

## 122<sup>nd</sup> Meeting of the Machine Protection Panel

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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#120's minutes

- Actions from 121<sup>st</sup> MPP:
  - 2 actions from FGC lite
    - FGC lite delay to ramp down increased to 10s, **firmware and documentation updated. Done.**
    - Define FGC lite hardware commissioning.
  - From Phase Interlocking: We will trigger an expert discussion between Coll, MPP, OP to agree if the phase advance interlock is a pre-requisite to operate the LHC in 2016 at  $\beta^*=40\text{cm}$  or not (following the LBOC discussion on the new optics on TUE 8<sup>th</sup> of March)?
- No additional comments were received on the minutes, therefore they are considered approved.

### 1.2 AFP interlock test strategy and plans (M. Trzebinski)

Two EDMS reference documents:

- Pot motion control based on ALFA system with switches (IN, OUT, HOME). The laser measurements show good linear motion range close to zero, non-linearities moved to  $+20.000\mu\text{m}$ 
  - Markus: is it radiation resistant/are there redundancies in the switches?
  - No, but the switch system is mechanical and retraction is done with springs.
- AFP-BIS (copy of ALFA) shows correct distribution of LHC signals up to the ATLAS CIBU and the different modes are functioning.
- The hardware tests were done during the week. The system is ready for production software deployments. Can the AFP-BIS commissioning be performed on March 14<sup>th</sup>?
  - Jorg: interlock tests should be synchronised between TOTEM, ALFA and AFP as beam modes and other signals/flags need to be simulated during the test. One has to be careful with the Stable beam signal because a lot of the experiment's systems are reacting on it.
    - Jamie: will mention the date/week of the tests in the LPC and LHC Page1
  - Belen: does AFP want to use the collimation GUI to control the pots?

- Yes, Belen will provide the template to Maciej, which needs to be filled. Jorg states that the TOTEM and ALFA XRPCs already can be controlled by this GUI.
- Parasitic data acquisition could happen at the end of April (assuming a successful interlock commissioning and beam based alignment).
- AFP should be using low  $\mu$  run as a parallel user but will not be driving such needs.
- Is there anything else?
  - Daniel: as AFP aims to insert the pots with high intensity beam at the end of the year, one should insert AFP during EOFs of the intensity ramp-up as done with TOTEM. These insertions were performed during the second fill of every intensity step after two hours of stable beams.
  - Markus: AFP temperature sensors should be given to Benoit to be added in the available fixed displays with temperatures along the machine and into 'heating watchlist'.
  - Beam based alignment should be performed with ALFA, TOTEM and Coll with subsequent loss maps → an agreement on AFP operational settings needs to be found with Collimation.
- Decision: MPP endorses going ahead with the interlock tests. After the commissioning we might request a debriefing presentation.
  - Jorg: how is the injection inhibit transferred?
    - Sigg: It is merged with ATLAS's.
  - **Action:** Check the AFP interlock document and send comments to AFP (MPP).
  - AFP: would like up to date optics with latest  $\beta^*$  (will be available after next weeks LBOC).
- Comment from ALFA added to the minutes:
  - The operation of AFP close to high intensity beams and subsequently the use of TCL6 may introduce much larger radiation levels at the ALFA stations. This may jeopardize the operation of ALFA. The AFP operation will therefore be discussed inside ATLAS before going to next step.
  - An ATLAS internal meeting is setup on Monday (14.03.) to discuss this issue further.

### 1.3 BLM threshold changes for 2016 run (BLMTWG)

- These changes are the outcome of various discussions and the basic ideas behind were already presented during the Chamonix workshop.
- For Cold Magnets in the arcs, at 6.5TeV 13 dumps from UFO, 1 quench avoided and 2 quench were aborted too late which leaves 10 unnecessary dumps and one event, which caused a quench but did not reach the BLM dump limits. Protection against such events would mean more unnecessary dumps. In order to increase availability the thresholds were already raised during the 2 last weeks of proton operation. There is not enough statistics to extrapolate on 2016 rate of UFOs quenches and dumps.
- Two BLMs were added to a dedicated family for the ULO.

- IPQ and IPD BLM's thresholds were raised to avoid dumps from IP debris, and to avoid reaching warning levels with the expected instantaneous luminosities.
- Since the QPS cannot protect the IPQs, IPDs and IT magnets in case of symmetric quenches, the applied thresholds will stay well below the expected quench levels.
  - Bernhard: Availability comes second to Magnet Protection on such issues.
- Triplets in IR8: losses reached up to 40% of threshold in stable beams. A flat top correction will be implemented to avoid reaching the warning levels and then dumping due to debris from the collisions. With these new thresholds it is expected to reach 13/19% of threshold depending on luminosity.
- Other equipment: BGI BLM threshold set to maximum to avoid unnecessary dumps (as BLMs are not protecting the BGI itself). In case of massive losses this will still be sufficient to dump the beams before damage occurs.
- AFP is similar to the cylindrical TOTEM XRP, which showed the highest BLM signals, thus the same thresholds will be used. As losses could be different due to the different crossing schemes and slightly different distances to between XRP and BLMs, these might need adjustments during the run.
- TCL6 will become a separate family.
- MQMs are still under study by MP3.
  - Arjan: promises results by mid of next week whether the MQMs also should be considered for a (QPS) threshold decrease.
  - Arjan: proposes to keep the monitor factor in the IPQs and IPDs of the LSSs at 0.1 and not to increase to 0.333 before finishing the analysis. This excludes the IPQs in the dispersion suppressor as the probability to quench the quadrupole due to a UFO is considered to be very low (--> mainly dipoles affected due to energy deposition by neutral particles).
  - Maciej: asks if it would be possible to mount dosimeters close to the ALFA pots to assess the integrated dose due to AFP pot insertions.
    - Mario proposes to contact Federico Ravotti from RP.
- MPP endorses the changes in BLM thresholds, with a baseline of maintaining the MF=0.1 in all the LSS. If required the MF can be increased in a future TS.

#### 1.4 MQY symmetric quench protection issues (G. Willering)

- Current protection based on asymmetric quenches with differentiation between 2 apertures, magnets or cold masses. Other strategies based on di/dt measurements are under development but their implementation is not immediate.
- For IPQ a 100mV drop could be detected in 10ms
  - Bernhard: The initial protection assumption (where the total voltage threshold was lowered to 100mV for the quench tests) was wrong as we would not have been able to see a symmetric quench (the voltages cancel out).
- For beam induced quenches the difference between two poles is very small, thus, we are insensitive.

- Solution: subtract the inductive part from the total voltage. This requires a reliable and measurement of  $di/dt$ . This solution will not be available before 2017 or the end of run2. In the mean time it is proposed to lower the assymmetric QPS threshold from 100mV to 40mV, assuming that even beam induced quenches are never 100% symmetrical.
- Feasibility: Checked 2 full cycles with no fuse trip during a thunder storm and an electrical perturbation. No trips expected due to the lower thresholds, excluding MQYs right and left of IP5, which show significantly higher noise levels than the other IPs.
  - Arjan: we should keep conservative BLM thresholds for D1 and triplet.
  - Markus: MPP endorses the presented proposal. The proposed strategy for protection symmetric quenches of IPQs (lowering QPS thresholds and decreasing likelihood of symmetric quenches by keeping conservative BLM thresholds) should also be included into the considerations when revising the BSRA thresholds (for likelihood of quenches of Q4 and Q5 following regular dumps).
  - Arjan: Could we get a matrix where and how often of losses, which can cause beam induced quenches can happen and which magnets are affected? **Action:** Provide list with failure cases and failure probability and affected magnets to MP3 (BLMTWG, Anton).

### 1.5 Replacement of RD1/RD34 power converters for increased rejection of network perturbations (H. Thiesen)

(see EDMS Doc 1534654).

- 2015: 20 dumps because of (external) electrical perturbations, the PCs couldn't maintain the required current stability at its output during these perturbations.
- PCs equipped with thyristors with a LF cut will be replaced by slicing PCs with an intermediate energy storage level. Impact on the ring is unknown. Crowbars will be replaced by diodes.
- Frequencies sent to the magnets: at 10kHz, 10 ppm can be tolerated, the PC should input 1 ppm of these perturbations, actions are necessary.
- The new power converters will be installed in parallel with the old ones to ease operation and prevent downtime.
- During LS1 the 18kV switch was installed. The PCs should be manufactured in 2016. Installation and commissioning should happen in EYETS for both the 2xRD1 and 2xRD34.
  - Ivan: Can a test be conducted with the FMCMs connected to the new power converter type
    - Hugues confirmed that this can be performed while the PCs are above ground on test benches.
    - When? September.
  - The controls aspects of this hot-spare configuration should be discussed with OP/CO, as one would want to avoid two different types of PCs to be controlled / switched between.

## 1.6 AOB

- Jorg: after phase advance optimization it was finally decided to change the settings of arcs 56 and 81 to adjust the phase between MKDs and triplets/TCTs. This means that changes in  $\beta^*$  for any IP will require special optic. This will be presented next week at the LBOC by Riccardo.