HL-LHC Collimators:
Design, Engineering and Prototyping #34
Minutes

Thursday, 5th December 2019

376/1-020

Attendees: A. Bertarelli (AB), A. Infantino (AI), E. Berthome (EB), F. Carra (FC), J. Guardia (JG), L. Gentini (LG), M. Pasquali (MP), M. Sabate Gilarte (MSG), R. Key (RK)

AGENDA:

- Wrap-up on leadscrew taskforce activities (L. Gentini)
- Update on the design of masks (E. Berthome, L. Gentini)
- Update on calculation from collimators (R. Key)
- AOB

1) *Approval of minutes from previous meeting and review of action list*

Minutes reviewed and approved.

2) *Wrap-up on leadscrew taskforce activities*

LG goes through the final report about the activities of the leadscrew taskforce and the attendees propose improvements. The main comments are:

- Organise the requirements of the lead screws in a table
- Add references for the numbers stated in the report (10 MGy…)
- Clarify what is visual-manual inspection or put clear name.
- In Table 1, explain what is 0/90°. How the measured values compare with theoretical values.
- In Table 2, change 30000 cycles by >30000 cycles (tests stopped). For SKF, refer to tests done in the past with lubricant.
- Add estimation of torque from current (current-torque factor)
- Add why the test was stopped at 10400 cycles (due to maximum current reached from motor driver, how much amperes, torque…)
- Last part of the document (conclusions…), separate it in sections: Findings, recommendations & future actions
- For section "Recommendations":
    - Add flexibility to the system, less rigid, thinner screw, connection…
    - Comment the effect this would have on the movement precision
    - Other option could be to specify tighter tolerances in the design

The report will be modified to include these comments (**action L. Gentini**).

3) *Design of masks*

EB gives an overview of the current design proposal for the TCLMs masks. The updated solution features a single table for the two beam lines, as suggested by IL. The table has 3 supports for the alignment of the 2 masks present on the table.

The screwed solution has a beam pipe made of 2 halves electron-beam (EB) welded, which are produced by milling a solid Cu rod. The flanges for the pipe require brazing and EB-welding operations. The outer surfaces of the pipe are precisely machined after welding to match the required tolerances for the contact with the absorber blocks. This design is compatible both with Cu and tungsten (INERMET 180) masks. A very thin Cu pipe (even microns) is not a problem for the energy deposition, while a maximum of 3 mm must be respected for the IT180 mask. However for vacuum requirements a minimum pipe thickness of 2 mm is required. The absorber blocks are fitted around the Cu pipe in the shape of two halves, compressed by screws onto the pipe. The tolerances of this design allow fitting the absorbers with no gaps between them nor at the contact with the pipe, which is the optimum for cleaning efficiency. AB suggested that the absorber blocks could be spitted into 2 or 3 parts along the mask length in order to reduce the cost (shorter IT180 raw blocks should be cheaper). Besides, EB adds that shorter blocks can be turned more precisely.

MSG stated that, **due to cleaning efficiency requirements, TCLM 4 mask must be made in IT180 material** (Ø140 mm). **TCLM 5 and 6 masks can be made in copper** (Ø100 mm).

The copper-made masks have the main advantage of being much less expensive than the tungsten ones. Besides, a different manufacturing process could be used, by integrating the pipe and the absorber block together. In this case the parts, after machining the internal beam pipe, would have to be brazed or EB-welded to insulate the vacuum from the atmosphere. This option, compared to the screwed design, has much less machining cost and less raw material requirements. As the company producing these masks would most likely will have brazing capabilities, the brazed option is favoured over the EB one.

The proposal is therefore the IT180 screwed tungsten solution for TCL4 and the brazed Cu solution for TCL5 and TCL6 (see powerpoint presentation). Check the proposed solution **(Action S.Redaelli, I.Lamas and STI colleagues)**.

4) *Update on calculations from collimators*

RK shows updated results of simulations on RF fingers. Update simulations with higher friction, and check videos of tests on the old design which share some features (**action R.Key**).

A cycling test should be organized for January 2020 with the current design (**action L. Gentini, R. Key**). At the same time updates in the design can be studied.

AOB:

- This was the last HiColDEM with M.Pasquali's participation, as he has now left CERN. J.Guardia is replacing the secretary role.

ACTIONS

- Leadscrew taskforce report will be modified to include the comments (**action L. Gentini**).
- Check the proposed solution for the masks **(Action S.Redaelli, I.Lamas and STI colleagues)**.
- Update RF fingers simulations with higher friction, check videos of old experimental tests (**action R.Key**).
- Organise a cycling test for the RF fingers design (**action L. Gentini, R. Key**).