

VI. Indian nuclear forces

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As of January 2022, India was estimated to have a growing stockpile of about 160 nuclear weapons—a small increase from the previous year (see table 10.7). These weapons were assigned to a maturing nuclear triad of aircraft, land-based missiles and ballistic missile submarines. The warhead estimate is based on calculations of India's inventory of weapon-grade plutonium, the estimated number of operational nuclear-capable delivery systems, India's nuclear doctrine, publicly available information on the Indian nuclear arsenal, and private conversations with defence officials.¹ The Indian government itself has not provided much public information about the size of its nuclear forces, other than conducting occasional parade displays and making announcements about missile flight tests. India has continued to expand the size and capability of its nuclear weapon inventory as well as its infrastructure for producing nuclear warheads.

The role of nuclear weapons in Indian military doctrine

Until the early 2010s, the limited ranges of India's initial nuclear systems meant that their only credible role was to deter Pakistan. However, with the development over the subsequent decade of longer-range missiles capable of targeting all of China, it appears that India has placed increased emphasis on China in recent years. It remains to be seen how this development, as well as recent border clashes with China and Pakistan, will affect India's nuclear arsenal and strategy.² While India has adhered to a nuclear no-first-use policy since 1999, this pledge was qualified by a 2003 caveat that India could use nuclear forces to retaliate against attacks by non-nuclear weapons of mass destruction (WMD).³ This 2003 statement was reaffirmed as recently as 2018, and could still be in place as official policy.⁴ Doubts about India's commitment to the no-first-use policy have increased, and although India is believed to store its warheads separate from its delivery systems, there has been increasing evidence of some parts of India's nuclear arsenal

¹ Kristensen, H. M. and Korda, M., 'Estimating world nuclear forces: An overview and assessment of sources', SIPRI Topical Background, 14 June 2021.

² On the border tensions in 2021 between China and India and between India and Pakistan see chapter 4, section III, in this volume.

³ Indian Ministry of External Affairs, 'The Cabinet Committee on Security reviews [o]perationalization of India's nuclear doctrine', Press release, 4 Jan. 2003; and Indian Embassy in Washington, DC, 'Draft report of National Security Advisory Board on Indian nuclear doctrine', 17 Aug. 1999.

⁴ Indian Prime Minister's Office, 'Prime Minister felicitates crew of INS Arihant on completion of nuclear triad', Press release, 5 Nov. 2018.

Table 10.7. Indian nuclear forces, January 2022

All figures are approximate and some are based on assessments by the authors.

Type/designation	No. of launchers	Year first deployed	Range (km) ^a	Warheads x yield ^b	No. of warheads ^c
<i>Aircraft^d</i>	48				48
Mirage 2000H	32	1985	1 850	1 x 12 kt bomb	32
Jaguar IS	16	1981	1 600	1 x 12 kt bomb	16
Rafale	–	[2022]	2 000	–	–
<i>Land-based missiles</i>	64				64
Prithvi-II	24	2003	250 ^e	1 x 12 kt	24
Agni-I	16	2007	>700	1 x 10–40 kt	16
Agni-II	16	2011	>2 000	1 x 10–40 kt	16
Agni-III	8	2018	>3 200	1 x 10–40 kt	8
Agni-IV	–	[2022]	>3 500	1 x 10–40 kt	–
Agni-V	–	[2022]	>5 000	1 x 10–40 kt	–
Agni-VI	–	[2025]	>6 000	1 x 10–40 kt	–
Agni-P	–	[2025]	1 000–2 000	[2 x 10–40 kt MIRV]	–
<i>Sea-based missiles</i>	3/14 ^f				16
Dhanush	2	2013	400	1 x 12 kt	4 ^g
K-15 (B-05) ^h	12 ⁱ	2018	700	1 x 12 kt	12
K-4	– ^j	[2025]	3 500	1 x 10–40 kt	–
<i>Other stored warheads^k</i>					32
Total stockpile	126				160^k

– = nil or a negligible value; [] = uncertain SIPRI estimate; kt = kiloton; MIRV = multiple independently targetable re-entry vehicle.

^a For aircraft, the listed range is for illustrative purposes only; actual mission range will vary according to flight profile, weapon payload and in-flight refuelling.

^b The yields of India's nuclear warheads are not known. The 1998 nuclear tests demonstrated yields of up to 12 kt. Since then, it is possible that boosted warheads have been introduced with a higher yield, perhaps up to 40 kt. There is no open-source evidence that India has developed two-stage thermonuclear warheads.

^c Aircraft and several missile types are dual-capable—that is, they can be armed with either conventional or nuclear warheads. This estimate counts an average of one nuclear warhead per launcher. All estimates are approximate.

^d Other aircraft that could potentially have a secondary nuclear role include the Su-30MKI.

^e The Prithvi-II's range is often reported as 350 kilometres. However, the United States Air Force's National Air and Space Intelligence Center sets the range at 250 km.

^f The first figure is the number of operational vessels—two ships and one nuclear-powered ballistic missile submarine (SSBN); the second is the maximum number of missiles that they can carry. India has launched two SSBNs, but only one—INS *Arihant*—was believed to be operational as of Jan. 2022, and was believed to have only a limited operational capability. The other SSBN—INS *Arighat*—was being fitted out and might become operational during or after 2022.

^g Each Sukanya-class patrol ship equipped with Dhanush missiles was thought to have possibly one reload.

^h Some sources have referred to the K-15 missile as 'Sagarika', which was the name of the missile development project rather than the missile itself.

ⁱ Each SSBN has 4 missile tubes, each of which can carry 3 K-15 submarine-launched ballistic missiles (SLBMs), for a total of 12 missiles per SSBN. SIPRI estimates that around 12 additional K-15 missiles and warheads have been produced for deployment on INS *Arighat* and might become operational during or after 2022 (see notes f and k).

^j Each missile tube will be able to carry one K-4 SLBM once it becomes operational.

^k In addition to the approximately 128 warheads estimated to be assigned to operational forces, SIPRI estimates that around 32 warheads might have been produced to arm Agni-IV and Agni-V missiles (c. 20 warheads) and K-15 missiles (c. 12 warheads for INS *Arighat*), for a total estimated stockpile of around 160 warheads. India's stockpile is expected to continue to increase.

Sources: Indian Ministry of Defence, annual reports and press releases; International Institute for Strategic Studies, *The Military Balance*, various years; US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat*, various years; Indian news media reports; *Bulletin of the Atomic Scientists*, 'Nuclear notebook', various issues; and authors' estimates.

being kept at a much higher state of readiness.⁵ This growing emphasis on increased readiness and quicker ability to launch has prompted some analysts to consider the possibility that India could be transitioning towards a counterforce nuclear posture with the goal of targeting an adversary's nuclear weapons early in a crisis, before they could be used.⁶ However, other analysts have challenged those claims, citing a lack of evidence and pointing to other ways in which declaratory policy has remained consistent.⁷

Aircraft and air-delivered weapons

Aircraft are the most mature component of India's nuclear strike capabilities. India has several types of combat aircraft with performance characteristics that make them suitable as nuclear delivery platforms, including the Mirage 2000H, Jaguar IS and Rafale. However, with the exception of the Mirage 2000H, for which there is at least one detailed source that describes how the aircraft was converted for a nuclear strike role in the 1990s, there are no official sources that confirm their nuclear-capable roles. Given this significant uncertainty, SIPRI estimates that approximately 48 nuclear bombs have been assigned to Indian aircraft.

The Indian Air Force (IAF) has reportedly certified its Mirage 2000H combat aircraft for delivery of nuclear gravity bombs.⁸ The IAF has begun upgrading 51 of these aircraft with new mission computers, radar, navigation, avionics, and communications systems, as well as a life-extension programme intended to keep the aircraft in service until the 2040s.⁹ It has also been

⁵ For further detail see Kristensen, H. M. and Korda, M., 'Indian nuclear forces', *SIPRI Yearbook 2021*.

⁶ Clary, C. and Narang, V., 'India's counterforce temptations: Strategic dilemmas, doctrine, and capabilities', *International Security*, vol. 43, no. 3 (2019); and Kaushal, S. et al., 'India's nuclear doctrine: The Agni-P and the stability–instability paradox', Royal United Services Institute (RUSI), 8 July 2021.

⁷ Rajagopalan, R., *India and Counterforce: A Question of Evidence*, ORF Occasional Paper no. 247 (Observer Research Foundation: New Delhi, May 2020).

⁸ Kampani, G., 'New Delhi's long nuclear journey: How secrecy and institutional roadblocks delayed India's weaponization', *International Security*, vol. 38, no. 4 (spring 2014), pp. 94, 97–98.

⁹ Philip, S. A., 'Why India is set to miss 2021 deadline to upgrade Mirage 2000 fighters', *The Print*, 7 Oct. 2021.

widely reported in Indian media sources that the IAF's Jaguar IS combat aircraft might also be certified to deliver nuclear gravity bombs.¹⁰

In addition to the Mirage 2000H, India has acquired 36 Rafale combat aircraft from France, scheduled for full delivery by early 2022.¹¹ According to the Indian Ministry of Defence (MOD), the 'Rafale will provide IAF the strategic deterrence and requisite capability cum technological edge'.¹² It is unclear whether this language indicates a future nuclear role for the Rafales, and there have been other instances where the Indian MOD used similar language to describe non-nuclear systems.¹³ However, at the time of the sale, Indian defence officials reportedly told the media that the decision to purchase the Rafales was based on its ability to be converted for a nuclear strike role.¹⁴

Land-based missiles

The Indian Army's Strategic Forces Command operates four types of mobile nuclear-capable ballistic missile: the short-range Prithvi-II (250 kilometres) and Agni-I (700 km); the medium-range Agni-II (>2000 km); and the intermediate-range Agni-III (>3200 km).¹⁵ As of January 2022, three new land-based ballistic missiles were in development: the Agni-P (1000–2000 km), the Agni-IV (>3500 km) and the Agni-V (>5000 km); while a variant with an even longer range, the Agni-VI (6000 km), was in the design stage of development.¹⁶

The Agni-P and Agni-V missiles achieved significant milestones in 2021, with test launches, respectively, in June and December, and in October.¹⁷ The

¹⁰ See e.g. Cohen, S. and Dasgupta, S., *Arming Without Aiming: India's Military Modernization* (Brookings Institution Press: Washington, DC, 2010), pp. 77–78; and Shukla, A., 'Jaguar fighter gets 20-year lease of life with DARIN-III avionics', *Business Standard*, 24 Nov. 2016.

¹¹ Gupta, S., '36th Rafale to have all India specific enhancements, arrives Jan 2022', *Hindustan Times*, 10 Sep. 2021; and NDTV, '3 of 4 remaining Rafale jets will arrive on time in February: Air Force chief', 18 Dec. 2021.

¹² Indian Ministry of Defence (MOD), *Annual Report 2018–19* (MOD: New Delhi, 2019), p. 43.

¹³ See e.g. Tiwary, A. K., 'IAF: The strategic force of choice', *Indian Defence Review*, vol. 22, no. 3 (July–Sep. 2007); and Major, F. H., 'Indian Air Force in the 21st century: Challenges and opportunities', *Journal of Defence Studies*, vol. 2, no. 1 (summer 2008).

¹⁴ Singh, S., 'Behind Rafale deal: Their "strategic" role in delivery of nuclear weapons', *Indian Express*, 18 Sep. 2016; and Malhotra, J., 'India favoured Rafale also because of its "nuclear advantage"', *The Print*, 15 Feb. 2019.

¹⁵ The Prithvi-II's range is often reported as 350 km. However, the range is set at 250 km in information provided by the United States. See e.g. US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat 2020* (NASIC: Wright-Patterson Air Force Base, OH, July 2020), p. 17.

¹⁶ Vikas, S. V., 'Why India may not test Agni 6 even if DRDO is ready with technology', *OneIndia*, 10 July 2019.

¹⁷ Indian Ministry of Defence (MOD), 'DRDO successfully flight tests new generation Agni P ballistic missile', Press release, 28 June 2021; Indian MOD, 'Surface to surface ballistic missile, Agni-5, successfully launched from APJ Abdul Kalam Island', Press release, 27 Oct. 2021; and Indian MOD, 'New generation ballistic missile "Agni P" successfully test-fired by DRDO', Press release, 18 Dec. 2021.

medium-range Agni-P (described by the Indian MOD as a next-generation nuclear-capable ballistic missile) reportedly incorporates technology developed specifically for the Agni-V programme, including advanced navigation and new mobile canisterized launch systems, which will reduce the time required to place the missiles on alert in a crisis.¹⁸ The solid-fuelled Agni-P can reportedly manoeuvre upon re-entry, which could allow the missile to evade regional missile defences.¹⁹ It is expected that the Agni-P will eventually replace India's first-generation Agni-I missile, and possibly the Prithvi-II and Agni-II missiles, once the system becomes operational. The three-stage, solid-fuelled Agni-V was test launched for the eighth time in October 2021.²⁰ Notably, this was the first user trial for the system, meaning that its integration into the Indian armed forces is likely to take place in 2022 or 2023.²¹

India has also begun developing a land-based, short-range version (750 km) of the K-15 submarine-launched ballistic missile (SLBM), known as the Shaurya. Because the K-15 is nuclear-capable, media reports have also widely attributed nuclear capability to the Shaurya.²² No official government statement has confirmed this, however, and with only three or four flight tests, reports about imminent deployment seem premature.²³ The United States Air Force's National Air and Space Intelligence Center (NASIC) did not mention the Shaurya in its ballistic and cruise missile reports of 2020 and 2017.²⁴ Because of the high level of uncertainty about the status of the Shaurya, it is not included in SIPRI's estimate for January 2022.

India seems to have been pursuing a technology development programme for multiple independently targetable re-entry vehicles (MIRVs). Notably, the June 2021 Agni-P test appeared to use two decoys to simulate a MIRV-equipped payload, with defence sources suggesting that a functional MIRV capability would take another two years to develop and flight test; however, given the inherent technological barriers to developing an operational MIRV

¹⁸ 'DRDO successfully flight tests new generation Agni P ballistic missile' (note 17); and Rout, H. K., 'India test fires new generation nuclear capable Agni-Prime missile off Odisha coast', *New Indian Express*, 28 June 2021.

¹⁹ Philip, S. A., 'Agni Prime is the new missile in India's nuclear arsenal. This is why it's special', *The Print*, 30 June 2021; and Zhen, L., 'India's latest Agni-P missile no great threat to China: Experts', *South China Morning Post*, 1 July 2021.

²⁰ 'Surface to surface ballistic missile, Agni-5, successfully launched from APJ Abdul Kalam Island' (note 17).

²¹ Gupta, S., 'Strategic Forces Command conducts Agni V trial, hits target 5,000 km away', *Hindustan Times*, 28 Oct. 2021.

²² See e.g. Press Trust of India, 'India successfully test-fires nuclear capable hypersonic missile Shaurya', *Hindustan Times*, 3 Oct. 2020; and Gupta, S., 'Govt okays induction of nuke-capable Shaurya missile amid Ladakh standoff', *Hindustan Times*, 6 Oct. 2020.

²³ Subramanian, T. S. and Mallikarjun, Y., 'India successfully test-fires Shaurya missile', *The Hindu*, 24 Sep. 2011; and Press Trust of India, "'Shaurya" successfully test fired', *The Hindu*, 3 Oct. 2020.

²⁴ United States Air Force (note 15), p. 17; and US Air Force, NASIC, *Ballistic and Cruise Missile Threat 2017* (NASIC: Wright-Patterson Air Force Base, OH, June 2017).

capability, it could take much longer.²⁵ It is also possible that the Agni-V, and eventually the intercontinental Agni-VI, could be equipped with MIRVs.²⁶

Sea-based missiles

With the aim of creating an assured second-strike capability, India has continued to develop the naval component of its nascent nuclear triad and build a fleet of four to six nuclear-powered ballistic missile submarines (SSBNs).²⁷ The first SSBN, INS *Arihant*, was launched in 2009, formally commissioned in 2016 and completed its first 'deterrence patrol' in 2018, although it is doubtful that the submarine's missiles carried nuclear warheads during the patrol; it is unlikely that India's submarines will carry a nuclear payload during peacetime.²⁸ SIPRI estimates that 12 nuclear warheads were delivered for potential deployment by INS *Arihant* and another 12 produced for a second SSBN, INS *Arighat*. INS *Arihant* appears to have only a limited operational capability relative to its successors, given its less powerful reactor and fewer missile tubes.

INS *Arighat* was launched in November 2017 and was undergoing advanced sea trials in 2021 ahead of its expected commissioning into the Indian Navy in 2022.²⁹ A third submarine, known as S4, was reportedly launched in November 2021, and a fourth was expected to be launched in 2023.³⁰

Photographs indicate that INS *Arihant* and INS *Arighat* have each been equipped with a four-tube vertical-launch system and could carry up to 12 two-stage, 700-km-range K-15 (which may have been renamed to the B-05) SLBMs.³¹ India's third and fourth submarines are expected to be larger than its first two. They will reportedly have eight launch tubes to hold up to 24 K-15 missiles or 8 K-4 missiles, which are in development.³²

²⁵ Pandit, R., 'Key trial of 5,000-km ICBM Agni-V in October', *Times of India*, 24 Sep. 2021.

²⁶ Rout, H. K., 'India to conduct first user trial of Agni-V missile', *New Indian Express*, 13 Sep. 2021.

²⁷ Davenport, K., 'Indian submarine completes first patrol', *Arms Control Today*, vol. 48, no. 10 (Dec. 2018).

²⁸ Dinakar, P., 'Now, India has a nuclear triad', *The Hindu*, 18 Oct. 2016; Indian Prime Minister's Office (note 4); Davenport (note 27); and Joshi, Y., 'Angels and dangles: Arihant and the dilemma of India's undersea nuclear weapons', *War on the Rocks*, 14 Jan. 2019.

²⁹ Bhattacharjee, S., 'Third Arihant class submarine quietly launched in November', *The Hindu*, 4 Jan. 2022. Until its launch, the submarine was assumed to be named INS *Aridhaman*.

³⁰ Chris Biggers (@CSBiggers), 'India quietly launched S4 in November 2021 at SBC ...', Twitter, 28 Dec. 2021; and Unnithan, S., 'A peek into India's top secret and costliest defence project, nuclear submarines', *India Today*, 10 Dec. 2017.

³¹ Indian Defence Research and Development Organisation (DRDO), 'MSS—achievements', 6 Sep. 2019.

³² Bhattacharjee (note 29); and Hans Kristensen (@nukestrat), 'New submarine cover (17°42'23"N, 83°16'23"E) constructed at Vizag is 40m longer than first one. India's third SSBN will be longer with more missile tubes than the 4 on first two boats. Current missile compartment is -15m with tubes in row instead of pairs as other navies have', Twitter, 12 Mar. 2021.

The K-4 is a two-stage, 3500-km-range SLBM being developed by the Indian Defence Research and Development Organisation (DRDO). The K-4 will eventually replace the K-15, although with only four or eight missiles per submarine, depending on the number of launch tubes.³³ The DRDO has also started to develop extended-range versions: the K-5, which will reportedly have a range in excess of 5000 km, and the K-6, which will have an even longer range.³⁴ With only two successful launches, which took place in January 2020 after two previous attempts failed, and none from a submarine, as of January 2022, the K-4 still seemed to be several years from operational capability.³⁵

India's first naval nuclear weapon, the Dhanush missile, is a version of the dual-capable Prithvi-II that can be launched from two Sukanya-class offshore patrol vessels often seen at the Mumbai and Karwar naval bases on India's west coast.³⁶ Although NASIC has listed the Dhanush system as deployed, its usefulness in combat is highly questionable, given the slow speed and high degree of vulnerability of the Sukanya-class vessels.³⁷ Therefore, the system will probably be retired when the SSBN programme with longer-range missiles matures.

Cruise missiles

There have been numerous claims in news articles and on private websites that some Indian cruise missiles are nuclear-capable. These claims concern the ground- and air-launched Nirbhay subsonic cruise missile and the supersonic air-, ground-, ship- and submarine-launched BrahMos cruise missile.³⁸ However, no official or authoritative source has attributed nuclear capability to India's cruise missiles. Therefore, they are not included in SIPRI's estimate for January 2022.

³³ Jha, S., 'India's undersea deterrent', *The Diplomat*, 30 Mar. 2016; and United States Air Force (note 15), p. 30.

³⁴ Unnithan (note 30).

³⁵ Peri, D., 'India successfully test-fires 3,500-km range submarine-launched ballistic missile K-4', *The Hindu*, 19 Jan. 2020; and Pandit, R., 'DRDO: Arihant's N-capable missile "ready to roll"', *Times of India*, 25 Jan. 2020.

³⁶ 'Nuke-capable Dhanush and Prithvi-II launched', *New Indian Express*, 12 Mar. 2011; and Indian Ministry of Defence (note 12), p. 100.

³⁷ US Air Force (note 24).

³⁸ See e.g. Pandit, R., 'India successfully tests its first nuclear-capable cruise missile', *Times of India*, 8 Nov. 2017; Gady, F.-S., 'India successfully test fires indigenous nuclear-capable cruise missile', *The Diplomat*, 8 Nov. 2017; and Mitra, J., 'Nuclear BrahMos: on the anvil?', *South Asian Voices*, 10 July 2018.