GEOPOLITICS AND INTERNATIONAL SECURITY PROGRAM

JUNE 2025

SILENT DETERRENTS

India's Undersea Gamble Amid China's Indo-Pacific Surge

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Recommended citation:
Desai, Hely (2025). Silent Deterrents: India's Undersea Gamble Amid China's Indo-Pacific Surge. New Delhi: Council for Strategic and Defense Research.

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ABOUT THIS REPORT

India's nuclear submarine program represents a critical but challenging effort to establish credible sea-based deterrence amid China's expanding Indo-Pacific naval presence. This comprehensive analysis examines India's nascent SSBN fleet, currently comprising just two operational submarines with limited-range missiles, against China's superior undersea capabilities and Pakistan's evolving nuclear naval ambitions. The report reveals significant gaps in India's deterrent credibility, from reactor limitations and stealth vulnerabilities to infrastructure delays, while China's "String of Pearls" strategy increasingly constrains India's maritime freedom. Despite symbolic milestones like INS Arihant's patrols, India faces a 50-60-year timeline to achieve truly credible, continuous at-sea deterrence, highlighting the enormous strategic and technological challenges ahead.

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Executive Summary

- India's nuclear submarine program represents an ambitious but challenging effort to establish credible sea-based nuclear deterrence in response to China's expanding maritime presence in the Indo-Pacific. With only two operational SSBNs—INS Arihant and INS Arighat—India lags significantly behind China's six Jin-class submarines, highlighting a substantial capability gap that undermines deterrent credibility against its primary strategic adversary.

- The strategic rationale for India's SSBN development stems from its position between two nuclear-armed neighbors and China's growing influence in the Indian Ocean Region through its "String of Pearls" strategy. Recent tensions, including the 2020 Galwan Valley clash and ongoing territorial disputes, have intensified India's perceived need for survivable second-strike capabilities, particularly as China deepens military ties with Pakistan, Bangladesh, and Myanmar.

- India's current SSBN fleet faces critical operational limitations that compromise its deterrent value. The Arihant-class submarines are constrained by short-range K-15 missiles (750 km) that force operations dangerously close to enemy shores, while the newer K-4 missiles (3,500 km) offer improved but still limited strategic reach. Technical challenges include reactor endurance issues, inadequate stealth capabilities, and vulnerability to low-frequency acoustic detection systems.

- The program operates under a bastion strategy, confining SSBNs to protected waters in the Bay of Bengal and northern Indian Ocean rather than pursuing continuous at-sea deterrence. This approach reflects both geographic advantages and technological limitations, but restricts operational flexibility and the full survivability potential of submarine-based deterrence. Naval experts estimate it will require 50-60 years to achieve truly credible persistent deterrent patrols.

- China's superior undersea nuclear capabilities include six operational Jin-class SSBNs armed with JL-2 and JL-3 missiles capable of ranges exceeding 9,000 kilometers. China's expanding naval presence in the Indian Ocean, combined with port access agreements and dual-use infrastructure in neighboring countries, is increasingly constraining India's maritime freedom and challenging its traditional regional dominance.

- Pakistan's evolving sea-based nuclear capabilities, while technologically inferior, add complexity to regional deterrence dynamics. Pakistan relies on diesel-electric submarines armed with nuclear-capable Babur-III cruise missiles and benefits from Chinese assistance in submarine acquisition and naval modernization, creating what analysts term a "Goldilocks dilemma" where India's capabilities appear too strong for Pakistan to ignore yet too China-focused to provide strategic clarity.

- India's infrastructure development includes the new Project Varsha submarine base near Visakhapatnam and the expansion of the Karwar naval facility, supporting bastion-focused deployment strategies. However, persistent delays in submarine construction, reactor refueling cycles lasting 18-24 months, and gaps in command and control systems continue to limit operational readiness and strategic credibility.

- The report recommends accelerating the deployment of K-4 missiles, developing longer-range SLBMs, enhancing maritime domain awareness, and strengthening regional partnerships to counter Chinese encroachment. Long-term priorities include expanding the SSBN fleet to 3-4 operational submarines, improving acoustic stealth technologies, and establishing robust underwater surveillance networks to ensure survivable deterrent patrols in an increasingly contested maritime environment.

The Strategic Urgency of Sea-Based Deterrence

The Indian Ocean Region (IOR), a vital crossroads for global maritime trade and energy transit, which handles approximately 80% of the world's seaborne oil, has become a critical theater of strategic competition.[1] As global and regional powers pursue their competing interests, the region is witnessing the emergence of overlapping security frameworks, military deployments, and infrastructure investments. This evolving maritime environment spans three critical dimensions: the surface domain, dominated by warships, research vessels and commercial traffic; the underwater domain, increasingly defined by submarines and critical infrastructure such as seabed communication cables; and the air domain, which encompasses surveillance, reconnaissance, and strike capabilities projected by maritime patrol aircraft and carrier-based aviation. Amid this intensifying tri-domain militarization of the ocean, the role of nuclear-powered ballistic missile submarines (SSBNs) has emerged as a central feature of evolving deterrence postures in the region.

For India, this maritime environment intersects directly with the longstanding land-based threats along its Northern and Western frontiers. For instance, the 2020 Galwan Valley clash with China marked a significant escalation along the Line of Actual Control (LAC), reigniting enduring cartographic disputes, and a surge in naval activities in the IOR.[2] Meanwhile, recurrent terrorist attacks originating from Pakistan, such as those in Uri (2016), Pulwama (2019)[3], and most recently Pahalgam (2025), have prompted a series of military responses, including the alleged strategic deployment of INS Vikrant[4] in closer proximity to Pakistani waters and the crucial utility of the P-8I Poseidon[5] during the crisis, underscoring the persistence of cross-domain security risks, especially in the IOR.

These developments point to an increasingly plausible challenge for India, spanning nuclear, conventional, and maritime domains. In this environment, credible nuclear deterrence, particularly sea-based, acquires renewed salience.

For India, situated between two conflicting nuclear-armed neighbours, both of which are actively expanding their undersea capabilities, creating an increasingly hostile political and security environment, especially as its smaller neighbours team up with China, the rationale for developing a robust SSBN force is clear. However, while the strategic rationale remains sound, its material realization continues to encounter significant roadblocks. India's SSBN force, anchored by INS Arihant, followed by its delayed follow-on vessels, has demonstrated incremental symbolic and technical milestones. However, its operational depth remains limited, given constraints in its missile range, evolving stealth capabilities, and a command-and-control framework that is still maturing for undersea deterrence.

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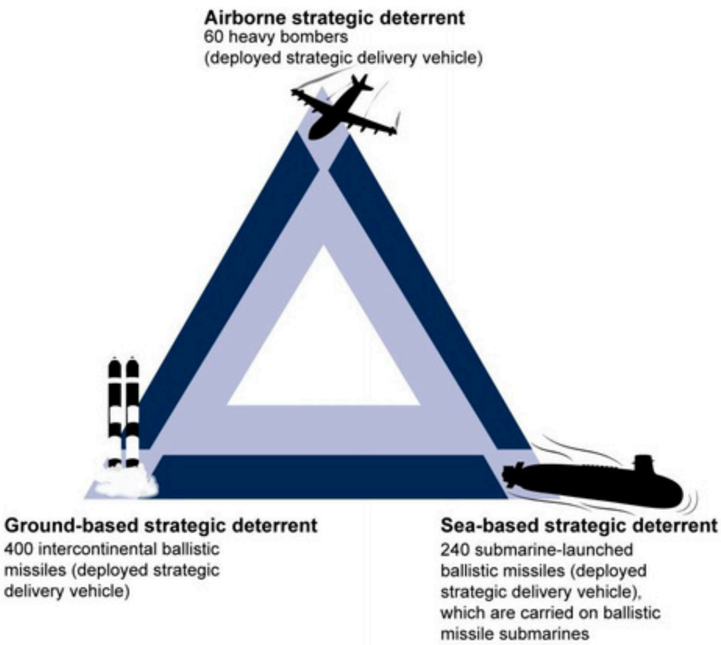
The Role and Challenge of SSBNs

SSBNs deploying submarine-launched ballistic missiles (SLBMs), are deemed to represent the most survivable leg of a nuclear triad.[6] By virtue of their stealth, mobility, and extended operational reach, SSBNs are widely regarded as the most reliable platform for ensuring a secure second-strike capability.[7] This ability to absorb a nuclear first-strike and retaliate credibly underpins the fundamental logic of deterrence and serves as a cornerstone of strategic stability among nuclear-armed states. The defining advantage of SSBNs lies in their capacity to remain concealed within vast maritime domains, making them exceptionally difficult to detect, track, or neutralize. Unlike land-based missile silos or vulnerable airbases, SSBNs operate submerged, leveraging acoustic discretion and the opacity of the underwater domain. When effectively deployed, SSBNs create uncertainty for any adversary by ensuring that a retaliatory strike cannot be ruled out. This uncertainty is central to their deterrent value.



Source: GAO analysis of Department of Defense documents. | GAO-18-158 [8]

However, as noted, the strategic advantages of SSBNs are contingent upon meeting substantial operational and technological requirements. Most SSBN forces are built around two core concepts of operation: Continuous at-sea deterrence (CASD) and the bastion strategy.[9] Each reflects a distinct approach to balancing survivability, readiness, and resource constraints.

The CASD approach requires maintaining at least one SSBN on deterrent patrol at all times, ideally in areas far from home waters.[10] This strategy enhances survivability by operating in vast regions, complicating detection, and ensuring a credible second-strike capability. However, it is resource-intensive, demanding multiple operational SSBNs (typically four or more),[11] high submarine endurance, extensive command-and-control systems, and often, an additional fleet of SSNs for protection in hostile waters. This approach is employed by the United States and, on a more limited scale, by the United Kingdom and France.[12] CASD requires high-endurance reactors, quieting technologies, and dispersed basing infrastructure. Even for advanced navies, maintaining round-the-clock deterrent patrols is a costly and complex endeavor. The United Kingdom's Vanguard class SSBN force, for example, relies on four submarines to ensure one is always at sea—an operational minimum that assumes regular maintenance cycles, trained crews, and uninterrupted force readiness.[13]

The bastion model, by contrast, relies on confining SSBN operations to well-defended maritime zones close to home, such as coastal trenches or enclosed seas, pioneered by the Soviet Union in the Barents Sea and the Sea of Okhotsk.[14] "Bastion" emerged as a strategic term in Cold War-era U.S. military discourse, denoting the Soviet practice of fortifying specific maritime spaces to ensure survivable deployment zones for its SSBN fleet against Western Anti-Submarine Warfare (ASW) threats.[15] Here, the SSBN is protected by layered defenses: surface ships, SSNs, maritime patrol aircraft, and proximity to land-based assets. Traditionally, the bastion model is conceptualized with two primary sectors: an outer zone dedicated to sea denial operations and an inner zone focused on sea control.[16]

The key trade-off is between survivability and flexibility. While bastion deployment allows for better protection and maintenance access, it may risk introducing geographic predictability. The feasibility of either strategy is shaped by a nation's geography, technological maturity, and resource base. The bastion strategy may also serve as a transitional posture for emerging nuclear navies that lack global reach.

Finally, SSBNs also place unique demands on nuclear command and control.[17] Secure and survivable communication links must be maintained with a platform designed to remain hidden, potentially for weeks or months at a time. Decision-makers must reconcile the need for tight civilian control with the imperative of timely retaliation. In peacetime, this requires rigorous procedures and safeguards. In crisis scenarios, it demands resilience, clarity, and near-instantaneous communication. SSBNs are not plug-and-play assets. Their effectiveness as second-strike platforms depends not just on technical capability, but also on the operational model adopted, the number of boats in rotation, and the credibility of command protocols. As more states pursue sea-based deterrence, these considerations are shaping a new era of maritime nuclear dynamics, one defined by submerged competition, technological asymmetry, and the strategic ambiguities of the deep ocean.

India's Nascent SSBN Program

Fleet Status: A Slow Burning Start

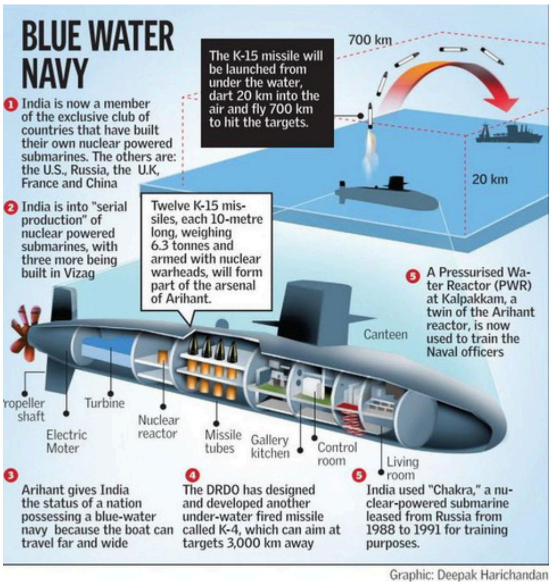
India's pursuit of a sea-based nuclear deterrent, aimed at completing its nuclear triad and ensuring a credible second-strike capability, remains in the early stages of operational viability. Nevertheless, there is a clear and sustained ambition to develop a robust naval nuclear deterrent force, centered around mustering four nuclear-powered ballistic missile submarines, long-range sea-based ballistic missiles, and a major new naval base.

Although India formally entered the SSBN domain only recently, the underlying development effort has spanned decades. Foundational efforts had long aimed at developing a nuclear-powered attack submarine (SSN) with Soviet support, under the Advanced Technology Vehicle Project (ATVP) since the mid-1980s.[18] But following India's 1998 nuclear tests, the ATV program shifted its focus from developing SSNs to an SSBN. However, since the construction of the first hull, originally designed as an SSN, was already underway, design constraints limited the missile payload and range of INS Arihant, India's first SSBN.[19] This presumably makes Arihant better viewed as a transitional platform, laying the groundwork for more capable deterrent assets rather than serving as a fully credible counter to China.[20]

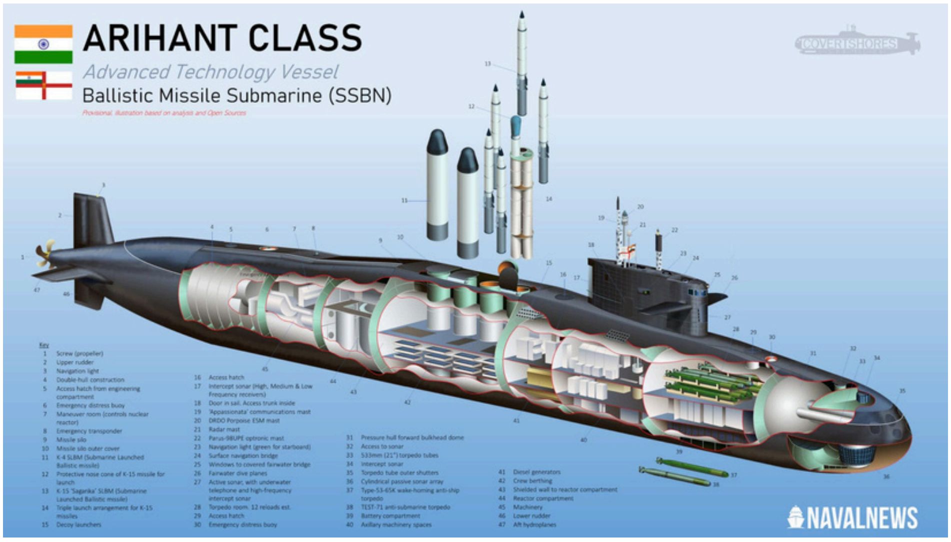
Initially developed under the codename S2 and bearing hull number SSBN-80, INS Arihant was commissioned in 2016 and completed its first deterrence patrol in 2018. Prime Minister Modi had hailed this milestone as "a fitting response to those who indulge in nuclear blackmail."[21]

The phrase, often repeated during conflicts,[22] echoes a long-standing theme in South Asian nuclear dynamics, where threats, implicit or explicit, have shaped security postures since the nuclearization of the region.

Over the years, however, Indian submarines have demonstrated vulnerabilities to operational setbacks. In the case of SSBNs—INS Arihant, for instance, suffered major propulsion system damage due to water ingress in 2017, rendering it non-operational for almost a year.[23] Even beyond such incidents, Arihant's limited stealth, modest missile payload, and constrained range as a result of post-hoc technological fixes,[24] significantly diminish its strategic credibility, particularly against advanced adversaries like China.[25] India also currently lacks operational nuclear attack submarines (SSNs), a critical gap in ensuring the survivability and escort of its SSBN fleet.



Source: The Hindu



The broader SSBN program has also been hampered not only by such technical constraints but also by persistent delays. INS Arighat (S3), launched in 2017 and initially expected to be commissioned by 2020, faced significant setbacks, only to be inducted as late as 2024.[26] Follow-on vessels S4 (INS Aridhaman) and S4* modelled along the Arihant-class design have experienced similar impediments; S4, launched in 2021, is now slated for commissioning in 2025, while the S4* was launched only recently in 2024 with no estimated date of commissioning.[27] Though these submarines represent significant improvements, India's SSBN fleet continues to function primarily at a "work-in-progress" capability.[28] Analysts note that a credible deterrent posture requires a minimum of four SSBNs to ensure at least one submarine is always on patrol, a threshold India has yet to meet in fully operational terms.[29] To address these gaps, India is also laying the groundwork for its next-generation S5-class SSBNs, which are expected to be larger, stealthier, and equipped with longer-range ballistic missiles.[30] This future fleet will be supported under a new submarine manufacturing complex in Visakhapatnam.

Over the years, India has also operated leased Russian Akula-class SSNs, INS Chakra I and II, both of which have now been returned to Russia.[31] INS Chakra III, another Akula-class submarine, is expected to join the fleet by 2028.[32] Concurrently, India aims to develop its fleet of SSNs under Project 75 Alpha, initially envisioned for six boats, though, as per the current planning, the number has been reduced to four, given technical and budgetary constraints.[33]

India currently operates a fleet of around 150 warships, with the Navy aiming to expand to 175 by 2027–2030.[34] Despite this forward momentum, India's submarine acquisition efforts remain plagued by delays and supply chain disruptions. This liability has been exacerbated by its longstanding reliance on Russian systems, which has been brought into sharper focus by the Russia-Ukraine conflict disrupting key defense deliveries and the supply of advanced technologies, such as air-independent propulsion systems (AIP).[35] As a result, India has ostensibly begun pivoting toward Western partners to diversify its supply chains and strengthen technological resilience.

This shift is evident in acquisitions such as the French Rafale Marine fighter jets and Scorpene-class submarines, the American P-8I Poseidon maritime aircraft, as well as in Project 75I, to procure six next-generation AIP-equipped diesel-electric submarines.[36] A joint bid by Mazagon Dock Shipbuilders Limited (MDL) and Germany's Thyssenkrupp Marine Systems (TKMS) has successfully cleared the Indian Defence Ministry's technical evaluation, marking a key milestone in India's broader push to modernize its underwater capabilities and reduce reliance on Russian-origin platforms.[37]

Together, these developments reflect a broader strategic ambition: to establish a credible sea-based nuclear deterrent and secure maritime dominance in an increasingly contested Indo-Pacific environment.

India's SSBN Overview

Submarine	Displacement	Reactor Power	Missile Loadout	Missile Range	Status	Length (m)	Beam (m)	Missile Tubes
INS Arihant	~6,000 tons	83 MW	4 × K-4 or 12 × K-15 SLBMs	K-15: 750 km; K-4: 3,500 km	Commissioned (2016)	112	11	4
INS Arighat	~6,000 tons	83 MW	4 × K-4 or 12 × K-15 SLBMs	K-15: 750 km; K-4: 3,500 km	Commissioned (2024)	111.6	11	4
INS Aridhaman	~7,000 tons	190 MW	12 × K-4 SLBMs	K-4: 3,500 km	Sea trials; expected commissioning in 2025	~128-130*	(not specified)	8

**Estimated length of INS Aridhaman (S4) based on satellite imagery; about 16 to 18 meters longer than the first two SSBNs.[38]*

Reactors and Propulsion

For the submarine leg of the nuclear triad to be credible, one or more fully armed SSBNs must remain on continuous patrol at all times, capable of staying submerged and undetected for months. Strategic continuity requires that a returning SSBN be immediately relieved by another, necessitating not just a minimum fleet size, but also that at least 2–3 SSBNs are operationally available at any given time.[39] A crucial determinant of SSBN availability is the reactor refueling cycle. Refueling or replacing the enriched uranium fuel rods of a submarine's reactor is an intricate dockyard operation that can take the vessel out of service for 18 to 24 months.[40] Unlike land-based reactors that can be shut down for routine maintenance, naval reactors are sealed and must operate continuously for the duration of the submarine's deployment, often without access for inspection or repair.

India's SSBNs, including INS Arihant (S2) and INS Arighat (S3), are powered by 83 MW pressurized light-water reactors (PWRs) using enriched uranium.[41] The Arihant, based on Soviet-era first- or second-generation reactor designs, features relatively short refueling intervals.[42] While these PWRs use light water as both coolant and moderator and are adequate for propulsion, their limited endurance places constraints on mission flexibility and patrol duration. The submarine's initial deterrent patrol, which lasted only 20 days, has raised questions about the endurance and reliability of its nuclear propulsion system. As a result, patrol areas may have to remain closer to base, and longer maintenance intervals between patrols could compromise continuous at-sea deterrence.[43]

> "The technical demands of naval reactor design far exceed those of civilian and/or land-based nuclear power... India's current SSBN force structure, combined with its reactor constraints, suggests that the nation will require substantial financial and technological investments, underscoring the significant challenges ahead in establishing a survivable and credible sea-based nuclear deterrent.

The technical demands of naval reactor design far exceed those of civilian and/or land-based nuclear power. A submarine reactor must respond rapidly to frequent power shifts required for maneuvering, while also maintaining nuclear safety, shock resistance, noise reduction, and radiation shielding, all within the confined environment of a crewed vessel. These requirements necessitate high standards of design, manufacturing, and quality assurance.[44] Given these limitations, India's current SSBN force structure, combined with its reactor constraints, suggests that the nation will require substantial financial and technological investments, underscoring the significant challenges ahead in establishing a survivable and credible sea-based nuclear deterrent.

Stealth and Survivability

Stealth is fundamental to the survivability of SSBNs, and India's Arihant-class boats reflect a nascent but evolving effort to establish this capability. While India has made strides with its indigenous USHUS sonar system and basic acoustic quieting measures, critical gaps remain.[45] Publicly available data offers little clarity on whether Indian SSBNs employ essential dampening features such as anechoic tiles, pump-jet propulsion, or modular acoustic isolation.[46] Both Chinese and Indian SSBNs remain vulnerable to low-frequency acoustic detection (LOFAR) systems due to their relatively high noise levels, posing a significant risk to the stealth and effectiveness of deterrent patrols.[47] Situational awareness is equally vital. India also lacks a real-time underwater surveillance network comparable to the U.S. SOSUS or China's seabed sensor arrays.[48] The USHUS sonar, though functional, may fall short in range and sensitivity against modern benchmarks, leaving SSBNs vulnerable in contested waters. Without a robust underwater domain awareness infrastructure, India's deterrent fleet risks operating in an acoustic vacuum, undermining both survivability and operational confidence.

Efforts remain underway to address these vulnerabilities. The Indian Navy is planning a multi-layered undersea surveillance network across the IOR, integrating seabed sensors, towed array sonars, airborne Magnetic Anomaly Detectors (MADs), and advanced Superconducting Quantum Interference Devices (SQUID) sensors.[49] Led by DRDO's Naval Physical and Oceanographic Laboratory, this initiative may eventually link with U.S.-Japan systems like the "Fish Hook" Sound Surveillance System (SOSUS) chain to enhance regional submarine tracking.

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Still, until these systems mature and become operational, India's SSBN survivability remains constrained by technological limitations and limited real-time awareness, critical challenges that must be addressed to achieve a credible posture.

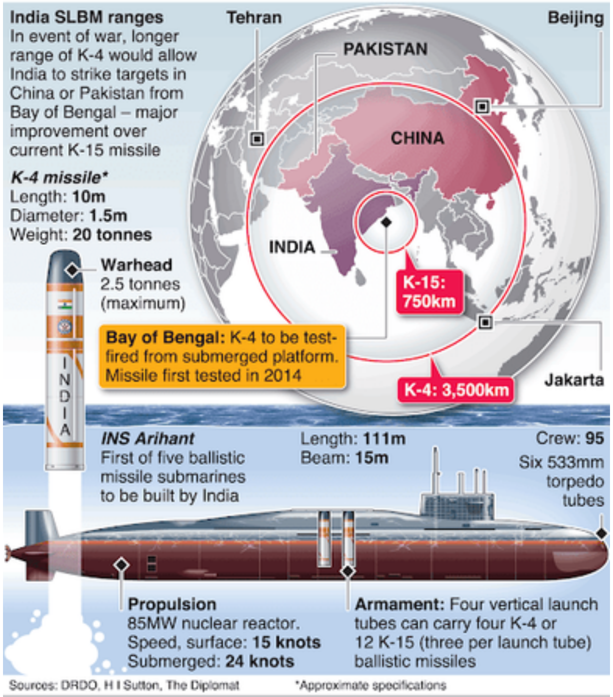
Missile Range and Relevance

The strategic value of SSBN hinges on both the range and the number of SLBMs it can carry. While stealth and mobility give SSBNs a covert advantage, these traits only translate into effective deterrence when paired with missiles capable of reaching distant strategic targets. The longer the missile's range, the farther from adversarial coastlines the submarine can safely operate, enhancing survivability while preserving a credible second-strike capability.

For India, the primary strategic concern involves deterring China, a major regional adversary whose critical nuclear infrastructure remains dispersed deep across its inland. To maintain a credible sea-based deterrent, India requires SLBMs with intercontinental ranges of up to 8,000 kilometers, sufficient to target critical Chinese cities and military assets.[50] Such reach would enable Indian SSBNs to patrol safely within the Bay of Bengal, minimizing the risk of detection and pre-emptive strikes.

India's initial foray into sea-based deterrence began with the Dhanush missile, a naval version of the short-range Prithvi-II.[51] Deployed on two modified Sukanya-class patrol vessels, these liquid-fueled missiles had to be fueled shortly before launch, significantly limiting their operational utility. Their short range meant Indian vessels had to approach dangerously close to enemy shores, compromising their safety.[52] To overcome these shortcomings, India introduced the K-15 (Sagarika/B-05) SLBM, with a range of around 750 kms, and has only recently also developed the more advanced K-4 missile, which has an estimated range of 3,500 kilometers. While the K-15 marked an important milestone in domestic missile development, its limited range constrains SSBNs to operate in forward areas, making them vulnerable and reducing their strategic deterrence value. In a crisis scenario, even though the Indian Navy's exact operational zones remain classified, it is plausible to infer that deployed vessels operate around designated attack points, potentially extending into or near hostile waters, based on the capabilities of their sensors, weapon systems, and missile ranges.

The K-4, modelled on the Agni-III intermediate-range ballistic missile, offers a substantial leap in capability. From patrol zones in the northern Bay of Bengal, the K-4 may reach some Chinese targets, greatly enhancing operational flexibility.[53] While some officials have suggested that the K-4 has "near-zero circular error probability" and could eventually carry multiple warheads, such claims remain unverified.[54] Further testing of India's sea-launched ballistic missiles, such as the K-4, which have so far only been trialled from submerged platforms rather than from submarines themselves, the test results of which remain undeclared.



Currently, India's two operational SSBNs - INS Arihant and INS Arighat, are equipped with four missile tubes and can carry up to 12 K-15 missiles, allowing for tailored mission configurations. The newer S4 submarine, launched in 2021, is projected to be roughly 16–18 meters longer than its predecessors. It features eight missile tubes, signaling an intent to expand both firepower and mission range.[55] The under-development S5-class SSBNs are projected to carry at least 12 SLBMs. Additionally, the Defence Research and Development Organisation (DRDO) is reportedly working on a new SLBM with a 5,000-kilometer range, potentially matching the capabilities of the land-based Agni-V missile.[56]

India's Missile Profile[57]

Type/designation	*No. of launchers*	Range (km)	Warheads x yield	*No. of warheads*
Sea-based missiles	2/24m			***24***
Dhanush	0	400	1 × 12 kt	0[n]
K-15 (B-05) Sagarika	24	700	1 × 12 kt	24
K-4 Kalam	.	3,500	1 × 10–40 kt	.
K-5	.	5,000+	(1-3 × 10–40 kt MIRV)	.

Command, Control and Rationale

A key challenge in assessing India's sea-based nuclear deterrent also lies in the opacity surrounding its operational posture, especially the status of warhead-missile mating aboard its SSBNs. Official doctrine is silent on whether SLBMs are routinely deployed with nuclear warheads pre-mated. While some former naval chiefs and Strategic Forces Command (SFC) officers have suggested that India's SSBNs carry fully assembled, pre-mated SLBMs under tight civilian oversight, others contend that the legacy three-stage mating protocol may still apply at sea, mirroring procedures used for land-based platforms.[58] This lack of clarity is likely intentional and not a reflection of doctrinal uncertainty. Rather, it is a deliberate decision to maintain strategic ambiguity while keeping operational details classified.

This ambiguity is not unique to India. In the United States, for instance, analyst Bruce Blair has noted that SSBNs typically operate under strict radio silence, and even central command may not know their precise location during patrols.[59] India's SSBN command and control framework is dual in nature.[60] Upon deployment, operational control shifts to the SFC, while administrative control remains with the Navy. This division necessitates clearly defined change of operational control (CHOP) protocols and survivable communication links between the National Command Authority (NCA), Commander-in-Chief of Strategic Forces Command (SFC), and the SSBN commander.[61] Reports indicate that a two-step authorization process involving civilian authorities is required for any SLBM launch, even under crisis conditions.[62]

Mechanisms such as software-based Permissive Action Links (PALs), triple-redundant communication systems, and secure underwater signaling are believed to be in place, although the operational maturity of these systems remains uncertain.[63]

The challenges facing India's SSBN force stem more from technical limitations, gaps in operational transparency, and the need for resilient real-time command and control systems, factors that continue to evolve in tandem with India's broader nuclear force modernization.

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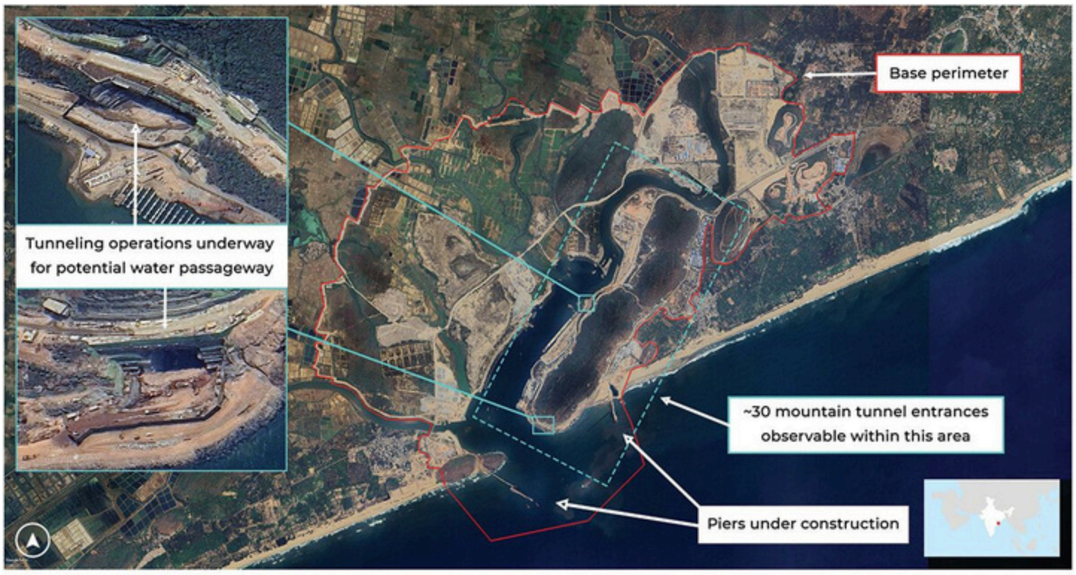
The New Bastion

India currently operates its SSBNs under a bastion strategy, restricted to proximate, secure waters, primarily the Bay of Bengal, the Andaman Sea, and the northern Indian Ocean, where it enjoys naval superiority and limited hostile submarine presence. This enables India to shield its deterrent force through conventional naval superiority and anti-submarine capabilities, particularly against Chinese and Pakistani threats, thereby creating a protective cordon for its nuclear assets.[64] While its sea-based deterrent is significantly ahead of Pakistan's, Indian naval experts assess that it will take another 50–60 years for India to field a fully credible, survivable, and persistent at-sea deterrent posture involving long-range patrols.[65] This would ideally require support from SSNs under Project 75 Alpha. Although the Indian Navy has not officially declared a CASD objective, military sources indicate that CASD is treated as the long-term assumption, consistent with the practices of other nuclear naval powers.[66] The infrastructure underpinning this posture is expanding, albeit with delays.

India's New Ballistic Missile Submarines, Visakhapatnam Shipyard

India is constructing a fleet of nuclear-powered ballistic missile submarines (SSBNs), known as the Arihant-class. The first boat, INS Arihant, reportedly completed its first deterrence patrol in November 2018, and the second boat, INS Arighat, is expected to enter into service with the Indian Navy before the end of 2024. Both submarines have four missile tubes for launching nuclear-capable ballistic missiles. India's third SSBN, known as S4, is longer and appears to have eight missile tubes.

17.7103°, 83.2690° (March 2024) - *Imagery: Airbus via Google Earth*



Construction Operations at India's New Submarine Base, INS Varsha

India is building a large new submarine base, known as INS Varsha, near Rambilli on the country's east coast. The base, part of which will be housed within a mountain, is undergoing extensive construction operations to potentially create a passageway through the mountain. Approximately 30 tunnel entrances can be observed through satellite imagery, as well as new piers and housing. Upon completion INS Varsha will become the homeport for India's ballistic missile submarine fleet.

17.4336°, 82.8868° (April 2024) - *Imagery: Airbus via Google Earth.*

On the eastern seaboard, India's new submarine base, Project Varsha, in Rambili, near Vishakhapatnam, features hardened underground pens for nuclear submarines and is expected to be operational by 2026.[67] This setup enables submarines to enter the Bay of Bengal covertly, potentially evading satellite surveillance, and conduct deterrent patrols that extend toward the Malacca Strait and further into strategic waters. On the western front, Project Seabird at Karwar is also undergoing phased expansion projects. Phase-IIA is deemed to accommodate 32 major warships and submarines, while Phase-IIB is projected to scale this to 50, with expanded dockyards, logistics hubs, and naval aviation support.[68] Karwar serves as a comprehensive naval base housing aircraft carriers and destroyers, while the new Andhra Pradesh facility is dedicated exclusively to nuclear submarines.[69] Together, these bases constitute the core infrastructure supporting India's bastion-focused SSBN deployment. Such induction of new submarines, missile systems, and support infrastructure marks progress, but operational deployment is shaped by cautious doctrine, infrastructural lag, and a deliberate posture of restraint. As such, India's Sea-based strategic deterrence (SBSD) remains a symbol of strategic arrival and a catalyst for critical reassessment.[70]

However, adopting a bastion strategy comes with trade-offs. While it reduces exposure to hostile ASW, it limits operational flexibility and the full potential of SSBN survivability. China's growing undersea surveillance and deepening ties with Bangladesh and Myanmar could eventually constrain India's control over the Bay of Bengal.[71] In the context of India's 'bastion' development, Chinese media have been quick to respond, urging India to exercise "responsible" behavior, revealing Beijing's underlying unease.[72] At the same time, reports of upcoming SSBNs equipped with longer-range SLBMs have been welcomed in India as crucial advancements in strengthening the credibility of India's sea-based nuclear deterrent. However, without operational SSNs or a doctrinal shift toward CASD, India's SSBNs remain susceptible to preemption, despite technical advancements.

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Gaps and Rhetorics

Strategically, beyond efforts to complete its nuclear triad and establish regional dominance, India's nuclear submarine program is also presumed to be an effort to bridge a widening capability gap with China, but the disparity remains stark. China's undersea nuclear forces, bolstered by decades of sustained investment and operational experience, are not just larger in number but, understandably, also more advanced in terms of deployment readiness and integration into broader strategic systems. In contrast, India has only two operational SSBNs, which are limited by the short-range K-15 missile, forcing them to operate closer to hostile shores to reach key targets, thereby compromising survivability and deterrent credibility.

Moreover, China has embedded its SSBN force within a broader nuclear modernization framework and integrated C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance) systems,[73] while India's sea-based deterrent remains technologically nascent. The absence of operational SSNs to escort SSBNs, as well as incomplete basing infrastructure, further deepens the asymmetry.[74] China's strategic posturing in the Indian Ocean further compounds these vulnerabilities. Regular PLAN submarine deployments in the IOR, port access agreements, and dual-use infrastructure in Myanmar and Bangladesh further signal an attempt to shape a permissive maritime environment for future Chinese SSBN operations, while simultaneously constraining India's.

Narrative Building and Strategic Implications

Despite the hostile neighbouring postures, the Indian government has, however, framed INS Arihant's patrols and subsequent milestones as major achievements, heralding India's entry into the elite club of nuclear triad powers.[75] This narrative serves multiple purposes: signaling strategic maturity, asserting technological self-reliance, and projecting credible power in the Indian Ocean Region. Yet, while symbolically important, these framing risks overstate the substantive capabilities currently in place. As stated before, with only two operational SSBNs and missiles of limited range, India's sea-based deterrent still lags significantly behind China's more advanced and numerically superior fleet.

The government's rhetoric also often attempts to portray India's SSBN force as an adequate counterbalance to China's growing maritime ambitions.[76] However, this perspective risks masking critical capability gaps, downplaying the urgency of modernization, and potentially fostering complacency in resource allocation and strategic planning. The question then arises: Is India's SSBN program evolving as a tool of national survival or as a marker of prestige,[77] and does that ambiguity expose it to strategic misreading in Beijing and Islamabad? Furthermore, can India's nascent SSBN force effectively project power in a region where Chinese influence continuously extends through growing partnerships with neighboring states like Bangladesh and Myanmar? And how does this evolving dynamic complicate India's long-standing security challenges with Pakistan, especially given that New Delhi has struggled to fully de-hyphenate its strategic posture from Islamabad, still remaining deeply entangled in the broader regional security landscape, as recent events demonstrate?

The answer may be multifaceted and carries significant consequences. China's expanding naval footprint, increased research activities in the Indian Ocean, and deepening ties with India's maritime neighbors intensify the urgency for India to assert reliable sea control. However, the challenge goes beyond mere capability demonstration. The Galwan crisis illustrated that China's reactions to Indian military advances can be disproportionately escalatory,[78] suggesting that India's SSBN development must be carefully calibrated to avoid unintended escalation while maintaining credible deterrence. This underscores a critical strategic paradox: India must project strength to secure its interests without provoking destabilizing responses that could undermine regional stability. Some analysts even argue that rather than indulging in premature triumphalism over the Arihant's milestones, India would be better served by adopting a more measured approach,[79] mirroring China's strategy of concealing capabilities while patiently building operational strength.[80]

The nexus also illustrates that India's SSBN program is not merely a response to external strategic threats but will also be a critical test of its indigenous technological ecosystem and broader strategic autonomy. The program exposes underlying institutional bottlenecks, innovation gaps, and delays that reflect the challenges of sustaining a complex, high-technology capability in a multi-adversary maritime environment. This intersection between advancing deterrence capabilities and managing intricate geopolitical fault lines underscores that

“India's SSBN program is not merely a response to external strategic threats but will also be a critical test of its indigenous technological ecosystem and broader strategic autonomy. The program exposes underlying institutional bottlenecks, innovation gaps, and delays...

India's strategic challenge extends beyond deterrence or power projection alone. The challenge lies not just in acquiring platforms, but in ensuring they are integrated into a resilient, adaptable defense-industrial base capable of sustaining a credible, survivable sea-based nuclear deterrent amid evolving regional uncertainties.

The Goldilocks Dilemma and Sino-Pak Capabilities

Over the past few years, there has also been a noticeable shift in Chinese nuclear thinking and discourse, often emphasizing "joint counter-nuclear intimidation" across various domains, potentially aimed at countering India's deterrent through advanced information warfare and escalatory tactics.[81] For instance, during the 2021 border crisis, Beijing's release of footage featuring nuclear-capable missile drills hinted at a calibrated messaging strategy—one that embeds nuclear cues even in a limited conventional crisis. This approach suggests a growing Chinese willingness to leverage nuclear posture for psychological and political effect in regional disputes.[82]

Additionally, Chinese Type 039 Yuan-class diesel-electric submarines and Type 094 Jin-class SSBNs have been spotted alarmingly close to Indian maritime boundaries in recent years. In one instance, the 'Dong Fang Hong 3,' ostensibly a civilian research vessel, is known to have conducted a month-long survey near the Ninety East Ridge, an area of strategic interest for undersea navigation.[83] Indian officials suspect that the survey was covert submarine mapping, part of a larger pattern of Chinese dual-use activity in regional waters.

This expanding Chinese footprint is viewed with acute concern in India, as it bolsters its capabilities, but it also has ripple effects elsewhere, particularly in Pakistan. For example, in the case of INS Arihant, although it is not Pakistan-specific by design, its technological evolution and limited range have effectively precluded any broader strategic utility.[84] But as India further enhances its undersea deterrent, ostensibly aimed at China, Pakistan continues to perceive a growing imbalance. This dynamic reinforces what some analysts refer to as the "Goldilocks dilemma": India's posture is seen as too strong for Pakistan to ignore, yet too China-centric to offer it any strategic clarity.[85] The result is a deepening sense of insecurity in Islamabad, which is now accelerating its own naval modernization programs in response, palpably with ample support from Beijing. Though Pakistan lacks an SSBN fleet, it has long-declared its intention to field a sea-based second-strike capability, primarily via cruise missiles launched from submarines. The Babur-III sea-launched cruise missile (SLCM) had been tested in 2018 from a submerged platform off Pakistan's coast in the Arabian Sea and flew to strike a target at an undisclosed location.[86] Additionally, Pakistan is investing in Chinese-origin Hangor-class submarines and expanding its naval infrastructure, moves likely motivated as much by Indian capability developments as by internal deterrent logic.[87]

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These evolving maritime nuclear dynamics are further unsettling an already volatile regional triangle, where the Sino-Indian rivalry forms the dominant axis, and Pakistan remains an entrenched knot that binds the region in persistent tension. The recent Pahalgam incident has sharpened the focus on nuclear signaling and crisis stability. While the conflict remains localized for now, it underscores how nuclear deterrents, particularly at sea, can become entangled in unpredictable escalation pathways. The stage is thus set for deeper reflection on the potential for conflict escalation in the Indian Ocean and beyond. Against this backdrop, it becomes essential to examine the evolving composition and posture of China's and Pakistan's sea-based nuclear forces, each of which shapes India's strategic calculus in distinct ways.

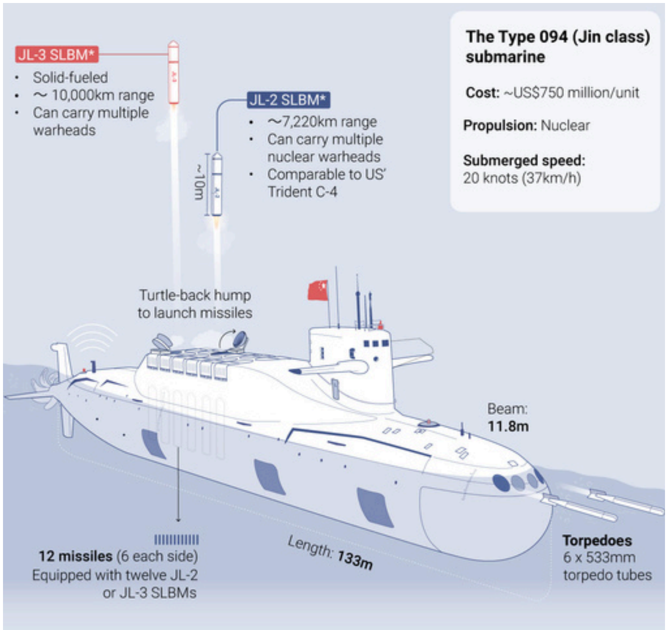
China's Fleet Status

Currently, China operates six second-generation Jin-class (Type 094) SSBNs, based at the Yalong naval base on Hainan Island, and six SSNs. The two newest subs are believed to be improved variants, sometimes referred to as Type 094A, though this designation has not been officially confirmed. These upgraded vessels feature a more prominent hump, which initially sparked speculation they might carry up to 16 SLBMs, but satellite imagery has confirmed they maintain 12 launch tubes each. The enhancements are primarily related to sound silencing, making the Type 094A quieter than the original design. The Jin-class SSBNs carry either the JL-2 (CSS-N-14) SLBM, with a range of approximately 7,200 kilometers, or the newer, longer-range JL-3 (CSS-N-20), which exceeds 9,000 kilometers.[88] China appears to also be gradually replacing the JL-2 with the JL-3 as submarines return for maintenance. It remains unclear whether the JL-3 is equipped with multiple warheads, as US intelligence has not explicitly confirmed this.[89]

Chinese Missile Snapshot[90]

Type	NATO Designation	Number of Launchers	Year Deployed	Range (kilometers)	Warheads × Yield (kilotons)	Warheads
JL-2	CSS-N-14	0j	2016	7,000+	1 × 700	0
JL-3	CSS-N-20	6/72	2022	9,000+	1 × 425	72

While Chinese submarines are generally considered acoustically inferior to their Western counterparts, "noisy" and easier to detect, continued patrols suggest growing Chinese confidence in their undersea capabilities and a desire to eventually operate SSBNs in the IOR. A new submarine construction hull completed in 2022 at the Huludao shipyard could be intended for the Type 096, expected to be larger and quieter, potentially rivaling Russia's Borei-class SSBNs.[91] Reports suggest Russia may be assisting China in developing quieter propulsion systems for the Type 096.[92] Although some speculate it might carry up to 24 missiles, public sources estimate the missile capacity will likely be 12 to 16.[93]



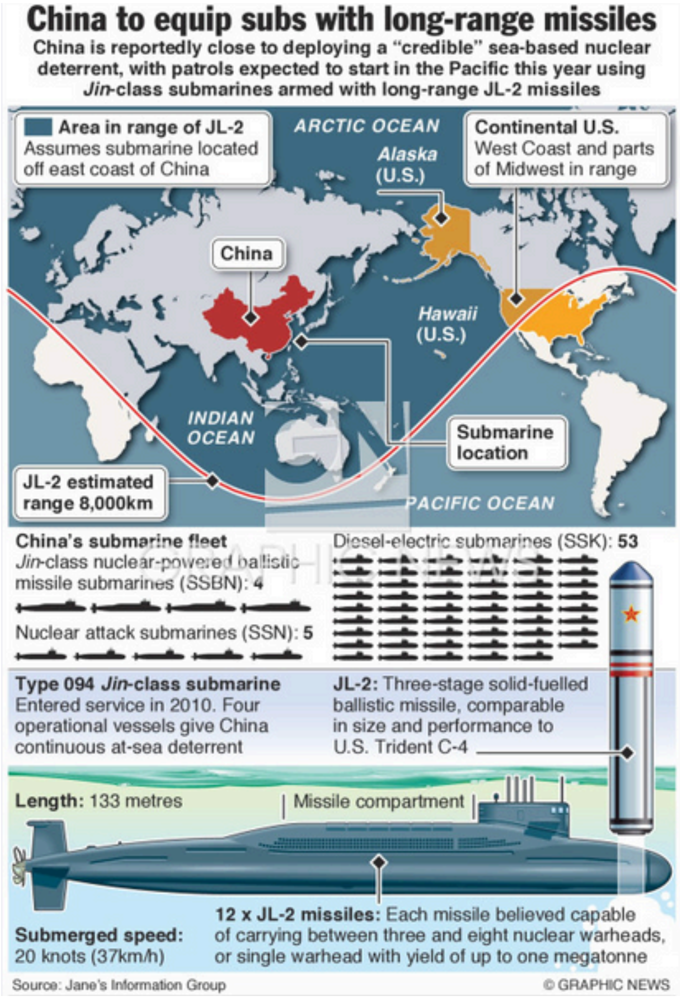
Due to their noise levels, China's SSBNs would probably operate within protected "bastions" in the South China Sea or Bohai Sea during conflicts.[94] According to the US Congressional Research Service, China's submarine fleet is projected to expand to 76 vessels by 2030, including eight SSBNs, 13 nuclear-powered attack submarines, and 55 diesel-electric submarines.[95]

SSBN Production at Bohai Shipyard - Huludao, China

China has recently completed construction of new facilities at Bohai Shipyard, where they produce nuclear-powered submarines including the JIN-class Type 094 SSBNs. The new facilities will enable China to expand production of nuclear submarines, including the next-generation Type 096 SSBN, which is expected to begin construction soon and be larger and heavier than the Type 094.

Key Chinese Submarine Bases[96]

Base Name	Location	Submarine Assets
Jianggezhuang (Northern Theatre Navy)	36°06.5' N, 120°35.1' E	1 × Xia Class, 3 × Han Class, 2–3 × Shang Class
Longpo (Southern Theatre Navy)	18°12.6' N, 109°41.3' E	6–7 × Jin Class, 4–5 × Shang Class
Xiaopingdao (Submarine Trial Base)	38°49.1' N, 121°29.5' E	Used for trials/testing, no operational subs



Pakistan's Continued Shadow

China's growing role in enhancing Pakistan's naval strength, including joint patrols and military exercises, has also raised serious concerns for Indian defense planners. Indian assessments project that Pakistan's navy could grow by 50% by 2030, largely due to Chinese support.[97] This expanding China-Pakistan maritime axis is increasingly viewed in New Delhi as a pressing strategic challenge, reinforcing India's rationale for accelerated naval modernization and force expansion in the Indian Ocean region.

Pakistani Missile Range

Type / Designation	Range (km)	Warhead × Yield (kt)
Babur-3 SLCM (Hatf)	450	1 × 5–12 kt

Pakistan, though significantly behind India and China in naval nuclear capabilities, is steadily working to establish a rudimentary sea-based deterrent. Lacking nuclear-powered submarines (SSBNs or SSNs), Pakistan is deemed to rely on its diesel-electric Agosta-class and the newly acquired Hangor-class submarines to deploy nuclear-capable cruise missiles, most notably the Babur-III.[98] These dual-use platforms, capable of carrying both conventional and nuclear payloads, often tend to create strategic ambiguity and heighten crisis instability by blurring the distinction between conventional and nuclear deployments. This ambiguity is further intensified by reports of Pakistan modifying Western-origin cruise missiles, such as variants of the Harpoon, and developing indigenous nuclear-capable systems like the ship-launched Harbah missile.[99]

Pakistan is also transitioning away from its older Western naval platforms toward newer vessels supplied by China and Turkey.[100] A pivotal moment in this shift came with a 2016 agreement to procure eight Yuan-class submarines from China, commissioned as the Hangor class. These submarines, equipped with AIP systems, enable longer submerged operations without the need to surface and recharge their batteries, providing a significant tactical advantage. The first of these boats was delivered in May 2024, marking a milestone in Pakistan's evolving undersea capabilities. Notably, the Pakistani Navy has long been the only South Asian force to operate AIP-equipped submarines.[101] Although nuclear-powered submarines offer superior endurance, AIP–equipped vessels present a more affordable middle path.[102]

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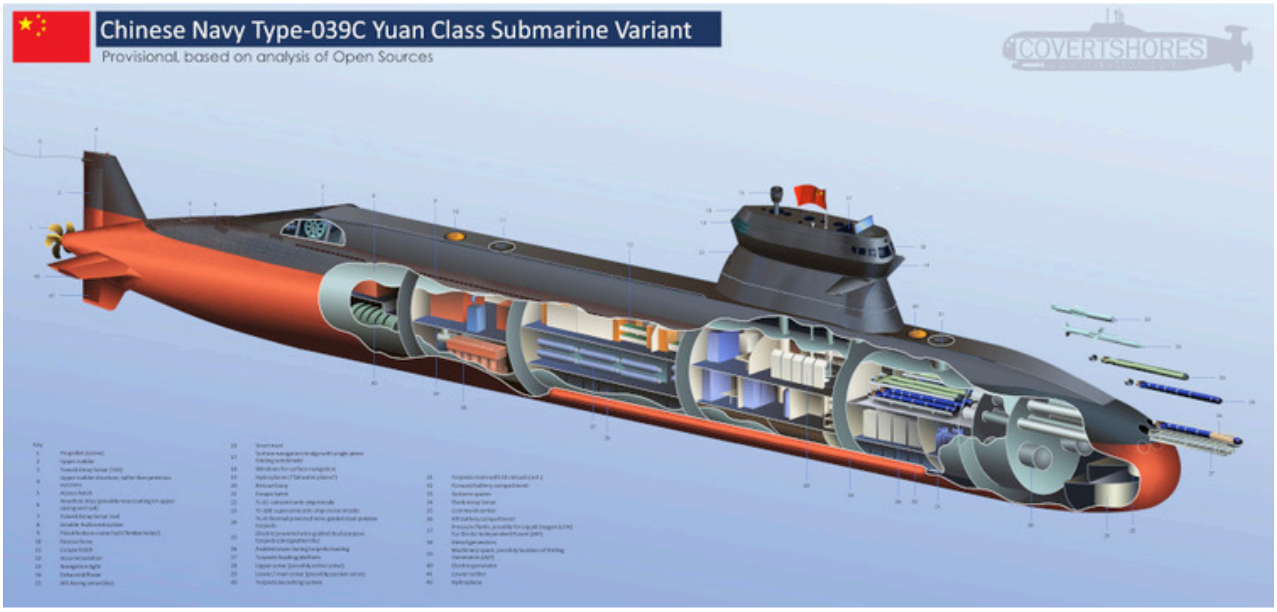

Forced Alliances and Regional Flashpoints: Potential for Trouble?

India's bastion-based SSBN strategy remains under increasing pressure from the steady expansion of Chinese maritime influence in its neighborhood. Amidst this, India's still-maturing sea-based deterrent and Pakistan's opaque and evolving nuclear posture, all three navies now find themselves navigating a largely unprecedented and increasingly complex strategic environment.[103]

At the heart of China's encroachment lies Beijing's "String of Pearls" strategy, an arc of dual-use infrastructure projects across the Indian Ocean Region (IOR) that could be repurposed for military use in a crisis. While ports like Gwadar in Pakistan and Hambantota in Sri Lanka are already central nodes, the recent acceleration of the long-stalled Kyaukphyu deep-sea port in Myanmar marks a worrying new frontier for India.[104]

Kyaukphyu's location on Myanmar's western coast places it uncomfortably close to INS Varsha, India's under-construction strategic naval facility for housing its nuclear submarines.[105] The port's proximity could allow Chinese vessels or surveillance assets to monitor SSBN movement, compromising the secrecy vital for India's second-strike capability.

The challenge is further compounded by China's broader footprint in the Bay of Bengal. In Bangladesh, the newly inaugurated submarine base at Cox's Bazar, constructed with Chinese assistance, raises the prospect of regular PLA Navy (PLAN) access.[106] While the official narrative frames it as support for the Bangladesh Navy, satellite imagery and Chinese personnel presence suggest the base could provide logistical support for Chinese submarines under the guise of training or repairs. This development places PLAN assets uncomfortably close to India's Eastern Naval Command, further crowding an already sensitive strategic theatre. Further complicating matters, the political shift in Bangladesh has deepened ties with Pakistan and China, amplifying strategic pressures on India's eastern flank. Combined with China's military pact with the Maldives and increasing influence in Sri Lanka, India faces a slow but deliberate encirclement.[107]

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China's interest in the IOR is not merely tactical but also strategic. Its energy lifelines run through these waters, and the Bay of Bengal offers Beijing a gateway to operate farther from its shores. The PLA Navy's growing blue-water ambitions, evidenced by increased submarine deployments, oceanographic surveys, and port diplomacy, signal long-term efforts to chip away at India's geographic advantage.[108] This growing presence is also likely to complicate India's ability to maintain maritime domain awareness and control over its eastern seaboard.

Beyond naval posturing, Beijing's influence is also bleeding across domains into regional politics and internal security. The Kyaukphyu project aligns with Beijing's broader Belt and Road ambitions but also intersects with insurgent networks.[109] The Arakan Army in Myanmar, with alleged ties to Chinese proxies like the Kachin Independence Army, has previously targeted Indian interests such as the Kaladan Multimodal Project.[110] A port with Chinese stakes in such a volatile region risks serving not only strategic surveillance purposes but also fueling proxy instability along India's northeastern flank.

Such a shift in political winds in South Asia has added further complexity. A post-Hasina tilt in Bangladesh toward Pakistan and China, Beijing's security pact with the Maldives, and deepening influence in Sri Lanka point to a tightening strategic ring around India. Each of these countries now hosts Chinese-built infrastructure capable of dual-use deployment, increasing the risk of surveillance and maritime denial in a crisis.

India's current naval advantages, geographic centrality in the IOR, dominant presence in the Bay of Bengal, and forward bases in the Andaman and Nicobar Islands are increasingly being challenged by China's encroachment. In response, India will need to recalibrate its regional strategy. This includes bolstering surveillance capabilities, investing in undersea warfare, and strengthening strategic partnerships with actors that have regional stakes, such as Australia, Japan, and the United States. Diplomatic outreach to counter China's influence in South Asia and a renewed focus on forward basing, including in the Lakshadweep and Andaman Islands, will also be crucial. India's SSBN survivability is no longer a question of stealth alone; it also rests on navigating a crowded, contested maritime landscape shaped as much by geopolitics as by technology.

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Catching Up

India must accelerate the modernization of its naval forces, particularly its undersea deterrent and surveillance capabilities, to maintain credible deterrence and strategic dominance in the Indian Ocean region. This includes enhancing indigenous submarine production, expanding anti-submarine warfare assets, and investing in next-generation propulsion and missile systems. It is imperative for India to prioritize and institutionalize these objectives in light of the rising instability and evolving maritime threat landscape in the region. The following specific actions could be considered:

Short-Term (5-10 years)

- Accelerate K-4 SLBM deployment: Fast-track the completion and operationalization of the K-4 missile to extend SSBN patrol range and reduce exposure near hostile waters. Address past development delays through dedicated project management and increased resource allocation.

- Advance maritime domain awareness: Integrate coastal radars, underwater sensors, and patrol aircraft to reduce surprises and ambiguity near SSBN operating zones.
- Improve communication reliability: Develop interim solutions for secure, resilient communication with SSBNs, such as mobile or sea-based relay platforms, to ensure credible command and control despite current VLF/ELF limitations.
- Enhance regional maritime partnerships: Strengthen naval cooperation and intelligence sharing with strategic partners like Sri Lanka, the Seychelles, and Mauritius to counterbalance Chinese naval influence in the Indian Ocean.
- Negotiate maritime confidence-building measures: Taking cue from and updating the INCSEA, engage China and other regional actors to implement transparency mechanisms and communication channels that reduce the risk of crisis escalation.

Medium Term

- Develop longer-range SLBMs (K-5/K-6): Expedite the development and deployment of longer-range SLBMs, such as the K-5 and K-6, to ensure a credible second-strike capability across broader strategic distances.
- Institutionalize joint naval nuclear crisis management systems: Establishing integrated crisis management protocols between civilian and military leadership is essential to ensure coordinated, real-time decision-making during maritime nuclear contingencies.
- Improve Anti-Submarine Warfare: Enhancing ASW and surveillance capabilities, critical to safeguarding India's SSBN fleet and countering undersea threats.
- Bolster Defense-Industrial base: India must also prioritize strengthening its defense-industrial base across domains—sea, air, and land—to ensure integrated force development, technological self-reliance, and long-term deterrence credibility.

Long Term

- Build a credible SSBN fleet with assured continuous deterrence: Expand shipbuilding and nuclear propulsion expertise to maintain a reliable fleet of 3-4 SSBNs.
- Invest in acoustic technologies: Advance indigenous research in propulsion systems and anechoic coatings to reduce submarine acoustic signatures and improve stealth.
- Expand SSBN support infrastructure: Conclude INS Varsha-like projects and expand crew training programs to establish regular, routine deterrent patrol cycles, to overcome bottlenecks caused by infrastructure delays.

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