MPP meeting 30 September 2011

Original agenda:

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- Effect of SEUs on position control and monitoring of collimators (TCTVB event)
(R.Losito)
- BLM sun-glasses during injection – Selected Monitors + proposed HW
implementation + (W.Bartmann / C.Zamantzas)
- Fluka studies of the Asynchronous Beam Dump Effects on LHC Point 6 (R.Versaci)
- AOB – Agreed collimator settings in IR2 for Ion run (M.Zerlauth)
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Present:

B. Dehning (BE/BI), V. Vlachoudis (EN/STI), S. Wenig (PH/ADO), W. Bartmann (TE/ABT), B. Todd (TE/MPE), S. Wagner (TE/MPE), A. Di Mauro (PH/ALICE), J. Uythoven (TE/ABT), M. Koratzinos (TE/MPE), A. Masi (EN/STI), M. Zerlauth (TE/MPE), B. Puccio (TE/MPE), C. Zamantzas (BE/BI), M. Solfaroli (BE/OP), E.B. Holzer (BE/BI), B. Goddard (TE/ABT), J. Emery (BE/BI), R. Losito (EN/STI), R. Assmann (BE/ABP), R. Versaci (BE/STI) and J. Blanco Sancho (TE/MPE).

Minutes:

SEU Risk Analysis of the LHC Collimators low level control rack in UJ14, UJ16, UJ56 (A. Masi)

Alessandro presented the collimator's low level control system architecture. It consists of two systems: MDC responsible for the motors drive and control and the PRS responsible for the readout and survey. Only PRS system is part of machine protection as is the one responsible for triggering a beam dump.

Each collimator has 4 stepper motors operated in open loop (4 degrees of freedom) with its corresponding resolvers to detect loss steps + 4 LVDT resolvers. Two additional degrees of freedom are given by the gap. In total the 6 position measurements gives some redundancy.

There are six position function tables vs time (one for each degree of freedom) + two gap limits vs Energy + two gap limits vs β* implemented in the PRS. The four additional gap limits give redundancy to the position function tables. **Roberto Losito** pointed that there are single points of failures. Not every function is triplicate.

The MDC system consists of a double core CPU that communicates with three FPGAs. Each FPGA controls one collimator.

The PRS system consists of a double core CPU that receives the position, energy and β* tables from the network, redundant data acquisition cards and an FPGA that handles the trigger signal for ramping up and interfaces with the interlock system.

The collimator system was reviewed on 2005 (review collimator motorization) and 2006 (review collimation controls). (not the architecture). **Ruediger Schmidt** and **Michael Jonker** among others reviewed the architecture.

There are 12 collimator's electronic racks on exposed locations (UJ14, UJ16 and UJ56).

Typo on slide 15: 3.92 p/cm^2 should be 3.92E9 p/cm^2.

Several SEU failures were identified during test on CNRAD on the MDC and PRS. Worst case scenario concerns PRS failures: CPU core stuck, FPGA loss communication. One of the worst case scenarios occur on the 12th of September 2011, bit stuck on the right value in a counter of the FPGA that surveys TCTVA.4R1.B2.

Collimation system is not machine protection as you always have BLM's behind. **Brennan** commented that some collimators are machine protection (injection collimators…), but they are not in these regions.

MDC and PRS power supplies will be replaced with redundant ones to increase the availability (not safety issue). **Markus** pointed that redundant power supplies should be connected to independent mains in order to avoid common failure.

PRS critical failures (machine 'unprotected') can be avoided by implementing triple redundancy (TMR) in FPGA, watchdog timers on CPU, FPGA communication and software interlock (via FESA). **Markus**: the WDT must be implemented carefully. Revalidated and qualified according to machine protection procedures. **Alessandro** commented that TMR might not fit in MCS's FPGA.

Alessandro explained that he would like a review of the collimator's low level control system, including the code. **Markus** pointed out that with a review you don't get a stamp (safe system) however they are going to make you know better your system and give you a series of guidelines. Critical Systems Lab doesn't do full code review.

Ralph proposed to reboot the system after every beam dump in order to flush the system memory. **Alessandro** said that in that case you will be obligated to reboot both PRS and MCS.

List for Sunglass BLMs (W. Bartmann)

Wolfgang presented the list of BLMs for B1 and B2 with more than 10% loss with respect to dump threshold, excluding P6 and P7. As expected, TDI collimator is the one that exceeds more often the 10% loss value and with the highest ratio (loss/threshold). There are more collimators affected on B1 than B2. This is due to the difference in the transfer line that makes B2 injections cleaner than B1.

Barbara proposed a mixed solution where for some BLMs a higher threshold or smaller monitor will be sufficient and for others sunglasses. She strongly proposes to remove all BLM's filters. Not to combine sunglasses with RC filters.

LHC BLM system: possible modification schemes to KEEP or to FORCE true the beam permit signal at injection (Christos Zamantzas)

Christos introduced the current BLM design rules. He remarked that the system does not implement any function to force the Beam Permit to true.

The BLM system consists of a tunnel card (BLECF), with a non-reprogrammable FPGA, that concentrates the signals from 8 BLMs and redundantly sends it to the surface. On the surface, the BLETC card receives the signal from 2 BLECF. Each VME crate on the surface contains 16 BLETC cards whose signals are combined by a BLECS card. Finally, all VME crates in a point are daisy chained with each other and connected to the Beam Interlock System via a CIBUS interface. With this schema if you want to blind 1 BLM, you are obliged to blind the whole set of monitors that are read by the same BLECF card.

Christos presented four proposals:

1. Smaller Ionization chambers (LIC) + higher thresholds. **Barbara** asked if using LICs would be sufficient as the reduction factor from a IC is 40x and the largest filter used gives a factor of 170x.
2. LIC + Modify the Combiner and Survey (CS) Firmware.
3. Moving a set of monitors to separate crates and modify the CS firmware. Then the combiner will force the signal to true during a period of time. Cost aprox: 60kCHF (two crates). Should be check how many monitors will be affected.
4. Modify TC and CS firmware + control logic + new monitor flag. All needs to be changed for this option.

Markus commented that options 3 & 4 are very ambitious for next TS and personally he prefers options 1 & 2. He asked if a factor 40x would be sufficient for option 2. **Brennan** proposed Wolfgang to check it.

Bernd proposed to start with solution 1 and then go to solution 2. For solution 2 is better after Christmas in order to qualify it with low intensity beam. Replacing the monitors with LIC could be done this year.

Brennan pointed out that using vey high thresholds blinds those detectors at 450 GeV. And therefore it is better to blind them for a certain time than using high thresholds.

Bernd: the BLM system is a protection system and before modifying it is to try to minimize the losses at injection. **Brennan** commented that they are currently mulling other options. **Bernd** proposed to fix a date to review all other options to minimize injection losses. **Brennan** said that in any case the BLM system has to introduce these modifications. **Bernd** disagreed. **Brennan**: let LMC decide. **Markus** proposed to discuss it during a coffee meeting before raising it to LMC.

FLUKA studies on the LHC Asynchronous Beam Dump (Roberto Versaci)

Roberto presented the studies on the Asynchronous beam bump that aim to answer how many magnets would quench and what could be done to mitigate it.

The starting parameters are: 4.86E12 protons at 4.5 TeV distributed along the TCDQA collimator in point 6. The geometry considered is based on v6.500 LHC optic and covers around 550m of the arc. Only Beam 1 has been simulated. Magnetic fields have been considered only for dipoles and quadrupoles. The scored quantities are total and maximum energy deposited in magnet coils and busbars. **Vasilis** commented that the uncertainty factors on slide 11 come from experience.

Roberto explained that the quench limit considered for coils and busbars is 10mJ. **Mike** pointed out that the quench limit of a busbar is 4-5 orders of magnitude higher than the coil.

Results show that the closer you install a new tertiary collimator at 8 σ are the more particles you intercept. Future studies need to investigate interconnects quenches and also they should focus on the early part of the geometry.