SPS injection interlocking – 5th meeting 12.10.2017

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Review of Injection BIS from BE-OP (Indico link)

Verena recalled the layout of the TT2-TT10 lines and how the beam is transferred from the PS to the SPS. After a second iteration with the SPS users, BE-OP proposes to slightly change the interlock layout proposed by TE-MPE (see Ivan's presentation). Verena suggested to have two BICs and decouple SPS injection from TT2 extraction. This means that a BIC will be in charge of giving the injection permit to the SPS (SPS Injection BIC) and a second one will be in charge of allowing the beam transfer from TT2 to TT10 line (PS to SPS Transfer BIC):

- **SPS injection BIC**: it will receive inputs from the SPS BIS, MKP state and TT10 FEI. Beam permit targets will be the MKP and the MDSH magnet.
- **PS to SPS transfer BIC**: it will receive inputs from the SPS injection BIC, TT10 BLMs, SEM grids and BTVs. The targets will be the BHZ377 power converter and the "SPS to LINAC4 chopper" gadget to stop the beam at the source.

The main reason of the split is not to perturb the circulating beam in the SPS by the MDSH magnet in case of an interlock in TT10.

Open questions / discussion:

- No PS Beam Quality Monitor (BQM) will be connected to the Injection BIS for the moment.
- The response time of the BHZ is in the order of 0.5-1 s and for the "SPS 2 LINAC4 chopper" will be several seconds.
- If the SPS injection permit is inhibited, the MKP will be fired and the MDSH will have to pulse in order to centre the beam on to the injection dump (TBSJ). In addition, if the MDSH current goes above 0 A, the circulating beam in the SPS will have to be dumped which is not the case now. Therefore, the MDSH has to be connected to the SPS ring and interlock the beam if $I_{MDSH} > 0A$.
- A special case to be considered on the interlocking strategy is for Fixed Target beams when 4 injections are programmed but only 2 of them are enabled. Two injections will go onto the injection dump, with the MSDH not pulsing, which means that the beam will be sent to the injection dump (TBSJ) in a non-perfect manner. In the case of the LHC and HiRadMat there is a mechanism that allows to inhibit the beam on request. Maybe a similar mechanism can be implemented for Fixed Target beams (not generating the beams which are not needed).
- The Beam Permit delivered by the BIC is asynchronous. This means that the Power Converter controls of the BHZ magnet will take the next cycle into account and will not extract the beam to TT10 if the cycle already started to avoid spraying the beam around in TT10.
- In order to inhibit the beam at Linac4, we need to use a similar approach to the "gadget" developed by Nicolas (https://wikis.cern.ch/display/TEABT/SPS+to+PS+Inhibit). At present, the beam inhibit signal is received by a FESA class which acts on the Linac2 timing to stop the beam. David suggested the use of the SIS but it might not be sufficiently fast for this purpose.

ACTION (MI, ABT, EPC): discuss the technical details of the interface implementation between the BIC-MKP and BIC-BHZ377_PC

SPS timing integrity

Related to the integrity of the SPS timing and how users react if the timing is not received, Verena and Jan discussed with ABT, EPC and BI. Verena noted that BLMs rely strongly on the integrity of the timing, to the extent that if the timing is not received, the BLMs will not start counting. In addition, she proposed to have hardware connections from the SPS central timing to the SPS BIS and to the TT40/60 BICs to interlock in case of drifts between the SPS and LHC timing.

The criticality of the timing system for the transverse damper also needs to be checked.

ACTION (Verena, Jan): bring the subject to the MPP and agree on the best way to implement the timing interlocks