Machine Protection Working Group

Minutes of the 20th meeting held on January 24th 2003

Present: R. Assmann, J.-C. Billy, E. Carlier, B. Dehning, R. Denz, B. Goddard, G. Guaglio, R. Lauckner, D. Macina, B. Puccio, R. Schmidt, J. Wenninger, C. Zamantzas

Excused : F. Balda, C. Dehavay, R. Giachino, B. Jeanneret, V. Montabonnet, J. Uythoven

Main topics of this meeting:

- Machine failures and triplet protection (R. Schmidt and R. Assmann)
- AOB

Machine failures and triplet protection / I (R. Schmidt)

R. Schmidt started his presentation by mentioning that in 2002 two asynchronous beam dumps at the Tevatron have caused damage to the CDF detector. The main problem in both cases seems to be due to a wrong setting of the collimators.

For his analysis **R. Schmidt** recalled that the orbit in the dump region should be stabilized to ±1 mm, and that under such conditions the aperture of the circulating beam at 450 GeV is n1 = 7 σ (which corresponds to a total aperture of 10 σ, since the definition of n1 also includes margins for betatron beating…). The TCDQ position is only modified when the collimator move (for example following the squeeze), else it remains in position. For a well-stabilized orbit in IR6, the maximum trajectory excursion in the arcs due to an asynchronous beam dump is 10σ (3 mm at 7 TeV). **R. Schmidt** considered then the case of an asynchronous beam dump where the orbit at the TCQD is off by ±2 mm. The ring 1 beam is likely to be stopped by the collimators in IR7, but as mentioned by **R. Assmann**, the beam can also slip through the system and reach amplitudes of up to 10σ depending of the phase. The maximum particle excursion in the arcs reaches

6 σ (beam size) + 14 σ (oscillation) + 4 mm (orbit margin) = 12 mm

which is not a problem for the arcs themselves. But for ring 2, the beam could hit the beam screen of the triplet in CMS since there is no ‘obstacle’ between the TCDQ and IR5. The maximum excursion in the triplet depends on many details like the crossing angle (plane and amplitude), the orbit in the triplet… The conclusions of the presentations are:

- For un-squeezed beams there should be no problem for the triplets.
- For squeezed beams, there might not be enough aperture in the triplet.

- The TCDQ position is very critical and an object with jaws on both sides would be desirable. Alternatively one might consider a collimator at either end of the TCDQ.
- The beam density in the triplet is lower than at the collimators, but it may still damage the beam screen.

During the discussion **R. Assmann** insisted that the operation of the TCDQ must be failsafe, in particular the position information. He also pointed out that a two-sided TCDQ is simpler to adjust and that a local absorber in front of the triplets would make the protection of the triplets insensitive to the orbit throughout the machine. Concerning the standard operation for TOTEM with 36 bunches, the situation is no as critical as for the triplet since the probability that during an synchronous dump a bunch is hit with the correct timing to send it into the TOTEM detector is low. On the other hand, **D. Macina** mentioned the fact that TOTEM also plans special runs with close to nominal beams: for such conditions the consequences of an asynchronous dump still need to be evaluated.

Machine failures and triplet protection / II (R. Assmann)

R. Assmann first recalled the various apertures of the LHC at injection and during physics:

450 GeV	10 σ	in the arcs
	6/7 σ	at the collimators
7 TeV	40 σ	in the arcs
	10 σ	in the triplet ($\beta^* = 0.5$ m)
	6/7 σ	at the collimators

The protection of the triplets by the collimators and the TCDQ works only if the orbit is well controlled in the triplet and at the TCDQ. **R. Assmann** gave arguments in favour of a local protection of the triplet by a fixed absorber, with the triplet in the shadow of that element. It is then possible to relax the very demanding cleaning efficiency since the tertiary halo produced by the collimation system, which presently hits the triplets, would be absorbed by this protection device. With an absorber in front of the triplets, the amount of tertiary halo that can be accepted is significantly larger since the triplets would no longer quench as easily. The main problem with the TCDQ is that the protection relies on a good orbit throughout the machine.

AOB

As a follow up on the actions for the previous meeting, **R. Schmidt** mentioned that the D1 failure is really the most outstanding failure compared to other warm insertion magnets. He proposes to consider an interlock on the beam position. A protection entirely based on beam loss monitors is very difficult and delicate to achieve, in particular if one assumes beam profiles that are not gaussian

Following the discussion on the triplets, **R. Schmidt**, **B. Goddard**, **R. Assmann**, **P. Sievers** and **J. Wenninger** presented short outlines of their presentations at the Chamonix Workshop that will be organized beginning of March in Chamonix.