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Nuclear Wrap-Up 2025

An Indian Perspective

From 89 seconds to midnight, To...?

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Left image: The Doomsday Clock, Bulletin of the Atomic Scientists

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Drifting Deeper into the Nuclear Marshlands in 2025

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Whew! Eight decades without another physical use of nuclear weapons are now behind us. But in 2025, the ominous nuclear shadow was felt most palpably. As several inter-state conflicts waged across the globe, three of these involved one or more nuclear-armed states. In these, the threat of nuclear use was unabashedly used to shape the conflict and its outcome.

While the year has turned, many settled nuclear issues stand upended. Both nuclear and non-nuclear states are re-examining their approach to these weapons of mass destruction. An uncertain nuclear order lies ahead as countries rethink the requirements of nuclear deterrence, adopt new technologies, consider the possibilities of nuclear proliferation, and continue not to talk to one another. 2025 has brought light to many factors likely to exacerbate nuclear risks. The following sections briefly identify nuclear issues that particularly stood out in 2025.

The Nuclear Great Game among Major Powers

Amongst the first executive orders that Donald Trump signed after assuming the presidency was to instruct his Secretary of Defence (later rechristened Secretary of War) to present him with “a reference architecture, capabilities-based requirements, and an implementation plan for the next-generation missile defense shield”[1] within the next 50 days. Based on the plan presented to him, on May 20, 2025, President Trump announced a missile defence system, the Golden Dome, to provide 100 per cent protection to the USA from ballistic, cruise

and hypersonic missiles, including those launched from space.[2] Envisaged as a layered defence architecture at a projected cost of USD175 billion, it is expected to become fully operational before the end of the term of this administration.

Several American voices have expressed disbelief at such a possibility, the very practicability of the promise of absolute security, and questioned the need for such defence spending. Expectedly, Russia and China too have criticised it as a destabilising pursuit of strategic advantage that would undercut their nuclear deterrence. They are also sceptical about the system's feasibility. Nevertheless, both are developing countermeasures ranging from numerical buildup to unconventional delivery systems to defeat the United States Ballistic Missile Defense (US BMD), which has been in the making over the last couple of decades. The novel element that the Golden Dome has introduced is the placement of weapons and interceptors in outer space.

Russia has demonstrated some new delivery platforms, which President Putin had already described in 2017 as "invincible." Two of these were tested in October 2025. The first was the 9M730 Burevestnik,[3] a nuclear-powered, nuclear-tipped cruise missile with theoretically unlimited range and capable of flying under the radar around the globe. The second was the Poseidon,[4] a robotic, nuclear-propelled torpedo, which analysts believe has a range of 10,000 km and can travel at about 185 km per hour. It is claimed to be able to carry a multi-megaton warhead into coastal areas that could be detonated offshore to swamp cities with a radioactive tsunami. While neither of these systems is operational yet, they are being projected as "doomsday" devices, which could not only be hard to defend against but also have a massive psychological impact.

China, too, has been engaged in an unprecedented expansion of its nuclear arsenal. The warhead numbers are reported to have jumped by a hundred from 2024 to 2025, standing now at 600. China displayed a number of new delivery platforms in its September military parade to mark the 80th anniversary of the end of the Second World War.[5] Amongst the new nuclear systems were the DF-61 intercontinental ballistic missile, a road mobile, MIRVed missile with a range of 18,000 km; the DF-31BJ ICBM, an improved variant of the DF-31 ICBM; the

10,000 km range, MIRVed JL3 submarine launched ballistic missile aboard the Type 094 (Jin)-class SSBNs; the HQ-29 BMD and anti-satellite systems that has the capability of midcourse interception of long range ballistic missiles.

Meanwhile, the US too remained engaged in the modernisation of its nuclear delivery platforms across the triad. The US Air Force Global Strike Command carried out a Minuteman III launch[6] in early November 2025, to validate its combat performance. This 9,650 km range missile is part of the US strategic nuclear force and is eventually to be replaced by the LGM-35A Sentinel. But the development of the latter has been embroiled in controversy, owing to exceptionally high costs and the need to rebuild new silos to host the missiles. As regards its nuclear warhead numbers, too, Washington has voiced the need for an increase to cater for multiple nuclear adversaries and their expanded and improved arsenals. Not surprisingly, even at the end of the year, President Trump had not responded to President Putin's call for retaining the limits set by the New Start treaty, even if the instrument expires in February 2026.

Another ruffling of nuclear feathers was caused in October 2025 when President Trump announced the possibility of the resumption of nuclear testing by his country. The US had stopped underground explosive testing in 1992 after having conducted 1030 nuclear tests. But Trump expressed a desire to restart these because he believed that Russia, China, DPRK (North Korea), and Pakistan were conducting nuclear tests. As he said, "I don't want to be the only country that doesn't test."[7] Was President Trump confusing the test of nuclear-capable delivery vehicles with nuclear testing? His instructions for testing were given to the Department of War, not the Department of Energy, though his Energy Secretary, the person in charge of nuclear testing, responded that the reference was to non-critical explosions.[8] Not many in the US strategic community believe that the US has any technical, military or political reasons to resume testing. Rather, doing so is likely to create security dilemmas by triggering similar actions by others. Russia has already indicated as much. While China has not said so, it does maintain a level of readiness at Lop Nor.[9] So, if the US were to break the norm on nuclear testing, the two are likely to follow suit. 2025 has ended with a shadow of ambiguity on the issue of nuclear testing, a subject that was a non-

issue for decades.

Three Conflicts Under the Nuclear Shadow

The Russia–Ukraine war continued through 2025 despite the well-intentioned, though not well-thought-through attempts by President Trump. Both Ukraine and Russia continued to employ new tactics and test new thresholds, keeping alive the threat of nuclear escalation and concern over the state of the nuclear power plants in the conflict zone. Russia continued to use nuclear rhetoric and brinkmanship. Meanwhile, its drone incursions into some European countries also heightened a sense of insecurity and accelerated the search for effective responses. A renewed debate rages in European capitals about the need for a non-US Euro-deterrent. Could this be protection through the French nuclear arsenal, a combined UK-France nuclear deterrent, or a state of nuclear latency of Germany and Poland? Facing the double whammy of the Russian threat alongside a fear of US abandonment, 2025 has heightened Europe's security dilemmas and opened up the debates on proliferation. Nuclear non-proliferation no longer appears as settled a norm as it was just some years ago.

In West Asia, the Israeli–Hamas conflict took a new turn as Israel destroyed the Iranian nuclear facilities long alleged of supporting the country's nuclear weapons ambitions. Earlier in the year, in March 2025, President Trump had sent a letter to the Supreme Leader of Iran expressing interest in concluding a nuclear deal. While negotiations were held, the sticking point remained Iran's insistence on the right to uranium enrichment, a condition unacceptable to the US. Israel and the US launched aerial attacks on Iranian nuclear plants in June 2025. While accurate estimates of the long-term damage this would cause to the facilities remain unknown, including the fate of the more than 400kg of stockpile of enriched uranium, the military strikes created a new precedent where two nuclear-armed states, one a member of the Nuclear Proliferation Treaty (NPT) and the other not, jointly attacked the nuclear facilities of an NPT Non-Nuclear Weapon State (NNWS). Iran responded by threatening to withdraw from the NPT and suspending International Atomic Energy Agency (IAEA) inspections over its nuclear programme. While the inspections have since been allowed on sites

other than those that were bombed, there is no clarity on what happened to the enriched uranium. At the end of 2025, it remains unclear whether the attacks would mark the end of the Iranian nuclear weapons programme or the beginning of a resolve to go nuclear.

In South Asia, May 2025 witnessed a 4-day conflict between India and Pakistan triggered by an incident of cross-border terrorism. This is an instrument that Pakistan has regularly used against India since it acquired nuclear weapons and the confidence that these would protect it from a military response. However, in 2025, the killing of Hindu tourists in Pahalgam elicited a military response from India against Pakistan's terrorist infrastructure as India signalled its refusal to be subjected to Pakistan's nuclear blackmail. The response was also enabled by the acquisition of military capabilities, which allowed for precise and calibrated strikes and minimised the possibilities of escalation. Pakistan responded with attacks against Indian military and civilian targets, which then led to India's use of cruise missiles against Pakistani military targets. While the operations wound down to a ceasefire in 88 hours, they did involve the use of drones and missiles for the first time. China's operational help to the Pakistani military and widespread use of disinformation through the media were also new factors. With none of the underlying political issues having been resolved and given the continuing absence of bilateral dialogue, the region lives with the possibility of yet another crisis between nations that are building more and improved nuclear arsenals. While they share a hostility, they do not seem to share an equal sense of nuclear risks.

Nuclear North Korea – Emboldened and Unchecked

In North Korea, the nuclear build continued in 2025, including the testing of new delivery capabilities aimed at refining its nuclear triad. North Korea claimed the test of a new ICBM with a hypersonic warhead in early 2025 and also announced a nuclear-powered submarine. Besides testing a volley of missiles in response to the US-ROK (South Korea) joint drills in mid-2025, Pyongyang also tested for the fourth time its "strategic" sea-to-surface cruise missiles from one of its new warships on October 28, 2025. Later, on November 7, it launched another ballistic

missile of approximately 800 km range. Russia-DPRK cooperation has grown since Pyongyang provided soldiers for the Russian war against Ukraine, and Russia has possibly been reciprocating with a helping hand in strategic areas of nuclear, missile and space. Additionally, the coming together of DPRK, Pakistan, China and Russia at China's Victory Day parade showed the development of a new nexus that has the potential for nuclear and missile proliferation.

Non-proliferation on Rickety Legs

Meanwhile, non-proliferation has been known to be on shaky ground for several years now. While this was earlier attributed to fissures amongst states on issues of treaty compliance, asymmetry of responsibilities on non-proliferation and lack of progress on disarmament, additional stresses are expected from the possibility of new breakout states. As explained earlier, Russia's actions have exacerbated demands for strengthened extended deterrence in Europe, while President Trump's behaviour has raised doubts about the credibility of US nuclear deterrence. Europe, therefore, is beginning to rethink its nuclear deterrent requirements.

But these thoughts are not confined to Europe alone. Other countries in North East Asia, which are under the nuclear umbrella, are also facing the heat from an assertive and more capable nuclear China, a more advanced nuclear arsenal of North Korea, and a fear of abandonment by the US. It is not surprising that South Korea and Japan are not only seeking greater engagement in nuclear decision-making architectures with the US, but also building conventional long-range strike missiles and submarine capabilities. Debates for acquiring one's own nuclear weapons are also on the rise.

The third and final session of the NPT Preparatory Committee (PrepCom) ended in deadlock in May 2025. States failed to agree on recommendations for the 2026 Review Conference, or even adopt a summary report. As divisions between nuclear and non-nuclear states and amongst the two sets of states deepen amid rising geopolitical tensions, the sustainability of the treaty remains questionable.

Nuclear Brinkmanship through Word and Action

Nuclear brinkmanship is a form of deterrence signalling that relies on fear-mongering. Traditionally, such threat-making has been decried as irresponsible and ascribed mostly to 'rogue' states. But in 2025, this became mainstream behaviour as Russia, the USA, North Korea, Pakistan, and Israel liberally indulged in such behaviour. Leaders did not shy away from drawing attention to their nuclear capability, such as by testing nuclear-capable missiles, threatening 'unpredictable consequences', or by holding exercises involving nuclear platforms. Early August 2025, Trump resorted to brinkmanship by announcing that two US Navy nuclear submarines are 'getting closer to Russia' after an online spat with former Russian president Dmitry Medvedev, now deputy chairman of Russia's National Security Council.[10] In response, Russia and China showcased their strengthening military ties as they took part in staged joint mock combat drills and other war games in the Sea of Japan. Brinkmanship behaviour was evident in South Asia too in the context of the May conflict, as Pakistan tried to amplify the risk of nuclear escalation to deter a conventional war with India. Subsequent to the ceasefire, too, Field Marshal Asim Munir has continued to make threatening statements, including from third countries.

A lack of international outrage against brinkmanship behaviour can only embolden states to test new brinks. Unless loud and united public criticism is voiced to prevent the normalisation of such behaviours and actions, a misstep could have global repercussions. 2025, however, ended with a creeping acceptance, even normalisation of nuclear brinkmanship.

Sullen Nuclear Armed States

2025 was also marked by a lack of availability of channels for nuclear adversaries to talk to one another. Rather, like sullen children, nations chose not to provide/seize opportunities of engagement, whether in moments of crisis or even relative peace. Nations, in fact, seem to hold differing views about the value of crisis communication, with some, like China, believing that having channels of communication during a crisis provides the other side with the leverage to

create a crisis. Therefore, it prefers prioritising crisis prevention rather than communication. Where such channels, in the form of military hotlines, do exist as in the case of India and Pakistan, these were not used optimally during the conflict in May. Overall, the understanding of the significance of communication channels for crisis prevention and de-escalation remained abysmally low in 2025, creating grounds for more misperception and hardened behaviour.

Unseeing and Uncaring Leaders

To a large extent, the current flux on nuclear issues is a reflection of the turbulent international geopolitical order. At this moment, none of the major powers wants to take ownership of the situation because each appears to be unhappy with the present state of affairs for its own reasons and desirous of a revision in a manner singularly focused on making itself great again. A sweeping wave of nationalism across the globe has consequently de-prioritised peace and stability, including in the nuclear domain. Additionally, as the power differential amongst nation-states has reduced significantly, the ability of one or two states to 'drive' the others has also flattened out. 2026 sets in, therefore, at a juncture where the number of nuclear-armed states is many but the capability and the will to take ownership of nuclear problems is at an all-time low.

Conclusion

2025 saw heightened geopolitical rivalries where nations mindlessly pushed the envelope on language, behaviour and actions on the nuclear front. Guardrails of bilateral and multilateral agreements that had been crumbling for years all but disappeared, and no efforts were made to revive them or build anything new. Inter-state relations moved towards a greater propensity for the use of force and emphasis on the buildup of hard power. Nuclear-armed nations faced even higher trust deficits and perception gaps, openly voicing worst-case assumptions of each other's capabilities but refusing to initiate strategic dialogues through which they could offer or seek clarifications. It is somewhat like the Cold War, only worse, since the nuclear world today is multipolar, comprising multiple, complex bilateral nuclear dyads, which in some cases, elongate into strategic chains.

The most dangerous of the developments is that the leaders are refusing to acknowledge the dangers, and the populace is apathetic. The world seems to be slowly moving deeper into the nuclear marshlands. To visualise the current state of affairs, the world is not as it was felt at the time of the Cuban missile crisis or the long Cold War at the edge of a nuclear precipice, from where there could be a sudden, sharp fall into an abyss. But it is as if the edge has flattened into swampy marshes. The world is slowly sleepwalking, one step at a time, into deeper and deeper weeds that might entangle it beyond retrieval.

The hope, however, is that the marshlands run for several miles before they become thick, deep and engulfing. We may be at the edges right now. It is up to each one of the nations and their people, to find ways to retrace our steps back into nuclear sobriety and safety in 2026.

Notes:

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[9] A part of this is condensed from Manpreet Sethi, "Testing Times: Likely Responses and Implications," *Strategic Space*, No. 589, Institute for Peace and Conflict Studies, no. 18, 2025.

[10] Cahal Milmo, "Nuclear bluff or step towards war? How Trump's submarine threat could play out," *MSN*, August 03, 2025, https://www.msn.com/en-za/news/other/nuclear-bluff-or-step-towards-war-how-trump-s-submarine-threat-could-play-out/ar-AA1JPuXj. Accessed on December 24, 2025.

A Look at Missiles, Space, AI, and Cyber Dominance in 2025

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Global security remained in a deep dive throughout 2025. Major wars, which had been in steep decline since 2010, resurfaced as a significant part of international politics in the 2020s. Emerging uncertainties have continued since the election of Donald J. Trump as the president of the United States, and major armed conflicts and wars were witnessed in parts of Africa, Europe, West Asia, and Southern Asia in 2025.

Around this arena of war and conflict, all nuclear-armed states moved ahead with their planned nuclear modernisation. The year 2025 saw greater momentum towards the addition of newer nuclear warheads in some nuclear-armed states, a revisit to proliferation debates in Europe, West Asia, and East Asia, and integration of emerging and disruptive technologies in the nuclear enterprise. The Stockholm International Peace Research Institute (SIPRI) Yearbook 2025 captured this trend by stating “that a new qualitative nuclear arms race is gearing up and, compared with the last one, the risks are likely to be more diverse and more serious.”

This article examines the trends in Missile, Space, Artificial Intelligence (AI), and Cyber domains across the nine nuclear-armed states in 2025.

Missiles: Meeting Precision with Lethality

The year 2025 started with a surprise from the administration of outgoing US President Joe Biden, which introduced new guidance on missile technology

exports. The guidance was directed through National Security Memorandum and "direct[ed] the interagency to provide increased flexibility for case-by-case review and facilitate support for certain MTCR Category I military missiles, Unmanned Aerial Systems (UAS), and Space Launch Vehicle (SLV) systems to certain partners with strong export control systems."[1] At the same time, the US also accused Pakistan of developing long-range ballistic missiles and announced new sanctions on four Pakistani entities involved in the development of these systems. This was the first instance where the US sanctioned a Pakistani state-owned entity involved in missile development. The sanctions also involved listing commercial entities in Belarus and China, which were found to have supplied missile-applicable items to Pakistan's ballistic missile programme, which included its long-range missile programme. Besides banning entities in Pakistan, the US also acted against six entities and six individuals based in Iran and China, building a procurement network meant to transfer ballistic missile propellant ingredients to the Islamic Revolutionary Guard Corps (IRGC).[2]

Meanwhile, in Southern Asia, after the May 2025 India-Pakistan conflict, Pakistan decided to create a new force, the Army Rocket Force, to be overseen by the Army. While no official explanation on the new Army Rocket Force has emerged, some writing[3] suggested that it is being formed to deliver conventional warheads against India, which also effectively calls the bluff of Pakistan's tactical nuclear weapons.

In terms of the hypersonic programme, 2025 saw the USA, Russia, and North Korea all make progress in testing or deploying hypersonic systems. Early in the year, the US Army's Rapid Capabilities and Critical Technologies Office, in collaboration with the US Navy Strategic Systems Programmes, completed an end-to-end flight test of a conventional hypersonic missile.[4] Russia, on the other hand, also expanded its hypersonic capabilities in 2025 with the deployment of its Avangard hypersonic missile.[5] Unlike the US, Russia's hypersonic system, such as the Avangard, is a dual-capable platform intended to fulfil strategic missions. North Korea also made progress in testing hypersonic systems. However, North Korea's claims about the successful test of the hypersonic system are more consistent with ballistic missiles or reentry vehicles than with a proper hypersonic

system, such as an Hypersonic Glide Vehicle (HGV) or an Hypersonic Cruise Missile (HCM), as there is no conclusive evidence that North Korea has successfully achieved the technological requirements. China also showcased its inventory of hypersonic systems in a highly publicised military parade. China showcased several hypersonic systems such as YJ-15, 17, 19, and 20. The standout feature of the YJ series of missiles is that it helps build China's A2/AD posture more effectively in the Indo-Pacific.

There also was greater momentum towards testing of new ballistic missiles along with associated systems. The USA continues to face some issues regarding the cost of building of the new nuclear missile, the LGM-35A Sentinel, including that of new silos for the Sentinel. The US has stated that the existing inventory of the Minuteman III Intercontinental Ballistic Missiles (ICBMs) can be utilised well until 2050, though it had earlier planned to retire them by 2036.

Keeping in mind its ongoing military modernisation along with the war with Ukraine, Russia, in 2025, tested various ICBMs with limited success.[6] While Russia practised manoeuvres with its Yars ICBM, its nuclear modernisation faced a setback with the test failure of its Sarmat ICBM.[7] China, on the other hand, showcased its new ballistic missiles intended for nuclear missions. On the 2025 Victory Day parade, China demonstrated its new ICBM, the DF-61. China also presented its sea-based nuclear missile, the JL-2 and its air-delivered nuclear missile, JL-1.

North Korea maintained its streak of testing new systems with a new intermediate-range ballistic missile (IRBM) tipped with a hypersonic warhead. A report published by the Centre for Strategic and International Studies (CSIS) revealed that North Korea had built a secret military base near its border with China, and it may house its newest long-range ballistic missiles.[8] The facility in North Pyongan province likely houses six to nine nuclear-capable ICBMs and their launchers, the report mentioned. In 2025, North Korea developed new capabilities for its new ballistic missiles, and made sure to work on multiple warhead capabilities, such as in the MIRVs domain. To do so, in 2025, North Korea not only launched its most powerful ICBM, the Hwasong-19, but also plans

to build a new engine with more thrust for its next in line ICBM, the Hwasong-20, which was unveiled during a military parade.

Meanwhile, in Southern Asia, Pakistan tested two surface-to-surface missiles in May 2025. The Inter Services Public Relations (ISPR) stated that the missiles were of the Fatah series with a range of 120 km. On the other hand, India in 2025 also successfully launched the intermediate-range Agni-P missile from a rail-based mobile launcher system.[9] The rail-based system essentially provides India with a mobile system which can be dispersed during a heightened crisis and a secure second-strike capability.

Space: No Longer a Forbidden Frontier

Following the trend from previous years, the domain of space continued to become significantly more important for major nuclear-armed states. President Donald Trump created a strategic buzz in terms of the ambitious Missile Defence Shield plan, aka the Golden Dome. Though right after the Executive Order 14186 was signed by Trump, experts and industry officials called it unrealistic.[10] However, private industries such as SpaceX and Palantir did support the idea. In order to further generate voice in favour of the Golden Dome, the US Defence Intelligence Agency in 2025 released an unclassified report depicting current and future missile threats to the US homeland. The report highlighted the danger posed by the adversaries' ICBMs, SLBMs, hypersonic systems, LACMs and fractional orbital bombardment systems (FOBS).[11] The Trump administration carved out USD 25 billion for the Dome in the 2026 defence budget, and the Congressional Budget Office estimated that the US could have to spend more than USD 500 billion over 20 years to develop the missile shield.[12]

Another important concern which was raised about the Golden Dome was its potential to launch a new era of arms race in space. Jessica West, while explaining the core elements of the Golden Dome, such as Advanced Space Sensors, Space-Based Interceptors and Multiple Intercept Opportunities, stated the study conducted by the American Physical Society, which estimated that defending against a single solid-fuel missile from North Korea could require up

to 1,600 space-based interceptors and as many as 36,000 if faster response times are needed. This estimation becomes far bigger when adversaries such as Russia and China are concerned due to their far more sophisticated weaponry.[13] The hype created by the Golden Dome project became a little clearer when in the mid-2025, the US made a presentation under the name 'Go Fast, Think Big' to 3,000 defence contractors and mentioned that the Golden Dome missile defence system will include four layers — one satellite-based and three on land — with 11 short-range batteries located across the continental U.S., Alaska, and Hawaii.[14] The Golden Dome project further got a boost in 2025 when Lockheed Martin announced that it aims to conduct an on-orbit demonstration of at least one space-based anti-missile interceptor design no later than 2028.[15] As the end of the year approached, the US Missile Defence Agency (MDA) announced that it had tapped hundreds of companies to supply tech for the Golden Dome initiative.

Among the main adversaries of the US, the Russian Federation was the first one to openly oppose the idea of a defence shield. The Chinese and North Korean side also put forward their apprehension about the Golden Dome in 2025. Undermining nuclear deterrence remained central to the opposition as proposed by all three countries in 2025. However, Russia not only condemned the development of the project but also showcased some of its own defensive measures against such a project. Russia was accused by the UK of stalking British military satellites and trying to jam the UK's military satellites with ground-based systems.

Russia became the first country to test a long-range, nuclear-powered cruise missile known as Burevestnik. Powered by a small nuclear reactor, the Burevestnik is able to stay aloft 'indefinitely,' enabling long airborne flights that avoid radar detection. Three days after the test of Burevestnik, Russia demonstrated another, seemingly even more hair-raising nuclear weapon system — the Poseidon, an autonomous, long-range nuclear torpedo, again designed to avoid U.S. defences and hold homeland targets at risk.[16] While China is taking stock of the US space-based capabilities, it has also expanded its space capabilities beyond building traditional satellite constellations. By the end of 2025, Chinese scientists had managed to develop an advanced satellite power system capable of supporting

high-energy particle beams and other directed-energy weapons.[17] Implications of these for space weaponisation will become clearer in the coming times.

Humans, Machines and Algorithms: AI and Cyber Technologies in 2025

The year 2025 saw a mix of AI and cyber technologies being pursued for military strategies. Since the 2024 Joe Biden and Xi Jinping agreement that artificial intelligence must never supplant human judgment in the authorisation or execution of nuclear weapon launches, this issue has been seen to be settled. However, countries progressed in integrating AI in decision-making and further compounding the dangers. Not only countries but private firms such as Alphabet, which owns Google, dropped their promise not to use AI for purposes such as developing weapons and surveillance tools. Google's AI head, Demis Hassabis, in 2025 stated that the guidelines were being overhauled in a changing world and that AI should protect "national security."[18] However, in another development, through a public-private partnership, the US and Anthropic, a private firm, managed to develop a classifier- an AI system that automatically categorises content that distinguishes between concerning and benign nuclear-related conversation with 96 per cent accuracy, as shown in the preliminary testing.

The danger of integrating AI in the nuclear enterprise saw a greater discussion in the United Nations in 2025. In the UN, several states suggested that the Conference on Disarmament should discuss AI, in particular in relation to nuclear weapons.[19] Not only the UN but initiatives such as the Responsible AI in the Military Domain (REAIM) Global Commission, a public-private initiative led by the Netherlands and South Korea, also made the recommendation in its first guidance report on AI governance in the military domain. The commission noted that "Critical decisions about the use of nuclear weapons must unequivocally remain under human authority as they require moral, legal and strategic considerations."[20] Almost at the end of 2025, the UN's First Committee proposed and adopted a resolution to keep nuclear weapon systems under human control in a bid to prevent AI from using the weapons in an unintended way.[21]

In terms of offensive cyber technologies and their relations with the nuclear

enterprise, a couple of cases emerged in 2025. The US's National Nuclear Security Administration (NNSA), which oversees the US's nuclear weapons development, was breached by a hack of Microsoft Corp.'s SharePoint document management software. The NNSA denied any leak of sensitive or classified information and blamed Chinese state-sponsored hackers for the attacks.[22]

Conclusion

The year 2025 underscored a significant shift in the global nuclear landscape. Across missiles, space, AI and cyber domains, nuclear-armed states not only advanced modernisation programmes but also integrated emerging and disruptive technologies in ways that increasingly blur the lines between conventional and nuclear deterrence. Hence, nuclear-conventional entanglement could become a reality earlier than expected. Missile developments, from hypersonic systems to new ICBMs, to improved mobility to multiple-warhead capabilities, show the trend towards enhanced precision, survivability, and lethality.

In space, initiatives such as the US Golden Dome project and countervailing responses from Russia and China signalled the erosion of long-standing restraints, bringing space closer to becoming an active domain of strategic competition and potential conflict. Meanwhile, the growing role of AI and cyber technologies in 2025 has showcased new vulnerabilities and uncertainties, particularly in decision-making. Despite parallel diplomatic and normative efforts to preserve human authority over nuclear use, the AI-enabled decision support systems dictating command and control architecture require more clarity of thought and increased understanding of risks.

Taken together, the trends of 2025 point to a more complex, technologically entangled and fragile deterrence environment. Strategic stability now faces challenges not just by the number of weapons but also by speed, precision and interconnectedness of the systems.

Notes:

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China's Nuclear Development in 2025

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China's nuclear developments in 2025 signalled a significant shift. The year was defined not by single events, but by a series of actions that reinforced one another. Estimates of warheads surpassed previous highs. Satellite imagery showed the construction of new missile silos. A Victory Day parade in Beijing offered unusually explicit visual signals to both domestic and international audiences. Taken together, these developments demonstrated that China is transitioning from a small and opaque "minimum deterrent" posture to a more assertive and confident nuclear posture.

At the same time, China's official language maintained continuity. Beijing maintained a no-first-use strategy signalling restraint and a defensive nuclear posture. However, the gap between these declarations and observed developments is widening. The latest White Paper of November 2025 on arms control, non-proliferation and disarmament provides little insight into China's rapid nuclear modernisation. As of 2025, developments indicate that while China wishes to maintain ambiguity, it is also signalling some transparency arising from a greater confidence in its capability.

Warheads Expansion

The year witnessed a rapid increase in warhead numbers, a noticeable expansion of delivery systems, and the most overt public demonstration of a Chinese nuclear triad so far. According to the Stockholm International Peace

Research Institute (SIPRI) Yearbook 2025, China's nuclear arsenal is the fastest-growing in the world. SIPRI assessments estimate that China possessed around 600 nuclear warheads by January 2025, up from 500 a year earlier. Since 2023, China has been adding approximately 80 to 100 warheads each year.[1]

Similarly, the Bulletin of the Atomic Scientists report in 2025 estimated that China possessed approximately 600 nuclear warheads. They also agreed that China's nuclear arsenal is expanding at the highest rate among nuclear-armed states.[2] In December 2024, the US Department of Defence had projected that the People's Republic of China would possess over 1,000 operational nuclear weapons by 2030, with a significant number maintained at a higher level of readiness.[3] This rate of expansion reflects a deliberate decision regarding long-term force planning. Adding around 100 warheads per year shows priority for nuclear expansion rather than incremental developments. China appears to be focused on achieving parity with established nuclear powers.

Silos Expansion

Another prominent aspect of China's nuclear expansion is the extensive development of new ICBM silo fields, as evidenced by commercial satellite imagery from 2020 to 2025. Analysis reveals that China is constructing approximately 320 new silos for solid-fueled intercontinental ballistic missiles (ICBMs) in three primary locations: Yumen, Hami, and Yulin, while simultaneously upgrading its legacy DF-5 liquid-fueled missile arsenal significantly. This entails augmenting current DF-5 brigades and establishing additional ones, possibly increasing the number of DF-5 silos from 18 to 48.[4] According to the latest Draft Pentagon Report, China has likely loaded over 100 solid-fuel DF-31 ICBMs into these three new silo fields.[5] Collectively, these initiatives represent the most significant growth of China's silo-based nuclear capabilities ever recorded. The scale of this construction exceeds the requirements for a fundamental second-strike capability. A force of this magnitude aims to complicate adversary targeting and enhance the survivability of its own arsenal.

These nuclear modernisation efforts are not driven solely by the technical

requirements of deterrence, but also by political ideas rooted in China's worldview. As Tong Zhao argues, Chinese leaders increasingly view nuclear weapons as a source of "geopolitical leverage" rather than mere military deterrents. According to this viewpoint, nuclear modernisation is designed to influence how competitors perceive China's power and resolve, rather than to prevent specific acts of aggression. Under Xi Jinping, nuclear weapons have been elevated as markers of national power and strategic status. Therefore, force expansion is tied to political messaging and long-term rivalry with the United States rather than strictly defined military objectives.[6]

Signals from the Victory Parade

In September, a military parade was organised in Beijing to mark the 80th anniversary of China's victory in World War II. This displayed the complete nuclear triad for the first time. The parade showcased the Jinglei-1 (JL-1) air-launched ballistic missile, marking the first display of an air-based nuclear strike component. It also included the Julang-3 (JL-3) submarine-launched ballistic missile, which has an intercontinental range, and established land-based intercontinental ballistic missile forces.[7]

Dozens of foreign leaders, including Russian President Vladimir Putin and North Korean leader Kim Jong Un, and Pakistan's Shahbaz Sharif, attended the parade. China used the opportunity to communicate its strategic position. Beijing presented its operationally mature deterrent posture by displaying conventional and nuclear forces. Aside from its technical content, the parade reflected a shift in strategic communication, indicating growing confidence in China's nuclear posture and a willingness to associate these capabilities with national strength openly.

Qualitative Modernisation

China's nuclear modernisation in 2025 was not limited to numbers. It was accompanied by qualitative advances that affect how its force might be used. In the qualitative aspect, notable development is increasing focus on hypersonic weapons as part of strategic modernisation initiatives. China views hypersonic

weapons as a means to complicate the US's missile defence and early-warning advantages.

In late September 2025, China conducted a missile test from northern China that followed an unusually low and curved trajectory. Analyst linked the flight profile to hypersonic boost-glide weapons. Unlike conventional ICBMs, this one used a curved trajectory. Open-source and visual analysis indicated that the test exhibited advancements in manoeuvrable glide vehicles and unconventional flight trajectories, potentially enhancing China's capacity to circumvent early-warning and missile-defence systems. Observers interpret the test as an element of China's overarching strategy to strengthen hypersonic capabilities and challenge current missile defence systems.[8]

Recent developments from private-sector players suggest that China may be capable of producing hypersonic weapons on a large scale and at a significantly lower cost. Lingkong Tianxing Technology, a Beijing-based aerospace company, announced in October 2025 that the YKJ-1000 hypersonic missile was now in mass production. According to the company, the missile can reach speeds of Mach 5 to Mach 7 and has a range of 500 to 1,300 kilometres. It also stated that production costs are approximately one-tenth of traditional missiles.[9] If these claims are correct, they indicate a shift in hypersonic weapons from limited, high-cost capabilities to more scalable deployments.

Development without Testing

Alongside delivery systems, China has invested heavily in advanced research infrastructure that supports nuclear weapons development without overt testing. In early 2025, satellite imaging and investigative reporting revealed that China is developing a substantial laser-driven inertial confinement fusion facility near Mianyang in Sichuan Province. Some analysts estimate that it will surpass the size of the US National Ignition Facility. Officially characterised as a significant investment in fusion energy research, such facilities also possess evident implications for nuclear weapons technology. They can replicate the tremendous pressures and temperatures present in the initial phases of a nuclear detonation.[10]

These capabilities enable states to analyse warhead physics, validate computational models, and enhance weapon designs without performing explosive nuclear tests. This provides China with the possibility of modernising its arsenal while formally complying with testing standards. However, this reduces transparency; other states face challenges in assessing whether China is simply maintaining current designs or actively innovating new and more sophisticated warheads.

This ambiguity is reinforced by developments at Lop Nur in Xinjiang, China's historical nuclear test site. Satellite images show that new construction and tunnelling have occurred at Lop Nur. This includes new access roads, drill rigs, and possible underground access points. This suggests that the site's infrastructure is being updated and its capabilities are being preserved.[11] Even while these actions don't mean that China is about to start nuclear testing again, the amount of work being done shows that the country is keeping up its ability to support underground nuclear tests if it wants to in the future.

Action in the Civilian Nuclear Sector

In the civilian nuclear energy sector, China has become the leading nation in the construction of nuclear power plants. By mid-2025, China had approximately 32 reactors under construction, accounting for over half of all new nuclear developments worldwide. It continues to authorise additional projects that will enhance capacity in the coming decade. These initiatives align with China's overarching strategy to decarbonise its energy mix, improve energy security, and develop industrial expertise as state-supported companies construct reactors more rapidly and cost-effectively than many Western firms. China aims to export its reactor designs and associated services through initiatives related to the Belt and Road, thereby enhancing its influence in international nuclear markets. Given the current rate of construction and planning, China is projected to emerge as the leading global producer of nuclear electricity by the end of the decade.[12]

In addition to China's domestic nuclear expansion, its partnership with Russia is also becoming significant in shaping the country's civilian nuclear development.

In September 2025, Russia's state nuclear corporation, Rosatom, announced its intention to support China in its efforts to become the world's largest producer of nuclear power, highlighting continued collaboration in reactor construction and fuel-cycle assistance. This collaboration enhances the influence of both states in the global nuclear fuel and technology markets, with Russia and China collectively possessing a significant share of enrichment and fuel fabrication capacity.[13]

Declaratory Position

Despite these material developments, China's official nuclear doctrine remains unchanged on paper. On November 27, 2025, China released White Paper on "China's Arms Control, Disarmament, and Nonproliferation in the New Era." The white paper reaffirms China's long-standing nuclear principles. It reiterates China's commitment to an unconditional no-first-use, the non-use and non-threat of nuclear weapons against non-nuclear-weapon states and nuclear-weapon-free zones, and the maintenance of nuclear forces at the minimum level necessary for national security. The text also restated that China does not station nuclear weapons overseas and does not provide a nuclear umbrella to its partners.[14]

The White Paper further reiterates China's call for the five recognised nuclear-weapon states to establish a mutual no-first-use agreement and to enhance negative security assurances for non-nuclear-weapon states. Beijing positions itself as a cautious nuclear power, asserting that significant disarmament efforts should initiate with the United States and Russia, whose nuclear arsenals are substantially larger than that of China.[15]

This framing allows Beijing to portray itself as a restrained and responsible nuclear power, even as its own arsenal expands rapidly. The gap between China's declared doctrine and its expanding capabilities is thus critical. If the concept of a "minimum" nuclear force is defined by shifting threat perceptions rather than fixed requirements, it places no absolute limit on expansion. In this case, declaratory policy serves as a political shield, allowing for continued growth while deflecting external criticism.

Conclusion

In 2025, China's nuclear program moved beyond incremental change and entered a more decisive phase. Growth was evident in numbers, infrastructure, and capability. New missile silos, a more complete and publicly displayed nuclear triad, hypersonic delivery system advances, and advanced research facilities indicated a sustained effort to strengthen China's strategic forces. Meanwhile, civilian nuclear energy has grown rapidly, expanding the industrial and scientific base that can support modernisation.

While no single development stands out as particularly glaring, many elements reinforce each other to signal a more capable and confident China. China views its nuclear forces as a key part of its great-power posture. Its war fighting capabilities have grown though it continues to suggest a political role for its nuclear weapons.

These developments have direct implications for India. The strategic gap between Beijing and New Delhi grows as China develops its arsenal, including longer-range systems, and signals confidence through nuclear means. India is unlikely to seek numerical parity, but it faces increasing pressure to maintain its deterrent, especially at sea.

Overall, 2025 developments suggest China is no longer satisfied with a minimum deterrent. It is building the capacity and posture of a nuclear power whose forces are intended to matter both politically and militarily. This shift will impact global stability depending on how other nuclear powers respond.

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A Promising 2025 for the Peaceful Atom

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It has now become common to speak of a nuclear renaissance. After decades of stagnation, following major nuclear accidents and sustained underinvestment, nuclear energy has re-emerged as an important component in national energy portfolios, and 2025 saw an uptick in the momentum. The numbers support this conclusion. Currently, over 70 gigawatts of new nuclear capacity are under construction worldwide, which is one of the highest levels seen in the past three decades. Meanwhile, more than 40 countries have announced plans to increase the use of nuclear power in their national energy systems.[1] The latest report by the International Energy Agency says that nuclear is making a comeback, with global nuclear power capacity set to increase by at least one-third by 2035.[2] Rising electricity demand, particularly by power-hungry technologies such as artificial intelligence, has resulted in a spike in policy interest in nuclear power as a source of clean, stable and reliable energy.

A significant development in 2025 was the World Bank's decision to end its long-standing ban on financing nuclear energy projects.[3] These positive trends on nuclear power are complementary to the International Atomic Energy Agency's (IAEA) own: according to IAEA projections in 2025, global nuclear power capacity could double by 2050, with more countries entering the nuclear market, and non-power applications of nuclear energy growing.[4] At COP30 this year in Brazil, the declaration to triple capacity by 2050 was joined by more countries, companies

and financial institutions.[5]

However, achieving a tripling of global nuclear capacity by 2050 would require annual investment of between USD 150 billion and USD 250 billion.[6] While large-scale nuclear deployment followed the 1973 oil crisis in several countries such as Sweden, Belgium, Finland, France, Canada and Spain, current conditions are characterised by tighter public finances and greater caution toward large nuclear construction projects in many advanced economies. Despite the financing concerns, a powerful alignment of factors has made a comprehensive case for nuclear today. Nowhere is this more evident than in India, where the nuclear sector is entering an exciting phase of progress.

This overview offers a snapshot of some of the significant developments in the international and Indian nuclear energy landscape in 2025.

Global Trends

In early 2025, the United States moved to accelerate domestic deployment of advanced nuclear technologies, particularly small modular reactors (SMRs). In January, a coalition led by the Tennessee Valley Authority, alongside GE Hitachi Nuclear Energy, Duke Energy, American Electric Power subsidiaries, Bechtel and other industry partners, applied for USD 800 million in federal funding under the Department of Energy's Generation III+ SMR programme. The effort is aimed at building the first commercial SMR deployments in the United States, with TVA's planned BWRX-300 reactor at Clinch River in Tennessee targeting operation in the early 2030s.[7]

At the same time, nuclear cooperation has taken on greater geopolitical significance. In November 2025, the United States and Saudi Arabia signed a landmark agreement on civilian nuclear cooperation, laying the groundwork for a long-term nuclear partnership under a future Section 123 agreement. Beyond reactor deployment, the cooperation may have implications for the nuclear fuel cycle: Saudi Arabia's uranium resources could position the kingdom as a future supplier of enriched uranium to the US nuclear industry, potentially reducing American dependence on Russian supplies. In this context, a broader trend is also

noticeable. Nuclear energy is increasingly becoming embedded in wider strategic and technological partnerships. For example, the US-Saudi cooperation also sits alongside broader cooperation on rare earth minerals and artificial intelligence.[8]

Similar dynamics were visible in East Asia. In November 2025, the United States signalled support for South Korea's long-standing push to expand its nuclear fuel-cycle capabilities. A joint fact sheet issued after US President Donald Trump and South Korean President Lee Jae Myung met at a summit in Gyeongju confirmed Washington's backing for a process that could eventually allow South Korea to enrich uranium and reprocess spent fuel for peaceful purposes under the bilateral 123 agreement. While the agreement still requires ironing out of details, it also paved the way for South Korea to eventually realise its long-cherished dream of constructing nuclear-powered submarines.[9]

In Europe, 2025 saw renewed commitments alongside continued uncertainty. Poland took a significant step towards constructing its first nuclear power plant by approving up to USD 14.7 billion in state funding for a 3.75 GWe project on the Baltic coast. The state-owned utility PEJ will oversee construction, with 30 per cent of the funding to be provided through equity injections and the remainder expected to come from debt, potentially including support from the US Export-Import Bank. The project is intended to replace ageing coal-fired power stations and is still awaiting approval from the European Union.[10]

Italy is at an earlier stage of re-entry. Following referendums in 1987 and 2011 that banned nuclear power, the Italian government announced plans to finalise a strategy for the return of nuclear energy by 2027, focusing on SMRs and advanced reactors. Officials have positioned nuclear energy as a complement to renewables, particularly for decarbonising energy-intensive industries. It is estimated that nuclear energy could significantly reduce Italy's long-term decarbonisation costs if it accounts for even a modest share of the energy mix. Discussions with international partners such as the United States' Westinghouse and France's EDF point to a gradual rebuilding of nuclear policy capacity in countries that previously exited the sector.[11]

Elsewhere in Europe, Belgium's experience shows the complexities of managing nuclear phase-outs alongside energy security concerns. Unit 2 at the Doel nuclear power plant (445 MWe PWR) was permanently shut down in 2025 after 50 years of operation and has now entered the decommissioning phase. This closure occurred despite the repeal of Belgium's 2003 nuclear exit law, which permitted the extension of the operation of other reactors beyond 2035. This was in response to pressures on the energy supply following the conflict in Ukraine and subsequent sanctions on Russian oil.[12]

In Asia, developments have been even more pronounced. China continues to drive the world's largest nuclear construction programme. Roughly half of the 61 reactors under construction globally are located in China, and official projections indicate that the country could nearly double its nuclear capacity to around 200 GWe by 2040. With domestically developed third-generation reactors such as the Hualong One forming the backbone of this expansion, China is set to overtake the United States as the world's largest nuclear power generator in terms of installed capacity by around 2030.[13]

Southeast Asia, long cautious about nuclear energy, is also re-engaging with the technology. Fast-growing electricity demand, persistent reliance on fossil fuels and worsening air pollution have prompted countries such as Indonesia, Vietnam, Malaysia and the Philippines to revisit nuclear options. Indonesia has outlined plans for 20 nuclear power plants, Vietnam has revived discussions after shelving a costly project in 2016, and Philippines is looking to start Southeast Asia's only nuclear power plant built in Bataan that was left idle for more than 40 years due to safety concerns and corruption. Several countries have expressed interest in SMRs as a potentially more flexible and affordable entry point.[14]

Closer home, Bangladesh is approaching a key milestone. As the Rooppur nuclear power plant prepared for fuel loading at its first unit in late 2025, the authorities launched an extensive public awareness campaign to address safety concerns and build local support. The project uses two Generation III+ VVER-1200 reactors (each with a capacity of 1200 MWe) supplied by Russia.[15]

Technological innovation by unexpected players is also shaping the trajectory of nuclear energy. In the United States, a nuclear energy startup, Valar Atomics, in collaboration with the Los Alamos National Laboratory, achieved a notable milestone in November 2025: its graphite-moderated NOVA Core reached zero-power, or cold criticality. This marked the first criticality achieved by a venture-backed company using high-assay low-enriched uranium (HALEU) fuel carried out in the US in more than two decades.[16] The reactor will soon undergo extensive safety and regulatory processes with the Department of Energy. While it is easier to achieve cold criticality than to make power in a reactor, it is nonetheless a significant leap forward with startups now aiming to contribute to the nuclear energy boom.

A Landmark Year for Nuclear Energy in India

The year 2025 proved to be a seminal one for India's nuclear energy sector. It got off to a strong start with the launch of the Nuclear Energy Mission for *Viksit Bharat*, setting a clear path for expanding capacity, advancing indigenous technologies, and encouraging private sector participation. The year also ended on a high note with the tabling of the landmark SHANTI Bill, overhauling India's nuclear energy framework that previously included the Atomic Energy Act of 1962 and the Civil Liability for Nuclear Damage Act (CLNDA) of 2010. A year of decisive action was bookended by these milestones.

Right off the bat, in January, the Nuclear Power Corporation of India Limited (NPCIL) issued a Request for Proposals inviting "visionary Indian industries" to finance and build a fleet of 220 MWe Bharat Small Modular Reactors (BSMRs). These reactors are upgraded, pressurised heavy water reactors (PHWRs) designed for captive industrial use, for sectors such as steel, aluminium, and metals. Under the proposed model, private entities would provide land, cooling water, and capital, while NPCIL would retain ownership and operational control of the plant.[17]

This initiative followed the July 2024 Budget announcement that committed the government to opening nuclear power to private investment, especially

through SMR pathways.[18] In parallel, the Bhabha Atomic Research Centre (BARC) confirmed that it was developing separate SMR designs for repurposing retiring coal plants and for deployment in remote areas, signalling a broader diversification of India's nuclear toolkit.

Following this initial step, the Union Budget 2025-26 provided a major boost to India's nuclear ambitions through the launch of the Nuclear Energy Mission for *Viksit Bharat*. The budget earmarked INR 20,000 crore for research and development of SMRs, aiming to develop at least five indigenously designed units by 2033. It also set the country on a path to achieve 100 GWe of nuclear capacity by 2047, positioning nuclear energy as a key pillar of India's clean energy transition. In addition, the budget outlined partnerships with private companies for the construction of BSMRs, as well as broader R&D initiatives.[19] This announcement reflects India's ambitious two-pronged strategy in its nuclear expansion programme, featuring both large-capacity reactors as well as SMRs.

By August 2025, nuclear ambition had moved into the political mainstream. In his Independence Day address, Prime Minister Narendra Modi announced that India was working on 10 new nuclear reactors and reaffirmed the government's goal of expanding nuclear capacity more than tenfold by 2047. Nuclear energy was framed as a central pillar of India's long-term development strategy, alongside semiconductors and indigenous technology-building.[20] The launch of a dedicated mission on nuclear energy, followed by the Prime Minister's public endorsement of its objectives, distinguishes the current nuclear trajectory from India's previous delayed or missed attempts to expand its nuclear capacity.

Momentum continued into October 2025, when NPCIL extended the deadline for its BSMR tender to March 2026. Major Indian conglomerates, including Reliance Industries, Tata Power, Adani Power, JSW Energy, Hindalco, and Jindal Steel and Power, had entered the process, signed non-disclosure agreements, and identified 16 potential sites across six states.[21] The extension reflected both investor interest and the complexity of evaluating sites and costs.

December proved to be the most consequential month in India's nuclear

landscape, witnessing a flurry of activity across technology deployment, fuel supply, and, most importantly, regulatory framework.

On the operational side, India received the first batch of nuclear fuel for unit 3 of the Kudankulam nuclear power plant, supplied by Russia's Rosatom. Unit 3 will be the first VVER-1000 reactors globally to begin operations with an 18-month fuel cycle. Construction also continued on units 4, 5 and 6.[22] On the bilateral front, Prime Minister Modi and Russian President Putin agreed to broader cooperation on nuclear energy, including fuel cycle, life cycle support for operating Kundankulam, and non-power applications during President's Putin visit to India in December. It was also noted that India was aiming to soon finalise the allotment of a second site for a nuclear power plant.[23]

While construction of large reactors progressed steadily, India also made incremental advances on BSMRs. In support of the broader target of 100 GWe of nuclear capacity by 2047, the government confirmed the first proposed sites for India's indigenously designed SMRs. Lead units of the 200 MWe BSMR the 55 MWe SMR will be built at Tarapur in Maharashtra, while a 5 MWth high-temperature gas-cooled reactor for hydrogen production will be developed at BARC's Vizag campus in Andhra Pradesh.[24]

In a much-anticipated development, the government tabled the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India or SHANTI bill in the Lok Sabha in mid-December. This landmark legislation proposes to open nuclear power generation to any company or joint venture, allowing them to construct, own, operate, and decommission nuclear plants under a licensing regime (enrichment, management of spent fuel and production of heavy water will remain under the purview of the government or entities owned by it). It repeals both the Atomic Energy Act of 1962 and the CLNDA 2010, and, most critically, removes the controversial supplier liability clause that has long deterred foreign and domestic investment. In fact, 2025 also marks two decades since the announcement of the India-US civil nuclear deal. Yet, the energy and commercial promises of the deal have not yet been realised, with India's liability laws being one of the primary impediments. The SHANTI bill could pave the

way for the long-overdue fruition of the deal. Additionally, the government has proposed to set up an Atomic Energy Redressal Advisory Council to hear any complaints of any licensee or operator, along with fixing tariffs.[25]

In 2024-25, nuclear power accounted for only around three per cent of India's electricity generation. Recognising that the government alone cannot support the rapid expansion of capacity, the SHANTI Bill aims to increase the role of nuclear power in the energy mix by changing who is legally permitted to build and operate nuclear facilities. This opens the door for licensed domestic private companies to participate more directly in nuclear power generation. With more players in the market, construction risks and capital requirements are shared more broadly, with the government maintaining control over sensitive fuel-cycle activities. However, clarity regarding details such as the role of the atomic energy regulator has not yet been provided, and it is likely that additional clarifications on several aspects will be provided over time. While 2025 was undeniably a landmark year for India's nuclear energy sector, the true test will be whether this momentum is responsibly sustained in the years ahead.

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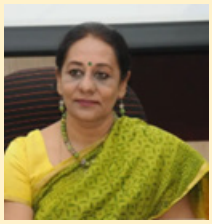
NukeNerds at CAPSS

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