Minutes of the Booster Commissioning Working Group held on 14th of March 2011

Present: S. Damjanovic, A. Newborough, A. Lombardi, L. Hein, T. Hermanns, K. Hanke, C. Carli, I. Kozsar, M. Widorski, F. Regis and B. Mikulec.

Agenda:

1. Communications
2. Follow-up of open actions
3. Update on LBS line upgrade plans (T. Hermanns)
4. PSB Fluka simulations - LHC-type BLM response (S. Damjanovic)
5. AOB

1. Communications

Nothing special.

2. Follow-up of open actions

The list of open actions has been discussed and a couple of actions closed. The action to study the feasibility of putting collimators in Linac4 has been closed, but discussions should continue to evaluate the need of upstream collimation to protect the PSB injection equipment.

Assigned to	Start date	Description	State	Result
Main.A.Lombardi	2011-03-28	Organise a discussion with W. Weterings to evaluate the damage potential of the new PSB injection equipment to halo particles from Linac4 to judge the necessity of upstream collimation.		edit

3. Update on LBS line upgrade plans

A summary of recent discussions on the LBS line upgrade has been given by T. Hermanns. In his slides he explained that the upgrade plans focused on 2 basic options: either to design a new spectrometer magnet (bending angle 54 deg.) as presented in previous meetings of the Booster Commissioning WG, or to use as proposed by A. Lombardi the same bending magnet that will be installed in the new Linac4 transfer line (bending angle 35 deg.). Both energy measurement layouts could be implemented either with a slit and a reduced-current dump or without slit, a full current dump and an additional transfer line-type quadrupole to provide suitable optics. The LBS line has to stay compatible with measurements of ions from Linac3. Several discussions organised by C. Carli led to the conclusion that a resolution of 10% for the energy spread should be sufficiently precise to avoid problems at PSB injection. Therefore the option with a transfer line-type spectrometer magnet has been chosen as the cheaper one and as it avoids a new complex magnet design and reduces the number of required spare magnets by one.

The aim is now to complete all necessary information (for example slit feasibility study) and organise a sum-up meeting in the framework of the Linac4 BCC, where the decision should be taken on the final LBS line upgrade layout.

4. PSB Fluka simulations

A Fluka model of the PSB is under development by S. Damjanovic. The presentation of S. Damjanovic followed a first discussion round on 31st of January 2011, where she showed the first iteration of the model for one typical PSB section including a magnet description conform to the existing geometry and materials (see this link). In the presented new iteration, the aperture of the magnets has been correctly implemented and the beamscope window aperture restriction added (which then represents section 8 of the PSB). LHC-type BLMs have been placed at various locations in the section, which allow to obtain a BLM response in units of pC/primary or pC/s (instead of Gy/primary or Gy/s) through convolution of a BLM response function provided by S. Roesler.

Two loss mechanisms have been assumed for ring 3:

1. Large beam impacting almost on the full beam scope window surface (beam covers almost full beam pipe diameter)
2. Point-like beam loss on the top edge of the beam scope window
3. Point-like beam loss on the right edge of the beam scope window (this case gives very similar results than case 2)

Very different residual ambient dose rate distributions after 38h were obtained for 50 MeV, 160 MeV and 1.4 GeV losses. 38h are used to be able to compare the results with the radiation survey of section 8 done by RP 38h after the 2010 operational period. The simulated loss data for 1.4 GeV and case 1 shows a relatively good match with the measured data if 1.5% of losses are assumed; the 50 MeV residual dose rate is orders of magnitude below these values as the losses are very localized due to the short proton range in carbon (1.2 cm compared to 145 cm). Case 2 leads to lower dose rates for 1.4 GeV protons and higher figures for 50 MeV particles. An average beam intensity of 2.7E12 p/s has been assumed from 2010 statistics (last 2 weeks of running) provided by B. Mikulec. Varying the irradiation time from 38h to 50 years, it can be seen that 180 days are already almost asymptotic (within a factor 1.3).

When investigating the BLM response, it can be seen that there is a slightly higher signal for the BLMs that are placed at the outside of the ring. This can be explained by the fact that the bendings have an opening (and therefore less shielding material) facing the outside of the rings. BLM signals in pC/primary for case 1 are up to a factor 3 higher than signals for case 2 (slide 21). When calculated for a 1.5% beam loss in pC/s (slide 22), the BLM response for both cases would be comparable (one has to multiply with the number of protons lost). The magnetic field has not yet been included in these simulations.

The presented results lead to the following conclusions for the potential location of new BLMs:

- Placing the BLMs outside the ring increases the signal by up to a factor of 2.
- It should be enough to place 1 BLM for all 4 rings, but could be interesting to use the second one for a different longitudinal position in each section.

The simulations also provide input for the **required dynamic range of the BLMs** - feedback would be highly appreciated from the section of B. Dehning.

It should be noted that only losses on the beamscope window have been simulated. For different loss mechanisms (like injection and capture losses or losses during longitudinal shaving), more input into the simulations would be needed. The Fluka model should be coupled with a tracking model as it will be done for the LHC collimators to include particle angles and orbit offsets. This will be discussed, but is currently not planned.

The question has been asked why residual dose rate levels from survey were higher in section 9 than in section 8. One potential explanation was given that particles from losses close to the beamscope window edge could be focused by the quadrupole and lost more downstream. Nevertheless this should be followed up by

the operations team as this fraction between losses in sections 9/losses in section 8 seems to have changed along the years.

Additional input after the meeting:
S. Damjanovic has extended the Fluka simulation by adding the magnetic field model provided by M. Buzio and A. Newborough for the two bending magnets (see results at this link). The BLM response stays practically unchanged (as was the case for the PS Fluka simulations), maybe due to the charge symmetry of the secondaries.

-- BettinaMikulec - 28-Mar-2011

- 1103_PSBCommissioning_ThHermanns.pdf: Summary of discussions on the LBS line upgrade.
- March14_BLM-Response-BR8-EnergyDependence.pdf: BLM response to losses at the beamscope window (Fluka studies).
- Presentation_PSBooster_Monday31January.pdf: First PSB Fluka simulations of 1 PSB period.
- March28_BLM-Response-BR8-EnergyDependence.pdf: Fluka simulations providing BLM response of PSB section 8 with magnetic field in the bendings.

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