SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems (4)

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STUDY RESULTS ON A SOLAR ELECTRIC POWER SYSTEM FOR HIGH POWER ELECTRIC PROPULSION (HIPER) APPLICATIONS

Abstract

The aim of this study is, on top of the investigation of an overall PMAD system capable to fulfil the requirements of both solar and nuclear energy sources, to define a solar based power system able to feed high power electric thrusters. This kind of propulsion system could play a very important role in future space exploration programmes by enabling more affordable and sustainable space-to-space missions. HiPER is a project partly funded by the EU aimed at laying the technical and programmatic foundations

for the development of technologies to fulfil these future needs. The abstract presents results of the development and prototyping of solar generation technologies and gives indications on the optimal PMAD architectures. The power demand of next generation spacecraft will overcome the limits of existing state of the art solar generation systems. Today the multi panel deployable solar array is the most common system utilized for medium and high power applications. Its ability to provide accommodation for power growth (up to tens of kW), high reliability, competitive weight and low cost, lead to world wide success but we need something more. Light concentration techniques, thin solar cells and light/flexible substrates are going towards this direction. Starting from our previous experience in lightweight photovoltaic systems, we all initiated the development activities. The main topics addressed in this study are: light concentration (up to 10 times the nominal flux) system design, inflatable substrate and flexible electrical network structural design, prototyping and verification; The solar cell trades started from the very latest achievements in crystalline solar cells. Based on that, a component suitable for light concentration has been identified. This component has been integrated on top of a flexible structure in combination with the concentrating lenses and with an innovative "smart" deployment mechanics based, also, on Shape Memory Alloys (SMA) performances. The PMAD is a critical aspect of the whole system design which can undermine all the other technical advances. A direct drive approach is the most suitable solution and an architecture based on solar DC voltage level of about 300V and a current level of about 800 A has been extensively simulated. Of course there are risks associated with the operation at high current and voltage and this are mainly related to coronal discharge effects. The scope of the present study is to define generic mitigation strategy for making a more precise assessment for the total system mass estimate.