



REXUS / BEXUS

Experiment Preliminary Design Review

Flight: BEXUS 26

Payload Manager: TBC

Experiment: TUBULAR

Location: SSC, Esrange Space Center, Sweden **Date:** 6th Feb. 2018

1. Review Board members

Stefan Kramer, SSC (chair)
 Veronica Botti (minutes)
 Giorgio Parzianello, ESA
 Koen Debeule, ESA
 Simon Mawn, ZARM
 Dieter Bischoff, ZARM

Katharina Schuetttauf, DLR MORABA
 Maria Holmström, SSC
 Klas Nehrman, SSC
 Jörgen Blomberg, SSC
 Juha Keinström, SSC
 Jianning, Li SSC

2. Experiment Team members

Gustav Dyrssen
 Jordi Coll Ortega
 Natalie Lawton
 Nuria Agües Paszkowsky
 Hamad Siddiqi
 Muhammad Ansyar Rafi Putra
 Pau Molas Roca

3. General Comments

- Presentation
 - The presentation was clear and well done.
- SED
 - In general, the SED was well done and appreciated by the panel.
 - The team should clarify better the objectives.
 - In general, the team should include more labelled diagrams instead of long pages of text.

4. Panel Comments and Recommendations

- Requirements and constraints (SED chapter 2)
 - There are too many functional requirements. The team should reduce them.
 - The requirements F16 to F27 do not need to be listed.
 - The team shall add a performance requirement about the volume of air to analyse.
 - The requirements P16 to P22 are all design requirements.
 - For the requirement P16 the team should specify the altitude.
 - The design requirement D8 is fine, but the team should remember that that 374Wh is the capacity of the battery at nominal temperature and with a current draw of 0.1A. A more typical capacity of 7Ah (196 Wh).
 - Regarding the design requirement D13 the team might expect the experiment environment to be below -30C.
 - The constraints listed in the SED are not real constraints.

- **Mechanics**
 - The team should consider also the locations and accessibility of the external electronic interface.
 - The team should think about a solution to access the experiment without taking it off from the gondola.
 - The set-up of the box needs to be re-discussed.
 - The team should consider a thermal insulation for the experiment since the experiment is drawing cold air from the environment.
 - The team should check the capability of the pump is enough to suck the required amount of air.
- **Electronics and data management** (SED chapter 4.2.2, 4.2.3, 4.5, 4.7, 4.9)
 - A consumption of 1 mA is underestimated.
 - The team should check how to connect the device to the microcontroller and choose a possible interface.
 - To reduce the voltage to that required the team shall use a DC/DC converter.
- **Thermal** (SED chapter 4.2.4 & 4.6)
 - The team should perform a thermal analysis of the experiment, especially considering that the experiment will suck very cold air from the external environment.
 - The team should finish to list the temperature ranges of the components.
 - The team should clarify which temperature they need inside the box.
 - The team should find an alternative solution to access the experiment in order to prevent unwanted openings of the box.
- **Software** (SED chapter 4.8)
 - The software design was well done.
 - The team should consider to perform some manual actions on the experiment. The experiment does not need to be all automatized.
 - If the team wants to keep the triggered watchdog, all the events should be activated from the beginning of the countdown. Maybe it's better to remove the watchdog.
- **Verification and testing** (SED chapter 5)
 - The verification matrix must be reviewed.
 - In general, not everything can be verified by test. Test is often proceeded by an analysis or review.
 - The team should make sure that the test really covers the requirement. M
 - any requirements point to the same test so a detailed test plan will be needed to ensure the test specifically addresses that requirement.
 - In some cases, it might be better to split out separate tests.
 - The team should add a test to verify the functioning of the pumping system.
 - The team should verify that the pump is able to produce the required velocity with such a small delta-p.
 - It's very important for the team to test the opening and closing of the valves.
- **Safety and risk analysis** (SED chapter 3.5)
 - The team, in general, should review the risk register.
 - In general, the risks are underestimated.
 - The team should foresee some managerial risks, such as the risk of someone leaving the team.
 - The team should consider as a major risk the partnership with the Finnish.
 - The team should consider as a major risk also the use of the single pump. This should be ordered early and tested and maybe it would be better to order at least two pumps.
- **Launch and operations** (SED chapter 6)
 - The chapter was well done, however the team should add more information about the recovery, since it is a critical part of the experiment.
 - The team should clarify where did they get the data about balloon descent rate.
 - The team should specify why they cannot flush on the ground.
 - The team should clarify whether the valve operation is linked to time or altitude.

- Organisation, project planning & outreach (SED chapters 3.1, 3.2, 3.3 & 3.4)
 - The team should clarify the work packages and specific tasks of each team member in the WBS.
 - The Gantt chart is too basic and should be refined.
 - There is no mapping of team availability over the project period to the work required.
 - The team should clarify whether the project is part of a course.
 - The budget description is too basic. The team should describe all the costs and clarify better what is already covered and what needs to be covered.
 - The outreach plan is good but not implemented yet. The team should create soon a webpage and a page in different social media.

5. Internal Panel Discussion

- Summary of main actions for the experiment team
 - The team should verify that the bags and the pump work properly before the CDR.
 - The team should review the Requirements and Constraints section.
 - The team should further develop and document their electronics design.
 - The team should provide a more defined thermal analysis.
 - The team should improve the management section.
- PDR Result: conditional pass
- Next SED version due: v1-2, 12th March 2018