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BALLISTIC MISSILE DEFENCE TECHNOLOGY: INDIA'S PATH

Gp. Capt. Vivek Kapur
Senior Fellow, CAPS

Ballistic missile defence (BMD) systems require the ability to destroy incoming ballistic missiles in flight at high altitudes. Given the speed of flight of ballistic missiles in their terminal phase of flight, the task of BMD systems has been described as the ability to hit a bullet in flight with another bullet. Proliferation of ballistic missiles and of nuclear weapons has forced many countries to aspire to field BMD systems. During the Cold War period BMD capability was the exclusive preserve of the USA and the erstwhile Soviet Union, the two superpowers of the era.

Background

Initially nuclear weapons were intended to be delivered by manned bombers much in the same way that the only two weapons actually used in wear were by the US on Japan in 1945. Detection and interception of manned bombers had been practiced for tens of years with relatively high rates of success. In this scenario the assurance of an attacker being able to deliver nuclear weapons at intended targets especially those located well inside the adversary's territory did not exist. Both the superpowers fielded manned bombers powered by turbo propeller (turboprop) and jet engines as well as interceptor aircraft, specially designed to intercept and destroy such bombers, all this backed up by a suitable radar surveillance and control system.[i] In this situation an uneasy balance of power prevailed and hostilities were kept at bay by astute statesmanship and diplomacy than any technical means.

Strategic thinkers desired an assured attack capability. This emerged in the form of ballistic missiles built upon the technology base acquired from the laboratories and captured scientists

from defeated Nazi Germany. Development of nuclear weapons and ballistic missiles to deliver these led to near assurance that a nation armed with nuclear topped ballistic missiles would be able to visit unacceptable devastation on its adversaries. Ballistic missiles followed a parabolic ballistic path that took them to very high altitudes, to the very fringes of and even outside the atmosphere. Such trajectories remained outside the capability of aircraft technology of the time and proved difficult to detect as well. Thus a ballistic missile once launched could be reasonably be expected to be on its way to delivering its payload at its intended target with minimal probability of it being destroyed or deflected. Initially only the US had such capability and held the upper hand in the ongoing superpower rivalry. However, once the Soviet Union developed and deployed similar capability as situation akin to both parties holding a loaded gun to the other's head at the same time emerged. Strategic thought of the time led to the Mutually Assured Destruction (MAD) theory.[ii] On essence MAD assumed that in absence of any means to destroy in flight ballistic missiles, that by then were based on land as well as at sea aboard submarines, initiation of a nuclear exchange by any party would invite a similar response from the other side and in view of the power of nuclear weapons would lead to destruction of both the adversaries with no winner able to emerge. In a situation such as this MAD tried to remove the very concept of any of the involved parties being able to win a nuclear war. This in turn was assumed to result in stability in which as each side was certain that it could not survive it had no incentive to initiate a nuclear exchange. Such negative stability depended upon the near assurance of in-flight ballistic missiles being immune from destruction by any action by the adversary. Destruction of the opposing side's ballistic missiles prior to their being launched was made impossible through basing land based missiles in hardened underground silos, or in constantly moving modes such as aboard some disguised railway coaches, and other missiles aboard nuclear powered submarines that held station for long durations of time in secret locations all over the world's seas and oceans. Such deployments made even a pre-emptive nuclear strike by one party difficult through making sure that adequate nuclear weapons with their delivery systems would survive to cause devastation in the attacker's country. A balance of fear emerged in the world, but centred on Europe and the US.

In time technological advancements enabled the superpowers to develop methods to intercept and destroy incoming ballistic missiles. Radar technology advanced far enough to enable accurate tracking of objects at distances of several hundred kilometres. This was coupled with

advanced guidance systems able to compute interception trajectories by suitable interceptor missiles. The world's first BMD system was the Soviet System-A, that led to deployment of the A-35 (ABM-1A) in the early 1960s.[iii] The first US ABM system resulted in the US "Safeguard" system in 1975 which operated for a mere 133 days.[iv] These developments led to nascent capabilities to put together a BMD system. Such developments though totally defensive were seen to be destabilising as they held out the slender hope that some nuclear armed missiles or other targets could be saved from the enemy's nuclear attack. The side possessing effective BMD systems could therefore assume that it had a breakout path from MAD and could initiate a nuclear war. These fears led to the Anti-Ballistic Missile Treaty (ABM Treaty) Treaty, which came into force in 1972, between the US and the Soviet Union.[v] This treaty limited BMD systems to just two locations. These locations were to be within 150 km of and to defend the capital city and to defend missile silos through location within 150 km of these. Moreover BMD launchers and missiles were to be limited to 1000 per location. The treaty also banned research, development and deployment of more potent BMD systems, including their enhancements such as automatic re-loading and second launch capability of BMD launchers etc.[vi] Such limitations were apparently aimed at keeping the MAD concept on life support through limiting each side's BMD capability to less than the numbers of missiles expected to be received. In 2001 the US unilaterally withdrew from the ABM Treaty.[vii]Earlier in the early 1980s the US initiated the Strategic Defence Initiative also known as "Star Wars" aimed at achieving global capability to detect launches of and carry out boost phase, mid-course and terminal phase intercept of ballistic missiles. SDI envisaged cutting edge technologies including a major space based component. The program proved too complex to fructify and was later abandoned.[viii] Research led the US to develop limited capability for BMD through modifications of its Patriot anti-aircraft missile system to come to the Patriot Advanced Capability (PAC)3 missile system.[ix] Other US initiatives include the Terminal High Altitude Area Defence (THAAD) to give limited area BMD coverage.[x] Many initiatives by the US continue in this field. In response to US efforts, Russia today fields a limited BMD capability in its S-300PMU2 and S-400 anti-aircraft missile systems.[xi] The next iteration, the S-500 under development is claimed to feature full capability BMD abilities.[xii]

China's BMD is currently based loosely upon imported Russian S-300 and S-400 systems. Unlike the US and Russia India faces a more complex situation. India could face a full range of

ballistic missiles from China as well as Pakistan armed with nuclear as well as conventional payloads. Such missiles could be encountered in the tactical as well as the strategic attack roles. The whole of India is covered by this ballistic missile threat. At the strategic level major targets could require protection from nuclear attack. At the same time important targets in the tactical battle zone could face heavy ballistic missile attack. These could merit defence also. Hence India does require effective BMD capabilities.

India has adopted the indigenous route to obtain BMD capabilities. India's Defence Research and Development Organisation has conducted several trials of its locally developed Prithvi Air Defence (PAD) and Advanced Air Defence (AAD) systems. These tests have covered endo-atmospheric as well as exo-atmospheric tests. These trials have demonstrated the availability of expertice in India to detect, track and effectively engage short and medium range ballistic missile threats. One of the US initiatives in BMD is its cooperation with Israel to develop the arrow BMD system. This system includes more than one missile to take on short to medium range, intermediate range as well as continental range ballistic missiles. This program intends to meet Israel's perceived need for defence against potential Iranian threats while feeding technology into the US' own BMD initiatives. The US and Israel conducted a successful partial test of the Arrow3 system on 16 Dec 2014. In this test while the target missile was detected and tracked, the interceptor missile was not actually launched due to 'other', considerations.[xiii] In comparison, the Indian BMD tests conducted so far have achieved their objectives. Due to the nature of the threat and geometry, the current Indian BMD system requires further development to increase the detection and tracking range of the system thus enabling engagement of longer range missiles at longer ranges than is possible today. Such development would expand the area that a single BMD system can provide effective cover to. This aspect is especially important to reduce the potential numbers of systems needed to provide effective defence to important areas of the country. In view of the requirement to provide degradation of conventionally armed ballistic missiles in tactical areas makes this capability enhancement even more important. Adoption of the indigenous route to develop BMD capabilities is also likely to be more cost effective than importing such capabilities. The Indian BMD program appears to be on track given available reports on performance of foreign trials and tests to develop similar capabilities.

Conclusion

Proliferation of nuclear weapons and ballistic missiles in turn led to development of counters to these. The Soviet Union deployed the world's first BMD system in the early 1960s followed by the US in 1975. Thereafter several countries have pursued BMD projects, notable amongst these being China, Israel and India. India's requirements are especially complex as they involve defending against nuclear as well as non-nuclear armed ballistic missiles from Pakistan as well as China. In this context the known progress of the Indian BMD development is promising. In addition the decision to follow a purely indigenous path should prove cost effective in the long run.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies (CAPS)

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[iv] See http://www.users.cloud9.net/~bradmcc/Safeguard.html, accessed on 17 Dec 2014.

[v] ""Anti-Ballistic Missile Treaty Between USSR, US in Details"", http://www.spacedaily.com/reports/Anti_Ballistic_Missile_Treaty_Between_USSR_US_in_Details_999.html, accessed on 17 Dec 2014.

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