LHC Beam Operation Committee

Notes from the meeting held on 28th June 2011

Participants

L. Evans asked why RF does not blow up the longitudinal emittance to more than 1.2 ns. He explained that a larger blow up would be beneficial especially from the point of view of the lifetime. He suggested to increase the longitudinal emittance as much as possible provided that this does not cause drift of particles out of the bucket.

1. Radiation Induced Faults in QPS Systems during LHC run 2011 – R. Denz (slides)

R. Denz presented the radiation induced fault statistics for LHC operation until 25/06/2011. Particular attention was dedicated to the Quench Protection System (QPS) and the Energy Extraction System (EE) that, for functional requirements, are highly exposed to radiation. The radiation load depends strongly on the equipment location: QPS and EE are both in the tunnel and in partially shielded and protected areas.
In total 48 events were recorded and 46 were proven to be clear SEU events. No destructive event or total loss of magnet/circuit protection happened so far. 25 events were transparent to OP, while 3 events caused beam dump and 18 events required an access. No event was recorded in the protected areas.
R. Denz explained in detail the cause of each fault and possible mitigations (see slides for details). The main aim of mitigation actions is to make these events as transparent as possible to operation and to reduce the number of required accesses. All sensitive components should also be re-located, when possible, in protected areas. Upgrading and re-location works are ongoing during TS and downtimes.

Discussion:
L. Evans asked if any problem was found with circuit breakers on quench heater power supplies. It was answered that there is a plastic part which is systematically breaking. Dedicated studies on this material showed that the plastic mixture is wrong and becomes brittle with usage. All these part are systematically being replaced.

M. Lamont asked how the failure rate scales with beam intensity.
M. Brugger answered that for equipments close to the experiments the scaling depends mainly on the luminosity, while, for equipments in the arc, all beam and machine changes play a role. Energy, instead, does not have a dominant effect (factor 1.5 between 3.5 TeV and 7 TeV) .

2. Radiation Induced Failures in the LHC– G. Spieza (slides)

G. Spiezia presented the status of radiation induced failures observed until Friday 24/06/2011. He explained the analysis strategy used to define if a failure is induced by radiation or not. The main checks are: beam presence during failure, reproducibility in the lab and increased frequency with radiation. Correlation with radiation monitor is also considered.
This study does not include minor events, since they do not affect the operation and therefore are less visible. The main source of information for failure analysis is LHC-OP elogbook and meetings. Good documentation of any event and discussion with equipments responsible is extremely important.
G. Spiezia listed all the encountered failures for the different equipments and classified them in ``confirmed'' and ``to be confirmed'' events (see slides for details).
Giovanni showed also correlation between failures and luminosity: a linear scaling, for a factor 50 higher integrated luminosity and same beam conditions, would give about 1500 errors per year due to radiation.

Discussion:
M. Brugger commented that a factor 10-15 more events are expected for next year.

M. Zerlauth asked whether the 3 PLC failures observed by CRYO could be clearly classified as radiation induced, since, for the PIC, on 2 occasions a memory corruption has happened while operating without and once with very low beam intensity.
M. Brugger answered that, for CRYO PLC, all the events happened with beam and showed the same signature as during irradiation tests. Relocation is then recommended for all these components.
K. Foraz explained that preparation is on going to move CPU in UJ75 already during the next TS, while PLC will be moved during winter stop (better situation at least in point 8).

G. Arduini asked why there is a difference between point 1 and point 5.
M. Brugger answered that this depends on shielding for ventilation and additional shielding is foreseen to be installed during Xmas stop. He also pointed out that a crucial role is played by the thermal neutrons and that this contribution is extremely difficult to be evaluated.

3. TS#3 –July 4th – 8th Activities– K. Foraz (slides)

K.Foraz presented the list of actions that will take place during the next technical stop; recurrent activities are indicated in light grey (see slides for details). To be noticed that access will be limited in PM45 and PZ33 due to lift maintenance and that for PM45 only 32 keys are available.
DQQBS will be installed in sector 45 and not 81 where test tomography will be put in place.
The CRYO OK is expected to be back for all sectors on Friday at 18:00.

Only sectors 45-56-67 will not be affected by CRYO intervention.
BE-BI full list of actions is still pending; M. Zerlauth commented that additional BLMs will be installed at MKI in point 2.
Powering test will be performed Wednesday and Thursday night, while R cable measurements of 120 A correctors will be carried out on Thursday during the day.
Help is needed for patrols during night.
RF should be back on Thursday night: 24 hours before beam.

Discussion:
G. Arduini asked if any request came from RF to install solenoids also in point 4.
K. Foraz answered that no request was done up to now but it has to be checked.

J. Wenninger informed that access to LSA DB will be much more restricted. All public accounts will be blocked, individual protected passwords will be implemented for LSA DB access. A dedicated write access configuration will be set up for each account.

4. Changes of Machine Protection System– M. Zerlauth (slides)

Markus Zerlauth presented Machine Protection (MP) changes foreseen for the next TS. Beam Presence Flag (BPF) thresholds will be increased by a factor of 2 and the signal from the fast BCT will be disconnected from the calculation logic of the BPF within the SMP. After the TS the BPF will rely only on the new button pickups based system that proved to be fast and much less noisy than the fast BCT. This will also allow BI to freely upgrade and modify the fast BCT.
Markus discussed also about the option of connecting more families of LHC circuit to the maskable BIC input. This would induce a reduced flexibility but would provide a better protection. Some correctors, now running at $1/4^{th}$ of the nominal current, could instead be connected to the maskable BIC input.
All RF modules are now interlocked to the BIC (beam dump if 1 module fails). A list of possible changes, to have a smaller impact on operation, has been presented. P. Baudrenghien commented that, in order to allow for more granularity and mask only part of the RF, the cabling would have to be reorganized. For the time being is better to leave everything connected to the BIC and re-discuss this option if operation becomes problematic. Re-cabling could be done during the winter stop.
A long list of modifications is foreseen for the LBDS system. The main change concerns the implementation of an additional hardware, connected to two dedicated CIBUs and fully complying with the CIBU interface specification, to solve the timing problem in the XPOC data acquisition chain in case of dumps being internally triggered by the LBDS (resulting in the XPOC BLM buffers only showing noise and failing the XPOC analysis).
Finally M. Zerlauth mentioned the installation of additional monitors (BLM + QPS for upcoming MD and UFOs investigation) plus the connection of a first Beam Current change monitor prototype.

Discussion:
J. Wenninger: commented that the BPF will go up to 2E9.

R. Schmidt asked how many trips were induced by not interlocked circuits and pointed out the importance of redundancy.
M. Zerlauth answered that he will make some statistics before deciding the final strategy of changes

5. AOB

Jean-Jacques Gras presented a few plots (see: https://espace.cern.ch/be-dep-bi-tb/Lists/BI%20Logbooks/DispForm.aspx?ID=336) to show the apparently significant effects of the filters lately installed on the spare fast BCT (B-system) on reducing the dependence on bunch length variations.
DCCT and fast BCT signals show an agreement within 1%.
The remaining jittering (a few per mil) of the fast BCT is most probably related to beam orbit variations (TBC).
J-J. Grass requested to implement the same filter to A-system in order to test it during the MD. The request was accepted but has to be confirmed by R. Jones.

Discussion:

P. Baudrenghien asked why there is a modulation of the DCCT signal and why DCCT is not shown on Page1.
J-J. Grass answered that the modulation is due to the ADC binning (24 bit ADC), and is present both for BCT and FBCT. At injection the DCCT signal is very noisy with pilot only.
J. Wenninger proposed a clever system to switch between FBCT (low intensity) and DCCT (high intensity)

G. Papotti asked if there is an effect on beam lifetime on bunch length dependence of the FBCT. She also asked if it is possible to improve the signal for B2 since this is more noisy.
J-J. Grass answered that the effect on lifetime is negligible because the bunch length variation is very slow especially with stable beam.
Noise could be improved by checking the phase. The filter could also help.

Next LBOC on July 5th .