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IMPACT ON SOLAR ARRAY PERFORMANCE DUE TO PLUME IMPINGEMENT ON SATELLITES

Abstract

The space solar arrays are the best source for energizing the power system for any satellite which cannot wholly depend upon batteries to perform all on-board tasks. Therefore, requisite is that the efficiency of panels at the End of Life (EOL) shall not drop excessively. Thus, the study of plume impingement is often needed to estimate the lifetime of a spacecraft which uses a robust Propulsion System. The plume impinges on the neighboring surfaces which affects the performance of the structure and the panel. The study is done for the Mission SRMSAT-3: An Autonomous Rendezvous and Docking Mission for Nano-satellite that intends to dock Autonomously a Chaser with the Target satellite in the near-earth circular orbit at approximately 500 Km altitude. The power requirement is estimated to be 30 Watts and hence the Electrical Power System of the satellite cannot be compensated due to variable impinging effects.

The Chaser hosts an active Propulsion System that is designed to be efficient with least impinging effects. Consequently, the nozzle positioning plays an important role in assessing the total plume flow and heat flow over the entire surface of the satellite. Due to design constraints the Chaser consists of a nozzle positioned on the body-mounted panel face which will be needed during the Docking phase for ne manoeuvres. Impingement may also be complemented by the other nozzles placed on the adjacent faces. Moreover, due to heavy power demand, deployable solar panels are employed on the structure which prompts more impinging surface. These effects are often unavoidable due to the unrestricted spreading of the gas. Hence, we perform a comparative study to recognize the propellant with lesser potential heating load, and contamination on the exposed satellite components which can especially degrade the optical properties and performance of solar panel. The contamination from out gassing and propulsion plume will result in the degradation in optical properties of the cover glass. The heat flow due to impingement causes thermo-elastic cycling which cracks the solder joints of the interconnects. Hence, the impingement effect of different propellants over the surface of the solar panels will be presented in this paper.