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From the ground to DREAM ON: ground support equipment to new PERSEUS bi-liquid demonstrator

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Abstract

The CNES and the PERSEUS project are at the service of students in order to help them become game changers. The ambitious ground and flight segment implemented in the program both contribute to the development of innovative technologies, and are in line with the CNES strategy for space transportation systems. PERSEUS project has the long term objective to launch a 5km apogee bi-fluid rocket and retrieve for reuse, a LOX/CH₄ propelled rocket through DREAM-ON challenge.

Over the next 2 years the PERSEUS project will essentially work on the project's next generation of sounding rockets, called ASTREOS. This is a demonstrator of a recoverable first stage, including the associated Ground segment. The ground segment, or "stage 0", is a large part of ASTREOS overall development and design. Due to the bi-liquid propulsion (ethanol and liquid oxygen in first version of ASTREOS) used for the first time in the framework of PERSEUS, fluid ground support equipment (FGSE) has been designed with the help of our partner Ariane Group and its expertise in Vernon site. The ground segment is at the heart of the launch autonomy objective, from ESRANGE or CSG, set by PERSEUS in order not to depend on the equipment and limitations of the ground base in the future launch campaign.

Aligned with this PERSEUS objectives and roadmap, ground segment equipment is becoming more and more important in the overall development of PERSEUS project.

The ground segment developed within the PERSEUS program is fully modular and adaptable. The roadmap from ASTREOS-1 to DREAM-ON is planning to launch one rocket per year at least and increase technology and complexity launch after launch.

The main requirement of the ground segment definition inside PERSEUS is the flexibility and the mobility of the equipment. PERSEUS ground segment is fully mobile contrary to standard launch. Moreover the ground segment has been designed as modular as possible: it aims to require a short time to adapt to all new innovations of the ASTREOS versions keeping a quality of service of all necessary functions.

The solution to this problem has been managed to develop several products with a modular evolution planned in every technology choices. For each product a main trade off has been made in order to anticipate future evolution and the possibility to upgrade the product after each launch campaign.

The ground segment has been split in 5 main products fully modular:

- A mobile launch rail
- A transport and connection vehicle
- A ground station and control bench of the ground equipment
- A fluid ground support equipment
- A flight safety support

All these products will interface with launch bases such as Guyana Space Center or Swedish Space Corporation, and allow the PERSEUS project to be autonomous on launch service. The article will summarize the results achieved by students and project so far.

References

[1] Fabien CHAMPALOU, David Tchoukien, « The 5th element: Modular ground support equipment to new PERSEUS bi-liquid launcher », paper EUCASS 2022