

RELIABILITY AND SAFETY OF LAUNCH COMPLEXES

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This paper is concerned with the reliability and safety of launch complexes. The problems to be solved in launch complex reliability evaluation are identified: calculations of the probability of no-failure operation of passive redundancy systems with equal- and nonequal-reliability elements, reliability analysis for replacement redundancy with integer multiplicity and unloaded reserve; calculations of the probability of no-failure operation of the launch complex components in launch preparation, and calculations of the reliability indices of a component part as a whole and a comparison of the calculated reliability indices with the specification requirements. Since a launch complex consists both of renewable elements and of nonrenewable ones, the reliability indices must be calculated so that one may evaluate the reliability both of individual elements and of a system of different-type elements as a whole. These indices are characterized by the nonfailure operation time and recovery time distributions and show the probability of serviceable state or a failure state of an element and a system. On condition that the nonfailure operation time and the recovery time can be described by the Weibull distribution, expressions are obtained for the availability factor, i.e., the probability of the launch complex being operative at an arbitrary time, except for scheduled periods during which the launch complex is not envisaged for use. Launch complex safety is evaluated by the probability of hazards, the identification of main ways to mitigate their consequences, and account for weight of the consequences of possible hazards in service. Launch complex safety indices are identified. It is shown that safety must be evaluated using indices suitable for the practical solution of problems of the justification and assurance of specified safety requirements against possible threats in the development of launch complexes. The adopted safety index is the probability that each hazard that occurs in a certain time will be eliminated. A renewal process is used to describe a random number of hazard occurrences. To determine the hazard frequency, it is recommended to use statistical data on launch complex accident rate and reliability, logical methods of event tree and fault tree analysis, accident simulation models, and expert judgments.

Keywords: *launch complexes, launch vehicles, reliability indices, safety indices, Weibull distribution.*

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