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139th Meeting of the Machine Protection Panel

Participants: A. Boccardi, C. Bracco, R. Jones, M. Kallikoski, T. Lefevre, Y. Nie, J. Popisil, C. Schwick, A. Topaloudis, J. Uythoven, M. Valette, M. Wendt, J. Wenninger, D. Wollmann, C. Zamantzas, M. Zerlauth.

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#138's minutes

- No actions from 138th MPP.
- No additional comments were received on the minutes; they are therefore considered approved.

1.2 Interlock BPMs - IR6: Review of HW failure cases and overview of planned hardware changes during EYETS (M. Wendt, T. Lefevre)

- The upgraded BPM interlock system in IP6 being in operation since LS1, is reviewed. The status is the following:
- Hardware modifications during LS1 include 50 Ohm terminations, new firmware and FESA classes, an expert GUI and improved long term stability with acquisition electronics in water cooled racks.
  - Jan asked about the status of the PM buffers and related routines to analyse the PM data.
    - The signal is now split and the processing is running on different hardware with different firmware, one for the orbit feedback and one for the interlock. The XPOC buffer is currently pointing to the wrong data set. The proper buffers are available in the orbit feedback buffer. It is know that there is a bug in the interlock BPM firmware concerning the PM buffers, but reviewing the firmware is a lot of work. It is not foreseen to patch this before LS2.
    - The modification was motivated by the addition of new functionalities. The firmware now stores the last 154 turns of each bunch so one can see which ones became unstable and triggered the interlock; the min max position for the last 1024 turns are also stored. This is presently only available via the expert GUI.
  - R. Jones commented if there was a spike coming from the electronics taking care of the interlock and not from the hardware BPMs one would not be able to see it in the PM data and diagnostic would be difficult. Markus confirmed this concern and stated it would be better to get the PM data via the system on which we interlock.

- As the amount of work required to redo this system is non negligible and the data on which the interlock is based is stored in the expert GUI; it is not seen as a priority by BI.
  - Jan added that the question remains if this data should stay at an expert level or be accessible for everyone. Daniel reminded the commissioning was going to start in two month and an agreement should be reached before that.

Action (Jan): Since a consensus might not be reached during the MPP a coffee with Nicolas is organised for 16/02/2017.

- At some point during the Ion run the sensitivity was improved for interlocking by adding amplifiers, the system was designed, built, installed, removed and forgotten in 5 weeks. It would increase sensitivity by 24dB if installed again. The weakness was that it didn't provide full redundancy (one power supply for the amplifier of both channels). The BPM team asked if this was still needed.
  - Daniel asked how long in advance such a request should be made. A two month prior notice should be enough.
- The additional amplifier was installed in a way that doesn't comply with MP standards, the failure scenario would be the following: if the power supply would fail during a fill there would be no signals anymore and this would be interpreted as the beam being absent. Therefore the interlock would be disabled. This was mitigated by a software (SIS) check/interlock and these amplifiers should now be included in the verification chain and independet power supplies used, if installed again. The amplifiers are redundant so both would need to fail at the same time for this to happen.
  - Jan asked if in that case the injection would be prevented afterwards.
    - R. Jones answered yes, via the calibration check.
    - Andrea added that implementing a hardware interlock for the case that both channels are disconnected would prevent injection, as the non circulating beams would be interpreted as fault. Therefore this was never foreseen in the current BPM interlock.
- About the doublets that will be injected in the LHC for scrubbing: the BPM system was not made to deal with a bunch spacing below 25ns, if there was a doublet in the machine one would see a fake orbit drift of a few millimetres, which would violate the interlock limit of the IP6 BPMS.
- The challenge with the interlock BPMs is the large sensitivity range required, the sensitivity to doublets is quite challenging to add but this constraint is also relaxed by the low resolution required for doublets (mitigation measures).
- The solution to deal with doublets would include a time delayed bpm signal where the signal from one electrode is delayed by 10 ns and combined with the other. This signal would be subtracted numerically afterwards. This would cancel sensitivity to LF noise, drift and aging. The analog design is still at a simulation stage. This layout would also improve against noise and phase

errors. It would provide both position and intensity for each bunch in a doublet, thus, allowing for intensity dependent sensitivity and dump thresholds without relying on the BSRT. This would require for more buffers but more memory could be made available.

- o Manfred asked if there was anything in the conceptual stage that looked unwanted as the prototyping will start soon. He also asked about the range which would be required and if the foreseen 12 mm would be enough.
    - Chiara and Jan answered the beam wouldn't survive a 12 mm orbit excursion, 2mm above the interlock limit is enough or interlocking which should then be completed with a margin.
    - The specifications on the sensitivity will come from the physics experiment and the MDs, the ion operation will not be a limitation as the intensity is lower but does not need have a higher dynamic range.
- o R. Jones proposed to update the specs with ranges which could then be reviewed by ABT and MPP.

Action (BE-BI, TE-ABT, MPP): Finalize the specifications for the dynamic range of the interlock BPMs

- Manfred concluded by adding there will be no hardware changes on the current interlock BPMs in the EYETS. Also there will be a window to test the detection of doublets in the SPS in the coming years.

1.3 AOB - Re-commissioning of MP Systems after EYETS (D. Wollmann, M. Zerlauth)

- A general review of re-commissioning of the Machine Protection Systems will be done system by system in the next two months. All responsible should update MPS commissioning procedure by the end of March (in case of changes). As in 2016 it is proposed to create shared Excel document (2016 version) to track commissioning steps concerning multiple systems (after the individual system tests) or require beam.
- The list of responsible persons per system is shown in the slides, please check that it is accurate by next MPP on February the 17th.
- A changelog of known modifications was also presented. Some of these topics are foreseen for presentations in the coming MPPs. E.g. AGK procedure for parameter change, TDE N_2 pressure, test of the AC dipole mode of the ADT, … The modifications on this changelog are ones known to the MPP, if some others do not appear please mention them to the MPP members.
    - o The cryogenic BLMs were mentioned. C. Zamantzas confirmed they have been installed, the signal is still noisy and some follow up has to be done.

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- C. Zamantzas added that the BLM (re-) commissioning procedure is ready but input concerning two hardware tests, which recently haven't been performed anymore, is required from MPP.

Action (MPP): Provide input the Christos concerning the two tests in question.

- Next step for the MPS commissioning: a 2-3 slides MPP presentation per system by the end of March and update the aforementioned commissioning document if required.

AOB - all

- Next meeting on February the 17th.