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IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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JAXA'S CONCEPT OF A LUNAR ISRU PLANT

Abstract

This presentation shows the concept of a lunar ISRU plant for reusable transportation architecture in JAXA's future space exploration scenario. The feasibility study of a whole plant system is of the essence not only to identify the technical issues from a system integration standpoint but to optimize the designs and operations of lunar ISRU plant elements. This work is carried out under the cooperation agreement on the conceptual study of a lunar ISRU Plant between Japan Aerospace Exploration Agency (JAXA) and JGC Corporation, one of the world's largest total engineering companies.

For the future transportation architecture on the Moon, JAXA plans to deploy reusable landers and lunar hoppers on the Moon. Formulating long-term broad strategies to reduce launch mass of propellant for these transportation systems is critically important to ensure sustainability of future exploration, accomplished by in-situ production of liquefied hydrogen (LH2) and liquefied oxygen (LOX) from lunar regolith with water contents. Given that the target of propellant production is set as 50 tons at an early stage of lunar exploration according to Global Exploration Roadmap published by ISECG last year, 57.6 tons of propellant is required to fuel spacecrafts on a yearly basis according to JAXA's estimation. The target of annual production rates of LH2 and LOX are 49.3 tons and 8.3 tons respectively. As a first step to produce LH2 and LOX from lunar regolith with water contents in a lunar polar region, lunar regolith excavated in permanent shadow (Permanently Shadowed Regions or PSRs) is transported to a lunar ISRU plant located in highly illuminated area. Subsequently, water is extracted from regolith and condensated, then purified. Gaseous hydrogen and oxygen produced by electrolysis are transferred to GH2/GOX liquefaction element. LH2 and LOX are stored in cryogenic storage tanks to be filled into re-usable landers and lunar hoppers on demand.

The conceptual study covers five categorized issues as follows:

1. Whole plant system. Conceptual study of a lunar ISRU plant system from an optimization perspective.

2. Element. Technical assessments of each subsystem from regolith excavation to filling process.

3. Construction Infrastructure. Technical issues during construction phase and necessitated infrastructure. In-situ manufacturing of construction materials by 3D printing technology.

4. Operation. Technical issues from launch operations to nominal phase including maintenance and study of reusability after mission accomplishment.

5. Project Management. Managemental issues to formulate long-range strategies including appropriate project management and international cooperation.