

OffWorld Prospector: Lunar Oxygen and Hydrogen Production Demonstration. D. G. Bienhoff¹ and O. Borgue, ¹Off-World, Inc., dallas.bienhoff@offworld.ai, ²OffWorld Europe, olivia.borgue@offworld.ai. (Contact: dallas.bienhoff@offworld.ai)

Introduction: OffWorld is going to the Moon! Our goal is to demonstrate oxygen production from regolith minerals and oxygen and hydrogen production from icy regolith on OffWorld Prospector 1 (OWP-1), the first mission of our OffWorld Prospector Program (OPP). Subsequent missions will incorporate volatiles separation and liquefaction followed by a pilot plant and industrial-scale operations. Multiple participants will provide critical path, parallel path, and non-critical technology demonstrations, plus scientific instruments.

Background: Off-World, Inc., was established in 2016 to develop autonomous mining robots and swarm robotic mining capabilities. To date, we have demonstrated an excavator and a surveyor in operational mines and are about to start production. OffWorld Europe was established in 2022 under an agreement with Luxembourg Space Agency to develop a Lunar Processing Module (LPM). The LPM is to extract water from icy regolith to produce oxygen and hydrogen by 2028. OffWorld US is to provide the mobility unit that will find and excavate icy regolith and procure transportation to the Moon. We called this mission Demo 1.

In November 2023, NASA released its LIFT-1 RFI seeking information on end-to-end demonstration missions to produce oxygen from regolith minerals [1]. The LIFT-1 mission is to be conducted in late 2027. NASA foresees a more capable LIFT-2 mission around 2030 and a pilot plant in 2033.

OP-1 is the combination of NASA's LIFT-1 and OffWorld's Demo 1 objectives.

OffWorld Prospector Program: Industrial scale ISRU that uses every gram excavated is the end goal of our OPP. The first step is OP-1 to produce and store oxygen and hydrogen from regolith minerals and icy regolith. OP-2 will demonstrate increased production rates and liquefy the oxygen and hydrogen. With success, the third mission will establish an ISRU pilot plant producing and storing water, oxygen, and hydrogen.

OffWorld Prospector 1. Our end-to-end OP-1 is scheduled for Q4 2024. The mobility unit, Prospector-1 (Figure 1), will be transported to the lunar south pole region by a commercial provider. Prospector-1 will excavate and deliver regolith to an oxygen-from-regolith processing unit from multiple sites at greater distances from the lander. Oxygen will be captured and stored from each location.

Next, Prospector-1 will travel to and enter a permanently shadowed region (PSR) to prospect for icy regolith. Once located, the icy regolith will be excavated and deposited into the LPM. Prospector-1 will leave the PSR to extract and electrolyze water to produce and store oxygen and hydrogen. We repeat this cycle at multiple potential Artemis III landing sites.

OP-1 Participants. OffWorld has contacted 30 potential participants in OP-1. Roles include critical path providers and partners, parallel path providers, and independent technology demonstrations. Critical path roles include transportation, oxygen-from-regolith processing, communications, prospecting, position-navigation-timing, and power generation. Parallel path roles include communications, power generation, water purification, electrolysis, and prospecting. Independent technology demonstrations roles include power transfer and surface communications.

OP-1 Status. OffWorld Europe is testing its LPM breadboard and is heading to PDR in mid-2024. OffWorld US has held the OP-1 SRR and Concept Review and is preparing for a PDR.

OP-1 Schedule. 2024 milestones include submitting a LIFT-1 proposal, conducting a CDR, and signing a transportation contract. Engineering Unit fabrication and procurement, with some assembly, will occur in 2025. Engineering Unit assembly complete and testing happens in early 2026. Protoflight fabrication, procurement and assembly is completed in 2026. Participants' hardware is integrated in Q1 2027. Integration and testing by the transportation provider is scheduled for Q3 2027, with launch in Q4 2027.

References:

[1] NASA STMD Lunar Infrastructure Foundational Technologies-1 (LIFT-1) Demonstration RFI 80HQTR24L002_LIFT1, Amended 12/01/23.

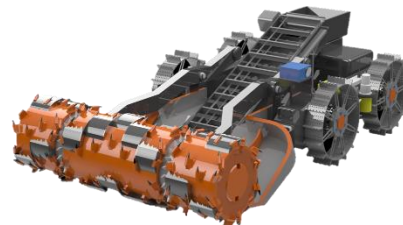


Figure 1. OffWorld's Prospector-1 will produce oxygen from regolith and oxygen and hydrogen from icy regolith.