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INDIA GETS A LEG UP IN HEAVY SATELLITE LAUNCH CAPABILITY

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Introduction

Indian Space Research Organisation (ISRO) commenced working on developing its own satellite launch rockets in the latter half of the 1970s. Prior to this India had relied upon booking launch slots on Soviet and European satellite launch rockets to carry its satellites to space. The early developments of satellite launch technologies – including the Satellite Launch Vehicle (SLV)-3[1], Augmented Satellite launch vehicle (ASLV), Polar SLV (PSLV) and the Geosynchronous SLV (GSLV) – have been written about in some detail earlier on this website[2]. Starting with the 40 kg payload to low earth orbit (LEO) of SLV-3, progressively increasing to about 2,500 kg to geosynchronous transfer orbit (GTO) for the GSLV Mk-II, ISRO has seen a slow but steady increase in its ability to launch ever heavier satellites. A major shortfall that ISRO had till recently was the inability to place satellites weighing over 4,000 kg into orbit. This inability resulted in the need to book launch slots on the European Space Agency's (ESA's) Arianne launcher for the heavier satellites that India needed to place in orbit. At 1758h on 05 June 2017, ISRO successfully launched its GSLV MK-III D-1 rocket on its first developmental flight. This is another step towards filling in the gaps in ISRO's satellite launch capability.

Background and Recent Developments

In order to increase its payload lift to orbit weight capability ISRO required developing a rocket more powerful than its workhorse – the PSLV. It was realised in the late 1980s that this would require use of cryogenic rocket engine technology, a technology that was not then available in India. Initially, after exploratory talks with more advanced nations, ISRO decided upon obtaining cryogenic rocket engine technology from the erstwhile Soviet Union. The dismantlement of the erstwhile Soviet Union in 1991 and vigorous attempts by the US to apply the rules of the Missile Technology Control Regime (MTCR) – of which both the US and erstwhile Soviet Union, and Russia, the erstwhile Soviet Union's successor state, were members – resulted in denial of transfer of cryogenic rocket engine technology from Russia to India. Deprived of the shortcut of obtaining tested and proven cryogenic rocket engine technology from an established space power, ISRO embarked upon a plan to develop cryogenic rocket engine technology indigenously. Early attempts resulted in several failures during test launches. Of these some failures were attributed to failure of the indigenous cryogenic stage and some to failure of other systems of the rocket. Some success was achieved with GSLV MK-II completing its development phase and obtaining operational status. The GSLV-Mk-II, however, is yet to establish a track record of reliability and consistency such as that boasted of by PSLV. Moreover, GSLV Mk-II can carry payloads of up to 2,000 to 2,500 kg to GTO[3]. Need for enhanced payload lift capability led ISRO to develop a more powerful cryogenic rocket engine, the C-25. ISRO redesigned the GSLV to its GSLV Mk-III configuration to enable payloads of up to 4,000-4,500 kg to be carried up to GTO and of up to 8,000 kg be carried to LEO[4]. In order to reduce development risk, ISRO tested the component parts of the GSLV Mk-III rocket separately in ground static tests as well as in flight. The careful, painstaking effort and attention to detail led ISRO to accomplish a copybook mission on 05 June 2017 with the GSLV Mk-III D-1 mission[5]. The successful launch of GSLV Mk-III gives India freedom from dependence on other countries for heavy satellite launch. It also opens up potential opportunities for India to gain from the global satellite launch market by offering the capability to launch the entire spectrum of satellites ranging from nano satellites to heavy satellites at very competitive costs. The fact that ISRO boasts the lowest payload to orbit costs in the world has been written about, in great detail, in earlier articles on this website. Ability to place heavy payloads into orbit also opens up strategic options for the country in several fields of endeavour extending up to deep space exploration and exploitation of space resources, such as asteroid mining, etc.

Future Expectations

The logical next step to expect from ISRO with respect to GSLV Mk-III is a series of missions to help establish the new rocket's reliability and consistency. The establishing of such a reliability track record is essential before satellite launches on this new rocket are offered to international customers. Such a reliability track record is a pre-requisite for using the rocket for a prospective manned space program as well.

All said and done, ISRO has again risen to the occasion and delivered the required technological capability for exploitation, aimed at betterment of the nation.

While the GSLV Mk-II and MK-III add to give ISRO a well-rounded rocket based satellite and other payloads launch capability, the most exciting project that ISRO is running is the Reusable Launch Vehicle (RLV) technology development[6]. This project has the potential to change the whole paradigm of space access on several planes. A fully developed RLV could reduce space payload insertion costs by a factor of 10 to 100 while also reducing the lead time to go into space. The component technologies of RLV have potential spin-offs in fields ranging from transportation to national security. Most of the technologies involved in the RLV have been tested separately by ISRO over the past months[7]. This step by step approach to RLV gives hope that ISRO could in the foreseeable future test fly the complete RLV and then go on to complete its development phase and offer it for use in an operational configuration. The next five years could well see an operational RLV being offered alongside the PSLV, GSLV Mk-II, and GSLV Mk-III.

Conclusion

ISRO has made giant strides since it commenced developing its own rockets for space access. The early SLV-3, ASLV and PSLV served a useful function. The later GSLV series aim to fill the gap in heavy satellite launch capability. The GSLV Mk-II successfully completed its development phase and was declared operational in year 2015. Now the GSLV Mk-III, the heaviest rocket in ISRO's inventory, has commenced its development phase with its first successful flight on 05 June 2017. The next few months should see more flights of GSLV Mk-III aimed at establishing its maturity and reliability before it is offered for use in the global satellite launch market. Even more exciting is the prospect of ISRO moving ahead with its RLV. As far as space technology is concerned, exciting times lie ahead for ISRO and the country.

(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] Isro.gov.in, "Launchers", http://www.isro.gov.in/launchers, accessed on Jun 06, 2017.

[2] Vivek Kapur, "ISRO Moves to Add To India's LaunchCapabilities",http://capsindia.org/files/documents /CAPS_Infocus_VK_44.pdf

[3] Isro.gov.in, "GSLV", http://www.isro.gov.in/launchers/gslv, accessed on June 06, 2017.

[4] Isro.gov.in, "GSLV Mk-III", http://www.isro.gov.in/launchers/gslv-mk-iii, accessed on June 07, 2017

[5] Thehindu.com, "GSLV-Mark III - ISRO's most powerful rocket successfully launched", http://www.thehindu.com/sci-tech/science/live-gslv-mark-iii-isros-heaviest-rocket-launching-gsat-19-satellite/article18723129.ece, accessed on June 06, 2017.

[6] Isro.gov.in, "RLV-TD", http://www.isro.gov.in/launcher/rlv-td, accessed on June 06, 2017.

[7] Isro.gov.in, "SramjetEngine-TD", http://www.isro.gov.in/launcher/scramjet-engine-td, accessed on June 06, 2017; Isro.gov.in, "RLV-TD", http://www.isro.gov.in/launcher/rlv-td, accessed on June 06, 2017.