Linac4 'Critical' Settings

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with input from

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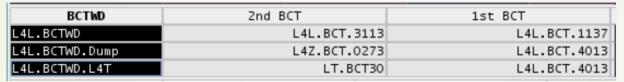
Interlock-Related Settings

From lost meeting...

- **BLMs**: along Linac4 and all transfer lines (~20)
 - Running sums: 2 µs, 400 µs, 1 ms, beam presence, ambient, cycle
 - HW threshold x 6
 - SW threshold x 6
 - Should we only set the thresholds for beam presence and maybe cycle?
- **Watchdog:** 4 watchdogs for LBE line run (8 more to add with PSB)
 - High-loss threshold [mA]: 1
 - Low-loss threshold [%] + max. no. of bad pulses
- What is the damage threshold??? (how to define the high-loss thresholds?)
- How to deal with **beam profile measurements?** → lead to losses
 - Have to map losses once commissioning is finished
 - Low-loss thresholds to be modified with SIS when inserting BI equipment or more relaxed threshold settings?
- Settings cannot be provided from the start still in commissioning phase
- Roles to set thresholds who?
- How to follow threshold changes?

Approach

- For Linac4 we have identified 3 groups of 'critical' settings:
 - 4 watchdogs measuring transmission between 2 BCTs (see picture + LBE watchdog) x 3 interlock settings → protection from damaging losses plus machine activation considerations



- ► High-loss threshold [mA], Low-loss threshold [%] + max. no. of bad pulses
- BLMs along the linac and transfer lines: threshold interlock settings for 2x6 running sums (HW and SW thresholds) → protection from damaging losses plus machine activation considerations
- Window/threshold equipment settings for certain critical power converters: source HV, 3 MEBT quads (optics to assure good beam chopping efficiency) and all bending magnets along the transfer lines
- Different options available in the controls system, and we should consider
 - Desired protection level
 - Operational flexibility
 - Definition of roles

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Watchdogs and BLMs

- Remark machine damage potential
 - Certain risk of producing a hole in the beam pipe/bellows, in particular at low energy, but damage threshold at different energies unknown (very few FLUKA simulations available)

Proposed implementation of threshold settings:

- Create virtual parameters for all 'critical' settings in LSA (no 'Machine Critical Settings'=MCS)
- For each cycle, SIS will compare the setting of the 'real' parameters with the 'virtual' parameters
- Action: if the CCV exceeds the setting of the virtual parameter, the **beam will be inhibited** (BAD SIS user_input to corresponding BIC; correct geographical mapping of equipment to BICs required); message will show which threshold has triggered the inhibit
 - Check is also valid when re-mapping old cycles (thresholds might have changed in the meantime...)

Implement RBAC roles

- To modify virtual parameter settings (Linac4 supervisors, J-F. Comblin, G.P. Di Giovanni)
- To be able to mask the SIS processes (Linac4 supervisors, G.P. Di Giovanni and CPS shift leaders); masking will sometimes be needed in case of special operational conditions or setup (like cavity rephasing)

Special Considerations for Watchdogs and BLMs

- The possibility to reset watchdogs and BLMs remains
- Low-energy high-loss threshold will for moment be disabled (see https://indico.cern.ch/event/768188/); triggered by sudden RFQ voltage drops (beam losses, RFQ spikes); decided to increase instead the low-loss transmission threshold and decrease the no. of allowed bad pulses)
- BLMs:
 - Loss inventory during LBE run (once stable operational conditions) to propose high-loss HW thresholds
 - Plan to actively use only 'beam presence' running sum SW threshold (SW thresholds for other RSs at high levels for the moment)

Increased losses will happen during:

- Cavity re-phasing → plan to temporarily disable corresponding SIS
- Insertion of devices into beam: BTV, wire scanners, Semgrids, BSM wires, stripping foil
 - Loss inventory during LBE run (including different measurement optics) with longest possible beam pulse
 - Should temporarily increase corresponding watchdog and BLM thresholds when inserting the measurement device
 - Investigating possibility to use sequencer tasks when starting and stopping these measurements

Power Converter Critical Settings

- Proposed implementation 'à la SPS FEI'
 - Through OP application set voltage/current thresholds or window threshold settings
 - Difference compared to SPS: BIS card settings can be set non-ppm (BIS.PPM property set to 'disabled');
 need only to set up non-ppm MCS (in non-multiplexed cycle context)
 - Implement RBAC and MCS protection to be able to change (Linac4 supervisors, J-F. Comblin, G.P. Di Giovanni, EPC experts tbd)
 - Try to have application ready for LBE line run (L. Kolbeck)

- A plan concerning the handling of 'critical' settings for Linac4 is now available
- Implementation of Power Converter MCS hopefully for LBE line run; of 'critical' settings for BLMs and watchdogs for 2020 restart after systematic study of loss levels at different operational scenarios
- Modifications of 'critical' settings through RBAC/MCS roles and traceable through LSA
- Reminders for active SIS masks should be sent every shift → elogbook?