

Title

CONCEPT OF SPACE SOLAR POWER SYSTEMS (SSPS) IN JAXA

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Abstract

Japan Aerospace Exploration Agency (JAXA) has been conducting studies on Space Solar Power Systems (SSPS) using microwave and laser beams for years organizing a special committee and working groups. In case of microwave based SSPS (M-SSPS), the solar energy must be converted to electricity and then converted to a microwave beam. The on-ground rectifying antenna would collect the microwave beam and convert it to electricity to connect to commercial power grids. In the laser based SSPS (L-SSPS), a solar condenser equipped with lenses or mirrors and laser-generator would be put into orbit. A laser beam would be sent to Earth-based hydrogen generating device.

JAXA is proposing a roadmap that consists of a stepwise approach to achieve commercial SSPS around 2030. The first step is tens of kW class space technology demonstration satellite to demonstrate microwave or laser power transmission. This satellite will be launched in a low earth orbit by the H-IIA class rocket. The second step is to demonstrate robotic assembly of 10MW class large scale flexible structure in space on ISS co-orbit. The third step is to build a prototype SSPS in GEO. The final step is to build commercial GW class SSPS in GEO. In parallel with these space technology demonstration, ground demonstration will be conducted step by step.

Current SSPS study undertaken by JAXA consists of three main subjects, SSPS concepts and architectures study, technology demonstration plan-making and elemental technology development. In SSPS concepts and architectures study, special committee and working groups which include 130 persons participate from industrial, administrative and academic sectors are organized. In this study, system concepts and architectures of commercial type of M-SSPS and L-SSPS has been studied for years. A major focus is on identifying system concepts, architectures and key technologies that may ultimately produce a practical and economical energy source. In the study of technology demonstration plan-making, system design of tens of kW class technology demonstration satellite and ground energy transmission experiment are conducted. With the primary objective of demonstration of wireless energy transmission technology, long distance and high power transmission ground experiment is planned and both microwave and laser energy transmission experiment facilities were designed. These experiments will show that the high-power and long-distance microwave / laser power transmission is possible and will clarify the major challenge in system establishment. In elemental technology development study, several key technologies such as prototype of Gallium nitride material and direct solar pumping solid-state laser which are needed to be developed in appropriate R&D roadmap are investigated.

This paper presents the results of these study effort of JAXA and the most promising SSPS concepts, including their key technologies.