Orbital Space Solar Power Option for a Lunar Village

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One of the most significant challenges to the implementation of a continuously manned lunar base is power. During the lunar day (14 Earth days), it is conceptually simple to deploy solar arrays to generate the estimated 35 kilowatts of continuous power required. However, generating this level of power during the lunar night (also 14 Earth days) has been an extremely difficult problem to solve. Conventional solutions range from the requirement that the base be located at the lunar south pole so as to take advantage of the continuous sunshine available there to developing a space-qualified nuclear reactor and power plant to generate the needed energy. There is a third option: Use the soon-to-be-available Space Launch System to place a space based solar power station in lunar orbit that would beam the needed energy to the lunar base.

Several detailed studies of have been performed by NASA, universities and others looking at the lunar south pole for locating the base. The results are encouraging: by taking advantage of the moon's orbital tilt, large solar arrays can be deployed there to track the sun continuously and generate the power needed to sustain the base. The problem with this approach is inherent to its design: it will only work at the lunar south pole. There is no other site on the Moon with geometry favorable to generating continuous solar power.

NASA has also considered the development of a compact fission reactor and power plant to generate the needed power, allowing the base to be sited anywhere on the Moon. The problem with this approach is that there are no space fission reactors available, none are being planned and the cost of developing one is prohibitively expensive.

Using an orbiting space based solar power station to generate electrical power and beam it to a base sited anywhere on the moon should therefore be considered. The technology to collect sunlight, generate greater than the estimated 35 kilowatts of power, and beam it to the surface using microwaves is available today. The problem with this concept in the past would have been the mass and packaging volume (for launch) required to put such a system in place in lunar orbit. This problem is potentially solved with the advent of the Space Launch System (SLS). The SLS, with its 70 mT launch capacity, it more than capable of placing such a system into lunar orbit in a single launch.

This paper will examine the potential use of an SLS-launched, space solar power system in lunar orbit as the primary power source for a first-generation, continuously-occupied lunar base and compare it with the other power generation and storage options previously considered.