# VI. Indian nuclear forces

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India is estimated to have a growing arsenal of 130–40 nuclear weapons (see table 6.7). This figure is based on calculations of India's inventory of weapon-grade plutonium and the number of operational nuclear-capable delivery systems. India is widely believed to be gradually expanding the size of its nuclear weapon stockpile as well as its infrastructure for producing nuclear warheads.

## Military fissile material production

India's nuclear weapons are believed to be plutonium-based. The plutonium was produced at the Bhabha Atomic Research Centre (BARC) in Trombay, Mumbai, by the 40-megawatt-thermal (MW(t)) heavy water CIRUS reactor, which was shut down at the end of 2010, and the 100-MW(t) Dhruva heavy water reactor. India operates a plutonium reprocessing plant for military purposes at the BARC.[1]

India plans to build six fast breeder reactors by the 2030s, which will significantly increase its capacity to produce plutonium that could be used for building weapons.[2] An unsafeguarded 500-megawatt-electric (MW(e)) prototype fast breeder reactor (PFBR) is being built at the Indira Gandhi Centre for Atomic Research (IGCAR) complex at Kalpakkam, Tamil Nadu. The PFBR is expected to be commissioned in mid-2018 following a series of technical delays.[3] The IGCAR has announced that a fast reactor fuel cycle facility will be built at Kalpakkam to reprocess spent fuel from the PFBR and future fast breeder reactors. The plant is scheduled to be commissioned by 2022.[4]

India is currently expanding its uranium enrichment capabilities. It continues to enrich uranium at the small gas centrifuge facility at the Rattehalli Rare Materials Plant (RMP) near Mysore, Karnataka, to produce highly enriched uranium (HEU) for use as naval reactor fuel. India has begun construction of a new industrial-scale centrifuge enrichment plant, the Special Material Enrichment Facility (SMEF), at a site in Karnataka. This will be a dual-use facility that produces HEU for both military and civilian purposes.[5]

[1] International Panel on Fissile Material (IPFM), 'Facilities: reprocessing plants', 12 Feb. 2018.

[2] Ramana, M. V., 'A fast reactor at any cost: the perverse pursuit of breeder reactors in India', *Bulletin of the Atomic Scientists*, 3 Nov. 2016.

[3] *Deccan Herald*, 'Plan to make 6 N-reactors operational by 2039', 5 Nov. 2017.

[4] *The Hindu*, 'HCC to construct fuel processing facility at Kalpakkam', 7 Aug. 2017; and World Nuclear News, 'India awards contract for fast reactor fuel cycle facility', 8 Aug. 2017.

[5] Albright, D. and Kelleher-Vergantini, S., *India's Stocks of Civil and Military Plutonium and Highly Enriched Uranium, End 2014* (Institute for Science and International Security: Washington, DC,

**Table 6.7.** Indian nuclear forces, January 2018

| Type (US/Indian designation) | Launchers deployed | Year first deployed | Range (km)[a] | Warheads x yield[b] | No. of warheads[c] |
|---|---|---|---|---|---|
| *Aircraft*[d] | *48* | | | | *48* |
| Mirage 2000H | 32 | 1985 | 1 850 | 1 x bomb | 32 |
| Jaguar IS | 16 | 1981 | 1 600 | 1 x bomb | 16 |
| *Land-based ballistic missiles* | *60* | | | | *60* |
| Prithvi-II | 24 | 2003 | 250 | 1 x 12 kt | 24 |
| Agni-I | 20 | 2007 | >700 | 1 x 10–40 kt | 20 |
| Agni-II | 8 | 2011 | >2 000 | 1 x 10–40 kt | 8 |
| Agni-III | 8 | 2014 | >3 200 | 1 x 10–40 kt | 8 |
| Agni-IV | 0 | (2018) | >3 500 | 1 x 10–40 kt | 0 |
| Agni-V | 0 | (2020) | >5 200 | 1 x 10–40 kt | 0 |
| *Sea-based ballistic missiles* | *14* | | | | *16* |
| Dhanush | 2 | (2013) | 400 | 1 x 12 kt | 4[e] |
| K-15 (B05)[f] | (12)[g] | (2018) | 700 | 1 x 12 kt | (12) |
| K-4 | (4)[g] | .. | 3 500 | 1 x 10–40 kt | 0 |
| *Cruise missiles* | .. | .. | .. | .. | .. |
| Nirbhay ALCM[h] | .. | .. | (>700) | .. | .. |
| **Total** | | | | | **130–140**[i] |

.. = not available or not applicable; ( ) = uncertain figure; ALCM = air-launched cruise missile; kt = kiloton.

[a] Aircraft range is for illustrative purposes only; actual mission range will vary according to flight profile and weapon loading. Missile payloads may have to be reduced in order to achieve maximum range.

[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 2-stage thermonuclear warheads.

[c] Aircraft and several missile types are dual-capable. Cruise missile launchers carry more than 1 missile. This estimate counts an average of 1 warhead per launcher. Warheads are not deployed on launchers but kept in separate storage facilities. All estimates are approximate.

[d] Other fighter-bombers that could potentially have a secondary nuclear role include the Su-30MKI.

[e] Each Dhanush-equipped ship is thought to have possibly 1 reload.

[f] Some sources have referred to the K-15 submarine-launched ballistic missile (SLBM) as Sagarika, which was the name of the missile development project.

[g] The K-15 and K-4 use the same 4 launch tubes on the *INS Arihant* nuclear-powered ballistic missile submarine (SSBN). Each launch tube can hold either 3 K-15s contained in a triple-missile canister or 1 of the larger K-4 SLBMs (once the K-4 becomes operational). Thus, according to the US Air Force National Air and Space Intelligence Center (NASIC), the K-15 has 12 possible launchers and the K-4 has 4.

[h] There are reports that the Nirbhay, which is in development, might have a nuclear capability, but the Indian Government has not confirmed them.

[i] In addition to the 124 warheads estimated to be assigned to fielded launchers, warheads for additional Agni-III and future Agni-IV medium-range ballistic missiles may already have been produced giving a total stockpile of 130–40 warheads.

*Sources*: Indian Ministry of Defence, annual reports and press releases; International Institute for Strategic Studies, *The Military Balance 2018* (Routledge: London, 2018); US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat*, various years; Indian news media reports; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and authors' estimates.

India's expanding centrifuge enrichment capacity is motivated by plans to build new naval propulsion reactors. However, the HEU produced at the plants could also hypothetically be used to manufacture thermonuclear or boosted-fission nuclear weapons.[6]

## Aircraft

Aircraft constitute the most mature component of India's nuclear strike capabilities. The Indian Air Force has reportedly certified the Mirage 2000H multi-role combat aircraft for delivery of nuclear gravity bombs.[7] It is widely speculated that the Air Force's Jaguar IS fighter-bomber may also have a nuclear delivery role.[8]

## Land-based missiles

Under its Integrated Guided Missile Development Programme, which began in 1983, India's Defence Research and Development Organization (DRDO) has developed two families of nuclear-capable, land-based ballistic missiles: the Prithvi family (although only the Prithvi-II is thought to be nuclear-capable), consisting of three types of road-mobile, short-range missiles; and the Agni family of longer-range, solid-fuelled ballistic missiles. The latter are designed to provide a quick-reaction nuclear capability and have taken over much of the Prithvi's nuclear delivery role.

The Agni-I is a single-stage, road-mobile missile that has a range of 700 kilometres. The nuclear-capable missile was first deployed in 2007. The Agni-II is a two-stage, solid-fuelled rail-mobile ballistic missile that can deliver a 1000-kilogram payload to a range exceeding 2000 km. The missile is in service with the Indian Army under the Strategic Forces Command (SFC), which is the body responsible for exercising operational command and control over the country's nuclear weapons. The Agni-II appears to have been plagued by technical problems; according to estimates in 2017,

2 Nov. 2015).

[6] Levy, A., 'India is building a top-secret nuclear city to produce thermonuclear weapons, experts say', *Foreign Policy*, 16 Dec. 2015.

[7] 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.

[8] Cohen, S. and Dasgupta, S., *Arming Without Aiming: India's Military Modernization* (Brookings Institution Press: Washington, DC, 2010), pp. 77–78; and India Defence Update, 'SEPECAT Jaguar is India's only tactical nuclear carrying and ground attack aircraft', 13 Dec. 2016.

fewer than 10 launchers have been deployed.[9] On 4 May 2017 a user trial of an Agni-II failed when the test had to be aborted shortly after the launch of the missile. Indian defence officials did not comment on the cause of the failure.[10]

The Agni-III is a two-stage, rail-mobile missile with a range exceeding 3200 km. It was inducted into service in 2011 but, according to estimates in 2017, fewer than 10 launchers have been deployed.[11] On 27 April 2017 the SFC successfully test launched an Agni-III as part of a user training exercise. The missile was randomly chosen from the production lot.[12]

India is developing two longer-range ballistic missiles, the Agni-IV and the Agni-V, which would give it the capability to strike targets throughout China for the first time. The two-stage, road-mobile Agni-IV missile, which has a range of over 3500 km, is in development and undergoing user trials. An Agni-IV was successfully test launched by the SFC on 2 January 2017—the sixth consecutive successful test of the missile.[13]

The DRDO has prioritized the development of the three-stage, road-mobile Agni-V missile with a range in excess of 5000 km. Unlike the other Agni missiles, the Agni-V is designed to be stored in and launched from a new mobile canister system, an arrangement that, among other things, increases operational readiness by reducing the time required to place the missiles on alert in a crisis.[14] On 18 January 2018 an Agni-V missile was test launched from a sealed canister mounted on a truck located at the Integrated Test Range complex on Abdul Kalam Island (formerly Wheeler Island). The missile flew on a programmed trajectory for 4900 km. This was the third consecutive launch from a canister on a road-mobile launcher and the fifth successful flight test of the Agni-V since 2012.[15] The missile will undergo several additional test flights before it is inducted into service.

India is pursuing a technology development programme for multiple independently targetable re-entry vehicles (MIRVs). However, there are conflicting statements from DRDO officials as to whether India will deploy MIRVs on the Agni-V or a future Agni-VI with an even longer range.[16] The

[9] US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, OH, July 2017), p. 25.

[10] Pandit, R., 'Trial of Agni-II ballistic missile fails: sources', *Times of India*, 4 May 2017.

[11] US Air Force, National Air and Space Intelligence Center (note 9).

[12] *New Indian Express*, 'India successfully test fires nuclear capable Agni-III missile off Odisha coast', 27 Apr. 2017.

[13] Subramanian, T. S., 'Agni-IV test a "grand success"', *The Hindu*, 2 Jan. 2017.

[14] Aroor, S., 'New chief of India's military research complex reveals brave new mandate', *India Today*, 13 July 2013.

[15] Gurung, S. K., 'India successfully test-fires nuclear-capable Agni-5 ballistic missile', *Economic Times*, 18 Jan. 2018.

[16] Basrur, R. and Sankaran, J., 'India's slow and unstoppable move to MIRV', eds M. Krepon, T. Wheeler and S. Mason, *The Lure and Pitfalls of MIRVs: From the First to the Second Nuclear Age* (Stimson Center: Washington, DC, May 2016), pp. 149–76.

Agni-VI is in the design phase and awaiting approval but may begin testing as early as 2018.

### Sea-based missiles

India continues to develop the naval component of its triad of nuclear forces in pursuit of an assured second-strike capability. It is building a fleet of up to five nuclear-powered ballistic missile submarines (SSBNs) as part of its four-decade-old Advanced Technology Vessel project.

India's first indigenously built SSBN, the *INS Arihant*, was launched in 2009 and formally commissioned in 2016.[17] According to Indian media reports in January 2018, the *Arihant* had been out of service for 10 months for repairs after its propulsion compartment suffered significant flood damage when a hatch was left open by mistake while leaving harbour.[18] A second SSBN, the *INS Arighat* (originally thought to have been named *Aridhaman*), was launched in November 2017.[19] Construction work has reportedly begun on a third and fourth submarine, with expected launch dates in 2020 and 2022, respectively.[20]

The *Arihant* is equipped with a four-tube vertical launch system and will carry up to 12 two-stage, 700-km range K-15 (also known as B05) submarine-launched ballistic missiles (SLBMs). Unconfirmed reports have claimed that the *Arighat* is equipped with eight launch tubes to carry up to 24 K-15 missiles (three per launch tube), but the United States Air Force National Air and Space Intelligence Center made no mention of additional launch tubes on a second submarine in its 2017 assessment of ballistic missile and cruise missile threats.[21] In November 2015 the SFC and the DRDO conducted an underwater ejection test of a dummy missile, reportedly from the *Arihant*, but the maiden flight test of a K-15 from the submarine had not been conducted as of the end of 2017.[22]

The DRDO is developing a two-stage, 3500-km range SLBM, known as the K-4, that will eventually replace the K-15.[23] The *Arihant* will be capable of carrying four K-4s but the *Arighat* and subsequent SSBNs will be able

[17] Dinakar, P., 'Now, India has a nuclear triad', *The Hindu*, 18 Oct. 2016.

[18] Peri, D. and Joseph, J., '*INS Arihant* left crippled after "accident" 10 months ago', *The Hindu*, 8 Jan. 2018.

[19] Gady, F. S., 'The Indian Navy's second nuclear-powered ballistic missile submarine was quietly launched in November', The Diplomat, 13 Dec. 2017.

[20] Unnithan, S., 'A peek into India's top secret and costliest defence project, nuclear submarines', *India Today*, 10 Dec. 2017.

[21] Indian Defence Update, 'India's 2nd nuclear submarine "*INS Aridhaman*" to be deadlier than *INS Arihant*', 27 Dec. 2016; and US Air Force, National Air and Space Intelligence Center (note 9).

[22] Indian Defence News, 'Confirmed: first ejection test of K-15 (B-05) SLBM from *INS Arihant* SSBN', 28 Nov. 2015.

[23] Jha, S., 'India's undersea deterrent', The Diplomat, 30 Mar. 2016; and US Air Force, National Air and Space Intelligence Center (note 9), p. 33.

to carry eight. On 17 December 2017 the test launch of a K-4 missile from an underwater pontoon in the Bay of Bengal failed. Indian officials did not release information on the cause of the failure.[24] The missile had previously been tested four times, including a test launch from the *Arihant* in 2016.[25] The DRDO is currently developing a K-5 SLBM, which is expected to have a range in excess of 5000 km, and has announced plans to develop a longer-range K-6 SLBM.[26]

The nuclear-capable Dhanush missile is a naval version of the Prithvi-II that is launched from a surface ship. It can reportedly carry a 500-kg warhead to a maximum range of 400 km and is designed to be able to hit both sea- and shore-based targets.[27] The Dhanush has been inducted into service with the Indian Navy on two Sukanya class coastal patrol ships based at the naval base near Karwar on the west coast of India.

### Cruise missiles

The DRDO has been developing a long-range subsonic cruise missile since 2004. Known as the Nirbhay, it has a range exceeding 700 km and is believed to have ground-, sea- and air-launched versions. Development of the missile has been delayed by technical problems with its flight control software and navigation system. Following a second consecutive failed test flight in December 2016, sources within the DRDO indicated that the Nirbhay programme was likely to be terminated.[28] However, on 7 November 2017 the Indian Ministry of Defence announced that the DRDO had conducted a successful test flight of a Nirbhay cruise missile at the Integrated Test Range on Abdul Kalam Island that 'had achieved all the mission objectives'.[29] The Indian Government has not confirmed media reports that the Nirbhay has the capability to carry nuclear warheads.[30]

[24] Pubby, M., 'Setback for Indian missile programme: two failures in a week, submarine version stuck', *The Print*, 24 Dec. 2017.

[25] Rout, H. K., 'Maiden test of undersea K-4 missile from Arihant submarine', *New Indian Express*, 9 Apr. 2016.

[26] Unnithan (note 20); and Jha (note 23).

[27] Mallikarjun, Y., 'Dhanush missile successfully test-fired from ship', *The Hindu*, updated 3 Nov. 2016; and US Air Force, National Air and Space Intelligence Center (note 9), p. 33.

[28] Subramanian, T. S., 'Nirbhay missile test "an utter failure"', *The Hindu*, 21 Dec. 2016; and Rout, H. K., 'DRDO's cruise missile project Nirbhay on verge of closure', *New Indian Express*, 23 Dec. 2016.

[29] Indian Ministry of Defence, Press Information Bureau, 'DRDO conducts successful flight trial of "Nirbhay" sub-sonic cruise missile', 7 Nov. 2017.

[30] Pandit, R., 'India successfully tests its first nuclear-capable cruise missile', *Times of India*, 8 Nov. 2017; and Gady, F. S., 'India successfully test fires indigenous nuclear-capable cruise missile', The Diplomat, 8 Nov. 2017.