

## **K-4 Missile Test a Roaring Success**

Balalore: Even as the Defence Research and Development Organisation (DRDO) has not yet made public its recent test of nuclear capable submarine launched ballistic missile (SLBM) K-4, the elite agency, known for developing some best weapons with minimum failures, has validated a few new technologies pushing the country one step ahead in indigenous technology.

A source on Tuesday told 'The Express' that the mission conducted secretly on March 7 from a submerged pontoon (replica of a submarine) in the Bay of Bengal off the Visakhapatnam coast was a 'roaring' success. Some critical parameters set by the mission team were successfully met during the test.

The K-4 missile was fired at a depressed trajectory. Starting from successfully clearing the launch tube and breaking the water surface to stage separation and maintaining the ballistic trajectory, the missile achieved all parameters before zeroing in on the pre-designated target with high accuracy. The trial was stupendous and a copy book success," the source claimed.

As far as submarine launched weapon system is concerned, the success of K-4 missile, in terms of technology, is a significant achievement for the country which has surprised the enemy nations by developing some powerful yet potent missiles with limited budget and period.

Although the missile is yet to get its actual name, it was being developed under a secret project, code named K-4. The name is learnt to have been derived from Missile Man of India and former President APJ Abdul Kalam.

The 10-metre tall two-stage missile having a launch weight of 20 tonne can strike a target 3,500 km away. It is capable of carrying more than 2,000 kgs of warhead, both conventional and nuclear. According to sources, apart from several other new technologies, a top-end rocket technology involved in the weapon system is an innovation and initial boost velocity is a plus in this system.

However, the silence of DRDO over the test has left many defence experts surprised.

An eminent national security expert and professor at New Delhi-based Centre for Policy Research (CPR) Bharat Karnad said the logic behind such rationing of publicity escapes him.

"Sure, a failed launch is best kept under wraps. But the success of what is a decisive nuclear warhead delivery system from submerged platform is something that needs to be crowed about a bit, just so everybody knows," he said in an e-mail reply.

Sources said while the K-4 missile has to undergo two/three more developmental trials before being inducted in the armed forces, its shorter version 750-km range K-15 (renamed as B-05) is ready for induction. Meanwhile, the DRDO is also learnt to have been developing K-5 missile which will have a strike range of more than 5,000 km capable of hitting targets deep inside China.

## **Army Goes Green, to Produce Bio-fuel for Battle Tanks**

Chennai: A scientist from Tamil Nadu is playing a key role in what is seen as a major eco-friendly step towards the use of renewable energy in the country with the Indian Army, the world's second largest standing army, considering the use of bio-fuels from microalgae for its battle tanks. Top defence laboratories have executed a three-year project in this regard.

Speaking to Express, Dr S Elumalai, head, Department of Biotechnology, University of Madras, the only scientist from academia to be working with the Army, said the Indian Army was going green and is aiming to reduce its dependency on conventional fossil fuels. Defence Institute of Bio-energy Research (DIBER) in Haldwani in Uttarakhand along with eight other defence research laboratories are carrying out extensive research on different microalgae systems to extract bio-fuels. There is also a field research station located in Pithoragarh at an altitude of 12,000 feet in the eastern Himalayan region of Uttarakhand, where the research is going on.

“Besides the nine defence labs, I am the only scientist from an academic institution working with the prestigious Army Bio-diesel Research Programme. Phase I (3 years) of the project was executed successfully from 2011-14 and Phase II will start as soon as the Ministry of Defence gives its approval,” Dr Elumalai said.

Elumalai added that algal biomass is one of the emerging sources of sustainable energy, and for the Indian Army it is seen as a strategic product. The army can cultivate algal biomass in camps and produce bio-fuel to be used in military vehicles. “(By using bio-fuels) the army can extend operations during war-time. Some algae grow in as little a time as 4-6 hours,” he said.

Like plants, microalgae use sunlight to produce lipid oil, but they do so more efficiently than crops. Oil productivity of many microalgae greatly exceeds the oil productivity of the best producing oil crops with less land mass and water.

“We have surveyed and catalogued different species of highly-tolerant microalgae in the eastern Himalayan region up to Dharchula pass using molecular methods. They thrive in extreme condition like cold, heat, stress and salinity. They naturally accumulate the free fatty acids and one could do the transesterification (the organic conversion of algal fats into bio-fuel). Our studies have shown that some species of microalgae are producing 57 per cent or more of their dry weight (biomass) in the form of oil. Some algae, like *Botryococcus braunii*, produces 67 per cent oil, and this particular alga also serves to recycle waste water as well as bio-fuel production, thus serving a dual purpose,” he said.

With potentially millions of species, algal diversity gives DRDO and the “Army Biodiesel Research Programme” several options for identifying production of algal strains.

## **DRDO's K-4 underwater missile test 'met all critical mission parameters': Report**

Recent reports suggested that India's premiere defence research lab, the Defence Research and Development Organisation (DRDO), had test-fired the nuclear-capable K-4 underwater missile from a submerged pontoon March 7.

Though the supposed test details were not made public, the New Indian Express cited a source as saying that the test "successfully met" all the "critical parameters" set by the mission team and it was a "roaring" success. The K-4 missile belongs to the K series of missiles and has a range of 3,500 kms. The missile has the ability to carry both conventional and nuclear warheads weighing over 2,000 kgs. The missile is a submarine-launched ballistic missile (SLBM) and once the tests are completed, it will boost the country's deterrent capability as it will complete the nuclear triad -- traditionally strategic bombers, intercontinental ballistic missiles (ICBMs), and SLBM -- process.

The source, which the New Indian Express report cited, offered several new details of the test, while claiming that the trial was a "copy book success," firing at a depressed trajectory.

According to the source, the missile was "successfully released from the launch tube and broke the water surface to stage separation and maintained the ballistic trajectory." It achieved "all parameters before zeroing in on the pre-designated target with high accuracy."

In the event that the DRDO confirms the developments surrounding this secretive project, it will prove to the world that India has the technology and the resources to create a SLBM, thus completing the process to have a successful and powerful nuclear triad. India adheres to its self-declared "No First Use" policy when it comes to the use of nuclear weapons.

Meanwhile, defence experts and analysts have been surprised at the DRDO's silence. "Sure, a failed launch is best kept under wraps. But the success of what is a decisive nuclear warhead delivery system from submerged platform is something that needs to be crowed about a bit, just so everybody knows," reported the New Indian Express, citing Bharat Karnad, national security expert and professor at New Delhi-based Centre for Policy Research.