FUEL POWERED IN-SITU RESOURCE UTILIZATION ON THE MOON. R. A. Chandrachud[1], [1]Student, Mumbai University, India (rachandrachud@spacophile.com)

.

Introduction: ISRU means a lot to whole lunar community. Thus in the initial stages the structures which could be built over lunar surface would require instant energy. The lunar regolith is enriched with the constituents which would meet large energy and habitational requirements there only. The earth has no need to calculate the launching costs and payloads as the required materials could be transported to desired locations, but on the moon each gram costs much to lift off from the earth. ISRU will reduce cost of launch ultimately by reducing weight of objects launched from the earth.

Primary objectives of ISRU: a new frugal and least earth dependant lunar structure (Sustainable Permanent Lunar Modules) are emerging. Totally different from terrestrial colonies these modules would first introduce humans to the surface of moon and allow humans to perform experiments on the lunar surface. It is very important for the In-Situ Resource Utilization units to proliferate on the lunar surface as they will drastically meet all the energy needs of the structures installed on lunar surface. These ISRUs will be powered with solar panels along with fuel cells as back-up plan.

Important Technological aspects: The aspects carefully considered here are Energy Generation ISRUs, Water Processing on the lunar surface, and Refining of the metals and most importantly extraction of Helium-3

ENERGY NEED CATERING ISRUS: Energy ISRU refineries are lunar base stations and can even support a permanent population and pressurized area for workers. Despite this, ISRU units are often left unmanned during periods of routine operation. If an ISRU that uses solar power utilizes 900 square meters of thin film solar panels for a total power output of 147 kW at a mass of 720 kg. This power is sufficient to run the station's diagnostics, pressurize helium for transportation, and provide power to the fuel cells that augment the solar panels and are used when the ISRU faces away from the sun for two weeks at a time.

WATER PROCESSING ISRU UNITS: Primary purpose is to extract the water beneath lunar surface. Then it is passed through a cooling loop and recondensed into liquid water. Here several options remain for water. The water processing /chemical means. ISRU has a capacity of 500 tons of water in the form of a below-ground pool walled with sintered lunar regolith. After the complete water extraction structure is abandoned and new structure is built on new ice deposit. Much more units can be built once a trial unit is tested.

EXTRACTION OF HELIUM-3 GAS: Helium-3 is one of the principal most profitable export of ISRU Systems as it is very much effective nuclear fuel along with the present scarcity of this gas on the surface of the Earth. Extraction of helium gas would require less power than previous mentioned operations. Thus mobile helium-3 gas extraction platforms set up on the lunar surface could turn highly profitable and could be one of the best exports to Earth from lunar surface.

EXTRACTION OF HELIUM-3 GAS: Lunar regolith is mined around the ISRU, and then brought back to the ISRU for processing. Power supply is similar to water processing ISRU. They can run 12 hours a day and 6 hours unloading. When extracted regolith has been transported to the ISRU with help of mobile vehicles, it is separated into its composite oxides via selective reduction. This result into several different oxides, such as CaO, TiO_2, FeO, Fe_2O_3, Al_2O_3, and others, which can be easily, separated using magnetic /chemical means. Metal refining ISRUs are typically located in the Oceanus Procellarum region of the near side of the Moon. This location holds the highest concentrations of most metals (with the exception of aluminum, which is more commonly found in the lunar highlands). Particularly, titanium, iron, and thorium are most common in this area, especially around the Copernicus crater

Conclusion: Carefully chosen isotopes of Uranium could power ISRU units. Another type of ISRU units is water processing ISRU units powered by U-233 fission reactor which run a 10MeV S-CO_2 Cycle. The Metal refining units could be installed at Oceanus Procellarum region. For Helium-3 Extraction the power required would be very low compared to the other operations.