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MATHEMATICAL MODELS OF THE SAFETY ASSESSMENT OF GROUND FACILITIES IN CASE
OF FAILURE OF THE LAUNCH VEHICLE EQUIPPED WITH ON-BOARD AUTOMATIC
EMERGENCY ENGINE SHUTDOWN

Abstract

Trails of launch vehicles (LV) and the surrounding areas are areas of potential danger due to possible failures on the LV boost phase. The main part of the task of ensuring LV flight safety is to assess the risks of people and the various ground facilities located along the route of excretion and the surrounding areas. To ensure the security of ground facilities in case of an accident on the flight stage LV are equipped with special safety systems. Historically, LV developed by the Yuzhnoye SDO are equipped with an automatic safety system, which provides the emergency engine shutdown (EES) in case of an emergency condition. This leads to the limitation of emergency LV falling areas. The report presents the mathematical models of safety performance (probability of falling in the emergency LV ground object, individual risk) assessment in case of an emergency LV equipped with standard EES system developed by the author. Firstly, the author suggesting to take into account different sorts of LV failure, leading to the accident. The set of failures on the flight stage suggested dividing into two groups. The first group consist failures occurring almost immediately, which leads to the nullification of thrust and fall of an emergency LV (e.g., failure LRE). The second group includes failures that lead to loss of stability and LV deviation from the regular flight path (e.g., failure of the steering motor, one or more steering drives). In view of the failure graduation and the logic of the EES system mathematical model of the ground objects risk assessment was made. Second, in case of a LV accident in the initial part of the flight, LV developed by Yuzhnoye SDO provides EES lock to improve the safety of the launch complex. As part of the report, the development of the constructed models of safety assessment, taking into account EES lockout in the initial part of the flight, was shown. The report for the LV developed by the Yuzhnoye SDO shows the practical use of the developed models of the safety assessment.