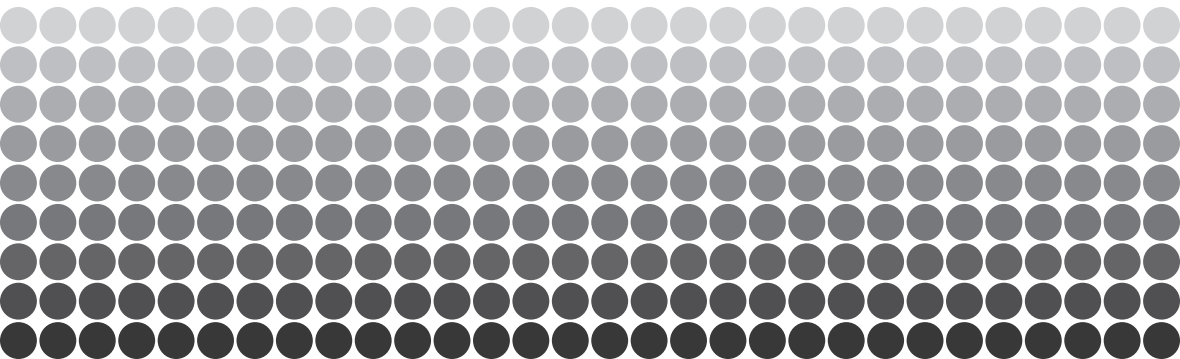


SIPRI YEARBOOK 2013

Armaments, Disarmament and International Security

Indian nuclear forces

SHANNON N. KILE AND HANS M. KRISTENSEN



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VI. Indian nuclear forces

SHANNON N. KILE AND HANS M. KRISTENSEN

India is estimated to have an arsenal of 90–110 nuclear weapons for delivery by aircraft and land-based missiles. 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. India's stockpile of weapon-grade plutonium is estimated to have been 400–680 kilograms in 2012 (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 (BARC) near Mumbai, Maharashtra. A new high-flux plutonium-production reactor is under construction at the new BARC complex near the port city of Visakhapatnam (also known as Vizag), Andhra Pradesh. India 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, and is scheduled to be commissioned in early 2013.¹ At 75 per cent operating capacity the reactor, which is liquid sodium-cooled, 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.² The IGCAR also houses a reprocessing facility that is not subject to International Atomic Energy Agency (IAEA) safeguards.

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. In 2010 the Indian Atomic Energy Commission announced plans to build a Special Material Enrichment Facility, at a site in Chitradurga district, Karnataka, which could potentially 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 has been no official

¹ Press Trust of India, 'India's breeder reactor to be commissioned in 2013', *Hindustan Times*, 20 Feb. 2012.

² Cochran, T. B. et al., *Fast Breeder Reactor Programs: History and Status*, International Panel on Fissile Materials (IPFM) Research Report no. 8 (IPFM: 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/in-focus-article.htm?18916>>.

Table 6.7. Indian nuclear forces, January 2013

Type	Range (km) ^d	Payload (kg)	Status
<i>Aircraft^b</i>			
Mirage 2000H Vajra	1 850	6 300	Reportedly certified for delivery of nuclear gravity bombs
<i>Land-based ballistic missiles^c</i>			
Prithvi I/II	150/350	800/500	Prithvi I entered service in 1994; Prithvi I reportedly had nuclear capability; Prithvi II also widely rumoured to have nuclear capability; nuclear role likely diminished with introduction of Agni; fewer than 50 launchers deployed; most recent flight tests 12 Dec. 2012 (Prithvi I) and 20 Dec. 2012 (Prithvi II)
Agni I ^d	~700	1 000	Most recent Indian Army operational test on 12 Dec. 2012; deployed with the Indian Army's 334 Missile Group
Agni II	2 000	1 000	In service with the Indian Army's 555 Missile Group; test-launched on 9 Aug. 2012
Agni III	~3 000	1 500	Inducted into service but not fully operational; test launched on 21 Sep. 2012
Agni IV ^e	~4 000	1 000	Under development; test launched on 19 Sep. 2012.
Agni V	>5 000	1 000?	Under development; test launched on 19 Apr. 2012
<i>Sea-based missiles</i>			
Dhanush	350	500	Induction underway but probably not operational; test launched on 5 Oct. 2012
K-15 ^f	700	500–600	Under development; final test-launch from a submerged pontoon conducted on 27 Jan. 2013; to be integrated with the submarine INS <i>Arihant</i> beginning in 2013

^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 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, 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 the current Agni I as A1.

^e An earlier version was known as the Agni II Prime.

^f The DRDO is developing a land-based variant of the K-15, called the Shourya. It was test launched in Nov. 2008 and 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.

statement specifying the size of the arsenal required for a ‘minimum credible deterrent’ but, according to the Indian Ministry of Defence (MOD), it involves ‘a mix of land-based, maritime and air capabilities’ (a ‘triad’).⁵ In June 2012 the Indian Prime Minister, Manmohan Singh, convened a meeting of India’s Nuclear Command Authority, which reportedly stressed the need for the ‘faster consolidation’ of India’s nuclear deterrence posture based on an operational triad of nuclear forces.⁶ However, it is not clear if the maritime element of the triad is operational.

Strike 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 Shamsher and Sukhoi Su-30MKI combat aircraft have also been mentioned as having a possible nuclear role.

The Indian Strategic Forces Command (SFC), the body responsible for the operational management of the country’s nuclear force and for their command and control, depends on the IAF for delivering nuclear weapons under its command. However, it has reportedly sought to acquire two squadrons of combat aircraft with a dedicated nuclear delivery role.⁷

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 2012 the SFC conducted three successful test flights of Prithvi II missiles—on 25 August, 4 October and 20 December—as part of its regular user-readiness trials.⁸

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

⁶ Pandit, R., ‘PM takes stock of country’s nuclear arsenal’, *Times of India*, 14 June 2012. 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. The Political Council is the sole body that can authorize the use of nuclear weapons by India. 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.

⁷ PTI, ‘Strategic Command to acquire 40 nuclear capable fighters’, *Hindustan Times*, 12 Sep. 2010.

⁸ Indian Ministry of Defence, ‘Prithvi-II missile successfully test- fired’, 20 Dec. 2012, <<http://pib.nic.in/newsite/erelease.aspx?relid=91027>>; Indian Ministry of Defence, ‘Prithvi-II missile test- fired

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 problem-plagued Integrated Guided Missile Development Programme, which ended in 2008.⁹ The 700 km-range Agni I (designated the A1 by the Indian MOD) is a single-stage, solid-fuelled missile. The SFC carried out successful test-launches of Agni I missiles during routine training exercises on 13 July and 12 December 2012.¹⁰ The Agni II is a two-stage solid-fuelled missile, based on the Agni I, that can deliver a 1000-kg payload to a maximum range of 2000 km. On 9 August 2012 the SFC successfully launched an Agni II from a rail-mobile launcher at the Integrated Test Range on Wheeler Island off the coast of Orissa. The test was intended to validate the SFC's operational readiness to fire the missile.¹¹

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.¹² On 19 September 2012 an Agni IV was successfully launched from the Wheeler Island complex and travelled 4000 km to a target zone in the Bay of Bengal.¹³ This marked the second successful test of the missile since an initial failure in 2010.

The DRDO has developed the Agni III, a two-stage, solid-fuelled missile capable of delivering a 1500-kg payload to a range of 3000–3500 km. On 21 September 2012, the SFC launched from Wheeler Island a rail-mobile Agni III missile that had been randomly chosen from a production lot. The launch was the SFC's first user trial of the missile following three consecutive successful flight tests.¹⁴

The DRDO has prioritized the development of the long-range, three-stage Agni V missile. The new missile incorporates a number of the new indigenously developed propulsion and navigation system technologies

successfully: hits target area, across 350 km', 4 Oct. 2012, <<http://pib.nic.in/newsite/erelease.aspx?relid=88130>>; and Subramanian, T. S., 'Prithvi-II missile test, a success', *The Hindu*, 25 Aug. 2012.

⁹ E.g. Verma, B., 'How DRDO failed India's military', Rediff, 15 Jan. 2008, <<http://www.rediff.com/news/2008/jan/15guest.htm>>.

¹⁰ Indian Ministry of Defence, 'Successful flight test of Agni-I', 12 Dec. 2012, <<http://pib.nic.in/newsite/erelease.aspx?relid=90425>>; and PTI, 'India tests nuclear-capable Agni-I missile', *Times of India*, 13 July 2012.

¹¹ Mallikarjun, Y. and Subramanian, T. S., 'Agni-II launch, a flawless mission', *The Hindu*, 9 Aug. 2012.

¹² Pandit, R., 'With China in mind, India tests new-generation Agni missile with high "kill efficiency"', *Times of India*, 16 Nov. 2011.

¹³ Indian Ministry of Defence, 'Successful flight testing of Agni-IV', 19 Sep. 2012, <<http://pib.nic.in/newsite/erelease.aspx?relid=87855>>.

¹⁴ Mallikarjun, Y., 'Agni-III test-fired successfully', *The Hindu*, 21 Sep. 2012; and Rout, H. K., 'Agni-III user trial today', *New Indian Express*, 21 Sep. 2012.

used in the Agni IV. On 19 April 2012 the DRDO test-launched an Agni V for the first time. The missile flew 5000 km from Wheeler Island before impacting in a pre-designated target zone in the Indian Ocean.¹⁵ India media reports hailed the successful test as evidence that India had joined China, France, Russia, the United Kingdom and the United States as the only countries possessing intercontinental ballistic missiles (ICBMs).¹⁶ Some Indian analysts emphasized that the Agni V had sufficient range to strike targets throughout China and thereby strengthened India's nuclear deterrence capabilities.¹⁷ The Agni V is expected to become operational in 2014–15 after 'four to five repeatable tests' and user trials.¹⁸

Sea-based missiles

India continues to encounter delays in developing the naval element of its triad of nuclear forces. Its first indigenously built nuclear-powered submarine, INS *Arihant*, was launched in 2009, under the Advanced Technology Vessel (ATV) project. The Indian Navy's plan to commence sea trials in 2012 had to be postponed because of problems with the vessel's propulsion system.¹⁹

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 submarine using a gas-charged booster. Indian MOD statements have designated the missile as the K-15 or B-05, although other sources have referred to it as Sagarika, which is the name of the DRDO development project.²⁰ The 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.²¹ The nuclear-capable missile will be able to deliver a 500–600-kg payload to a distance of up to 700 km. On 27 January 2013 the DRDO successfully launched a K-15 missile from a submerged pontoon in the Bay of Bengal. The launch marked the final development test of the missile prior to its integration with the INS *Arihant*; DRDO officials stated that the missile was already in pro-

¹⁵ Indian Ministry of Defence, 'India launches new generation strategic missile Agni-V', 19 Apr. 2012, <<http://pib.nic.in/newsite/erelease.aspx?relid=82371>>.

¹⁶ Dixit, R., 'India successfully test-fires Agni-V, joins ICBM club', *Mail Today* (Delhi), 19 Apr. 2012.

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

¹⁸ Pandit, R., 'India test-fires nuclear-capable Prithvi-II missile', *Times of India*, 25 Aug. 2012.

¹⁹ Ray, K., 'INS Arihant will miss December deadline', *Deccan Herald*, 10 Nov. 2012.

²⁰ 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.

²¹ Rout, H. K., 'K-15 test off Andhra coast next month', *New Indian Express*, 27 Nov. 2012; and Sharma, S., 'DRDO headline mistake makes Pak go ballistic', *Sunday Guardian* (Delhi), 16 Feb. 2013.

duction.²² The K-15 was also test-launched on 11 March, 16 March and 26 December 2012.

The DRDO is developing a submarine-launched ballistic missile, known as the K-4, which may have a range of up to 3500 km.²³ The K-4 will eventually replace the K-15 missile in arming the *Arihant*, although this will probably require the rebuilding of the submarine's hull.

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 off the coast of Orissa on 5 October 2012.²⁴

²² Fiddian, P., 'Indian Navy K-15 SLBM launched', Armed Forces International News, 28 Jan 2013, <<http://www.armedforces-int.com/news/indian-navy-k-15-slbm-launched.html>>; and Mallikarjun, Y., 'India to integrate K-15 missiles into nuclear submarine soon', *The Hindu*, 20 Nov. 2012.

²³ Unnithan (note 20).

²⁴ PTI, 'India successfully test-fires nuclear-capable Dhanush missile', *Times of India*, 5 Oct. 2012.