LHC-Beam Commissioning Working Group

Notes from the meeting held on
10 November 2009

Present: Carmen Alabau, Ralph Assmann, Wolfgang Bartmann, Oliver Brüning, Helmut Burkhardt, Andy Butterworth, Rama Calaga, Octavio Dominguez Sanchez, Lene Drosdal, Massimiliano Ferro-Luzzi, Kajetan Fuchsberger, Rossano Giachino, Massimo Giovannozzi, Brennan Goddard, Eugenia Hatziangeli, Barbara Holzer, Hitomi Ikeda, Lars Jensen, John Jowett, Verena Kain, Dobrin Kaltchev, Mike Lamont (chair), Yngve Levinsen, Alick Macpherson, Malika Meddahi, Gabriel Mueller, Mario Pereira, Bruno Puccio, Stefano Redaelli, Mariusz Sapinski, Frank Schmidt, Katarina Sigerud, Gennady Sivatskiy, Ralph Steinhagen, Marek Strzelczyk, Yipeng Sun, Ezio Todesco, Rogelio Tomas, Jan Uythoven, Walter Venturini Delsolaro, Glenn Vanbavinckhove, Simon White, Jörg Wenninger, Daniel Wollmann, Frank Zimmermann.

Excused: Reyes Alemany, Roger Bailey, Stefan Roesler.

1. Follow-up from the last minutes

None.

2. News from LMC – Mike Lamont

Summary notes from previous LMC meetings, written by Brennan Goddard or Frank Zimmermann, are available here.

- Cryo-system: all ready to go.
- HW status overview: 92% of all tests done for 2 kA.
- Moving to global machine check-out from 17 November.
- LHC circulating beam commissioning foreseen as of Friday 20 November.

Jörg Wenninger: Please remember that when beam will be taken next week, all interlock will be activated.

3. Dry Run news – Reyes Alemany and Verena Kain (slides)

Week 45:

Operate the RF cavities and low level over the LHC nominal cycle:
RF control applications: o.k.
RF damper application: working well.
Sequencer tasks: o.k.

Still to be done:
- coupler: create a task to trim the Q to a given value
- abort gap cleaner: FESA class need to be completed
- RF damper loop timing event
- RF Control application: some follow-ups
- Check the orbit correctors' interface with SIS
- Test the FMCM interlock: Everything tested except RD34.LR3 and LR7, and some issues to follow.

Plans for week 46:

- LHC Timing system new release

- Prepare vacuum for access -> Alick Macpherson: matrix of valves properly defined before including it into the sequencer. Work in progress.
- Mode change with experiments and handshakes
- RBAC strict mode test
- RF dampers
- RT mapping check
- RF frequency ramp + mode change
- LBDS connection to LAS -> postponed for week 47
- Injection kickers + LBDS alarm test

Jan Uythoven: To be added to the week 46 programme: LBDS tracking tests: half a day.

Machine checkout:
PGC (powering of group of circuits) in sector 23
FGC tracking test in sector 23. Unfortunately problem with RB.A23 did not allow much progress with the test.

4. Proposed commissioning of beam-based feedback– Ralph Steinhagen (slides)

Motivation: From beam stability requirements (from Chamonix '06).
Consequences of the 2009 reduced energy operation: snapback effects are expected to scale linearly down with a factor 6. However effects such as β*-squeeze, PC transients, girder drifts remain.
Commissioning strategy: one step at a time, in 3 parts: Input concentration and sanity checks, output mapping/fan-out tests and sanity checks, and finally feedback response.
Proposed sequence to be followed: Radial loop -> orbit FB -> Q-PLL -> Q'-PLL, Q'-FB -> Q-FB. Comment: One FB system will be commissioned at a time, in order to avoid at the end to have them all only partially commissioned.
The three main lines of defence against BPM errors and faults were listed. As shown, a status monitoring is available and provides a very clear status summary. Real time feedback performance depends on the correct numerical results and the latency it had been applied. Some convenience function is available to produce simple status reports. GUI allows accessing to more frequently used functions (Optics, FB gain...). Status monitoring example was given.
Similar synopsis and tool chain applies to the cod circuits. FGC data concentration, polarity and calibration checks have been checked during HWC, injector tests and first circulating beam. FGC data fan-out mapping has never been done for all circuits. When done, feed-forward checks can be performed, by applying known RT trims and verify with LSA/measurements. Algorithm used: SVD and extended SVD, which has it benefit for large eigen values –fast correction. It was clarified that, at first, global SVD is used.
Feedback response: closed-loop response, add perturbation to the beam (orbit eigen vector), switch on FB and measure response.
Operation in 2009: could run OFB with 0.1 Hz bandwidth and / or ref. orbit taken at on to off transition. Beyond this, time is needed to re-commission and re-tune.
Conclusions:
Feedbacks are most useful when used at an early stage.
Feedback commissioning is divided into 3 components: Beam instrumentation checks, corrector circuits, feedback set-up. All is ready but ultimate checks to be done with beam.

Stefano Redaelli: Strategy with common correctors? Jörg Wenninger: do not change them, before the two beams are circulating.
Ralph Assmann: Dispersion and chromaticity measurements: do we need to switch off the FB? Jorg Wenninger: indeed, to be cautious, because if the model varies from the machine values for off momentum measurements, it is probably safer to switch it off.

Ralph Steinhagen: please note that the momentum modulation for the chromaticity measurements is very small: 1e-5!

5- Preliminary results from the 2nd sector test – round table

High order polarity measurements – Rogelio Tomas (slides)

A robust and accurate procedure was used for the measurements and allowed to obtain excellent results.
To note: Q4.R2.B1 confirmed to be O.K.
Conclusions:

- For B1 and B2 elements which were tried: "Normal" quadrupoles, sextupoles and octupole elements are in perfect agreement with model.
- Systematic reversed polarity for all skew quadrupoles and sextupoles.
- Knobs generation will take care of this opposite sign polarity.

Coupling measurements from the aperture scans – Rogelio Tomas (slides)

Thanks to the large horizontal trajectory excursion during the aperture measurements, the x-y coupling could be measured.
Conclusions:

- Beam 2 arcs 8-5 show larger coupling than beam 1 arc 23, from measurement and from preliminary models (considering the dipoles a2).
- This verifies to some level the Wise a2 components
- Need to compare to last year's data
- Need to verify the model

ABT studies - Brennan Goddard (slides)

IQC -Verena Kain: IQC was deployed and is working very well. Very useful. When beam sent on TDI, systematically got an IQC. Strategy to be discussed at the MPS WG.
TDI setting-up: Scanned both jaws through beam, looks very good in point 2. Measurements with tilted TDI –by 2mrad- were performed as well with ALICE and LHCb. Experiment signals were worse when TDI was tilted, and an asymmetry was found on one side of the scan in P8, which made suspecting a problem of alignment in TDI in point 8. There, the TDI could not be set to protection settings (±3.8mm)
MKI2 waveform measurements completed in flat top. Being anaylsed.
MKI8 waveform measurements done. Looks pretty good, length maybe slightly short, only issue is the 2% overshoot, to be adjusted.
Steering through the injection to point 8. Was adjusted before the aperture measurements. Needed some large V kicks, to be understood.
P8 aperture: Aperture restriction confirmed between MSI and Q5. VSC was making checks this morning. Survey to be checked (Q5 tilt done correctly?).
Dump studies:

- Scan of MKD strength: O.K
- Physical dump aperture looks like ~8σ in both H and V. Data to be further analysed.
- Scan of the dumped beam sweep, by varying the injected bucket number: Looks good. Compared with expectation: shape is perfect, horizontal offsets to be understood (trajectory offset, reference systems?)

RadMon data for R2E: Good news: no reading on the other RadMon in the UA.
To follow-up:
Aperture P8, unexpected losses on TDI, H trajectory in dump line, logging of some variables, TI 8 downstream steering, MKI overshoot

TCDIH scans in TI 8 - reproducibility of centering – Wolfgang Bartmann (slides)

BLM data taken as a function of the jaw positions for 3 different TCDIHs.

Conclusions:

- TCDIH.87441 and 88121: centering reproducibility looks O.K.
- TCDIH.87904: Centers do not agree, too few data points
- TCP tail scan was not possible due to lack of beam time

Preliminary results from BLM system (unmasked dump test) - Mariusz Sapinski (slides)

Four dumps were generated during the last injection test. In all cases post-mortem data have been produced. The thresholds were lowered to 3% of Quench Level. The repeatability was good, especially when a correction for the beam current signals is made (~15%). Jörg Wenninger: remember that BCT intensity has an error of about 10%.
Note that on the pictures, the green line is for beam 1 as all the other measurements were done with beam 2.
The BLM signal as a function of the bump amplitude shows that the signal increases by about a factor 2 per 0.1mm of the bump.
Latency: Difference in time between bunch at the MKI and the break of the beam permit loop recorded at the BIC. Unexplained 20 μsec. Decision at the threshold comparator for fast losses is taken every 40 μsec but might need twice that if data are split between two acquisitions. Alick Macpherson: What was assumed? Global beam permit vs local beam permit time? To be checked.

Collimator studies - Ralph Assmann (slide)
Took 18 b2 collimators in IR7 closed to same normalised settings, without collimator alignment, which gave information on the raw transmission. For some points, collimators were further close, and the smallest collimation gap found in IR3 for 3 σ was at +/-1.3 mm. In the future this will allow starting the setting up around 4mm and not 10mm. Measured emittance was assumed. Results are based on BLM measurements.

6- A.O.B. –

DAILY LHC pre-operation meeting at 17:00 CCC conference room.

Next meeting

Tuesday 17th November 2009, 15:30, 874-1-011. Agenda will be sent in due time.

Malika Meddahi.