

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Future Space Transportation Systems (4)

Author: Mr. Aleksey Romashkin

Central Research Institute for Machine Building (JSC TSNIIMASH), Russian Federation,  
ram@tsniimash.ru

Dr. Nikolai Panichkin

Central Research Institute for Machine Building (JSC TSNIIMASH), Russian Federation,  
corp@tsniimash.ru

Mr. Yuri Gusev

TSNIIMASH, Russian Federation, uggusev@mail.ru

Ms. Alla Serikova

Central Research Institute for Machine Building (JSC TSNIIMASH), Russian Federation, Alla7371@ya.ru

Dr. Anton Kolozevnyy

TSNIIMASH, Russian Federation, Anton.Kolozevnyy@tsniimash.ru

ANALYSIS OF UTILIZATION EFFICIENCY OF SPACE LAUNCH VEHICLE WITH REUSABLE  
FIRST STAGE IN SPACE ACTIVITY

**Abstract**

Currently basically all space-faring nations are actively engaged in developing advanced space launch vehicles. Today a qualitatively new phase of rocket and space industry development is supposed. Namely, it is intended to realize new space projects, such as development of advanced launch vehicles and space manned transportation systems. One of the problems is selection of an optimal fleet of space launch vehicles and in the future development of space systems for exploration of Moon, Mars, and other planets and bodies of the Universe. The projects include development of a national advanced reusable rocket and space system at the first development stage based on the space launch vehicle with a reusable recoverable first stage (Russian abbreviation – MRKS). The reusable recoverable rocket and space system comprises a Reusable Space Launch Vehicle (MRKN), Ground Infrastructure with a Launch Complex (LC), Technical Complex (TC), Landing Complex for winged reusable first stage modules, Turnaround Servicing Complex, Instrumentation Complex, Information Acquisition and Processing Complex, Transport Vehicle Park. The MRKN technical configuration is identified as a partially reusable heavy vertical-take-off launch vehicle derived from an aircraft-type winged reusable first stage recovered to the launch site for horizontal landing at an aerodrome and expendable second stages and boosters. The winged reusable module of the first stage is equipped with a reusable sustainer LPREs. Thus MKRS-1 is a capability for launching new-generation spacecraft, which due to its qualitatively new development and operation principles would enable to ensure a high reliability and safety level and to refuse separated part impact areas which in its turn would enhance efficiency of future commercial program realization. The mentioned principles are extremely valuable for Russia, as the only world country with existing and future space launch sites located within the continent. The given paper devoted to the analysis of the MKRS efficiency with due regard for the space activity assumes: 1. Assessment of the degree of effects of the MKTS and ordinary launch capabilities design parameters on PL orbit insertion efficiency based on a set of criteria. 2. Assessment of the key problems associated with MKRS development elaboration of proposals for solving the problems including the following aspects: - reusable propulsion systems; - turnaround servicing of recoverable first stages; - reusable cryogenic propellant tank sections. The obtained results may be used for assessing

the feasibility of advanced launch vehicles development including development within the framework of international space projects.