

194th Meeting of the Machine Protection Panel

Injectors topics

June 26th, 2020 via Zoom

Participants:

Andrea Apollonio (TE-MPE), Tibor Bukovics (BE-OP), Andrew Butterworth (BE-RF), Chiara Bracco (TE-ABT), Cedric Hernalsteens (TE-MPE), Bettina Mikulec (BE-OP), Filip Moortgat (EP-CMG), Jan Uythoven (TE-MPE), Mathieu Saccani (BE-BI), Belen Salvachua (BE-BI), Brad Schofield (BE-ICS), Andrzej Siemko (TE-MPE), Jose Somoza (TE-VSC), Federico Roncarolo (BE-BI), Richard Scrivens (BE-ABP), Frank Tecker (BE-OP), Christoph Wiesner (TE-MPE), Daniel Wollmann (TE-MPE).

The slides of all presentations can be found on the website of the Machine Protection Panel and on [Indico \(194th meeting\)](#).

Minutes from the 192th MPP meeting

- At the time of the meeting, the minutes of the 192th meeting were still in preparation.

Minutes from the 189th MPP meeting (Major Event Reports)

- The template and procedure for the Major Event Reports on Machine Protection have been approved by the IEFC and the two sample reports have been shared as draft for discussion on EDMS. Minor comments have been received for the report about the Linac4/PSB incident and have been implemented.

PSB operation procedure for injection into less than 4 rings (Bettina Mikulec)

Bettina presented the operational procedure for injection into the booster with less than 4 rings as initially discussed at the [182nd MPP meeting](#) (“PSB: injection into less than 4 rings”). The Linac4/PSB BIS cannot cut the beam for individual rings: the full pulse is always cut by the pre-chopper or chopper. However, risk analyses identified ring-specific failures that could lead to long down-time of the PSB and therefore all subsequent machines. Therefore, a modification of the BIS layout has been carried out to allow masking of certain PSB injection equipment in case of failure (painting kickers, chicane bumpers, injection foil system and for specific failures the vacuum valves).

The procedure to mask one of these inputs at the BIS is detailed below. A pre-requisite is to have the written go-ahead from a member of the rMPP injector team. The following steps are:

1. Insert the L4T beam stopper.

2. Set the number of injected turns in the booster to zero for the corresponding ring. Four new external conditions, with corresponding push-buttons in the CCC, have been created (I_B.RINGr with r=1..4). They inhibit the individual ring and force the pulse length to zero. The corresponding button must be pushed to activate the inhibit.
3. It is then allowed to mask the failed equipment in the BIS:
 - a. The masked channels will be shown as warnings in LASER and also in the elogbook at each start of shift.
 - b. TE-MPE will implement RBAC protection for all maskable user inputs channels for these four PSB-BICs (using the PSB supervisor e-group).
4. The beam stopper can be removed.

Comment Jorg added a comment that the individual BIC inputs cannot be separated and assigned individual access rights. There is one rule for all maskable channels of one BIC device as it is a single FESA property.

An additional level of protection is in place in case it is needed to close the vacuum valves around sector 1L1 and mask their BIC user input: 2 additional BLMs are installed downstream of the vacuum valves in the BI line. One BLM covers the lower rings and the other one covers the upper rings. These BLMs are connected to the BIC. The SIS will also monitor the status of the vacuum valves. In case one valve is not open, the timing event Bir.NTO-SIS will force the pulse length to zero for the corresponding ring.

The procedure was approved by the MPP. It is available in EDMS ([EDMS 2380281](#)) and approved for release.

- **Question** Christoph asked if there is anything special when returning to normal operation. Bettina replied that the procedure should simply be followed in reverse order.
- **Question** Belen asked who is responsible for defining the BLM thresholds. It is the responsibility of OP and the idea is to set the threshold about 20 % above the normal operational value.
- **Question** Jan asked how the procedure will be tested. It will be tested during hardware commissioning first (dry run). The interlocking from the BLMs can be tested by reducing the thresholds of the BLMs (below the value measured for normal operation).
- **Comment** Jan clarified that the rMPP must be contacted to provide a written "OK" to perform the procedure. One member can be contacted (by phone) who will then contact the other members and send back a written approval, which can be by email.
- **Jose mentioned that is should be avoided to send beam on the valves for testing the BLMs, even with very small intensities. Even if the valves might not be destroyed, there is a risk they will not be tight afterwards anymore.**

PSB commissioning procedure for injection of the Linac4 H- beam without stripping foil (Bettina Mikulec)

Bettina presented the commissioning procedure ([EDMS 2370098](#)) or injection in the booster without stripping foil. This mode of operation will be required to optimize the steering of the beam on the H- and H0 dump. The angle of the injected beam is adjusted and the H0/H- monitor (4 current signals on the 4 plates) is calibrated. The interlock thresholds (ratio between the H0

and H- dump signals) are also determined. Without the foil, a test beam is steered to the H0 dump (by disabling BSW 3 and 4) and then to the H- dump.

The procedure is as follows:

- The LEBT beam stoppers are inserted;
- A super-cycle is programmed with 1 measurement per 10 cycles
- A button in the CCC (external condition “I_BCD_CHANGE”) is pressed to inhibit the change of super-cycle;
- In the cruise control application, set the number of turns to 1 for the ring to be measured and to zero for the other rings;
- Check the tail clipper acquisition to ensure that the length is 1 microsecond maximum;
- Program the chopper table to produce a 200ns-long beam (minimum pulse length measurable by the instrumentation in the injection line). Use the peak current from L4;
- Mask the BIS input #10 (“injection foil status”), to be RBAC protected (PSB supervisors);
- Mask the BIS input #9 (“BIr.BSW”) in case the pulse of BSW3 and BSW4 have to be disabled (for H0 measurements), using the same RBAC role;
- Make sure the IC BLM interlock threshold of the BLM installed besides the dump is set to a level that will cut the beam if more than one turn is injected by mistake;
- Set the foil position of the foil loader for the ring to “no foil”.

Question Christoph asked why two different beam stoppers are used in the two procedures. Bettina replied that by using the L4 stopper while preparing the injection into less than four rings, one would still have the possibility to deliver beam to other destinations. However, the procedure for injection without stripping foil will be used during commissioning only, so that the beam can be stopped at the LEBT beam stoppers.

Question Christoph asked about the reaction time of the SIS. Will the next pulse be cut? The reaction time depends on the load of the server; it will be the next pulse or the one just after. Jorg added a comment that the SIS response time does not just depend on the server state, it also depends on the time of the data publication and on the evaluation trigger. For a pulsed machine, the evaluation must come once all data have been received, typically at the start of the following cycle (trigger on “start cycle” event).

Action The MPP asked Bettina to recirculate the procedures after updating with the comments received in the meeting (recalibration of the BLMs and H-/H0 monitor, intensities to be used during the procedure), after which it can be uploaded in EDMS for approval ([EDMS 2370098](#)).

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Follow-up on the action from the 182nd MPP meeting (Jan Uythoven)

- “Update the LINAC4/PSB specification of the BIS, replacing the input from the External Conditions (section 4.6 to be removed and complete document to be updated accordingly)” (C. Martin):
 - The link has been physically removed from the BIS;
 - The engineering specifications (EDMS 1016233) has been updated accordingly

Disabling BIS of PSB to prevent sending beam to PSB during Linac4 LBE run (Bettina Mikulec)

- The BIS determines if the LBE or PSB destination is allowed based on the acquisition from LTB.BHZ40. However, that means that the PSB destination will be allowed if the acquisition is zero. Post-LS2, this will not be an issue for personnel safety as the access into the PSB will be forbidden when the switchyard is in BEAM mode. Nevertheless, a solution has been found to avoid potential activation of the BI line region during LS2.
- The 4 PSB BICs have been forced to false by removing the enable jumpers, this will guarantee that there will be no beam sent to the PSB.
- The jumpers should be put back in nominal position before the PSB restarts with beam towards the end of this year.

Update rMPP for Injectors (Christoph Wiesner)

Christoph reported on the updates for the rMPP for injectors, as endorsed by the 186th MPP. It has been approved by the 268th IEFC.

- It was proposed and approved that, in addition to the members already presented during the 186th MPP, M. Zerlauth is added as member to the rMPP for injectors. The complete member list now reads: A. Lombardi, B. Mikulec, C. Wiesner, D. Wollmann, D. Nisbet, F. Tecker, J. Uythoven, J. Wenninger, M. Zerlauth, V. Kain.
- An e-group has been created: inj-mp-restricted@cern.ch .

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A Doodle will be sent around after the meeting to check on a possible better timeslot for the MPP injector meetings.

Summary of actions

The actions from the meeting are:

- Update and approval of the procedure for injection without stripping foil ([EDMS 2370098](#)) following the comments from the MPP (B. Mikulec).