# VI. Indian nuclear forces

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India is estimated to have an arsenal of 80–100 nuclear weapons. This figure is based on calculations of India's inventory of weapon-grade plutonium as well as the number of operational nuclear-capable delivery systems.

India's nuclear weapons are believed to be plutonium-based. As of 2011 India's military plutonium stockpile was estimated to be between 0.38 and 0.66 tonnes (see section X below). The plutonium was produced 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. Both are located at the Bhabha Atomic Research Centre near Mumbai, Maharashtra. India has plans to build six fast breeder reactors, which will significantly increase its capacity to produce plutonium for weapons. A 1250 MW(t) prototype fast breeder reactor is nearing completion at Kalpakkam, Tamil Nadu, which also houses a reprocessing facility that is not subject to International Atomic Energy Agency (IAEA) safeguards. The reactor is scheduled to be commissioned in June 2012.[1] At 75 per cent operating capacity, it could potentially produce around 140 kilograms of weapon-grade plutonium per year, or enough for 28–35 weapons depending on bomb design and fabrication skills.[2]

India continues to enrich uranium at the centrifuge facility at Rattehalli Rare Materials Plant near Mysore, Karnataka, to produce highly enriched uranium (HEU) for use as naval reactor fuel. The Indian Atomic Energy Commission has announced plans to build a 'special material enrichment facility', at a site in Chitradurga district, Karnataka, which potentially could be used to produce HEU for weapons, among other purposes.[3]

India's nuclear doctrine is based on the principle of a minimum credible deterrent and no-first-use of nuclear weapons.[4] There have been no official statements specifying the size of the arsenal required for 'minimum credible deterrence' but, according to the Indian Ministry of Defence (MOD), it involves 'a mix of land-based, maritime and air capabilities'.[5] In May 2011 the Indian Prime Minister, Manmohan Singh, convened a meeting of

[1] Kanavi, S., 'Why India's fast breeder programme is cutting edge', Rediff.com, 13 June 2011, <http://www.rediff.com/news/slide-show/slide-show-1-why-indias-fast-breeder-programme-is-cutting-edge/20110613.htm>.

[2] Cochran, T. B. et al., *Fast Breeder Reactor Programs: History and Status* (International Panel on Fissile Materials: Princeton, NJ, Feb. 2010), pp. 41, 45.

[3] Jha, S., 'Enrichment capacity enough to fuel nuke subs', IBNLive, 26 Nov. 2011, <http://ibnlive.in.com/news/enrichment-capacity-enough-to-fuel-nuke-subs/206066-61.html>.

[4] Indian Ministry of External Affairs, 'Draft report of National Security Advisory Board on Indian nuclear doctrine', 17 Aug. 1999, <http://www.mea.gov.in/mystart.php?id=51515763>.

[5] Indian Ministry of Defence (MOD), *Annual Report 2004–05* (MOD: New Delhi, 2005) p. 14.

India's Nuclear Command Authority (NCA), the body responsible for overseeing the country's nuclear arsenal, to assess progress towards the goal of achieving an operational 'triad' of nuclear forces.[6]

### Strike aircraft

Aircraft constitute the most mature component of India's nuclear strike capabilities (see table 7.7). The Indian Air Force (IAF) has reportedly certified the Mirage 2000H multi-role combat aircraft for delivery of nuclear gravity bombs. The IAF's Jaguar IS Shamsher and Sukhoi Su-30MKI combat aircraft have also been mentioned as having a possible nuclear role.[7] The Indian Strategic Forces Command (SFC) has reportedly submitted a proposal to the MOD for setting up two dedicated squadrons of fighter aircraft for the nuclear delivery role under its command.[8]

### Land-based missiles

The Prithvi short-range ballistic missile was India's sole operational ballistic missile for many years. The 150 kilometre-range Prithvi I is a single-stage, road-mobile, liquid-fuelled missile that was inducted into Indian Army service in 1994. A number of Prithvi I missiles are widely believed to have been modified for a nuclear delivery role, although this has never been officially confirmed. The Prithvi II is a longer-range variant that is rumoured to also have a nuclear role. In 2011 the SFC conducted three successful launches of Prithvi II missiles—on 11 March, 9 June and 26 September—during routine exercises.[9] Pakistan complained that India had failed to inform it in advance about the March test launch, as required under a 1991 bilateral agreement on missile test notifications.[10]

Indian defence sources indicate that the family of longer-range Agni ballistic missiles, which are designed to provide a quick-reaction nuclear

[6] The NCA comprises the political council, chaired by the prime minister, and the executive council, chaired by the national security adviser to the prime minister. The NCA's directives are operationalized by a Strategic Forces Command under the control of a commander-in-chief. Pandit, R., 'Manmohan Singh takes stock of country's nuclear arsenal', *Times of India*, 17 May 2011.

[7] Naik, P. V., 'IAF aiming for diverse capabilities, says vice chief of air staff, Air Marshall P. V. Naik in his keynote address on fighter technology and advance systems', India Strategic, 26 Sep. 2008, <http://www.indiastrategic.in/topstories178.htm>.

[8] Press Trust of India, 'Strategic Command to acquire 40 nuclear capable fighters', *Hindustan Times*, 12 Sep. 2010.

[9] 'Prithvi-II ballistic missile test-fired successfully', *Indian Express*, 26 Sep. 2011; Mallikarjun, Y., 'Prithvi-II successfully flight-tested', *The Hindu*, 9 June 2011; and 'Prithvi II, Dhanush test-fired successfully', *Times of India*, 11 Mar. 2011.

[10] 'Pakistan test-fires Abdali missile', *Dawn*, 26 Mar. 2011.

**Table 7.7.** Indian nuclear forces, January 2012

| Type | Range (km)[a] | Payload (kg) | Status |
|---|---|---|---|
| *Aircraft*[b] | | | |
| Mirage 2000H Vajra | 1 850 | 6 300 | Has reportedly been certified for delivery of nuclear gravity bombs |
| *Land-based ballistic missiles*[c] | | | |
| Prithvi I/II | 150/250 | 800/500 | Prithvi I entered service in 1994; Prithvi I reportedly had a nuclear capability and Prithvi II also is widely rumoured to have nuclear capability, but any nuclear role is probably diminishing with the introduction of the Agni; fewer than 50 launchers deployed; most recent test flight on 26 Sep. 2011 |
| Agni I[d] | ~700 | 1 000 | Most recent Indian Army operational test on 1 Dec. 2011 |
| Agni II | 2 000 | 1 000 | Successful test launch on 30 Sep. 2011; operational status uncertain |
| Agni III | ~3 000 | 1 500 | In production and inducted into army service |
| Agni IV[e] | >3 000 | 1 000 | Under development; test launched to 3000 km on 15 Nov. 2011 |
| Agni V | >5 000 | 1 000 | Under development; test launch planned for 2012 |
| *Sea-based ballistic missiles* | | | |
| Dhanush | 350 | 500 | Test-launched on 11 Mar. 2011; induction under way but not thought to be operational |
| K-15[f] | 700 | 500–600 | Under development; test-launched from a submerged pontoon on 26 Feb. 2008 |
| K-4 | 3 500 | 1 000 | Developmental tests of gas booster reportedly carried out in Jan. 2010 |

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

[b] The Jaguar IS Shamsher and Sukhoi Su-30MKI combat aircraft have also been mentioned as having a possible nuclear delivery role.

[c] India has also begun developing a subsonic cruise missile with a range of 1000 km, known as the Nirbhay (Fearless), which may have a nuclear capability.

[d] The original Agni I, now known as the Agni, was a technology demonstrator programme that ended in 1996. The Indian Ministry of Defence refers to Agni I as A1.

[e] A previous version was known as the Agni II Prime.

[f] A land-based version of the K-15, known as the Shourya, was test-launched for the first time on 12 Nov. 2008 and again on 24 Sep. 2011.

*Sources*: Indian Ministry of Defence, annual reports and press releases; International Institute for Strategic Studies, *The Military Balance 2010* (Routledge: London, 2010); US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, OH, June 2009); Indian news media reports; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and authors' estimates.

capability, has largely taken over the Prithvi's nuclear delivery role. Like the Prithvi, the Agni was developed by India's Defence Research and Development Organisation (DRDO) as a part of its problem-plagued integrated guided missile development programme.[11] The 700-km-range Agni I (designated the A1 by the Indian MOD) is a single-stage, solid-fuelled missile that is deployed with the Indian Army's 334 Missile Group. On 1 December 2011 an Agni I missile was test-fired from a road-mobile launcher during an army training exercise.[12] The Agni II is a two-stage solid-fuelled missile that can deliver a 1000-kg payload to a maximum range of 2000 km. On 30 September 2011 the SFC successfully launched an Agni II from the Wheeler Island complex on the Orissa coast. This marked the second successful test launch of the missile following two failures in 2009.[13]

The DRDO has been developing a variant of the Agni II, known previously as the Agni II Prime but redesignated as the Agni IV. According to DRDO officials, the two-stage Agni IV incorporates several technological advances, including composite rocket engines, improved stage separation and a state-of-the-art navigational system.[14] On 15 November 2011 an Agni IV was successfully launched from the Wheeler Island complex and travelled 3000 km to a target zone in the Bay of Bengal.[15] The DRDO plans for the Agni IV to be inducted into army service in 2014, following two to four more flight tests.[16]

The DRDO has also developed the Agni III, a two-stage, solid-fuelled missile capable of delivering a 1500-kg payload to a range of 3000–3500 km. In June 2011 Vijay Kumar Saraswat, the director-general of the DRDO, said that the missile had been inducted into army service and was in production.[17]

The DRDO has prioritized the development of the three-stage, road-mobile Agni V. With a range of 5000 km, the missile will be capable of reaching targets throughout most of China. The first test launch of the Agni V had been expected by the end of 2011 but did not take place until 19 April 2012.[18]

[11] Verma, B., 'How DRDO failed India's military', Rediff, 15 Jan. 2008, <http://www.rediff.com/news/2008/jan/15guest.htm>.

[12] Indian Ministry of Defence, Press Information Bureau, 'Army conducts successful flight test of missile Agni A1-06', 1 Dec. 2011, <http://pib.nic.in/newsite/erelease.aspx?relid=77985>.

[13] Subramanian, T. S., and Mallikarjun, Y., 'Agni-II soars in success', *The Hindu*, 30 Sep. 2011.

[14] Pandit, R., 'With China in mind, India tests new-generation Agni missile with high "kill efficiency"', *Times of India*, 16 Nov. 2011.

[15] Subramanian, T. S., 'Agni-IV test-flight a "stupendous success"', *The Hindu*, 15 Nov. 2011.

[16] Shukla, A., 'DRDO plans early entry of Agni-4 into arsenal', *Business Standard*, 17 Dec. 2011.

[17] Press Trust of India, 'India to test fire Agni-V by year-end', *The Hindu*, 3 June 2011.

[18] Pandit, R., 'Eyeing China, India to enter ICBM club in 3 months', *Times of India*, 17 Nov. 2011.

### Sea-based missiles

The DRDO has tested components of an underwater missile launch system and is developing a two-stage ballistic missile that can be launched from a submerged submarine using a gas-charged booster.[19] Indian MOD statements have designated the missile as the K-15 or B-05, although other sources have referred to it as Sagarika (Oceanic), which is the name of the DRDO development project.[20] The new nuclear-capable missile will be able to deliver a 500-kg payload to a distance of up to 700 km. A land-based variant of the K-15, called the Shourya, was successfully test-launched for the third time on 24 September 2011.[21]

The DRDO is also developing a new submarine-launched ballistic missile, known as the K-4, which may have a range of up to 3500 km.[22] The K-4 will eventually replace the K-15 missile in arming an indigenously constructed nuclear-powered ballistic missile submarine that is the product of India's Advanced Technology Vessel (ATV) programme. The first of the submarines, the INS *Arihant*, was launched in 2009 and is expected to begin sea trials in 2012. The new submarine can carry either 12 K-15 or 4 K-4 missiles.[23]

India also continues to work on the Dhanush missile, a naval version of the Prithvi II, which is launched from a stabilization platform mounted on a surface ship. It can reportedly carry a 500-kg warhead to a maximum range of 350 km and is designed to be able to hit both sea- and shore-based targets. A Dhanush was successfully test-launched from an Indian Navy ship, the INS *Suvarna*, off the coast of Orissa on 11 March 2011.[24]

[19] Unnithan, S., 'The secret "K" missile family', *India Today*, 20 Nov. 2010; and Subramanian, T. S., 'DRDO plans another K-15 missile launch', *The Hindu*, 28 Jan. 2011.

[20] Subramanian (note 19).

[21] Subramanian, T. S. and Mallikarjun, Y., 'India successfully test-fires Sourya missile', *The Hindu*, 24 Sep. 2011.

[22] Unnithan (note 19).

[23] Press Trust of India, 'Nuclear sub Arihant to start sea trials in some months: Verma', IBN Live, 2 Dec. 2011, <http://ibnlive.in.com/generalnewsfeed/news/nuclear-sub-arihant-to-start-sea-trials-in-some-months-ver ma/921449.html>; and 'India to achieve N-arm triad in February', *Times of India*, 2 Jan. 2012.

[24] Shukla, A., 'Strategic Forces Command tests Prithvi and Dhanush missiles', Indian Military.org, 12 Mar. 2011, <http://www.indian-military.org/news-archives/indian-air-force-news/1428-strategic-forces-command-test-prithvi-and-dhanush-missiles.html>.