171st Meeting of the Machine Protection Panel

The meeting took place on October the 12th in 774/1-079.
Participants: C. Schwick, W. Bartmann, C. Bracco, R. Bruce, N. Fuster, D. Lazic, M. Schumann, J. Howett, B. Todd, T. Medvedeva, A. Lechner, C. Zamantzas, Y. Nie, J. Uythoven, M. Valette, J. Wenninger, D. Wollmann

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

1.1 Approval of MPP#170's minutes

- No actions from the 170th MPP.

1.2 Summary and conclusion from asynchronous dump tests after TS2 (W. Bartmann, C. Bracco)

- Wolfgang presented an overview, for which phases of the operational cycles asynchronous beam dump tests (ASD) are required before normal operation can be performed. After a long shutdowns, major HW interventions, collimator alignment and change of optics, a full revalidation is required, including: injection with injection protection elements, flat top, end of squeeze, collisions, collisions with roman pots in. After technical stops, a reduced list of validations is required consisting off: injection with injection protection elements and collisions with roman pots in.
- The sanity checks include reviewing AG population distribution before the dump and verifying most of the beam was either recirculated or ended up on the TCDQ. A systematic plotting tool allows verifying the losses are within the trend defined by previous dumps. Finally, setting verification, verification of the global loss distribution and peak ratios respectively unforeseen asymmetries allow validating a test.
    - Jan asked about a data point sticking out in the summary of losses during ASD on slide 5. Wolfgang answered this dump is an outlier in terms of protons lost and therefore loss signals but it fits the trend of others for the ratio from one to the other so it was validated.
- Wolfgang concluded that the asynchronous dump tests performed after TS2 have been successfully validated. For the future verifications could be automatized more and a tool is being prepared for Run 3 due to the variety of optics and machine settings foreseen. Nevertheless, an expert should still verify the events by eye for safety.
    - Jan suggested we could learn from normal dumps with a little beam in the AG to avoid spending too much time on these regular tests. Wolfgang responded, that dedicated verifications are still required before going to high energies and intensities after a longer stop or interventions.

1.3 Summary and conclusion from loss map validation after TS2 (N. Fuster)

- Nuria presented a summary of the loss maps performed in 2018 until TS2.
- During physics commissioning betatron and off-momentum loss maps (LM) were performed for each static point in the cycle. After TS1 the standard physics optics were revalidated with betatron and one sign off-momentum LM as well as VdM and high-β optics. The other sign off-momentum LM was performed after TS2. A matrix on slide 3 summarizes which LM was done when.
    - Daniel asked why the continuose LMs during the squeeze were not required anymore. Roderik answered the continuous squeeze LMs are time consuming. Daniel concluded that if a degradation of the cleaning efficiency during squeeze is observed it might be required re-doing these.
- There are up to 56 LM performed for each revalidation cycle, requiring up to nine fills when combined with the ASD discussed previously. An overview of the issues found and solved includes:
    - Broken hierarchy in B2V/IP2 at injection, leading to changes of TCLIB settings, same at top energy in B1V/IR7.
    - After TS1, the same problem came up in IP2, solved by improvements on orbit and change of ALIC polarity.
    - After TS2, a new tool for automatic analysis of off-momentum LM improved the resolution and contributed to a smooth validation.
- Nuria followed by giving detailed examples of LM. In the future, an automated tool for a first analysis could be envisaged, for the moment the analysis is done by experts now.
- The observed inefficiencies are similar to 2017 with similar hierarchy and settings. Overall ATS optics tighter collimator settings and lower margins to secondaries lead to improved efficiencies, which have been stable in the last two years. Inefficiencies during physics with various crossing angles and β* have been investigated without issues.
    - Jan commented that collimators are globally getting closer. Daniel added that since everything seems stable now one could think about reducing the number of LM. Roderik concluded that this decision does not need to be taken today but one could rely on operational data and request LM once discrepancies are observed. Jorg observed that there are almost no losses during operations in IR7 but one could study the physics debris losses in the TCT.
- In conclusions: LM validation was stable this year and showed consistent hierarchy after problems spotted during commissioning. The delicate part consisted in off-momentum LM for which the automated tools helped a lot, to reduce the number of fills required.

1.4 BLM thresholds for the Ion run (T. Medvedeva)

- Tatiana presented a summary of the changes to BLM thresholds for the ion run. They include:

- Extension of flat top corrections: the machine will operate one energy level lower than in the proton run so corrections will be extended to energy level 26, covering the 6.37 TeV/Z
- Removal of threshold bottlenecks identified during the ion quench test in 2015: five special families with flat top corrections were created in 2016 mostly containing cells 11 right and left of 1 & 5. They will be reused in 2018 with the extended flat top corrections mentioned earlier.
- The monitor factor (MF) for MB-LE BLMs in the dispersion suppressor (DS) next to IP1 & 5 will be increased from 0.33 to 1. The previous changes mentioned are for the master thresholds, with the MF unchanged.
    - Jorg asked why the thresholds were not kept as tight for the proton run with the argument that if the considered thresholds are safe for ions they should also be safe for protons and would allow simplifying the definition of families and thresholds. Anton answered the loss patterns are different, also some BLMs are moved from one family to another on purpose as the secondary ion losses in the DS are specific to the ion run and need dedicated thresholds with no warning level. Daniel added that the BLM thresholds are set based on loss scenarios. For the mentioned BLMs these are different for the proton and the ion run.
- The dumping hierarchy was also updated in order to dump on losses at the collimators and not at cold magnets, two new families created in 2016 for four skew TCSG in IR7 will be reused with lower thresholds in RS09-12.
    - John added the changes would be done during TS3, except for the ones needing LM. In case of problems the changes could be implemented during turnaround, as they should take only time ~10 minutes. Daniel asked if some thresholds could be scaled from 2015 data. John answered that there were no ion collisions in LHCb and the spacing was changed from 50 to 100 and 75 ns so extrapolation is difficult.
    - Anton concluded the ion run in Run III should be homogenized with the proton run from the thresholds point of view and thresholds should be relaxed where possible.

1.5 Ion ramp up (DW)

- Daniel presented a proposal for the ion run intensity ramp-up.
- In 2015, the intensity steps were as follows: 10b, 51b, 250b, 474b, 518b with a maximum of 1.7e10 charges per bunch (i.e. 2.1e8 Pb^{82+}per bunch) for a total stored energy of ~9 MJ.
- This year, with 6.37 TeV/Z 620b and 100 ns spacing the total energy will reach 11 MJ per beam at first and later 14 MJ with 75 ns spacing and 790b.
- **Proposal**:
    - Setup with 10b, LM and ASD as specified by ABT and CWG.
    - 50b, one fill with at least 2 hours of stable beams (SB).
    - 250b, two fills for at least 6 hours of SB.
    - 450b, two fills for at least 6 hours of SB.
    - A checklist before the start of full physics production with 620b.

  - Second checklist when switching to 75ns spacing and one fill back at 450b for at least 4 hours of SB before going t 790b.
  - Final checklist at the end of the run.
- John asked if a call was needed before going to the next step. Daniel answered MPP will closely follow the ramp-up and will give the green light, to go to the next step. The detailed filling schemes can be adapted, as the stored beam energy is the main parameter.

AOB - all

- Jorg brought up the special physics run and the return to normal physics after the weekend. Due to the unavailability of people over the weekend, the best would be to go back to 11 m and resume the switch back to 30 cm on Monday. Since there would not have been high intensity beam in the machine for more than 48h a revalidation is necessary. Daniel proposed to have an intermediate step in intensity before 3000b.
  - Jorg proposed a short fill with 50b, just colliding and then dumping unless there is interest from the experiment to use 50b. Then 600b in SB for 2 hours, for heating, and resume with 300b. Christoph added that he would see with the experiments if there were an interest for physics with 50b.
- There was a recent discovery that the SIS interlock of one LRBB wire could not power down the converter, as it did not have the appropriate RBAC role. This problem was fixed and its correct function was verified. Nevertheless, a change in RBAC can inhibit this in the future. Jan concluded the RBAC team should not update too often. Daniel pointed out that in case the LRBB wires will become operational devices in the future the interlocking should be done in hardware.