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Future Operational Scenario for Antitank Guided Missile Systems*

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Air Cmde Gopalaswamy, Lt Gen Sundaram, Sri Prasada Rao, Sri Iyer, participants in the Seminar and friends,

I am delighted to be here at Research Centre Imarat (RCI) today to address you all in the Inaugural Session of this Seminar on Advances in Antitank Guided Missile (ATGM) Systems. We have a strong technology base in the ATGM systems, with millimeter wave radar and devices, focal plane array sensors etc. We also have industrial base in production of antitank missile systems.

Now I would like to share with you a few thoughts on the future operational scenario for antitank missile systems, i.e., how, in future, advances in tank technologies and supporting systems would influence the design of antitank missile systems. I would like to discuss the following areas:

- Advances in armour,
- Superior range and ECCM capabilities of third generation ATGMs,
- Third generation technologies and multi-role deployment, and
- ATGM options and performance growth profile.

ARMOUR TYPES

From the rolled homogeneous armour (which is a monolith steel armour), spaced armour, laminated armour and composite armour were developed progressively. Since these developments are known to most of you here, I shall focus on the latest types, viz. explosive reactive armour (ERA) and active armour. For defeating ERA that contains a slab of a relatively less sensitive explosive, sandwiched between two metal plates and attached to the main armour to be protected, tandem shaped charge warheads have been configured. If more than one ERA slab is used in future (tandem ERA one over the other), the warhead specialists are talking of countering it by configuring multiple tandem warhead—three shaped charges, one behind the other. However, weight limitations of tank and the missile would decide the practical limits. Anyway, we can defeat ERA with a suitably designed tandem warhead.

The futuristic type of armour is active armour on which various countries are working. In this, multiple sensors are deployed by the target tank covering the sectors in which attack by ATGMs is expected. These sensors would sense the approach of the ATGM and detonate a device which would destroy/deviate the approaching missile and its warhead before the missile strikes the tank. Considerable work is being progressed on the type of sensors, optimisation of their beam width/FOV etc. However, against third generation antitank missiles with seeker and top attack capability, the active armour would have certain limitations. Firstly, the practicable sensor range limit would be typically about 200 m only to cater for wide angular coverage (beam width/FOV). Hence, acquiring the missile and tracking from such a short distance (hardly one second flight time for 200 m distance even for a subsonic ATGM) would be difficult, especially since third generation homing type missiles could perform

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maneuvers up to even 8 'g' during the proportional navigation phase. Missile trajectory is not easily predictable unlike LOS trajectories of first and second generation ATGMs. Secondly, due to the use of composite airframe, wings and fins in such missiles, tracking using radar-based sensors would be difficult due to low RCS and small size. IR signature also would be low due to relatively low speeds and low/no sustainer flame in the terminal phase, especially when seen from the frontal side. Thirdly, because of 'top attack' capability of third generation ATGMs, providing sensor coverage on top in all directions is also difficult. Fourth, probability of damage to the missile warhead would be low since shaped charge warheads are required to be designed to withstand small arms fire and splinters. However, we have to watch the progress being made in such advanced armour and cater for the warhead and missile design to defeat them.This is one area which ATGM designers have to address to.

SUPERIOR RANGE AND COUNTER-COUNTERMEASURE CAPABILITIES OF THIRD GENERATION ATGMs

The third generation ATGMs have a typical range capability of not less than 4 km when launched from a tracked vehicle launcher system. The thermal sighting system also has a matching recognition range capability of at least 4 km. As against this, the range capability of the tank firing heat rounds against the missile carrier vehicle is 2.5 to 2.8 km. The thermal sight of the tank also has only such a range capability. Hence, there is a clear range superiority for the missile platform; and the preferred range of operation is 2.5 to 4 km by standing outside the reach of adversary's tank gun, except for surprise targets appearing at closer ranges.

Since the third generation ATGM has fire and forget capability, the missile guidance does not require any transmitter or active sources on the platform deploying such missiles. Hence, it is difficult for the adversary's tank to track the platform, especially since the platform can leave the launch site immediately after firing the missile (fire and forget concept) from the platform. At 94 GHz, it is extremely difficult to generate adequate power over a wide angle to jam the missile in flight. Also, it is difficult to jam the narrow beam of the seeker with typical beam width of 2-3 degrees, especially during the maneuvering phases. In case of jamming, the seeker is usually designed to home on to the jammer on the tank. However, with advances in 94 GHz technology like magnetron sources, ECCM capabilities of tanks would improve and the missile designers have to take into consideration this during the design phase.

Imaging infrared (IIR) seekers employ multi-mode image processor using area correlation algorithm in conjunction with moving target indicator algorithm during launch phase, centroid algorithm during mid-course phase and correlation algorithm within the target area in the terminal phase. Such algorithms are area-based and not intensity-based. Hence, simple IR flares/sources cannot mislead the IIR processor-based seeker. Deploying area targets with heating and temperature profiles simulating tanks as decoys under tank battlefield environment is considered difficult due to logistics problems. However, research efforts are on to continuously improve the electro-optical countermeasures capabilities against IIR homing type missiles. For IIR seeker designers this should be one of the design concerns.

THIRD GENERATION TECHNOLOGIES

The lead technologies for the third generation ATGM are IIR and MMW seekers and associated devices like focal plane array sensors and 94 GHz Impatt, Gunn and mixer diodes. Trans-twist antenna and onboard, real-time signal processing/image processing which also involves high technology, both in terms of software and hardware. Tandem shaped charge warhead, compact electric actuation system and digital autopilot are some other high performance sub-systems.

MULTIROLE DEPLOYMENT

With increasing cost of missile systems and deployment platforms, it is essential that the designers should address to multirole capabilities and deployment on multiple platforms for realising cost-effective systems. For example, one can think of deploying the ATGM on different tracked vehicle carriers including main battle tanks and various helicopter platforms. Multiroles like launch from tracked vehicle platform against tanks and helicopters and launch from helicopters against tanks and helicopters need to be configured from the design stage itself. Another method of reducing the system cost is through the use of intelligent and high performance software to accomplish the mission requirements even with limited power from the hardware systems. The thrust area is software power.

ATGM OPTIONS

If we look at the various requirements of ATGM systems, we have the following options and capabilities available with us. Man-portable infantry type ATGMs with a common launcher : further improvements such as incorporating tandem warhead can be considered. For longer range futuristic ATGMs for deployment from tracked vehicles and attack helicopters, we have the NAG system with fire and forget and top attack capabilities under advanced stage of development. By utilising the seeker and warhead technologies and by suitable hardening, gun-launched antitank guided munitions/submunitions can be configured. By combining NAG technologies with fibre optics, one can configure fibre optic guided missiles for longer ranges of 10 km. With the FSAPDS penetrator technology and advanced solid propulsion technology available and by combining with laser guidance and thrust vector control, we can realise the hyper velocity missile systems of 1500 m/s speed in a cost-effective and fast way. Hence I would like to emphasise that we have all the basic technologies, facilities and capabilities within our country to realise the antitank missile systems of futuristic types.

PERFORMANCE GROWTH PROFILE OF ATGM SYSTEMS

For a study of the performance growth profile of ATGMs, one figure of merit to decide the growth is the operator's role index. On a relative scale, this has come down from 100 for the first generation ATGM to just 10 in the third generation fire and forget type missile. This has been made possible since the operator is now only required to acquire the target and handover to the seeker whereas in the first generation ATGM, he was required to track the tank, track the missile, generate the commands by looking at the deviations from LOS of the missiles and transmit the same over the guidance wire using a joystick in the case of first generation ATGM. Another performance improvement is a three-fold increase in missile speed from about 100 m/s in the first generation missile to about 300 m/s now. This has been made possible due to the removal of wire link and manual tracking of missile and tube launching. One has to consider supersonic/hypersonic velocity missiles with decreased flight time. I would like this point to be debated during the Seminar in one of the sessions. Another important need is to have higher ranges which would necessitate lock-on-after-launch capability instead of the lock-on-before-launch capability of present missiles. This would mean in-flight acquisition of the target by the missile which would call for more powerful algorithms to be built into the missile and scanning capability for the seeker with the missile being launched in the general direction of the target.

Currently, the ongoing programmes in the world for third generation ATGMs are long range version of TRIGAT being developed by Germany, France and the UK together with support from a number of other European countries. This system with IIR guidance and configured for launch from helicopter and vehicles is undergoing development tests and would be ready for induction by 1998-99. The tank breaker missile and variants like Javelin with IIR guidance also would be ready for induction in the US Army around the same time. Millimetric wave guidance was being tried in WASP (wide areas special projectile) for launch from aircraft against multiple tank targets. Whether the US is still going ahead with this programme is to be watched. In India, we have the NAG system for which we have developed both IIR and MMW guidance systems. This is one missile system where we can lead the others by completing the development and testing ahead of them and be the first to induct the system into service. This is an excellent opportunity to all of you in this forum to realise this goal.

Future trends of development would be configuring dual mode sensors for ATGM by synergetically combining the advantages of high resolution capability of IIR system with all-weather capability of MMW system. Of course, there are challenges like combining an IR dome transparent to 8-12 micron IR wavelengths and the radome transparent to 94 GHz band, common hardware for onboard, real-time images processor and radar signal processor, configuring optics module and antenna in the same package, common gymbal system etc. This is a very challenging technology area for many of you here at our work centres like Research Centre Imarat/Defence Research & Development Laboratory, Solidstate Physics Laboratory, Defence Electronics

Applications Laboratory, Instruments Research & Development Establishment, Defence Science Centre and academic institutions.

I hope the Seminar would address to some of the issues raised relating to futuristic operational scenario for ATGMs, since the design of the missiles needs to be linked to the operation and deployment right from concept defini·ion phase. I wish the Seminar all success and would like to thank you all for calling me to inaugurate it.