

SPACE POWER SYMPOSIUM (C3)
Space-Based Solar Power Architectures / Space & Energy Concepts (1)

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HIGH POWER ELECTRIC POWER GENERATION, TRANSMISSION AND MANAGEMENT OF
MR-SPS

Abstract

Space Power Satellite (SPS) is a huge spacecraft to utilize solar energy in space. Because of the huge size, immense mass and high power, there exist many technical difficulties. The Multi-Rotary joints SPS (MR-SPS) is a new non-concentrator concept proposed by CAST in 2015. The important innovation is that the huge solar array is replaced by many separate small solar sub-arrays and each has two middle power rotary joints. So the intractable technical difficulty of the high power rotary joint is simplified by many middle power rotary joints and the single-point failure problem existing in traditional SPS concept is avoided. For a GW class SPS system, the generated electric power in space will be over 2GW, the area of solar cells will be several km square. The high power electric power generation, transmission and management in space is a huge challenge. In the paper, the primary scheme of MR-SPS concept is presented and two important sub-systems, Solar Energy Collection and Conversion (SECC) sub-system, Power Transmission and Management (PTM) sub-system are introduced and the key technologies are analyzed. The SECC sub-system includes fifty solar sub-arrays. Each solar sub-array is composed of twelve solar array modules that are divided into two groups. The area of each solar sub-array is about 0.12 km². The solar sub-arrays transfer the electric power to the cables installed on the main structure of SPS by 100 middle power rotary joints. PTM sub-system combines, converts, transfers and distributes the output electric power of SECC sub-systems. Most power is transferred to two high-power electric power interfaces of the antenna so that the electric power is distributed in the antenna. The remaining power is transferred and distributed to the platform devices of SPS for normal operation of SPS. The mix of distributed and centralized high voltage PTM is adopted to meet the requirement of electric power supply of the electric devices on SPS. The key technologies need to be researched and solved include high efficient, long life thin film GaAs solar cell, ultra large high voltage (500V) solar sub-array, high power rotary joint, ultra-high voltage (20kV), ultra-light cables, high power DC/DC converter, high power switch, etc.