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ISRO VALIDATES CRYOGENIC ENGINE TECHNOLOGY

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The Indian Space research organisation (ISRO) on August 27, 2015 successfully launched its twenty fifth geostationary communication satellite, the GSAT-6 from the second launch pad at Satish Dhawan Space Centre in Sriharikota (SDSC SHAR). The launch was successfully carried out aboard ISROs Geosynchronous Satellite Launch Vehicle-Development 6 (GSLV-D6), which used the indigenously developed Cryogenic Upper Stage for the third time. Indian Prime Minister Narendra Modi congratulated the ISRO scientists for this remarkable accomplishment.

ISRO has two satellite launch vehicles, Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Launch Vehicle (GSLV). PSLV is meant for launching satellites into sun synchronous and low earth orbit (LEO), whereas, GSLV is used for launching telecommunications satellites into the 36,000 km geostationary orbit. While the PSLV project has been highly successful, GSLV has posed a major challenge for ISRO due to failures in the past.

The success of the indigenous launch vehicle GSLV-D6 is important for ISRO on many counts as the launch has now validated the third and most important Cryogenic Upper Stage (CUS). Speaking about the launch, ISRO chairman A. S. Kiran Kumar said, "It is a result of tremendous amount of hard work put in by the entire team to build in an indigenous cryogenic engine and today's performance of the launch vehicle clearly demonstrates that all the systems have been performing very normally and the various intricacies of the cryogenic engine performance and the systems have been understood".¹ A



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Cryogenic rocket stage is more efficient and provides more thrust for every kilogram of propellant it burns compared to solid and earth-storable liquid propellant rocket stages.² It is technically a very complex system compared to solid or earth-storable liquid propellant stages due to its use of propellants at extremely low temperatures and the associated thermal and structural challenges.³ Mastering of the cryogenic technology has been the result of painstaking effort of generations of scientist community and now this technology would pave way for ISRO to launch heavier satellites with payload capacity of more than two tons. The next step for ISRO would be to improve the Cryogenic stage further to fulfil the aim of launching payloads in the range of 10 tonnes in the Low Earth Orbit (LEO) and in excess of four tonnes in the geosynchronous transfer orbit.⁴ ISRO's former chief K Radhakrishnan, while addressing the 50th Foundation Day of Institute for Defence Studies and Analyses (IDSA), had expressed the need of achieving 12 tonnes launch capability in the decades to come.⁵

The second important outcome of this launch is that ISRO is now one step closer to shedding its developmental tag of GSLV and formally declare the launch vehicle operational. Director, Vikram Sarabhai Space Centre (VSSC), K Sivan had earlier said that ISRO was planning to declare GSLV rocket as fully operation on success of the mission.⁶ ISRO now stands to gain in international launch market as the robustness of GSLV has been proved by demonstrating the quality and reliability of launch vehicle.

GSAT-6 is the twenty fifth geostationary communication satellite of India built by ISRO and twelfth in the GSAT series. Soon after its injection into GTO, the two solar arrays of GSAT-6 were automatically deployed and the Master Control Facility (MCF) at Hassan in Karnataka took control of GSAT-6.⁷ One of the advanced features of GSAT-6 satellite is its S-Band unfurlable antenna of 6 m diameter which also happens to be the largest satellite antenna made by ISRO. As per Shri S Rakesh, Director ISRO Propulsion Complex (IPRC), the antenna is planned to be deployed on August 30, 2015 after a series of orbit raising



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manoeuvres. The other advanced feature of the satellite is the 70 V bus, which is flying first time in an Indian communication satellite.

With this launch, India now seems to be closing in to compete in multi-million dollar commercial launch market and has earned a reputation which will help secure overseas contracts. The success of ISRO's indigenous GSLV series will be watched closely over the next few years and with a few more successful launches, its marketing arm Antrix would be in a position to secure international contracts for high tonnage satellites with lucrative low cost solutions. This in turn would necessitate mass production facilities as ISRO now aims to increase the launch capability to ten satellites in a year. This increased rate of launch capability would entail higher share of responsibilities to budding private space industries. The government has already initiated steps to attract small, medium and large companies in this direction by lucrative proposals and provision of subsidies. In fact, ISRO acknowledged the large role played by the private industries in the success of GSLV D-6 once the GSAT-6 was released into the orbit. As each rocket launch requires a considerable lead time spread over a few months, and ISRO uses two launch pads at SDSC SHAR, the need of the hour is to minimize the turnaround time for rocket launch which demands setting up of new rocket launch pads.

(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])



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End Notes

¹ "ISRO successfully launches GSLV-D6 carrying GSAT-6 satellite", at http://www.business-standard.com/article/current-affairs/isro-s-gslv-d6-takes-off-successfully-115082700648_1.html accessed on August 28, 2015

² "GSLV D-6", at http://www.isro.gov.in/launcher/gslv-d6?_ga=1.14686454.1950792466.1432535102 accessed on August 24, 2015

³ ibid

⁴ William Graham, "India debuts GSLV Mk.III with prototype crew capsule", accessed at <http://www.nasaspaceflight.com/2014/12/india-gslv-mk-iii-prototype-crew-capsule/> on December 18, 2014

⁵ "ISRO to conduct experimental flight of GSLV Mk III in December", accessed at http://zeenews.india.com/news/space/isro-to-conduct-experimental-flight-of-gslv-mk-iii-in-december_1497364.html on December 18, 2014

⁶ "GSLV rocket may be declared fully operational", at http://zeenews.india.com/news/space/gslv-rocket-may-be-declared-fully-operational_1653565.html accessed on August 27, 2015

⁷ "GSLV Successfully Launches India's Latest Communication Satellite GSAT-6" at <http://www.isro.gov.in/update/27-aug-2015/gslv-successfully-launches-india%E2%80%99s-latest-communication-satellite-gsat-6> accessed on August 28, 2015
