage direct current (HVDC) and high-voltage alternating current (HVAC) transmission lines.

(c) National Transmission: Using inter-state “power highways”, electricity is transmitted across the country. The Power Grid Corporation of India monitors and balances this supply dynamically. If regional power pools experience deficits, grid operators can reroute Kalpakkam’s electricity to different states through the interconnected National Grid.

(d) Distribution to Consumers: When the electricity reaches its destination state, it passes through regional substations where the voltage is progressively stepped down through successive transformers, ultimately reducing it to low-voltage lines (415V/230V) to safely power homes and businesses across the nation.

By design and according to the laws of nuclear physics, the PFBR at Kalpakkam produces high-grade Plutonium-239, the primary fissile material used in nuclear weapons. A fast breeder reactor (FBR) uses a core of mixed uranium-plutonium fuel surrounded by a “blanket” of depleted Uranium-238. Fast neutrons generated in the core bombard this blanket, transmuting the uranium into Plutonium-239. While reactors inherently produce different grades of plutonium, the FBR’s operating cycle can be manipulated to yield highly pure, weapons-grade Plutonium-239 by removing the fuel and blanket rods before they become “overexposed”, which would otherwise create less desirable plutonium isotopes. India’s three-stage nuclear programme is designed ultimately to harness the country’s vast thorium reserves.

Because India maintains a civil-military separation in its nuclear programme — and is not a signatory to the Treaty on the Non-Proliferation of Nuclear Weapons 1 the PFBR operates outside the safeguards of the International Atomic Energy Agency. While the PFBR’s stated primary objective is to produce clean baseload electricity and establish a closed fuel cycle for thorium

utilisation, the facility also provides an industrial-scale capability that yields the precise materials required for nuclear weapons. While this is a historic milestone for long-term energy security, it will have no immediate effect on mitigating the current global energy crisis, as the reactor will require months of safety testing, grid integration, and commissioning before reaching full commercial power capacity.

The immediate impact is primarily symbolic and strategic: it makes India only the second country in the world, after Russia, to operate a commercial-scale fast breeder reactor, thereby demonstrating the country's technological capability to manage complex closed-loop nuclear fuel cycles.

<https://dailypioneer.com/news/india-acquires-capacity-to-operate-a-commercial-scale-fast-breeder-nuclear-reactor>

*

The Tribune
The Statesman
ਪੰਜਾਬ ਕੇਸਰੀ ਜਨਸਤਾ
The Hindu
The Economic Times
Press Information Bureau
The Indian Express
The Times of India
Hindustan Times
नवभारत टाइम्स
दैनिक जागरण
The Asian Age
The Pioneer