62nd Meeting of the Machine Protection Panel

Participants:
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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 Beam impact parameters for horizontal RPs in IR5 due to a MKD kick – (D. Wollmann)

- Follow-up on special MPP on Roman Pot operation, to understand the energy deposition in nearby and downstream magnets due to beam impacting on Roman Pots and therefore evaluate the damage risk.
- Two worst-case scenarios were considered: Asynchronous beam dump and intercepting beam during alignment. The first was addressed here.
- Input provided for FLUKA studies:
    - Phase advance between MKD and Roman Pots.
    - Impact parameter and impact angle of beam due to MKD kick.
    - Local beta function at the respective RPs to calculate the beam size.
- Assumptions for MadX single turn calculations::
    - LHC V 6.503, 4 TeV, 0.6m / 3.0m / 0.6m / 3.0m, emittance = 2µm.
    - Kick in all MKDs.
    - Asynchronous dump during RP operation.
    - Jaw position of horizontal RP at 4 sigma (half gap)
    - Impact parameter 3 sigma, i.e. beam offset of 7 sigma.
- Results B1:
    - XRPH.A6R5.B1 has -89.9 degree phase advance.

  - Hor. RPs are single sided devices, with jaw mounted at outside of the ring (positive x-direction).
  - Pos. MKD kick causes negative offset (x-direction) at hor. XRPs.
  - Jaw cannot be hit by positive MKD kick.
- Results B2 (simulation performed for B4):
  - XRPH.B6L5.B2 has ~53 degree phase advance to MKD.
  - Positive MKD kick (B4) results in positive beam offset at hor. XRP.
  - If B4 has the same sign conventions for the kick and the beam offset, the hor. XRPs can be hit in case of an asynchronous dump.

Discussion:

- Jorg comments that B2 / B4 coordinate conventions need to be checked. The dump in B2 kicks into negative x-direction (inside the ring).
- Further analysis after the meeting showed that B4 has the opposite sign compared to B1. In B2 the MKD kicks into negative x-direction and causes a negative offset at the hor. Roman pots. As the single jaw is always installed at the outside of the ring (positive x-direction), the jaw cannot be hit in case of an asynchronous beam dump with the current standard collision optics.

1.2 Results of FLUKA simulations for RP failure cases (A. Lechner)

- Two cases possible: asynchronous dump with 3 sigma impact parameter or grazing incidence on the pot surface. Only the first scenario is discussed here.
- Input parameters see in Daniel's presentation. All results are scaled to one nominal bunch.
- In the studied case (3 sigma impact parameter) the beam sees 3mm of silicon and 1 mm of stainless steel.
- Energy deposition was calculated from the RP to the MQML.8L5:
  - The largest energy deposition is found in the MQM.A7L5 (~60m downstream, 51+-4mJ/cm^3 per bunch in the coils) and the MB.A8L5 we capture about 15mJ/cm^3 per nominal bunch). In the MQML.6L5 it one gets ~24+-2mJ/cm^3.

- Simulations were also performed to determine the energy deposition in the DS (up to Cell 13):
    - Largest losses occur in MB.C12L5. The particles lost there experienced a vertical kick in the interaction with the RP. The energy deposition is < 0.125mJ/cm3 per bunch.
- Furthermore the energy deposition in the RP was studied. High local energy deposition is found there (> 100 J/cm^3).
- For further tracking of nuclear elastic and coulomb interactions as well as single -diffractive
- Nuclear elastic and Coulomb interactions as well as single-diffractive scattering in RP can lead to proton losses beyond cell 13L5 or to multi-turn losses:
    - Corresponding loss pattern would require further tracking studies.
    - FLUKA coupling with Sixtrack would be available.

Discussion:

- Bernd asks with which factor this can be scaled to 7TeV. The assumed factor to scale between 4 and 7 TeV is ~3.
- It is assume that in case of an asynchronous dump only 1 bunch (maximal 2 bunches) can hit the aperture.
- Mario asks what a energy deposition in a magnet of 50mJ/cm^3 causes in the magnet? Bernd responds that the assumed quench limit is ~1mJ/cm^3 (7TeV). The result means we should assume about 4 magnets quenching. The assumed damage limit at 7TeV is ~30J/cm^3.
- Anton comments that it would be worth to simulate the gracing incident scenario, as this would mean to go through the full length of the stainless steel foil.
- **Action:** Simulate the case with a direct impact into the stainless steel case (Anton). Daniel will provide the beam parameters for the case.
- Markus asks if the RP itself would survive such a scenario. Mario responds that this would be interesting to investigate.
- Daniel asks how sensitive the simulated energy deposition in the downstream magnets is on the position of the RP jaw. Anton answers that

he doesn't expect a major change, as the pots are currently far from the aperture.

- **Action:** Due to a mistake in the simulation the deposited energy was underestimated by a factor ~2. Anton corrected this and will present the corrected results in the upcoming MPP.

1.3 Proposal for the adjustment of BLM thresholds in IR7 – (E. Nebot del Busto)

- After the TS1 beams were dumped several times due to losses of 50-60kW. We would like to allow 500kW peak losses (tested in B2 in an MD) and 200kW continuous losses.
- The calculations for the new BLM thresholds are based on the losses during qualification loss maps. The loss pattern were found to be similar the losses during normal beam operation. The results were provided by B. Salvachua and D. Wollmann
- The proposed strategy for the threshold change is to apply the new thresholds to the whole family, of one monitor in the family needs an increase of the threshold.
- The proposal is to allow :
    - 500kW peak losses (RS 08, 09, 10, 11) and 200kW in RS12 for MF=1.
    - 200kW peak losses (RS08, 09, 10, 11) and 80kW in RS12 for MF=0.4.
- The RS08 threshold needs to be increased, as otherwise RS08 would have a lower threshold than RS09, which would be un-physical and make the longer running sums irrelevant.
- For TCP: with MF=0.4 the thresholds for short running sums will decrease by a factor 2.5, we are currently operating with MF=1. RS 08 to RS12 stay either about the same or will be increased. Comparable changes happen for the TCSGs.
- In the TCLA families the thresholds in short running sums will increase by a factor 2 or 4 (as MF increases from 0.2 to 0.4, respectively 0.1 to 0.4).

- MQW: The thresholds were already scaled on the 13th of April. For 200kW the current thresholds are fine. For 500kW we need a factor 1.8, which is still available with the current thresholds (MF=0.5).

Discussion:

- Barbara asks if the Q4.L6 was also considered, as we previously dumped on this magnet. Daniel responds that the thresholds in this monitor were already increased by a factor 2, therefore, there is currently no need to increase the threshold for these monitors.
- Ruediger comments that we recently had a dump in the 80s running sum, with a loss power of ~45kW.
- Barbara asks why we are keeping the RS06, RS07 and RS08 constant in the TCLA. Eduardo explains that this is due to a mix of electronic limits (RS01, 02, 03) and the requirement not to change thresholds below RS09.
- Ruediger comments that we should check, if the reduction in the shorter runnings sums could cause a problem. **Action:** Eduardo will check this and report to MPP.
- Barbara points out that we should start the discussion for increasing the thresholds in IR3. **Action:** Belen will look into the loss maps and operational losses for IR3 and prepare a proposal for increasing the thresholds as input for Eduardo.

1.4 Miscellaneous

- RP settings for operation. Ruediger mentions that he understands that there will be a setup of the RPs for 0.6m. Mario answers that this is foreseen either before the MD period or directly at the start-up after the technical stop.
- Markus comments that there exist 2 EDMS documents for the RP settings from last year, which should be updated for the 2012 RP operation.
- **Action:** Mario, Daniel and Stefano will meet to create an EDMS document for the RP setup and operation in the different beam modes.
- There is still the main part of machine protection documents missing for the upcoming MDs.

- **Action:** Markus + Daniel will send an email to the colleagues responsible for MDs classified as C or D to provide an respective MD document.