SPACE DEBRIS SYMPOSIUM (A6)
Modeling and Risk Analysis (2)

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NAK RELEASE MODEL FOR MASTER-2009

Abstract

Sodium-potassium droplets from the primary coolant loop of Russian orbital reactors have been released into space. These droplets are called NaK droplets. Sixteen nuclear powered RORSATs launched between 1980 and 1988 activated a reactor core ejection system, mostly between 900 km and 950 km altitude. The core ejection causes an opening of the primary coolant loop. The liquid coolant consists of eutectic sodium-potassium alloy and has been released into space during these core ejections. The NaK coolant has been forming droplets up to a diameter of 5.5 cm. NaK droplets have been modeled before in ESA's MASTER Debris and Meteoroid Environment Model. The approach is currently revised for the MASTER-2009 upgrade. A mathematical improvement is introduced by substituting the current size distribution function by a modified Rosin-Rammler equation. A bimodal size distribution is derived which is based on a modified mass based Rosin-Rammler equation. The equation is modified by truncating the size range and normalizing over the finite range between the size limits of the smallest and the biggest droplet. The parameters of the model are introduced and discussed. For the validation of the NaK release model, sixteen release events are simulated. The resulting size distribution is compared with radar measurement data. The size distribution model fits well with revised published measurement data of radar observations. Results of orbit propagation simulation runs are presented in terms of spatial density.