LHC-Beam Commissioning Working Group

Notes from the meeting held on
2 March 2010

Present: Masamitsu Aiba, Carmen Alabau, Gianluigi Arduini, Ralph Assmann, Roger Bailey, Wolfgang Bartmann, Chiara Bracco, Roderik Bruce, Oliver Bruening, Helmut Burkhardt, Andy Butterworth, Rama Calaga, Pierre Charrue, Laurent Deniau, Lene Drøsdal, Alan Fisher, Massimilano Ferro-Luzzi, Rossano Giachino, Massimo Giovannozzi, Brennan Goddard, John Jowett, Per Hagen, Lars Jensen, Mike Lamont (chair), Malika Meddahi, Ryoichi Miyamoto, Gabriel Müller, Giulia Papotti, Mario Pereira, Bruno Puccio, Stefan Roesler, Adriana Rossi, Frank Schmidt, Marek Strzelczyk, Ralph Steinhagen, Ezio Todesco, Rogelio Tomas, Jan Uythoven, Glenn Vanbavinckhove, Simon White, Uli Wienands, Walter Venturini Delsolaro, Simon White, Daniel Wollmann, Frank Zimmermann.

Excused: Reyes Alemany, Verena Kain, Alick Macpherson.

1. Comments and follow-up from previous minutes

- Improved model of the LHCb spectrometer – Massimo Giovanozzi (slides)
  During the 2009 beam commissioning, the nominal bumps of the spectrometers (LHCb and Alice) were found to not close. The bump closure was easily established, but this triggered the issue of improving the situation.
  Strategy:
  - Re-measure and re-check parameters of spectrometer compensators;
  - Collect data from measured field map of the experimental compensators;
  - Improve the representation of the experimental spectrometer in the MAD-X model;

  New MADX implementation:
  The single spectrometer magnet is replaced by a sequence of thick kickers.
  Each kicker has a strength given the field map at the corresponding location.
  The bump generated by the sequence of kickers is closed using the three compensators (imposing also a passage through zero at the IP).
  A set of files is provided to generate and install the set of kickers, and the new definition of the compensators' strength
  - mbaEw_model.madx -> with E=a, or l
  - mbaEw_install.madx
  - job.sample.mbEw.madx

  NB: the spectrometer and its compensators are not in the plane of the machine. A non-closure of the bump implies a leakage also in the orthogonal plane.
  The strength difference was given.
  The new model is now available, the knobs are to be generated to compensate the spectrometers. **Action: Stefano**

- Expected snapback at 3.5 TeV – Ezio Todesco (slides, from p12 onwards)
  Decay and snapback of dipole and quadrupole main component are negligible. What is left is the decay of b_3. Much work is on going on this subject. And the problem is still under analysis.
  Summary on the snapback – new measurements:
  - In 2009 we probably run with a 30% correction (0.1 units instead of 0.3 units)

- Snapback should double from 2009 according to measurements
- We have some doubt on the speed – this could add an additional uncertainty of 0.2 unit

2. LMC News – Mike Lamont

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

Some of the subjects discussed:

- LHC MAD.
- Effect of pre-cycling on beat beating.
- Luminosity estimate.

To note: Regeneration of the function for Q4.LR3, Q5.LR3 and Q4.LR7, Q5.LR7 were done in order to bring their current to injection energy (~35 A) instead of leaving them at 20 A until injection request is sent. A new pre-cycle was done on these magnets and all was fine –Finished at 35 A.

3. HWC news – Gianluigi Arduini

Powering failure during a test ramp to 6 kA followed by fast power abort triggered 50 quench heaters. The origin of that is related to the so-called “sunglass” adaptive filter normally supposed to prevent the quench heater firing when we have a fast power abort. Being investigated.

Tests performed in view of the 3.5 TeV operation: study the behavior of the RB circuits while switching off the converter and opening of the energy extraction system performed on RB.A12 and RB.A23
8hrs needed for HWC this week, tentatively scheduled on Thursday morning shift.

4. LHC beam Re-start

Malika Meddahi made a brief status of the LHC beam re-start (slides).

Concerning RBAC, after last week LBCM presentation, it was expected from the equipment group to verify that their ROLES and RULES comply with the presented RBAC policy. Saturday morning a missing entry in the LHCTM access map was preventing the RF-Expert to commit their trim. Today a missing entry in the QpsAmx access map was preventing the QPS-Expert to access the QPS device. In both cases the RBAC team was present and helped to solve the problem.
Please be aware that the machine mode “Beam set up” is “non- operational” while the machine mode “Access” is “operational”, as presented in the RBAC slides of last Tuesday. The RBAC team is available to check the access maps with the equipment groups and a test with the OPERATIONAL mode on is expected in the coming days.

Dumped beam event- coming from the BIS of the timing system, do need the correct conditions. Same problems with the post mortem issues.

Injection and dump commissioning – Brennan Goddard (slides)

Overall, from the first pass done on 27-28th Feb, the systems performed very well for both beams. In short:

- Injection
  i. MKI synchronisation checked and OK
  ii. Some minor re-steering of injections at few urad levels
  iii. Residual injection oscillations already very good
  iv. MKI kick missing gave beam on TDI a few times
  v. Sequences for inject & dump, circulate & dump gave problems

vi. Injection onto TDI still gives interlocks (in long timescales)
vii. Loss spike on P8 Q3 still present

- Dump
  i. Beams dumped OK
  ii. Bunch is near bucket 1
  iii. Sweep shape looks good
- Issues
  i. Injecting found TCTH4.L2B1 in P2 wrongly closed, threading found TCTH in P1 wrongly open
  ii. MKI kick missing for a few injections – Abort Gap Keeper problem?
  iii. No 'beam dumped' events in I&D/C&D when BIS loop broken – prevented TD BI readout
  iv. Dump triggered by beam on TDI at long integration times
  v. Spike still present on Q3 for B2 injection onto TDI
  vi. XPOC server and BCT acquisition issues – now solved
  vii. IQC problems with BLM acquisition – now understood
  viii. Sequence issues for I&D/C&D – tidy-up needed
- To do now: Solve timing issues, Tidy-up sequences, XPOC and IQC checked and unmasked
- To do this week:
  - 4 h beam: start real dump tests (AGK, synch, aper, …)
  - 4 h beam: injection studies (losses at TDI, steering to golden, Q3, over injection)
- To do later (before ramp / higher intensity)
  - Remaining checkout (interlocks, BETS, TCDQ ramp, …
  - All systematic checks and tests…

In progress: BLM time window to be re-adjusted at the location of the TDI

Alternative method to determine available n1 – Ralph Assmann (slides)

Method:

1. Calibrate beam position and size at primary collimator.
2. Retract all collimators.
3. For single bunch of 3e9 p blow up x/y emittance or increase momentum offset until losses occur at overall LHC aperture bottleneck.
4. Repeat this measurement while closing the primary collimator to setting n1'.
5. Once the primary collimator starts shadowing the overall LHC aperture bottleneck, record n1'.
6. Calculate n1 as n1 = n1'/1.21.
7. Required setting of primary collimator: 0.86 * n1

Do the measurements for the following cases:

- X plane, on-momentum
- X plane, +/- off-momentum
- Y plane, on-momentum
- Y plane, +/- off-momentum
- Energy aperture +/- off-momentum

In total:

- 8 cases for complete characterization of on- and off-momentum n1.
- Use RF frequency trims and Qx/y resonances and/or transverse damper.

Request to test method (soon): 3h beam time at injection, 3e9 p in one bunch
Once corrected orbit and beta beat, assumed stable.
Request to perform the full measurement: 8h

This method would provide the information on the apertures which must be protected and the settings of the collimators with the agreed hierarchy. To be done at injection, top energy, squeeze and un-squeeze.
It was pointed out that emittance blow-up techniques are regularly used in the SPS. The new components of the proposed LHC approach are the precise cross-referencing of the aperture bottle-neck to a calibrated collimator jaw position and a straight-forward experimental determination of the n1 parameter in the LHC.
These measurements will be performed in the LHC.

Beam commissioning planning – Malika Meddahi

Planning for the next days of the LHC beam restart was discussed, as well as the plans for the "hump" investigations (slides and slides p7-8). The planning and hump investigation will be discussed daily at the 17:00 meeting.

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: **9 March 2010,** 15:30, 874-1-01. Agenda will be sent in due time.

Malika Meddahi.