SPACE PROPULSION SYMPOSIUM (C4)
Joint session on Nuclear Propulsion and Power (7.-C3.5)

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COMPARISON OF COSTS FOR VARIOUS LUNAR SURFACE POWER SYSTEMS

Abstract

Surface power is the sine qua non of any robust exploration program. Apollo missions were sufficiently short that relatively low amounts of power were sufficient for the limited science content these missions contained. Future missions planned by NASA and the international community envision lunar residence times of more than 45 days. Some missions, perhaps having an objective of training for future Mars exploration, may last for almost two years. Such missions will require extensive habitat power for such items as: food production; waste processing, water recovery, machine tool use, equipment charging, as well as lighting, heating and air conditioning, science and exploration, computing, communications, and hygiene. These power requirements could demand as much as 20-50 kWe per person, consequently, a crew of six could require 120-300 kWe or more.

However, NASA is currently strapped with other budgetary demands, including Ares, Ares V and Orion. Other demands such as Altair and J-2 development are also required. These budgetary demands proscribe near-term funding for lunar surface power and other infrastructure elements. Consequently, NASA has identified surface power as one area that a commercial firm might develop and qualify the power system and sell power to the exploration enterprise. This paper analyzes three possible power sources, two are nuclear, and one is an off-shoot of space based solar power, where power is generated in lunar orbit and beamed to rectennas on the lunar surface, providing power to the exploration systems. Each of these system concepts exhibits various virtues and liabilities. Each may benefit from developments for other missions and scenarios.

In this paper the author discusses the operational virtues and drawbacks of each system, discusses on-going cost assessments from the government and commercial sector, makes some recommendations for developmental pathways that could lead to a rate structure where investments could be recouped in a realistic time frame.