**LOCKHEED MARTIN'S McCANDLESS LUNAR LANDER CAPABILITIES FOR ISRU MISSIONS.**
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**Introduction:** Lockheed Martin has designed a lunar lander to carry a variety of small to medium- class payloads to the surface of the Moon. The lander, named for astronaut Bruce McCandless, was selected by NASA as a candidate in the Commercial Lunar Payload Services catalog in late 2018 [Ref 1]. McCandless Lunar Lander capabilities are particularly relevant for ISRU pilot plants or resource explorationy rovers, which require more power and mass than many other types of lunar payloads.

**Experience:** The design, flight software, and operations concept of the McCandless Lunar Lander (Fig. 1) is based on Lockheed Martin's history of developing, building, and operating numerous planetary spacecraft in partnership with NASA and JPL, from Viking to OSIRIS-REx. It particularly draws on aspects of the Phoenix and InSight Mars landers, and the GRAIL A & B lunar orbiters. Like McCandless, these missions involved integrating multiple payloads with differing requirements. LM planetary missions have a strong track record of meeting unforgiving planetary launch schedules.

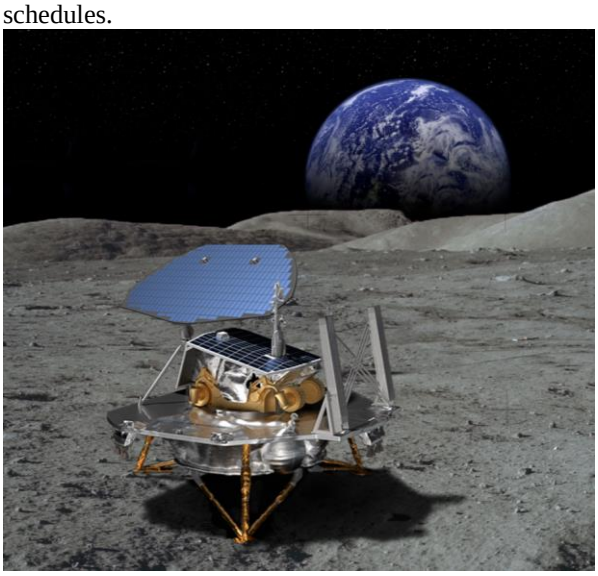

**Fig. 1: McCandless Lunar Lander carrying a large rover.**

**Payload Accommodations:** In addition to accommodating collections of distributed smaller payloads, the McCandless Lunar Lander is designed with the capability to carry large, monolithic payloads such as a rover or ISRU pilot plant (Fig. 2). The large, flat payload deck, with approximately 5 $m^2$ of payload area, is positioned only 1 m above the lunar surface to simplify egress of a rover or access for a sample collection arm. Smaller payload volumes are available suspended underneath the top deck for payloads which need to be closer to the lunar surface or need a more isolated thermal environment inside the lander thermal blankets.

The lander can deliver in excess of 250 kg of payload mass to most locations on the lunar surface and is adaptable to larger payload masses if required.

A large solar array provides 400 W of payload power at ~28 VDC during lunar surface operations. In order to maximize the useful mission duration, the array is mounted on a Sun-tracking gimbal, enabling landing shortly after lunar dawn and full-power operations throughout one lunar day, for a total landed mission duration of about 315 hrs depending on latitude and local terrain at the selected landing site. The lander is presently designed only to operate for one lunar day, but upgrades for surviving the lunar night can be considered depending on mission requirements. A portion of the top deck is reserved for radiator area, depending on the landing site latitude and payload power duty cycle.

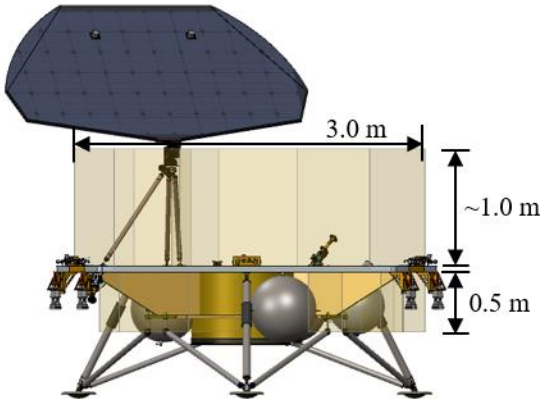


**Fig. 2: McCandless Lunar Lander payload envelopes**

**Conclusions:** The McCandless Lunar Lander is capable of carrying substantial payload mass to the lunar surface. It can accommodate a prospecting rover or ISRU pilot plant and provides the power levels required to run high-power payloads such as ISRU processing experiments

**References:**

[1] NASA Announces New Partnerships for Commercial Lunar Payload Delivery Services, Nov. 29 2018.