REXUS / BEXUS
Experiment Preliminary Design Review

Flight:	BEXUS 30
Payload Manager:	TBC
Experiment:	BoB
Location:	**Webconference** **Date:** 13 May 2020

1. Review Board members

DLR Agency:
- ███████████

DLR MORABA:
- ██████████████

ESA:
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SNSA:
- █████████████

SSC:
- ████████████████
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ZARM:
- ██████████
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2. Experiment Team members
- ██████████
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3. General Comments

- **PRESENTATION**
  - Slides contained a lot information. Sometimes too much for being able to catch them all.

- **STUDENT EXPERIMENT DOCUMENTATION**
  - Section 7 should be updated.
  - **ACTION 1**: The team shall remove the reference to REXUS when it is not applicable to BEXUS (e.g. REXUS User Manual or specify why is it a needed reference).

4. Panel Comments and Recommendations

- **EDITORIAL**
  - **ACTION 2**: The team shall remove the blank pages. **(PDR ACTION 2)**
  - **ACTION 3**: The team shall use the document naming convention "BX30_BoB_SED_v2-0_28Apr20".
  - **ACTION 4**: The team shall change document type to "SED". **(PDR ACTION 3)**
  - **ACTION 5**: The team shall remove "Name of the person/s who approved the document" below the "Approved by" section on the front page.

- **ACTION 6**: The team shall correct the content table (i.e. start a new page for it, remove "Table des matières", etc).
- **ACTION 7**: The team shall be careful when exporting the document not to export the comments done. With word the team shall click on: Export > Create PDF/XPS > Options > In section "Publish what", select "Document" instead of "Document showing markup".
- **ACTION 8**: The team should improve the aesthetic quality of tables such as Table 1-2 or 5-2.
- **ACTION 9**: The team may include pictures of team members.
- **ACTION 10**: The team shall add "SNSA" ad "SSC" in the abbreviations list.

- **REQUIREMENTS AND CONSTRAINTS** (SED chapter 2)
  - **ACTION 11**: The team shall correct the sentence "00 000 (6 numbers to identify the requirements)" and change it to "00 000 (5 numbers to identify the requirements)".
  - **ACTION 12**: The team shall let the header of the requirements table visible (Requirement ID, Description, Work Package).
  - The team may avoid obvious statement in Functional Requirements.
  - **ACTION 13**: The team shall not combine range, uncertainty and frequency requirements e.g. PR-04-100C/200C, PR-05-100C/200C, PR-06-101C, PR-08-200C. Global ranges (or uncertainties) are usually verified during the same analysis or test by means of different parameters or test set-up.
  - The team may combine flight environment requirements such as DG-11-100C and DG-11-101C into "The experiment shall operate nominally within the temperature profile of a BEXUS flight" or similar.
  - Power use, dissipation, average current, peak current, etc. could be added to design requirements and will be needed for another platform
  - (DG-04-300C) The team is focusing on the wrong direction since it depends on the type of attachment.
  - **ACTION 14**: (DG-04-400C) The team shall detail and provide values enabling the compliance with the Swedish law on pressure vessel.
  - As the team is expecting to move further on with the experiment to other platforms, some constraints may be added.

- **MECHANICS**
  - **ACTION 15**: The team shall ensure that Table 4-6 and Table 6-1 are similar (i.e. same conventions, values, etc).
  - The team should consider vibration especially during the parachute opening. The distance between the clamps and the housing is not optimal to carry forces/accelerations from the sides.
  - **ACTION 16**: The team shall provide an attachment spot for fixating a security cable.
  - The team is recommended to use self-locking nuts and locking pin and provide a checklist to ensure the experiment is attached in a proper manner.
  - **ACTION 17**: The team shall provide more detail on the welding to be done one the pressure vessel. How will it be realised? Who will be responsible for welding it? Etc.
  - The team is highly recommended to use O-ring sealing rather than gaskets.
  - **ACTION 18**: The team shall make clear how the 50pin vacuum feedthrough will be realised. The team is advice to buy a flange including this feedthrough and manufacture out of the surrounding material lid. The team should contact Dieter Bischoff (ZARM) to have further information on this point.
  - The team shall consider their need to use AL-7075-T6 which is more expensive than other alloys that could be used.
  - **ACTION 19**: The team shall make clear who will manufacture the housing and try to have components as soon as possible.
  - **ACTION 20**: The team shall ensure enough space for the electric cable connection (electrical interface).
  - **ACTION 21**: The team shall precise on which side will be placed the electrical interface.
  - **ACTION 22**: The team shall specify what is included in the presented mass. Are the clamps and attachments included?
  - The connection to the gondola are not thermally insulated.
  - **ACTION 23**: The team shall further investigate the differences shown between the two performed simulations.
  - **ACTION 24**: The team shall check the loads at interfaces.
  - **ACTION 25**: The team shall provide information on their vibration sources (please refer to the interface report and the vibration source form).

- **ELECTRONICS AND DATA MANAGEMENT** (SED chapter 4.2.2, 4.2.3, 4.5, 4.7, 4.9)
  - **ACTION 26**: The team shall build more structured schematics. It is confusing on some parts especially around the Raspberry Pi.
  - **ACTION 27**: The team shall limit the comments which do not bring value.
  - **ACTION 28**: The team shall make sure to use the correct icon and correct info.
  - The team is reminded that they shall be careful when using the GNSS module with the altitude lock.
  - **ACTION 29**: The team shall be careful with the voltage input. It is believed that the team misunderstood what would be the input voltage.
  - **ACTION 30**: The team shall consider that the ascent phase lasts around 1.5h (longer than written in the SED).
  - The team is reminded that voltage drops will lead to an increase of the current. The team may assume that for an average current of 0.5A, the battery capacity (at approx. 0C) is around 9Ah, and the voltage will be approx. 26.5V, with a low of 25.5V at 1.1A.
  - The waiting time on batteries of 5 hours on ground taken into account for power consumption will not happen (section 4.7.1).
  - SSC/EuroLaunch can only guarantee a float duration of 1h.
  - The ADC 24 bits seems too performant compared to the need of the experiment.
  - The method to implement the ADC 24 is however consistent.
  - The team is reminded that they can find application notes to use the ADC converter with sensors on the manufacturer website.

- **ACTION 31**: The team shall be very careful when handling flat wires connector and the Raspberry Pi camera and consider if another interface would be more suitable.

- **THERMAL** (SED chapter 4.2.4 & 4.6)
  - The main loss of heat will occur by conduction during the float phase. Clamps and the aluminium housing will operate as heat bridge with the gondola.
  - **ACTION 32**: The team should consider attaching the heating foils onto critical components. If there is a leak in the pressure vessel, the heating foils would overheat (no convection).
  - **ACTION 33**: The team shall make sure to position the heaters in strategic position in respect with the thermal inertia of the experiment.
  - Heating foil should be conducted on a material with a certain heat capacity.
  - **ACTION 34**: The team could consider using black painting to keep the experiment warmer while on flight and otherwise if the sun may overheat the experiment the team may implement a covering blanket.

- **SOFTWARE** (SED chapter 4.8)
  - **ACTION 35**: The team should make possible to influence the data rate for downloading data to the ground because the bandwidth is shared with the other teams.
  - **ACTION 36**: The team shall consider generating more files during flight to improve reliability.
  - **ACTION 37**: The team may consider using journal file system.
  - The team mentioned to set up several ports and several client/server lines. The team is reminded that the Ethernet link is shared with the other teams and that each line needs a header data.
  - The download of large files can interrupt the E-link. This point is to be checked with SSC E-link expert.
  - **ACTION 38**: The team shall precise how to determine the flight phases to control the experiment (e.g. section 4.8.5.3). The team shall precise when it is supposed to act autonomously and when not.

- **VERIFICATION AND TESTING** (SED chapter 5)
  - **ACTION 39**: The team shall cross reference the verification matrix and tests (i.e. give the test ID in Table 5-2 and give the requirement reference in test plans). **(PDR ACTION 22)**
  - **ACTION 40**: The team shall make sure requirements are identical in chapter 2 and 5 (e.g. PR-04-200C).
  - Many of your functions will be reviewed by review as you are building the experiment.
  - **ACTION 41**: The team shall verify ranges and uncertainties of the circuits by analysis before even building them. It will help you debunk a lot of issues that may appear at later stage otherwise.
  - **ACTION 42**: The team shall add the thermal analysis performed in the verification matrix (i.e. you did the analysis to verify thermal requirements).
  - **ACTION 43**: The team shall rethink the use of inspection. Very often it is stated when no inspection is possible to verify the requirements (e.g. mass, transportation method).
  - If the team buy a motor with a safety circuit and encoder from Faulhauber then it is review of design and not inspection.
  - PR-10-101C: the wording is not correct, it is not a shock.
  - **ACTION 44**: (test 14) The team can perform the vibration test by placing the experiment on the back of a trailer and driving around.
  - **ACTION 45**: (test 15) The team shall perform the test with the same loading on the clamps (mounting clamp onto a square tube and hang certain masses on them).
  - **ACTION 46**: The team shall explain why they are willing to use O2 for the pressure vessel verification instead of air. The use of O2 is not recommended.

- **SAFETY AND RISK ANALYSIS** (SED chapter 3.5)
  - **ACTION 47**: The team should re-think some of the presented risks and consider if so many of them would lead to a severity of 4. Many of them would be either 3 or even 2.
  - **ACTION 48**: The team shall provide liquids quantities list as well as checklists, recovery procedures and needed storage.
  - **ACTION 49**: The team shall stay in contact with SSC for the needed forms to be filled.
  - **ACTION 50**: The team should go more in detail and explain what could happen to people on campaign for the biological contamination risk.
  - **ACTION 51**: The team should detail the contamination risk.
  - **ACTION 52**: The team should provide an ID number for the risks.
  - The thermal analysis performed allow you to reduce the risk of thermal failure.
  - **ACTION 53**: The team shall always write the cause and consequence for each risk (e.g. "Component or tool failure before launch", "Electrical component failure during launch campaign").
  - The gondola power failure is not your risk. The team should write it in a way to explain what is their risk in this situation.
  - **ACTION 54**: "Explosion of the pressure vessel in flight" The team shall add testing as mitigation action.
  - "Increase in scope and complexity of development" The statement of the risk is not clear, what is the risk here?
  - **ACTION 55**: "Pumping too cold growth media into chamber" The team shall give the current status of this risk and if it is still high.
  - **ACTION 56**: The team shall add risks related to the assembly of the experiment since it has a lot of components and mounting can be challenging.
  - **ACTION 57**: The team shall clarify what is the risk on "biological contamination breach".

- **LAUNCH AND OPERATIONS** (SED chapter 6)

- **ACTION 58**: The team shall correct the request for 2 E-link interfaces on Table 7-3.
- A data rate of 400KB/s can be accepted but need to be coordinated with all the teams download plan.
- **ACTION: SSC will verify the availability of requested biology equipment.**
- **ACTION 59**: The team should not rely on working the arrival day.
- The interference test is supposed to take place on day 3.
- Switching the experiment ON and OFF should be discussed with SSC.
- Timing for removing the RBF blanket is to be confirmed with SSC.
- **ACTION 60**: The team shall add specification of the cold storage needed (fridge, freezer), the temperature, the needed space (volume), etc.
- **ACTION 61**: The team shall precise the needed time between sterilization of the multi-chamber sample disc and the integration into the gondola.
- **ACTION 62**: The team shall precise what are the other actions TBD in the launch chronology as soon as possible.
- **ACTION 63**: The team shall prepare a procedure for bringing back the experiment to the home university.
- The timeline starts at T-4h however after the FCT the team will have a supervised access to the experiment.
- **ACTION 64**: The team shall precise what will be needed to be performed after the FCT. Do you need power after FCT? Or do you need to maintain a constant temperature? Etc.
- **ACTION 65**: The team shall specify the cold recovery needed (conditions, checklist for the recovery crew and procedure).
- **ACTION 66**: The team shall update the post flight analysis section.

- **ORGANISATION, PROJECT PLANNING & OUTREACH** (SED chapters 3.1, 3.2, 3.3 & 3.4)
  - **ACTION 67**: The team shall add a progress line to the Gantt chart. **(PDR ACTION 27)**
  - **ACTION 68**: The team shall also include the Gantt chart in the Schedule section.
  - **ACTION 69**: The team shall think of having some support on different high loaded WPs such as outreach.
  - The team will be contacted soon concerning IPR and EAR dates.
  - The campaign is now planned to start on the 9th of October.
  - **ACTION 70**: If the team still plans to start a crowdfunding campaign, the team shall try to set up and advertisement plan.
  - **ACTION 71**: The team shall provide more detail on correlation between resource availability and the planning. It would give a better view of incurred delays and the transition to
  - **ACTION 72**: The team shall update the budget.
  - **ACTION 73**: The team should train a team member to handle biologic samples.
  - Website and social media were not very active so far. It is believed that the experiment however provide a great source of interest for any kind of audience and would help the team to move further on with it.
  - **ACTION 74**: The team shall add links to sponsors' and organisers' websites.

5. Internal Panel Discussion

- Summary of main actions for the experiment team
  - The download of images shall be coordinated with the other teams by the payload manager. The team shall provide enough information on measurement plans, images size and timing they are willing to achieve.
  - The team shall work on the thermal system and precise when to actuate them and prevent overheating.

- CDR Result: **PASS**
- Next SED version due: v3-0 / TBD 1 week before IPR