Machine Protection Working Group

Minutes of the 48th meeting held on September 2nd 2005

Present: R. Bailey, B. Dehning, A. Butterworth, R. Giachino, B. Goddard, V. Kain, M. Lamont, L. Pereira, B. Puccio, P. Pugnat, F. Rodriguez Mateos, R. Schmidt, B. Todd, V. Tsaplin, J. Uythoven , J. Wenninger

Excused: J.C. Billy, E. Carlier, D. Macina, V. Montabonnet

Topics of this meeting:

- Commissioning of the beam interlock system (B. Todd).
- Commissioning of the transfer line interlocks for CNGS & LHC (J. Wenninger).
- AOB:
  - Injection interlock 'loop' & beam dumping system (B. Goddard)
  - RF frequency interlocking

Commissioning of the beam interlock system (B. Todd)

After a quick recapitulation of the main components of the Beam Interlock System (BIS), **B. Todd** discussed issues associated to system tests. The links between the user interface boxes (CIBU) and the beam interlock controllers are designed to be almost 100% testable using the build-in test mode of the system. The only exception is the cable that connects the user system to the CIBU interface. **B. Todd** presented a test and commissioning procedure split into 4 phases.

- Phase I consists of the standalone BIC test that can be realized in the laboratory or in the LHC.
- In Phase II the BIC and the CIBU interface (including any links) are tested. Those tests can again be realized in the laboratory and in the LHC.
- In Phase III the beam interlock loop is tested. While the first two phases are internal to the BIS, Phase III involves the LHC Beam Dumping System since this system is involved in closing the permit loops. This point is rather delicate since the permit loop cannot be closed if the LBDS is not ready. A solution for a test procedure must still be worked out.
- Finally in Phase IV the user systems are included to test the link from the users to the CIBU interface. The difficulty of this phase is due to the fact that one must not force the permit signal of a user to TRUE. Ideally, of the 2 links between user and CIBU, one would like to force one to TRUE and the other to FALSE during the test.

A high level sequencer program, similar to what is used to test PIC, QPS and PCs, would be ideal to run through most of the test phases.

J. Wenninger said that the tests of the transfer line BIS must also be considered, since they differ from the LHC ring BIS by the absence of a permit loop. **F. Rodriguez Mateos** noted that the presentation reflected a bottom to top approach. He also commented that for the HW commissioning, the documents reflect the test responsibilities. He suggested to split document(s) according to the responsibilities, i.e. whether only the interlock team is involved or not. **B. Dehning** asked if the interlock team was considering an automated procedure, which **R. Schmidt** confirmed (at least up to phase III).

Another question that needs to be addressed is how frequently a partial / entire test of the should be performed (one before every fill, once per month, ….).

Commissioning of the transfer line interlocks for CNGS & LHC (J. Wenninger)

First ideas and concepts for the commissioning of the transfer line interlock systems were presented by **J. Wenninger** who concentrated on functional interlock tests that could be considered as Phase V of the commissioning following the nomenclature introduced by **B. Todd**. The document that he is preparing for the transfer lines will not describe the Phase I to IV tests, but will be referring to other documents that describe such tests, as for example the document prepared by **B. Todd** for the BIS. **J. Wenninge**r classified the systems that are involved in the tests according to their size and to external conditions that are required to perform the commissioning: timing (for triggering and synchronization), settings (thresholds, references and tolerances) and beam. Such external conditions constrain the time and location of the tests, in particular of course if the beam is involved, which is the case for almost all beam instrumentation (except screens where the position interlock tests are independent of the beam). **J. Wenninger** proposed to assign the responsibility for the test coordination to an interlock commissioning team of 2-3 persons. This team is responsible for ensuring that all tests required for a given beam commissioning phase of the transfer lines have been performed before such a phase may begin. **J. Wenninger** discussed the test organization as well as number of tests for certain systems, and pointed out some open questions and suggestions.

During the presentation it became clear that as one of the next steps, it is important to define a common naming scheme for the test phases and to give a better structure to the documents. The experience from the LHC HW commissioning should be reused as much as possible.

The protection systems rely on many parameters and settings that must be correct for safe machine operation. There is a wide range of such parameters (thresholds for beam loss monitors, parameters for the SLP system, currents of power converters for the ROCS supervision, collimator settings, etc.). During the commissioning of the protection systems, the correctness of critical settings must be validated. A system must be in place that ensures that such settings remain correct. Management of critical parameters will be discussed in a future meeting (**Action: B.Goddard, M.Lamont, J.Wenninger**).

AOB

B. Goddard presented the 'chicken and egg' problem in the arming of the LHC Beam Dumping System. To arm the LDBS it is foreseen to require a valid BEAM_PERMIT, but the BEAM_PERMIT cannot be valid if the LBDS is not armed. This problem could be solved if the LDBS would be connected to injection BICs in IR2 and IR8. In that case it is possible to inhibit injection during the arming process when the USER_PERMIT of the LBDS could be forced TRUE for a short time interval.

J. Wenninger reported for **E. Carlier** that the issue of RF frequency interlocking has not been solved yet, in the sense that nobody is responsible for it. **A. Butterworth** reported the point of view of **P. Baudrenghien** who estimates the work to ~ 6 months and who feels that this is not the responsibility of the Low Level RF section. **R. Schmidt** suggested that representatives of RF, BT and the MPWG meet to work out a proposal for an interlock system and a possible responsible for the system (**Action: A.Butterworth, B.Goddard**).

In the meantime injection protection requires a limit on SPS energy changes of ~0.05% because some transfer line collimators are installed in positions of small betatron function and large dispersion. **J. Wenninger** said that the SPS energy is stable over time to better than 0.01% (measured in 2003 and published in an AB-Note). In fact the energy on the flat top has not been changed for any SPS cycle over the past years. **J. Wenninger** suggests therefore that a SW interlock in the main bends current should be sufficient. It is on the other hand much more likely that the RF frequency is changed for measurements (Q' and dispersion). In that case the beam would end in the wrong bucket and it is possible that the RF group will implement an interlock that holds back the pre-pulse for the extraction kicker. **J. Wenninger** will check this point with **P. Baudrenghien**. It is also possible that the RF frequency of the SPS is locked onto the LHC RF frequency for 'real' extractions to the LHC, in which case trims of the frequency are not possible.

R. Schmidt informed all present members of the WG that 2 ECRs concerning the FMCM and the interlock system for CNGS and LHC transfer line have been accepted recently.