

## Reaching for the stars through 'Mangalyaan'

-- Pallava Bagla

The success of India's maiden mission to Mars is hailed as a global landmark as it paves the way for cheap and reliable inter-planetary travel, this has been possible only because of a robust high technology infrastructure that has been put in place by the country. The same is also true in the sector of atomic energy where India's prowess is slowly being recognized so much so that in the world's only fusion energy reactor being constructed in France, India is a full member. Today, the country's Mars Orbiter Mission (MOM) truly symbolizes 'Make in India'.

Speaking at the 'Make in India' workshop on December 29, 2014 The Prime Minister Narendra Modi said 'Human Resource Development, Innovation and Research should become part of the Government's DNA. He said these should be aligned to the nation's overall goals in various sectors.' Modicalled upon all sectors of manufacturing in India to take inspiration from the "Space" sector, and the achievements of India's space scientists.

On his recent visit to New York where Prime Minister had the crowd in raptures as he repeatedly brought up India's success of reaching Mars. Modi said 'everything about Mangalyaan is indigenous,... made in small factories. We reached Mars at a smaller budget than a Hollywood movie," he said adding "India is the only country to reach Mars on its first attempt. If this is not talent, then what is?'

Not many know that the darling of the masses, Mangalyaan is truly also the flag bearer for Modi's 'Make in India' campaign where he is pitching for India becoming the hub for making 'satellites to submarines'. *India Incorporated* a website dedicated to promoting India's strengths highlighted that 'some 40 industries are directly involved in the making of the spacecraft itself that was put together by the Indian Space Research Organisation (ISRO). From small firms like Sangvi Aerospace Pvt Limited from Ahmedabad that supplied the wires and cables to giants like L&T and Godrej, to Technocom in Rajkot which helped with the camera that gave MOM its first view of Mars. All truly symbolize the humble 'made in India' tag that Mangalyaan carries.'

'Space is the last frontier so push and push some more' was part of Prime Minister Narendra Modi's pitch to India space scientists when he came to the partake in the joys and sorrows of the small 16,000 strong space community that made India proud by hitting bull's eye in the very first attempt of reaching planet Mars. A feat not achieved even by great space powers like USA and America. Acknowledging India's achievement NASA Administrator Charles Bolden called it 'an impressive engineering feat'.

Another 100 or so industries are directly involved with the making of the rocket that launched MOM into space on November 5, 2013.

What caught the attention of the world was the relatively small cost of the mission Rs 450 crores or about \$ 75 million, which is ten times cheaper than the NASA's latest mission that reached Mars two days ahead of India's. This was undoubtedly the lowest cost inter-planetary mission ever to be undertaken in the twenty-first century. As ISRO chairman K. Radhakrishnan says 'modularity' of sub-systems helps reduce

costs and the low wage bills alongside the long hours put in by ISRO's 500 work force that worked on the Mars satellite helped keep the cost very low.

On June 30, Modi watched the majestic lift-off of the 114 Indian mission of the Indian space agency the launch of the Polar Satellite Launch Vehicle that has till date launched 40 satellites from as many 19 different countries. ISRO's commercial arm the Antrix Corporation Limited has an annual turnover of about Rs 15,000 million and it has already procured orders for three more dedicated commercial launches using the PSLV, which will place in orbit another 14 foreign satellites in the coming years. V S Hegde, Chairman and Managing Director of Antrix Corporation Limited says 'we are already a force to be reckoned with and we are definitely going to grow'.

Reaching for the stars is not the only frontier where India's efforts are bearing fruit, tapping nuclear energy is also a big aspirational dream for India. India today is contributing actively in world's largest science project to generate fusion energy.

### **Evergreen atomic energy a possibility!**

A star is set to be born in southern France, a humongous over \$ 20 billion effort is being made to make a nuclear reactor like never before, a special steel cauldron where fusion energy could be tapped and it is called the International Thermonuclear Experimental Reactor (ITER). Ratan Kumar Sinha Chairman of the Atomic Energy Commission says 'fusion energy holds the promise of becoming an unlimited source of environment friendly energy for the world.'

This is till date world's largest scientific project ever to be undertaken and it is getting off the ground in Europe, a mammoth project that experts say will pave the way for generating unlimited clean nuclear energy by fusing atoms, a process not very different from what happens on the Sun.

The reactor will weigh about 23,000 tons the equivalent of the weight of 3 Eiffel Towers in Paris. Some 80,000 kilometres of special super conducting wires will be used.

Six nations India, China, South Korea, USA, Japan, Russia and the European Union have joined hands as equal partners to see if they can jointly harness the power of the Sun by literally confining it in a steel bottle.

Within the massive steel frame gas will be heated to over 150 million degrees temperature and it will be confined into a limited space using giant magnets, some atoms will then fuse together releasing huge amounts of heat which can then be directed to run turbines to generate electricity. In the first instance, it is hoped the fusion reactor will produce ten times more energy than what is used to initiate the reaction estimated to produce the equivalent of 500 MW of power.

But it is easier said than done since taming the power of the Sun is a Herculean task and for the last half a century scientists have dreamt about this feat but it was only in 2006 that the ITER organisation come into being when things started become real.

### **India's role**

India is a full member of this enterprise providing about ten percent of the components for the massive nuclear complex unfolding at Cadarache in France. New

Delhi is contributing what would when completed in 2021 would be world's largest refrigerator. It also acts like a thermos flask but operates at some of the coldest temperatures ever seen in the universe working at minus 269 degrees Celsius (-269 degrees Celsius) and technically called a 'cryostat', it is being made to order for the Department of Atomic Energy by L&T Industries. M V Kotwal, President, Heavy Engineering L&T industries, Mumbai says 'manufacture & installation of the cryostat has been entrusted to L&T. Work on this project is already in progress in our Hazira Manufacturing Complex. We have also constructed a special workshop at the site in Cadarache, France to enable site assembly of the large & complex stainless steel structure from components which will be supplied from Hazira in India.'

India will make in-kind investment probably totalling about Rupees 9000 crores over the next decade thus contributing about 9.1% of the share of the total costs.

Sinha says 'participation of India in the ITER project, with its immense scientific talent and industrial competence, has provided an opportunity to India to master the cutting edge technologies manifest in this massive project. In the near term, it has facilitated a huge impetus to scientific research, manpower development and building an internationally competitive industrial capability within Indian private sector in the highly advanced field of fusion energy'.

Once the proof is established that mankind can harness the power of the Sun, India could well build its own fusion reactors possibly very soon after 2050, thus providing unlimited energy.

Modi said ISRO has made it a habit of 'making the impossible possible'. So could India, literally pave the way for cheaper, durable and reliable satellites in the 'Make in India' movement that Modi has flagged off. A multi-billion dollar space and nuclear energy market is waiting to be tapped.

In this bold new initiative Modi called for making a globally recognized "Brand India" famous for "Zero Defect, Zero Effect" Manufacturing – free from defects, and with no adverse impact on the environment.

Pallava Bagla

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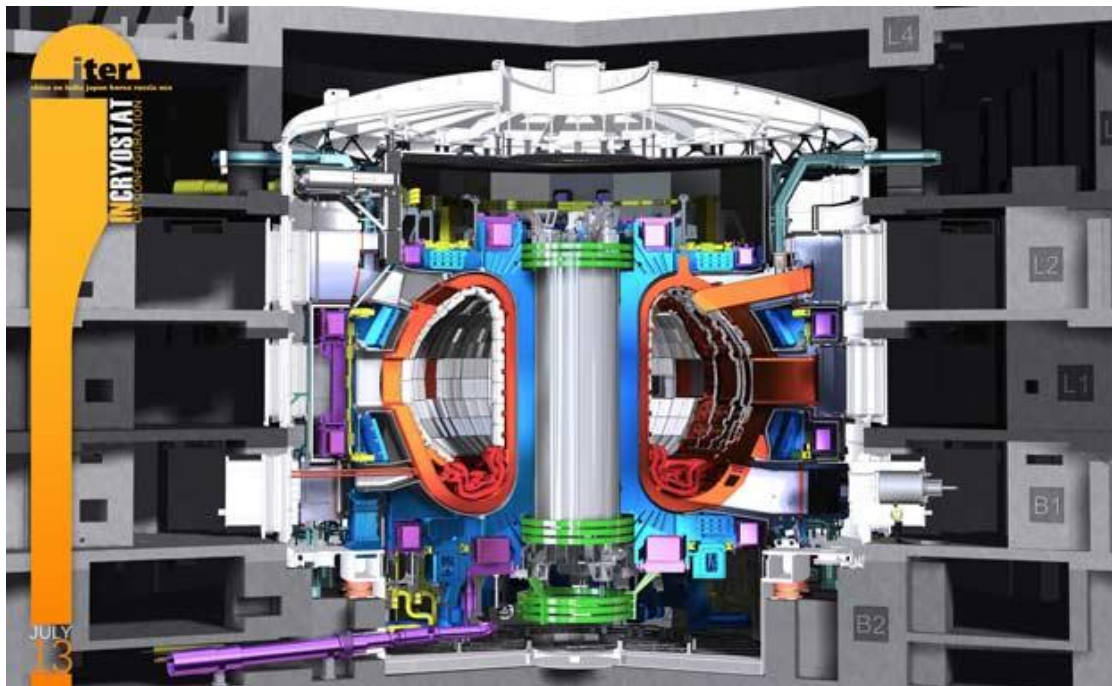
*(India's highly successful maiden mission to Mars, is the cheapest inter-planetary mission till date costing less than \$ 75 million and truly a remarkable example of 'make in India'. Seen here is the lift off the Mangalyaan on November 5, 2013 using the indigenously made Polar Satellite Launch Vehicle (PSLV) sent into space from India's spaceport at Sriharikota on the coast of the Bay of Bengal. Credit: ISRO)*



*(India's satellite that orbits Mars, seen here when it was being integrated. Mangalyaan hit bull's eye and created world history making India the first country to reach Mars in its debut attempt. Credit: ISRO)*



*(India is a full member of the world's largest scientific experiment to make a fusion energy reactor coming up at Cadarache in France.)*



*(At the International Thermonuclear Experimental Reactor (ITER) being made at France the world's largest refrigerator is being made by India, a truly 'make in India' initiative. Credit: ITER)*