Executive Summary

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Presentation Title

NASA ISRU Incorporation and Development Plans

Key Ideas

The incorporation of In-Situ Resource Utilization (ISRU) capabilities into the buildup and operation of a lunar Outpost can have a significant impact on the affordability and sustainability of lunar exploration and permanent human presence on the Moon. Early development and demonstration of ISRU hardware and capabilities, along with laboratory and field demonstrations with other critical and linked Surface Systems is required to minimize long-term costs and maximize the benefits of ISRU for human exploration of the Moon and beyond.

Supporting Information

The ISRU phasing and capability incorporation strategy developed during LAT Phase I & II is based on the premise that while ISRU is a critical capability and key to successful implementation of the US Vision for Space Exploration, it is also an unproven capability for human lunar exploration and can not be put in the critical path of architecture success until it has been proven. However, at the same time, the lunar architecture needs to be open enough to take advantage of ISRU when proven available. From this, the following ISRU capabilities and phasing was determined to be most beneficial for establishing an Outpost for sustained human presence while incrementally proving and building confidence in ISRU fulfilling critical mission needs:

- Excavation & site preparation (i.e. radiation shielding for habitats, landing plume berms, landing area clearance, hole or trench for habitat or nuclear reactor, etc.)
- Pilot-scale oxygen production, storage, & transfer capability (replenish consumables)
- Pilot-scale water production, storage, & transfer capability – assuming hydrogen source/water is accessible
- Scavenge descent propellants (oxygen, hydrogen, and fuel cell water)
- Fuel cell reactant production, storage, & transfer capability

ISRU can be integrated into Outpost habitat and lunar surface system functions and needs without being in the 'critical path' since early mission consumables could still be brought from Earth if ISRU is shown to be not technically feasible or not beneficial from a mass or cost perspective. ISRU oxygen and water production would be complementary to life support by providing a functional backup and providing makeup for consumables that were not completely regenerated. ISRU would also provide consumables for open systems, like Extra Vehicular Activity (EVA) suits, and could potentially utilize trash as an in-situ feedstock. If properly coordinated early, ISRU could utilize similar functions, technologies, and modules with life support, fuel cell power, and EVA systems to provide a robust surface architecture, and minimize development and deployment mass and cost. With the ability to produce mission consumables, ISRU could also off-set uncertainties in development and deployment of other lunar architecture transportation and surface elements. For example, the impact of life support system development not meeting the water and air recycling loop closure requirements could be mitigated with ISRU. Once demonstrated in terrestrial field tests and possibly robotic precursors, and demonstrated early in the Outpost, ISRU production and use can be expanded with increased confidence in both ISRU and lunar transportation elements, such that in-situ propellant for lunar ascent might be possible.