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Author: Dr. Francesco Latini
Italian Space Agency (ASI), Italy

Dr. Simone Pirrotta
ASI - Italian Space Agency, Italy
Dr. Raffaele Mugnuolo
Italy
Prof. Michèle Lavagna
Politecnico di Milano, Italy
Dr. Ivan Troisi
Politecnico di Milano, Italy
Ms. Alice Dottori
Politecnico di Milano, Italy

DEVELOPMENT STATUS OF ORACLE, THE ISRU DEMONSTRATOR FOR OXYGEN EXTRACTION ON THE MOON

Abstract

Since the beginning of the decade, several space agencies and private industries have set their plans to going back to the Moon: in addition to NASA, who is leading the exploration of the Moon with its Artemis program, ISRO performed the first ever landing on the lunar south pole while JAXA have managed to reach the lunar surface, showing the capability of pin-point landing with extreme accuracy. On the other hand, with the CLPS and LIFT-1 initiatives, NASA aims at supporting private industries to develop their platforms to reach the Moon and bring scientific and technological payloads to perform experiments and collect data. In particular, great importance is given to demonstrating the capability of extracting and using resource locally, allowing a future sustainable human presence on the Moon. In this frame, the Italian Space Agency (ASI) and Politecnico di Mi-lano (PoliMi) started the agreement for the Phase A/B1 to develop the ISRU demonstrator for oxygen extrac-tion from the lunar regolith, named ORACLE (Oxygen Retrieval Asset by Carbothermal reduction in Lunar Environment). The process has already been proven in laboratory and manages to produce liquid water from regolith simulant following several steps in two different reactors, one at 1100 C where carbon oxides are first produced and the second at 250 C where water vapour is obtained. The present mission is aimed at demon-strating the extraction process using regolith from the lunar surface, showing also that the regolith used as batch does not affect the yield of extraction. The project has successfully completed the first technical review (MDR) in January 2024 during which important trade-offs were highlighted. Also, preliminary mass, power and data budgets were estimated along with an evaluation of the subsystems to be included in the baseline configuration. Further refinement is expected for the following phase, directly related to the choice of the service provider among those offering a service launch in the timeframe of 2028. This step is crucial for the identification of the interfaces, especially the one related to the regolith handling system. Indeed, its presence on the accommodat-ing platform would simplify the overall payload architecture, resulting also in the optimization of the core sub-systems (i.e. carbothermal reactor, methanator and water condenser).