74th Meeting of the Machine Protection Panel

Participants: N. Bacchetta, T. Baer, W. Bartmann, C. Bracco, R. Bruce, F. Burkart, V. Chetvertkova, A. Dabrowski, B. Dehning, M. Deile, W. Hofle, A. Lechner, E. Nebot, A. Priebe, S. Redaelli, B. Salvachua, M. Sapinski, R. Schmidt, N. Shetty, J. Uythoven, A. Verweij, S. Wenig, J. Wenninger, D. Wollmann, C. Zamantzas, M. Zerlauth

1 Presentations

The slides of all presentations can be found on the website of the LHC and SPS Machine Protection Panel:
http://lhc-mpwg.web.cern.ch/lhc-mpwg/

1.1 Estimating the energy density in MQ beam screen in view of ADT quench test – (A. Lechner. K. Brodzisnki)

- Krystof Brodzisnki shows the recorded temperature increase in the beam screen during an impact of 1.5e10p @ 3.5TeV over 6s. The temperature increased by one Kelvin. The average over the plotted time period of 20mins stayed very close to its value before the beam impact (~+0.1K).
    - Mariusz adds that this was a vertical loss of 1.5e10 p @ 3.5TeV over 6s. Krystof comments that horizontal losses will directly go into the helium.
    - Arjan states that if 5 times more beam would impact, as expected for the ADT quench test, then the beam screen can never be damaged before the quench of the magnet.
- Anton shows the result of a simulation for an impact of a 50um beam and $1*10^9$p in stainless steel. The dose will be < 27J/g. Anton assumes that the temperature will not increase to more than room temperature. With a more diluted grazing incident, which is a more realistic scenario for the test, the peak dose will be less than 2 J/g.

1.2 The latest quench test planning – (M. Sapinski)

- The quench test will take place in about 2 weeks.

- Status of MP documents: 3 documents are currently in EDMS (ADT fast losses, Steady state with orbital bump, Q6 injection) and are ready for discussion. The collimation documents will be circulated on Monday after the discussions in the CollWG.
- Test period: 11.02.2013, 6:00 to 13.02. 6:00.
- There are pre-tests to be performed:
    - Preparations for ADT fast losses: Installation of scope for fast acquisition of QPS signal (1hour access).
        - Joerg points out that the planned quench tests require very different beam intensities. Therefore one needs to plan a shift for accesses to change attenuators for the BPMS, Q-feedback, etc., especially for the eventual Ion quench test. Jan also points out that this needs to be clearly discussed.
- Quench tests:
    - Fast (UFO like) losses (~1ms) with ADT and orbital bump. MP issues:
        - Losses of up to 1e9 protons at 4TeV.
        - Masking BPMS in IR6.
        - Raise BLM thresholds to allow magnet quench and scraping without a premature dump in the IR7 collimators.
            - Wolfgang explains that there needs to be a seeding of the oscillation with the MKQ.
    - Collimation quench tests (slide 6): MP issues
        - 500kW (7.5e11 protons/s @4TeV) for 10s.
        - Maximum allowed constant loss rate into IR7 Collimators of 1MW (~1.5e12 protons/s on collimators @ 4TeV).
    - Steady State orbital bump:
        - Loss of 1e9 p/s to 4e9 p/s on the magnet for 10s.
        - Beam in the machine 10 x 1e11 protons.
        - Masking IR6 BPM interlock and collimation interlock.
        - Raise BLM thresholds to allow magnet quench without premature dump.
    - Q6 @ intjection

        - Loss of up to 1e11 protons on TCLIB collimator.
        - Mask all maskable BLMs and collimator interlocks.
        - Increase probe beam limit to 1e11.
        - Q6 magnet was commissioned to 7TeV (4310A) in 2008.
- Planning:
    - Ramp for ADT gain with Ions
    - Ion collimation ramp2, with assuming quench
    - ADT fast losses
        - Joerg asks what the baseline for the collimator settings are for the fast ADT quench test. Mariusz responds that the vertical collimators will stay nominal and the horizontal collimators will be opened during the MD. The ramp will be performed with nominal settings.
    - Proton collimation.
    - Steady state losses with orbital bump. Losses are targeted in the same magnet as planned for the fast ADT quench tests (Q12L6).
    - Q6 quench test @injection:
        - There was an idea to perform the test during the quench recovery of the Q12L6, which is however not recommended as it would require masking of several conditions within the powering interlock system.
        - Jorg comments that this would mean to disable the SIS and other interlocks, we are currently very well protected against injecting into a non-ready machine.

Discussion:

- Wolfgang points out, that the ADT will be used in 4 out of the 5 quench tests. This is important information for manpower planning.
- Markus points out that one should be prepared to make a priority call in case of non-availability of the machine.
- Ruediger states that Collimation Ions, Collimation protons and steady state losses with orbital bumps are addressing the same time scale of losses into sc. magnets. Therefore not all need to be highest priority.

- Bernd asks what the priority is for collimation. Stefano replies that the results of the collimation quench tests are needed to decide if the construction of DS collimators is needed. Stefano summarizes that the proton collimation test has the higher priority of the two.
- Markus summarizes the priority (highest to lowest):
    - ADT
    - Proton collimation
    - Q6 @ injection
    - Steady state with orbital bumps
    - Ion collimation

1.3 Potential beam screen damage during quench tests – first results (V. Chetvertkova)

- Vera presents the current status of the MadX simulation she is currently performing to achieve the impact beam distribution of the particles excited during the ADT fast losses quench tests (UFO like).
- Vera shows that with the ADT excitation the particles showed oscillations, but didn't get lost.
- By changing the phase losses were achieved within 5 turns.
    - Wolfgang comments that the behavior of the particles seems to be totally normal with the ADT excitation.
    - Wolfgang explains that the ADT in reality measures the oscillation of the beam and amplifies this. Then the ADT amplifies the oscillation seeded by the MKQ. Therefore, the phase advance between ADT and MKQ needs to be taken into account to drive the oscillation.
    - Jorg comments that the positions of the losses are counter indicative. Jorg would expect to lose the particles in the quadrupole.

1.4 Results of FLUKA simulations for the Q6 Quench test @450GeV – (N. Shetty)

- Nikhil shows the assumptions for the impact of the beam used for the simulations to estimate the energy deposited in the Q6.

- To achieve the max. energy density of ~20mJ/cm^3 in the Q6 one would need an impact of about 5e10p on the TCLIB.
- The energy deposition in the TCLIB is equivalent to a temperature increase of 6.5K for 1e11p impacting.
    - Anton comments that the assumption is an impact parameter of 3sigma.
    - Chiara states that one can also move the TCLIB into the beam with an angle to avoid leakage of primary protons out of the collimator.
    - Arjan mentions that the quench limit at 7TeV is 3mJ/cm3, at 3.5TeV it is ~20mJ/cm3.
    - Ruediger proposes to use 6e10p and change the current in the magnet to achieve a quench.

1.5 Miscellaneous

- Daniel reports on a discussion between MP (Jorg, Ruediger, Daniel) and Vacuum (Miguel, Paul, …) about the upgrade of the sector valves foreseen for LS1. This upgrade, requested by the task force following up the sector 34 incident, will lead to an increase in the closing speed of the valves by a factor 2, compared to the current state. This value is about a factor 10 faster than initially assumed for MP studies by R. Appleby in 2009. Nonetheless the protection is assured in case of an erratic valve closing with beam stored in the LHC. In the moment when the movement of the valves would be detected by the BLMs due to beam losses from the valve touching the beam halo @ ~6sigma the remaining time of 2ms (~20 turns) would be sufficient to dump the beam safely. In view of HL-LHC and a possible 'halo free' operation it was noted that the interlocking of the valve movement needs to be re-viewed and improved. MP will add a paragraph mentioning these possible future restrictions to the currently circulating ECR on the upgrade of the sector valves.