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UTILIZATION OF NUCLEAR POWER FOR MOON MISSIONS: NUCLEAR POWER GENERATION USING HELIUM COOLED REACTOR FOR SUSTAINABLE MOON HABITATS

Abstract

As the closest space based natural satellite in space, the moon has been one of the main interests of mankind since the dawn of the civilization. On the moon, it is essential to have extensive support to create power for the various logistical requirements such as life support, communications, lights, waste removal, etc. as well as for the scientific experiments 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 based 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 such as the Heavy Water Pressurized Reactor or the Light Water Pressurized Reactor systems 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 waste water will be extremely difficult due to subzero temperatures as well as the vacuum outside of the Moon Habitat One workable example for sustainable power for a lunar base or lunar production facility would be the utilization of a 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 reduced gravity conditions and even under microgravity conditions. In addition, the pumping and the cycling of Helium would be easier and the logistics of wastewater will not be a problem as well. Thus, by using a helium cooled reactor, the challenges of using a water cooled reactor can be overcome and the necessary long term power supply can be provided to a Moon Habitat. 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 and lack of natural resources necessary for operation of such a system.