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SUSTAINABLE LUNAR SETTLEMENT DESIGN CHARRETTE: HOW SCIENCE REQUIREMENTS DRIVE SUSTAINABLE LUNAR HABITAT DESIGN

Abstract

The science design drivers are primarily the Lunar environmental conditions. The space environmental considerations include the lack of an atmosphere (space vacuum), extreme temperature variations, illumination variability, asteroidal impacts, and persistent radiation (i.e., Galactic Cosmic Rays (GCR), Solar activity). The other aspect is the geophysical formation of the Moon that affects the seismic activity, novel electrochemistry considerations, and the absence of magnetic field protection, which define a novel design environment that must be carefully characterized and ultimately tested in-situ.

The OASIS design-build process has three phases, each of which includes specific sets of experiments:

- Phase 0 – Analog and subscale portlight element and distributed system testing ground analog model, LEO, space-born, and lunar resources
- Phase 1 – Establish a viable construction site and accomplish in situ testing of all flight elements scalable distributed systems
- Phase 2 – OASIS primary buildout infrastructure operations

Environmental conditions on the surface of the Moon are caused by solar activity and other space radiation environments that affect the Lunar surface (i.e., space weather and coronal mass ejection from the sun, as well as high energy UV radiation). It is essential to make a full high-resolution map of that soft X-ray radiation (E = 0.1 – 10 KeV) at the surface level of the Moon using the orbital remote sensing method. This soft X-ray map (fluorescent X-ray emitted from excited elements on the Lunar surface) will provide a better understanding of the conditions that will affect the systems built on the Lunar surface. We propose developing a CubeSat equipped with a soft X-ray camera/detector to map the moon's surface (other EM wavelengths will be observed).

Regolith and moon dust must be tested to understand their thermal properties, chemical composition, soil mechanics, and interaction with lunar surface equipment. In addition, exposure to regolith poses human health hazards, which constitutes a significant obstacle to any successful human presence on the Moon, impacting surface and intravehicular operations.

The Lunar landscape has additional considerations that must be addressed. These include but are not limited to the stability of extant topological structures of the habitat site and surrounding area (density, stiffness, and morphology), which must be tested. A robotic lander must be designed and deployed to test the above requirements. Test the composure of the Lunar surface layers using GPR (Ground Penetrating Radar) and measure other properties.