

The Canadian Lunar Exploration Accelerator Program (LEAP) Rover Mission (LRM): Rove, Gather, Overcome, and Inspire. C-E. Morisset¹, M. Picard¹, and F. Moroso¹, ¹Canadian Space Agency, 6767 Route de l'Aéroport, St. Hubert, QC, J3Y 8Y9, Canada (caroline-emmanuelle.morisset@asc-csa.gc.ca, martin.picard@asc-csa.gc.ca, franco.moroso@asc-csa.gc.ca).

Introduction: In 2019, the Government of Canada announced a new Lunar Exploration Accelerator Program (LEAP) with an investment of \$150M over five years. Its aim is to expand and prepare Canada's space sector, particularly small and medium sized enterprises, for future exploration missions by offering technology development, science and mission opportunities in lunar orbit, on the Moon's surface, or further into deep space.

The Lunar Rover Mission (LRM) is part of LEAP and will aim at the development of space technologies related to lunar mobility systems and science investigations on the lunar surface.

The primary focus of LRM will largely be used as a feed-forward demonstrator of Canadian industry's and academia capabilities for future Canadian rover missions in addition to performing opportunistic science investigations and promoting public engagement.

Mission Summary: The mission will consist of landing a 30-kg class rover (including payloads) on the lunar south pole within the next 5 years to demonstrate key technologies and accomplish meaningful lunar science. A minimum of two science payloads will be accommodated: one Canadian and one American. The Science Objectives will be aligned with one or all of the LEAP science themes: (1) Know your environment; (2) Prospect for Resources; and (3) Safe and Healthy Astronauts. The rover will be delivered to the lunar surface in collaboration with NASA through the Commercial Lunar Payload Services (CLPS) Initiative.

Rover Duty: The prime duty of rover is to "Rove, Gather, Overcome, and Inspire". It needs to rove the surface of the Moon to access, explore and discover remote areas of interest. Across those areas, the rover will continuously gather new scientific and engineering data and imagery. This data will feed the Canadian science community to help increase our understanding of the Moon and other planetary bodies. To successfully "rove" and "gather", the rover will have to demonstrate its capacity to endure and overcome the harsh lunar environment, including the extreme temperatures and the lunar dust. This will provide a clear demonstration of the Canadian space industrial capabilities in terms of robotics and instruments applied to planetary exploration. Publishing and publicizing the resulting data, imagery

and other mission-related stories will strongly inspire people of all ages, and highlight the benefits of space exploration.

Mission Success criteria: In order for the rover to fulfill its duty during the mission, seven mission success criteria were established following these themes: Traverse, Permanently Shadowed Regions (PSR), 2D imagery, 3D imagery, Science, Lunar Night Survival and Outreach. The baseline criteria for each is as follows:

- Traverse 500 m within two lunar days;
- Explore the edge of a permanently Shadowed Region and conducting a "toe dip" into it, i.e. progressively entering the very edge of the PSR and backing out safely increasing its travel until the rover's wheels are fully inside the shadow. It then executes a few basic maneuvers, and gathers imagery and measurements with the on-board instruments;
- 2D imagery must include images with the Earth and lander in the background as well as full panorama taken from about 50 m from the lander;
- 3D imagery must demonstrate the benefits of 3D imagery by "mapping" at least one target of scientific interest and creating a composite 3D map of a traverse (e.g. by stitching successive meshed 3D point clouds);
- Science objectives must two LEAP science and technology themes: "Know your environment" and "Prospect for resources";
- Demonstration of lunar night survival involves operating during a first lunar day, going into hibernation over one lunar night, waking up and then demonstrating subsequent useful operations over a second lunar day, without the use of a radioisotope heating unit;
- Outreach will focus on imagery presented in its 3D context available to Canadians within 24 hours of its reception on the ground. In this case, the imagery and 3D data become well referenced and presented with respect to their location in a 3D virtual environment that replicates the area explored by the mission.

Next Steps: The Project has competitively, through a request for proposal (RFP), selected two contractors for the execution of the First Definition phase (Phase A) . Subsequently, the CSA will issue another RFP to

downselect from the two which Contractor will proceed to accomplish the rest of the Mission.

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