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CHANDRAYAAN-2 LANDER VIKRAM TESTED OVER ‘CRATERS’ CREATED AT CHALLAKERE SCIENCE CITY

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An illustration of Chandrayaan-2 lander Vikram. Photo: ISRO

To simulate the lunar surface at the Bengaluru test facility, professional crushers broke down the rocks brought from around Salem in Tamil Nadu to the micro grain sizes sought by the ISRO-led team. Transporters moved the tonnes of this ‘lunar earth’ to ISITE, all free of charge, Dr. M. Annadurai, former U.R. Rao Satellite Centre (URSC) Director recalls.

These challenges were not there when he led the first lunar orbiting-only mission, Chandrayaan-1, as its project director. At the Lunar Terrain Test Facility (LTTF), the team spread the soil trucked in from Salem up to a height of about 2 metres. Studios were hired to illuminate the facility exactly as sunlight would play on the lunar terrain.

On the Moon, the metre-long rover, weighing 27 kg, must move for about 500 metres during its expected life of 14 Earth days (one lunar day). Rover tests began as early as in 2015. The ISRO team had to reckon with the weak lunar gravity, about 16.5% of Earth’s. The rover’s weight was artificially reduced using helium balloons.

Previous missions by other countries have suggested that the southern part of the Moon is mineral rich with the promise of water, which was first confirmed by the Chandrayaan-1 mission.

ISRO Chairman K. Sivan recently said the Indian lander Vikram would be the first ever spacecraft to land at the lunar south pole.

It has two site options, the craters Manzinus-C and Simpelius-N.

The sites were picked after scouring through a few thousand lunar images from Chandrayaan-1 and other missions.

For testing the lander, ISRO had a large test bed created at its new R&D campus at the Challakere Science City, some 400 km from Bengaluru. Vikram’s set of sensors, called the Hazard Detection and Avoidance (HDA) system, is a critical part of the mission.

In the actual descent to the Moon, the lander hovers for a few seconds over a site and the sensors must assess whether the spot is flat enough for the lander’s legs: whether it has rocks that might topple the lander, and whether the lander can be steady to release the rover within it. If the spot is not safe, it must quickly rise and shift to a neighbouring spot and again assess if it is suitable to land on, all in seconds.

ISRO’s lunar touchdown has dry run on soil fetched from Tamil Nadu

Sometime in 2016, the URSC created several artificial ‘lunar’ craters at the Challakere site. Late that year the team put a test bed of lander sensors in a small ISRO plane and flew it over the craters to see if the sensors could read the terrain and find the right landing spot.

According to Dr. Annadurai, the success of the landing depends on the sensors’ correctly guiding the lander to a safe site; and the fuel in the lander lasting for duration of the whole exercise.

Other tests were conducted to clear the working of the lander’s propulsion system, its actuator and legs, and the rover’s movement.

In a joint paper presented at the International Academy of Astronautics symposium in June 2017, Dr. Annadurai and his co-authors wrote: “One of the key elements essential for safe landing is the Hazard Detection and Avoidance (HDA) system. [It] comprises of several sensors... [which] provide information like lander’s horizontal velocity, vertical velocity, height above moon’s surface, relative position of the lander with respect to moon’s surface, and hazard/safe zone around the landing site.

“The HDA system processes the inputs from various sensors, compares the data collected with the information already stored in the lander and provides the required inputs to the navigation and guidance system in real time to correct the trajectory at the end of rough braking to enable a safe and soft landing.”

Citing a report from U.S.-based West American Analytical Laboratories, Shiv Shankar Gupta, chairman of Godhum Grains and Food Products, accused some

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