Lunar Operating Guidelines for Infrastructure Consortium (LOGIC) In-Situ Resource Utilization (ISRU) Working Group Overview and Update M.J. Kinczyk[1], P.A. Burke[1], D.M. Meidenbauer[1], A.K.F. Shin[1], K.L. Jaburek[1], A. Gerger[1]. [1]Johns Hopkins Applied Physics Laboratory, 11100 Johns Hopkins Rd. Laurel, MD 20723. (mallory.kinczyk@jhuapl.edu, paul.burke@jhuapl.edu)

Introduction: As lunar exploration continues to surge, the Lunar Operating Guidelines for Infrastructure Consortium (LOGIC), established by DARPA and managed by the Johns Hopkins Applied Physics Laboratory (APL), brings together international stakeholders to identify critical lunar infrastructure interoperability and interface needs.

To build a vibrant and sustainable commercial lunar economy, designing interoperable systems is critical to enable shareable and scaleable operations that serve all stakeholders. Utilizing DARPA's 10-Year Lunar Architecture (LunA-10) capability study, DARPA has established the Lunar Operating Guidelines for Infrastructure Consortium (LOGIC), bringing together stakeholders from commercial corporations, academia, and government entities to accelerate the development of foundational technology concepts and standards beginning with the following focus areas: Power, Communications, Position/Navigation/Timing (PNT), and In-Situ Resource Utilization (ISRU).

Standards Recommendations: LOGIC facilitates working groups focused on the creation, adoption, and adaptation of technical standards to promote an interoperable lunar economy. Our primary goal, through use case analysis, is to derive interface requirements and map those to standards that enable interoperability. The resulting product is a series of standards recommendations for each focus area above.

ISRU Use Cases: LOGIC has identified and begun work on several use cases related to ISRU including O_2 Production and Material Storage.

I1 – O2 Production: In-situ oxygen production is critical for enabling sustained lunar exploration and settlement. Oxygen extracted from lunar regolith or ice deposits can be used as breathable air for astronauts or an oxidizer for rocket fuel, reducing the need to transport these vital resources from Earth. This approach significantly lowers mission costs and logistical challenges associated with heavy payload launches. This use case focuses on identifying standards relevant to the production of oxygen, regardless of technology used for extraction.

I2 – Material Storage: As humanity moves toward lunar resource extraction and production, intermediate stockpiling and end product stores will be necessary to modulate the flow of materials through the production process. As such, standardizing material storage is critical for ensuring sustainable operations. Without standards in place, byproduct streams and processing residues could pose environmental and safety risks, potentially contaminating resources like water ice or interfering with future missions. Given the Moon's low gravity, lack of atmosphere, and extreme temperature variations, storage solutions should minimize dust dispersion and space debris hazards, as well as allow for potential material reuse. This use case focuses on identifying standards relevant to the safety and sustainability of material storage at various steps along the ISRU production line from extraction to consumer.

I3 – Prospecting: Before any Lunar resources can be extracted or processed, they must be located and characterized. The prospecting use case explores the mapping and extraction planning of lunar resources, which will increase the confidence and enable the efficient extraction of resources.

I4 – Metals Production: In-situ production and refinement of metals will enable a sustained lunar presence. Metals extracted from the lunar regolith can be used in the production of several key elements of lunar infrastructure, including: wires, power infrastructure, habitats, and radiation shielding.

Path Forward: The LOGIC ISRU team plans to focus on main thrusts in the coming year. First, the ISRU Working Group (WG) will explore the use of credible lunar resource data. The ISRU WG will leverage interoperability standards such that members can benefit from the collection and dissemination of lunar resource data that enbales ISRU. The WG will also identify interoperability information gaps and ways to fill those needs. Next, the LOGIC ISRU team will explore resource utilization value chains, reviewing lunar ISRU and terrestrial mining architectures for interoperability gaps and opportunities. The ISRU WG develop a ISRU architecture study, focusing on a specific value chain. Throughout the process, the WG will enage the community.

References: [1] M. Kinczyk, et al. *Lunar Operating Guidelines for Infrastructure Consortium Overview and Progress Towards Standards Recommendations for In-Situ Resource Utilization as Applied to the Moon*. Space Resources Roundtable (2025). [2] LOGIC Core Team. LOGIC Semi-Annual Meeting (2026).