

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Technologies (5)

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SYSTEM DESIGN OF REUSABLE SOUNDING ROCKET

Abstract

Recently, in spite of existence of many launch demands for scientific researches using sounding rockets, opportunities of launches are actually restricted because of, for example, high-cost of launches, long period of launch preparations, etc. In order to make the opportunities of launches more frequent and the access to space much more affordable, a fully reusable sounding rocket is proposed.

The reusable sounding rocket is designed for observations of atmospheric phenomena, micro-gravity experiments, and so on. It is capable to reach more than 100km in altitude and safely return to the launch site. It also has a 24 hour turn-around capability to offer the second chance for scientific observations. It is considered to be operated in Uchinoura Space Center Japan, where the current sounding rocket is operated. However, the vehicle and most of the ground systems are considered to be transportable, which will give potential to operate on other sites. We consider the reusable sounding rocket should bring significant changes on scientific observations, by its capabilities. Also, it will be Japan's first opportunity to operate an operational reusable launch system, and we expect to obtain knowledge for future RLV.

In terms of system configuration, key features are the following; 1) 14m high and has 3m of fuselage width, 2) gross weight of 11tons, 3) LOX/LH2 propulsion system with four 40 kN engines, 4) vertical take-off and landing, 5) abort capability on single engine failure. Vertical take-off and landing is selected from the consideration on operating in Japan, where the land, which enables a 24 hour turn-around operation for horizontal landing is very limited. Also, from range safety considerations, the vehicle has the downrange capability of more than 30km on reentry. Downrange capability is realized by nose-first entry. Therefore, the vehicle conducts a turn over maneuver, before the reignition of engines for landing.

To realize this system, there are several technical challenges; the controllability of the turn over maneuver, and propellant management during the turn over, as well as, transient condition on engine failure, are the typical ones. Mitsubishi Heavy Industries is conducting a system study and R&D on critical technologies, such as propellant managements, under Japan Aerospace Exploration Agency. This paper describes the current status of system design on the reusable sounding rocket. Also, status of research and development are mentioned.