IAF SPACE EXPLORATION SYMPOSIUM (A3)
Space Exploration Overview (1)

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ROBOTIC LUNAR SURFACE OPERATIONS 2

Abstract

Results are reported from a new lunar base study with a concise architectural program: build and operate a human-tended base that produces enough oxygen and hydrogen from lunar polar ice resources for four flights per year of a reusable lander shuttling between Gateway and the base. The study examines for the modern era issues first developed and reconciled by the RLSO study published in 1990 and resurrected at the 69th IAC in Bremen. The new study updates key assumptions for 1) resources – lunar

polar ice instead of ilmenite; 2) solar power – polar lighting conditions instead of the 28-day equatorial lunation cycle; 3) transportation – use of multiple flight systems now in development and planning; 4) base site planning – a range of options near, straddling, and inside permanently shadowed regions; 5) ISRU scenarios – for harvesting ice and for constructing radiation shielding from regolith. As did the original study, RLSO2 combines US experts in mission design, space architecture, robotic surface operations, autonomy, ISRU, operations analysis, and human space mission and lunar surface experience. Unlike the original study, the new study uses contemporary tools: CAD engineering of purpose-design base elements, and integrated performance captured in a numerical operations model. This allows rapid iteration to converge system sizing, and builds a legacy analysis tool that can assess the performance benefits and impacts of any proposed system element in the context of the overall base. The paper presents an overview of the groundrules, assumptions, methodology, operations model, element designs, base site plan, and quantitative findings. These findings include the performance of various regolith and ice resource utilization schemes as a function of base location and lunar surface parameters. The paper closes with short lists of the highest priority experiments and demonstrations needed on the lunar surface to retire key planning unknowns.