CRUISE MISSILES: NEW CONCERNS IN INDIA'S THREAT ENVIRONMENT

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Technological advancements in the military domain are progressing at an all time high in the 21st century. New weapon systems, as well as more sophisticated versions of existing weapon systems, are all vying for military attention and budgets. Amongst these, one weapon technology that is fast acquiring a formidable reputation and profile is the cruise missile. Of course, this is not a new technology. In fact, such missiles have been around since the 1970s. But, ironically, at the time, they were described as "weapons without a clear mission"[1]. Much has happened since then for cruise missiles to acquire multiple roles and emerge as weapons of choice across nations.

In India, the supersonic, 290 km range cruise missile, the Brahmos, is deemed a big hit with the armed forces. The army already has three regiments equipped with the Block I and II variants of the Brahmos and recent reports have indicated the government's go-ahead for the induction and deployment of the more advanced steep dive, manoeuvrable Block III version for mountain warfare in the northeastern part of the country.[2] The naval version of the missile is already deployed on 10 warships and the air-launched Brahmos is in the process of undergoing testing from Su-30s.

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1. Rose E Gottemoeller, "Land Attack Cruise Missiles", *Adelphi Papers 226* (London: International Institute for Strategic Studies, Winter 1987-88), p. 3
2. Rajat Pandit, "Army to get Steep Dive Brahmos Missile Regiment for China Front", *The Times of India*, August 4, 2016

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Across Indian borders also, on both the east and the north, cruise missiles are making their presence felt. The strategic force postures of Pakistan and China are beginning to reflect a much larger footprint of cruise missiles in terms of their capabilities, numbers and types. Declared with a dual role capability in both these countries (unlike the case in India which has declared the Brahmos for conventional deterrence), these missiles signify a new element in the nuclear triads even as they add a host of complexities to conventional warfare.

However, the attention being devoted to these new developments is not apace with the rate at which these are occurring in India's neighbourhood. The more glamorous ballistic missiles have evoked greater interest. But the future seems to indicate a greater role for cruise missiles. As Dennis Gormley wrote in 2006, "Flying under the radar, both literally and figuratively, cruise missiles potentially present a far more pressing threat than their ballistic counterparts and the US quest to sell BMD is making matters worse"[3]. Indeed, most contemporary justifications for cruise missiles are being pinned on the need to negate the adverse implications of the Ballistic Missile Defence (BMD) on nuclear deterrence.

Consequently, over the last decade, the spread of these missiles has been significant. There are several attributes of the cruise missile that make it an attractive investment for militaries. This paper briefly identifies these. The larger focus of the paper, however, is on examining the current capability and future focus areas of Pakistan's and China's cruise missile developments. How are they seemingly integrating these into their militaries, including nuclear strategies? Given that no missile of any kind has ever been used in the region in past wars, and even the use of air power has been constrained owing to its escalatory potential, will countries be inclined to use cruise missiles? Or will this too breach a psychological threshold? Will the use of cruise missiles

3. Dennis Gormley, *Missile Contagion: Cruise Missile Proliferation and the Threat to International Security* (Westport, CT: Praeger Security International, 2008).

be seen as less escalatory than ballistic missiles? Most importantly, what does all mean this for India's security? What specific steps are needed to address this new challenge? This paper is an attempt to examine these questions.

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ADVANTAGES OF MODERN CRUISE MISSILES

Modern cruise missiles offer six main advantages. Firstly, they are far more technologically and financially within the reach of nations compared to building and maintaining expensive air forces and ballistic missiles.[4] They have even been referred to as a poor nation's air force. They are easy to acquire and operate, requiring no major specialised training as is necessary for flying combat aircraft. Neither are the technologies involved as sophisticated as in the case of ballistic missiles. Secondly, cruise missiles offer the advantage of evading detection as they speed towards their targets. Owing to their ability to fly at low altitudes, they can keep themselves well below ground-based radar horizons. With a small radar-cross section, such missiles can successfully avoid detection and penetrate enemy air defences. Thirdly, as compared to ballistic missiles reliant on conventional inertial guidance with the help of gyroscopes, cruise missiles offer the possibility more accurate navigation/ guidance if equipped with Terrain Contour Matching (TERCOM) systems, on-board computers, and a radar altimeter that correlates data received from altimeter readings with maps in its memory. They could even be satellite linked, thereby further improving their accuracy, and making them suitable for hitting out at many alternative targets. The fourth gain of cruise missiles emanates from the deployment flexibility that they offer

4. According to one estimate, a Western cruise missile is available for anything between $0.5 to 2 million, depending on its capability. Those from China are in the market at far lower prices, even a few hundred thousand dollars. For more, see Brian A Jackson, David R Frelinger, Michael J Lostumbo and Robert W Button, *Evaluating Novel Threats to the Homeland: Unmanned Aerial Vehicles and Cruise Missiles* (Santa Monica, CA: Rand Corporation, 2008), p. 6.

owing to their ability to be used from land, air or sea-based (surface and sub-surface) platforms. Fifthly, the missiles can carry variegated types of payloads – conventional, nuclear, chemical or biological. In the initial years, cruise missiles were relatively slow delivery platforms and were, hence, considered unsuitable as first strike nuclear weapons. But this situation has completely changed today with the development of supersonic cruise missiles and hypersonic versions on the anvil. Lastly, since they are lighter and can be placed in canisters, they are highly mobile, easier to handle and more suitable for shoot and scoot tactics. In fact, a major advantage of these missiles from the military point of view is the relatively limited support requirements for the mobile, ground-launched versions. A smaller logistics requirement enhances mobility which, in turn, enhances their survivability.

Given the above attributes, it is hardly surprising that cruise missiles have emerged as multi-purpose platforms that can be used for a variety of missions. Naturally then, they are being considered as a valuable strategic supplement to ballistic missiles in terms of nuclear deterrence, as well as being drafted for a clear role in conventional war-fighting strategies. Their use in the first Gulf War, and subsequently in Iraq and Afghanistan, demonstrated their offensive capability and utility.

In India's neighbourhood, these weapon systems are now beginning to make their presence felt. While China has had cruise missiles for a long time, it is only in the 2000s that newer and more effective variants entered its arsenal. In the case of Pakistan, the development is still more recent and the capability is slowly but steadily becoming operational. It is critical that the cruise missile capability build-up in these two countries, which are of the greatest national security significance for India, is consistently monitored so that an informed understanding of the threat scenario can enable the correct choice of responses.

PAKISTAN'S CRUISE MISSILES : CURRENT CAPABILITY AND FUTURE FOCUS

The presence of cruise missiles in Pakistan is only about a decade old. It was in 2005 that, for the first time, Pakistan declared the test of a ground-launched cruise missile, the Babur. But since then, the capability has shown

rapid development and the envelope has extended to include an air-launched cruise missile too, the Ra'ad. The two missiles have undergone as many as 15 tests over the last ten years.

Pakistan claims the Babur to have been indigenously developed by its National Engineering and Scientific Commission (NESCOM), which was established in 2001. It may be recalled that during the 1990s, Pakistan had expressed keenness to get off-the-shelf Land Attack Cruise Missiles (LACMs) and had hit upon Ukraine as a source. By August 2001, the engineering design of one such missile, the Korshun, had been smuggled out of Kiev as part of an effort led by AQ Khan that had been going on since 1997.[5] China and Pakistan are believed to have collaborated (reverse engineered) to create their own versions of this missile, including using the six American Tomahawks launched on targets in Afghanistan in 1998 that had fallen into the hands of Pakistani scientists. As Gormley writes, "Given the unreadiness of Pakistan's purely indigenous capabilities to undertake a sophisticated LACM program entirely on its own, it appears reasonable to believe that the Chinese government or its military-industrial entities assisted Pakistan in acquiring a LACM capability".[6] According to some reports, the Chinese created six prototypes of their version, called the DH 10A, which began to be tested from 2004 onwards.[7] One of this was tested in early 2005 and became the Babur. China also gave NESCOM the production engineering designs as well as the moulding/machining/milling tooling necessary for fabricating the sub-assemblies of the missile.

After having been tested at 500 km range and subsequently at 700 km, the Babur is believed to have been in service from 2010 onwards. It can carry conventional and nuclear payloads [10-30KT(Kilo Tonne)].[8] According to press releases issued by the Inter-Services Public Relations (ISPR)[9] after each test, the missile has a high subsonic speed of 880 km/h provided by a

5. Prasun K Sengupta, "Trishul: Babur LACM and Ra'ad ALCM Detailed", blog by Sengupta, posting of December 10, 2008, available at http://www.trishulgroup.blogspot.in/2008/12/babur-lacm-raad-alcm-detailed.html.
6. Gormley, n.3, pp. 84-85.
7. Sengupta, n. 5.
8. Naseem Shah, "Babur Missile Vs Brahmos Missile", Pakistan Defence Forum, Web Discussion, January 2, 2013.
9. One such ISPR Press Release is No. PR 135/2012, May 31, 2012, available at http://www.ispr.gov.pk. Accessed on March 31, 2014.

turbofan engine. Once thrown out by a booster rocket that provides additional thrust to accelerate the missile away from the launch vehicle, it moves along a low-level, terrain-hugging trajectory that enables it to avoid radar detection. It uses a special high-density blended aviation turbine fuel that has more energy for a given volume than standard fuels, and can endure harsh weather conditions and long storage periods. The ISPR claims also equip the Babur with an advanced and modern navigation and guidance system which combines the Inertial Navigation System (INS), Terrain Contour Matching (TERCOM), Digital Scene Matching and Area Co-relation (DSMAC) and Global Positioning System (GPS) satellite guidance! It is being speculated that in the future, Pakistan will also make the missiles GLONASS, Galileo or Beidou enabled!!

The ISPR also attributes a high degree of manoeuvrability to the Babur. In fact, if the claims are to be believed, the radar altimeter enables the missile "to fly as low as 20 m over water, 50 m over moderate hilly terrain, and 100 m over mountains, making it impossible to be detected with ground-based radars. The turbofan engine is capable of flying a cruise missile up to 2,000 km ranges at low altitude and 50 per cent more, if the first 1,500 km is flown at higher altitude with the rest at tree-top level."[10] Such assertions do appear to be currently beyond the capability of Pakistan, especially since China too is yet to operationalise such TERCOM and DSMAC enabled missiles. But there is no doubt that these capabilities are on the wish list of Pakistan.

Meanwhile, it is worth noting that the Babur does enjoy the advantage of being road mobile, launched as it can be from a three-tube assembly mounted on a truck. The Transporter-Erector-Launcher (TEL) is reportedly a Chinese reverse-engineered variant of an 8X8 Russian vehicle, but it has been procured by Pakistan from North Korea.[11] Amongst other ground support requirements of the cruise missile is a separate 10 KW (Kilo Watts) electrical generator to power the missile's pre-launch operations and two hydraulic pumps to raise the missile canisters to their launch positions. The number of Baburs in service is not known. Some reports suggest that the Pakistan Army has ordered the

10. Pravin Sawhney, "Being Ready for any Eventuality", *The Pioneer*, June 6, 2013
11. Sengupta, n. 5.

formation of two battalions with cruise missiles, with each having four batteries with six TELs housing 24 Baburs and another 24 reloads.

Relatively less is known about the Raád, an air-launched cruise missile which had been under development since 2003 and was finally tested for the first time on August 25, 2007. The missile was launched from a Pakistan Air Force (PAF) Mirage IIIE or Mirage 5 and declared to have a range of 350 km. It will also be usable from the JF-17 that Pakistan is co-producing with China in large numbers. According to an ISPR statement, the Ra'ad is described as a "state-of-the-art cruise missile with stealth capabilities… a low altitude, terrain hugging missile with high manoeuvrability, and can deliver nuclear and conventional warheads with pinpoint accuracy"[12]. In January 2016, the seventh test of the missile was carried out. Given that it enjoys effective standoff range, it may be surmised that it could be used to hit fixed installations such as radar posts, command and communication nodes, ports and refineries or missile launchers, etc.

As far as the sea leg of cruise missile deployment is concerned, Pakistan has procured the C-602 anti-ship cruise missile, with an estimated range of 280 km and a speed of 0.8 Mach, from China. An order for 120 of these had been placed in 2009 and the first batch arrived by 2011. A news report of 2014 stated that the missiles had been deployed on "frontline units of the Pakistan Navy"[13], making Pakistan the first, and until now, the only, foreign recipient and operator of the Chinese missiles.

Amongst the future areas of focus for Pakistan in its cruise missile capabilities, three can be easily identified. The first of these could be an enhancement of the range of its ground-launched cruise missile. Babur II is slated to have an increased range of 1,000 km and there are reports that Pakistan is working on this with help from Turkey. A second capability on the wish list is a sea-launched variant to be placed on its Agosta submarines after necessary modifications to the dimensions of the missile to fit into the submarine torpedo tube. The tubes are attributed to have a diameter of 533

12. "Pakistan Tests Self-Developed Cruise Missile", *The Hindu*, February 2, 2015. However, South African technical help on this missile is believed to have been used. It bears a close resemblance to the South African MUPSOW and Jorgos missiles.
13. "Pakistan Navy Depoys Chinese C-602 Cruise Missile", *The International News* (Pakistan), April 12, 2014.

That Pakistan considers this weapon system rather seriously is evident from the fact that it has been described as constituting a part of the country's pursuit of full spectrum credible nuclear deterrence against India.

mm while the diameter of the missile is 560 mm. A third development would be of supersonic cruise missiles. High speed with long range would give Pakistan an ideal platform to evade interception and mount surprise attacks. China is known to be working on supersonic and hypersonic cruise missiles and it is not unlikely that these would be handed down to Pakistan at some time in the future.

CRUISE MISSILES IN PAKISTAN'S MILITARY STRATEGY

Having acquired this capability, the important question is: what purpose do cruise missiles serve in the Pakistani military strategy? How does it intend to use this capability? Of course, the impact of these missiles on Pakistan's military strategy will depend on how quickly these evolve and the kinds of capabilities that begin to enter operations. But the issues that need to be considered are their utility as strategic weapons, their role in conventional war-fighting strategies, and the problems of ambiguity if they are used as dual capable platforms.

For Nuclear Deterrence

That Pakistan considers this weapon system rather seriously is evident from the fact that it has been described as constituting a part of the country's pursuit of full spectrum credible nuclear deterrence against India.[14] After one of the recent tests of the Ra'ad in February 2015, the former Director General (DG) of the Strategic Plans Division (SPD), Lt Gen Zubair Mahmood Hayat commended the development for "strengthening Pakistan's full spectrum credible minimum deterrence capability"[15].

Such pronouncements clearly bestow a nuclear dimension to the cruise missile. Apparently, Pakistan wishes to use the threat projection capability of

14. It may be recalled that the Nasr, the very short range ballistic missile that Pakistan has propagated as a tactical nuclear missile, is also a constituent of full spectrum deterrence.
15. n.12.

the missile more for nuclear deterrence than its actual military potential in a conventional role. This is an interesting formulation and not a matter to be dismissed lightly. Unlike India that does not refer to its cruise missiles for nuclear delivery, Pakistan has not shied away from flaunting these missiles as carriers of nuclear weapons. Given that the missile diameter of the Babur at 560 mm is the same as that of its Hatf-1, it is plausible that a nuclear warhead could be carried by the cruise missile. Its low detectability and, hence, high penetrability could make a salvo launch of such weapons effective in a first strike mode. If supplemented with ballistic missiles, a combined first strike would become even more lethal and indefensible by a nascent BMD.

Air Cmde (Retd) Kaiser Tufail, for instance, has ruled out the possibility of the Ra'ad being employed in a conventional mode "because a payload of 450-kilograms [at best] can do little harm unless launched in a shower of a few score, something that would be outrageously costly".

Understandably then, Rawalpindi emphasises the nuclear role of its cruise missiles in an attempt to indicate diversity in targeting options and greater flexibility in operational deployments. Some Pakistani military analysts have even argued against the suitability of these missiles for a conventional role. Air Cmde (Retd) Kaiser Tufail, for instance, has ruled out the possibility of the Ra'ad being employed in a conventional mode "because a payload of 450-kilograms [at best] can do little harm unless launched in a shower of a few score, something that would be outrageously costly".[16]

This, however, may not be strictly true. In fact, it is quite likely that Pakistan's projection of the cruise missile in the nuclear role is exactly that – a projection to further its deterrence. But the greater chances of credible use lie in the conventional realm.

As Conventional War-Fighting Weapons

Cruise missiles offer the advantage of surprise and precision that could be effectively used for the purpose of degrading capability, mounting a

16. Usman Ansari, "Pakistan Tests Cruise Missile", *Defense News*, February 2, 2015

psychological impact while remaining below the nuclear threshold. For a Pakistan keen to keep a conflict from escalating to the nuclear level, the use of the Babur and Ra'ad with conventional payloads would possibly fatigue India's air and missile defences to open it to follow-on air strikes. Such use has the potential to upset India's military choices and cast a deterrent effect.

Given that the US is developing its newer hypersonic versions of cruise missiles for conventional global prompt strikes, the general trend seems to be towards accepting these missiles as conventional platforms. China too has indicated its use of these missiles for long range ground attack or anti-ship operations in a strategy of conventionally degrading US capabilities and morale. There is no reason to believe that Pakistan too will not see merit in using this weapon as a conventional platform.

Ambiguity From Dual Use

Pakistan claims that its cruise missiles are dual use delivery platforms. This ambiguity comes in useful to enhance deterrence. Writing at the time of the Cold War, in the context of the US and USSR, Gotemoeller had noted about cruise missiles, "In terms of strategy, they can be used to increase risks to the opponent, diversifying the long range strike capability of the air force and navy and expanding the number of nuclear warheads available".[17] This is what Pakistan seems to believe too — that this capability could be a significant addition to the deterrent ballistic missile force, particularly if it was perceived to be invulnerable to an Indian BMD. In this context, the dual use capability of the weapon system proves handy to obscure the thresholds between conventional and nuclear war.

However, such dual use deployments are not without their problems. For instance, the deployment of nuclear-tipped cruise missiles alongside conventional variants on multi-purpose naval platforms can complicate the naval strategy. If the platforms carrying nuclear missiles must survive to enhance strategic reserve, they should remain out of harm's way in the early stages of conventional war. But if they are to simultaneously carry out conventional land attack missions, they must deploy to areas from where

17. Gotemoeller,n.1, p. 28.

they can undertake these missions even if they face the risk of taking a hit themselves. So, how must the naval vessels, on which both conventional and nuclear missiles are deployed, behave? What if such a ship was to be hit by a conventional missile of the adversary in the absence of his knowledge that it was carrying nuclear-tipped cruise missiles too? Would it be taken as an attack on nuclear capability, leading to a nuclear retaliation?

In its desire to reap maximum deterrence benefits from such a capability, Pakistan has not thought through some of these issues and their dangerous potential repercussions. Cruise missiles, which are difficult to detect and can lead to surprise attacks, particularly if seen to be capable of decisive results without recourse to nuclear weapons, may tempt states to risky actions, and Pakistan could begin to think so too. This does pose challenges of misperception and inadvertent escalation, severely threatening crisis stability.

CHINA'S CRUISE MISSILE CAPABILITY

China first began to explore cruise missiles in the 1950s largely from the perspective of using them for coastal defence. In fact, before the rupture in its relations with the USSR, China had already procured "models, blueprints and technologies relevant to ASCM development". As a result of this initial help, some modest types of cruise missiles were made and the first generation of SY-series of Anti-Ship Cruise Missiles (ASCMs) had been inducted into the People's Liberation Army (PLA) by the late 1960s. Nearly five decades down the line, the Chinese Navy today is believed to be one of the "most ASCM equipped compared to other major naval powers"[18]. Most of its surface ships and many of the conventionally powered submarines are equipped with these missiles. In the Western Pacific, China has an overwhelming asymmetry over American ASCMs that are outnumbered seven to one.[19]

Given that Taiwan constitutes a core interest of China, the emphasis on ASCMs is not surprising to cater for a counter-intervention strategy in the Taiwan Strait. The Aegis missile defence equipped American warships push

18. Dennis Gormley, Andrew Erickson and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions* (Washington DC: National Defence University Press, 2014), p. 89.
19. Ibid., p. 91.

the Chinese to find ways of defeating the defences and they have found a way of doing so by using the older versions of cruise missiles to saturate/ overwhelm the BMD. China can afford this because several new variants of the ASCM have been developed and are operational with the Chinese Navy today. These range from the 25-km short-range YJ-7, to the 42-km YJ-8, to the 120 km YJ-83. Meanwhile, the YJ-62 is claimed as a modern, indigenously developed missile, which is presently outfitted on the LUYANG destroyer. The latest in the impressive arsenal of Anti-Access Area Denial (A2AD) weapons of the PLA is the YJ-12 (400km) air-launched ASCM and the YJ-18 (200-220 km) ship/submarine-launched ASCM. Both are supersonic, with top speeds of 2.5 to 3 Mach. They can manoeuvre in the final stages to avoid air defence. The newest class of Chinese destroyers, the LUYANG III has the new vertically launched YJ-18.[20] Meanwhile, YJ-12 can be launched from H-6 bombers and from the J-11 aircraft.

An important attribute of the Chinese ASCM capability is that all its ASCMs of the different ranges, speeds and accuracies have variants that are capable of being launched from ships, submarines, air or land. According to US estimates, the PLAN is "training to launch cruise missiles from multiple platforms; many surface vessels and conventionally powered submarines are also taking ASCM delivery as their priority operational roles".[21] Its new array of frigates and destroyers, as well as the Song, Kilo and Shang class SSNs (nuclear powered attack submarines) are capable of carrying ASCMs. In fact, some analysts have described this tendency as treating "every surface combatant to be the aquatic equivalent of a missile Transporter-Erector-Launcher."[22]

The different types of these missiles are also equipped with varied types of navigation systems ranging from electro-optical signals (YJ-7) to inertial/active radar (YJ-83) to those that can receive targeting updates in flight through GPS (YJ-83 A and YJ-62). The range of sophistication available across the platforms is not the same. But it can provide greater flexibility and choices for making missions more cost-effective.

20. Office of Naval Intelligence, Government of USA, *The PLA Navy: New Capabilities and Missions for the 21st Century* (Washington, 2015).
21. Gormley et al., n.18, p. 5.
22. William Murray as quoted in Ibid., p. 43.

One major limitation, however, of the Chinese ASCMs that are operational today is in their ability to undertake detection and monitoring in real time of enemy surface ships which are over the horizon. China is yet to develop the full panoply of relevant enabling technologies and systems to resolve this problem. For instance, intelligence support, command and control, stealth and survivability features on its own platforms are yet to reach full maturity. For submarine-launched ASCMs, the limited range of radar detection is a handicap and since using own active sonar could lead to revelation of its own position, the submarine has to necessarily depend on targeting information communicated via radio. But this necessitates some form of antenna to receive data, making the platform vulnerable to revealing itself and opening up the risk of attack. Moreover, as pointed out by one analyst, "The accuracy of the data can be degraded by computer processing issues, data latency, and particularly for long range missiles, weapon flight time, all of which make a successful attack by cruise missiles less likely"[23]. A moving target demands real time data cueing which can best be done through satellite navigation aids such as relay stations as part of a distributed sensor network. China is moving in that direction but is still a fair distance from arriving at such a sensor fusion for long range targeting capability.

While this may be so, the point to note is that through the very development of this capability, China has managed to enhance its deterrence and sowed the seeds of doubt in the minds of adversaries. At the same time, it has also managed to impose peace-time costs on adversaries by compelling them to develop defensive counter-measures. As put forward candidly by American analysts, "In the event of a maritime conflict with US forces, PLAN is likely to undertake massive multi-axis ASCM attacks against US Carrier Strike Groups (CSGs) and their Aegis air defense perimeters."[24] Once China develops and inducts supersonic ramjet powered variants, it would have serious implications for how, where and to what extent the US would be able to deploy its carrier battle groups to honour its security commitments to Taiwan. ASCMs are also deployed by China along its

23 Ibid., p. 52.
24. Ibid., p. 62.

A more modern, second generation version, with a 1,500-2,500 km range, the DH-10 has GPS/inertial guidance equipped with TERCOM that enables digital scene matching to ensure 10 m accuracy.

coast to provide defence for naval bases and to block an enemy fleet from getting too close to the base to conduct reconnaissance, missile attacks or deploy any blockades. Seen in the context of active defence, these are considered best suited for carrying out surprise attacks to degrade the enemy.

Built through considerable Russian technical assistance, Chinese LACMs offer another impressive capability. Being mobile, these are difficult to detect prior to launch. From the indigenous HY-4, popular in Western literature as the Silkworm and exported widely, China has graduated to the DH-10. A more modern, second generation version, with a 1,500-2,500 km range, the DH-10 has GPS/inertial guidance equipped with TERCOM that enables digital scene matching to ensure 10 m accuracy. In fact, China is known to be working hard to improve further its navigation and timing information in order to improve accuracy. China's geostationary satellite navigation system, the Beidou, is steadily being built with every satellite launch. Though full operations for global coverage would be possible only after a 35-satellite constellation has been installed, enough is already available for the immediate regional context. When launched from Chinese aircraft, with 500 kg warheads, the DH 10 could threaten hardened aircraft shelters, command and control nodes and other high value targets such as sensors that would disrupt enemy air attacks.

Considering the amount of resources – financial and human – being invested in cruise missile developments, it is clear that this capability is being seriously followed by the country as a viable deterrent strategy. The future of cruise missiles in China is certain to include a number of new technologies.

Supersonic and hypersonic cruise missiles appear to be a predominant area of Chinese focus in the future. The former are powered by ramjet engines and operate in the range of Mach 2-4, while the latter have scramjet engines

that give them a speed of more than Mach 5.[25] High speed condenses the sensor to shooter to target time, making defences against such vehicles extremely difficult. If Cruise Missile Defences (CMDs) are going to be developed in the future, then defeating them naturally means allowing less reaction time to the adversary to defend himself. Also, the increased speed would make them more accurate against mobile targets. Secondly, it would increase their kinetic energy, which, in turn, would increase the explosive power of the warhead even if the payload is not much. This would then enable range enhancement of the missile. Therefore, a hypersonic missile would have implications for speed, range, accuracy and precision. A usage of mix of supersonic LACMs/ ASCMs with subsonic versions and also ballistic missiles would create huge processing difficulties for any Electronic Warfare (EW) or missile defence system.

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Hypersonic reusable cruise missiles comprise a technology of the future. Propelled by dual mode ramjet/scramjet engines, these would have a speed of Mach 7 and be sustained by hypersonic air breathing. The Qian Xuesen National Engineering Science Experiment Base in Beijing is believed to be working on developing scramjet engines at a new wind tunnel. Though this is currently placed at testing models capable of reaching speeds of 5.6 Mach, some reports also suggest wind tunnel modelling capabilities for supersonic devices at Mach 9.[26] It is also reported that the China Aerodynamics Research and Development (R&D) Centre and the National University of Defence Technology are engaged in scramjet propulsion, pulse detonation engines and turbine-based combined cycle engines that will help them develop

25. The US DARPA is known to be working on an air breathing cruise missile that could deliver a 5, 000 kg payload over 17,000 km in two hours by travelling at speeds of Mach 6. Gormley, n. 3, p. 73.
26. J Michael Cole, "Russia, China, and America's Hypersonic Missile Race", *Flashpoints, The Diplomat*, August 20, 2012.

hypersonic missiles.[27] Armed with conventional warheads and high kinetic energy, such cruise missiles are seen as useful to attack ships, radars and communication systems, command and weapons bunkers, airfields, missile launchers, etc.

The other capability that will emerge more prominently in Chinese cruise missiles is stealth. According to American estimates, "Stealthy cruise missiles would be used to achieve operational surprise while hypersonic missiles would run past heavy enemy defenses".[28] Development of new stealth materials and technologies, such as plasma stealth technology and high power jammers are all strides in this area.

In order to use own offensive capability while staying clear of harm's way, firing at enemy targets from longer and longer ranges is required. But long range missiles can be more accurate and effective only if capable of mid-course programming and an active terminal seeker warhead, particularly in the case of mobile targets. Chinese ASCMs which are part of its anti-access and area denial strategy are not yet of very long ranges. But reports abound on the DH-10 LACM of 3,000 km range being converted into an anti-ship variant.

In order to further enhance the accuracy of its missiles, there is no doubt that China will focus on electro-magnetic attack technology, data links and distributed sensors/networks and improved artificial intelligence to autonomously hunt targets in denied environments. Terminal evasion manoeuvres too would be the future focus of Chinese cruise missiles in order to defeat missile defences.

ASCMs bring for the Chinese Navy the flexibility of employing subsonic or supersonic variants, of short or long ranges and with conventional or nuclear warheads. Nevertheless, a very clear picture is not available on whether the Chinese ships have met with much success in the integration of these missiles into effective operations. Can the Command, Control, Computers Communications, Intelligence, Surveillance, Reconnissance (C4ISR) hardware

27. Kalyan M Kemburi, "High Speed Cruise Missiles in Asia: Evolution or Revolution in Fire Power?", RSIS, Commentaries, No. 044/2014, March 4, 2014.
28 Jeffrey Lin and PW Singer, "China Shows off its Deadly New Cruise Missiles", *Popular Science*, March 10, 2015.

and software undertake the pressures of deployment? Testing has proved the capabilities of the missiles, but their actual employment in the hands of the users has never been proved in any combat scenario. Unlike the US which has used missiles in wars and, thus, tested and improved their capabilities, China has not.

Joint training between the PLA Air Force (PLAAF) and PLA Navy (PLAN) to optimally use cruise missiles in offensive and defensive roles remains an untested issue. Chinese documents, including its White Papers on national defence, indicate an emphasis on joint operations and inter-Services coordination, including with the strategic rocket forces missile units, which are also the custodians of China's cruise missiles. "It is unclear how sophisticated and realistic is firing training for SLCMs or how advanced and effective are the C4ISR to cue their targeting…"[29] Issues such as retaining effective positive controls over nuclear-tipped Submarine-Launched Cruise Missiles (SLCMs) when they are deployed in operational areas will also become a live issue.

CRUISE MISSILES IN THE CHINESE NUCLEAR STRATEGY

Going by its own military doctrine that envisages future wars to be intense and localised, fought with high technology weapons, China lays immense score on the right weapons to fight such wars in order to ensure victory and attainment of its objective. What role would cruise missiles play in this context?

Enhanced Conventional Combat Capability

Given the accuracy of cruise missiles, their all weather capability, long range, low detectability and compatibility with a range of launch platforms, the missiles pose a deadly, stealthy and flexible weapon against the adversary. The use of cruise missiles by China to degrade Indian air defences or attack command and control nodes seems plausible to jeopardise retaliatory actions, while leaving the country vulnerable to follow-on air or missile strikes.

Another development to watch out for, which currently is some distance away, is operationalisation of conventionally armed hypersonic cruise

29. Gormley, n. 3, p. 66.

missiles. This could give China the ability to conduct a conventional first strike to degrade India's nuclear retaliatory capability. Coupled with a BMD on Chinese assets, this capability would seriously erode nuclear deterrence, compelling India to recalculate the numbers in its 'minimum' deterrence. As pointed out by a Chinese scholar in the context of American efforts towards hypersonic missiles, "Nations concerned about the survivability of their deterrents might build additional nuclear facilities deep underground – or begin to demonstrate less transparency about their nuclear policies". [30] Both trends point towards greater strategic instability, and will demand an Indian consideration.

Cruise Missiles for Nuclear Delivery

If one was to go by the historical experience of the Cold War and the stated Chinese nuclear doctrine of no first use, there can be no real logic and strategic purpose of cruise missiles as nuclear delivery vehicles. There certainly is one school of thought in Chinese literature that upholds the belief that nuclear weapons are for strategic deterrence and that no nation can cross the threshold of use of nuclear weapons that easily. Command and control challenges and inconsistency with the nuclear doctrine are identified as complicating factors in developing and deploying such a capability.

But, given the Soviet influence on China, it cannot be ignored that the Soviets (as also the US) did employ cruise missiles as nuclear delivery platforms. More pertinent is the ongoing debate in the US (which is sure to be keenly watched by China) on the development of the new Long Range Stand-Off (LRSO) cruise missile for nuclear delivery.[31] A PLAN officer, Capt Liu Yang has been quoted to have advocated consideration of cruise missiles as a foundation to carry out a low-weight nuclear burst, or as a fuel air explosive warhead, especially against aircraft carriers[32].

30. Tong Zhao, "Banning Hypersonics: Too Much to Hope For", Development and Disarmament Roundtable, *Bulletin of Atomic Scientists*, June 26, 2015.
31. For more on this, see Aaron Mehta, "Senators Urge Obama to Cancel Nuclear Cruise Missile", *Defense News*, July 21, 2016. http://www.defensenews.com/story/defense/policy-budget/congress/2016/07/21/senators-obama-nuclear-missile-lrso/87384128/. Accessed on August 6, 2016.
32. Gormley, n. 3, p. 74.

Though China's cruise missiles have not traditionally been attributed with a nuclear payload, in an article in 2013, Hans Kristensen, a nuclear weapons specialist with the Federation of American Scientists, mentioned the CJ 20 as a nuclear capable cruise missile, which, he said, was the first such listing he had seen in an official US publication crediting a Chinese air-launched cruise missile with nuclear capability. The CJ-20 can be carried by the long-range H-6 bomber in a land-attack operation that could strike targets all over Asia and eastern Russia as well as the US military base hub on Guam Island, in the Western Pacific.[33] More recently, another US report mentioned the possibility of China opting to nuclear tip its SLCMs.[34]

Ambiguity in Use of Platform

Dual use cruise missiles carry the risk of miscalculation or misperception in times of crisis, leading to inadvertent escalation. Indeed, the use of highly accurate, long range and stealthy weapons that enjoy the further benefit of flexibility of employment to carry out disabling nuclear strikes against strategic targets such as command centres, silo launch installations, nuclear weapons storage sites, etc add to the dangers. These would only multiply as and when manoeuvrable hypersonic missiles enter the fray. As pointed out by Dr Rajaram Nagappa of the National Insitute of Advanced Studies (NIAS), misunderstandings would arise about a missile's intended destination, "A nation might conclude, for example, that its nuclear forces were under attack when, in fact, its conventional forces were the intended target."[35] The implications of this for stability can be well imagined.

IMPLICATIONS FOR INDIA

It is evident that the advent of cruise missiles complicates the Indian security environment. While the intuitive response to the developments in the neighbourhood is to mirror image adversary capabilities, besides

33. Michael Richardson, "Cruise Missile Threat in Asia", *Japan Times*, June 18, 2013.
34. "China May Pursue Nuclear Cruise Missiles, US Military Study Warns", *Global Security Newswire*, Nuclear Threat Initiative, June 3, 2014.
35. Rajaram Nagappa, "New Technology, Familiar Risk, Development and Disarmament Roundtable," *The Bulletin of the Atomic Scientists*, June 26, 2015.

The Brahmos is already a formidable system. But further enhancement of its range (by using it as an air-launched vehicle) or on other ground/sea-launched variants (as now possible with India's entry into the Missile Tecnology Control Regime – MTCR) would enhance deterrence.

building cruise missile defence, the need of the hour, however, is to consider the options with greater clarity of purpose. India has a finite amount of technical expertise and financial resources and the areas where these should be invested must be carefully thought through.

The first point to acknowledge is that the cruise missile is a potent weapon system with many unique attributes. It appears particularly suitable for targeting high value, heavily defended enemy assets. In this context, it cannot but be recommended that the country must effectively exploit the potential of cruise missiles to undertake precision attacks on specific high value targets that are likely to be far more protected through air defence. Building own capabilities on cruise missiles is important to signal an effective deterrent. The Brahmos is already a formidable system. But further enhancement of its range (by using it as an air-launched vehicle) or on other ground/sea-launched variants (as now possible with India's entry into the Missile Tecnology Control Regime – MTCR) would enhance deterrence.

However, as for the use of cruise missiles for nuclear delivery, the case needs deeper examination. Miniaturisation of nuclear warheads and their mating with cruise missiles is no technological marvel and is within the reach of most nuclear armed states. What is essential to determine, however, is the *need* to do so, based on the national nuclear strategy. In the case of India, the role of its nuclear weapons is essentially premised on deterrence in order to obviate the chance of use of such a weapon against ourselves. India does not brook the thought of fighting a war with these weapons since it can serve no rational political purpose. With India's deterrence philosophy resting on the promise of punishment, it should be possible for India's designated nuclear delivery systems, which are consistently improving their range, accuracy and reliability, to undertake a punitive response. In fact, nuclear-tipped cruise

missiles would not add any more to the task of deterrence that the panoply of other systems could not. This would remain true till such time as the adversary's BMD capabilities evolve to such a degree as to make them invulnerable to unacceptable damage – which is pretty difficult in the foreseeable future. Point or area defences may be deployed by China and Pakistan, but nuclear deterrence would continue to rest on population centres remaining vulnerable to qualify for being inflicted with unacceptable damage as punishment for first use of nuclear weapons against India.

Since the adversary will not be sure of how the missile is armed, there could be a tendency to assume the worst, triggering a nuclear war when there might have been no such deliberate design.

Therefore, it would serve India better to retain the declared distinction between nuclear and conventional delivery systems even when a dual use option exists and may easily be operationalised if ever found necessary. Retention of this difference would help enhance strategic stability. Nuclear weapons comprise ordnance that falls in a different category altogether. Mixing them up on dual use delivery vehicles may enhance deterrence, but it, nevertheless, significantly raises existential risks of inadvertent use and miscalculation. Since the adversary will not be sure of how the missile is armed, there could be a tendency to assume the worst, triggering a nuclear war when there might have been no such deliberate design. So, while Pakistan is compelled by its circumstances and self-created existential delusions to project first use of nuclear weapons, it remains well cognisant of India's ability to retaliate with nuclear weapons to nullify any gains it hopes to so make.

In fact, in the face of the adversary's dual use projection of cruise missiles, India's no first use strategy gains even greater relevance since it has opted to retaliate only after being impacted by a nuclear weapon. In view of an incoming missile, India has the option of interception (even if limited) through its nascent BMD capability, and it certainly has the option of assured nuclear retaliation as laid down in its nuclear doctrine. So, irrespective of the mode of delivery, nothing changes for India as far as its nuclear doctrine

is concerned. The focus of the country's nuclear efforts must be retained on enhancing the credibility, reliability and effective integration of its nuclear declared ballistic missile force, including operationalising the deployment of Agni V, extending the range of Submarine-Launched Ballistic Missiles (SLBMs), and enhancing survivability measures over the other two legs of the triad, and nuclear command and control.

At a third level, in the more defensive capacity, it would be necessary to enhance air defences over high value military targets that might be on the adversary's list for the use of his cruise missiles. Improving the sophistication of early warning systems and detection capabilities spread across platforms [aircraft, aerostats, Unmanned Aerial Vehicles (UAVs), shipborne radars, etc] and as over the horizon as possible, including through space assets, naturally fall within the purview of future development areas since the benefits of these would be widely reaped across other areas too. The ability to fuse data obtained from variegated sensors to obtain a common operating picture to provide real-time responses and to reduce the clutter is equally important.

Lastly, India must explore possibilities of Confidence-Building Measures (CBMs) and arms control that aim to reduce nuclear risks. Included amongst these would be measures that retain a sharp distinction between conventional and nuclear delivery systems since multiplicity of warheads and missions linked to a single weapon system like the cruise missile exacerbates nuclear dangers. Political engagement on nuclear risk reduction measures with both adversaries is an idea whose time has been here for long. And yet it remains a chimera. The longer this situation continues, the greater the chances that China, Pakistan and India will be sucked into an offence-defence spiral based on a worst case assessment of each other's capabilities and intentions.