

LHC-Beam Commissioning Working Group

Notes from the meeting held on
16 March 2010

Present: Carmen Alabau, Gianluigi Arduini, Wolfgang Bartmann, Oliver Bruening, Roderik Bruce, Helmut Burkhardt, Rama Calaga, Pierre Charrue, Laurent Deniau, Octavio Dominguez, Lene Drosdal, Alan Fisher, Massimiliano Ferro-Luzzi, Kajetan Fuchsberger, Rossano Giachino, Massimo Giovannozzi, Brennan Goddard, Per Hagen, Lars Jensen, Rhodri Jones, John Jowett, Yngue Levinsen, Malika Meddahi, Ryoichi Miyamoto, Gabriel Mueller, Giulia Papotti, Mario Pereira, Bruno Puccio, Stefan Roesler, Adriana Rossi, Frank Schmidt, Marek Strzelczyk, Ezio Todesco, Rogelio Tomas, Jan Uythoven, Glenn Vanbavinckhove, Simon White, Daniel Wollmann.

Excused: Reyes Alemany, Ralph Assmann, Roger Bailey, Chiara Bracco, Andy Butterworth, Verena Kain, Delphine Jacquet, Mike Lamont, Alick Macpherson, Ruediger Schmidt, Ralph Steinhagen, Walter Venturini Delsolaro, Jorg Wenninger, Frank Zimmermann.

1. Comments and follow-up from previous minutes

None.

2. LMC News

Summary notes from previous LMC meetings, written by Brennan Goddard or Frank Zimmermann, are available [here](#).

3. HWC news – Malika Meddahi on behalf of the Ruediger Schmidt

In the preparation to safe operation at 3.5 TeV, the HWC team is performing interventions, over Monday 15 and Tuesday 16 March:

- nQPS: Reprogramming of about 450 DQAMG cards in the tunnel to cure the setting problems (incl. increase of thresholds).
- Energy extraction: introduce delay of switch opening by 100ms.

These two interventions should fully solve the "50 magnets quench problem" (new QPS triggered quenches in 50 magnets) and should partially solve the "14 magnets quench problem" (old QPS triggered quenches in 14 magnets).

Analysis of HWC tests performed over the night of Monday 15 to Tuesday 16 is ongoing. For the moment it is proposed to continue the operational powering cycles, first without the bends, and then if there are no trips, repeat them with the bends. HWC tests will continue as well tonight.

Availability of sectors for operational cycling:

- S12-23 available Monday 15 March, 19h
- S56-67 available Tuesday 16 March, 19h
- S45 available in the morning of Wed.
- S34 available in the morning of Wed.
- S78 and S81 available midday on Wed.

4. LHC beam Re-start

Results from collimation setup – Daniel Wollmann ([slides](#))

Much work has been done by the collimation team in order to set up the collimators for 450 GeV and perform the verification programme. Full details of the measurements performed: please check out [slides](#).

In summary:

- Setting up the full system within 10h and with 2x2 people is possible, but gives rise to mistakes. 2 shifts of 8hs (including validation with slow losses) would be better.
- B1: measured half gaps (i.e. beam size) bigger than expected, as already seen in the 2009 run. For beam 2 the half gap is close to expectation.
- Beam size can be determined by full beam scraping or centering of the jaws (deviations < 30%)
- To achieve also the beam position by scraping, the scraping procedure needs to be improved
- Each collimation setup needs to be validated by creating slow losses

Questions / discussion:

Slow losses? These are losses within a few seconds, slow enough that phase space mixing occurs.

Beam positions shown on the plots are with respect to the zero as given by the collimators. Would be interesting to add the orbit information at this position.

Collimators for B1 can be opened up slightly, but care should be taken while intensity is increased. For beam 2 losses are very small. Difference between B1 and B2 remains to be understood.

TO NOTE:

- Need to check the loss map every week, can be done after the first 3.5 TeV ramp trial.
- For the first ramp: collimators will be left at constant injection values.
- Need to start closing the collimators during the ramp (~3rd ramp), will be done when beta beat corrected and orbits well under controls.

Injection and beam dump systems – Wolfgang Bartmann ([slides](#))

Further detailed studies and setting-up work have been done on the injection and dump systems. All details to be found in Wolfgang Bartmann's [slides](#).

Transfer lines:

- Overall performance is fine so far and injection OK with low losses (5e9)
- Need to track stability of injection and trajectory
- Interference with LHC 'Cured' by switching lines off when not injecting

Injection:

- Steering of the injection oscillation to be done once per week – and TCDI re-adjustment needed?
- Beam losses at injection still under study

Additional information: there are different chromaticity settings in the SPS at extraction for the LHC INDIV and LHCPROBE. It was clear that the losses happened on the first turn and the beam spot was huge onto the beam dump. To be tested in the SPS and in the TL, as soon as Wednesday afternoon 17 March when beams are back in the SPS.

Set-up the TL collimators to be done?

SPS BQM checks only the longitudinal plane.

Beam dump: Overall status and performance look very good. Some issues and tests still pending

- Interlock BPM thresholds to deploy
- BETS test for 3.5 TeV ramp
- XPOC full deployment?
- TCDQ movement – software issues

- Completion of all MP tests for higher intensity

MQKA/AC dipole: fully commissioned with beam

Short term outlook and to do:

- 3.5 TeV ramp with beam Thursday
 - BETS test maybe tomorrow night
 - Collimators to 'ramp' at same time (TCDQ) -> not for first ramp where they will be set to "injection" position
 - Deploy IR6 interlock BPMs
 - Protection device settings and thresholds into control system
- Maybe higher intensity over the w/e
 - Finish main MP checks for LBDS first (without and with beam –this will take some time –maybe 1 shift?)
 - Setup TCDI B1 in TI2
 - Demonstrate reproducible clean injection of $5e10$
- Losses at injection: studies to continue B1/B2 difference in injection losses, B2 TDI Q3 spike, losses with TCDIs, higher bunch intensity, BLM thresholds ...

Comments/Discussion: on slide 3: losses shown are for the worst case i.e. grazing incidences on the TDI. With this information, it is proposed to scale the corresponding intensity which would give a quench. To be evaluated by the BLM team. Remember TDI must protect against damages, not quenches.

Generating Machine Collimation Settings from Beam Data – Roderik Bruce ([slides](#))

Very nice work has already been done on generating machine collimation settings from beam data. All details: [slides](#)

Status and future work:

- Files are generated with a format readable by the control system
- Import tested (takes time, but works)
- Future work
 - Thresholds for warning and dump calculated from LVDT readout
 - Graphical user interface under development
 - Generation of functions internally from LSA (S. Redaelli, alternative to Mathematica tool)
 - Energy dependent limits

Comments / Questions:

- Running this simulation for the moment on a laptop or in the office. Not yet operational.
- Consistency checks done after threshold generation? yes- can also be graphically visualised to spot inconsistency.

TO NOTE: Please forward threshold requests to the collimation team.

Aperture measurements – Stefano Redaelli

Stefano Redaelli reported on the aperture measurements which were performed over the last days. Much interesting results have been obtained.

A- Standard method ([slides](#)): orbit oscillations. ~3-4 hrs per beam are needed to perform the measurements. Examples of the measurement results were given. Cross checks were done with MADX on line and agreements were excellent.

Summary: Standard method of oscillating orbit bumps completed for both beams, for the on-momentum case with separation ON. The aperture is above 9 (H) / 11 (V) nominal sigmas. More detailed calculations are ongoing to take into account measured beta-beat and emittance. Detailed n1 estimates are under preparation. Aperture kicker was also used to blow up the emittance and beam sizes were measured at the wire location. Increasing the kicker strength to its maximum and could not reach the

aperture bottleneck, maximum amplitude at the wires were $A_h = \pm 8.5$ mm and $A_v = \pm 12$ mm. Nice measurements of detuning with amplitude was obtained.

Beam time requests:

- Off-momentum aperture measurements - 8h
- Local bumps to re-centre apertures - 4h
- Local measurements of quad for squeeze - 8h
 - Repeat IR measurements?

B- Alternative aperture measurements ([slides](#)). The procedure was recalled. The results are very consistent with respect to the standard method, the same bottlenecks are found and the preliminary estimates of n1 are consistent. Losses in point 4: secondary showers. Aperture scans were presented. It was noted that losses at collimator can be correlated with the losses in the arcs. The method is very fast method: measurements can be done in about 40 minutes.

Beam time requests:

- Repeat for beam 2 - 4h for both planes
- Off-momentum n1 measurements - 8h

Beta beating study – Rogelio Tomas ([slides](#))

The campaign of beta beat measurements and corrections continued and Rogelio Tomas presented the very interesting results obtained.

The local correction performed in IR1 and IR6 at injection worked very well. These corrections are not implemented yet. A re-iteration is needed in IR7.

At 1.2 TeV, the measurements show some deterioration in H plane as compared to last year.

The beta beating at 450 GeV is better than at high energy -no correction were applied at 1.2 TeV, the injection correction were brought down linearly to zero, from 450 GeV to 1.2 TeV. **To check:** stay on the same side of the hysteresis?

From the measurements done at 1.2 TeV, the candidates are only triplets and MQWBs (no MQWAs). Corrections were attempted and successful.

Comments: To add the nominal settings of the magnets, in the summary table of candidate and % of current changes requested.

Questions to follow-up:

- Should we further correct at 450 GeV?
- How to go about correcting at 1.2 TeV and beyond?
- Massimo Giovannozzi requested new IR7 optics with stronger MQWBs (to avoid the remanent magnetization).

Beam commissioning planning – Gianluigi Arduini - Malika Meddahi

Planning for the next days of the LHC beam – [link](#)

5. A.O.B.

Daily 8:30 HWC meeting in the CCC conference room (09:00 at weekends).

Daily 17:00 Beam commissioning meeting /OP, CCC glass box.

Next meeting: 16 March 2010, 15:30, 874-1-01. Agenda will be sent in due time.

Malika Meddahi.