Solar Power Satellite with No Moving Parts

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ABSTRACT

The only solution to the global energy mess is sunlight captured in space. No other technology scales as well, and is as clean as Space Solar Power. Best of all, this is baseload power – "always on" – without the intermittency which will always plague ground-based solar and wind. Although invented in 1968, SSP designs have been impractical until now. A novel design architecture, relying on use of materials already in space, enables SSP at costs competitive with existing baseload power sources. And all this without greenhouse gas emissions. This work describes the technology and economics. The "tin can" solar power satellite is comprised of a cylindrical shell of solar panels. This configuration has integral thermal management by using the non-illuminated portions of the shell as a radiating heat shield, maintaining the solar cells within workable temperature ranges. The tethers holding the shell to the central conductor spire present a complex radiative environment which is studied further herein to obtain a more precise measurement of high and low temperature limits. Heat generated by the transmitting antenna and its power electronics is also studied to understand its impact on the requirements imposed on components and subsystems. Achieving a slow rotation of a very large diameter cylindrical shell with minimal internal strength interacts with the assembly process through tradeoffs between propellant, assembly jigs, and construction spacecraft. Vibrations induced in the cylindrical shell are studied including transient behavior during spin-up. The panel-to-panel forces expected during spin-up, and during on-going operations as gravity gradients excite low-frequency modes are studied in order to derive specifications for linkage rotation and strength. Finally, the results of imperfect assembly, lost parts, and meteorite strikes are investigated to assess risk to other spacecraft. Solar wind pressure is evaluated to determine station-keeping requirements. Assembly in an orbit slightly higher than GEO may be selected to minimize collateral damages, and means of adjusting the orbit are studied to derive overall architecture propellant requirements, anticipating a mixture of in situ propellant options versus earth-sourced propellants. This work charts a pathway to the ultimate energy source for all mankind for all time to come.