

Jaguar has a gross weight of 15,450 kilograms and a range of 1,600 kilometers with a maximum external load of 4,775 kilograms. Three operational squadrons—numbers 5, 14, and 16—man approximately 79 Jaguar IS variants, with additional IB dual-seat trainer aircraft attached. One maritime attack squadron—number 6—operates the Jaguar IM variant, which is not nuclear capable. A likely candidate to host nuclear-capable Jaguars is Ambala Air Force Station, which is 525 kilometers from Islamabad, Pakistan. A few aircraft from Squadrons 5 or 14 may be specially modified to carry one or more nuclear bombs. An increase in Jaguar crashes during the last several years has raised concerns over the serviceability of the 25-year-old aircraft, but the issue appears to have been resolved, as four Jaguars flew to Alaska in 2004 to participate in the U.S. Air Force “Cope Thunder” exercise.

The MiG-27 Flogger may also be assigned nuclear strike missions, although indications are scarce. The MiG-27 is a nuclear-capable Soviet aircraft produced in the 1970s and 1980s. Hindustan Aeronautics assembled, under license, 165 of the aircraft, which India calls the Bahadur (“valiant” or “brave”). The last aircraft was delivered in March 1997.

When fully equipped, the aircraft can fly to a range of approximately 800 kilometers, although combat range at sea level with external fuel tanks is only 390 kilometers. The MiG-27 has been optimized for a strike role and can carry up to 4,000 kilograms of bombs on external hard points. A few of these aircraft may be specially modified to carry one or more nuclear bombs.

Land-based missiles. Since our last estimate of India’s nuclear forces (see March/April 2002 *Bulletin*), India has deployed two new ballistic missiles, the Agni I and Agni II. The two-stage Agni (“fire”) I intermediate-range ballistic missile has been tested to a range of 700 kilometers and is deployed with the army’s 334 Missile Group. Its first stage uses solid propellant taken from a

satellite launch vehicle based on the U.S. Scout missile, and the second stage is a shortened version of India’s Prithvi liquid-fueled short-range ballistic missile. The Agni’s warhead section separates from the second stage during flight. The missile can be launched from a road- or rail-mobile launcher, and was last test-fired on July 4, 2004.

India deployed the Agni II, an improved version of the Agni, with the 335 Missile Group in 2004. The missile, which has a range of more than 2,000 kilometers, is 20 meters long, weighs about 16 tons, carries a 1,000-kilogram payload, and can be deployed on a road or rail launcher. It was first test-launched in April 1999, flying 2,000 kilometers in 11 minutes and possibly carrying a nuclear warhead assembly without the plutonium core. Its second flight-test was on January 17, 2001, from a mobile launcher at the Chandipur-on-Sea missile test range in the eastern state of Orissa. A third test took place on August 29, 2004.

The Agni II reentry vehicle is rumored to be superior to Western designs in terms of maneuverability and gliding, with an accuracy of only 40 meters. These claims are probably exaggerated, however, given the considerable technical difficulties and command and control requirements Western nuclear powers encountered when developing such capabilities. India is continuing to develop a longer-range Agni III missile to reach distances of up to 3,500 kilometers, but tests of this new missile have been repeatedly put off for several years. In the meantime, the Indian Defence Research and Development Organisation (DRDO) told the *Hindu* newspaper in February 2005 that a decision had been made to increase Agni II’s range, first by 300 kilometers and possibly more later.

India still maintains its Prithvi (“earth”) family of missiles. The missile began development in 1983 and was first tested in 1988. There have been 28 tests of all types of Prithvis since 1988, the most recent on May 12, 2005. The Prithvi exists in three versions, of which only the Prithvi I (the army ver-

sion) has been stated by the CIA to have a nuclear role. The missile is 9 meters long and 1.1 meters in diameter; it weighs 4,000 kilograms and has a range of 150 kilometers. The Prithvi II (air force version) has a range of 250 kilometers with a 750-kilogram warhead, but the air force has decided to extend the payload to 1,000 kilograms. An improved Prithvi II with greater accuracy was test-launched on March 19, 2004. India is said to be developing a solid-fueled version, the Prithvi III, that would increase the capability and operational logistics of the Prithvi system.

Rumors persist concerning plans for an intercontinental ballistic missile (ICBM) program, referred to as the Surya. Most components needed for an ICBM are available from India’s indigenous space program. The latest model Indian polar space launch vehicle (PSLV), the four-stage PSLV-C6, is capable of launching 1,600-kilogram satellites into a 621 by 632 kilometer-high polar orbit or 3,500-kilogram satellites into a low Earth orbit of 400 kilometers. The CIA assessed in 2001 that conversion of the PSLV to an ICBM would take a year or two after a decision to do so.

India is rapidly approaching a capability to place permanent satellites in geosynchronous equatorial orbit that could be used to provide continuous command and control of nuclear forces. It declared the geosynchronous satellite launch vehicle (GSLV) operational after successful April 2001 and May 2003 developmental test flights. On September 20, 2004, the first operational flight of a GSLV launched the EDUSAT into a geosynchronous transfer orbit.

Naval weapons. In order to complete its nuclear triad, India is developing at least two naval weapon systems, the Dhanush (“bow”) and Sagarika (“oceanic”) missile systems. The navy successfully test-fired the Dhanush sea-based surface-launched ballistic missile on November 7, 2004, from the converted patrol vessel the INS *Subhadra* off the eastern coast of Balasore in Orissa. The 8.56-meter

India's arsenal

Type/Designation	Range (KILOMETERS)	Payload (KILOGRAMS)	Comments
AIRCRAFT			
Mirage 2000H/Vajra	1,800	6,300	India has 40 of this type of aircraft, possibly located at Gwalior Air Force Station.
Jaguar IS/IB/Shamsher	1,600	4,775	India has 131 of this type of aircraft, possibly located at Ambala Air Force Station.
MISSILES			
Agni I	700+	1,000	Thirty-six missiles deployed with the army's new 334 Missile Group in 2004.
Agni II	2,000+	1,000	Thirty-six missiles deployed with the army's 335 Missile Group in 2004.
Agni III	3,000+	1,500	Under development. Test scheduled for the end of 2005.
Prithvi	150	1,000	Army version. Deployed with 333 and 355 Missile Groups. Will be converted from liquid to solid fuel.
Dhanush	350	1,000	Under development. Naval version of Prithvi II. Third test was held on November 7, 2004.
Sagarika	300+	?	Under development. Possible flight-test in late 2005; deployment scheduled for 2010 or later.

missile, the naval version of the Prithvi II, can carry a 1,000-kilogram payload to a range of 350 kilometers; the launch weight of the missile is 4,600 kilograms. DRDO developed the missile, and the Hyderabad-based Bharat Dynamics Ltd. manufactures it. The Indian Defence Ministry stated on November 8, 2004, that the Dhanush is capable of carrying both conventional and nuclear warheads.

For the November 2004 launch, the Dhanush was situated on the aft deck of the *Subhadra*. A photo of the setup shows the missile attached to a rail-mounted erector that enables the missile to be stored horizontally inside the ship's helicopter hangar prior to launch. The name Dhanush appears to formally refer to this ship-mounted stabilizer. When ignited, the missile's exhaust plume is led through a hole in the deck that connects to vents on either side of the ship. The missile appears to be capable of launching while the ship is in motion. According to the Defence Ministry's 2004 annual report, "weaponization on ships is under

progress." If deployed with a nuclear warhead, the Dhanush would give the Indian Navy its first nuclear strike capability. A June 2004 naval doctrine document argued forcefully for a naval nuclear capability. With a range of only 350 kilometers, however, the missile would need to be positioned close to enemy shores to reach targets on land, making the ship highly vulnerable to detection and counterstrike.

The Dhanush appears to be an interim step toward a more capable nuclear strike capability in the form of the Sagarika missile, which began development in 1991 and is now at an advanced stage. Sometimes rumored to be a cruise missile, the Sagarika is a submarine-launched ballistic missile with a range of only 300 kilometers, according to U.S. intelligence. But India reportedly wants to extend the range to 1,000 kilometers and has approached Israel and Russia for technical assistance to help extend its range to 2,500 kilometers. The Sagarika has not yet been test-launched, and deployment is not expected until 2010 or later.

The Sagarika launch date may be timed with Indian efforts to complete the Advanced Technology Vessel (ATV), a nuclear-powered submarine project that has been under way since at least 1985 and is expected to carry the missile. In building the ATV, India is applying design and operational experience it gained from operating a Charlie I-class cruise missile submarine (named the *INS Chakra*) that it leased from the Soviet Union from 1988 to 1991. The vessel's reactor is reported to be of Indian design. Scientists at the Indira Gandhi Centre for Atomic Research at Kalpakkam in southern India have built and installed a land-based prototype reactor.

Vice Adm. R. N. Ganesh, who commanded the *Chakra*, was appointed director general of the ATV project in 2000

in an apparent attempt to jump-start the much delayed project. So far, however, additional progress has not been reported. Full-scale work on the ATV began in 1991 shortly after India returned the *Chakra*, and construction started in 1997. A launch date may be scheduled for 2007 at the Mazagon dockyard in Mumbai (design has taken place in Vishakhapatnam on the east coast), but technical challenges could delay the ATV further. If delays continue, the navy could add a Sagarika launch capability to existing or new diesel submarines. India is considering buying six French or German submarines, and rumors suggest that it is also attempting to lease one or more nuclear submarines from Russia. ✽

Nuclear Notebook is prepared by Robert S. Norris and Hans M. Kristensen of the Natural Resources Defense Council. Data for all nuclear weapon states is available online at thebulletin.org. Inquiries should be directed to NRDC, 1200 New York Avenue, N.W., Suite 400, Washington, D.C., 20005; 202-289-6868.