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HIGH VOLTAGE SOLAR ARRAY TECHNOLOGY FOR LEO PLASMA ENVIRONMENT: LABORATORY TEST RESULTS

Abstract

In order to create lighter and more efficient solar array, one possible approach is to build high-voltage solar arrays. In china, the manmade space station calls for high voltage power generation and transmission to minimize the energy loss during power transmission. Higher voltage solar array offers more power for less mass-due to reduced resistive (I2R) losses in conductors that carry lower currents but deliver the same power (Power=Current Voltage). Unfortunately, the efficiency gains of operating at high voltage can be offset by solar array charging problems. Nowhere is this trade-off between system efficiency and spacecraft charging more evident than in the case of high voltage solar arrays operating in a plasma environment. When a solar array generates electricity in LEO, most of the voltage becomes negative with respect to the surrounding plasma, the electric field near triple junction, where interconnector, adhesive and vacuum meet together is enhanced and an arc occurs. An arc on solar array surface is usually a pulse of current whose energy is supplied by the electrostatic energy stored on the glass surface. Such an arc is often called primary arc. Moreover, a single arc might shorten momentary the array circuit and the current flows for a much longer time than a primary arc, called secondary arc. A secondary arc might lead to short-circuit in the solar array circuit. It is now known that an arc occurs once an array has a negative potential as low as100V with respect to plasma. In this paper, an electrostatic discharge test system was setup, the high-voltage discharge test data will support the designing of high voltage solar arrays.