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NUCLEAR POWER GENERATION USING MODULAR HELIUM COOLED REACTORS FOR SUSTAINABLE LUNAR BASES AND MOON HABITATS

Abstract

The moon has been one of the main interests of mankind since the dawn of the civilization and since Jules Verne it has been considered as a stepping-stone to our solar system and beyond. On the moon, it is essential to create power for the various logistical requirements such as life support, communications, lights, waste removal, scientific payloads, and for the facilities that will process materials. On the moon, chemical or thermal means of generating electricity would be quite difficult under vacuum and reduced gravity conditions. However, with the availability of a nuclear reactor, all of the power requirements in a moon habitat can be met for several years without any difficulty. A nuclear reactor on the surface of the Moon can be a source of reliable power to provide life support, and to supply the large power demands of facilities processing materials. Unfortunately, the standard types of reactors found on Earth that use water such as LWPR will not be feasible on the moon. Since the moon has the 1/6th gravity of the Earth, the fission kinetics would be harder to control and using water as a coolant will not be practical as having thousands of tons of water on the moon will not be logistically feasible. In addition, the circulation of wastewater will be extremely difficult due to subzero temperatures and vacuum outside of the Lunar Base. One workable example for sustainable power for a lunar base or lunar production facility would be the utilization of a Modular Helium Cooled Nuclear Reactor, where Helium will be used both as a neutron moderator and as a coolant. Since helium is a noble gas, it will not be chemically reactive and also several studies suggest that Helium circulation would function well under microgravity conditions. In addition, the pumping and the cycling of Helium would be easier, and the logistics of waste will be simplified. Thus, by using a helium cooled reactor, the challenges can be overcome, and the necessary long term power supply can be provided to a Moon Habitat. Since, the design will be modular, it will be easy to transport and assemble or even to move to another location. The paper will discuss the issues while addressing moon-based criteria such as the reduced gravity, lack of atmosphere, availability of large amounts of moon dust, variable temperatures, and lack of natural resources necessary for operation of such a system.