Status of MPS aspects for the BLM System commissioning – Pilot Run

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29th Oct 2021 – Machine Protection Panel (MPP)

Introduction

- **Last MPP presented the general system status (Sara Morales 22/10/2021 MPP)**

  - MPS aspects for the system validated accordingly for the Pilot Run at injection

  - Some issues encountered and mitigated or solved.

Beam tests – To be done

It was decided not to perform two beam tests before the Pilot Run:

1. **Interlock request functionality of the BLETC for RS > 1.3 sec (steady state)**

2. **Test the interface of direct BLMs with the beam dumping system**

3. **Test the Injection Interlock Inhibit functionality**

To be done before Run 3

Issues encountered during Pilot Run

- **Noisy channels in 11R1** -> Not passing HV modulation tests, **fixed yesterday** during access

- **SR5.R crate sending SIS interlocks on HV** -> Crate seems a bit faulty, not limiting operation, but will need to be investigated and repaired **after the Pilot Run**

- **Beam dump request from all crates and both M&U outputs while beam circulates:**

  1. Device to bypass the beam info installed during LS2 in all LHC points to run tests on the system

  2. Device forgotten in IP1 and IP8 before the Pilot Run, consequences:

     1. Sanity checks expire after 24h

     2. IP1 and IP8 reading fake beam info (no beam) -> Remove the beam permit -> Dump the beam

     3. Rest of crates read updated beam info (no beam) -> Remove the beam permit

-> **Device removed from IP8, switched off in IP1 as original plug was not found -> To be done in YETS**

-> **Test to be added in the procedure to check all devices are removed before operation**

BLM MPS aspects status

- **Status today in view of a possible energy ramp up to 3.5TeV with a pilot bunch < 1e10 protons.**

- **MPS functionality tested and ok, issues encountered:**

  - PM data not synchronized. BLM buffers are randomly not re-armed after a PM event or a FEC reboot. Effect is that when next PM event arrives some buffers are empty. **Mitigation**: a sequencer task is added when the LBDS is re-armed in order to ensure that the BLM buffers are started. This mitigation does not hide anomalies (still logged) but ensures that it affects only the time between the beam dump and the next fill.

  - SR5.R crate sending SIS interlocks on HV. Could be a problem of the crate, it was accepted to mask this in the SIS during Pilot Run.

- **Radioactive source tests / Battery test**

Triplet areas and ARC from cell 11 have not been tested.

The plan is to do over YETS.

We cannot guarantee that there is no channel inversion in those areas.

BLM status for Run 3 - 2021-10-21
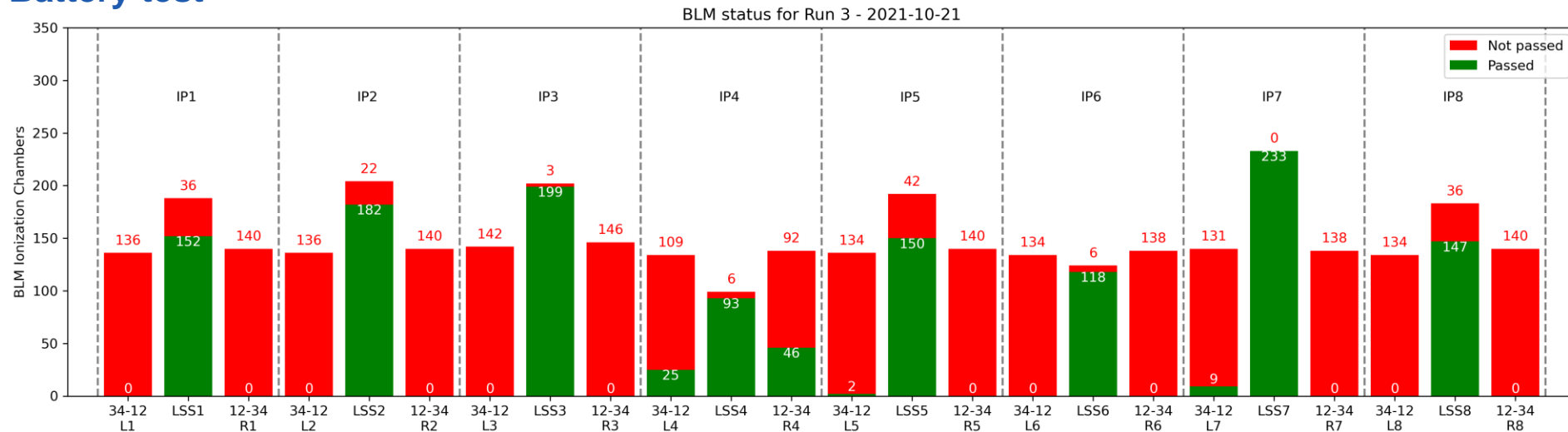
BLM Thresholds

- **New BLM monitors have been added during LS2 , thresholds are not ready and will be done over YETS, this concerns:**

  - TCLD collimators in 11R2 and 11L2: temporarily added to TCL_W family. Connected to BIS

  - TCSPM collimators in IP7: THRI_TCSPM family. Connected to BIS.

  - Crystal collimators in IP7: NOT connected to BIS

Anton Lechner

1) Energy deposition in coils:
From our past quench test studies [1] we know that the energy density in the coils of a SC magnet is < 1 J/cm3 for a bunch with 1E9 protons at 3.5/4 TeV (assuming that the losses are spread over a few tens of cm longitudinally). In the beam screen and vacuum chamber, the peak energy density can be a few factors higher (say a few J/cm3)

2) Damage levels:
[2] HiRadMat test (D. Wollmann et al.): NbTi coils can sustain a few 100 J/cm3 without damage.
[3] TT40 test (Thesis of V. Kain): copper can sustain 2-3 kJ/cm3
So we should have sufficient margin.

For 1e10 protons:
10 J/cm3
10 times below damage limits

[1] https://journals.aps.org/prab/pdf/10.1103/PhysRevSTAB.18.061002
[2] https://indico.cern.ch/event/1079026/contributions/4546147/attachments/2331358/3973030/hl_scdamage.pdf
[3] http://cds.cern.ch/record/902813/files/thesis-2005-047.pdf

Update of the BLM Latency

BLM latency from beam injection (rise time of MKI) to BLM removal of USER_PERMIT in the BIC, should be below 3 LHC turns (BLM_BIC).

Latency (μs)	B1		B2		Combined
	BLM_BIC	BIC to MKD	BLM_BIC	BIC to MKD	
IP1	142	130	132	149	☑
IP2	72	109	100	181	☑
IP3	96	88	-	-	☑
IP4	-	-	-	-	-
IP5	82	102	*		☑
IP6	80	14	69	34	☑
IP7	143*	-	123*	-	☑
IP8	105	78	-	-	☑

Includes transmission time of the signal through cabling from detectors to CIBUS -> Some km
BIC to MKD added for information as discussed in the last meeting