

192nd Meeting of the Machine Protection Panel

Injectors topics

June 5th, 2020 via Zoom

Participants:

Andrea Apollonio (TE-MPE), Andrew Butterworth (BE-RF), Eva Calvo (BE-BI), Stephane Cettour Cave (BE-OP), Ewald Effinger (BE-BI), Fabio Follin (BE-OP), Cedric Hernalsteens (TE-MPE), Lars Jensen (BE-BI), Steen Jensen (BE-BI), Anton Lechner (EN-STI), Kevin Li (BE-OP), Jan Uythoven (TE-MPE), Belen Salvachua (BE-BI), Andrzej Siemko (TE-MPE), Federico Roncarolo (BE-BI), Frank Tecker (BE-OP), Eric Veyrunes (BE-OP), Jorg Wenninger (BE-OP), Christoph Wiesner (TE-MPE), Daniel Wollmann (TE-MPE), Yu Wu (BE-OP), Christos Zamantzas (BE-BI), Markus Zerlauth (TE-MPE).

The slides of all presentations can be found on the website of the Machine Protection Panel and on [Indico \(192th meeting\)](#).

Minutes from the 188th MPP meeting (Special meeting on RFQ protection)

- No comments on the minutes have been received and the minutes are approved.

Minutes from the joint 189th (Injectors)

- No comments on the minutes of the last MPP meeting on injectors topics (189th MPP) have been received.

Introduction to BLM related activities during LS2 in the injectors (Christos Zamantzas)

Christos presented the BLM activities taking place during LS2 in the injectors. A major upgrade of the legacy SPS BLM system is on-going to allow for operation during Run 3. The present system in the SPS is a few decades old. However, its upgrades and maintenance have not been properly tracked over the years; the tracking of the different assets has not been done using the common CERN tools.

The complete upgrade of the SPS BLM system has been postponed to LS3. However, the BLM systems in the other injectors have been fully upgraded during LS2. A request to the consolidation project for the new cabling and electronics in the SPS ring has been approved, covering the renovation of the system, except for the BLM detectors themselves. Another request has been made for the refurbishment of the BLM systems in the transfer lines but has not been approved yet.

The damage potential in the SPS machine is already high and will get even larger with the LIU beams. The new BLM system needs a better measurement accuracy and a shorter interlocking latency. The system under development has a radiation tolerance of up to 1kGy, an acquisition period shortened to 10 μ s, an increased dynamic range of more than 8 orders of magnitude and real-time processing in the electronics.

The work on the BLM system in the SPS during LS2 consists mainly in the preparation for the coming replacement of the system. In particular, a better knowledge of the assets (locations and quantities) is required.

- **Question** Jan asked if the replacement of the system in the SPS has been approved for LS3. Christos replied that the consolidation project approved it for LS3 (besides the detector production in Russia), the on-going work during LS2 is an intermediate change. The new system in the LHC will be deployed during LS4, after its validation in the SPS. One will then have two different system: Linac4 to PS and SPS + LHC. The PS and TT10 have been equipped with the new injector system.

BLM hardware changes at SPS (Ewald Effinger)

Ewald presented the motivations for the changes on the BLM hardware. The aging and obsolescence of the components, installed in the end of the 90's, is a key factor.

During LS2, all integrator cards have been collected and brought back to the workshop and all the chassis have been checked for unused cards. All cards have been cleaned in ultrasonic baths, the soldering has been verified or fixed. The front-panels have been exchanged with new versions. The empty slots have been closed with blinds for better ventilation. Five spare integrator cards have been produced.

Due to timing problems on the VME bus during the last run and to decrease the read-out time, changes have been carried out on the Ionisation Chambers (ICs) and on the integrator cards. In addition, the calibration factors (in Gy/bit) have been updated and corrected.

- **Question** Daniel asked about the harmonization of the ICs (*e.g.* TI2 mismatch of different ICs on the same card). Ewald replied that they will be changed to have the SPS and LHC ICs read by the same integrator card.
- **Question** Daniel asked about the effect of the two capacitor combinations on the reaction time. Ewald replied that these two different types are to prevent the saturation for higher beam losses, they do not change the reaction time. The main bottleneck is the ADC readout. It has been reduced from 20 ms to 5 ms. Ewald also clarified the status of the spares. Cards of type 1 can also be replaced by types 2 and 3 while type 4 only has a small number of spares. However, the situation is not critical as only one or two cards are in average replaced per year.

BLM software changes at SPS (Steen Jensen)

Steen discussed the software changes introduced during LS2. The acquisition time has been reduced to 5ms (from 20ms). The typical readout time is ~2.2ms, so it might even be possible to go down to an acquisition time of 3ms.

A major change concerns the thresholds. Before LS2, only the value integrated over the whole cycle was interlocked (checked at each acquisition time against the threshold). Five running sums (RS) have been introduced. RS0 covers the whole cycle.

- Before LS2, the thresholds are set to accommodate the full losses on the cycle and are therefore quite large.
- **Comment** Daniel commented that the RSs offer more granularity, but short running sums should not shadow longer ones.

Another improvement concerns the coasting mode. Before LS2, a blind window of ~1s with no measurement/interlocks was present at the end of each cycle to reset the integrator of the electronics. It has been decreased to 100ms.

Before LS2, all measurements were published only at the end of the cycle. They are now published every 1.2s. A new GUI has been put in place by Fabio F. to follow all the changes in the FESA class.

- **Comment** Anton L. commented that the measurements are reported in terms of dose and not dose rate as it is the case in the LHC. It was discussed that dose is a more natural unit for a cycled machine, in particular in the absence of RSs of varying lengths, and this is what the SPS operators are presently used to.
- **Question** Markus asked about the risk of reducing the acquisition time to 3ms. What if the acquisition time is too short, do we just miss a reading? If an acquisition is missing, then the beam will be dumped. Daniel commented that it is a safe behavior, however the logs can then not be trusted.

Jan commented that the experience with the new system should be shared during a future MPP meeting.

- **Action** Report on the first operational experience, including the use of the new running sums (K. Li)

BLM database changes at SPS (Eva Calvo)

Eva presented the changes that have been introduced regarding the SPS BLM detectors in the layout database. In the past, changes were not always propagated. This work has been done in order to prepare the path towards the future upgrade in LS3. Also, the old names used in the applications, logging and documentation were not compliant with the SPS naming convention.

A new naming convention has been proposed, including a layout name and an associated expert name. The BLM ring detectors of the first 3 sextants are already published in the LDB. An update of the obsolete drawings is on-going.

- **Comment** Jorg commented that with the new naming convention, which includes the electronics type in the names, if the electronics changes, the names will change. Eva replied that only the expert names will change; not the layout names. However this change has an impact on logging etc.

Summary of actions

The actions from the meeting are:

- Report on the first operational experience of the SPS BLM system after LS2, including the use of the new running sums for interlocking (K. Li)