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Author: Dr. Dana Andrews
United States

Mr. Roger X. Lenard
LPS, United States

A FULLY REUSABLE LOX-METHANE ORBITAL VEHICLE COUPLED WITH A MEO TETHER

Abstract

Developing a fully reusable, single-stage-to-orbit (SSTO) has been the objective of many programs. The issues with such a vehicle are replete with risk. The three primary problems are a large DV required to achieve orbit, the second is thermal management on the outbound as well as the return legs of the journey. The third problem is the required mass fraction. All of these problems are interrelated, of course. The first problem is bounded at first glance by physics, in other words, orbital velocity is what it is, and it cannot be overcome. However, the concept of a Mid-Earth Orbiting tether system offers the ability to reduce the required DV by 3 km/s, which, for a fully reusable SSTO vehicle is huge. The thermal management issues on the outbound and return legs are similarly reduced.

This and a companion paper describing the MEO tether will define a launch system whose primary payload could be nuclear waste disposal to the Moon. In the United States, a nuclear waste trust fund has been established since the advent of the commercial nuclear age, and by now is many billions of dollars. However, the available fiscal envelope for nuclear waste disposal is not unlimited, and launch costs must be restricted in order for the concept to have some traction. Notwithstanding cost, safety will be the paramount issue. The worst failure mode for a nuclear waste payload is to almost make it to orbit, where the waste can come down anywhere along the ground track. When launching to a MEO tether the nuclear waste gets to orbit only when grappled by the tether, so any failure in the launch system results in an abbreviated reentry into known, controlled impact areas. There is no possibility of widely dispersing the waste. This launch system must come close to achieving launch reliability factors commensurate with commercial aviation. The combination of the MEO tether and a reduced DV fully reusable launch system that integrates with it may have the chance to achieve these reliabilities because the system demands can be much lower. We investigate this integrated option for nuclear waste disposal missions.