MPP meeting 11th of February 2011

Present: Benjamin Todd; Annika Nordt; Juan Blanco Sancho; Anton Lechner; Moritz Guthoff; Tobias Bär; Eduardo Nebot Del Busto; Christoph Kurfuerst; Eva Barbara Holzer; Mario Deile; Richard Jacobsson; Bernd Dehning; Siegfried Wenig; Andrzej Siemko; Arjan Verweij; Mariusz Gracjan Sapinski; Sigrid Wagner; Jan Uythoven; Rudiger Schmidt; Antonello Di Mauro; Laurette Ponce; Massimiliano Ferro-Luzzi; Markus Zerlauth; Jorg Wenninger

AOB:

The next MPP meeting will take place on the 4th of March and will be entirely devoted to upgrade of the Safe Machine Parameter System for the 2011 run. A detailed announcement and agenda will follow during the week.

S.Wenig enquired whether the verification of possible/allowed beam modes will already be introduced for the startup this year (ie the execution of certain validation checks in LSA/sequencer before allowing the declaration of a new state such as STABLE BEAMS). Jorg commented that this new functionality is currently being validated, but will only be deployed in operation in 1-2 months.

The commissioning and testing of the SMP 3v0 has started: The SIS is already publishing a (still fake) beta* value. There has been no opportunity yet to verify the SPS intensity (no beam yet in SPS). Reminder: In recent days there was some doubt about the operational usage of the DCBCT system B – This system MUST be kept OPERATIONAL by BI during beam operation as it is required to conserve the specified redundancy of the SMP throughout the whole chain.

Technical Review of the Trigger Synchronisation Unit of the LHC Beam Dumping System (Etienne Carlier):

Etienne gave a very interesting summary on the technical review of Trigger Synchronization Unit of the LBDS, which was conducted by the French company STUDIEL. The LBDS system itself, Trigger Synchronizations and Distribution System (TSDS) and the Trigger Synchronizations Unit (TSU) have already been internally reviewed in January 2008. The main recommendations of this audit was that a full review of the FPGA code should be done along with the deployment of a full test bench, both of which have been addressed in the past month.

The main objective of the current review was the correct implementation of the functional requirements, verification of pre-series performance and the identification of possible HW/SW anomalies with the aim to provide recommendations for possible improvements and proposals of guidelines for maintenance procedures of the embedded software.

For this, the LBDS team has delivered to the company all functional requirements, schematics of boards + the related VHDL code, which was used as the basis for the review (e.g. no field-measurements were done by the company, but everything was based on design documentation). The equivalent of ~ 1 man-

year was in the following put by the company into an impressively detailed verification/reverse-engineering of the HW (i.e. by analyzing the HW, identifying the implemented functionalities + cross-checking against the initial design specification).

Etienne in the following highlighted a few of the most interesting/critical findings (see slides for details), the major one probably being a loss of the system redundancy in case of an internal fault of TSU cards. In such cases only the redundant TSU would issue a beam dump request, while the faulty card will not issue the expected asynchronous beam dump, leaving half of the system un-triggered. While a number of further improvements have been identified, none of them would actually result in the complete lack of a synchronous/asynchronous dump request; in all cases at least the asynchronous request will be produced. Other points which were brought forward by the company but rather widely applied in the LHC MPS: They don't recommend the use of redundant CPLDs with diversity in writing of the code (due to problem with long term maintenance, etc...), but rather invest to achieve a 100% tested and validate implementation. Similar idea applies to power supply redundancy; they would rather see separate VME crates and put individual supplies, mainly to avoid that e.g. common mode failures on the VME bus (like oscillating DTACK signals) disturb several boards of the chassis.

Following this detailed technical review, a number of actions have already been taken for 2011, e.g. minor HW modifications and a number of additional SW corrections were performed along with the development of a test bench for the complete validation of the TSU hardware and embedded software. The IPOC system has been equally extended to the TSU. For 2012/13 a more extensive redesign of the interface board is foreseen to take into account the various other remarks made, along with an increase of the embedded software and post-operation diagnostic functionalities.

In summary, Etienne judged this review very useful (also to understand the approach industry is taken at such developments). The effort put into this review was quite considerable, i.e. 2 persons for 6 months at a cost of 60kEuros (not counting the contributions of CERN staff).

A very interesting approach that we definitely should think of adopting is the so-called 'V-cycle process' for the development of safety critical components. It foresees to completely separate the development and testing process of HW/SW related to functional safety into two different teams that in theory do not have any contact with each other. This approach obviously requires very complete and accurate design documents but will guarantee to uncover any incomplete/incorrect implementations of functionality.

Procedure for steps to be taken if beam dump does not work (Jorg Wenninger):

Jorg showed first ideas for a procedure to be followed in case the beam cannot be removed from the machine (because e.g. the beam interlock system or LBDS system should fail blind) – see slides. The proposed measures will try to probe other easy ways of interrupting the beam permit loops and trigger the LBDS system to circumvent the possibly faulty component within the system. Jorg commented that this list is only preliminary and certainly needs additional work. Any further ideas/suggestions are more than welcome; the idea would be to summarize a final proposal in an EDMS document for approval.

Please send any input by mail to Jorg W., Rudiger S. and Markus Z.

MPS envelope for Dipole Orbit Corrector Circuits (CODs) (Jorg Wenninger):

Jorg presented the proposal for a new strategy concerning the repair of CODs during beam operation. IN order to limit the necessary access/interventions for the repair of such CODs, the repair is only mandatory in 2011 if the kick strength produced by the faulty corrector is too big to be corrected elsewhere (ie to accept a certain orbit bump in the machine). A number of margins have to be taken into account for this (injection protection, injection oscillations, orbit interlocks,…) leaving around 2.5 sigma for orbit changes. This would translate into a maximum tolerable missing kick of 22 microrad, which may further decrease to only 11 micorad if more margin is used by injection protection (8.5 instead of 7.5 sigma).

As a tentative first order envelope (to be finalized by end of March) Jorg presented the following for CODs that MUST be repaired:

- LSS1/2/5/8: located between Q8.L and Q8.R.
- LSS3/7: if it affects the collimation (exact limit to be verified).
- LSS6: between Q8.L and Q8.R (tbc).
- LSS4 for the Damper?!
- Rest of the machine: if the missing kick is larger than XX microrad at injection – exact value to be defined.
- What if the COD falls into none of those categories and is connected to the PIC (120 A)? -> Could be masked in PIC config if access should be avoided, can only be done by PIC expert.

BLM thresholds for 2011 (Eduardo Nebot):

Eduardo presented the proposal of the BLM team for the definition of new thresholds in 2011. As there are no final results from simulations yet, the tuning of the current thresholds on cold magnets has been done with measurements from 2010 (for both ms range of UFOs and second range for the quench limits) – see slides.

When superposing the current thresholds with the measurements from UFO events and the quench tests, one can conclude that the thresholds have to be increased by up to a factor of 5 in the short running sums RS03-05 and reduced by a factor of 3 for the RS07 and higher.

It was agreed to increase the thresholds in the short running sums to avoid a high UFO rate when moving to higher energies. For the reduction of RS07 and higher it was agreed to reduce them before beam start-up in 2011 on all arc elements, the dispersion suppressor regions and all matching sections. A number of stable fills with high intensities have been and will be checked to make sure the reduction of thresholds is compatible with normal beam losses seen during operation (see as well presentation by A.Nordt in Evian). One of the reasons to increase also for e.g. MQY in the insertions is the fact to again have additional margins to increase the MF for UFO probing.

➔ Action BLM team: Provide results of verification of stable fills to validate reduction of factor of 3 without risking additional BL triggers during normal operation. To be presented during a short meeting/mail early next week to define final plan.

Barbara enquired about the strategy for the inner triplets: Rudiger commented that the triplets are in principle designed for higher beam loads than e.g. arc magnets. Further studies are needed, but the thresholds shall not be decreased for the triplets for the time being.

Results of Wire Scanner quench test (Mariusz Sapinski):

Mariusz presented the results of the wire scanner quench test, performed on November the 1st at 3.5 TeV, using a slowed down wire scan of 5 cm/s on a beam of 144 bunches (1.53e13 protons), beam size 0.28mm. In the following the D4 magnet (MBRB) quenched, located some 32 meters downstream of the wire.
The post-mortem data of the test suggests that the wire (or parts of it) passed three times through the beam, most likely due to vibration or deformation of the wire due to repulsing forces (already the profile at 15cm/s is slightly irregular, i.e. not gaussion which haws also been observed during an event in 2008 in the SPS where a wire actually broke).

Fluka results (neglecting wire sublimation and oscillations) show a quite good agreement with the measurements (especially for high loss locations). A probable explanation might be that the integrated losses for an ideal passage wrt to a multiple (but partial?) passage are more or less identical….
From the FLUKA results, the energy deposition in the coil can be estimated to be around 37mJ/cm3 in average, with a maximum of 73 mJ/cm3. This fits quite well the QP3 results of 45-85 mJ/cm3, which can be extrapolated to a loss of around 20-28 mJ/cm3 for a scan with 15cm/s, which hence should be safe to perform. An additional test to bench mark was suggested during the year, probably not at full intensity (or slowest speed) to avoid breaking of the wire during this test.

Reported by M.Zerlauth