Agenda MPWG 4 February 2005

- **Comments to minutes**

- Chamonix debriefing.
- Modification of the MPWG mandate (extension to the SPS).

- AOB
  - MAC
  - Machine Protection and Interlocks Review

"Chamonix" Conclusions

With 43 / 43 nominal bunches luminosity exceeding $L = 10^{32}\ cm^{-2}s^{-1}$ reasonably safe operation

- Damage at injection hardly possible, only few failure modes that could lead to damage at top energy
- Quenches still likely, good opportunity to learn about the LHC

Beam losses and quenches: THE performance limit for LHC ?

- Simulations … to be continued .. **lot of studies** -
- Better understanding of beam generated heat deposition and quench levels (**workshop 3-4 March 2005**)

Beta beating: how much, how to measure it, how to correct it, how to squeeze (partial squeezing during the ramp?)

Controls and software is an issue

- **Controls for collimators** (and other objects touching the beams)
- **Injection sequencer / Master setting management for protection**
- **Procedure for accepting software that is safety critical**

"Chamonix" Conclusions

Interface to experiments is being addressed (MPWG and LEADE)

- For magnets: proposal worked out with E.Sbrissa – to be approved
- Objects that could touch the beam, proposal discussed in LEADE with experiments, to be presented to MPWG (Daniela), functional spec to be written and approved

Objects that could touch the beam

- For slow vacuum valves: ok
- For fast vacuum valves: to be rediscussed (spec will be rejected and proposal will be made)
- For instruments: meeting between BDI and MPWG members, Paul Collier might help

Machine protection when operating with ions

- Much less beam energy, but beam has still damaging power
- Future meeting on ions, one member knowledgeable on ions to work with us

"Chamonix" Conclusions

Magnet current decay monitor - **who does it?**

- M.Werner from DESY will come with their electronics for four weeks (March / April)
- We will prepare an experiment to try it out and evaluate the results
- Help from other groups needed to do this test!
- After we have the results, discuss who finally takes over the responsibility

Beam instruments for protection

- Important role for protection – encouraging – **to be followed up**
- Should be presented at the review on machine protection and interlocks

Studies on safety and availability

- "My system is very reliable" … **numbers should complement "feeling"**
- Work continuing – can it be better than 5% ?

Commissioning

- How to go on? not clear to me….

"Chamonix" Conclusions

Entire machine protection system

- Simulations with all machine imperfections… Are there any holes ?
- Tracking with imperfections for a limited number of failure scenarios
- How to do these simulation: MAD / SIXTRACK ?
- Who helps ?

Material tests: FLUKA calculations can well predict the damage

- To be done for 7 TeV, for a few selected failure cases (do we always drill a hole in the vacuum pipe with one bunch? At what intensity?)
- 43 x 43 bunches: at injection damage is highly unlikely

Steve: Beam presence need to have machine settings included

- Needs some thinking…..

Worst case scenarios: work started, but there is a long way to go for a realistic evaluation

MAC 9-11 December 2004

- R. Assmann, Collimation, latest developments
- B. Goddard, Machine Protection at Injection
- R. Assmann, Collimation, optical imperfections, cleaning dynamics
- R. Schmidt, Machine protection for Circulating Beam

Machine Protection System

- The Committee is pleased to see great progress in developing a machine protection system which looks good at its present stage of development. The presentations showed awareness of the many faults and combination vulnerabilities that could occur both during injection and with circulating beams. The LHC is entering new territory in this regard.
- The software interface and security issues need much more emphasis and development now. While there is a detailed block diagram of the hardware, there is a need for a similar picture of how software interfaces with the hardware.
- The difficulties in providing adequate machine protection during commissioning are fully appreciated. Plans for a review involving experts from around the world are noted and encouraged.

Review on beam interlocks and machine protection week from 11-14 April 2005

When: week from 11-14 April 2005

Reviewers from outside

M.Harrison (BNL), G.Ganetis (BNL), R.Bacher, J.Annala (FERMILAB), Coles Sibley III (SNS), someon from PSI?, M.Ross SLAC), from nuclear industry, laser or or space programs

Chairpersons: possibly M.Harrison

Preparation:

- meeting in one weeks time 11/2, to define the programme and the speakers (draft was discussed last year)
- talk to the speakers within – by 18/2
- formal invitation to reviewers within three weeks by 25/2

Review on machine protection week from 11-14 April 2005

Introduction

Main systems for machine protection (all)

Single turn beam losses and protection

- Injection: from SPS to LHC first turns (Helmut)
- Dumping the beam (Brennan)

Other fast kickers (Q-measurement, aperture kicker, …) (Jan)

Multiturn beam losses and protection

- Mechanisms for beam losses at various energies, squeezed and unsqueezed (Rüdiger)
- Additional instruments used for Protection (Jörg)

Collimators, beam absorbers and movable elements (Ralph)

Failures beyond design, their impact and what can we do (probability) (Jan)

Commissioning and operation

Objects Capable of Touching the Beams (LHC and Transfer lines)

Strategy:

- establish the risk for the object that could touch the beam
- establish the role of the object (vital or not vital for operation)
- establish the risk for other accelerator equipment
- establish the reaction time
- establish the frequency of a failure

If possible damage to other accelerator equipment – Reliable failsafe hardware interlocks

If possible damage to vital instrument – Reliable hardware interlocks

If possible damage to non-vital instrument – Software or hardware interlocks

If possible quench – Software interlocks

Examples

- screen in transfer line that might quench LHC magnets at injection – software interlock likely to be sufficient
- fast vacuum valves moving into the beam in 13 ms – (if we need these valves) – reliable and redundant hardware interlock