SPACE POWER SYMPOSIUM (C3)
Technologies and Experiments related to Wireless Power Transmission (2)

Author: Mr. Wolfgang Wulfken
Astrium Space Transportation, Germany

Dr. Karl-Heinz Weber
Astrium Space Transportation, Germany
Prof. Stephen J. Sweeney
University of Surrey, United Kingdom
Mr. Jayanta Mukherjee
University of Surrey, United Kingdom
Mr. Frank Steinsiek
Astrium Space Transportation, Germany

FIRST EXPERIMENTAL RESULTS OF A LASER POWER TRANSMISSION AT AN EYE-SAFE WAVELENGTH USING DEDICATED PHOTOVOLTAIC CELLS

Abstract

A SBSP system aims to provide on Earth a renewable source of energy. It relies on the solar energy collected by the space element and transmitted via laser to Earth. A first step will be the development of a satellite providing about 10 kW to the ground end user. Such a satellite will be a prototype used both for an overall system demonstration and as a first operational system at 2023 horizon. Early experiments on ground are the initial steps of a technology development road map and elements of a demonstration strategy, relying on both, on-ground, inatmosphere and in-orbit tests. This paper describes the first results of such an experiment performed in 2011. The laser experiment was planned to be performed in-door, inside a commercial hangar at Astrium Bremen. The main experiment aims to demonstrate the transmission of power by a so called eye-safe laser at an appropriate power level over a reasonable distance. A pre-test was to validate the laser beam pattern and the beam behaviour in variable distances away from the laser source. The main test was to demonstrate the transmission of power by a fibre laser emitting at 1.55 micron at a beam power level of 50 W over a distance of 100 m. The laser receiver consists of an optimized photovoltaic cell targeting the laser wavelength. The intended results of the initial experimental campaign were; the validation of the laser power profile at an intensity of 1 kW/m2 (equivalent to the solar flux on earth), power intensity and profile measurements at the target, to investigate the influence of air particles on beam propagation, and laser transmission measurements at variable distances. The laser power transmission experiment planned for the year 2011 is conceived as the initial step in a series of follow-on experiments, with the final goal of providing 1-3 kW by the year 2017 and later, by the year 2023, a 10 kW pilot Power Satellite in GEO. At a later stage of the experimental campaign it is intended to use outdoor infrastructure providing distances of several hundreds of meters to kilometres unobstructed line-of-sight for ground-to-ground and ground-to-air experiments. The paper provides an outlook of the next experimental phases, comprising enhanced ground tests and atmospheric scenarios using balloons as target or relay platforms in air for a ground-to-ground power transmission.