

15th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Conceptualizing Space Elevators and Tethered Satellites (3)

Author: Mr. Vadym Pasko
Yuzhnoye State Design Office, Ukraine

AN ASSESSMENT OF THE TECHNOLOGICAL FEASIBILITY OF APPLYING GEO-BASED SOLAR
PUMPED LASERS FOR FEEDING THE SPACE ELEVATOR EXOATMOSPHERIC CLIMBER

Abstract

While the era of Space Elevator is slowly approaching the main aspects of its design and operations remain uncertain. One of the key problems that has been addressed in many studies but hasn't found any solidified solution is the space elevator climber feeding scheme. The original idea of Dr. Edwards to use a powerful ground- or sea-based laser meets several serious problems connected with: continuous operation of the high-energy laser in all weather conditions, over-flight of aircraft and spacecraft, pointing stability, etc. A different approach of using solar panels tethered to the climber has been proposed by the IAA but has its own weak sides: a huge required area of solar arrays, which leads to technological problems with maintenance and replacement of panels and the need to pack them inside an aerodynamic dome while moving in the atmosphere; the nighttime climber layup; restrictions on operational overloads, etc.

The current paper is devoted to the alternative concept of using GEO-based solar pumped lasers for feeding space elevator climber at its exoatmospheric phase. The solar pumped laser can concentrate solar energy from a large area into a thin laser beam with high efficiency of more than 40%. The energy from laser beam can be converted to mechanical or electrical energy by the Stirling engine with efficiency close to 30%. These two technologies can be used to build simple and robust system of feeding the space elevator climber.

The main advantage of the proposed solution is in reduction of the climber mass and complexity, while preserving solar energy conversion efficiency at the same level as in the case of using photovoltaic arrays. The paper contains estimations of basic parameters of the solar pumped laser feeding system for the 20-ton climber addressed in the IAA study. Advantages and complications of the proposed scheme are depicted along with the estimation of its feasibility.