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SYMPOSIUM ON COMMERCIAL SPACEFLIGHT SAFETY ISSUES (D6)
Commercial Point-to-Point Safety & Insurance Issues (2-D2.9)

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THE ROCKETPLANE XS-1 MACH 12 SUBORBITAL SPACEPLANE - A CASE STUDY FOR HIGH SPEED POINT TO POINT TRANSPORTATION SAFETY & OPERATIONAL ISSUES

Abstract

The US Defense Advanced Research Projects Agency (DARPA) has begun the Phase I preliminary design competition for a breakthrough in reusable launch vehicle technology intended to lower the cost of launch for small (1-2 ton) LEO payloads by an order of magnitude. The DARPA XS-1 program intends to achieve this disruptive reduction in launch costs by developing a reusable first stage spaceplane with aircraft-like operational characteristics while using a low cost expendable upper stage to reach orbit. The XS-1 spaceplane requirement is to fly at least to a Mach 10 velocity in a suborbital trajectory and be able to fly 10 times in 10 days.

Rocketplane Global, LLC (RGL) has submitted a proposal to DARPA for its Mach 12 spaceplane design, based on a 20 year legacy of systems engineering for a variety of high Mach suborbital spaceplanes. The Rocketplane XS-1 spaceplane is a winged horizontal takeoff and landing configuration using military turbofans for takeoff and landing and a LOX / kerosene rocket engine for the main propulsion on the zoom climb to a Mach 12 140km apogee. For satellite launch missions, the payload bay doors open to release the payload with an attached upper stage which takes the satellite to orbit.

For terrestrial Point to Point missions, a pressurized cargo module would be installed in the payload bay and the trajectory would be depressed to a 45 degree ascent angle to maximize downrange flight distance. A 5,000 km to 6,000 km vehicle range becomes possible with the XS-1 technology, and the hypersonic velocity means that total time from takeoff to landing is less than 90 minutes. This provides a technical framework to look at P2P flight services starting in 2020.

A key enabling technology for this system is the use of a KDC-10 tanker aircraft to transfer the majority of the propellant load to the spaceplane once the vehicle is in the air and flying at normal subsonic jet speed. The tanker carries the 64,000 kg of LOX plus additional kerosene to replace the fuel used by the turbofans during takeoff and the tanking maneuver. By taking off "light" with only a fraction of the fuel and oxidizer required and then transferring this propellant load in flight, the vehicle dry mass fraction challenges are greatly reduced.

This paper will examine the flight safety and operational issues associated with hypersonic suborbital spaceplanes flying from existing airports on international routes.