WP14 Coordination Meeting: D1 and Q5 masks, TCDS integration

June 27th, 2017, 865-1-D17, 10:30 – 12:00

Present: C. Bracco, M. Frankl, T. Polzin, C. Wiesner, M. Atanasov

Agenda: https://indico.cern.ch/event/648065/

Energy deposition studies for D1 and Q5 masks (M. Frankl)

- Standard beams were considered in the energy deposition studies for the D1 mask and the effects on the coils as they are the worst case in terms of energy density in the D1 coils. The beams were simulated with injection energy (450 GeV) assuming the worst case scenario of an injection kicker failure (small impact on the TDIS).
- The design goal is to reduce the peak energy density in the D1 coils below a damage limit of around 50 J/cc with a sufficient margin of a factor 3.
- With the proposed mask this goal could be achieved by effectively dropping the peak energy density in the coils of about 35 J/cc without mask to approximately 13 J/cc.
- For the investigation of the energy density in the Q5 downstream of the TCDQ in case of an asynchronous beam dump a Standard beam at top energy of 7 TeV sweeping over the TCDQ was simulated. Here, type 2 erratics are the worst case. Without further protection the peak energy density in the Q5 coils is with 45 J/cc presumably close to the damage limit. Applying a mask directly upstream of the Q5-cryostat effectively decreases the peak energy density to 7 J/cc.
- Check if RP requirements are still fulfilled after implementation of the mask.

Results of ANSYS calculations for D1 mask (T. Polzin)

- Simulation of the thermo-mechanical stresses in the mask made of stainless steel SS315LN. Temperature gradient within the mask from 1.9 K to about 20 K. In the model temperatures from 4 K at the cold side due to data availability to 25 K in order to be conservative with the temperature gradient. Thermal resistance of the contact plays a minor role.
- Peak energy density of 90 J/cc leads to a temperature maximum of about 99 K.
- Chamber is free to expand axial and radial but mask is 'glued' to the chamber as conservative assumption for the stresses.
- Calculated maximal stresses are a factor 11 lower than Yield Strength (Plastification) so that there is a huge margin against permanent deformation.

- For the simulation of the mask the same steel alloy as used for the beam pipe was assumed to guarantee the same behavior in terms of thermal expansion. However, due to the high cost of SS316LN the use of another alloy with similar behavior might be reasonable.

Preliminary integration studies for 3rd TCDS block (C. Wiesner)

- Investigation of moving the 1st TCDS module upstream and integration of a 3rd module in the free space as best solution from the energy deposition point of view. Check of the aperture for circulating and extracted beams.
- If the geometry of the new setup is not sufficient it is possible to replace the blocks in the modules.
- An aperture for circulating beam of more than 6.5 sigma is fulfilled for a beta smaller than 213m. A beam energy of 450GeV is assumed.
- For the extracted beam shifting the 1st TCDS module upstream leads to an aperture of 4.2 sigma, reduced by almost 1 sigma wrt the old TCDS position (450GeV beam).