WP14 Coordination Meeting: TDIS, D1

April 25, 2017, 865-1-D17, 10:30 – 12:00

Present: C. Bracco, D. Carbajo, M. Frankl, A. Perillo Marcone, T. Polzin, C. Wiesner, L. Gentini, W. Bartmann

Agenda: https://indico.cern.ch/event/632532/

Energy deposition studies for the TDIS: update (M. Frankl)

- Comparison of the calculated peak energy density profiles and temperatures in the TDIS jaws with a recent design and the design presented at the last internal review (01/12/2016). Focus on the back-stiffenener, higher-Z absorber blocks and cooling pipes. Simulation results considering the most recent TDIS design with a reduced total jaw width were not yet available.
- The new solution with TZM (Mo-Alloy) as back-stiffener material offers a better shielding of the cooling pipes leading to a lower energy density wrt the old jaw design.
- The energy density in the copper-part (downstream-side) of the higher-Z absorber blocks could be reduced to an acceptable level (see also talk of D. Carbajo) by replacing the Al with Ti-6-4 of the upstream-part of the absorber block. For the same reason also the length of this upstream-part has been increased from 782.5 mm to 956 mm. In case of small impact parameters a possible additional energy deposition of up to 15 % due to misalignment has to be kept in mind.
- Details about the thermo-mechanical response of the components given by D. Carbajo in the next talk.

Updates on TDIS design overview (D. Carbajo)

- Overview about the thermo-mechanical simulation results for the different TDIS jaw designs until now.
- MHC (Mo-Alloy) as promising material for the back-stiffener had to be ruled out. Using this material, the required length of the back-stiffener could not be provided by the supplier. As consequence, another Mo-Alloy, TZM, is under focus now.
- Among all considered back-stiffener materials TZM showed the best thermo-mechanical behaviour in case of beam impacts and meets the requirements with a safety-factor of 1.36. Drawbacks of TZM are high costs (10k-11k per stiffener), lower ductility and higher weight. However, associated costs fall within budget. TZM is now the baseline material for the jaw back stiffener.
- Aluminium 2219 as material for the back-stiffener with slightly worse performance than TZM is considered as fall-back solution. Both TZM and Al 2219 back-stiffener prototypes will be tested at HRM facilities in summer 2018.

- The baseline for the higher-Z absorber blocks (965 mm Ti-6-4/600 mm CuCrZr) shows sufficient strength against beam impact.
- Replacement of Al with Ti-6-4 in the absorber blocks goes along with an increased impedance of 8 %. On the other hand, the reduction in the absorber block width from 80mm to 62mm in the newest jaw version should have a positive effect on the impedance.
- Minor plastic deformation is expected in the inner surface of the cooling pipes in case of beam impacts, however, without negative effects on the functioning of the cooling pipes. With an assumed frequency of possible beam impacts in the order of 10s per year also in the long-term no detrimental effects like fatigue are expected.

Updates on detailed TDIS mechanical design (L. Gentini)

- Design modification overview. No more back-stiffener plate in the new TDIS jaw-design. Changed width of the jaw and the absorber blocks.
- FLUKA- and thermo-mechanical simulations for this newest version are outstanding.
- For the TDIS-tank the market survey is on-going

FLUKA calculations on D1 mask (M. Frankl)

- Overview of the LHC injection protection devices
- Recapitulation of previous energy deposition simulations for the D1 coils. The efficacy of the TCDD protecting the superconducting D1 is demonstrated. Furthermore, the shielding effect of the vacuum layout is significant with a reduction factor of 2-3 for the energy deposition in the D1 coils.
- The present protection of the D1 coils in case of grazing impacts of HL-STD beam on the TDIS is insufficient considering the presumed damage limit and a reasonable safety-margin (factor 3). Hence, a mask (abbreviation: TCMD for Target Collimator Mask Dipole) directly located in front of the cold mass end of the D1 is proposed for a better shielding. FLUKA-simulations to examine the energy density in such a mask and its efficacy in protecting the D1 were carried out.
- The simulated TCMD is 14cm long, 1.1cm thick and in direct contact with the beam pipe. The material is AISI 316 LN.
- With the TCMD, the energy density level in the D1 coils in case of a grazing impact of a HL-STD beam on the TDIS could be reduced by a factor of 2-3 and is now at a presumably acceptable level.
- Thermo-mechanical simulations of the TCMD are ongoing.