BLM THRESHOLDS WORKING GROUP - MINUTES

BLMTWG #81 Meeting 12.03.2021 - https://indico.cern.ch/event/1015737/
Chairs: *A.Lechner, B.Salvachua*

Participants: F.Carra, M.D'Andrea, A.Lechner, C.Hernalsteens, S.Morales, B.Salvachua, D.Wollmann, C.Wiesner

1. Recap of thermo-mechanical simulations for TCTs, Federico Carra

F.Carra presents a recap of the thermo-mechanical simulations done on the TCT collimators, based on the calculations by M.Pasquali. Two loss cases were considered, a short pulse of 40 μs (2.13e9 protons – 3.5TeV) and a steady deposition of 80 s (2.13e9 p/s – 6.5TeV). The worst case scenarios regarding the energy deposition were chosen for the study.

First scenario, 40 μs short pulse. The total energy is small, the limitation is the power density peak reaching ~ 10^{13} W/m^3. The maximum theoretical temperature is 260°C, this is not worrying as the Tungsten alloy melts at around 1500°C. What could be worrying is the strong gradient in temperature (thermomechanical stress), but the calculation showed that it is below the permanent deformation limit, confirmed by HiRadMat studies.

Second scenario, 80 s steady deposition. The power density peak is of ~10^9 W/m^3, maintained for a longer time. The maximum theoretical temperature peak is 150°C. The stress on the pipes is a bit critical but still not too problematic.

For both cases there have also been studied the energy deposition and stresses further downstream the impact point, and no issues have been identified. The stress wave losses amplitude when it propagates, so it is no relevant in components other than the inner blocks.

A.Lechner says that the scenario of 40 μs is not realistic, as the beam cannot be dumped in such a short time, so the energy deposition time would always be longer than that. He comments that it is good to see that for long running sums there could be a bit of margin in the thresholds, as in the proposal of **M.D'Andrea** the energy deposition was higher for the long running sums. **M.D'Andrea** replies that in his study he assumed a different position for the BLMs. **A.Lechner** says that a study should be done trying to understand how the thresholds would change keeping the same position as now, to see if the thresholds could be higher.

F.Carra comments that for the 80 s case, the temperature distribution in the collimator is not so far from the 0.2h beam lifetime case, hence it is of the same order of magnitude of the designed scenario. **A.Lechner** says it is an acceptable level, and it is comforting to see that the TCTs will not be damaged, and it would even be possible to increase the thresholds for the long running sums. However, one also has to take into account the steady-state background from collision debris. Once the empirical corrections for this background have been defined, the margin in the long running sums for protecting against direct proton impacts has to be reassessed. **F.Carra** says that the safety margin could be checked with FLUKA simulations.

C.Wiesner asks about the energy deposition plots shown in the presentation. **F.Carra** clarifies that the worst case among all the TCTs families is plotted for every energy, so not all profiles correspond to the same family.

A.Lechner comments that there were many corrections in the TCTs families during Run 2 and the old thresholds are outdated, as they were calculated before the LHC started. Therefore, it is better to start a new model and then apply corrections to it. **F.Carra** says that the thermomechanical studies are not very complex for certain collimators that have already been studied in the past. **A.Lechner** replies that some help could be needed with TCTs and TCLAs.

2. BLM layout at Crystal Collimators in IP7, Belen Salvachua

B.Salvachua presents the proposed BLM layout around the crystal collimators in IP7. Together with A.Lechner they point out the importance of having BLMs to interlock, considering the crystal collimators should be operational in Run 3.

This proposal has been discussed in previous meetings, notably the WP15 HL-LHC Integration Meeting (https://indico.cern.ch/event/1014314/) and the ICL Machine LHC Meeting (https://indico.cern.ch/event/1012496/).

B.Salvachua starts with a justification of this study for a new BLM layout, the main point is that they will be used operationally for ion halo cleaning.

A summary of the pre-LS2 configuration and proposed changes for the BLM layout around the four crystal collimators is presented, together with sketches of the layout, pictures taken on site and links to the videos close-up on cernbox.

- TCPCH.A4L7.B1 (Horizontal, beam 1): only update of BLM names in database.
- TCPCH.A5R7.B2 (Horizontal, beam 2): no change proposal.
- TCPCV.A6L7.B1 (Vertical, beam 2): Installation of new Ionization Chamber downstream the crystal.
- TCPCV.A6R7.B2 (Vertical, beam 2): Displacement of BLM to the yellow support downstream the crystal.

B.Salvachua comments that an ECR document which includes all the changes in the BLM layout is in preparation. It will be updated with the changes in the names of the collimators.

M.D'Andrea comments that he thinks that the name of the horizontal crystal in B2 includes only TCPC and not TCPCH. **B.Salvachua** says that once the ECR document is completed with the final name for the BLM it will be sent to the Collimation Team for revision.

D.Wollmann asks if it is actually possible to protect the crystal collimators with the BLMs. **B.Salvachua** replies that it will require some studies but having a BLM associated to the element will make these studies simpler, moreover the loss pattern will be different for protons and ions. **M.D'Andrea** agrees that the loss pattern is very different indeed.

M.D'Andrea comments that there were tests performed in HiRadMat and irradiations with neutrons that showed that there should not be much damage in the crystals.

3. AOB

B.Salvachua will prepare a presentation on the thresholds application tool to show how to check the thresholds.

After Easter, another meeting will be organized to propose and discuss ideas for the new model and new response factors. It is to be seen if the new thresholds could be higher and how to apply the corrections for the collision debris, possibly including data from Run 2.