252nd Meeting of the Machine Protection Panel

LHC topics

August 30th, 2024.

Participants:

Federico Alessio (EP-LBC), Andy Butterworth (SY-RF), Yann Dutheil (SY-ABT), Marek Gasior (SY-BI), Cedric Hernalsteens (TE-MPE), Dragoslav Lazic (EP-UCM), Tom Levens (SY-BI), Marko Milovanovic (EP-UAT), Anastasiya Radeva Poncet (BE-CSS), Matteo Solfarol (BE-OP), Georges Trad (BE-OP), Jorg Wenninger (BE-OP), Christoph Wiesner (TE-MPE), Daniel Wollmann (TE-MPE), Christos Zamantzas (SY-BI).

The slides of all presentations can be found on the website of the Machine Protection Panel and on Indico (252nd meeting).

Minutes and actions

Daniel introduced the meeting and mentioned that the minutes of the last meeting will be available shortly.

BCCM bunch intensity limitation and proposed solution (T. Levens, M. Gasior)

Tom first introduced the beam dumps by the BCCM observed during the last MD period when injecting high intensity beams with bunches with intensity greater than 2e11 ppb. It was first suspected that this was due to rf debunching. However, it was identified that these beam dumps were intensity-dependent, i.e. the ADC in the BCCM input channels were saturated, which leads to a beam dump by the BCCM, as it cannot anymore fulfil its protection function. Tom noted that a PM analysis module is not yet available (on-going activity), which would have eased the analysis of the origins of the beam dumps. The "overflow" flag of the BCCM is currently not in the PM data. It will be added for the future.

Tom then showed the signals analysis of the relevant dumps.

The BCCM interlocks when the signal level reaches the ADC full scale (by-design). The maximum allowed signal level is a trade off with noise and defines the dynamic range of the system. Higher maximum bunch intensity brings higher noise, which limits the resolution at lower signal levels. The Run 3 beam specifications set a limit at 1.8e11 ppb. This is to be reviewed for Run 4 onwards. The present BCCM saturation level is about 2.2e11 ppb (maximum per bunch) for trains with 25ns bunch spacing. However, due to the dynamics of the detector the limit will be higher with larger bunch spacing (and much higher with single bunches).

Jorg commented that this means that the exact intensity at which the dump is triggered is not precisely defined, as the saturation the BCCM response depends on the bunch pattern. Georges asked if increasing the average intensity to 1.8e11 ppb this could cause beam dumps due to higher bunch intensity within a train. This cannot be fully excluded, as one bunch reaching the saturation level is sufficient to trigger a beam dump. However, it is not expected that the BCCM limits beams with an average of 1.8e11ppb based on the current experience with the system.

Tom presented the proposed solution to increase the saturation level, allowing average bunch intensities of more than 2.2e11 ppb. The full scale can be increased by installing 2 dB attenuators. This would increase the absolute maximum by about 25% from 2.2e11 ppb to 2.75e11 ppb. These attenuators have are already been installed on system C, which is the development system and not interlocked. The scaling factors (LSA settings) for system C have been multiplied by 1.26 to compensate for the attenuation of the signal. These have been confirmed by the comparison between the system C readings and the readings of system A and B.

Tom proposed to install the attenuators on systems A and B before the next MD block. Two options are possible. One requiring a single access, changing both systems simultaneously with a single recommissioning. Or a second option requiring two accesses, changing each system in turn. Tom mentioned that the first option is preferred.

Tom pointed out, the scaling factors are intentionally (right now and after the future change) set 3 to 4% above the FBCT reading to ensure that the intensity is never underestimated.

Jorg asked if the scaling factors play a role in the protection. Tom replied that the thresholds are set in charges and the internal thresholds (ADC bit scale) will then follow the change in scaling factor.

The change would preferably take place after the 16th of September due to the availability of the team.

Tom suggested that the re-commissioning can take place during injections directly after the installation of the attenuators. Daniel agreed.

The MPP endorsed the proposal to install the attenuators on both systems at the same time and perform the re-commissioning it the next injections directly after.

Georges asked about the noise tolerance of the system. Marek replied that it would still be possible to increase the full-scale by 25% (4 db attenuator instead of 2 dB attenuator). This will further increase the noise level. Therefore, it is preferred to only attenuate to the required level and not beyond.

Intensity Ramp-Up for pp Reference Run 2024 (C. Wiesner)

Christoph introduced the main aspects of the p-p reference run. The p-p reference run will take place after MD5/TS2. The beam energy will be 2.68 TeV with a maximum of 2340 bunches at 1.6e11 ppb.

The proposed ramp-up steps are:

- 3b (or 12b) into collision
- 75b (> 2h in SB)
- 400b (> 5h in SB, checklist before advancing to 800b)
- *800b (> 5h in SB) – See below*
- 1200b (> 5h in SB)
- 2400b (checklist after first fill).

Compared to a standard ramp-up after a TS this adds one additional step at 800b. To be noted that a 1800b step which was intended for the p-p reference run of 2023 (which did not take place) has been removed.

Jorg asked if the 400b and 800b steps could be merged into a 600b step. Christoph and Daniel replied that for consistency reasons the 400b fill should be maintained. However, the need of the 800b step could be discussed. After further discussions it was agreed that the 800b step can be dropped without losing relevant information during the intensity ramp-up as from a heating point of view the same beam type is used as for nominal physics operation.

Federico confirmed that ALICE will do a polarity reversal midway through the run. Jorg commented that no validation fill is required after the reversal. Jorg proposed to start with the configuration featuring the smaller crossing-angle first. This was agreed.

The MPP endorsed the proposal of not adding a validation fill after the polarity reversal.

The MPP endorsed the following ramp-up plan:
- 3b (or 12b) into collision
- 75b (> 2h in SB)
- 400b (> 5h in SB, checklist before advancing to next intensity step)
- 1200b (> 5h in SB)
- 2400b (checklist after first fill)
- No validation fills after the ALICE polarity reversal.

Summary of actions

The complete list of actions can be found on the MPP website.

No action was identified during the meeting.