

Meeting of the restricted Machine Protection Panel

MD3 review

August 9th, 2024.

Participants:

Diogo Alves (SY-BI), Birk Baeck (SY-RF), Catrin Bernius (EP-UAT), Riccardo De Maria (BE-ABP), Yann Dutheil (SY-ABT), Pascal Dominik Hermes (BE-ABP), Cédric Hernalsteens (TE-MPE), Michi Hostettler (BE-OP), Giovanni Iadarola (BE-ABP), Matteo Solfaroli Camillocci (BE-OP), Lorenzo Giacomel (BE-ABP), Christophe Lannoy (BE-ABP), Bjorn Lindstrom (BE-ABP), Konstantinos Paraschou (BE-ABP), Milica Rakic (BE-ABP), Belen Salvachua (SY-BI), Guido Sterbini (BE-ABP), Helga Timko (SY-RF), Rogelio Tomas (BE-ABP), Georges Trad (BE-OP), Arjan Verweij (TE-MPE), Jorg Wenninger (BE-OP), Christoph Wiesner (TE-MPE), Daniel Wollmann (TE-MPE).

The slides of all presentations can be found on [Indico](#).

rMPP comments on MDs

MD9325 Beam halo population

It was asked to clarify the beam types which would be used during the MD. Pascal and Gianni replied that the 8b4e type will be used with a single train of 56b and that other beam types will use 3x36b trains. Christoph remarked that the MD procedure currently states a total number of 180 bunches in the LHC and that this should be clarified in the procedure.

Jorg commented that the injection process will take a long time (possible one hour) and the first injected trains will be degraded. It was suggested to re-inject the first injected types of beam trains at the end of the injection process for comparison.

Georges asked for the complete filling scheme to be prepared well in advance.

Daniel asked that the procedure is updated to include this information, and that the rMPP core team is informed once this has been done.

MD11843: Collimation performance with HL-LHC settings

It was asked to provide additional details on the collimator settings.

Christoph commented that the details are now included in the procedure. Pascal will verify with the collimation team that the information is up to date. Matteo and Georges stressed that the settings still have to be generated. Pascal replied that they indeed need to be implemented in a beam process.

[MD6925: Electron cloud coupled-bunch tune shifts at injection](#)

The number of bunches above $1.8e11$ ppb must be limited to 385 bunches (LHC limit) and the injection is limited to a maximum of 2×48 bunches of $2.3e11$ ppb (SPS limit).

Kostas confirmed that this is compatible with their plans and that the filling scheme will be prepared and included in the MD procedure.

Kostas commented that MD12807 was not scheduled for MD3. However, it would be beneficial to perform a subset of the planned optics measurement from this MD at the end of the approved MD12804. The request is to perform very long kicks of up to 40.000 turns with the ADT on one bunch. Daniel and Christoph replied that this is acceptable and that the additional measurements should be clearly mentioned in the procedure of MD12804.

[MD12743: RF power limitations for high-intensity batches](#)

It is asked to remain within the SPS limit of 2×48 bunches of $2.3e11$ ppb and within the LHC limit. In case of ramp, one must ensure that the beam is dumped at 500 GeV. Above 500 GeV the limit of $1.8e11$ ppb for 684 bunches applies.

Helga confirmed that the ramp will be performed and that the beams will be dumped before 500 GeV. It was agreed that the beams would be dumped manually using the operator switch.

[MD12805: Impact of longitudinal impedance and betatron coupling on the Schottky spectrum](#)

The bunch intensity must be specified. For individual bunches the limit is to remain below $2.4e11$ ppb.

Christophe L. confirmed that this will be updated in the procedure.

It was discussed how a shorter bunch length than 1.0 ns with high bunch intensity could be achieved. Helga remarked that the RF capture voltage might need to be adapted, which is considered safe for single bunches. Christophe L. replied that the topic will be discussed offline with the RF team and then explicitly described in the MD procedure.

MD12663: Wire compensation during the beta*-leveling (G. Sterbini)

Guido clarified in which order the loss maps will be performed. The wires will be first switched on at 41.5 cm with nominal crossing angles, then, arriving a 30 cm with 150 urad. At 30 cm the crossing angle will be reduced to 130 urad and the wires will be switched on. The procedure will be repeated for tight TCS and TCT settings (to have the wires closer to the beams). As a final step a scrapping measurement will be performed with the primaries to measure the diffusion rate. The loss maps will be performed to fully each of these steps. The full set of loss maps is summarized in Figure 1.

Validation test	Loss Maps Matrix							
	β^* (cm)							
	41.5	38.5	35.5	32.5	30.0	30.0	30.0	
	Xing (μ rad)							
	160	160	160	160	130	130	130	
	Collimator settings							
	Nominal	Nominal	Nominal	Nominal	Nominal	Tight	Tight	
BBLR								
	ON	ON	ON	ON	ON	ON	OFF	
B1H	X	X	X	X	X	X	X	
B1V	X	X	X	X	X	X	X	
B2H	X	X	X	X	X	X	X	
B2V	X	X	X	X	X	X	X	
+dp/p	X					X		
-dp/p	X					X		
ASD						X		

Figure 1 MD configurations and associated loss maps.

Jorg asked what the tight settings are and if the TCDQ is moved. Guido confirmed and added that Daniele prepared a beam process for this.

Daniel raised a concern about hierarchy breakage. Guido commented that the collimators would be moved in by 0.75 sigma. Daniel asked to update the procedure with details which criteria will be used to evaluate a hierarchy breakage on how to proceed in this case. Yann commented that he will check if the 0.75 sigma is compatible with the noise and drift observed on the TCDQ LVDTs.

Guido commented that ABT and the collimation team confirmed their availability to validate the ASD and loss maps.

Christoph asked if aperture measurements are needed for the validation. Pascal and Daniel replied that they are not considered necessary since the TCTs are moving in and the crossing angle is reduced.

Georges commented that 14 pilot bunches are required to perform the 7 required Loss Maps. This implies that it is not possible to stay below the Setup Beam Flag limit and add two additional INDIVs, which would be needed to establish collisions in all IPs. After a short discussion, it was decided that is preferable to only use one INDIV and only establish collisions in IP1 and IP5 instead of lowering the intensity of the two INDIVs significantly below the nominal value.

Concerns were raised regarding the validation during the ramp-down combined with the fast ramp-up to multiple 36b trains. It was proposed to split the MD in two parts to leave more time for the validation.

It was agreed to have an rMPP meeting with all parties involved after the validation and before proceeding with the fill with trains.

Guido suggested that one could remove some complexity and need for additional validation by simply moving the TCT by 0.5 sigma. Daniel replied that this would reduce the margin and should be avoided.

MD12723: HL-LHC optics cycle (part II) (R. De Maria)

Riccardo first summarised the MD goals.

The first comment from the rMPP concerns the use of pilots. In case the optics is completely new, one should first have a full cycle with pilots. This should be clarified for the first ramp. Riccardo commented that the first ramp and the following squeeze will use only one pilot per beam as the beta-beating might exceed 20%. The second ramp could use 3 pilots if the beta-beating is corrected below 20%.

Riccardo then provided more details on the measurements to be performed. A standard OMC procedure will be applied with active kicks from the AC dipole and using K-modulation. The BPM and BBQ data will be used, in addition the DOROS BPMs will also be used. On-momentum and off-momentum AC dipole measurements will be performed. In addition, to verify the tune stability, at least 20 AC dipole kicks are necessary under static conditions. This is one of the critical aspects of the MD which will also be re-done in 2024 with the dipole PC upgrade.

The third ramp will be used for loss maps and aperture measurement with nominals and pilots (remaining below $3e11$ protons in total). The rMPP commented that the aperture measurement should not be performed with nominals. Riccardo replied that the nominal procedure will be used: the nominals will be used to correct the orbit and align the collimators and will then be extracted using the ADT, only the pilots will remain for the measurements.

MD12844: Faser background mitigations (B. Lindstorm)

Bjorn first summarized the procedure to be used during the MD. Two INDIVs per beam will be injected, with collision in IP1. The cycle will be performed up to the nominal ramp and squeeze to 60 cm. The reference background will be measured for 1 hour. The configuration will be changed to non-nominal conditions, and the background will be measured for 1 hour. The first configuration uses inverted vertical crossing angle in IP1. The TCTs will be moved, the crossing-angle will be reversed, and the TCTs will be realigned. Then a horizontal crossing angle will be used. For this the TCTs and TCL4 will be moved and then re-aligned.

Bjorn clarified that the intensity will be low and that the setup beam flag will be active so that the standard collimation masks can be applied. The rotation of crossing-angle will use the lumi-server standard set of tools. After a comment from Jorg, it was decided that the TCTs in IR1 should not be moved to parking and reinserted but moved directly with the lumi server. Michi clarified that also the TCL4 can be moved by the tool. After the movement, the collimator position should be verified. Bjorn confirmed that this will be included in the procedure.