Machine Protection Working Group

Minutes of the 30th meeting held on February 27th 2004

Present: E. Carlier, B. Dehning, R. Filippini, G. Guaglio, W. Heinze, B. Holzer, C. Ilgner, J. Lewis, D. Macina, P. Nouchi, B. Puccio, F. Rodriguez Mateos, R. Schmidt, J. Serano, J. Uythoven , J. Wenninger, C. Zamantzas

Excused: B. Jeanneret

Topics of this meeting:

- Proposal for the distribution of safety critical parameters (P. Nouchi & R. Schmidt)
- AOB : Q4 tolerances in IR6 (J. Uythoven)

Proposal for the distribution of safety critical parameters (P. Nouchi & R. Schmidt)

R. Schmidt introduced the presentation by **P. Nouchi** by summarizing the present understanding of which safety-critical signals must be distributed, namely the safe beam information, the Safe Beam Flag(s) (SBF) and the Beam Presence Flag (BPF). The clients of the safe energy information are the BLM system (all IRs), the beam dumping system (IR6), the injection kicker system (IR2 & IR8) and whatever 'system' will generate the SBF. Another potential client is the RF system in IR4. The SBF must be distributed to all BIC modules for masking of maskable interlock signals. The BPF must be send to the LSS4 and LSS6 extraction interlock system of the SPS.

P. Nouchi proposes to use and adapt existing hardware of the timing system, in particular the CTG and CTRG cards. The modified CTG module would be responsible for the generation of the SBF from the safe energy information and the 2 BCT signals (per ring). The CTG would also inject the energy and intensity information into the CERN timing system for distribution around the ring (non-safety critical !). A proposal for the event coding is already available. Intensity and energy are coded with 2 bytes, which should provide a sufficient resolution, at least provided the full scale of 2^{16} corresponds to a fixed maximum of say 10 TeV/c (to anticipate potential energy increase beyond 7 TeV/c !). For such a choice, 1 bit corresponds to 0.15 GeV/c. The interface between the systems that generate the safety critical signals (BCTs and Beam Energy Meter) and the distribution system must still be defined. The same statement applies to the distribution around the ring and towards the SPS.

In the subsequent discussion **E. Carlier** indicated that the acronym *Beam Energy Meter* is generating confusion in the mind of many people who think that this is a real beam energy measurement while in reality, it is a main dipole *field estimate* obtained from a measurement of the main dipole currents combined with the known calibration curves of the dipoles (SM18 measurements). It was agreed that a different name must be

found, and everyone is invited to provide proposals (like Main Field Meter, B-Rho Meter….). The accuracy of the field measurement is in the range of 0.1%, limited by the DCCT accuracy. **B. Dehning** asked if the connection between the BEM/BCTs and the distribution system should not be redundant. **R. Schmidt** proposed that BEM should also receive the distributed energy information and compare it to the value that was sent out. This provides a very good test of the distribution system. **J. Lewis** remarked that the CERN timing system is a very complex real-time system with many tasks and that it should not be used to transmit safety critical information.

Concerning the number of safe current signals, it was agreed to generate a *SINGLE SBF* for the entire LHC. This signal should be the logical AND of the individual SBFs for each ring. As a consequence, the SBF will be present only when the beam intensity is safe in *both* rings. On the other hand the BPF must be generated for each ring individually, since this signal defines what intensity can be injected from the SPS into a given ring.

As an outcome of the meeting, the following points must be defined:

- **The interfaces of the distribution system to BEM and BCT**.
- **The hardware for the distribution** of the energy/SBD/BPF information.
- **The interface between distribution system and users.**

AOB

R. Schmidt informed the audience that the fast failures and possible protection mechanism were presented at the LTC by **V. Kain** and **M. Zerlauth**. HERA is presently limited in beam intensity by fast beam losses that are not detected by the HERA BLM system in time to dump the beam. A group a CERN people involved in machine protection and collimation will visit HERA on March 8th to understand the HERA problems and confront them with the LHC expectations. A report of that visit will be presented at a future MPWG meeting.

J. Uythoven presented a summary of a study on the strength tolerances for the Q4 quadrupole that provides 23% of the extracted beam deflection angle in the horizontal plane. A tolerance of 0.5% on the strength is acceptable. This tolerance may be enforced by including the Q4 into the Beam Energy Tracking system that already involves extraction kickers and septa. An additional DCCT is therefore required for Q4: this point must be checked with AB/PO. Another issue for the bam dumping system is coming from non-dipole contributions to the beam energy, namely RF frequency offsets and orbit correctors. Since the possible energy changes may exceed the ±0.2% tolerances, both RF frequency and integrated corrector fields must be interlocked. **J. Uythoven** will contact the RF group to verify if the RF frequency can be interlocked within the RF system. A software interlock seems to be the best solution for the orbit correctors, since the information of the entire ring must be gathered in a central place.