Reviewers Report from the LHCb SciFi cooling Techncial Review of the 11th of May 2017

Michele Battistin and Lukasz Zwalinski – 23rd of May 2017

The agenda and presentation of the review can be found in the INDICO page:

https://indico.cern.ch/event/628290/

Present persons: Olivier Crespo-Lopez, Martin Doubek, Michele Battistin, Ulrich Uwer, Antonio Pellegrino, Heinrich Schindler, Lukasz Zwalinski, Christian Joram.

Major points the reviewers have identified:

1. **Cooling system fluid** – we support idea of using Novec 649 as refrigeration fluid for the SciFi detector however the LHCb collaboration and the EN-CV-DC team shall closely follow up on the result of the material compatibility tests and filtering methods that are ongoing right now. Its results are critical for the correct selection of the cooling system components to guarantee safe long term operation.
2. **Cooling system P&ID** – it is strongly recommended that any section of pipe between two consecutive valve (manually or automatically actuated) would be equipped with a dedicated pressure relief valve. Cold liquid potentially trapped in between two valves could cause a large pressure increase because of liquid volume variation with the temperature. Brust disks shall be avoided because in case of intervention all the fluid can be lost.
3. **Cooling system controls** – the reviewers agree with the conceptual powering scheme it is in accordance with detector requirements. The communication channel to the LHCb DCS shall be discussed with LHCb experts soon to prepare required infrastructure and agree on the network paths.
4. **Cooling system design** – the system pressure rating shall be defined in the specification document according to PED standard. Any part of the cooling system shall be tested at at least 1.43 time the maximum allower pressure. The Experiment of the Detector can request a larger safety coefficient to increase the level of safety of the system (as an example, during the construction of LHC the CMS technical coordinator, Alain Herve, imposed a coefficient 4 to all pressure tests of the pipeworks). The LHCb community should decide if and what kind of instrumentation is required to monitor each cooling loop.
5. **Flex lines of the cold boxes** – there was no time to review the presentation on the cold boxes design. Clear number of the vacuum level or acceptable leak rate shall be provided. It is not clear who is responsible for the vacuum system design, production and what are the foreseen technologies to be used (what kind of vacuum pumps, permanent vacuum or constant pumping etc). The vacuum system should be well integrated with the cooling plant control and/or DCS and DSS. DSS action matrix shall be designed. It shall be defined how the correct vacuum level is monitored during the operation. It is not clear where the vacuum system will be located.
6. **Flow-rate pressure requirements** – At page 9 of the requirement presentation the ΔP of 4 bar is associated to 20 g/s flow rate. At page 12 the flow-rate requirement is 25 g/s and at page 13 the pressure drop requirement is 4 bar. The three information are not coherent and shall be

armonised. The design speed in the pipes has been set to 2.5 m/s; we suggest a deeper investigation as the standard design speed for water is 2.0 m/s and the density of the NOVEC-C6F14 is 1.7 times higher, erosion effects could be more relevant (lower viscosity plays in the good direction).

7. **Control and monitoring of the loops** – There is no requirement on the level of control/monitoring of the loops. It shall be clarified who has the rights to change the state of the system: loop on/off, main flow rate of the system, overall temperature set-point. It can be the detector control system or the EN/CV/DC personnel.
8. **Flexible vacuum lines** – it is not clear why the flexible lines are not equipped with MLI and spacers. It is advised to carry out additional test to evaluate worst case scenario for the flexible vacuum insulted lines outer surface temperature. We recommend to bend one line, painted in black, around pipe where its other diameter is adopted to bending radius of the SciFi vacuum lines. Cold liquid shall be provided. Thermal camera pictures shall be analysed to address if the proposed technical solution without multi-layer insulation and spacers is suitable one to guarantee no condensation at the other surface of the flexible line.
9. **Cooling system risk analysis** – the risk assessment exercise should be carried out.
10. **Cooling system interfacing to the detector** – the design for main flexible lines allowing for the detector opening is not done yet. Reviewers suggest to not underestimate the effort required in the engineering. This task should be addressed soon to the responsible group.
11. **Margins** - A deeper investigation of the safety margins that everybody is taking will be needed to avoid large performance oversizing of the cooling system.
12. **Leaktightness criteria –** the increased attention to the leaktightness of the system could require the adoption of another category of components. The reviewers suggest to investigate the adoption of butt-welded cryogenic valves.