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Indian nuclear forces, 2008

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Ten years ago, India officially declared itself a nuclear weapon state and announced its intention to develop and deploy a nuclear triad. Today, the sea- and land-based legs of its triad remain under development, and its fighter bombers constitute the only fully operational leg. Despite its slow pace, India's nuclear program continues to grow: India is developing a three-stage land-based ballistic missile, a nuclear-powered submarine, and a potentially nuclear-capable cruise missile.

In August 2008, India completed a Safeguards Agreement with the International Atomic Energy Agency for inspections of its civilian nuclear facilities.[1] The deal will allow India to import nuclear technology from countries that are party to the Nuclear Non-Proliferation Treaty (NPT)—even though India is not. This undercuts a long-standing principle of denying nuclear technology to countries that have not signed the NPT and also allows India to free up domestic uranium reserves for use in military reactors to produce plutonium for weapons in its emerging triad of nuclear weapons delivery platforms.

All Indian nuclear delivery systems are dual-capable (they can carry either nuclear or conventional warheads) and their operational statuses are ambiguous. This not only makes the size, composition, and operational status of India's nuclear arsenal difficult to determine, but also has troubling implications for stability on the subcontinent. In a war with Pakistan, for example, an Indian launch of conventionally armed ballistic missiles could be misidentified as incoming nuclear warheads, triggering a retaliatory nuclear attack from Pakistan.

India has said that its nuclear doctrine is "based on the principle of a minimum credible deterrent and no-first-use as opposed to doctrines or postures of launch-on-warning," stipulating that India's nuclear policy includes a "rejection of an arms race or concepts and postures from the Cold War era."[2] How large such a deterrence force would be is unclear; in 2007, Defense Minister Shri A. K. Antony said that India's minimum deterrence capability would be "commensurate with the size and geostrategic position of India in the world."[3]

We estimate that India's nuclear stockpile includes approximately 70 assembled nuclear warheads, with only about 50 fully operational, though we predict this number will grow over the next decade. Whatever the size, it is essential that there be firm civilian and military control over the stockpile; to this end, India established the Nuclear Command Authority in 2003.

SNAPSHOT

India is struggling to develop a complete nuclear triad.

IAEA deal allows nuclear technology import and frees up domestic uranium for weapons.

Long-range Agni III missile could be delivered in 2009.

Nirbhay cruise missile is scheduled for testing in early 2009.

Aircraft. Fighter bombers are the mainstay of India's nuclear strike force.[4] India's Mirage 2000H, Jaguar IS/IB, and possibly MiG-27 are the likely aircraft assigned nuclear missions.

The single-seat Mirage 2000H, known as the Vajra ("divine thunder"), is a multi-role aircraft deployed with Squadrons 1 and 7 of the 40th Wing at Gwalior Air Force Station, approximately 270 kilometers (170 miles) southeast of New Delhi; we estimate that one of the squadrons has a secondary nuclear mission.[5] The Jaguar IS/IB, known as the Shamsher ("sword"), was nuclear capable when deployed by both Britain and France. Four operational squadrons have approximately 76 Jaguar IS variants; we estimate that two of the squadrons have a secondary nuclear strike mission. The Hindustan Aeronautics–assembled, Soviet-origin MiG-27 Flogger, known as the Bahadur ("valiant"), may also have a nuclear strike mission, although evidence is scarce and circumstantial. (For more about India's nuclear-capable aircraft, land-based missiles, and naval weapons, see the Nuclear Notebooks of September/October 2005 and July/August 2007.)

Land-based missiles. India has four land-based, nuclear-capable ballistic missile types either deployed or under development: The short-range Prithvi I has been deployed since 1998; the short-range Agni I and medium-range Agni II were declared operational, but reliability issues with both missiles have delayed their full operational service; and the longer-range Agni III is under development. The slow maturation of the land-based leg of India's triad has prompted the government to reorganize missile production to deliver more missiles in a shorter time.

THE INDIAN ARSENAL

AIRCRAFT	RANGE (KILOMETERS)	PAYLOAD (KILOGRAMS)	COMMENT
Mirage 2000H/Vajra	1,800	6,300	Squadron 1 or 7 at Gwalior Air Force Station.
Jaguar IS/IB/Shamsher	1,600	4,775	At Ambala Air Force Station.

LAND-BASED MISSILES	RANGE (KILOMETERS)	PAYLOAD (KILOGRAMS)	COMMENT
Prithvi I	150	1,000	Nuclear version entered service after 1998 with the 333rd and 355th Missile Groups. Will be converted from liquid fuel to solid fuel.
Agni I	700	1,000	First operational training test in 2007; second in 2008. Deployed with army's 334th Missile Group in 2004.
Agni II	2,000	1,000	Under development. Tested August 29, 2004. Deployed with army's 335th Missile Group.
Agni III	3,000	1,500	Under development. Test-launched in 2006 (failed), 2007, and 2008.

SEA-BASED MISSILES	RANGE (KILOMETERS)	PAYLOAD (KILOGRAMS)	COMMENT
Dhanush	350	1,000	Under development. Naval version of Prithvi II. Fourth test March 30, 2007.
Sagarika/K-15	300–700	500–600	Under development. K-15 test-launched February 26, 2008, from a submerged platform; deployment expected after 2010.

Of the three Prithvi versions that comprise the bulk of India's ballistic missile force, only the Prithvi I (the army version) is identified by the CIA as having a nuclear role. The missile is 9 meters (30 feet) long and about 1 meter (3 feet) in diameter, weighs 4,000 kilograms, and has a range of 150 kilometers (93 miles). Due to the missiles' small size, it is difficult to identify Prithvi bases as well as which Prithvis are nuclear; Prithvi missiles are deployed with the 333rd and 355th Missile Groups, but nothing is known about deployment areas.

The two-stage Agni I has been tested to a range of 700 kilometers (435 miles). The Agni I has been test-launched six times, most recently in March 2008 during an army exercise, an indication that the missile may soon become operational. The Agni II, an improved version of the Agni I, has a range of 2,000 kilometers (1,240 miles), can carry a 1,000-kilogram payload, and is road- or rail-launched. The missile has only been test-flown three times, most recently in August 2004, indicating that it is not yet operational.

The Agni III is a two-stage, solid-fuel missile of 17 meters (56 feet) in length, 2 meters (7 feet) in diameter, and a launch weight of 50 metric tons. The Agni III has a range of 3,000 kilometers (1,860 miles) and is said to be rail-mobile. India has test-flown the Agni III three times. The first test, in 2006, failed, but two others in April 2007 and May 2008 succeeded. "With this missile," a spokesperson for the Indian Army's Eastern Command said, "India can even strike Shanghai."[6] Defense officials anticipate that the first Agni III could be delivered in 2009, although it will probably need additional flight-tests before the missile can become operational.

Soon after the 2008 Agni III flight-test, India's Defence Research and Development Organisation (DRDO) announced plans to build the Agni IV, with a range greater than 5,000 kilometers (3,110 miles), capable of targeting Beijing. The new missile (sometimes referred to as Agni III+) will have a third stage and be built with composite materials instead of steel; its first flight-test is scheduled for 2009 or 2010.

Defense officials say that after 2015 and before 2020, India's nuclear missile force will consist primarily of Agni III and Agni IV missiles, all carrying enhanced warheads to theoretically overwhelm ballistic missile defenses.[7] Some industry officials have said that both weapons will have multiple independently targetable reentry vehicles (MIRVs), but given the difficulties India has faced with the Agni I and Agni II—and the technological and financial challenges experienced by other nuclear weapon states developing MIRV technology—we remain skeptical of India's ability to MIRV its

missiles anytime soon. Perhaps more importantly, MIRVed missiles would seriously challenge the credibility of India's minimum deterrent doctrine.

Naval weapons. India is developing two naval weapon systems for the sea-based leg of its nuclear triad: the Dhanush ("bow") and Sagarika ("oceanic") missile systems. In March 2007, the navy successfully test-fired for the fourth time the dual-capable Dhanush, a sea-based surface-launched ballistic missile, which may soon become operational. Its utility, however, is compromised by its short range of 350 kilometers (220 miles); the vessel carrying the missile would need to be close to enemy shores to reach land targets, making it highly vulnerable to detection and counterstrike.

The Sagarika is a submarine-launched ballistic missile with a range of approximately 300 kilometers (190 miles), according to U.S. intelligence.[8] A version of the Sagarika, the K-15, was test-launched on February 26, 2008 from a submerged platform near Visakhapatnam on India's east coast. Media reports tagged the range at 700 kilometers (435 miles).[9] India currently has no delivery system for the Sagarika; the DRDO has said that the K-15 will be integrated with the Advanced Technology Vessel (ATV), a nuclear-powered submarine that India has been working on for more than 20 years.[10] One source said five ATVs are planned—an interesting number, given that the U.S. intelligence community has stated China might build five nuclear-powered ballistic missile submarines.[11] Rumors of a 2008 launch seem dubious. India has also leased a Russian nuclear-powered Akula-class attack submarine for delivery in September 2009.

Cruise missiles. In 2007, the Advanced Systems Laboratory (ASL) in Hyderabad began developing an intermediate-range land-attack cruise missile known as the Nirbhay ("fearless"). The subsonic cruise missile, described by India's *Telegraph* as similar to the U.S. Tomahawk sea-launched cruise missile and the Pakistani Babur cruise missile, will have a range of 1,000 kilometers (620 miles) and allegedly be capable of carrying 24 types of warheads.[12] It is unclear whether the missile will be nuclear-capable, but if it is being developed in response to Pakistan's Babur, then we suspect the Nirbhay might also have a nuclear capability. The ASL director said, "The need was felt for a subsonic cruise missile that will be capable of being launched from multiple platforms in land, air, and sea." A technology demonstration test is scheduled for early 2009.[13] ■

FOR NOTES, PLEASE SEE NEXT PAGE.

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In Review: Peak oil

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Crude prices soared from below $100 per barrel to $147 in July and then fell back to below $100 a barrel in September. The ongoing U.S. mortgage crisis has turned into an economy-wide liquidity crisis and now a worldwide economic crisis. In September, a pair of hurricanes slowed U.S. oil production and refining, which resulted in gasoline shortages across the southeastern part of the country.

U.S. voter concern about high gasoline prices has transformed this year's presidential election into a search for painless energy solutions with proposals to increase drilling and the production of biofuels, increase taxes on oil companies, punish speculators, and build more nuclear plants.

Yet no one is seriously talking about the world's flattening oil production, the likelihood of declining oil imports, the near certainty of much higher gasoline prices, or how we adjust to a world without cheap, abundant oil.

Alternative, renewable energy sources —solar, wind, tides, and biofuels—as yet provide only a tiny fraction of our energy needs. As the peaking of world oil production becomes more and more evident, our society will have to get by with considerably less energy, particularly from oil, in the next few decades, until new energy technologies can be brought into production and energy efficient forms of existing technologies become more widely adopted. ■

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NOTES

Rethinking personal sacrifice

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1. Paul Hawken, Amory Lovins, L. Hunter Lovins, *Natural Capitalism: Creating the Next Industrial Revolution* (New York: Little, Brown and Company), pp. 1–2.
2. Matt Palmquist, "Old Without Wheels," *Miller-McCune*, August 2008, p. 18.
3. William Connolly, *The Ethos of Pluralization* (Minneapolis: University of Minnesota Press, 1995), pp. 112–113.
4. Ibid., pp. 111–112.

Agreeing to disagree on nuclear rights

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1. President George W. Bush has commented on the existence of a "loophole" in the NPT, but nonproliferation experts point to the fact that Article IV of the treaty, which provides for the acquisition of peaceful nuclear power programs by all treaty parties, was a central element of the strategic bargain that allowed the NPT to be concluded. This point will be discussed further below. For more on President Bush's comments, see Wade Boese, "Bush Outlines Proposals to Stem Proliferation," *Arms Control Today*, March 2004.
2. This list is derived from a paper by Raymond Arnaudo, "The Unique Nature of the Antarctic Treaty System: Problem or Advantage?" *Wilton Park Proceedings*, Britain, November 14, 2001.
3. The fourth such celebration of peaceful scientific exchange in the polar regions has been taking place since 2007. For more on the current initiative, see U.S. National Committee for the International Polar Year 2007–2008, "A Vision for the International Polar Year 2007–2008," National Research Council, 2004, available at http://books.nap.edu/catalog.php?record_id=11013.
4. Richard E. Byrd, *Alone* (New York: G. P. Putnam Sons, 1938).
5. For further detail, see: "Question of Antarctica," U.N. General Assembly, August 11, 2005, available at www.unep.org/dewa/assessments/Ecosystems/Polar/Antarctica/PDF/A-60-222.pdf.
6. "President Bush's Radio Address Focuses on Energy Issues," Office of Public Affairs, Energy Department, February 18, 2006, available at www.energy.gov/print/3222.htm.
7. Article IV of the NPT states, "Nothing in this Treaty shall be interpreted as affecting the inalienable right of all the Parties to the Treaty to develop research, production and use of nuclear energy for peaceful purposes without discrimination and in conformity with Articles I and II of this Treaty."
8. Peter Crail and Jessica Lasky-Fink, "Middle Eastern States Seeking Nuclear Power," *Arms Control Today*, May 2008. It must be noted that the United Arab Emirates (UAE) announced a new nuclear energy program, but explicitly eschewed the development of indigenous enrichment capabilities as a matter of national policy. Other Mideast countries may follow suit. See Lin Noueihed, "UAE Says to Explore Nuclear Energy for Electricity," Reuters, March 24, 2008. We are grateful to Amb. Thomas Graham for emphasizing this point.
9. John Deutch, Arnold Kanter, Ernest Moniz, and Daniel Poneman, "Making the World Safe for Nuclear Energy," *Survival*, vol. 46, no. 4, Winter 2004–05, p. 69.
10. We are grateful to Amb. Norman Wulf for pointing out the importance of clear incentives for participation in the new arrangement.
11. See, for example, George Perkovich et al., *Universal Compliance: A Strategy for Nuclear Security* (Washington, D.C.: Carnegie Endowment for International Peace, 2005) pp. 66, 116.
12. For more on the Trilateral Initiative, see the National Threat Reduction summary "IAEA Monitoring of Excess Nuclear Materials," which can be found at www.nti.org/e_research/cnwm/monitoring/trilateral.asp?print=true%20-%2073k. Another precedent to consider is the transparency program associated with the U.S.-Russian highly enriched uranium (HEU) deal, under which HEU from Russian weapons is blended into low-enriched uranium for use as power plant fuel.

Indian nuclear forces, 2008

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1. Staff Report, "IAEA Board Approves India-Safeguards Agreement," International Atomic Energy Agency, August 1, 2008.
2. Indian Ministry of Defence (MOD), "Annual Report 2004–2005," pp. 14, 15–16.
3. Government of India, Press Information Bureau, "India Will Continue to Strive towards Achieving Minimum Deterrence—Antony," MOD press release, February 13, 2007.
4. Vishal Thapar, "N-Capable Agni-III Ready, but Aircraft Remain First Choice," CNN-IBN, May 8, 2008.
5. Some sources list a third Mirage squadron, No. 9, at Gwalior, but the Indian Air Force list does not. Moreover, commercial satellite images show only 18 Mirages at the base, not enough for three squadrons.
6. "Agni III Not Targeted at Any Particular Country: Army," *Times of India*, May 8, 2008.
7. Ajai Shukla, "Agni Missile to Get Multiple Warheads," *Business Standard* (India), January 28, 2008.
8. U.S. Air Force, National Air and Space Intelligence Center, "Ballistic and Cruise Missile Threat," NASIC-1031-0985-06, March 2006, p. 23.
9. "India Successfully Tests Submarine-Based Missile," Reuters, February 26, 2008.
10. "India Test-Fires Sea-Based Nuclear-Capable Missile," Agence France Presse, February 26, 2008.
11. On the ATVs, see "India Plans to Buy 6 New Subs, Says Navy Chief," *Times of India*, December 2, 2007.
12. Sujan Dutta, "Fearless Tomahawk-Type Missile on Radar," *Telegraph* (India), July 20, 2007.
13. Ibid.