138th Meeting of the Machine Protection Panel

Participants: W. Bartmann, E. Carlier, C. Martin, B. Puccio, C. Schwick, J. Uythoven, M. Valette, D. Wollmann.

The slides of all presentations can be found on the website of the Machine Protection Panel:
http://lhc-mpwg.web.cern.ch/lhc-mpwg/MPP-Minutes-2016.html

1.1 Approval of MPP#137's minutes

- No follow-up actions were discussed.
- The minutes of the 137th meeting were not yet issued and will be approved at a future meeting.

1.2 Local BIS loops in LHC point 6 (C. Martin)

- The project is to implement two local BIS loops in point 6. In normal operation the BIS loops relays the beam permit from the users (distributed along the LHC ring) to the LBDS. During an YETS the user systems are not ready and don't deliver a beam permit which prevents full testing of the LBDS and the BIS. These local BIS loops would allow: mimicking the beam permit for testing the new upgrades of the CIBDS and TSU boards as well as any other element of the LBDS triggering chain during longer stops (LS, YETS).
- The main BIS would still function, and can run in test mode, by bypassing the two TSUs from the LBDS which requires adding two BIS racks in point 6. Both TSUs would be wired on the short loops of the local BIS. Each local loop will include a CIBDS. The TSU and LBDS would be functioning normally. The only difference with the operational system is that both beams cannot be coupled, which would have required more cabling and be costly.
    - Etienne commented that this functionality is not necessary for the test mode of the LBDS.
- The elements for the local BIS loops will be made available in the local BIS racks in order not to deprive the normal rack for these tests. The bypass is done directly in the BIS rack and unused cables of the normal rack will be left hanging in the meantime. The CIBUs will be connected in the same way, there is no action necessary on the ABT racks.
- On the machine protection aspect, the transition must be secure and no oversight possible. For the CIBU connection, the "pre-op check" checks that all three cables are reconnected and would prevent arming the loop. In case of a false pre-op check the SIS will prevent a swap between the cables by going to False, the same for the deactivation of the jumpers.
- The short fibers for bypass cannot be forgotten because the operational ones have to be connected in their place. A swap can be made between the two loops but the frequency would then not match the requested 8 MHz, respectively 9 MHz, and the arming sequence would fail. (NB the arming is

done with the latch mode of the CIBG which allows generating the frequency for 400 µs without feedback, if after this delay the frequency is not transmitted back to the CIBG the arming fails)

- The cables connecting the CIBDS cannot be switched as the voltages would be wrong and prevent arming. Loop A and B can be switched at this stage but the inconsistency will be seen on the analysis of the first dump test during revalidation and LHC protection will not be compromised. If the synchronous path is not connected, there can only be asynchronous beam dumps, which will also be seen during the first dump tests. (NB the test sequence is the following: pre-op check, arming of B1, request a dump, check the buffer history, redo for Loop A and B, redo for B2, redo with linked loops)
- Conclusion, the switch to the local loop can be done quickly, there are few operations to be done. There are no foreseen dangers in the changing operation.
    - Wolfgang commented that the local loops are useful for tests and the availability runs, but the checkout will have to be done with the operational loop.
    - Jan stated this should only be used for YETS and LS and asked Etienne if there was a necessity to make this available for TS. Etienne answered there should not be.
    - Daniel asked how long the revalidation would take following the hour to implement the changes between local and operational BIS loops. C. Martin answered it should take half a day. Etienne added that it should take limited to no time on the LBDS side.
    - Etienne warned that one should make sure the machine cannot be run with beam with the local loop. The protection by the pre-op-check here is on the software level which is insufficient. Jan added that the safety here relies on the test procedure, including a first beam dump at injection with a pilot beam, and one could consider something preventing operation on the hardware level. Daniel answered the Database is a protection and one would only use this test loop during long stops and in crisis situations with approval from the MPP. Jan proposed to add the consignation of the machine by disconnecting the injection loop, this way it would require the intervention of another expert at another location in the ring to reinject. Etienne insisted on the fact the switching procedure sounds too fast and could open a door in the machine protection system if it was used regularly. Other ways to increase protection would be to check for the hardware status in the sequencer and make the procedure more complex. Wolfgang suggested that this was only done with a written authorisation from the MPP so it is not done in a rush or for a single day of testing.
    - Jan asked how complicated is the operation of disconnecting the injection loops from the BIS. C. Martin answered it only requires the unplugging of two cables in points 2 and 8. During revalidation one could test the BIS before re-plugging the loops to disentangle the sources of errors.

- Finally, it was decided not to include the injection BIS disconnection in the procedures for the local BIS loop.

1.3 Planned TSU firmware upgrade during EYETS and requalification requirements (E. Carlier)

- The LHC dump TSU is foreseen to be reused for the SPS dump. The only difference is the different revolution frequency. When testing the SPS TSU with the LHC systems some unforeseen problems occurred. For instance, the BRF (beam revolution frequency) signal from the LH RF system arrives via one signal to both TSUs, there is no redundancy. If this signal were to be faulty a dump would occur but with unknown timing. As of now, both TSU monitor each other, there was a proposal for a third one that would monitor both of them. This limitation was inside the system from the start and was reproduced in the lab. If there is a glitch in the BRF signal and it misses a pulse, it is interpreted as a sudden increase in revolution frequency. So far this type of failure has not occurred during normal operation.
- An improved BRF surveillance was implemented, a survey system checks that the BRF period is within 30 ns of the previous one and within 150ns of the design one. If the lock on BRF is forced false, the reference switches to the internal timing and a synchronous beam dump will be requested. This upgrade doesn't concern any change of hardware and but an update of the safety critical firmware.
- As a long term mitigation, a redundant transmission of the BRF is being considered and first tests are being performed in the lab. The impact of higher sensitivity to optical transmission discrepancy will be studied in detail.
  - Jan commented an asynchronous Beam Dump is an acceptable failure mode, some magnets would quench but the machine will survive.
  - Etienne added that a lot of effort was invested in the test bench in order to study all known failure modes. One cannot know the failure mode following the disappearance of the BRF signal, which was just discovered. The only concern to be investigated now is the potential drift/instability in the RF signals. Currently it is considered to request the transmission of the BFR signal to the ABT lab to allow the use of the BRF signal during lab tests. Daniel commented that it would be a good idea to perform lab tests also with the real BRF signal.
- The new firmware is foreseen to be installed in the coming EYETS and will be tested during the reliability run foreseen for the CIBDS.

AOB - all

- Last MPP of the year. See you all in 2017 and enjoy the holiday season.