India's Missile Programme and Odisha : A Study

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India's missile and nuclear weapons programs have evolved as elements of its strategic response to 68 years of wars and skirmishes it has fought with Pakistan and with China. Deep tensions and mistrust in the sub-continent continue unabated to the present. India's defeat by China in the 1962 border war, probably more than any other event, galvanized its leadership to build indigenous missile and "threshold" nuclear weapons capabilities as a credible deterrent against attack by China, and to attain military superiority over Pakistan.

As far back as in November 1978, the government had set up a Committee to identify a site for the establishment of an instrumented test range. A group of experts had surveyed a number of sites, including the *Sunderbans (West Bengal), the Kanyakumari (Tamil Nadu), Satbhaya (Orissa), Adaman and Nicobar Islands and the Balasore (Baliapal) coast (Orissa).* The only suitable site found was the Balasore coast having all advantages of a test range based on scientific, logistics and technical consideration compared to other places in the country.

The Government stated that it had strong technical reasons for choosing of Baliapal over other sites for this project. According to it, rockets and missiles can not be launched from anywhere. There are two major factors that have to be taken into consideration, while choosing a launch site. First, there must be an open, uninhabited stretch of land or water (several hundred kilometers long) 'down range.' Second, the site ideally, must allow for longitudinal launch. The first requirement is to ensure that a malfunction during the launch stage does not cause damage to civilian lives and property. Rocket propellant is highly explosive and if it does explode during the launch stage, burning fuel and metal fragments are sprayed over vast areas. Often, rockets fail to take off along the planned trajectory and have to be destroyed by the range safety officer. In this case too, the effects are so devastating that most launch sites around the world are consequently located on a coast.

The Bay of Bengal provides an ideal stretch of sea over which missiles can be fired. This part of the Indian Ocean does not have major international maritime or airlines routes criss-crossing it and during test launches the few existing routes can be closed temporarily without causing much disruption. More importantly, the Bay of Bengal is, in a sense, a protected sea. On the Western side, it can be monitored from Peninsular India and in the East; there is the Andaman & Nicobar Island chain. This means that telemetry stations can be set up easily to cover most of the Bay area.

Baliapal's additional advantage stems from the fact that it is located in a 'charmed'

meteorological spot. This is in area of the Orissa coast that forms a natural concavity and is not prone to cyclones that frequently develop in the Bay of Bengal. The continental shelf extends to several kilometres into the sea from Chandipur and the shallow workers dampen wind speeds. Consequently, studies have shown that at an average, between 248 and 280 days a year are available for launches. This is better than what can be obtained at any other site along the Eastern Coast. Baliapal's greatest advantage, however, stems from the fact that ballistic missiles as well as polar satellites can be launched longitudinally. Baliapal is located close to longitude 87 degree, 20 minutes East and missiles launched from here can have a totally unobstructed trajectory over the sea. In case of failure, the missiles will plunge into the sea without causing any harm. Moreover, it is much cheaper to launch rockets and missiles into orbital paths along a longitudinal direction.

After the stiff opposition to the creation of the National Test Range at Baliapal, the site had to be moved to the Wheeler Island about 2 sq.km in area and about 20 km off Chandipur coast. The local tribals opposed their eviction from the Chandipur site too. People of 15 villages formed the Purbanchal Suraksha Samiti to spearhead the agitation. In the end, the Government went for a compromise. Instead of permanently evicting all the tribals, it was decided that a core area would be cleared permanently and the rest of the zone cleared only during the actual launching of the missiles.

After locating the national test range at chandipur,a decisive shift in missile development plans occurred in 1983, when the Indian government launched the Integrated Guided Missile Development Programme (IGMDP). The programme involved the development of a family of strategic and tactical guided missiles.Under the strategic programme two ballistic missile systems were to be developed Prithvi and Agni.While the Prithvi was to be a short-range ballistic missile, the Agni was to be a medium-range technology demonstrator (TD).As for tactical guided missile systems, the DRDO sought to develop medium and short-range surface to air missiles (SAMs) the Akash and Trishul, as well as a third-generation anti-tank guided missile (ATGM), the Nag.

Agni-I is the first story that made India an innovative country as far as missile technology is concerned it was developed by the India's pride organization Defence Research & Development Organization(DRDO). It was first test fired successfully at India's famous Integrated Test Range in Chandipur situated in Odisha state on 25 January 2002.It is 12 tones in weight, 15 meters in length. Agni-I is capable to cover the range of 700-800 km and at the same time it is capable of carrying a conventional payload of 1,000 kg or a nuclear warhead at a speed of 2.5 km/s. Agni series missiles consist of one stage in the short range while two stages in the intermediate range. The most important aspect of the Agni series is that it can fired from rail and road mobile and powered by solid propellants. Agni-I is under use by the Strategic Force Command (SFC) of the Indian Army.

Agni-II is an another deadliest weapon in Indian basket capable to cover the range of 2,000-2,500 km, its length is 20 meters, with the diameter of one meter, while its weight is little more than Agni -I of around 18 tones. It has built upon solid propellant in both of its stages. They are said to be a part of the "credible deterrence" against China and Pakistan by India. India always claims that its nuclear and missile development programmers are not Pakistan-centric, that the Pakistani threat is only a marginal factor in India's security calculations, and that Agni series is at the

core of country's deterrence in the larger context of Sino-Indian power equation.

Agni-III is the third weapon in the Agni series of missiles developed by the Defence Research & Development Organization (DRDO). Agni III based upon the powerful solid propellant in its both stages. It was first test fired on July 9, 2006 from Wheeler Island off the coast of the eastern state of India, Odisha. After the unsuccessful launch, it was found by the DRDO scientists that the second stage of the rocket did not separate from the body and the missile had fallen well short of its pre determined target. It was again tested after ratifying the technical glitch on April 12, 2007, and this time it was successfully hit the target, again from Wheeler Island close to Orissa coast. On May 7, 2008 India again tested it successfully. This was the third consecutive test it confirmed the Agni-III's operational readiness while extending the reach of India's nuclear deterrent to most high-value targets of the nation's most likely adversaries. Agni-III has capability to cover the range of 3,500 km and can have a warhead of 1.5 tones. It has been claimed that the missile's circular error probable (CEP) lies within of 40 meters only, this makes Agni-III most accurate and deadliest strategic ballistic missiles of its range class in the world. It has also been reported that with smaller payloads, the Agni-III can hit strategic targets well beyond 3,500 km, this makes this missile ultra dangerous for enemy.

Agni-IV is the fourth brilliant outcome of DRDO work in the Agni series of missiles which was earlier termed as Agni II prime. Agni-IV was first tested on November 15, 2011 from famous Wheeler Island off the coast of the eastern state of Odisha. Agni-IV is capable to cover the range of 2,500-3,500 km depending upon the load factor. Agni-IV bridges the wide gap left by Agni II and Agni III. It is capable to take a warhead of 1 tone. It is a two-stage missile powered by powerful solid propellant. Its length is 20 meters and launch weight is about 17 tones. More importantly it can be launched from a road mobile launcher.

Agni-V is a solid fueled intercontinental ballistic missile (ICBM). It will greatly expand India's reach to strike targets more than 5,500 km away. Agni-V was first test fired on 19 April 2012 from Wheeler Island off the coast of Odisha, the test was successful. Agni-V ICBM has been designed with the addition of a third composite stage to the two-stage Agni-III missile. The 17.5-metre-long Agni-V would be a canister launch missile system so as to ensure that it has the requisite operational flexibility and can be swiftly transported and fired from anywhere. Agni-V weighs around 49 tones; one tone more than Agni III and a much longer range. The second test launch of Agni-V was successfully done on 15 September 2013 from Wheeler Island off the Odisha coast.

Agni-VI is another powerful intercontinental ballistic missile said to be in its early stages of development by DRDO labs. Agni-VI is going to be the real ICBMR of India. It is going to be the latest and most advanced version among the Agni (missile) program. Agni-VI will be capable of being launched from submarines or from land; it will be able to strike at a target of 6,000-10,000 km with MIRV warheads. After the success of Agni-VI India will become one of the countries which have the capability to target any spot in the world.

Prithvi I class is a surface-to-surface missile having a maximum warhead mounting capability of 1,000 kg, with a range of 150 km and can be launched from transporter erector launchers. This class of Prithvi missile was

inducted into the Indian Army in 1994. As Per (DRDO) Chief Avinash Chander the tactical 150 km-range Prithvi missile will be replaced with the Prahaar missile, which is more capable and has more accuracy." According to Chander, the Prithvi I missile withdrawn from service would be upgraded to be used for longer ranges.

Prithvi II class is also a single-stage liquid-fuelled missile having a maximum warhead mounting capability of 500 kg, but with an extended range of 250 km. It was developed with the Indian Air Force being the primary user. It was first test-fired on January 27, 1996 and the development stages were completed in 2004. This variant has been inducted into the army as well. In a recent test, the missile was launched with an extended range of 350 km and had improved navigation due to an inertial navigation system. The missile features measures to deceive anti-ballistic missiles.

Prithvi III *class (codenamed* ***Dhanush*** *meaning* ***Bow***) is a two-stage ship-to-surface missile. The first stage is solid fuelled and the second stage is liquid-fueled. The missile can carry a 1,000 kg warhead to a distance of 350 km and a 500 kg warhead to a distance of 600 km and a 250 kg warhead up to a distance of 750 km. Dhanush is a system consisting of a stabilization platform and the missile. It is a customized version of the Prithvi and is certified for sea worthiness. Dhanush has to be launched from a hydraulically stabilized launch pad. Its low range acts against it and thus it is seen a weapons either to be used to destroy an aircraft carrier or an enemy port. The missile has been tested from surface ships of the navy many times.

The Trishul (Trident) is a short range, quick reaction, all weather surface-to-air missile designed to counter a low-level attack. In fact, Trishul was one of the longest running DRDO missile development programmes. It can also be used as an anti-sea skimmer from a ship against low flying attacking missiles. The missile can engage targets like aircraft and helicopters, flying between 300 m/s and 500 m/s by using its radar command to- line-of-sight guidance. Powered by a two-stage solid propellant system, with a highly powered HTBP-type propellant similar to the ones used in the Patriot, the Trishul has necessary electronic counter-counter measures against all known aircraft jammers. Trishul, with its quickest reaction time, high frequency operation, high maneuver ability, high lethal capability and multi-roles for three services, is state-of-the-art system providing considerable advantage to the Indian armed forces.

The ***Akash system*** is a medium range surface-to-air missile with multi-target engagement capability. It can carry a 55-kg multiple warhead capable of targeting five aircraft simultaneously up to 25 km. It uses high-energy solid propellant for the booster and ram-rocket propulsion for the sustainer phase. The propulsion system provides higher level of energy with minimum mass, compared to conventional solid/ liquid rocket motor, which has better performance with minimum weight of the missile. It has a dual mode guidance, initially on command mode from phased array radar and later radar homing guidance with unique software developed for high accuracy. The phased array radar provides capability for multiple target tracking and simultaneous deployment of missiles to attack four targets at the same time, in each battery.

Another missile under ***IGMDP*** development is the ***Nag***, an anti armor weapon employing sensor fusion technologies for flight guidance first tested in November 1990. The Nag is a third generation &fire-and-forget, anti-tank missile developed in India with a range of 4 to 8 km. Nag was successfully test fired in August 2008

marking the completion of the developmental tests. Nag is expected to be the first weapon of its kind to be inducted into the army by December 2009. The Army urgently needs the more advanced Nag to improve kill probability as the missile using a high explosive warhead to penetrate the armor in modern tanks.

Significant additions also include the ***Multi-Barrel Rocket System PINAKA***, an area weapon system to supplement the existing artillery gun at ranges beyond 30 km, having quick reaction time and high rate of fire has been accepted by the user after extensive trials. ***BrahMos*** being jointly developed with Russia is a supersonic cruise missile that can be launched from submarines, ships, aircraft or land.

Brahmos is a two-stage missile with a solid propellant booster engine as its first stage which brings it to supersonic speed and then gets separated. The liquid ramjet or the second stage then takes the missile closer to 3 Mach speed in cruise phase. Stealth technology and guidance system with advanced embedded software provides the missile with special features. The missile has flight range of up to 290-km with supersonic speed all through the flight, leading to shorter flight time, consequently ensuring lower dispersion of targets, quicker engagement time and non-interception by any known weapon system in the world. It operates on 'Fire and Forget Principle', adopting varieties of flights on its way to the target. Its destructive power is enhanced due to large kinetic energy on impact. Its cruising altitude could be up to 15 km and terminal altitude is as low as 10 meters. It carries a conventional warhead weighing 200 to 300 kgs.

Nirbhay is an all-weather low-cost long-range cruise missile with stealth and high accuracy, the missile has a range of more than 1000 km. It weighs about one ton and has a length of 6 metres. *It carries a* ring laser gyroscope for high-accuracy navigation and a radio altimeter for the height determination. It is capable of being launched from multiple platforms on land, sea and air and shall be inducted into Indian Navy, Army, and Air Force. In particular, Nirbhay is being adapted for the Indo/Russian Su-30MKI. The missile is capable of carrying nuclear warheads. Proving a host of technologies and bridging the critical gap in the country's arsenal, India's first long range subsonic cruise missile, Nirbhay, was successfully test fired from the Integrated Test Range at Chandipur, in Odisha, for a distance of about 1,000 km on 17 October 2014. In 2008, New Delhi announced the end of the IGMDP with the focus now shifting towards serial production of missiles developed under this programme. Notwithstanding that the need for a systematically planned long-term doctrine has to be underlined, given that future wars would be autonomous and network centric, India needs more BrahMos like weapons systems which has emerged as the perfect strike weapon with a fine combination of speed, precision, power, kinetic energy and reaction time attributes. Delhi has also taken steps toward achieving submarine launched ballistic missile capability, with the first test of the K-15 (Sagarika) taking place in February 2008 from a submerged barge with a range of 750 km. Moreover, a landbased variant of the K-15 Sagarika named Shaurya, which can be stored in underground silos for longer time and can be launched using gas canisters as booster was successfully test-fired in November 2008. Sagarika missile is being integrated with India's nuclearpowered Arihant class submarine that began sea trials in July 2009. It would be apposite to conclude by stating that India's missile programme represents an iconic image demonstrating sovereignty and self-reliance vis-a-vis its technological achievements. Resultant of

nearly three decades of research, India's guided missile programme has assumed a self-sustaining character and become fundamentally crucial to New Delhi's proposed minimal deterrent.

Despite such types of development and production of missiles in India, its missile programme purely aims at peace in the country. *Defence Research and Development Organisation (DRDO) Director General Avinash Chander* said Bhubaneswar has been the Gateway for all the Missile Launch campaigns. *"I feel proud to say that Bhubaneswar has been the Gateway for all the Missile Launch campaigns for last many decades,"* Mr. Chander, who is also the scientific advisor to Defence Minister, said while addressing the third convocation of IIT-Bhubaneswar in the city. Stating that many of the Launch Complex and other Range Stations are located in proximity to Bhubaneswar, Mr. Chander said "they play a vital role in strengthening the National deterrence." *Whatever Research and Development effort goes in any corner of India with respect to our Missiles, ultimately needs to reach Bhubaneswar and then taken to Chandipur or Dhamra for its final testing,"* he said adding this place has divine blessings. Mr. Chander said this while telling students that they should be proud of the place and their institute.

Referring to the deterrent aspects of missiles, Mr. Chander said, *"Our missile programme is for peace in the country. And the message of peace went to the entire world from Odisha where Kalinga war was fought".*

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