VI. Indian nuclear forces

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India is estimated to have an arsenal of 90–110 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 2013 India's weapon-grade plutonium stockpile was estimated to be 360–780 kilogrammes (see section X below). The plutonium was produced at the Bhabha Atomic Research Centre (BARC) near Mumbai, Maharashtra, 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. To replace the CIRUS, construction of a new higher-power 'multi-purpose high flux reactor' similar to the Dhruva reactor is under way at the new BARC complex near the port city of Visakhapatnam (also know as Vizag), Andhra Pradesh. It is scheduled to begin operation in 2017–18.[1]

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 (PFBR) is nearing completion at the Indira Gandhi Centre for Atomic Research (IGCAR) complex at Kalpakkam, Tamil Nadu, which also houses a reprocessing facility that is not subject to International Atomic Energy Agency (IAEA) safeguards. It is expected to achieve first criticality during 2014, to be followed by an extended period of testing.[2] At 75 per cent operating capacity, the unsafeguarded liquid sodium-cooled reactor could potentially produce around 140 kg of weapon-grade plutonium per year, or enough for 28–35 weapons depending on bomb design and fabrication skills.[3]

India is currently expanding its uranium-enrichment capabilities, primarily to produce highly enriched uranium (HEU) for use as naval reactor fuel. It continues to enrich uranium at the small centrifuge facility at Rattehalli Rare Materials Plant (RMP) near Mysore, Karnataka.[4] In 2013 non-governmental analysts concluded, based on commercial satellite imagery, that India was building what appeared to be a second facility at the RMP

[1] TNN, 'BARC to set up centre in Vizag', *Times of India*, 24 July 2009; Jha, S., '"Enrichment capacity enough to fuel nuke subs"', IBN Live, 26 Nov. 2011, <http://ibnlive.in.com/news/enrichment-capacity-enough-to-fuel-nuke-subs/206066-61.html>; and International Panel on Fissile Materials (IPFM), *Global Fissile Material Report 2011: Nuclear Weapon and Fissile Material Stockpiles and Production* (IPFM: Princeton, NJ, 2011).

[2] '"PFBR at Kalpakkam will go critical in a year"', *The Hindu*, 15 Sep. 2013.

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

[4] Kelley, R. and Cloughey, B., 'Nuclear option: India increases it uranium enrichment programme', *Jane's Intelligence Review*, July 2014, pp. 8–15.

that could support an increasing number of centrifuges for uranium enrichment.[5] In addition, India has begun preliminary work on a new industrial-scale centrifuge enrichment plant, the Special Material Enrichment Facility, at a site in Chitradurga district, Karnataka, which will not be under IAEA safeguards.[6] Although India's expanded centrifuge enrichment capacity has been motivated by plans to build new naval propulsion reactors, the potential excess capacity could also signify an intention to move towards thermonuclear weapons by combining the current plutonium arsenal with HEU secondaries.[7]

India's nuclear doctrine is based on the principle of a minimum credible deterrent and no-first-use of nuclear weapons.[8] There has been no official statement specifying the size of the arsenal required for 'minimum credible deterrence'. However, according to the Indian Ministry of Defence (MOD), it involves 'a mix of land-based, maritime and air capabilities'.[9] Indian leaders have reportedly prioritized the full development of such a triad of nuclear forces as the basis for the country's deterrence posture.[10]

The National Command Authority (NCA) has overall responsibility for India's nuclear deterrent. The NCA comprises the Political Council, chaired by the prime minister, and the Executive Council, chaired by the prime minister's national security adviser. The Political Council is the sole body that can authorize the use of nuclear weapons by India. The NCA's directives are operationalized by a Strategic Forces Command (SFC), which is the body responsible for the operational management, command and control of India's nuclear forces.[11]

Aircraft

Aircraft constitute the most mature component of India's nuclear strike capabilities (see table 6.7). 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 and Sukhoi Su-30MKI combat aircraft have also been mentioned as having a possible nuclear role.

[5] Albright, D. and Kelleher-Vergantini, S., 'Construction finishing of likely new Indian centrifuge facility at Rare Materials Plant', Institute for Science and International Security (ISIS) Imagery Brief, 4 Dec. 2013, <http://isis-online.org/isis-reports/detail/construction-finishing-of-likely-new-indian-centrifuge-facility-at-rare-mat/>.

[6] Albright and Kelleher-Vergantini (note 5).

[7] Kelley and Cloughey (note 4).

[8] 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>.

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

[10] Pandit, R., 'PM takes stock of country's nuclear arsenal', *Times of India*, 14 June 2012.

[11] Saran, S., 'India's nuclear weapons not for national pride', *The Tribune* (Chandigarh), 9 May 2013; and Sidhu, W. P. S., 'India', eds H. Born, B. Gill and H. Hänggi, SIPRI, *Governing the Bomb: Civilian Control and Democratic Accountability of Nuclear Weapons* (Oxford University Press: Oxford, 2010), pp. 180–81.

Table 6.7. Indian nuclear forces, January 2014

Type	Range (km)[a]	Payload (kg)	Status
Aircraft[b]			
Mirage 2000H	1 850	6 300	Reportedly certified for delivery of nuclear gravity bombs
Jaguar IS	1 400	4 760	Some of 4 squadrons may have a nuclear delivery role
Land-based ballistic missiles			
Prithvi II	350	500	Inducted into the Strategic Forces Command in 2003; the nuclear role for the SRBM is probably diminishing with introduction of the Agni; fewer than 50 Prithvi launchers deployed; most recent flight test on 7 Jan. 2014
Agni I[c]	~700	1 000	Most recent Indian Army operational tests on 7 Nov. 2013; deployed with the Indian Army's 334 Missile Group
Agni II	>2 000	1 000	Possibly operational; test launched on 7 Apr. 2013
Agni III	>3 200	1 500	'Inducted' into the armed forces but not fully operational; test launched on 23 Dec. 2013
Agni IV	>3 500	1 000	Under development; fourth launch on 20 Jan. 2014, after which the MOD stated that the missile 'is now ready for induction and its serial production will now begin'
Agni V	>5 000	(1 000)	Under development; test launched on 15 Sep. 2013
Sea-based ballistic missiles			
Dhanush	400	500	'Induction' under way but probably not operational; test launched on 24 Nov. 2013
K-15 (B-05)	700	500–600	Under development; test launched from a submerged pontoon on 27 Jan. 2013; will probably test launch from the INS *Arihant* in 2014 or 2015
K-4	~3 000	. .	Under development; reportedly test launched from a submerged platform on 24 Mar. 2014

. . = not available or not applicable; ( ) = uncertain figure; MOD = Ministry of Defence; SRBM = short-range ballistic missile.

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

[c] The original Agni I, now known as the Agni, was a technology demonstrator programme that ended in 1996. The Indian MOD refers to the current Agni I as the A1.

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, July 2013); Indian news media reports; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and authors' estimates.

Land-based missiles

The Prithvi short-range ballistic missile (SRBM) was India's sole operational ballistic missile for many years. The 150 kilometre-range Prithvi I, a single-stage, road-mobile, liquid-fuel missile inducted into Indian Army service in 1994, was widely believed to have been modified for a nuclear delivery role. In June 2013 the Defence Research and Development Organisation (DRDO) announced that the Prithvi I would be withdrawn from service and replaced by the new solid-fuel Prahar tactical ballistic missile, which can be fired in salvo mode from a single launcher.[12] It is unclear whether the 150 km-range Prahar has a nuclear weapon delivery role. The longer-range Prithvi II, which was inducted into service with the Indian Army and Air Force in 2003, has been declared to have a nuclear role.[13]

India's land-based nuclear ballistic missile development is now dominated by the family of longer-range Agni ballistic missiles. Like the Prithvi, the Agnis are developed by the DRDO as part of its Integrated Guided Missile Development Programme. The road-mobile Agni I is a single-stage, solid-fuelled SRBM that became operational in 2007. An estimated 20 launchers are fielded with one or two missile groups.

The rail-mobile, two-stage Agni II medium-range ballistic missile (MRBM) became operational in 2011 after some delay. An estimated 10 launchers are deployed in a single missile group. An army user-readiness flight test was conducted on 7 April 2013 at the Integrated Test Range (ITR) complex located on Wheeler Island, off the Odisha coast.[14]

The two-stage, solid-fuelled, rail-mobile Agni III intermediate-range ballistic missile (IRBM) is in the final stages of induction into the Indian Army. The latest flight test—reportedly the SFC's second user trial of the missile—was conducted on 23 December 2013.[15] The Agni III is the first Indian nuclear-capable missile that can reach Beijing, China, from Indian territory. It is expected to become operational in the near future.

The DRDO has been developing the Agni IV IRBM, a variant of the Agni II previously known as the Agni II Prime. 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.[16] Following a successful test on

[12] Press Trust India, 'Prithvi missiles to be replaced by more-capable Prahar: DRDO', *Hindustan Times*, 30 June 2013.

[13] Indian Press Information Bureau, 'Prithvi does it again," 8 Oct. 2013, <http://pib.nic.in/newsite/pmreleases.aspx?mincode=33>.

[14] Indian Press Information Bureau, 'Agni-2 launched: accurately hits target area', 7 Apr. 2013, <http://pib.nic.in/newsite/erelease.aspx?relid=94527>.

[15] Indian Press Information Bureau, 'Agni-3 launch, a flawless mission', 23 Dec. 2013, <http://pib.nic.in/newsite/erelease.aspx?relid=102101>.

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

20 January 2014, the DRDO announced that it had approved the start of serial production of the missile.[17]

To enable targeting of all Chinese territory from bases further back from India's border with China, the DRDO is developing the three-stage Agni V missile with a near-intercontinental range 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 to enhance, among other things, the 'operational readiness' of the weapon, according to the Indian Government.[18] Since Indian missiles are not kept on alert in peacetime, increasing operational readiness reduces the time required to place the missiles on alert in a crisis.[19] Claims made by the DRDO that the Agni V will be deployed by 2015 are probably premature.[20]

DRDO officials are on record saying that India will deploy multiple warheads on some of its long-range missiles, including the Agni V and a future Agni VI with an even longer range. However, it is unclear whether the Indian Government at this point has authorized development of multiple independently targetable re-entry vehicles (MIRVs). DRDO officials, sometime the same individuals, are also on record saying 'there are no plans' for the Agni V to eventually carry MIRVed warheads.[21]

In addition to its ballistic missiles, India has also begun developing a new subsonic ground-launched cruise missile, known as the Nirbhay. A test launch of the Nirbhay failed on 12 March 2013 when it veered off course and was destroyed.[22] The missile, which has a range of 700–1000 km, appears similar to Pakistan's Babur cruise missile and the US Tomahawk cruise missile. It is widely rumoured to be nuclear capable but there is no official confirmation of such a capability.

Sea-based missiles

India continues to develop the naval component of its triad of nuclear forces. Its first indigenously built nuclear-powered submarine, INS *Arihant*, was launched in 2009 after numerous delays, under the Advanced Technology Vessel (ATV) project dating from the 1970s. The *Arihant*'s 82-MW(t) pressurized water reactor achieved criticality for the first time on 10 August 2013.[23] The submarine might begin sea trials in 2014.[24] A

[17] Subramanian, T. S., 'Agni IV successfully test fired', *The Hindu*, 20 Jan. 2014.

[18] Indian Press Information Bureau, 'Second test flight of Agni 5 successful', 15 Sep. 2013, <http://pib.nic.in/newsite/pmreleases.aspx?mincode=33>.

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

[20] Mallikarjun, Y., 'None can intercept Agni-V: Chander', *The Hindu*, 18 Sep. 2013.

[21] Mallikarjun (note 20).

[22] 'The launch and crash of cruise missile Nirbhay', *Economic Times* (Mumbai), 13 Mar. 2013, <http://economictimes.indiatimes.com/slideshow/18948444.cms>.

[23] Subramanian, T. S., 'In a first for India, nuclear sub's reactor activated.' *The Hindu*, 11 Aug. 2013.

second Arihant class nuclear submarine is said to be under construction, and work on a third submarine is at an early stage.[25]

The DRDO is developing a two-stage missile, designated the K-15 (or the B-05), for deployment on the Arihant SSBNs.[26] There is still some uncertainty about the capability of the K-15, but it is estimated to have a range of up to 700 km. Each SSBN will be able to carry up to 12 K-15s.[27]

According to unconfirmed Indian media reports, the DRDO is developing a land-based version of the K-15 SLBM, known as the Shourya, which some say may have a nuclear capability.[28] The mobile missile was reportedly test launched in 2008 and 2011.

With its relatively short range, the K-15's utility in a planned nuclear second-strike role will be limited. The DRDO is therefore developing a longer-range submarine-launched ballistic missile (SLBM), known as the K-4, which will have a range of around 3000 km.[29] The first test-launch, conducted from a submerged platform on 24 March 2014, was confirmed by DRDO officials but there was no official Indian Government announcement.[30] From a launch position in the northern Indian Ocean, the K-4 would be able to reach all of Pakistan and most of China. Each Arihant class submarine is designed to carry four of the missiles.

Construction of a naval base for the Arihant submarines has apparently started near Rambilli on India's east coast, approximately 50 km south of Visakhapatnam, where the first SSBN is fitting out. The base is in the early stages of construction.[31]

The Dhanush missile, a naval version of the Prithvi II that is launched from a stabilization platform mounted on a surface ship, has been inducted into service with the Indian Navy. 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. On 23 November 2013 a Dhanush missile was successfully launched from a warship deployed off the Odisha coast as part of a navy user-trial.[32]

[24] Pandit, R., 'India's first N-sub to head for sea trials in Feb–March', *Times of India*, 4 Dec. 2013.

[25] 'India's nuclear submarine force shaping up', Defence News, 18 May 2013, <http://www.defencenews.in/defence-news-internal.aspx?id=UkatsKbOlb4=>.

[26] Some sources have referred to the missile as the Sagarika, which is the name of the DRDO development project. 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.

[27] US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat*, NASIC-1031-0985-13 (NASIC: Wright-Patterson Air Force Base, OH, July 2013), p. 25.

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

[29] Isby, D., 'India's K-4 SLBM awaits first launch', *Jane's Missiles & Rockets*, 28 Aug. 2013; and Rout, H. K., 'Longest range ballistic missile all set for undersea launch', *New Indian Express*, 10 Dec. 2013.

[30] Subramanian, T. S., 'Success on debut for undersea launch of missile', *The Hindu*, 8 May 2014.

[31] Pandit, R., 'India readies hi-tech naval base to keep eye on China', *Times of India*, 26 Mar. 2013.

[32] Rout, H. K., 'Dhanush hits target', *New Indian Express*, 24 Nov. 2013.