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IAF SPACE POWER SYMPOSIUM (C3)
Space Power System for Ambitious Missions (4)

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MULTIFLUID GEOTHERMAL ENERGY GENERATION ON MARS IN THE SEDIMENTARY REGIONS UTILIZING INDIGENOUS RESOURCES OF THE PLANET

Abstract

With the beginning of the next era of human space exploration toward Mars, a number of long-term crewed space missions have been announced to ensure the successful functioning of civilization on the surface. A smooth operability and development of long-term crewed missions on Mars would require a sustainable and efficient power source developed from primary and secondary resources available there. Solar and wind energy resources are the most widely proposed mechanisms for generation of energy to sustain the needs of an independent civilization. However, data received from various missions launched show Mars to receive regular cycles of dust storms and inhospitable cold temperatures. Therefore, solar and wind energy resources would not be able to generate sufficient energy for civilization in these cases. Further, this may also halt the planned mission tasks for day-to-day exploration and activities. To solve this, this paper presents a power generation model utilizing the fluid and thermal storage capacity of the subsurface near a permeable layer with injected atmospheric carbon dioxide and nitrogen to generate energy. The idea discusses how energy would be extracted from these reservoirs and transported using insulated pipes, stored, and dispatched to electrical grids as per the needs. The injected carbon and nitrogen content would be extracted from the atmosphere through the Direct Air Capture technique and injected near the saline aquifers thereby generating pressure, resulting in a flow of brine. The flowing brine would act as a natural auxiliary fluid for extracting the heat from a sedimentary region on Mars which would be further used to generate energy. The proposed model consists of a concentric structure of 4 rings of both injection and production well which generates a hydraulic mound that helps trap the increased pressure, carbon content, and generated heat. Therefore, the thermal energy can be generated and extracted as per the requirement of the crew. Further, the extracted heat can be used to regulate the temperature of the habitat where astronauts will be living, and the greenhouse sites containing plants, thus aiding in efficient generation of oxygen for the crew. The proposed mission altogether aims at providing an alternative source of energy to the astronauts, thus reducing the dependence of solar and wind energy.