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THE REUSABILITY FLIGHT EXPERIMENT – REFEX: FLIGHT SAFETY, LAUNCH CAMPAIGN & LOGISTICS

Abstract

The launch campaign of the Reusability Flight Experiment (ReFEx) at Koonibba Test Range (KTR) scheduled for 2024 is fast approaching. It is aimed at demonstrating technologies necessary for an aerodynamically controlled return of a reusable launch vehicle (RLV) stage. ReFEx has been in development at the German Aerospace Center (DLR) since 2018 and is currently in final integration at the Institute of Space Systems in Bremen, Germany. ReFEx has a mass of around 400 kg, a length of 2.7 m and deployable wings with a span of 1.1 m. It will be launched on an unguided VSB – 30 sounding rocket, reaching velocities of up to Mach 5 and an altitude of around 135 km on a suborbital trajectory, representative of a returning first stage. A key demonstration goal is the maneuverability at hypersonic velocities to facilitate a return toward the launch site, conserving as much energy as possible for the return journey. To this end a minimum heading change of 30 with respect to the entry interface is required. This does not only provide valuable flight data at the other end of the spectrum for RLVs (Reusable Launch Vehicle) from propulsive return flights, but also adds capability with very flexible divert capabilities (which are calculated autonomously ad-hoc on board the vehicle). A key factor for such a flight experiment of an unproven vehicle is flight safety and how it can be achieved with the given regulatory framework of the nation/agency providing the test range (in this case Australia). Working together with Southern Launch as the partner for KTR and interface to the Australian Space Agency (ASA) and the DLR Mobile Rocket Base (MORABA) as the projects launch service provider, proved invaluable to solve the complex technical, regulatory and logistical challenges. Besides giving an update on the current status of the experiment, this paper will shed some light on the processes and analyses involved. In particular how the process of using a FMECA to derive vehicle failure response modes (FRMs), which in turn can be used in Monte-Carlo (MC) trajectory analyses to calculate the associated risks to people on the ground. In addition, the infrastructure on the ground is critical in this process, providing valuable information (vehicle tracking and data) to be able to make the right decisions with regards to safety. Hence, the infrastructure and its associated logistics for the launch campaign will be described.