98th Meeting of the Machine Protection Panel

Participants: R.Alemany, C.Bracco, R.Bruce, E.Carlier, V.Chetvertkova, B.Dehning, S.Gabourin, P.Gomes, T.Griesemer, M.Kalliokoski, D.Lazic, N.Magnin, G.Pigny, R.Schmidt, J.Uythoven, J.Wenninger, D.Wollmann, M.Zerlauth

1 Presentations

The slides of all presentations can be found on the website of the Machine Protection Panel:
http://lhc-mpwg.web.cern.ch/lhc-mpwg/

1.1 New link between BIS and LBDS: Experience from LBDS reliability run and CIBDS recap – (S. Gabourin)

- Stephane reminds us on the functionality of the CIBDS: It is a direct link from the BIS loop to the retriggering line of the LBDS and therefore provides a redundant path for the BIS to dump the beam directly via the re-triggering line.
- CIBDS is integrated into the BIS before the CIBG. If it detects a change in frequency in the BIS loop, it will send a trigger to the trigger delay unit (250us), which will then trigger the re-triggering lines. To avoid unnecessary asynchronous dumps, the CIBDS will remove the beam permit via a CIBU in case of an internal problem. This will induce a synchronous beam dump.
- CIBDS v1 was updated to v2: change of the lemo connector and the inversion of the LED signal, the critical part remained the same.
- There was a plan to upgrade to v3, which would change the polarity of the PLC local mode read back signal. Furthermore resistors were added to protect the output to the CIBU, the output to the TD box and get exactly 12V pulses for the TD box (V2 15V). Currently the V3 board is not working and could not be programmed. Therefore V2 is operating in the tunnel and will remain for run 2.

  - Jan asks when it is planned to install version 3. Stephane replies that he does not plan to replace version two for run2, as all the reliability runs have been performed with V2.
  - Markus asks if the signal inversion is critical. Stephan replies that the signal is already inverted in V2, by removing a Schmitt-trigger and adding a strap. In V3 a second Schmitt-trigger had been added to perform the signal inversion.
- The CIBDS' are installed in UA63 & UA67. The trigger delay boxes are installed in the same rack.
- Stephane shows the list with the commissioning steps.
- Everything (4TSUs, 2 CIBDS', 2 CIBGs) has to be armed within 5s. To ease this the two beams were kept independent (CIBDS for B1 only affects B1 and not B2 and vice versa).
  - Markus, Joerg and Ruediger comment that the CIBDS must not link the two beams together. B1 and B2 shall be linked exclusively by OP using the sequencer. Therefore, the flexibility of separation of the two beam permit loops should be kept also for the future.
- Tests have been successfully performed. No unexpected signals were recorded.

Discussion:

- Etienne comments that the major issue at the moment is during the arming sequence the CIBDS triggers regularly an asynchronous beam dump requiring an expert to unlatch the XPOC. Markus asks how often this happens. Etienne and Nicolas responds that this problem happened especially at the beginning due to a non-optimised arming sequence and is getting less and less with experience. Nicolas adds that the CIBDS allows triggers an asynchronous beam dump during each dump process.
- Markus comments that the supervision of the CIBDS will only be available in 2015. This then also has to be updated in the automatic tools for the BIS supervision/PM and the post operational checks. Stephane replies that he started to work on the integration of the diagnostics part into the specification.

1.2 Re-commissioning procedures for the LBDS/TSU and experience from reliability run (E. Carlier, N. Magnin)

- Changes performed in MKD HV generators:
  - During run 1 limited to 5TeV, as otherwise erratics would trigger an asynchonous beam dump. During LS1 insulation has been added in the GTO HV deflectors. In addition the GTO brans have been changed for a version with less probability for single event burn out.
  - In the first reliability runs erratic triggers were still experienced, when remaining for longer periods (~8h) at 7TeV.
  - The sources for these problems have been identified and mitigations were implemented:
    - a resistance was installed on all GTO trigger transformers;
    - in addition new bakelite insulator tubes were installed in all generators
    - furthermore dust has been found in the generators and they were thoroughly cleaned.
      - Jan adds that all this took about 6 months.
- Changes for electrical distribution:
  - The powering distribution architecture has been improved. A third UPS was installed everywhere.
  - Second UPS installed for LBDS (US65).
  - Distribution Boxes with Separate circuit breaker for every crate PSU.
  - Software monitoring of crate redundant PSU (DIAMON)
    => SIS request a dump in case of failure of redundant PSU.
  - 'Secondary' PSU surveillance inside TFO and all general purpose crates.
  - Nicolas shows a list of planned and performed actions.
  - Tests of the UPS and main cuts were performed in March and in October. Non-conformities have been identified and mitigated. SU - IPOC diagnosis was not available as the redundant PSU was not yet installed in KISS FEC.

        - Jorg comments that the remote surveillance of the VME and cPCI crates via the LHC SIS is not connected yet.
        - **Action:** Communicate flag to be surveyed by the LHC SIS to Jorg and agree on testing. (Nicolas, Etienne, Jorg)
- TSDS problems and renovation:
    - Follwing the 12V powering issues and the review from 2012 the TSU V3 has been developed and installed in the tunnel. The development of the firmware is still ongoing. Every upgrade is tested on the test bench before being installed in the tunnel.
        - Jan comments that this mainly involves changes in the diagnosis functionality. But still it is important to know if the reliability run is still valid after a firmware upgrade.
        - Rudiger adds that it is important to not touch the safety critical part of the firmware during these slow step upgrades. Nicolas responds that they are mainly touching non-critical parts. The arming sequence is also in the FPGA and changes need to be validated after implementation. This will be ready in the coming weeks.
    - A TSU test bench has been built to perform tests, which cannot be performed in the machine (TSU input, output signals IPOC analysis, simulation of more than 100 dump scenarios, ...).
- New direct connection from BIS to LBDS retriggering:
    - During the first dry run the trigger pulse from the CIBDS was detected with the correct delay, but the signal was very weak. This attenuation is caused by the impedance of the 15 pulse generators.
        - Markus points out that this is not special for the CIBDS pulse, but true for all direct dump channels entering the re-triggering circuit. Nicolas confirms that.
        - Ruediger asks if in the long term this signal would become even weaker and some of the kickers would then not receive the trigger anymore. Nicolas replies that this will not happen due to the domino effect in the re-triggering line, which causes the regeneration of the re-triggering

pulse at each MKD. Etienne adds that the challenge is that the CIBDS signals need still to be detectable by the monitoring (IPOC) at the end of the retriggering line.

  - Nicolas shows the action list for the direct connection from BIS to the LBDS retriggering lines.
- The second dry run was very successful (12h cycles with the help of the sequencer):
  - No problem seen with HV generators;
  - No problems arming the CIBDS cards;
  - No problems arming the new TSU cards;
  - => All dumps performed properly.
- Problem: The free-wheel re-trigger pulse could hide the TSDS pulse (measured up to 150us after dump request):
  - The proposed solution is to increase the delays: TSDS 200us --> 250us, CIBDS 250us --> 270us.
    - Jan comments that the increase of the delay is acceptable as it only applies if two rare and independent failures happen quasi simultaneously. Ruediger agrees.
- Nicolas shows the updated planning for the LBDS. The goal is to test the LBDS as long as possible in remote with the global BIS loop (without other users connected).
- Commissioning with beam (check-out):
  - Two days in remote to re-validate all parts of the system.
  - Re-synchronize MKD rising edge with the dump of pilot bunch 1 and adjust the delay.
  - Re-synchronize BAGK with injection of pilot bunch 1 and adjust delay.
  - Scan MKD rising edge.
  - Test of BLMDD TSU client.
- The Machine Protection Procedure for LBDS re-commissioning (EDMS 896392) has to be updated.
- The procedure in case of non-working dump triggers (EDMS 1166480) has to be updated.

Discussion:

- Jan points out that the LBDS team wants to have the global BIS loop as long as possible without other users being connected. How long can we operate like this? Stephane, Markus and Joerg answer that this is possible until mid-end January. Reyes adds that for the transfer-line test the current configuration will stay as it is.
- Etienne requests a concrete date, as this is the hard date, when the TSU work has to be finished. Ruediger summarizes that up to the 15.01.2015 it is guaranteed. Etienne replies that this fits with their plans not to touch the TSU after Christmas.
- Roderik asks if the dust problem will have an impacted on the predicted rate of asynchronous beam dumps? Jan replies that it increases the risk but it is un-know by how much.
- Bernd asks what is the planning for commissioning the direct BLMs? Markus points out that the input has to be activated and tested with pilot beam. Nicolas this can be tested by reducing the threshold.

1.3 Re-commissioning procedures for the Vacuum system – (G. Pigny)

- VGP = Penning gauge; VPI = Sputter Ion Pump (used as a pump and a gauge); VVS = Vacuum Sector Valve
- Vacuum sector valves:
    - Interlocks are given through use of dry contacts.
    - Logic for vacuum valves located between room temperature sectors (LSS3, 6, 7):
        - N = 4 devices as interlock source
        - Close valve if N-1 devices > 4.10-7 mbar
        - Close the previous and next VVS
        - Can be open if:
            - N devices < 1.10-7 mbar
            - Beam_Info = TRUE
    - Logic for vacuum valves located at the arcs and at the stand alones extremities:
        - N = 3 devices as interlock source

- Close if N-1 devices > 4.10-7 mbar
- Close the previous and next VVS
- Can be open if:
- N devices < 1.10-7 mbar
- Beam_Info = TRUE
- magnet temperature < 5 K
    - Markus points out that this would be a dead lock, as than the valve could never be opened, due to the closed valve. Probably the beam_info is a requirement for closing the valve?
    - **Action**: Gregory will check if the BEAM_INFO signal is needed for opening/closing of the valve.
- The test procedures for the commissioning of the LHC vacuum control system - EDMS Document No. 1405440

- Gregory shows the commissioning steps for the sector valves:
    - Sector valve functionality; Sector valve actuation => USER_PERMIT; Pressure threshold => USER_PERMIT; USER_PERMIT => BIS; BEAM_INFO => Vacuum system; Sector valve status monitoring, logging and display; Sector valve remote control via SCADA
        - Following a question from Markus', Gregory explains that penning gages were added around the first sector valves from the IP, which were also added to the logic for closing this valve. The interlock levels have still to be decided.
        - Markus asks how the thresholds can be changed. Gregory responds that the thresholds can be changed remotely.

- Electron stoppers:
    - Not in the vacuum sector valve interlock chain
    - Totally controlled by access system (GS/ASE)
    - Need VSC group only for mechanical check

  - Commissioning steps: Electron stopper functionality; Electron stopper actuation => USER_PERMIT; RF conditioning mode (Sector valve configuration, Electron stoppers configuration); Reporting and logging;
- Access safety blocks:
  - Not in the sector valve interlock chain
  - Totally controlled by access system (GS/ASE)
  - Need VSC group only for mechanical check
  - Commissioning steps: Safety blocks functionality; Safety blocks actuation => USER_PERMIT; Reporting and logging;
- Interface with the BIS:
  - CIBU commissioning steps are described in EDMS Document No. 1400288
  - Has been already performed for TI2 and TI8.
  - Commissioning steps: USER_PERMIT => BIC; BEAM_INFO => Vacuum system; USER_PERMIT => BEAM_INFO => Vacuum system; Reporting and logging;
- External interlocks ADT and RF system interface:
  - ADT interlock level > 4e-7mbar, remove interlock < 1e-7mbar
  - ACS (gauges on the beam pipe):
    - Signal to the RF if VGP > 4e-7 mbar; removed if VGP < 1e-7 mbar;
    - Signal to the HV if VPI > 1e-6 mbar; removed if VPI < 1e-6 mbar
  - ACS (gauges on the cavity):
    - Signal if VGP > 4e-7 mbar; removed if VGP < 1e-6 mbar
    - Analogue signal (0-10V) from VGP
  - Commissioning steps: Vacuum monitoring; Vacuum interlocks generation; Vacuum interlocks transmission; Reporting and logging;
- MKI system interface:
  - Each gauge sends its own interlock to the MKI:
    - 2x VPI + 1x VGP as interlock sources

- Signal if VGP > 2e-8 mbar; removed if VGP < 1e-8 mbar
- Signal if VPI > 2e-8 mbar
- Analogue signal (0-10V) from VGP
  - Jan explains that at the moment the MKIs are not interlocking on these analogue signals.
  - Markus asks if it would be possible to implement it into the supervision of the MKI.
  - **Action**: Paolo and team will provide the information how to access the VPI and VGP interlock values to the MKI team. (Paolo, Jan, Etienne).
  - Paolo points out that the analogue signal should never be used to interlock, as these signals are not filtered. The only clean signal, which can be sent to the user is an on/off contact. Etienne points out that for the conditioning of the magnet the analogue signal is essential. Paolo points out that the signal quality cannot be improved. Jan explains that this use will only slow down the conditioning and not dump the beam.
  - Markus asks if in the long-term a consolidation can be envisaged. Paolo and Gregory respond that everything is possible.

- Commissioning steps: Vacuum monitoring; Vacuum interlocks generation; Vacuum interlocks transmission; Reporting and logging;

- MKB system interface:
  - Interlock sent for each MKB follows the same logic as the sector valves:
    - 2x VPI + 1x VGP as interlock sources (N= 3 devices)
    - sent if N-1 devices > 2.10-5 mbar
    - removed if N devices < 1.10-5 mbar
    - Analogue signal (0-10V) from VGP

- Commissioning steps: Vacuum monitoring; Vacuum interlocks generation; Vacuum interlocks transmission; Reporting and logging;

- Vacuum system tests during machine checkout:
  - Test procedure is described in EDMS document (No. 1010244).
  - Test in LSS2 right already done with valve simulators:
  - Automatic over threshold generation is now OK
  - But, no access to User_Permit time stamps (TE/MPE)
    - Markus explains that the FESA class has changed. Gregory will meet J.C. Garnier to get the information needed.
  - Test must be re-done for delay calculation
- Commissioning steps: Beam dump request triggered by over threshold (Generate interlocks, Delay: threshold / Beam Dump, Delay: beam dump / NOT_OPEN sector valve status); Beam dump request triggered by sector valve closure (Generate interlocks, Delay: NOT_OPEN sector valve status / beam dump)

1.4 AOBs – (D. Wollmann, C. Bracco, J. Wenninger)

- Chiara reports that for the first BLMs at the MKI there is no space to mount them at the same positions/orientations as before LS1. Their orientation stays the same, though. Their position will be 3-10cm higher with respect to the position before LS1. ABT has requested the orientation and exact positions for reference. This move needs to be taken into account when comparing measurements before and after LS1.
- Daniel proposes a (final) update of the Setup Beam Flag values for the restart with beam (for 6.5TeV):
  - NORMAL: 1.2e10p (allows for 10% variations of the pilot);
  - RESTRICTED: 3e11p (in less then 20 bunches, with max. 1.5e10p each);
  - BEAM_SETUP: 3e11p.
  - The maximum allowed intensity at injection is 5e11p (according to existing EDMS). The suggestion is fixing the intensity for the whole energy range to 3e11 for the RESTRICTED and BEAM_SETUP flag

values. This would simplify the curve and also avoid dumps during the ramp, when the SBF goes to false and a (masked) interlock signal is present. J.Wenninger stresses that there are 2 equations with the same intensity values. M.Zerlauth comments that 2 equations are needed to keep the flexibility in case of future changes and to allow the SIS to easily distiongusih/ interlock the allowed bunch intensity for the RESTRICTED flag. S. Gabourin states that a constant value can easily be implemented, as it is just a table with values and then this value needs to be simply kept constant.

- J.Wenninger reports a problem with the flag, which allows moving of movable devices in stable beams. The beta* value is interlocked within a very small interval. This interval is too tight for beta* leveling. Two mitigation possibilities: remove the interval check, or make the interval wider.

  Action TE/MPE: Verify if the interval window can be easily increased.
- J.Wenninger reports on a problem discovered during the implementation of the virtual beta* limit for the TL collimators, which will be transmitted by the timing system. The implementation of so-called economy cycles in the SPS requires checking the reference currents for the magnets instead of the measured currents. Otherwise the collimator interlocks would have to be unlatched after each economy cycle.