Planetary and Deep Space Requirements for 1 'hotovoltaic Solar Arrays[1]

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ABSTRACT

in the past 25 years, the majority of interplanetary spacecraft have been powered by nuclear sources. However, as the emphasis on smaller, low cost missions gains momentum, the majority of missions now being planned will use photovoltaic solar arrays. This will present challenges to the solar array builders, inasmuch as planetary requirements usually differ from earth orbital requirements. in addition, these requirements often differ greatly, depending on the specific mission; for example, inner planets vs. outer planets, orbiters vs. flybys, spacecraft vs. landers, and so on. Also, the likelihood of electric propulsion missions will influence the requirements placed on solar away developers.

The paper will discuss representative requirements for a range of planetary missions now in the planning stages. Insofar as inner planets arc concerned, a Mercury orbiter is being studied with many special requirements. Solar arrays would be exposed to high temperatures and a potentiall y high radiation environment, and will need to be increasingly pointed off sun as the vehicle approaches Mercury. identification ant] development of cc]] materials and array structures will be key elements to enable such a mission. The performance of the arrays at high incidence angles will be critical to the design.

Missions to the outer solar system that have been studied include a Galilean orbiter and a flight to the Kuiper belt. While onboard power requirements would be small (as low as 10 watts), the low solar intensity will require relatively large array areas. As a result, such missions will demand extremel y compact packaging and low mass structures to conform to launch vehicle constraints in turn, the large area, low mass designs will impact allowable spacecraft loads. Inflatable array structures, with and without concentration, and multi-band gap cells will be considered if available. In general, the highest efficiency ccl] technologies operable under low intensity, low temperature conditions arc needed.

Solar arrays will power missions requiring as little as appproximately 100 watts, up to several kilowatts (at Earth) in the case of solar electric propulsion missions. "1'bus, mass and stowage volume minimization will be required over a range of array sizes. Concentrator designs, inflatable structures, and the combination of solar arrays with the telecommunications system have been proposed. performance, launch vehicle constraints, and cost will be the principal parameters in the design trade space.

Other special applications will also be discussed, including requirements relating to planetary landers and probes. in those cases, issues relating to shock loads on landing, operability in (possibly dusty) atmospheres, and extreme temperature cycles must be considered, in addition to performance, stowed volume, and cost.

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