gravitational fields, at low partial pressure of oxygen, and makes use of in situ regolith for system insulation.

The innovation extracts oxygen from lunar regolith using a method similar to vacuum pyrolysis, but with hydrogen cover gas added stoichiometrically to react with the oxygen as it is produced by radiatively heating regolith to 2,500 K. The hydrogen flows over and through the heating element (HE), protecting it from released oxygen. The H2–O2 heat of reaction is regeneratively recovered to assist the heating process. Lunar regolith is loaded into a large-diameter, low-height “pancake” reactor powered by photovoltaic cells. The reactor lid contains a 2,500 K HE that radiates downward onto the regolith to heat it and extract oxygen, and is shielded above by a multi-layer tungsten radiation shield. Hydrogen cover gas percolates through the perforated tungsten shielding and HE, preventing oxidation of the shielding and HE, and reacting with the oxygen to form water vapor. The water vapor is filtered through solid regolith and then condensed to a liquid state and stored at 300 to 325 K. Conversion to usable oxygen is achieved by pumping liquid water into a high-pressure electrolyzer, storing the gaseous oxygen at high pressure for use, and diverting the hydrogen back to the reactor or to storage.

The results from this design effort show that this oxygen-generating concept can be developed in an efficient system with low specific mass. Advantages include use of regolith as an oxygen source, filter, and thermal insulator. The system can be tested in Earth gravity and can be expected to operate similarly in lunar gravity. The system is scalable, either by increasing the power level and output of a standard module, or by employing multiple modules.

This work was done by Rodney Burton and Darren King of CU Aerospace LLC for Marshall Space Flight Center. For more information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors+nasa.gov. Refer to NPO-48762.