SPACE POWER SYMPOSIUM (C3)
Space-Based Solar Power Architectures – New Governmental and Commercial Concepts and Ventures (1)

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MAINTENANCE SCENARIO FOR SOLAR POWER SATELLITE TO PREVENT SPACE JUNKS

Abstract

The operational life of the Solar Power Satellite (SPS) is usually considered to be 30-40 years. However the disposal plan after expiration of life has not been well studied. This paper describes the engineering life analysis based on the radiation environment plus the probability of hyper-velocity impacts, and maintenance scenario to keep the performance of power plant without generating space junks. The SSPS basic model (tethered SPS) is used for this study. If we set the allowable degradation at 10 % in the operational life; 5 % for radiation degradation and 5 % for impact loss, 40 years life is expected in the following conditions; (1) photovoltaic cells with high radiation-resistance (5% degradation at 1x1016/cm2 (1 MeV electron equivalent fluences)), (2) tether wires (tape tether) of more than 15 mm wide, which will not severed by one hyper-velocity impact of a particulate less than 1 mm diameter, (3) modularized structure for the sandwich panel with a unit size less than 10 cm x 10 cm, beyond that the impact damage does not propagate. In the maintenance scenario, an inverse process of initial construction, a new unit (100 m x 95 m, 45 MT) is transported to the geostationary orbit from the ground and is exchanged for a degraded unit, and then the degraded unit is transported to the ground for recovery. This operation starts around the end of life and the refurbishment is completed in a year same as the initial construction. This procedure guaranties that space junks are not generated in the maintenance operation. For this scenario, each unit needs to be designed capable of folding/unfolding automatically and detachment/ attachment to the main plant using robotics. This scenario is heavily dependent on the space transportation system between the ground and orbit, that requires reusable launch vehicles (RLV) and orbit transfer vehicles (OTV) at low cost.