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Torchbearers

Indian core competence in rocketry has been firmly established again, beyond any doubt. The robust civilian space industry and viable missile-based defences has brought India into the select club of nations that call themselves superpowers. Always encouraged to follow Buddha's or Gandhi's teachings, how and why did India become a missile power is a question that needs to be answered for future generations.

Two centuries of subjugation, oppression and denial have failed to kill the creativity and capability of the Indian people. Within just a decade of gaining independence and achieving sovereignty, Indian Space and Atomic Energy Programmes were launched with a perfect orientation towards peaceful applications. There were neither funds for investing in missile development nor any established requirement from the Armed Forces. The bitter experiences of 1962 forced us to take the basic first steps towards missile development.

Would a Prithvi suffice? Would the indigenous development of four or five missile systems make us sufficiently strong? Or would having nuclear weapons make us stronger? Missiles and atomic weapons are merely parts of a greater whole. As I saw it, the development of Prithvi represented the self-reliance of our country in the field of advanced technology. High technology is synonymous with huge amounts of money and massive infrastructure. Neither of these was available, unfortunately,

in adequate measure. So what could we do? Perhaps the Agni missile being developed as a technology demonstrator project, pooling all the resources available in the country, could provide an answer?

I was very sure, even when we discussed REX in ISRO about a decade ago, that Indian scientists and technologists working together had the capability to achieve this technological breakthrough. India can most certainly achieve state-of-the-art technology through a combined effort of the scientific laboratories and the academic institutions. If one can liberate Indian industry from the self-created image of being mere fabricating factories, they can implement indigenously developed technology and attain excellent results. To do this, we adopted a three-fold strategy— multi-institutional participation, the consortium approach, and the empowering technology. These were the stones rubbed together to create Agni.

The Agni team was comprised of more than 500 scientists. Many organizations were networked to undertake this huge effort of launching Agni. The Agni mission had two basic orientations— work and workers. Each member was dependent on the others in his team to accomplish his target. Contradiction and confusion are the two things most likely to occur in such situations. Different leaders accommodate concern for workers while getting work done, in their own personal ways. Some shed all concern for workers in order to get results. They use people merely as instruments to reach goals. Some give less importance to the work, and make an effort to gain the warmth and approval of people working with them. But what this team achieved was the highest possible integration in terms of both the quality of work and human relationships.

Involvement, participation and commitment were the key words to functioning. Each of the team members appeared to be performing by choice. The launching of Agni was the common stake not only for our scientists, but for their families too. VR Nagaraj was the leader of the electrical integration team. Dedicated technologist that he is, Nagaraj would forget basic requirements like food and sleep while on the integration gig. His brother-in-law passed away while he was at ITR. His family kept this information from Nagaraj so that there would be no interruption in his work towards the launching of Agni.

The Agni launch had been scheduled for 20 April 1989. This was going to be an unprecedented exercise. Unlike space launch vehicles, a missile launch involves wide-ranging safety hazards. Two radars, three telemetry stations, one telecommand station and four electro-optical tracking instruments to monitor the missile trajectory had been deployed. In addition, the telemetry station at Car Nicobar (ISTRAC) and the SHAR radars were also commissioned to track the vehicle. Dynamic surveillance was employed to cover the electrical power that flows from the missile batteries within the vehicle and to control system pressures. Should any deviation be noticed either in voltage or in pressure, the specially designed automatic checkout system would signal “Hold”. The flight operations would then be sequenced only if the defect was rectified. The countdown for the launch started at T-36 hours. The countdown from T-7.5 minutes was to be computer controlled.

All activities preparatory to the launch went according to schedule. We had decided to move the people living in nearby villages to safety at the time of the launch. This attracted media attention, and led to much controversy. By the time 20 April 1989 arrived, the whole nation was watching us. Foreign pressure was exerted through diplomatic channels to abort the flight trial, but the Indian Government stood behind us like a rock and staved off any distraction to our work. We were at T-14 seconds when the computer signalled “Hold”, indicating that one of the instruments was functioning erratically. This was immediately rectified. Meanwhile, the down-range station asked for a “Hold”. In another few seconds, multiple Holds were necessitated, resulting in irreversible internal power consumption. We had to abort the launch. The missile had to be opened up to replace the on-board power supplies. A weeping Nagaraj, by now informed about the tragedy in his family, met me and promised that he would be back within three days. The profiles of these courageous people will never be written about in any history book, but it is such silent people on whose hard work generations thrive and nations progress. Sending Nagaraj off, I met my team members who were in a state of shock and sorrow. I shared my SLV-3 experience with them. “I lost my launch vehicle in the sea but recovered successfully. Your missile is in front of you. In fact you have lost nothing but a few weeks of rework.” This shook them out of their immobility and the entire team went back to retrieve the subsystems and re-charge them.

The press was up in arms, and fielded various interpretations of the postponement of the flight to suit the fancies of their readership. Cartoonist Sudhir Dar sketched a shopkeeper returning a product to the salesman saying that like Agni it would not take off. Another cartoonist showed one Agni scientist explaining that the launch was postponed because the press button did not make contact. The Hindustan Times showed a leader consoling press reporters, "There's no need for any alarm ... it's a purely peaceful, non-violent missile".

After a detailed analysis conducted virtually around the clock for the next ten days, our scientists had the missile ready for launch on 1 May 1989. But, again, during the automatic computer checkout period at T-10 seconds, a Hold signal was indicated. A closer inspection showed that one of the control components, S1-TVC was not working according to the mission requirements. The launch had to be postponed yet again. Now, such things are very common in rocketry and quite often happen in other countries too. But the expectant nation was in no mood to appreciate our difficulties. The Hindu carried a cartoon by Keshav showing a villager counting some currency notes and commenting to another, "Yes, it's the compensation for moving away from my hut near the test site—a few more postponements and I can build a house of my own...". Another cartoonist designated Agni as " IDBM— Intermittently Delayed Ballistic Missile." Amul's cartoon suggested that what Agni needed to do was use their butter as fuel!

I took some time off, leaving my team at ITR to talk to the DRDL-RCI community. The entire DRDL-RCI community assembled after working hours on 8 May 1989. I addressed the gathering of more than 2,000 persons, "Very rarely is a laboratory or an R&D establishment given an opportunity to be the first in the country to develop a system such as Agni. A great opportunity has been given to us. Naturally major opportunities are accompanied by equally major challenges. We should not give up and we should not allow the problem to defeat us. The country doesn't deserve anything less than success from us. Let us aim for success". I had almost completed my address, when I found myself telling my people, "I promise you, we will be back after successfully launching Agni before the end of this month."

Detailed analysis of the component failure during the second attempt led to the refurbishment of the control system. This task was entrusted to a DRDO-ISRO team. The team carried out the rectification of the first stage control system at the Liquid Propellant System Complex (LPSC) of ISRO and completed the task in record time with tremendous concentration and will-power. It was nothing short of amazing how hundreds of scientists and staff worked continuously and completed the system readiness with acceptance tests in just 10 days. The aircraft took off from Trivandrum with the rectified control systems and landed close to ITR on the eleventh day. But now it was the turn of hostile weather conditions to impede us. A cyclone threat was looming large. All the work centres were connected through satellite communication and HF links. Meteorological data started flowing in at ten-minute intervals.

Finally, the launch was scheduled for 22 May 1989. The previous night, Dr Arunachalam, Gen KN Singh and I were walking together with the Defence Minister KC Pant, who had come to ITR to witness the launch. It was a full-moon night, it was high tide and the waves crashed and roared, as if singing of His glory and power. Would we succeed with the Agni launch tomorrow? This question was foremost in all our minds, but none of us was willing to break the spell cast by the beautiful moonlit night. Breaking a long silence, the Defence Minister finally asked me, "Kalam! what would you like me to do to celebrate the Agni success tomorrow?" It was a simple question, to which I could not think of an answer immediately. What did I want? What was it that I did not have? What could make me happier? And then I found the answer. "We need 100,000 saplings to plant at RCI," I said. His face lit up with a friendly glow. "You are buying the blessings of Mother Earth for Agni," Defence Minister KC Pant quipped. "We will succeed tomorrow", he predicted.

The next day Agni took off at 0710 hrs. It was a perfect launch. The missile followed a textbook trajectory. All flight parameters were met. It was like waking up to a beautiful morning from a nightmarish sleep. We had reached the launch pad after five years of continuous work at multiple work centres. We had lived through the ordeal of a series of snags in the

last five weeks. We had survived pressure from everywhere to stop the whole thing. But we did it at last! It was one of the greatest moments of my life. A mere 600 seconds of elegant flight washed off our entire fatigue in an instant. What a wonderful culmination of our years of labour. I wrote in my diary that night:

Do not look at Agni
as an entity directed upward
to deter the ominous
or exhibit your might.
It is fire
in the heart of an Indian.
Do not even give it
the form of a missile
as it clings to the
burning pride of this nation
and thus is bright.

Prime Minister Rajiv Gandhi called the Agni launch "a major achievement in our continuing efforts to safeguard our independence and security by self-reliant means. The technology demonstration through Agni is a reflection of our commitment to the indigenous development of advanced technologies for the nation's defence." "The country is proud of your efforts," he told me. President Venkataraman saw in the Agni success the fulfilment of his dream. He cabled from Simla, "It is a tribute to your dedication, hard work, and talent."

A great deal of misinformation and disinformation had been spread by vested interests about this technology mission. Agni had never been intended only as a nuclear weapon system. What it did was to afford us the option of developing the ability to deliver non-nuclear weapons with high precision at long ranges. That it provided us with a viable non-nuclear option was of the greatest relevance to contemporary strategic doctrines.

Great ire was raised by the test firing of Agni, according to a well-known American defence journal, especially in the United States where Congressmen threatened to put a stop to all dual-use and missile-related technologies, along with all multinational aid.

Gary Milhollin, a so-called specialist in missiles and warhead technologies, had made a claim in The Wall Street Journal that India had made Agni with the help of West Germany. I had a hearty laugh reading that the German Aerospace Research Establishment (DLR) had developed Agni's guidance system, the first-stage rocket, and a composite nose cone, and that the aerodynamic model of Agni was tested in the DLR wind tunnel. An immediate denial came from the DLR, who in turn speculated that France had supplied the Agni guidance electronics. American Senator Jeff Bingaman even went to the extent of suggesting that I picked up everything needed for Agni during my four-month stay at Wallop's Island in 1962. The fact that I was in Wallop's Island more than 25 years ago and at that time the technology used in Agni did not exist even in the United States was not mentioned.

In today's world, technological backwardness leads to subjugation. Can we allow our freedom to be compromised on this account? It is our bounden duty to guarantee the security and integrity of our nation against this threat. Should we not uphold the mandate bequeathed to us by our forefathers who fought for the liberation of our country from imperialism? Only when we are technologically self-reliant will we able to fulfill their dream.

Till the Agni launch, the Indian Armed Forces had been structured for a strictly defensive role to safeguard our nation, to shield our democratic processes from the turbulence in the countries around us and to raise the cost of any external intervention to an unacceptable level for countries which may entertain such notions. With Agni, India had reached the stage where she had the option of preventing wars involving her.

Agni marked the completion of five years of IGMDP. Now that it had demonstrated our competence in the crucial area of re-entry technology and with tactical missiles like Prithvi and Trishul already test-fired, the launches of Nag and Akash would take us into areas of competence where there is little or no international competition. These two missile systems contained within themselves the stuff of major technological breakthroughs. There was a need to focus our efforts more intensively on them.

In September 1989, I was invited by the Maharashtra Academy of Sciences in Bombay to deliver the Jawaharlal Nehru Memorial Lecture. I used this opportunity to share with the budding scientists my plans of making an indigenous Air-to-Air missile, Astra. It would dovetail with the development of the Indian Light Combat Aircraft (LCA). I told them that our work in Imaging Infra Red (IIR) and Millimetric Wave (MMW) radar technology for the Nag missile system had placed us in the vanguard of international R&D efforts in missile technology. I also drew their attention to the crucial role that carbon-carbon and other advanced composite materials play in mastering the re-entry technology. Agni was the conclusion of a technological effort that was given its start by Prime Minister Indira Gandhi when the country decided to break free from the paralysing fetters of technological backwardness and slough off the dead skin of subordination to industrialized nations.

The second flight of Prithvi at the end of September 1988 was again a great success. Prithvi has proved to be the best surface-to-surface missile in the world today. It can carry 1000 kg of warhead to a distance of 250 km and deliver it within a radius of 50 metres. Through computer controlled operations, numerous warhead weight and delivery distance combinations can be achieved in a very short time and in battlefield conditions. It is a hundred per cent indigenous in all respects—design, operations, deployment. It can be produced in large numbers as the production facilities at BDL were concurrently developed during the development phase itself. The Army was quick to recognize the potential of this commendable effort and approached the CCPA for placing orders for Prithvi and Trishul missile systems, something that had never happened before.

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