Minutes of the 7th BLM Threshold Working Group Meeting February 24, 2015

Present: B. Auchmann, F. Cerutti, B. Dehning, M. Kalliokoski, E. Skordis, D. Wollmann, M. Zerlauth

FLUKA Simulation of orbit-bump beam-loss scenario in an MQW magnet (E. Skordis)

Lefteris recalls the origin of the dynamic orbit-bump beam-loss scenario: a 2010 quench test at 3.5 TeV on MQ14R2. The particle-tracking analysis was done by V. Chetvertkova. In order to re-use the scenario on a warm quadrupole, Lefteris had to change the vertical offset of the beam in order to touch the lower vertical aperture of the beam pipe.

The geometrical model in FLUKA consists of three MQW magnets. The orbit bump hits the aperture about one meter upstream of the center of the first magnet (MQWH.E5R7). Each MQW is equipped with one BLM.

The simulated peak energy density in the beam pipe is 7e-7 mJ/(cm^3 proton). The highest total energy deposition in a magnet is 42 nJ/proton, and the energy deposition in the most impacted coil (all coils are cooled in parallel) is 0.96 nJ/proton. The maximum BLM signal is 7.4e-14 Gy/proton. The values were computed for 3.5 TeV. They can be scaled upwards linearly to 6.5 TeV. For scaling downwards to injection energy, a significant (up to 100%) error is expected for linear scaling. The BLM reading can change by up to a factor 3 if the longitudinal location of the losses changes. The actual change of the orbit bump may change results by another factor 2-3.

Bernhard notes that, since there are five MQWAs and one MQWB in series, the simulation of 3 magnets can be interpreted as an orbit bump in the center of the six-magnet combination. This would be expected for a slow orbit bump scenario (maximum of the beta function in the center of the six magnets).

Lefteris and *Francesco* explain that the simulated magnets are equipped with the new shielding. For the peak value in the vacuum chamber, and the integrated values over the magnet volume and the coil, respectively, the shielding does not have an important impact. (The shielding reduces the peak energy deposition in the coil, but not so much the overall deposited energy.)

BLM Thresholds for MQWs (V. Raginel)

Vivien recalls the basic facts of MQW operating conditions. The coil temperature should remain below 65 ˚C at the water outlet, and, in order to protect the insulation, the temperature of the coil should not rise above 100 ˚C in the local hotspot. MQW magnets are subject to a “background shower” from the collimation system, possibly superimposed to the beam-loss scenario (dynamic orbit bump) for which we set the threshold.

Thresholds for steady-state losses

For steady-state conditions, the 65 ˚C criterion may be applied either to a single MQW coil, or to the entire MQW magnet. In the case of the coil, the cooling power of a single coil needs to be considered, as compared to the eightfold cooling power of the entire magnet. It turns out that the criterion based on the whole magnet is more stringent. The use of this criterion may be argued by the fact that there is little to no convective cooling through the ambient air in the location of MQWs.

Furthermore, it needs to be decided how to take showers from collimation into account. As in the past, MQW thresholds should not impede operation with 500 kW primary impacting power for 10 s, or 200 kW primary impacting power in steady-state conditions. Entries in the thresholds table that are in conflict with this criterion need to be set equal to the next lower running-sum entry that is not in conflict.

During a discussion, a consensus was reached to omit showers from collimation both, in the "background signal" in the BLMs, and in the power-balance of the magnet. The steady-state thresholds will be calculated exclusively based on the orbit-bump scenario, the magnet cooling power, and the target maximum temperature of 65 ˚C.

Thresholds for short running sums

For faster losses, two criteria may be applied: (a) the vacuum chamber walls shall stay below 500 ˚C (TT40 experiment), or (b) the vacuum chamber temperature shall not exceed 100 ˚C, which is the maximum allowed temperature for the coil. By applying the criterion to the vacuum chamber, the criterion can be applied without regard to the shielding protecting the coils in some, but not all locations. Early studies show that, even with the more stringent criterion, low running sum entries in the BLM thresholds table will have to be curtailed at the electronic maximum of 23 Gy/s, so the 100 ˚C criterion is retained.

Action: Vivien will produce thresholds plots based on the above proposals and present new vs. old thresholds in a future BLMTWG meeting.

Next Meeting

The next BLMTWG meeting will be on Tuesday, March 3, 10h30 in Bldg 864 1-C02. Topics will include

- New BLM threshold family names (E.B. Holzer).
- Status of threshold production tools and readiness for sector test (M. Kalliokoski).

Minutes by B. Auchmann (TE-MPE)