

177th Meeting of the Machine Protection Panel

The meeting took place on **April 26th 2019** in 774/1-079.

Participants: C. Bracco, D. Lazic, A. Lechner, S. Redaelli, J. Wenninger, D. Wollmann, C. Wiesner, M. Zerlauth, A. Masi

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

1.1 Minutes from the 176th MPP

No comments have been received for the Minutes from the last MPP. All actions have been added to the MPP homepage.

- Alessandro asked in which form the specifications for the **new collimator temperature interlock logic** should be written down. It was concluded that it should be in the form of a **Controls Change Request (CCR)** that describes the proposed changes but also summarizes the original interlock logic.
- Daniel reported that, as action from the last meeting, the **delay time of the interlock chain for the Long Range Beam Beam Compensating Wires (BBCW)**, including a WIC unit, has been measured by MPE-MI in conjunction with TE-EPC. In case of an internal power converter fault, the FGC's response time to send the PC_Status "false" signal to the WIC and finally the BIS user input was measured to be 1.2 ms. Daniel concluded that, thus, the WIC is fast enough for interlocking the device.
 - Markus remarked that the measurement was done with an FGC3 controller and not with an FGC2 controller, which will be the one used for the BBCW in Run 3. It should, thus, be repeated with an FGC2 system. → **Action (R. Mompo/MPE-MI): Repeat response-time measurement with FGC2 system and report results in an AOB at the MPP.**
- Stefano asked who would have the **responsibility for the BBCW** and its subsystem when it becomes an operational device.
 - Markus replied that the responsibility for the WIC stays within MPE and for the Power Converter within EPC, which includes the piquet or stand-by service. The responsibility and operational support for the temperature interlock of the wires has, however, to be clarified. → **Action (S. Redaelli/COLL, A. Rossi/BE-BI): Specify line of responsibility for the BBCW temperature interlock for commissioning and operational follow-up.**
 - Markus commented that one should also plan ahead and specify how to mask the interlock or remove it from the operational chain, in case of malfunctioning.
 - Stefano stressed that for an operational device sufficient time and resources have to be allocated during commissioning.

1.2 Injection incident following high beta run with crystal collimators (Stefano Redaelli)

- Stefano presented the **injection incident following the high beta run with crystal collimators**.
- The short but very successful high beta run implied a **highly non-standard operation**, relying on continuous expert involvement. It included interleaved high and low intensity fills.
- **Two different collimation schemes were used**: the standard ('nominal tight') and the crystal scheme. The crystal scheme improved significantly the background for TOTEM, but ALFA preferred the standard scheme. To allow optimum conditions for each experiment, the decision about what scheme to use was taken on a fill-to-fill basis, with the last fill of the high beta run using the crystal scheme. After this last fill, the vertical crystals were accidentally **left in their beam position**.
- The existing **crystal interlocks** during the high beta run included:
 - A **hardware interlock** to inhibit moving the crystal chamber between IN and OUT positions during beam operation.
 - A **software interlock** that prevents injections if crystals are IN. However, the interlock can be masked for MDs.
 - Time position limits, which have not been set and there were not used operationally.
- During the high beta run, the **software interlock was masked** to allow beam injection ('MD mode'). No specific high beta sequence for the settings of the crystal positions and angles was used.
- Stefano concluded that all the infrastructure for interlocking was available but that **the transition from safe to unsafe operation was not handled properly**. No formal procedure was prepared, and only oral *consigne* were given to the shift crew. Since the specific take-out sequence for the crystals was not executed, the **crystals remained IN**, sitting below 3 sigma in their channelling orientation during the subsequent injections.
- After the last fill of the high beta run, the **nominal sequence for a standard fill was played**, which re-established injection conditions for the machine. Since the crystals are not included in the preparation for injection sequence, no error for the crystal position was detected by the sequencer.
- While setting up the scheduled Van-der-Meer cycle, **high losses were observed when injecting trains of 8 bunches and 12 bunches**. This led to a **total of 8 dumps due to injection losses**. A fraction of the injected beam was channelled into the secondary collimators, which were sitting at their nominal positions. Simulations showed that the beam was intercepted by the secondary collimators in IR7 and no aperture was exposed (Slide 9).
- The **abnormal loss pattern in IR7** deviated strongly from the standard hierarchy pattern. However, since the 8 bunch VdM scheme was being set up, it was first believed that the losses could be caused by wrong ADT settings.
- The losses with injected single (probe) bunches were too small to dump, and became only visible when injecting bunch trains.
 - Replying to a question by Chiara, Stefano confirmed that we dumped also with the nominal 12 bunch train, but that the pilot injection seemed clean.

- Jorg remarked that fortunately we didn't inject a full train. Stefano replied that he considers it nearly impossible that we have a clean injection with the 12 bunches but then hit the crystals with a full train. He stressed that this experience reinforces the necessity to have a 12 bunch train injection before injecting a full train. He added that the loss patterns should always be put in the logbook for a quicker analysis. Chiara stressed the importance to properly check the IQC in case of injection losses.
- Jorg remarked that, looking on the **injection losses in the ring** in the IQC, the pattern was very unusual, which triggered the idea that it was not an ADT issues, but that the crystals had been left in.
- Chiara asked if the losses had been single turn. Stefano replied that the losses extended over a few turns.
- Stefano presented the **lessons learnt** (Slide 12):
 - All test devices should have a recovery task in the nominal sequence, or at least a check task, to make sure that they are in the desired configuration for subsequent (nominal) fills.
 - Non-standard operation needs better preparation and checks. It should not only rely on procedures.
 - In particular, long operation periods spanning over several shifts should be automatized through sequences.
- Daniel suggested to, in addition, integrate the crystal status in the collimator fixed displays. → **Action (S. Redaelli/COLL, OP): Include crystals into recovery sequences for Run 3 and integrate crystals into collimator fixed displays.**
- It was discussed how to best avoid that critical masks remain active after their usage. Presently, there are two masking levels, for all users and for experts. Jorg proposed that one could have an additional MD masking level. This way, one could include a sequencer task to unmask all "MD interlocks" for subsequent cycles. → **Action (J. Wenninger/OP): Evaluate feasibility and implications with OP and CO to include an "MD mask" level in the SIS.**
- Stefano asked if we could have more sophisticated **tests in the IQC**. Chiara replied that if we observe losses in IR7, the injection oscillations must be very large. If there are no oscillations visible, one can already conclude that it must be a different root cause.
 - Daniel asked if the IQC has an intensity scaling for pilot injection. Chiara explained that the intensity scaling for longitudinal losses is not trivial. Stefano stressed that the reasons for increased losses could also be a bump in an arc that was accidentally left in.
 - Daniel remarked that, independently from the incorrect procedural handling, a faster analysis of the losses would have been beneficial. Jorg added that there is presently **no automatic check of the loss pattern (e.g. against a current reference) in the Post Mortem**. Daniel replied that this has already been requested in the past and would be beneficial to include.
 - Alessandro asked who should be called in such a situation. Jorg replied that normally the Machine Coordinator should be called. However, each coordinator has a particular field of expertise. In this case, Jorg was called by the EiC.

1.3 AOB: MPP Workshop

The number of participants per day was reduced to below 40 upon request by the management. The participant list now mainly includes the speakers and the session chairs. Therefore, a more intense communication within the teams and groups is required during the preparation and follow-up of the workshop.

There are no proceedings foreseen, instead executive summaries will be written by the session chairs. The full program can be found on [Indico](#).

1.4 Open Actions

The actions from the meeting are:

- Action (R. Mompo/MPE-MI): Repeat response-time measurement with FGC2 system and report results in an AOB at the MPP.
- Action (S. Redaelli/COLL, A. Rossi/BE-BI): Specify line of responsibility for the BBCW temperature interlock for commissioning and operational follow-up.
- Action (S. Redaelli/COLL, OP): Include crystals into recovery sequences for Run 3 and integrate crystals into collimator fixed displays.
- Action (J. Wenninger/OP): Evaluate feasibility and implications with OP and CO to include an “MD mask” level in the SIS.