

LHC-Beam Commissioning Working Group

Notes from the meeting held on
9 March 2010

Present: Carmen Alabau, Roger Bailey, Wolfgang Bartmann, Chiara Bracco, Oliver Bruening, Helmut Burkhardt, Andy Butterworth, Rama Calaga, Pierre Charrue, Laurent Deniau, Alan Fisher, Massimiliano Ferro-Luzzi, Brennan Goddard, Per Hagen, Delphine Jacquet, Lars Jensen, Rhodri Jones, Mike Lamont (chair), Y. Levinsen, Alick Macpherson, Malika Meddahi, Ryoichi Miyamoto, Giulia Papotti, Bruno Puccio, Frank Schmidt, Marek Strzelczyk, Ezio Todesco, Rogelio Tomas, Jan Uythoven, Glenn Vanbavinckhove, Simon White, Jorg Wenninger, Daniel Wollmann, Frank Zimmermann.

Excused: Reyes Alemany, Gianluigi Arduini, Ralph Assmann, Rossano Giachino, Massimo Giovannozzi, Verena Kain, Stefan Roesler, Ruediger Schmidt, Ralph Steinhagen, Walter Venturini Delsolaro.

1. Comments and follow-up from previous minutes

Results from the improved field model of the LHCb spectrometer: non closure of the orbit from LHCb and ALICE magnets seems to be a factor 2 better than last year. To note: Forgot to include the pre-cycle of the compensators this year.

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:

- Electronic radiation tests performed in CNGS
- LHC hardware commissioning status
- Mandate of the task forces set up after Chamonix 10.
 - o SPS upgrade – Volker Mertens
 - o Triplet insertion upgrade – phase 1 and 2 - Lucio Rossi
 - o Booster energy upgrade – Klaus Hanke
- 8 kHz perturbation (Damper and Power convertor). Check out the minutes for all details.
- Fresca tests

3. HWC news – Ruediger Schmidt (e-mail communication)

In the preparation to safe operation at 3.5 TeV, the HWC team has requested two tunnel interventions:

- 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 (no intervention on power converter, since this is not so easy to delay the power converter switch off).

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)

Schedule: intervention on Thursday 11 March, and then on Monday 15 and Tuesday 16 March 2010. To Note: Information is preliminary, pending approval of the TE Department (and LMC).

4. LHC beam Re-start

Hump study summary – Malika Meddahi – Gianluigi Arduini ([slides](#))

A lot of checks were performed and for the moment no culprit was found. More investigation is planned varying i- RF, with distributing the total voltage differently between across cavities, ii- He flow on the beam screens, iii- Repeat the BLM measurements with RF on and off. Brennan Goddard said that no LBDS equipment can be switched off while performing the checks with beam in the machine.

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

Much work has been done and very good corrections were found and applied in IR2, IR3, IR7 and IR8. The beta beat was reduced and is now very close to specification for both beams, both planes and was reproducible after cycling of the magnets (<5%). This was an extremely encouraging results, which allowed to move forward in the commissioning steps, knowing that the optics was already pretty well understood. The trim on the MQWA improved as compared to last year. But for MQWB, the trims has not diminished, and are still large, although not much current is used in these magnets. Aperture kickers, AC dipole (to be commissioned) and increased bunch intensity will help in getting a better resolution.

Local coupling is over corrected. Local corrections with IRS skews should improve the coupling.

To do: Beta star knobs – AC dipole commissioning – test extra local and global correction at injection - test local coupling correctors – Precise measurement of off-momentum beta beat – measure and interpolate local corrections during the ramp.

It was agreed to keep the beta beat corrections which are so far in the machine.

Injection and dump commissioning – Chiara Bracco ([slides](#))

Extensive programme of measurements and checks were performed on the following systems: Interlocked BPM IR6 – TCDQ – TDI – MKI – Abort gap keeper – IQC – MKQ/MKA – BTV – LBDS (sync. and time stamp of inject inhibit) – Inject and dump.

To do :

- **Beam losses at injection:**
 - o Losses for B1, especially issue of losses at TCSG/TCDQ (dedicated local aperture checks?)
 - o Over-injection of B2 onto TDI – Q3 loss spike and TDI loss thresholds
 - o Losses on TCDIs and scraping in SPS (required for higher intensity)
- **First serious look at injection matching (linked to above):**
 - o Steering optimisation, emittance, dispersion & optics measurements
- **Continue with LBDS MP beam tests:**
 - o Still a large number of test steps to do – and all anomalies to check
- **Continue with Injection MP tests:**
 - o Including setup and protection level checks of Protection devices
- **Follow-up of the various small HW issues & test where needed**

All these are pre-requisite for higher intensity (multi bunches) and stable beams.

RF – Andy Butterworth ([slides](#))

To Do:

- Phasing of 6 cavities -1 hour with circulating beam
- At each increase in bunch intensity, readjust front-end gains - 30mins, inject & dump
- Collision point adjustment with experiments

- Commissioning of ramp: stable phase program -2 observation ramps + 1 trial ramp
- Adjustment of capture voltage
 - observe synchrotron frequency + quadrupole oscillation on flat bottom
 - half nominal intensity, longitudinal emittance: 2 hours
- Fine matching of energy for both beams at injection or distribution of frequency error between the 2 rings?
- Optimisation of beam control loop response –i- with captured beam at injection and along ramp ii- controlled measurements of loop step response and eventual optimisation
- Radial loop? To close?
- RF lifetime measurement?
- Procedure for injection phase optimisation?
- Longitudinal damper (later)

BQM to provide the on-line bunch length measurements (Giulia Papotti)

Beam commissioning planning – Mike Lamont

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

Laurent Deniau: Re-analysed the data from the main arc (dipoles) – Found some discrepancy in the data, where the warm measurements used had not not updated. Marek Strzelczyk has loaded this updated mode; therefore: re-check the phase advance and beta beating with beam. Main change is the b2 in the dipole (variation of 0.2-0.3 units).

Ezio Todesco: 3.5 TeV: analysis of the snapback is on-going and will be completed by the end of the week.

Pierre Charrue proposed that the Machine mode “Access”, which was declared “RBAC non-operational” over the last week end, be put back to “RBAC operational”. This was agreed.

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.