1st Meeting of the LHC Beam Cleaning Study Group 26.9.2001

Present: *R. Assmann, H. Burkhardt, G. Burtin, B. Dehning, C. Fischer, E. Gschwendtner, M. Hayes, R. Jung, V. Kain, H. Schmickler*

Excused: *O. Brüning, J.B. Jeanneret, M. Lamont, R. Schmidt, J. Wenninger*

1) General comments

R. Assmann explained that the meeting was called with very short notice in order to agree on the most important studies as soon as possible and to support requirements from BI and others as timely as possible. Under those circumstances, several people could not make it to the meeting. In particular J.B. Jeanneret agreed to have this first meeting without him. He will join for future meetings and support the work of this study group with his expertise.

2) Tools and First Results for Collimation Robustness Studies (R. Assmann)

R. Assmann presented the simulation tools developed for the robustness studies of the LHC collimation system. First the requirements were shortly summarized, based on work by Jean-Bernard Jeanneret. Beam loss in the cold sections must be controlled to the 10^{-9} level of the full current, in order to exclude quenches. The continuous beam loss for a 35 h beam lifetime must be suppressed by a factor 500-1000. Those requirements are far beyond the requirements in previous accelerators.

For simulation tools, both a fast and linear, and a slower, non-linear approach were followed. The new COLLTRACK program is based on the optics functions calculated in MAD, including any possible optics and orbit perturbations. It allows the fast linear tracking and eventual super-position of lumped non-linear fields. A specialized version of sixtrack allows the full simulation of the collimation system, including all sources of non-linear fields, orbit errors, coupling, synchrotron motion, etc.

Both programs include the same collimation scattering routine that allows multiple settings and imperfections (material, length, distance between jaws, offset errors, angle in x-y plane, angle in y-z plane). Surface deformations or surface roughness could be studied with thin slices of collimators.

The functionality of the COLLTRACK tool was demonstrated for the ideal betatron cleaning system. A possible definition of the collimation efficiency was shown for the ideal system and the system as perturbed by different levels of transient beta beating (worst phase of beta beating). For more details please see the posted electronic version of the slides and a paper (http://www.cern.ch/lhc-collimation).

It was accepted that the presented tools are a good basis for studying the robustness of the collimation system. In particular it was agreed that all relevant collimator imperfections are included.

3) Discussion of goals and deadlines (all)

The mandate and the membership of the LHC Beam Cleaning Study Group was discussed and accepted, as posted on the web page (http://www.cern.ch/lhc-collimation). It was suggested to have this study group reporting to the LCC and the MPWG.

Regarding the first goal, H. Schmickler explained the relevance of the BI review, originally planned for beginning of October and now being pushed to 20/21 November. It was foreseen as an important input for budget reviews. Since those budget reviews came earlier than planned, this role is obsolete for the moment. However, additional budget reviews might be ahead, possibly reinforcing the importance of the BI meeting. For the moment it was agreed to keep the present work targeted at the BI review meeting.

On the technical design of the LHC collimators, H. Schmickler summarized the present plans. Gerard Burtin et al are doing the work in BI. With the present budget pressures an amount of 5 MCHF has been allocated for the LHC collimation system in IR3 and IR7. The budget includes 4 injection collimators. A possible design approach is to design the best possible collimation system, given the available budget. BI would determine the achievable tolerances (geometry, alignment, positioning, straightness, etc), which could then be compared to the requirements for LHC beam cleaning. If there are incompatibilities, one should try to compensate with other measures. If it turns out that the collimation system does not work, a new design would be required.

R. Assmann commented that the LHC beam current might be severely limited until a better collimation system has been implemented, if the collimation system will not work with the required effi-

ciency. In view of the very stringent requirements, a sufficient collimation performance should be a high priority design criterion for the collimators.

A multitude of important issues was mentioned during the discussion (in addition to those listed in the mandate): Beam size control during the ramp, collimation control as a function of beam size, impedance from the collimators, operational procedures, the primary role of collimation: protection or cleaning, collimator surface roughness, thermal effects, orbit stability with power ripple, ramp effects, diffusion speed, … They will all require attention.

In view of the many issues it was agreed that it would be very helpful to define a list of required studies and assign priorities. All participants will present their "wish list" and personal priorities at the next meeting. Overall priorities should then be assigned during the discussion.

4) Estimates of quench levels (B. Dehning/E. Gschwendtner)

B. Dehning and E. Gschwendtner have summarized estimates of quench levels. The PDF file, received after the meeting is posted on the web site: www.cern.ch/lhc-collimation

5) Next meeting

Next meeting will take place 10h30 October 10th, 2001. B. 112, 4C17.