96th Meeting of the Machine Protection Panel

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1 Presentations

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 Status of (automatic) abort gap cleaning procedure – S. Mazzoni

- The focus of the presentation is on the new interlock logic implemented in the FESA software of the new BSRA implementation
- The software executes automatic calibrations in three ways:
  - Via a voltage-gain curve (before injection)
  - Via the synchrotron light generated with the pilot beam (injection)
  - Via a periodic system check (frequency TBC, probably 1 every hour): comparison with FBCT measuring a bunch of known intensity; Bernd comments that attenuation is needed for the comparison with the bunch intensity
- The BSRA will publish a warning status in case of a detection of a wrong calibration
- The BSRA publishes 2 flags: “AG cleaning” and “beam dump”
- AG cleaning is activated if 5 over the last 10 measurements (@1Hz) are above the defined threshold
- The PMT gate protection determines of the BSRA behavior for the dump
- A HV feedback is implemented to follow intensity variations and switch attenuators if the PMT goes into saturation
- To protect the gate the BSRA is switched off (for some seconds) for the introduction of suitable filters
- If the gate alarm occurs when the signal is already above the dump threshold then a dump is triggered. Markus comments that the abort gap population cannot rise suddenly, so no bigger problems should be expected due to this self-protection mechanism.
- Jan comments that 5 seconds is very low, as the physical process takes longer then this. Stefano explains that this can be adjusted in the running average, as it is just a parameter in the software
- Ruediger asks what is the possible damage of the instrument due to missed gate protection? Stefano explains that it would accelerate its ageing.

- The final thresholds have to be finalized: 'start cleaning' could be triggered around 10% of the quench level of Q4 and Q5
- Jan adds that there are two reasons to dump: the first is to avoid a massive quench of several magnets; the second is that big population implies not having the full control of the machine, in which case dumping the beam is advised. The 'start cleaning' should be triggered only well above the noise level and be limited by the quench levels of Q4-Q5
- Daniel comments that the impact of cleaning on losses in other locations should be taken into account
- Jan adds that a practical strategy would be to set the dump level 10 times above the cleaning value. To be cross-checked with studies made by Bernhard on this.
  Action: Jan will present a proposal for levels to commence operation I 2015 towards the end of the year.
- Bernd asks what is the gate length. Stefano explains it is 3 us, while the bin size is 100ns. Bernd comments that protons from bunch 1 have been observed to spill into the abort gap, which gives an offset for the abort gap population. Enrico explains that this is not a problem.

Discussion:

- An MD would be needed to calibrate the new optical line, to be added in the commissioning schedule (Action Jorg).
- The software development from BI should be followed by an update of the Java application for the AG cleaning and the implementation of the functionality in the SIS (Action OP).
- Jan: The SIS will set a default cleaning strength of LOW/MEDIUM, while it will always remain possible to override via the Java Application.
- A. Di Mauro commented that proposal was made and discussed in the past to provide alternative measurements from the experiments: ALICE could provide data at low frequency and contribute to the calibration. Jan and Markus confirm that it's indeed useful to maintain this ideas a backup measurements.

1.2 Beam dumps following trips of EXP magnets – MSS hardware upgrade - S. Ravat

INTRODUCTION (Markus)

- 2 trips of the CMS solenoid and of the LHCb magnet were observed in August 2012.
- In the first case high losses were observed in IR7 and the dump was triggered by the SIS (HV monitoring of the BLM); the initial cause of the losses was a trip of the CMS solenoid (due to a cooling) failure, that caused 3 minutes after the initial fault the dump of the particle beams.
- In the logging database large orbit deviations can be seen following the trip of the CMS solenoid

- the orbit feedback was not active during stable beams in run 1, as temperature effects lead to mis-steering of the orbit via the feedback (Jorg); for run 2 one could consider having the orbit feedback working also during stable beams
- The second event was related to a trip of the LHCb dipole magnet
- CMS has a dedicated entry from a CIBU to the BIS, which was not connected in run 1; LHCb has also a CIBU to the BIS, connected already during run 1.
- MSS (the powering protection for experiments' magnets) is being upgraded for the restart of the LHC
- The idea is to connect the MSS to the BIS and commission the inputs for run2

PRESENTATION (S. Ravat)

- The same Magnet Safety System (MSS) is used for all LHC experiments
- It was decided to redesign the MSS as some components will become obsolete
- The upgrade will allow reducing the time delay the MSS induces before requesting the beam dump after the trip of a magnet or power converter
- The upgrade of the MSS will by the end of LS1 only concern Alice (solenoid and dipole) LHCb (dipole) and Atlas (central solenoid, only MSSa); the plan is then to upgrade all the remaining items during the LS2.
- The MSS rack is composed of 4 types of crates (API, ACS, LCS, APC).
- The reaction time during run 1 was limited by safety relays in the APC to 15 ms. These will be replaced with optocouplers to reduce the delay to 1 ms.
- In the MSS2 the MAC module inherits the APC functionality
- Tests and validation of the new input will be performed in collaboration with Christophe Martin from the BIS team during next week.

Discussion:

- Markus comments that this solution is acceptable for MPS during run2, as for the most critical warm magnets in LHCb and ALICE the MSS2 will be already deployed
- Markus adds that it should be defined how to connect the redundant signals to one CIBU (still to be discussed with Christophe)
- It should be checked if the cabling of ATLAS and CMS MSS is already there to be connected to the BIS
- The question was raised if masking of such signals should be foreseen from the experiment side not to prevent operation in case of a major fault of an experiment magnet. Markus comments that there's always the possibility in case of big issues to intervene on the BIS. Rudiger comments that masking is critical normally, but in this case it could be considered to mask at the MSS level.
- CMS and ATLAS fast discharges have a time constant of 15 min, whereas the slow discharge takes several hours. It should be considered restricting the beam dump only to failures resulting in fast discharges. S. Ravat says it is possible by reprogramming the FPGA.

- Action: Markus suggest preparing a document with the final implementation and distribute it for comments.

1.3 New method for the validation of aperture margins in the triplet – V. Chetvertkova

- Vera reminds about the LHC collimation system. An extra TCDQ (block C4.L6) was added during LS1. Roderick comments that the settings in slide 2, taken from the design report, (e.g. 8.3 sigma for the TCT IR1 and IR5) are different from the ones in use. Vera explains that these values were only used for a proof of concept of the method.
- The method consists in measuring the aperture of the triplet by creating an orbit bump with 4 correctors and starting to retract the collimators until losses are observed in the various elements (TCSG, TCTs, triplet).
- The orbit in case of a 4-corrector bump reproduces exactly the orbit resulting from a MKD.H misfiring (i.e. causing an asynchronous dump)
- The central MKD is considered to be firing out of the 15
- A multipole is used in MadX to describe the MKD. Jan suggests using a corrector to generate the kick
- Roderick tries to quantify the angles in slide 6 in terms of sigma. Jan comments that the interesting case is for the TCT and TCDQ, for less than 10 urad.
- The considered optics is the ATS for 2015

Discussion:

- Jan tries to define the scope of the study: he thinks the best application is to check the ratio of the losses observed at the TCT, TCDQ, TCSG and triplet in case of an orbit bump
- Jorg comments that one should probably start by defining exactly what one wants to measure in order to converge towards a possible procedure which then could be applied during an MD for validation of the method.
- Roderick adds it would be useful to extend the same exercise from point 6 to point 1, even this would require significant efforts.
- Outscattering can cause significant losses therefore Six Track (rather than MadX) should be used to compare simulations with measurements.
- Roderick suggests checking the impact of the retrigger of the other 14 kickers on the overall kick strength. It could be better to take as a reference the kick of the last kicker.