

42nd SYMPOSIUM ON SAFETY AND QUALITY IN SPACE ACTIVITIES (D5)
From Parts to Systems : Contribution of Tests on Performance Prediction and Assessment (1)

Author: Dr. Vadim Kadzhaev

Design Bureau of General Machine-Building (KBOM), Russian Federation, senchen@kbom.msk.ru

Prof. Igor V. Barmin

Center for Ground-Based Space Infrastructure Facilities Operation, Russian Federation,
barminkbom@mail.ru

Mr. Jean-Yves Denoyers

Arianespace, France, jean-yves.denoyers@cnes.fr

Mr. Alain Rogot

Centre National d'Etudes Spatiales (CNES), France, jean-yves.denoyers@cnes.fr

THE ENSURING OF AN ACCEPTABLE LEVEL OF RELIABILITY AND SAFETY OF LAUNCH
SYSTEM IN "SOYUZ AT CSG" PROJECT

Abstract

The quality and efficiency of space programs is mainly sustains by reliability and safety of acceptable level. These factors acquire the most important issue on the stage of launch preparation, when all objects of rocket-space complex gather on launch site and start to interact. The presence of managing personnel increases demands to reliability and safety, what is specially emphasized in the "Soyuz" project. Risks are mainly characterized by probability and potential dangerous events. To eliminate the risks one should ensure the values of reliability and safety that are significantly higher than potential risks values. To find out these values we firstly calculate a "reliability a priori", using data of tests performed according Bernoulli method and mathematical models of Poisson's or Exponential laws distribution. It is important not only to evaluate the risks, but also to get the expected result. The values pointed above, reach usually 0.98. However some of the risks are lower than $1 \cdot 10^{-6}$. Therefore this gap needs to be filled in. Probability is quantitative measure of possibility of casual events, i.e. it is a case that can or can not occur. For improving the undesirable situation, the technological processes and "safety barriers" are used. The technology is based on analysis of "failures tree" and on results of functional tests. That allows eliminating the unfavorable hypothesis and making evaluation "reliability a posteriori" using Bayes equation. The value of the reliability increases up to 0.9999 as typical example of evolution. The cyclic operation of launch system (4 launches per year) allows performing high quality reparation that provides the "immediate readiness" and allows to accept the "simple Poisson's flow" as the model of casual process. To block potential dangerous outcomes conditions, we use "safety barriers", which further decrease the possibility of these fear events (by 3 to 6 order of magnitude) and give the solution.