BEAM DIAGNOSTICS SESSION SUMMARY

B. Dehning, CERN, Geneva, Switzerland

HARDWARE CHANGES IN THE LHC BLM SYSTEM DURING LS1

Fast automatic beam based alignment of collimators has been commissioned. It is based on a new dedicated capture buffer with 80 us integration time and 4396 values, implemented together with a real time client process. The process freezes the buffer, if thresholds are exceeded to allow high time resolution recordings for loss events.

BLM recorded system faults are mainly due to optical link failures, sanity checks and the controls middleware.

The LS1 splice repair requires the dismounting of most of the ionization chambers. A relocation of monitors (about 800) from their location at the quadrupole magnets to the interconnection of the bending magnets is ongoing to allow higher threshold settings in case of losses occurring in the bending magnets (in detail discussed in the next chapter). To reduce the optical fibre transmission errors, temperature controlled racks will be installed at the surface. To increase the data treatment performance the power PC CPUs will be replaced by Linux CPUs, allowing an increase of the data capture and post mortem buffer by a factor 10. Some FPGA changes are needed to exploit the features of the new CPUs and other small changes should overcome limitations in system.

BEAM LOSSES AND THRESHOLDS

Loss measurements in cell 19R2 showed a uniform distribution of dust particle initiated losses (UFO) along the cell, therefore a redistribution of the ionization chambers is proposed. The middle quadrupole ionization chamber for both beams will be relocated and placed in top of the MB.A-MB.B and MB.B-MB.C interconnections. These measurement locations ensure an equal loss detection potential (losses initiated in either of the 3 bending magnets or the quadrupole) for UFO initiated losses.

At the end of the running period in 2013 several quench tests were done to explore the superconducting magnet coil limits. The millisecond duration quench test showed that abort thresholds could be increased by a factor 2 to 8. This result concerns all superconducting magnets and in consequence larger UFO initiated losses could be tolerated.

The collimation quench test resulted in a possible increase of some dispersion suppressor magnet abort thresholds. It revealed that the thresholds for direct proton impact and secondary shower particle impact are different.

The transient quench test of the Q6 quadrupole magnet indicated that the abort thresholds for the shortest integration time could likely be increased for the secondary particle loss scenario.

A new threshold calculation procedure aims to keep the flexibility and reliability of the current calculation procedure. Moreover, functionality for a safe and automatic book-keeping of the different thresholds, as well as inputs for their calculation, will be provided. An improvement on the performance for the threshold deployment procedure is foreseen, because some of its verification steps will become part of the designed tools. The proposed system is based on the migration from C++ stand-alone threshold generation to an implementation of the algorithms in Procedural Language/Structured Query Language (PL/SQL) to be executed in the LSA database. In order to call specific algorithms, visualize parameters, generate thresholds and execute tests and make comparisons a Graphical User Interface is foreseen.

THE FEEDBACK SYSTEM

The system depends strongly on the UDP network latencies, middleware communication, technical network latencies and the timing infrastructure. These services are monitored by the orbit feedback controller but not further exploited.

The majority of the feedback associated dumps in 2011 were related to the QPS and noise in the tune feedback trims. The QPS limits were raised for the 2012/13 run and these beam abort causes disappeared. In 2012/13 the main causes of feedback related aborts were measurement quality related (BPM and BBQ) causing losses and finally aborts, front-end and infrastructure software related and insufficient loop stability.

Foreseen mitigations are the temperature control of the BPM front-end racks to minimize position drifts and of the deployment of the redundant diode based orbit measurement system in the straight sections. Two other improvements are envisaged, the search for several peaks in the BBQ based tune spectrum with some logic to identify the most likely tune value, and the use of the ADP system as a redundant tune measurements system.

Further recommendations are the review of the UDP, middleware, FESA and technical network infrastructure to increase the loop stability. To avoid congestions it is planned to separate the real time traffic from the operation traffic by using options in the technical infrastructure. The benefits of these changes need to be quantified. It is proposed to track and use the active machine optics in the feedback systems. Another proposal is to commission the gain scheduling option. For the test of the BPM functionality a short duration measurement procedure could be implementing to automate this test and execute it regularly before every fill (BLM like sanity test). The implemented feed forward, based on an average orbit measurement could be commissioned. A last recommendation concerns the design of a full feedback test bed.

After the workshop a feedback review took place and requested that the feedback service units need to be split and newly modular design is needed. In addition new features should only be implemented when a test bed exists.

EXPERIENCES WITH MPS RELATED SYSTEMS AND FORESEEN IMPROVEMENTS FOR LS1

The interlocked BPMs in IR6 were equipped in 2012 with attenuators for the proton operation to increase the reliability of the system. For the Pb–proton run the attenuation was again somewhat reduced to increase the minimum measurable bunch intensity to 3~4 10^9.

Changes in LS1 are foreseen to mitigate electrical signal limitations; the 50 Ohm termination scheme will be improved. Another improvement could be made by implementing remotely controllable thresholds.

For the DIDT system (the name comes from dI/dt) it is planned to produce a single PCB. The transformers themselves will be improved during LS1 with the aim of reducing the dependency on the beam position. Two different solutions are investigated: BERGOZ ICT and the CERN inductive pick-up. It is foreseen to have a complete and operational system, including software ready for the start-up.

The abort gap monitor (AGM) is based on a MCP-fast-gate-photomultiplier-tube measuring the intensity of synchrotron light emitted by the beam during the abort gap.

The main task for LS1 is to solve the problem of the heating mirrors. Other changes concern software improvements. It is foreseen to reduce to minimum manual interventions by adding automated calibration features, watch dogs, self tests, proper recovery from unexpected situations and the management of alarms.