239th Meeting of the Machine Protection Panel – Joint meeting with CollWG

LHC topics

September 1st, 2023, via Zoom

Participants:

O. Aberle (SY-STI), A. Abramov (BE-ABP), V. Aguiar Monteiro Martins Mendes (HSE-RP), R. Babu, R. Barlow (EP-ULB), R. Bruce (BE-ABP), R. Cai (BE-ABP), M. D'Andrea (BE-ABP), K. Dewhurst (BE-ABP), Y. Dutheil (SY-ABT), P. Dyrcz (HSE-RP), C. Hernalsteens (TE-MPE), A. Infantino (HSE-RP), J. Jowett (EP-UAI), D. Lazic (EP-UCM), A. Lechner (SY-STI), D. Mirarchi (BE-OP), F. Moortgat (EP-CMG), N. Mounet (BE-ABP), A. Perillo Marcone (SY-STI), A. Radeva Poncet (BE-CSS), S. Redaelli (BE-ABP), V. Rodin (SY-STI), R. Secondo (TE-MPE), M. Solfaroli Camillocci (BE-OP), M. Tisi (HSE-RP), G. Trad (BE-OP), F. Van Der Veken (BE-ABP), A. Vella (BE-OP), C. Wiesner (TE-MPE), D. Wollmann (TE-MPE), C. Zamantzas (SY-BI)

The slides of all presentations can be found on the website of the Machine Protection Panel and on Indico (239th meeting).

Minutes and actions from the 238th meeting (LHC topics)

The minutes of the previous MPP meeting have been distributed. Daniel recalled the actions from the meeting. It was agreed to close the action on the validation of new sliced threshold functions for the TCT. This validation will be performed after the EYETS 2023/24 with the then valid functions.

Scenarios for machine and beam parameters (R. Bruce)

Roderik reminded on the physics goals for the 2023 ion run: 3.25 nb^{-1} at ALICE and 3 nb^{-1} at ATLAS/CMS and 0.4 nb^{-1} at LHCb. Filip commented that these values should be 25% higher as the Ion run will be one week longer. To achieve these goals an availability of 62% is required. The optics will be similar to the 2018 ion run. Separation levelling will be performed in all IPS and an ALICE polarity switch is foreseen in the middle of the run. One shift of optics commissioning is still remaining. Crystal collimation will be used during the full cycle.

Discussion: Stefano asked when the trains will be ready from the SPS. The goal is that they should be ready on time, but the slip-stacking has not yet started to be commissioned in the SPS. If they are not ready in time 100ns beams can be used at the beginning (instead of the 50ns).

Collimation settings for the ion run (R. Cai)

Crystal collimators will be used as primary collimators an set at 5 sigma. The TCPs will be put to 6 sigma. Secondary collimators will be used as absorbers and kept at 6.5 sigma (during collision: TCSG.D4L7.B1, TCSPM.B4L7.B1, TCSG.D4R7.B2, TCSPM.B4R7.B2). The two skew TCSGs which are installed in between the crystal collimators and the absorbers will also be kept at 6.5 sigma. If they intercept the beam and reduce the cleaning efficiency they might be extracted to 8 sigma. It is proposed to tighten the TCLAs to 8 sigma from their 10 sigma in the proton run. The TCTs could be opened slightly from their current 9.5 sigma to mitigate the risk of dumps on 10Hz losses, depending on the available aperture. Roderik commented that one jaw of the IP6 TCSG might need to be slightly opened, if there are too much losses there.
Discussion:
Nicolas asked about the risk to damage the coating on the secondary collimators used as absorbers. Maria and Roderik responded that a grazing impact is very improbable. Alternatively the TCSGs in the horizontal plane could be used, but for the vertical plane the coated collimators have to be used. The prototype collimator could also be used. Stefano points out that this collimator is not an operational device.
Decision: It was agreed to use the TCSGs in the horizontal plane (CFC) and molybdenum Graphit collimators in the vertical plane. The same absorbers will be used through the whole cycle.
Antonio asked what the energy deposition would be in case of a failure. Roderik and Stefano answered that the beam loss power would be 28kW, which can be compared to 1 MW during the quench tests. Anton pointed out that the scenario is very different than the ones tested in HiRadmat, as these are steady state losses. Stefano proposed to extract the numbers, how the 28kW compare to the HiRadMat experiments. **Action**: Compare expected 28 kW losses to the HiRadMat tests (A. Lechner).
John proposed to take some data with the TCLD collimators inserted and extracted to learn about the sources of losses. Roderik responded that this is foreseen.

Analysis of loss maps for BLM thresholds (M. D'Andrea)

Cleaning losses shift during ion operation with crystal from the primary collimators (TCPs) to the absorber collimators, as compared to the use of the standard collimation system. This means, that a dedicated set of BLM thresholds is required for the ion run with crystal collimators. The analysis covers crystal in channeling, in amorphous and the use of the standard collimation system, leading to a complex set of loss scenarios. A scaling of losses to 50 kW has been used to evaluate the required update of the BLM thresholds. Results of this analysis have to be compared and reviewed with the loss maps that will be performed.

BLM thresholds strategy for the ion run (A. Lechner)

Compared to 2018 the ion run will take place at higher energy (6.8 versus 6.37 TeV), leading to a lower quench limit, 6 times higher luminosity in IP2 and using fully the new crystal collimators. This requires a review of the BLM thresholds as compared to 2018.
The maximum allowed power loss, before reaching the quench limit in the dipoles in the IP7 DS, is estimated between 30 - 50 kW.

The proposal is to increase the BLM master thresholds for the betatron losses of 50 (cold magnets in the DS) to 60 kW (IR7 collimators) for a duration of 10 sec.
Anton proposed to start with a MF 0.4 which lmits to losses in RS 8-10 to 24 kW and 12 kW in RS11 and 5 kW in RS12. An increase of the MF can be envisaged during the run as function of the losses observed after agreement between BLMTWG, MPP, Collimation and OP. If a quench occurs after the increase of the MF, the settings will be reverted to the previous MF level.
Master thresholds would need to be adjusted in case the standard collimation system has to be used.
To live with the losses due to BFPP in the IPs, the thresholds have to be adapted in the Q11. No quench is expected as the BFPP losses should be contained in the TCLDs and the connection cryostat.
As MB.B11L5 has possibly a non-conform diode the thresholds for this and the neighbouring magnet will be kept lower to avoid quenching in case the losses are not contained sufficiently in the connection cryostat.
BLM thresholds of Q10 in IR4 (wire scanner) will not be adjusted, as the dedicated studies are required before this.

Discussion:
Roderik asked about the BLM thresholds in for the TCTs. If bottle necks would be observed, would it be easy to change the thresholds? Anton responded that the situation is not as easy as in 2018. We have now flat-top corrections in the TCTs which should give more margin. If further margins are required changes of the monitor factors can be envisaged.

Decision: Daniel endorsed the proposal by Anton for the MPP and thanks all involved for preparing this proposal. Roderik endorsed the proposal for the CollWG

Proposal for the ion intensity ramp-up (C. Wiesner)

Christoph present the proposal for the intensity ramp-up for the ion run: cycle validation, 80b (one fill, > 2h in SB), 250b (two fills, > 5h in SB), 450b (two fills, > 5h in SB), combined checklist before going to 850 b; 850 b (two fills, > 5h in SB); 1240 b
Discussions on possible intermediate steps in case of a switch from 100ns to 50ns will be picked up in two weeks time
Alice Polarity reversal: TCTs in IP2 will be changed as the crossing angle sign in IP2 will be reversed. This will be validated with loss maps. The polarity switch should be followed by a low intensity cycle and a fill with 450 b.
Roderik asked Christoph to add a slide with the proposal for the low intensity and 450b following the Alice polarity switch.
The VdM run with ions will use between 100 and 150b and will use the same configuration. No special ramp-up required.

Decision: Daniel endorsed the proposal for the MPP.

Loss maps validation matrix (F. van der Veken)

Frederik showed the tables of proposed loss map for the ion run, the pp reference run, the VdM run and the nominal PP run. Yann proposed to perform the ASD also at injection and in physics with positive and negative polarity for the ion run.
Christoph asks if the SMP equation from Ion has been validated. This will be performed as soon as Ions are injected.

Decision: The proposal for the loss-map revalidation is endorsed by the MPP and CollWG.

Crystal interlocks and OP tool for channeling re-optimization (D. Mirarchi)

The crystal collimators will be automatically inserted and their position changed (including interlocks) via the sequencer. The SIS interlock for the replacement pipe will be masked during Ion operation, as the crystals will be used operationally. There is no interlock on the crystal angle, but the crystal position is interlocked as for the standard collimators.
Retraction of the crystals for proton operation is forced by the sequencer. This step is skipped during ion operation.
A new tool (pyCrystalCockpit) has been implemented to automatically find the planar channeling orientation, to optimising the channeling and to monitor the channeling. The functionalities are RBAC protected. The first one is only available for an collimation expert. The optimisation and monitoring functionality is available with the OP login. If losses go out of the optimal range a warning message will be created by the announcer.

Discussion: Stefano proposed to define guidelines for OP when and how to us the optimisation function. This function should be performed at injection and before stable beams. It should also be issued during the intensity ramp-up. To be learned during the commissioning and intensity ramp-up. After this the approach should be reviewed.

Summary of actions

The pending actions from the meeting are:

1. Collimation settings for the Ion run
    - **Action**: Compare expected 28 kW losses to the HiRadMat tests (A. Lechner).