M. Valette

146th Meeting of the Machine Protection Panel

Participants: N. Augustin, W. Bartmann, C. Bracco, J.P. Burnet, M. Deile, S. Gabourin, E.B. Holzer, S. Jakobsen, D. Lazic, I. Romera, C. Schwick. B. Todd, J. Uythoven, M. Valette, D. Valuch, 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#145's minutes

- Actions from 145th MPP:
    - Mario, Sune, Maciej: Schedule a talk in a future MPP on the status of the Roman Pots, the presentation should include the strategy of insertion during the intensity ramp up.
    - MPP: Organize a joint meeting of the CWG and the MPP at the end of May to finalize the BPM and Roman Pots statuses during the intensity ramp up.
    - N. Magnin, R. Bruce: Provide waveforms to collimation from the MKD.F.B2 erratic (to compare with the asynch beam dump type 2).
    - CIBDS: Request proposal from TE-MPE-MI on CIBDS performance during reliability run and send invitation for after 8:30 meeting.
    - N. Magnin: Produce procedure to be performed after any change of the AGK length.
    - Machine Coordinators: confirm starting configuration for AGK: 288b or 144b.
    - MPP: Distribute condensed list of MPS tests to be performed with beam.
- No additional comments were received on the minutes; they are therefore considered approved.

1.2 AOB: ADT -AC-Dipole mode: machine protection tests during beam commissioning (B. Lindstrom)

- The ADT is an element that can potentially generate a strong transverse kick, which can be tuned to excite the beam in a resonant way. The expected kick at full voltage (10.5 kV) is 2.5 μrad at injection energy and 0.2 μrad at top energy. The main parameters of excitation are the voltage, the excitation length, the bandwidth and the number of excited bunches in the excitation window as well as the offset of the excitation frequency from the tune.
- The proposed tests would allow the verification of the maximum settings available for users and to benchmark the kick estimator and the MAD-X model. The details of the required tests are available on the slides, they aim at verifying the reproducibility of the excitation and the saturation with the damping on.

- o Jan commented the tests should be mostly done far from the tune to allow for a proper scaling and only a selected few on-tune.
- o D. Valuch suggested increasing slowly the excitation length for the saturation test instead of going directly to a number of turns where the saturation is expected.
- o Jorg stated the top energy test must be done as a special fill as it requires specific beams; the injection test is not an issue. Jan added one should do all the required tests at injection and only some of the top energy to demonstrate reproducibility, after having gained experience at injection.
- o Daniel added an online analysis should be prepared to verify the results go in the expected direction, a sample of ObsBox data should be provided to prepare it.
- Following an earlier email discussion Daniel proposed to protect the settings of the ADT-AC dipole for coupling and tune measurements via an RBAC role and use MCS for the maximum parameter. Jan concluded the excitation limits as a function of the total beam intensities should be defined in a procedure. In parallel to these tests, the response and reaction time of the BLMs should also be verified. The remaining question is what parameters the users require for coupling and tune measurement. The tune spread measurement will be done with a full machine but, as they are relatively similar to the others, the limits should be the same.

Action (B. Lindstrom, D. Valuch): prepare a detailed procedure and provide sample data to prepare for the online post-processing.

Action (MPP): verify with Rogelio and the tune spread team what intensities and ADT parameters they require for their measurements.

1.3 Proposal for a new implementation of the Power Converter Beam Interlock System (D. Nisbet)

- David gave an outlook on the future developments foreseen for the interlocking of power converter currents. In the future, the latest generation of Function Generator and Controller (FGC) will be installed for all converters required to be interfaced with the BIS in the whole accelerator complex. All power converters will use FGC2, FGC3 or FGClite, the goal would be to standardise the BIS interface. For example, there are currently BIS interfaces in all SPS buildings (concentrated through the obsolete MUGEF crates), interfacing ~193 converters.
- The main functionality is to remove the beam permit when the current (and/or voltage), is outside a reference function +/- the tolerance window. The permit should be refreshed every 100 µs, and the overall delay to remove it should be smaller than 250 µs. These specifications are both requirements and a limit to what is achievable.
    - o Jorg commented the width of the window should also be a parameter. For example, the transfer line magnets could have tighter

windows at the flat top and wider windows during ramp up and down when beam is not present.

- David commented this would increase complexity a lot. In the current implementation, one could define different outputs for different windows, but it multiplies the number of BIS inputs and pushes the decision logic into the BIS layer.
- **Action EPC:** A variable window would be more complex to implement for EPC but will be studied in more detail.
  - o Jorg asked which reference current was used, one from a table or the requested current from the controls.
    - It is the latter.
- The thresholds and windows have to be re-evaluated regularly. For example: in the LHC, they are protected by RBAC roles; in the SPS, every user has different settings, the MCS could assist with the settings management while being complemented by SIS. Many input signals have to be handled/concentrated into a single BIS input, e.g. up to 64 in the SPS. The masking functionality is necessary. The beam permit should be calculated by the FGC software and provide the needed functionality to allow for different users and destinations. The output would be an AND of several conditions, one can include I, V, dI/dt, dV/dt, with a fixed tolerance window around the reference value.
- Implementation will be done via an FPGA, retrieving the reference and measured DCCT current and then transmitting the permit to the BIS card and the CIBU. The measured signal is an average of the current over the last µs, published every 2 µs which behaves like a low-pass filter, therefore the high frequencies might not be interpreted correctly and will not be interlocked.
- For the Booster, the signals from the four power converters for the injection chicane in each ring would be concentrated. Contrary to the transfer lines one does not need the beam permit to be rearmed so one does not care if the permit is removed temporarily prior to the beam arriving.
  - o JP Burnet commented that it is important that a test is organised in a realistic accelerator environment (e.g. LINAC4) before LS2, which is possible for 2018 on the EPC side.
  - o Jorg added that the complexity of the interface is also an issue as evidenced during this year's restart where many problems arose. David answered that aiming at a validation test next year will allow to put the necessary emphasis on the project to address the open points already this year. Markus concluded that we have to assure that the generic solution covers all possible use-cases we have across the injector chain and the LHC, including the example of the TLs/TT10 mentioned by Jorg.
  - o Daniel summarized that the MPP encourages to perform a test with the new hardware in a realistic accelerator environment before LS2. In addition, the special use cases discussed during the meeting (and possibly several others) should be studied in detail to verify the compatibility of the proposed solution.

1.4 Overview of MP system re-commissioning requirements with beam (M. Zerlauth)

- Markus presented a list of outstanding MPS tests that were agreed to be performed during this re-commissioning period. The requested tests with beam will be mapped into the beam commissioning program that Jorg put online on the coordination pages. Many of the tests can be done as End of Fills. All responsible should check that the tests that are relevant to them.
    - o Wolfgang commented some of the tests in the excel document are not relevant for machine protection. Markus replied that indeed the list of outstanding tests mostly includes tests, which are not already part of beam commissioning plan.
- Some responsible have started completing the document, they should give it another look now that it has been updated.

1.5 MPP proposal for 2017 intensity ramp-up and update of intensity increase check list template (D. Wollmann)

- Daniel presented a proposal for the 2017 intensity ramp up. Last year, the intensity went from 10b to 2040b in 15 days. This year, a similar intensity ramp-up is propsed because of heavy modifications like the ATS optics, the replacement of a MB and the introduction of full RF detuning.
- The steps of the ramp up above 12b will require 20h or three fills at a given intensity and a checklist.
    - o C. Schwick asked what the filling pattern would be after 12b.
        - ▪ From 72b and onwards there would be a switch from trains of 12b to longer trains, ending at 144b (BCMS).
- During the scrubbing, the heating of specific elements should be monitored. There would be a checklist at 400b and at the end of the scrubbing period.
- About the Roman pots, they would be inserted after 2h in the second fill of each step and for the full third fill. The margins for AFP would be initially increased for safety, as it is a new system. They would later be removed after some experience is gained.
- The ramp up after stops shorter than 48h would include 3b to verify and 2-5 hours with 600b before resuming the pre-stop intensity. For longer stops with massive interventions, an extra stop at 50b and half the maximum reached would be needed.
    - o Jan asked Jorg about the relevance of the 48h limit. Jorg answered it really depends on the nature of the interventions in the end.
- Daniel concluded with presenting a list of system responsible for the checklist. The MPP members should verify the lists; the goal would be to update it before next MPP on May the 12th. The checklist templates are linked in the presentation they should also be updated before the 12th.

Action (MPP): Add Tatiana to the BI responsible.

AOB - all

- Mario Deile made a comment on the interlock tests of the Roman Pots. The interlock crate was not changed but some hardware was modified on the pot movement. The essential tests were successfully performed already, the results will be documented and distributed. CT-PPS does not intend to perform the machine mode dependent tests this year if agreed by MPP.
    - Daniel answered MPP approves this. And asked about the status of AFP. Sune commented the movement hardware is not finished yet so there would be no point in doing the test before. There was to be an access later that day.
- There will be a presentation from the Roman Pots experiment in the next MPP on May the 12th.
- Sune Jakobsen was appointed ATLAS-AFP run coordinator, all interaction should now go through him.