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INDIA'S REUSABLE LAUNCH VEHICLE: TEMPERING JUBILATION WITH SOUND REASONING

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The Reality-Fantasy Disconnect

India has a formidable space programme and the country is justifiably proud about it. Thus, the news that India's ISRO plans a technology demonstration of its Reusable Launch Vehicle (RLV) on May 25 is met with great exultation and celebration. The press exults in the belief that "*India's own Space Shuttle would be ready by mid-May*"[1] or that this would be ISRO's big "*Hanuman Leap*"[2]to making an Indian Space shuttle. Some even suggest naming it "*Kalaamyaan*" after the legendary scientist APJ Abdul Kalaam. Amidst the din and noise of jubilation is lost the cautious optimism of ISRO that stays clear of adjectives and self –adulation simply stating that the test is but a Technology Demonstration and nothing more than an initial test[3]. For instance, Dr K Sivan, the VSSC Director states, "*What we do now is only a demonstration. It is no way near to the real RLV. It is like a drop test to bring back a launched vehicle to some point. It is just a baby step towards the giant leap*."On the other hand, Jitendra Singh, India's Minister of State in the Prime Minister's Office said in March 2015"*Development of RLV is a technical challenge and it involves development of cutting edge technologies. The magnitude of cost reduction depends on development and realization of fully reusable launch vehicle and its degree of reusability*."[4]

Tempering Hype with Reality

The position is precisely that and it would be essential to pay equal credence to the above facts since it is asserted by those actually engaged in the project. India is inherently multi-cultural and unlike any other nation, every month if not week is witness to some festival or the other. The cultural proclivity to celebrate has its uses, however, premature jubilation and hype also carries the hazard of raising expectations unreasonably. It would be essential to temper hype with reality. Simply put, the test would not

herald the addition of an Indian Space Shuttle to ISRO's inventory straightaway; it only heralds the beginning of a technically challenging endeavour. Actual operationalisation would be at least a decade away and it would be essential to be fully cognisant of this stark reality. The commercial meter does not start clicking straightaway and we would not be witness to frequent reusable launch vehicles launching and gliding back ever so frequently come June 2016.

In order to be more reasonable in our expectations of the Indian RLV, it would be essential to briefly examine the programme and the same is undertaken as below. The May 2016 test of the RLV-TD is part of a series of technology demonstration missions that are the initial steps to realising a Two Stage to Orbit (TSTO) fully reusable vehicle. Under the preliminary mission, which is planned as a suborbital one, a double-delta winged vehicle, which more or less resembles an aircraft, will be launched from the Sriharikota High Altitude Range (SHAR) atop a two-stage Rohini sounding rocket. The 6.5 meter-long vehicle, having a mass of 1.75 tonne, will go up to around 70 km after which it is expected to descend at a particular point on the sea. The winged RLV-TD has been configured to act as a flying test bed to evaluate various technologies using air breathing propulsion. These technologies will be developed in phases through a series of experimental flights. The first would be a Hypersonic experiment (HEX) flight, followed by the Landing experiment (LEX), Return flight experiment (REX) and Scramjet Propulsion experiment (SPEX). It is here that ISRO's assertion needs attention; as per ISRO, the May test is but a baby step and not a giant leap or a Hanuman leap. In all probability, the HEX flight would serve to;

- Demonstrate capability of HEX vehicle to survive atmospheric re-entry at speeds higher than that of sound.
- Qualify and validate the aerodynamic design characteristics during Hypersonic flight.
- Qualify and validate the avionics, aerodynamic control and guidance systems.
- Characterize induced loads during hypersonic re-entry into the atmosphere.
- Assess thermal protection systems like performance of materials like the carbon fibre used in construction of the nose of the vehicle.
- Demonstrate Mission management competencies like First Stage separation sequencing.
- Demonstrate competency of recovery of the HEX vehicle from sea.

Thus, the primary emphasis in the May 2016 HEX flight is on assessment of the hypersonic aerodynamic characteristics, thermal management, autonomous mission management and ability to land at a specific location.

Landing and recovery though part of the test are not the prime elements. With regards to

recovery experiments, ISRO already has demonstrated capabilities. This will be ISRO's third effort to recover a spacecraft after launch and evaluate the re-entry characteristics. The first was the unmanned 555 kg Space Capsule Recovery Experiment (SRE-1) which was launched on Jan. 10, 2007 by a PSLV and recovered on January 22. The second was the Crew Module Atmospheric Re-entry Experiment (CARE) launched on board the maiden flight of the GSLV Mark 3 on Dec. 18, 2014. After a 19-minute flight the unmanned module splashed down in the Bay of Bengal and was recovered by the coast guard and handed over to ISRO. The experience and knowledge gained by the SRE-1 and CARE missions will be used for the human space flight programme. The RLV-TD flight has nothing to do with manned missions, however, the experiment has great utility and hence the landing tests would add to competencies of ISRO. Nonetheless, the landing experiments (LEX) phase is yet to follow. Quite clearly, what is planned for May is but the first baby step in a series of tests and we need to be cognisant of the challenges inherent in the endeavour before prematurely raising expectations to the same levels as the American Space Shuttle.

Comparisons with the US Space Shuttle

In reality, the US Space Shuttle is also far from a grand success. It is the US's national icon, it celebrates its pride and criticising the Space Shuttle is akin to punching the US in its face and yet the Space Shuttle has been a subject of intense derision and criticism. Both its performance and cost have been subject to intense criticism. The US, for instance, spent $ 192 Billion on the Space Shuttle from 1971 to 2010. The average cost per launch works out to $ 1.2 Billion[5], far in excess of the total ISRO budget. It is an unaffordable experiment that does not merit emulation by India and hence it would be essential to stay clear of such comparisons right from the beginning. The endeavour is challenging in that it has not met with success in many other instances. For example, the Hermes spaceplane, a collaborative effort of the French space agency, CNES and the European Space Agency, was approved in November 1987, but cancelled in 1992 as it suffered numerous delays and funding problems. The HOPE-X of the Japanese Space Agency was launched in 1980, but was scrapped in 2003 for a variety of reasons, mainly financial. The Russian Buran spaceplane was started in 1974 in response to the Space Shuttle programme. It completed one unmanned orbital spaceflight in 1988 before it was cancelled in 1993. The Space Shuttle flew from 1981 to 2011 covering a total of 135 missions. Despite its numerous achievements like launching satellites and repair of the Hubble Space Telescope, the feeling among NASA officials and space experts was that the shuttle failed to achieve its promised cost and utility goals. Another major criticism was that it failed to lower the cost of access to space. An analysis showed that the

incremental per pound launch costs turned to be higher than those of regular expendable rockets.

Thus, elevating India's May 2016 RLV-TD test to the same level as the Space Shuttle and drawing comparison is inappropriate and out of context since;

- The RLV-TD is but a test and the Space Shuttle was a fully operational vehicle.
- The RLV is yet to demonstrate landing and reuse capability akin to the Space Shuttle.
- The Indian RLV is being designed to launch payloads/satellites into space and not for carrying humans into space like the Space Shuttle. India has no International Space Station and hence the requirement of a human certified Aerospace plane is some time away.
- The cost differences in the projects are phenomenal; the RLV tests costs Rs 95 Crores, the Space Shuttle cost the US $ 192 Billion or 19200 Crores (in Billions).

Additionally, a variety of other huge differences exist and it would be essential to perceive the RLV in light of its own competencies and unique Indian purpose rather than draw unfair comparisons with the Space Shuttle.

The Distinct Gains of the Indian RLV

Operationalisation of an Indian RLV makes more sense when viewed in light of India's quest of using space for national growth and civil development. A human rating for the RLV or using it for manned flight would be quite some time away, but the RLV certainly has enormous uses to plug gaps in earth observation and also communication satellites for tactical data relay etc. It also has enormous dividends when viewed in light of India's growing competencies in miniaturisation, nanotechnologies and microsatellites. The ability for microsatellite launches in multiple orbits has already been demonstrated and coupled with RLV capabilities; the gains for the country are enormous. The commercial gains are extremely significant. India already boasts of highly affordable and reliable launch capabilities in the international market. Operationalisation of the RLV can be expected to take India's capabilities and competencies much higher. Overall, disassociating expectations from the Space Shuttle and viewing the RLV in a uniquely Indian context makes more sense. While celebrating success, it augurs well for the country to not lose sight of the original developmental vision of the doyen of the Indian space programme, Shri Vikram Sarabhai, "*Our vision is to harness space technology for national development, while pursuing space science research and planetary exploration*." With development, pride automatically accrues and hence we need to perceive the RLV as symbolic of national development rather than just pride like the Space Shuttle.

(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])

Notes

[1] Ref Press Trust of India, "India's own Space Shuttle to be ready by Mid-May from ISRO", 28 Mar 2016 available at http://articles.economictimes.indiatimes.com/2016-03-28/news/71874482_1_satish-dhawan-space-centre-sriharikota-space-missions accessed on 16 may 2016, also NDTV, "ISRO embarks on launching Indian Space Shuttle", 16 May 2016

[2] Ref Ambarish Ganesh, "ISRO's big Hanuman Leap to launch fully made in India Space Shuttle RLV-TD" Indian Nerve, 15 May 2016 at http://indiannerve.com/isros-big-hanuman-leap-to-launch-fully-made-in-india-space-shuttle-rlv-td-22719/ accessed on 16 May 2016.

[3] Ref remarks of VSSC Director K Sivan in the above press release as also remarks of ISRO Chairman AS Kiran Kumar in the PTI press release.

[4] Ref release of Press Information Bureau, Government of India, "ISRO to carry out test flight of RLV during second quarter of 2015", 04 Mar 2015 at http://pib.nic.in/newsite/PrintRelease.aspx?relid=116388 accessed on 17 May 2016.

[5] Ref Carol Pinchefsky, "5 Horrifying facts you didn't know about the Space Shuttle" *Forbes Magazine*, 18 Apr 2012 at http://www.forbes.com/sites/carolpinchefsky/2012/04/18/5-horrifying-facts-you-didnt-know-about-the-space-shuttle/print/ accessed on 16 May 2016.