

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 and the number of operational nuclear-capable delivery systems.

India's nuclear weapons are believed to be plutonium-based. As of 2015 India's weapon-grade plutonium stockpile was estimated to be between 0.57 and 0.61 tonnes (see section X). The plutonium was produced at the Bhabha Atomic Research Centre (BARC) 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.¹ India has plans to build six fast breeder reactors, which will significantly increase its capacity to produce plutonium for weapons. A 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. It is expected to achieve first criticality during 2015, to be followed by an extended period of testing.²

India is currently expanding its uranium enrichment capabilities. It continues to enrich uranium at the small centrifuge facility at the Rattihalli Rare Materials Plant (RMP) near Mysore, Karnataka, to produce highly enriched uranium (HEU) for use as naval reactor fuel.³ India appears to be building a second gas centrifuge uranium hexafluoride facility at the RMP, which could support an increasing number of centrifuges for uranium enrichment.⁴ India's expanding centrifuge enrichment capacity is motivated by plans to build new naval propulsion reactors, but the HEU produced at the plants could also be used to manufacture thermonuclear nuclear weapons by combining the current plutonium arsenal with HEU secondaries.⁵

India has begun construction 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 International

¹ International Panel on Fissile Materials (IPFM), *Global Fissile Material Report 2013: Increasing Transparency of Nuclear Warhead and Fissile Material Stocks as a Step Toward Disarmament* (IPFM: Princeton, NJ, Oct. 2013), p. 21.

² 'Start-up of India's PFBR delayed', *Nuclear Engineering International*, Online news, 14 Aug. 2014, <<http://www.neimagazine.com/news/newsstart-up-of-indias-pfbr-delayed-4340186>>.

³ Kelley, R., and Cloughey, B., 'Nuclear option: India increases its uranium enrichment programme', *Jane's Intelligence Review*, vol. 26, no. 7, July 2014, pp. 8–15.

⁴ 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/uploads/isis-reports/documents/RMP_4_Dec_2013.pdf>.

⁵ Kelley and Cloughey (note 3).

Atomic Energy Agency (IAEA) safeguards.⁶ According to the chairman of the Indian Atomic Energy Commission, the plant will have both civilian and military roles and will not be under IAEA safeguards.⁷

Aircraft

Aircraft constitute the most mature component of India's nuclear strike capabilities (see table 11.7). The Indian Air Force (IAF) has reportedly certified the Mirage 2000H multi-role combat aircraft for delivery of nuclear gravity bombs.⁸ The IAF's Jaguar IS and Sukhoi Su-30MKI combat aircraft have also been mentioned as having a possible nuclear role.

Land-based missiles

The 350 kilometre-range Prithvi II, a road-mobile, single-stage ballistic missile, was the first Indian missile officially acknowledged to have a nuclear delivery role when it was inducted into service with the Strategic Forces Command (SFC) in 2003. A number of 150 km-range Prithvi I missiles, which entered Indian Army service in 1994, were widely believed to have been modified for a nuclear role. The Prithvi I may have reverted to exclusively conventional roles prior to its withdrawal from service, which was announced in 2013.⁹ The SFC conducted three successful test-flights of Prithvi II missiles in 2014—on 7 January, 28 March and 14 November—as part of its regular user-readiness trials.¹⁰

Indian defence sources indicate that the family of longer-range Agni ballistic missiles, which are designed to provide a quick-reaction nuclear 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 part of its Integrated Guided Missile Development Programme. The 700 km-range Agni I (designated the A1 by the Indian Ministry of Defence, MOD) is a single-stage, solid-fuelled missile. During a regular training exercise on 11 April 2014, the SFC

⁶ Albright, D. and Kelleher-Vergantini, S., 'India's new enrichment plant in Karnataka', Institute for Science and International Security (ISIS) Imagery Brief, 1 July 2014, p. 2, <http://isis-online.org/uploads/isis-reports/documents/SMEF_Brief_July_1_2014_FINAL.pdf>.

⁷ 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>>.

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 Press Trust of India (PTI), 'Prithvi missiles to be replaced by more-capable Prahar: DRDO', *Hindustan Times*, 30 June 2013.

¹⁰ PTI, 'Nuclear-capable Prithvi-II successfully test fired', *Indian Express*, 14 Nov. 2014.

Table 11.7. Indian nuclear forces, January 2015

Type	Range (km) ^d	Payload (kg)	Status
<i>Aircraft^b</i>			
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
<i>Land-based ballistic missiles</i>			
Prithvi II	350	500	Inducted into service with the Strategic Forces Command in 2003. Fewer than 50 Prithvi launchers deployed; most recent flight test on 14 Nov. 2014
Agni I ^c	~700	1 000	Most recent Indian Army operational test on 11 Apr. 2014; deployed with the Indian Army's 334 Missile Group
Agni II	>2 000	1 000	Possibly operational; test-launched on 9 Nov. 2014
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; fifth launch on 2 Dec. 2014
Agni V	>5 000	(1 000)	Under development; test-launched on 15 Sep. 2013
<i>Sea-based ballistic missiles</i>			
Dhanush	400	500	Induction under way but probably not operational; test-launched on 14 Nov. 2014
K-15 (B-05) ^d	700	500–600	Under development; test-launched from a submerged pontoon on 27 Jan. 2013; will probably test-launch from the INS <i>Arihant</i> in 2015
K-4	~3 000	..	Under development; reportedly test-launched from a submerged platform on 24 Mar. 2014
<i>Cruise missiles</i>			
Nirbhay	>700	250–450	Ground-launched cruise missile under development; widely rumoured to have nuclear capability; test-launched on 17 Oct. 2014; air-launched version for Su-30MKI possibly in development

.. = not available or not applicable.

^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 Ministry of Defence refers to Agni I as the A1.

^d Some sources have referred to the K-15 missile as Sagarika, which is the name of the DRDO missile development project.

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.

successfully carried out the first night-time test launch of an Agni I missile at the Integrated Test Range complex located on Wheeler Island, off the Odisha coast.¹¹ The Agni II is a two-stage solid-fuelled mobile missile that can deliver a 1000 kilogram payload to a maximum range of 2000 km.¹²

The Agni III is a two-stage, rail-mobile missile with a range exceeding 3000 km. It was test-launched by the SFC in December 2013.¹³ The missile was inducted into service in 2011 but may not be fully operational.

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 20 January 2014 an Agni IV was launched from the Wheeler Island test complex and travelled 4000 km to a target zone in the Bay of Bengal.¹⁵ Following the test, the DRDO announced that it had approved the start of serial production of the missile.¹⁶

The DRDO has prioritized the development of the long-range, three-stage Agni V missile. Many Indian analysts have emphasized that the near-intercontinental ballistic missile range of the Agni V allows it to strike targets throughout China, thereby strengthening India's nuclear deterrence capabilities.¹⁷ The missile incorporates a number of new indigenously developed propulsion and navigation system technologies. Unlike the other Agni missiles, the Agni V is designed to be stored in and launched from a new mobile canister system. Among other things, this increases operational readiness by reducing the time required to place the missiles

¹¹ PTI, 'India successfully conducts maiden night test of Agni missile', DNA India, 12 Apr. 2014, <<http://www.dnaindia.com/india/report-india-successfully-conducts-maiden-night-test-of-agni-missile-1977543>>.

¹² PTI, 'Nuclear-capable Agni-II missile test fired', *Hindustan Times*, 9 Nov. 2014.

¹³ Government of India, Press Information Bureau (Defence Wing), 'Agni-3 launch, a flawless mission', News release, 23 Dec. 2013, <<http://pib.nic.in/newsite/PrintRelease.aspx?relid=102101>>.

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

¹⁵ Indian Ministry of Defence, Press Information Bureau, 'India successfully test fires Agni-IV', News release, 20 Jan. 2014, <<http://pib.nic.in/newsite/PrintRelease.aspx?relid=102610>>.

¹⁶ Subramanian, T. S., 'Agni IV successfully test fired', *The Hindu*, 20 Jan. 2014.

¹⁷ PTI, 'Agni-V, capable of reaching China, test-fired successfully', *Times of India*, 19 Apr. 2012.

on alert in a crisis.¹⁸ According to the DRDO, the Agni V will be inducted into service in 2015.¹⁹

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.²⁰ There has also been speculation that the K-15 submarine-launched ballistic missile (SLBM) may be given a MIRV capability.²¹

In addition to its ballistic missiles, India has begun development of a new subsonic ground-launched cruise missile, known as the Nirbhay. The missile, which has a range of 700–1000 km, appears similar to Pakistan's Babur cruise missile and the US Tomahawk cruise missile.²² It is widely rumoured to be nuclear-capable but there is no official confirmation of such a capability. Following a failed first test in March 2013, a Nirbhay missile was successfully launched on 17 October 2014.²³ There are unconfirmed reports that India is developing an air-launched version of the Nirbhay for delivery by the Su-30MKI.²⁴

Sea-based missiles

India continues to develop the naval leg of its triad of nuclear forces. Its first indigenously built nuclear-powered submarine, INS *Arihant*, was launched after numerous delays in 2009, under the Advanced Technology Vessel project dating from the 1970s. The 6000 tonne submarine began sea trials in December 2014 following 18 months of harbour tests.²⁵ A second Arihant class nuclear submarine, INS *Aridaman*, is under construction, and work on a third submarine is believed to be at an early stage.²⁶

¹⁸ Aroor, S., 'New chief of India's military research complex reveals brave new mandate', *India Today*, 13 July 2013.

¹⁹ 'DRDO stresses indigenisation, outlines progress on Agni-V, Arihant', DNA India, 7 Feb. 2014, <<http://www.dnaindia.com/scitech/report-drdo-stresses-indigenisation-outlines-progress-on-agni-v-arihant-1960089>>.

²⁰ Mallikarjun, Y., 'None can intercept Agni-V: Chander', *The Hindu*, 18 Sep. 2013; and Mallikarjun, Y., 'Agni-V to be modified to attack multiple targets', *The Hindu*, 28 May 2013.

²¹ O'Donnell, F., 'Managing India's missile aspirations', Institute for Defence Studies and Analyses (IDSA), IDSA comment, 10 Feb. 2013, <http://www.idsa.in/idsacomments/ManagingIndiasMissileAspirations_fodonnell_100213.html>.

²² Pandit, R., '7 years in making, cruise missile fails test', *Times of India*, 13 Mar. 2013.

²³ Raghuvanshi, V., 'India test fires Nirbhay cruise missile', *Defense News*, 17 Oct. 2014.

²⁴ TASS, 'India begins development of the Nirbhay subsonic cruise missile for the Su-30MKI', Russia and India Report, 12 Feb. 2015, <http://in.rbth.com/news/2015/02/12/india_begins_development_of_the_nirbhay_subsonic_cruise_missile_for_the_41349.html>.

²⁵ Bedi, R., 'India's first SSBN embarks on sea trials', IHS Jane's 360, 15 Dec. 2014, <<http://www.janes.com/article/47020/india-s-first-ssbn-embarks-on-sea-trials>>.

²⁶ 'India's nuclear submarine force shaping up', DefenceNews.in, 18 May 2013, <<http://www.defencenews.in/defence-news-internal.aspx?id=UkatsKbOl4=>>>.

The DRDO has tested components of an underwater missile-launch system and is developing a two-stage missile that can be launched from a submerged Arihant class submarine using a gas-charged booster. Indian MOD statements have designated the missile as the K-15 or B-05.²⁷ The 700 km-range K-15 has been described as a 'hybrid missile' that combines aspects of both cruise and ballistic missiles; unlike the latter, its flight trajectory can be controlled after launch. In January 2013 the DRDO successfully launched a K-15 missile from a submerged pontoon in the Bay of Bengal. The launch marked the twelfth and final development test of the K-15 missile prior to its integration with the INS *Arihant*, which reportedly will carry 12 of the missiles.²⁸

The DRDO is developing a two-stage SLBM, known as the K-4, which will have a range of up to 3500 km.²⁹ The K-4 will eventually replace the K-15 missile in arming the INS *Arihant* and the other submarines in the new class. According to unconfirmed Indian media reports, on 24 March 2014 a K-4 missile was launched for the first time from a submerged pontoon off the Visakhapatnam coast.³⁰ The DRDO is also reported to be developing a 5000 km-range SLBM, designated the K-5.³¹

The nuclear-capable Dhanush missile is a naval version of the Prithvi II that 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. The missile, which has been inducted into service, is one of the five missile systems developed under the DRDO's Integrated Guided Missile Development Programme. On 14 November 2014 the SFC successfully launched a Dhanush missile from a warship deployed off the Odisha coast as part of a regular user trial.³²

²⁷ Unnithan, S., 'The secret "K" missile family', *India Today*, 20 Nov. 2010; and Rai, R., 'The inside story of SLBM K-15', *Indian Defence Review*, 11 Feb. 2013.

²⁸ Fiddian, P., 'Indian Navy K-15 SLBM launched', *Armed Forces International*, 28 Jan. 2013, <<http://www.armedforces-int.com/news/indian-navy-k-15-slbm-launched.html>>.

²⁹ Rout, H. K., 'Longest range ballistic missile all set for undersea launch', *New Indian Express*, 10 Dec. 2013; and Unnithan (note 27).

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

³¹ Isby, D., 'India's K-4 SLBM awaits first launch', *Jane's Missiles and Rockets*, 28 Aug. 2013.

³² PTI, 'Dhanush ballistic missile successfully test-fired', *Times of India*, 14 Nov. 2014.