214th Meeting of the Machine Protection Panel

LHC topics

October 22nd, 2021 via Zoom

Participants:

Andrea Apollonio (TE-MPE), Gabriella Azzopardi (BE-ABP), Andy Butterworth (SY-RF), Chiara Bracco (SY-ABT), Mario Di Castro (BE-CEM), Yann Dutheil (SY-ABT), Cédric Hernalsteens (TE-MPE), Hartmut Hillemanns (EP-AID), Grzegorz Kruk (BE-CSS), Dragoslav Lazic (EP-UCM), Anton Lechner (SY-STI), Ivan Lopez Paz (EP-ADO), Nicolas Magnin (SY-ABT), Belen Maria Salvachua (SY-BI), Christophe Martin (TE-MPE), Daniele Mirarchi (BE-OP), Filip Moortgat (EP-CMG), Sara Morales Vigo (SY-BI), Brien Petersen (EP-ADT), Gregory Pigny (TE-VSC), Jan Uythoven (TE-MPE), Mathieu Saccani (SY-BI), Brad Schofield (BE-ICS), Raffaello Secondo (TE-MPE), Matteo Solfaroli Camillocci (BE-OP), Stefano Redaelli (BE-ABP), Andre Rummler (EP-ADO), Georges Trad (BE-OP), Maciej Trzebinski (EP-UAT), Jorg Wenninger (BE-OP), Christoph Wiesner (TE-MPE), Daniel Wollmann (TE-MPE) Christos Zamantzas (SY-BI).

The slides of all presentations can be found on the website of the Machine Protection Panel and on Indico (214th meeting).

Minutes from the last meetings (LHC topics)

The minutes of the last MPP meeting on LHC topics have not been circulated at this time.

Status MP system commissioning before first injection of a nominal bunch

Collimation (Stefano Redaelli, Daniele Mirarchi)

Stefano summarized the progress on the collimation tests performed so far. All tests without beam were completed successfully. A temperature sensor failure was observed but this has been fixed. The alignment of the collimators with beam will be performed today with a pilot beam. This will have to be repeated for the nominals. In addition, systematic checks of the aperture will also be performed during the night. Stefano concluded that the system will be ready for nominals on Monday.

Preliminary loss maps were looked at following the ADT set-up yesterday. It was observed that the betatron losses were occurring in the primary collimators, as expected.

Daniele provided more details on the collimation tests. All machine protection checks have been performed: interlock tests on position, gap, and power cut. The details are in the checklist

tool, including links to the logbook entries. Additionally, as part of stress tests, all collimators were ramped with thresholds. The LVDT and motors were validated. The collimators can be moved through the sequencer. The settings have been generated for the roman pots and are available through the sequencer. The TOTEM roman pots are totally bypassed (the motors are off). For AFP, everything is prepared with the requested settings, but this needs to be validated with loss maps.

Questions

- Daniel asked about the ALFA roman pots. Maciej mentioned that they will stay in garage.
- Belen asked if it has been tested that the settings cannot be modified directly via FESA. Daniele mentioned that it was checked to change settings without being logged, and that a direct test using the FESA navigator can be performed, however, Stefano mentioned that trying to change it at the level of the FEC is sufficient and is an equivalent test. Daniele will verify that the settings cannot be changed directly via the FESA navigator.

Injection protection (Yann Dutheil, Chiara Bracco)

Most tests are validated or cancelled due to reduced needs for the beam test. The temperature probe on MKI8 has an issue, this will be followed-up during the YETS, but it is not critical.

The system is ready for injection of nominal bunches and for stable beams.

Question Daniel asked if the TDIS interlock has been tested? Yann replied that this has been done.

LBDS (Yann Dutheil, Chiara Bracco, Nicolas Magnin)

A few tests remain as work in progress but nothing critical for the pilot run.

A timing difference between the dump event recording on the TSU and the global timing of 400 µs has been observed (instead of the maximum allowed value of 130 µs). Nicolas is following this up with the timing team.

The XPOC filling pattern is incorrect.

Comments Jorg commented that this was not working at all because the BQM was not working. It should work now as the BQM is now operational. Nicolas commented that it is still missing as of this morning. Jorg will follow-up. Jan commented that this would be nice to have before we move further with multiple bunches. Jorg and Daniel agreed, that, as far as possible, the XPOC should be unmasked for stable beams even though we will be operating at low intensity. In case this is not reasonably feasible, XPOC issues will need to be checked and understood to ensure our capability to dump on demand with the experiments on. Nicolas agreed.

Action: Ensure that the issues currently requiring the masking of XPOC are resolved, so that it could be unmasked before declaring stable beams (Nicolas).

The BLM data are sometimes missing in XPOC. As long as the XPOC is concerned, this is not an issue. It is currently followed-up by the BLM team.

Comments Belen commented that the BI software team is following-up on that. Christos commented that they suspect that it is linked to the high "frequency" of dump triggers.

LBDS beam commissioning, mostly for aperture measurements, are scheduled for Saturday. Nominals will be used for some of these tests.

Daniel commented that some tests "with beam" are not needed for the beam test run. Daniel proposed to follow-up on that early next week. Yann added that the commissioning procedures for the injection and for the LBDS are being reviewed for outdated tests.

BLM system (Sara Morales, Belen Salvachua, Christos Zamantzas)

All the tests have been performed, with only three tests which are still work in progress. All of them passed. The pending tests are not critical for operation. The pending tests concern:

- Changes in the LSA database (detectors that need to be removed)
- 10 optical links which show few errors
- BLETC and BLECS tests to be repeated after the pilot run

The hardware checkout tests are:

- The high voltage modulation tests
- The radioactive or battery tests. All the BLMs identified as critical for the pilot run have been tested, lots of detectors in the arcs still need to be tested for Run III
- Beam energy reception tests.

A continuous monitoring of the system's status is operational and can be visualised with the expert applications. In addition, the BLM (fixed display) application has a "status bar" for OP, which summarises the state of the daily integrity checks and warn if they approach expiration time.

The machine checkout tests were performed. The user permit transmission test has been done manually in the lab and in one crate without beam. The majority of the CIBUs have been checked with beam during the beam tests on 19 October. The threshold values change with energy test was done on 18 October. The missing HV detection and propagation to the SIS has been checked - not in all locations but this is sufficient for the pilot run. Those tests will have to be completed for all crates before Run III. A false-positive HV fault in SR5.R caused some beam dumps and therefore the HV check is currently masked – crate needs to be thoroughly investigated for HW intermittent faults after the beam test.

A measurement of the interlock request system latency was performed: the time between the maximum of the injection kicker pulse and the dump request was measured. All latency values were around 100 µs (max. 140us?) and is below the 3 LHC turns design value.

Daniel commented that the design value should be below 3 turns. Jorg added that the initial design specifies a value of 3 turns from the moment the client triggers the dump to the actual dump. Jan commented that it would be interesting to check the latency also between the BIS and LBDS trigger for evaluating the full interlock chain.

Action Communicate the list of variable names (for NXCALS) that are needed to assess the latency of the full chain (Jan).

An additional test with beam that remains to be performed is to verify that steady-state losses (RS > 1.3 s) are able to trigger a beam dump on their own. This requires a means to induce better-controlled beam losses, *e.g.* with a local bump or ADT.

Some issues were encountered during the pilot run:

- A noisy group of channels appeared at 11R1 and their limits had to be opened for passing the HV modulation check. The installation was fixed yesterday morning during the scheduled access.
- The expiration of system checks timers (24h) induced interlock requests while the beams were circulating. Further investigation found that the 'beam info' signal bypass installed during LS2 in all LHC points to allow internal tests, was not removed and forgotten in IP1 and IP8 racks. This was fixed and tests will be added to the procedure to check that these are removed before operation in the future.

Action Update the BLM machine protection commissioning procedure with tests to ensure that the "beam info" bypass devices are removed prior to operation (Belen, Christos)

The BLM system is ready for nominal bunches and stable beams.

BIS / PIC / WIC /FMCM / SMP (Raffaello Secondo)

Raffaello provided a system-by-system summary.

WIC

All tests are complete.

PIC

The hardware commissioning is 100% done. The AUG tests were carried out more than one year ago (passed) and should be repeated during YETS. There are no PIC tests to be done with beam.

An issue with the transmission of the power permit for the 60A circuit is being investigated.

Comment Brad commented that the problem comes from WinCC and is understood. It should be fixed now.

FMCM

The hardware tests are 99% completed, analysis of the recently performed FMCM tests with beam are ongoing. The only missing test concerns the transmission of PM data from the FMCM of RMSI.R8.

Comments

- Jorg commented that this has been tested three times and no PM was generated by the FMCM. Daniel mentioned that this is also being followed-up by the software team.
- Jorg mentioned that it is difficult to trigger the FMCM in some cases as the WIC will be faster when a fault is provoked on the PC. For this reason, all tests have been also

repeated by sending an off command. In some cases, however, the beams are dumped by losses well before the FMCM. This is not blocking but needs to be followed-up.

SMP

Communication and machine checkout tests have been completed. The beam tests need to be performed. Not all the tests need to be done for the pilot run (only SBF_RESTRICTED (4e10) and SBF_BEAM_SETUP (3e11).

BIS

The ISTs are completed. The user link connections tests have been reviewed (LHCb connection forced to true, TCDQ and RF marked red by Jorg, The other statuses are in the checklist).

The LHC injection BIS tests are not part of the present MPS BIS tests. They need to be added to the checklist for Run III. Daniel commented that this should be cross-checked with the injection protection MPS tests.

Vacuum system (Gregory Pigny)

All tests were performed between end of August and mid-September. They are all green on the checklist. The compressed air distribution for the valves is affected by radiation, including the cabling, and will be consolidated during YETS (48 sector valves in total). There was an issue in UA87 with one valve closing when the beam info changed. This has been corrected by replacing the electronic unit.

The tests with MKI, MKB and RF will be performed on Monday during the access, pending confirmation from Andy and Yann.

SIS (Jorg Wenninger)

Jorg summarized the status of the SIS checklist: 60% are done, 20% are in work and 20% are still pending. Work is on-going with good progress. Some tests will be blocked out, such as the abort gap cleaning.

Summary

The decision to inject nominal bunches will be taken following the aperture tests of the weekend.

Summary of actions

The actions from the meeting are:

- LBDS
    1. Ensure that the issues currently requiring the masking of XPOC are resolved before declaring stable beams (Nicolas).
- BLM system
    1. Communicate the list of variable names (for NXCALS) that are needed to assess the latency of the full chain (Jan).

2. Update the BLM machine protection commissioning procedure with tests to ensure that the “beam info” bypass devices are removed prior to operation (Belen, Christos)