Issue Brief

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India's Missile Programme: Building Blocks for Effective Deterrence

■ **Monika Chansoria**

India is well on its way to test what can be described as its most ambitiously zealous strategic missile system—the Agni V, by the end of 2011. Providing credence to the need for a 5000 kms range missile, Director General of the Defence Research and Development Organisation (DRDO), VK Saraswat has assured testing of Agni V in December 2011, with three stages of Agni V already been tested independently and the integration process currently in progress. New Delhi's search and longing for an inter-continental ballistic missile (ICBM) shall likely be fulfilled with the Agni V, owing primarily to its high road mobility, fast-reaction ability and a strike range over 5,000 kms. The Agni V will provide for the must-needed credible deterrence especially against China, which already showcases a Dong Feng-31A ICBM that is capable of striking across the length and breadth of India. Being a canister-launch missile system, Agni V would display a ring laser gyroscope and accelerator for navigation and guidance, and would be easy to store and swift in transportation. When fired from India's Northeast regions, it would be capable of targeting China's northernmost city of Harbin.

India's Missile Arsenal

The missile capability of Indian armed forces received a major fillip from the DRDO following the launch of the Integrated Guided Missile Development Programme (IGMDP) in 1983. The aim was to develop a family of strategic and tactical guided missiles based on local design and development. Originally, the IGMDP comprised only four missiles—Prithvi, Akash, Trishul and Nag. Having accomplished its objective, the IGMDP was formally brought to a close in 2008 with New Delhi shifting its focus towards enhancement, upgradation and serial production of the following missile systems.

Agni I

The continuing Agni series was/is not part of the IGMDP and remains programmatically detached from it. **Agni I** is a single stage, solid fuel, road and rail mobile, medium-range ballistic missile (MRBM) using solid propulsion booster and a liquid propulsion upper stage derived from Prithvi. The strap-down inertial navigation system adopts explicit guidance—attempted for the first time globally. The shorter-range Agni I is specially designed to strike targets in Pakistan within a range of 700-800 kms.

Agni II

Agni II is an intermediate-range ballistic missile (IRBM) already introduced into service with two solid-fuel stages and a Post-Boost Vehicle (PBV) integrated into the missile's Re-entry Vehicle (RV) with mobile launch capability test-fired in April 1999. The range for Agni II is more than 2000 kms. The nuclear-capable version of the Agni II missile was successfully test fired last in May 2010. A new variant of the Agni II called the Agni III A is presently under development.

Agni III

A two-stage IRBM capable of nuclear weapons delivery, the **Agni III** was developed

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by India as the successor to Agni II (till the Agni V was being worked upon) as India's nuclear deterrent against China. The missile intended to support a wide range of warhead configurations, with a 3,500 kms range and a total payload weight of 2490 kgs. In February 2010, India successfully conducted nuclear-capable Agni III's flight test, thus qualifying it for full induction into the armed forces and establishing the repeatability of the missile's performance.

Trishul

The **Trishul** (Trident) is a short-range, quick reaction, all weather surface-to-air missile designed to counter a low-level attack. It can also be used as an anti-sea skimmer from a ship against low flying attacking missiles capable of engaging targets like aircraft and helicopters, flying between 300 m/s and 500 m/s by using its radar command-to-line-of-sight guidance and electronic counter-measures against all known aircraft jammers. Trishul is a state-of-the-art system with its quickest reaction time, high frequency operation, manoeuverability, lethal capability and multi-roles for the three Services.

Akash

The **Akash** system is a medium-range surface-to-air missile with multi-target engagement capability carrying a 55 kgs multiple warhead capable of targeting five aircraft simultaneously up to 25 kms. It finds itself in comparison as an air defence missile to the US' Patriot. It uses high-energy solid propellant for the booster and ram-rocket propulsion for the sustainer phase. It was reported in March 2011, that the improved Mark II version of the Akash SAM missile shall likely undergo its first flight test by end 2012. The Air Force and Army are reported to order more of Akash MK-1 and MK-2 SAM batteries to cover wide open areas along India's northeast and western borders.

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Nag

The **Nag** is a third generation 'fire-and-forget' anti-tank missile with a range of 4-8 kms. Developed in India as an anti-armour weapon employing sensor fusion technologies for flight guidance, the Nag was first tested in November 1990. Although in June 2010, Nag was successfully test-fired destroying a target at a close range of 500 metres in three seconds, it was reported in April 2011 that induction of the Nag is likely to be delayed by more than a year with the Army seeking improvements to the specially-made missile carrier, Namica. In addition, HELINA (HELIcopter launched NAG) which is the air-to-ground version of the NAG anti-tank missile is scheduled to be integrated into the HAL built Dhruv Helicopters. The weaponised version of the ALH Dhruv helicopter will be able to fire HELINAs by 2013. The upgraded propulsion will enable HELINA to strike enemy armor at a distance of 7-8 kms.

Prithvi

The **Prithvi** missile is the first indigenously built ballistic missile under India's IGMDP with ranges of Prithvi I at 150 kms and II at 295 kms. Surface-to-surface battle field missile, Prithvi demonstrates higher lethal effects as compared to any equivalent class of missiles in the world displaying manoeuverable trajectory and high level capability with field interchangeable warheads. Flight trails for the Air Force has been completed and the system is now being configured for launching from ship, thereby increasing its capability as a sea mobile system. It was reported in March 2011 that the Prithvi II which already has been inducted into the armed forces, was successfully test-fired as part of its routine testing.

BrahMos

The realisation of a need for an indigenous cruise missile technology resulted in India choosing the supersonic cruise missile, **BrahMos**, being developed with Russia as a private joint-venture. BrahMos is a multi-platform cruise missile enabling it to strike from various types of land, sea and air-based platforms. Among the fastest supersonic cruise missiles in the world with speeds ranging between Mach 2.5 – 2.8, the BrahMos rates nearly three and a half times faster than the American subsonic Tomahawk cruise missile. An important exception, however, is the Russian *Alfa* cruise missile, capable of speeds in excess of Mach 4 (four

times the speed of sound). BrahMos has emerged as the perfect strike weapon with a fine combination of speed, precision, power, kinetic energy and reaction time attributes. In fact, India is the only country in the world to have inducted the supersonic land-attack cruise missile in its Army. The presence of BrahMos in India's arsenal will successfully prevent any hostile ship closing in within an operational range of 290 kms at sea. Although BrahMos is primarily an anti-ship missile, it is also capable of engaging land-based targets. Presently, the Indian Army has one regiment armed with the Block I version of the BrahMos missile. The Army reportedly plans to induct three more batteries, given that each battery is equipped with four mobile launchers mounted on heavy 12x12 *Tatra* transporters. BrahMos is a 'fire and forget' weapon, requiring no further guidance from the control centre once the target has been assigned and it is launched. Upon completion of assembly, it has a 10-year shelf life. The cost-effectiveness of cruise missiles may alter the fundamental role of airpower.

Nirbhay

A supplement to the BrahMos is the **Nirbhay**—a subsonic missile using a terrain-following navigation system to reach up to 1,000 kms. Capable of being launched from multiple platforms on land, sea and air, Nirbhay is expected to undertake its first flight in 2012, with systems integration work currently under way. Nirbhay will be a terrain hugging, stealth missile capable of delivering 24 different types of warheads depending on mission requirements.

Sagarika

Taking significant steps toward achieving the crucial third leg of India's nuclear deterrent by means of its submarine-launched ballistic missile (SLBM) capability, the K-15 **Sagarika** was successfully tested in February 2008 from a submerged barge with a range of 750 kms. Sagarika missile is being integrated with India's nuclear-powered Arihant-class submarine that began sea trials in July 2009 and India will likely be able to fire the Sagarika from a submarine in the near future.

Shaurya

A variant of the K-15 Sagarika named **Shaurya** has been developed from ground up as a submarine-capable missile, which can be stored in underground silos for a longer time and launched using gas canisters as booster.

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This nuclear-capable missile aims to enhance India's second-strike capability. Specially designed to be fired from Indian submarines thus making for the crucial third leg of India's nuclear deterrent, the Shaurya missile can carry a one-tonne nuclear warhead over 750 kms and striking within 20-30 metres of its target. It needs to be mentioned here that, India's undersea deterrent had so far revolved around the K-15 ballistic missile, built with significant Russian assistance.

Dhanush

The sea-based **Dhanush** which has been tested several times in recent years is a short-range, sea-based, liquid-propellant ballistic missile—known as the naval version of Prithvi II. According to reports, the possibility of a two stage version, the first being solid fueled and the second liquid-fueled is expected—thus providing the missile with a maximum range of approximately 350 kms. It was reported in March 2011 that the nuclear-capable Dhanush was successfully test-fired from a naval warship.

Astra

The **Astra** is a beyond-visual-range air-to-air missile using a solid-propellant that was tested successfully in May 2011. In terms of size and weight, the Astra is the smallest missile developed by the DRDO. Envisaged to intercept and destroy enemy aircraft at supersonic speeds in the head-on mode at a range of 80 kms, the Astra shall ultimately be integrated with fighter aircraft including Mirage 2000, Su-30 MKI, MiG-29 and Light Combat Aircraft, Tejas. Astra's first flight trial took place in May 2003, and today, India is the first of the developing countries to possess a state-of-the-art air-to-air missile. Astra has an active radar seeker to find targets, and electronic counter-measure capabilities which permits it to jam radar signals from

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an enemy surface-to-air battery, thus ensuring that it's not tracked or shot down. With an eventual operational range of over 100 kms, the Astra is intended to have performance characteristics similar to the Russian AA-12 Adder which flies at four times the speed of sound and possesses a range of 100 kms.

Prahaar

The **Prahaar** is India's latest surface-to-surface missile with a range of 150 kms tested successfully for the first time in July 2011. The primary objective of the conventionally-armed Prahaar missile is to bridge the gap between the unguided Pinaka multi-barrel rocket launcher (ranging 45 kms) and the guided Prithvi missile variants. Stated to be a unique missile, the Prahaar boasts of high maneuverability, acceleration and accuracy. Primarily a battlefield support system for the Army, the missile can be fired from a road mobile launcher and can quickly be transported to different places. Following more flight tests, Prahaar shall be ready for production.

India also has a ballistic missile defence technology demonstrator project that includes the Prithvi Air Defence (PAD) missile named *Pradyumna*—labeled as an AXO (Atmospheric Intercept System). This system was tested in 2006 with a maximum interception altitude of 80 kms capable of engaging missiles with a range of 300-2000 kms up to a speed of Mach 5.0. In addition, New Delhi has also indigenously-developed an advanced air defence (AAD) interceptor missile—a single-stage supersonic Endo Atmospheric Interceptor tested in 2007—in possession of its own mobile launcher, secure data link, independent tracking and homing capabilities and sophisticated radars. Besides, the first test flight of the Indo-Israeli long-range, surface-to-air missile (LR-SAM), called Barak 2, is scheduled for 2011. The missile designed to hit targets at a range of 70-100 kms can be used as a point-defence system on warships, defending against aircraft, anti-ship missiles and unmanned aerial vehicles.

By successfully testing the triad of nuclear deterrence from sea, land and air, India's quest for a credible minimal deterrent appears on course with accuracy.

Conclusion

India's missile programme represents sovereignty and self-reliance towards enhancing national defence capability. By successfully testing the triad of nuclear deterrence from sea, land and air, India's quest for a credible minimal deterrent appears to be heading with accuracy. India's security concerns especially vis-à-vis China seem to find validation with China's reported placing of advanced Dong Feng-21 (DF-21/CSS-5) MRBMs that can be put to use along China's southern and north-western borders—thereby targeting areas throughout northern India. India's credibility in the field, therefore, shall receive a much longed-for boost, with the Agni V missile, enabling New Delhi to upgrade its present strategic posture of 'dissuasion' to that of 'credible deterrence.'

Dr **Monika Chansoria** is Senior Fellow,
Centre for Land Warfare Studies

CENTRE FOR LAND WARFARE STUDIES (CLAWS)
RPSO Complex, Parade Road, Delhi Cantt, New Delhi 110010
Tel.: +91-11-25691308, Fax: +91-11-25692347, Email: landwarfare@gmail.com
Website: www.claws.in

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