

SPACE POWER SYMPOSIUM (C3)
Space-Based Solar Power Architectures / Space & Energy Concepts (1)

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SPACE SOLAR POWER MISSION ANALYSIS AND DESIGN

Abstract

Space solar power (SSP) has been proposed as an approach to provide affordable terrestrial electric power, to service remote regions of the Earth and to supply other spacecraft in orbit. Prior work has also discussed the efficacy of SSP for deep space missions. A key step on the road to making SSP's common use a reality is to define design best practices for SSP systems and spacecraft.

This paper presents an overview of the space mission analysis and design process (based on Wertz, et al.'s Space Mission Engineering the New SMAD) specifically for space solar power provider and consumer missions. We discuss the changes to the common SME:SMAD process that are necessitated by the decision to use SSP. We focus particularly on missions transmitting power from one spacecraft to another (however, as the design for a transmitting craft for space-to-space and space-to-Earth could be quite similar, much of this work could be applicable to this as well).

We illustrate the differences in design through the mission architecture and design process utilized for the University of North Dakota's test mission. We describe the steps that were utilized (based on SME:SMAD) and the departures that were required in this particular instance and identify locations where other mission types would also require deviation from the SME:SMAD process. Through this, we highlight the benefits of using SSP. We also show where the use of SSP requires additional systems for redundancy (e.g., backup solar panels on a receiving craft) complexifying, somewhat, the design of a spacecraft. We discuss the cases where this redundancy is required and recommended.

The paper concludes by discussing the economic case for SSP and the impact of design decisions on these economic considerations. From this, we conclude that the economic viability of SSP missions can be enhanced via the use of high-ROI design strategies.