Machine Protection Working Group

Minutes of the 65th meeting, held 28th September 2007

Present: R. Schmidt, J. Wenninger, V. Kain, M. Zerlauth, R. Steinhagen, B. Puccio, J. Blanco, B. Todd, B. Dehning, M. Lamont, E. Carlier, B. Dehning, V. Montabonnet, D. Macina.

Meeting Agenda:

- Experiment Injection Interlocks [BT]
- LHC Injection SPS Extraction Interlocking [VK]
- AOB

R. Schmidt began the meeting by asking whether there was any follow up to the Post-Mortem ideas presented in meeting #64. **B. Puccio** said that efforts were ongoing and that the document has reached the 'checked-by' phase of approval.

R. Schmidt continued by making a presentation giving the open issues to be addressed by the MPWG**.** It was also noted that a new commissioning working group has been formed for the Machine Protection system with **J. Uythoven** as chair and **A. Macpherson** as scientific secretary.
(See http://lhccwg.web.cern.ch/lhccwg/MPS/mps.htm).

R. Schmidt then presented a list of topics that need to be to be updated in future MPWG meetings:

1. Interlock experiences in 2006 and 2007.
2. Software Interlocks and Power Converter Interlocking.
3. Management of Critical Settings.
4. Beam Loss Distribution following Power Converter Failures.
5. Beam Loss Monitors.

B. Dehning said that a presentation concerning the Beam Loss Monitors could be made at the next Machine Protection Working Group

R. Schmidt then explained that **D. Macina** has held a one day workshop concerning Experiment and Machine Protection. (see http://edms.cern.ch/document/856468/) Following this a Beam Interlock Supervisor (BISU) has been nominated for each experiment, acting as a contact point for the MPWG. Several items arose from the workshop, all to be addressed by the MPWG and possibly other working groups:

1. How is injection-inhibit to be managed for the experiments?
2. Are the Protection Systems to be installed on UPS?
3. How are TCT positions to be managed?
4. What are the different scenarios for errors in orbit-bump and injection-settings?
5. What is the status of the abort gap monitor?
6. What are the procedures that should be followed after an emergency beam dump to give beam permit by experiments?

D. Macina said that the final point is a key issue, **R. Schmidt** agreed and suggested that CMS could make a presentation on the relevant matters in the next Machine Protection Working Group.

Experiment Injection Interlocks [BT]

B. Todd made a presentation describing a proposal for the Experiments Injection Interlocks. **B. Todd** described that a dedicated interlock system was first requested in early 2006, a solution was proposed in 2006, but was never implemented due to several constraints. **B. Todd** continued to describe that an optical version of the User Interface (CIBF) has been developed to allow User Systems to connect to the Beam Interlock System with distances as far apart as 10km. It was then explained that the CIBF can be viewed exactly as a normal User Interface (CIBU) for the User Systems, requiring 2U of rack space and current loops to drive the User Permits, around 20 of these CIBF units are already foreseen for the Beam Interlock System and the Safe Machine Parameters Controller. It would be advantageous to increase the order quantities now, if this were to be chosen as a solution for the Experiment Injection Interlocks.

B. Todd then concluded by saying the maximum cost for each experiment would be around *15kCHF*, this would include the CIBF, fibre and the additional hardware required at the injection BICs. If a decision was not taken by early-mid November then the cost would increase by *30-50%* due to a reduced batch being ordered. **All Members** of the Machine Protection Working Group agreed that this was a sound idea and that it should be presented to the Experiments in the up-coming LEADE.

M. Zerlauth asked how the limit of 10km would be managed in the case of CMS, where the distance may be slightly longer, **B. Todd** and **B. Puccio** explained that repeaters could be foreseen, or component selection could be made to ensure a good optical power budget in each case.
J. Wenninger noted that this would replace the proposed software injection interlocks from the experiments. **E. Carlier** suggested that this technology may also be applied to the dedicated injection inhibit required from point 6 to the injection BICs, **B. Todd** and **B. Puccio** agreed that it is feasible and a proposal could be made in the near future.

LHC Injection SPS Extraction Interlocking [VK]

V. Kain made a presentation describing the concepts and requirements of the interlock systems for LHC injection and SPS extraction, in particular focussing on the Master BIC and Safe Machine Parameters Controller.

V. Kain began by summarising the architecture of the SPS extraction for LHC Beam-2, showing how the beam destination can be switched between CNGS and LHC, and how beam absorbers effect the requirements for extraction permit. **V. Kain** then continued by describing the Master BICs which will contain a special OR logic instead of the usual AND logic found in normal BICs. These will then be used to allow a completely autonomous extraction system that only allow beam to be extracted when all of the preconditions are met for the particular cycle.

V. Kain followed by describing the basis for the extraction interlock, which relies on several of the 'Safe Machine Parameters' for the correct conditions to be made. The key flags and their significances are:

Beam Presence Flag – This flag switches to TRUE when then there is beam of any intensity circulating in the LHC.

Low Intensity SPS Extraction Flag – This flag is TRUE when the SPS beam is below 10^{11} protons and the LHC has no beam presence, this ensures that the extraction of beam into an empty LHC cannot exceed 10^{11}. This flag is required by the experiments to exclude damage of sensitive detector parts when injecting beam into an empty machine, but the flag threshold is still being discussed.

Safe Beam Flag – This flag is TRUE if the circulating beam in the LHC at 450GeV has an intensity of less than 10^{12} protons, this is below the simulated damage levels for machine equipment and when this flag is TRUE, masks can be set on a certain sub-set of interlocks.

LHC No Safe Beam Flag – This flag is TRUE when the circulating beam in SPS would exceed the safe beam limits of LHC if it were injected into the LHC.

A sub-set of both the Master BIC and the Safe Machine Parameters Controller functionality is required for testing in *week 46*, beginning November 12th.

D. Macina noted that some experiments are requesting a very low value of intensity in the LHC when injecting beam into an empty machine, a value of $5x10^9$ protons has been suggested. **Various Members** acknowledged this, clarifying that beam operations and diagnosis were much more effective with higher intensities.
R. Schmidt said that an agreement should be made between experiments and operations to ensure all requirements are met.

AOB
none

Next Meeting
Friday 12th October 2007 at 10:00 in room 864-1-C02 (TBC)

BT