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97th Meeting of the Machine Protection Panel

Participants: C. Bracco, V. Chetvertkova, B. Dehning, M. Deile, P. Fassnacht,
K. Fuchsberger, M. Guthoff, W. Höfle, E.B. Holzer, S. Jakobsen, M. Kalliokoski,
D. Lazic, O. Stein, F.M. Velotti, D. Wollmann, M. Zerlauth.

1   Presentations

The slides of all presentations can be found on the website of the LHC and SPS
Machine Protection Panel:
http://lhc-mpwg.web.cern.ch/lhc-mpwg/

1.1   Re-commissioning procedures for the injection protection system – (W. Bartmann)

- W. Bartmann reminds about the existing test list for the injection protection system commissioning (tests during Beam commissioning and Machine Checkout). MPS aspects are listed in the EDMS document.
- TCDI alignment procedure:
  - o The jaws are set up at ±4.5σ (nominal) with respect to the reference trajectory, then one them is moved into the beam until the losses are registered by the BLMs, the same procedure is repeated for the second jaw. The test is performed with pilot beams (5e9 – 1e10 p).
  - o The alignment will after LS1 be done by a fully automatic Java tool (checks beam extraction from SPS to the Transfer Line (TL), records the BLM signal, is no beam is extracted waits for the next shot before moving the collimator, finds the beam center). Transfer Line tests are planned at the end of November.
    - § M. Zerlauth asks whether the 10Hz data from the BLMs is used by this tool and how the settings are finally propagated into LSA. W. Bartmann replies that while the tool finds the correct setting, the update of the settings is done manually. B. Dehning comments that these SPS BLMs only provide 1Hz data.

V. Chetvertkova

- TCDI setup validation:
    - all collimators are set to 4.5σ (calculated with nominal ε and β-functions), using correctors in the TL the influence of the phase oscillations from 0 to 2π is studies, the amplitude is increase from 4σ to 5σ with 0.5σ step, the procedure is done for both planes. The validation is done with an assumption that the beam is a perfect Gaussian.
    - Protection aperture is at 7sigma.
    - For post LS1 operation reference loss maps should be used for validation.
- Additional new TCDI validation: calculate loss maps with pyCollimate code (F. Velotti) for each phase and compare expected and measured losses.
    - § F. Velotti comments that the losses are checked at the collimators. C. Bracco adds that with this the most critical phase advances can be checked.
- TCDI gap control (virtual β*): for each optics the quadrupole currents are saved in LSA, for every cycle SIS compares the expected and published values, if current settings are in tolerance, SIS publishes according virtual β* (will be called optics_id in timing telegrams).
    - This solution needs half a day of implementation for database and code.
    - Can be tested without a beam during checkout. (wrong cycle/TCDI gap/quadrupole current – should be intercepted).
- MKI: Vacuum controls sends digital value to MKI for interlocking, envisage a 'sign off' procedure of the pressure level to be interlocked on. Loophole, because changes of the values are done in the PLC under the responsibility of the VAC team without direct control possible for ABT.
    - § M.Zerlauth comments that the level certainly could be read back and fed into a cross-check if deemed necessary by ABP.
- TDI validation:
    - measure attenuation (for several impact angles from MKI)

V. Chetvertkova

- o establish reference attenuation map and compare it to the results of pyCollimate simulations (also for TCLI)
- o verify TCP-TDI hierarchy (X-measurement).
  - § M. Zerlauth asks about the beam intensities for this case. W. Bartmann replies that pilots are used, as extrapolations of the intensity give a very good agreement with measurements at higher intensity.
- TDI should be checked continuously during the run (position and temperature drifts).
- Beam energy tracking system already existed on LBDS during Run1. For Run2 similar system should be added on MSI, TDI and TCDQ (see also).
  - o Transfer functions for MSI, TDI: change of the transfer function – only in the tunnel, to be checked by MCS, arming sequence not needed.
  - o MSI: proposed tolerance on the current: 1σ oscillation (the same idea for TDI).
  - o TDI and TCDQ: proposed tolerance: 1σ.
  - o TCDQ transfer function: change – in the tunnel, to be placed in MCS, BETS on TCDQ needed during the arming sequence of the LBDS. Repeat for both jaws.
    - § M.Zerlauth comments that there is no connection of the MCS to the BIS, so eventual inconsistencies in the settings should be interlocked by the BETS or by a dedicated (pre-)operational check within e.g. the sequencer.

Discussion:
- W. Hofle asked whether the interferometry was a 3rd interlock channel still. W. Bartmann replied that the interferometry measurement of the TDI gap would replace the current LVDT measurements for the BETS and hence provide a fully redundant interlocking of the BETS wrt to the current collimator position interlocks.
- M. Zerlauth stresses that Transfer functions for MSI, TDI and TCDQ cannot be changed remotely, necessary to do it in the tunnel.

- B. Dehning enquired concerning the availability of the interferometer. W. Bartmann replied that the system is not ready yet. A spare TDI equipped with such devices should be installed in the winter stop 2015-16.

- D. Wollmann asks if there are any prior tests planned to check if there are heating problems still to be expected with the refurbished MKI. W.Bartmann comments that there is no heating source available; therefore tests with beam are needed.

- B. Dehning asks about the dependability of the BETS interlock and whether they could have a detrimental effect on the overall availability. M. Zerlauth replies that the BETS principle was already used before with an excellent operational record.

- M. Zerlauth concludes that there are not too many additional tests that require beam time wrt to previous commission years. He reminds that the first TL tests are foreseen November, 22 and that the document should be updated asap.

1.2   Re-commissioning procedures for BLM system – (E.B. Holzer)

- [EDMS](#) document describes the tests to check the BLM system, no major changes from what was done at the end of Run1. The MPS tests are the final validation of the individual system tests which are planned for the whole BLM system.

- Few tests were done differently than described, some were found not to be necessary.
    - o   Direct Dump BLMs were not tested, even though reported tested (as very difficult to test).
    - o   Reaction time test at 7 TeV, optics change
    - o   Source test not done during each shut-down (but currently being executed)
    - o   Some tests are executed automatically; need to verify if they are performed.

- The document should be updated:
    - o   Take out quench tests

- o Reflect the system changes in the introduction

- o Create a separate document for blind-out systems

- o Add SIS BLM HV test

- The frequency of the tests should be defined better. New category R introduced – relevant repairs, F for firmware updates.

- Fast-failure scenarios with low intensity beams (Powering failures of RD1.LR1 and/or RD1.LR5; of selected normal-conducting quadrupoles or separation dipoles in IR3 and/or IR7) should be checked to verify that BLM thresholds and reaction times are adequate.

  - o The tests must be performed at injection and at physics energy. They must be repeated for RD1.LR1 and RD1.LR5 when the beta squeezing is reduced significantly. During the test any FMCM, powering interlock or beam excursion must be masked to ensure that the BLM system will see the beam loss as first protection system.

    - § M. Zerlauth comments that the losses will be similar (and occur mostly in IR7) for most of the failure cases. He asks about the objectives of repeating the same test if it will trigger the same crates. E.B. Holzer replies that the rise time is different (depends on beam optics and magnet that fails).

    - § Action: M. Zerlauth suggests to organize such tests in parallel with the FMCM tests which will anyway be done as EOF tests during the MPS commissioning.

- Action: The interface of Direct Dump BLMs with the LBDS should be tested. Dump the beam on TCDQ and TCSG (run for both beams). Make sure that the dump is triggered by direct BLMs. Measure delays between the time where the loss signal exceeds the threshold and the time of the beam dump.

  - § D. Wollmann asks if the signal from direct BLMs is registered.

  - § B. Dehning comments that threshold changes in the system have to happen directly on card. M. Zerlauth comments that

access is needed to change the threshold and should hence be accordingly scheduled .

- o Additional individual system tests were outlined by B.Holzer. Laboratory tests on one card for each firmware. Not to be put in the document. EMC test (to be verified for every IC).
  - § B. Dehning this kind of test is meant to check accidental triggers and is normally done by measuring the noise floor during commissioning periods. Several BLM cables have been exchanged during LS1 to improve critical locations
- o Beam energy reception test. Check if the process is running.

Discussion:

- M. Zerlauth comments that the triggering of BLM crates by shooting on a closed collimators was not tested after every shutdown. To verify the propagation delay to the BIS .
- B. Dehning comments that the test changed, but not the functionality.
- E.B. Holzer mentions that the test was done in 2 sectors in 2012. It should be done at all points.
- M. Zerlauth suggests triggering each crate at least once due to the numerous changes that happened during LS1.
- W. Hofle asks if the detectors have shown aging and why the source tests are not needed each year. E.B. Holzer replies that the reason is gas composition. However the tests are time consuming. The source tests mainly verifies the correct cabling of monitors to the BLM crates and higher level systems, no calibration is performed.
- W. Hofle asks whether blind systems are related to sunglasses.
  M. Zerlauth explains that it was finally suggested by BI to apply the change in the firmware of the concerned crates only. The solution will be ready for deployment in the first TS of 2015 and deployed as a function of the experience gained with initial 50ns operation and the first scrubbing run.
- E.B. Holzer: EDMS has already the draft for injection LICs.

- C. Bracco comments that after the refurbishment no high UFO activity is anymore expected at the MKI.

- Action: She comments on an outstanding change request to change the orientation of BLM by 90° (requested by T,Baer et al) and will report back in next week's MPP meeting.