Machine Protection Working Group

Minutes of the 28th meeting held on November 14th 2003

Present: J.-C. Billy, D. Bocian, E. Carlier, B. Dehning, R, Denz, F. Ferioli, R. Filippini, R. Giachino, G. Guaglio, B. Jeanneret, D. Macina, M. Oriunno, B. Puccio, R. Schmidt, J. Uythoven , J. Wenninger, M. Zaera Sanz, C. Zamantzas, M. Zerlauth

Topics of this meeting:

- TOTEM and Roman Pots operation (D. Macina)
- Protection issues for operation of the ALICE ZDC and machine luminometer at IR2 (D. Macina)
- Accidental beam losses during injection at IR1 (D. Bocian)
- Interfaces BIC-clients (B. Puccio)
- AOB

TOTEM and Roman Pots operation (D. Macina)

D. Macina started her presentation with a short overview of the TOTEM experiment. The physics program of TOTEM consists mainly on measurements of the total pp cross-section and of elastic and inelastic processes in the forward region. The total pp cross-section must be known precisely for luminosity measurements. The experiment detects protons produced at very small angle (~ 10 μrad) and has to move very close to the beam (~ 10 σ, 1 mm). Dedicated TOTEM runs must be scheduled, since TOTEM also requires a special high β* (~ 1.5 km) optics. The 6 Roman Pots stations are installed symmetrically around IR5, at a distance of 147 to 218 m from the IP. A 0.2 mm thick window is used to minimize the amount of material traversed by a particle. The pots are designed to stand a 1 bar pressure difference. The number of bunches for TOTEM runs varies between 43 and 156, with bunch populations of 2×10^{10} to 11×10^{10} protons. The requested transverse normalized emittances vary between 1 and 3.75 μm. The corresponding luminosities are in the range of 10^{28} to 10^{29} cm^{-2} s^{-1}.

At injection the roman post will be retracted. They will be moved towards the beam when the beams are colliding and are stable. The proposed position is at 10σ from the beam, but the actual position will depend on the machine conditions. Very stable beam positions are required during a run.

Important points for TOTEM protection concern the availability of BLM signals and of interlocks (software and hardware). Mechanisms that can drive part of the beam into the detector before the beams can be dumped must be studied.

R. Schmidt commented that the BLM are likely to provide the best protection when the beam moves too close to one of the pots. The BLMs must be of the same type as the BLMa installed near the collimators, i.e. very fast and failsafe (at least during

TOTEM runs). **B. Dehning** stressed that simulations must be performed to evaluate the signal level in the BLMs, since he fears that the signals may not be sufficiently high. In the discussion it was also mentioned that in case the secondary vacuum inside the pots is lost, the deformation will push the edge by 5σ (~ 0.5 mm) toward the beam.

Actions :

- Study the BLM layout around / behind TOTEM **(TOTEM team together with BLM team).**
- Evaluation of the deformation speed of the Roman Pots when the secondary vacuum is lost **(TOTEM team).**
- Study of the classical fast failure scenarios in the context of TOTEM protection **(TOTEM team and MPWG).**
- A strategy needs to be defined who will be responsible for the movement of the Roman Pots – the accelerator operation or the TOTEM team? **(Action: R.Giachino, J.Wenninger and LHC-OP working group).**

Protection issues for operation of the ALICE ZDC and machine luminometer at IR2 (D. Macina)

An integration issue in IR2 between the ALICE ZDC (Zero Degree Calorimeter) and the LHC machine luminometers has been identified recently and is being addressed in a small study group. The presently favoured luminometer design is based on ionization chambers that required a ~ 30 cm Cu block in front to act as a converter. The ZDC is rad-hard quarz fiber calorimeter that is used to detect the spectator neutrons during the heavy ion runs, and the detector fulfils most of the requirements for the machine luminometers. The resolution of the ZDC would however be affected by the 30 cm Cu absorber if the ZDC is placed behind the ionization chamber. To minimize radiation damage, the ZDC will be installed on a movable table and will be put into data taking position only when the beams are in collisions.

The integration with the ionization chamber is not easy, and the solutions might be :

- Since the ZDC is also a good candidate as a luminometer, machine operation could use the ZDC as luminometer for heavy ion runs. This implies that the ZDC must already be in data taking position during the squeeze and in pre-collision phase. For that scenario, ALICE would like to know if there is a specific risk associated to the pre-collisions phases.
- Another option is to switch from ionization chamber to ZDC after collisions have been established.

In the discussion it was agreed that there are no additional failures that affect the beams before collisions, and that there is no additional risk to move the ZDC into data taking position at an early stage (end of ramp, pre-squeeze), except somewhat higher backgrounds. **B. Jeanneret** proposed to re-evaluate the need for a mini-TAN (1 m Cu) and to install the machine luminometer inside it, with the ZDC installed in front of the min-TAN.

Accidental beam losses during injection at IR1 (D. Bocian)

D. Bocian presented a study on injection accidents that he realized on behalf of ATLAS. He considered failures associated to wrong settings of the MCBX(H & V) orbit corrector and of the D1 and D2 separation-recombination dipoles. Using the geometrical layout of the insertion and its apertures, he evaluated currents ranges that are potentially harmful to ATLAS. For the MCBX corrector, dangerous settings correspond to the range of 30-100% of the total current (both signs). When the MCBX is off, the deflection is too small for the beam to hit the vacuum chamber edge in ATLAS. Similarly he also evaluated unacceptable settings for the D1 and D2 dipoles.

The study will be published as a note in the near future, and it will be used as input for detector simulations to evaluate damage to the ATLAS detector. **D. Bocian** concluded that the requirement to inject only low intensities into the LHC was very important to prevent damage to ATLAS.

R. Schmidt mentioned that it would be extremely interesting to evaluate through the ATLAS simulation what is the highest intensity that this low intensity 'pilot' beam should have. For the high luminosity detectors ATLAS and CMS there would be no problems due to the radiation dose, since the inner part of the detectors are using radiation hard technologies. The beam intensity should be limited such as to avoid mechanical damage of the vacuum chamber and the detector. However, for ALICE, the inner part of the detector might be more sensitive to radiation damage, and might impose more strict limits for the beam intensity **(Action: D.Macina)**.

Interfaces BIC-clients (B. Puccio)

After a short reminder on the beam interlock architecture, **B.Puccio** presented the list of interlock client partitioned according to whether they request a dump of a single beam or both beams and according to the possibility of masking the signals (see slides). **B.Puccio** made a request for comments from the clients and stated that the cables must be ordered soon, and any additional client should be identified asap. Possible additional interlocks concern the Q4 current (IR6) and the MSD voltage (the current is already part of the energy meter interlock).

For specific studies, it will be required to dump one beam only (in general by the operators). The mechanism how to dump one beam only must still be addressed **(Action: B.Puccio, E.Carlier and R.Schmidt).**

AOB

R. Schmidt reported that the LTC encouraged the MPWG to go ahead with the study of the 'safe beam' flag and to come up with hardware proposals. He also said that all SPS tests proposed for 2004 had been accepted in the various committees.