Management and Protection of Linac4 LEBT settings

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Machine Protection Panel

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Introduction

- Transmission of the Linac4 RFQ (measured from LEBT BCT to first MEBT BCT) is in the range of 70% with the present source/LEBT/RFQ combination.

- It is very strongly dependent on LEBT settings.

- When settings are changed, losses occur in the LEBT, or in the RFQ.

- We have to tolerate some losses in the RFQ – the objective is to avoid that they are increased losses occur unnecessarily, nor maintained for a long period.

- This is a summary of the specification EDMS L4-CIB-ES-0007 .

Layout of the LEBT
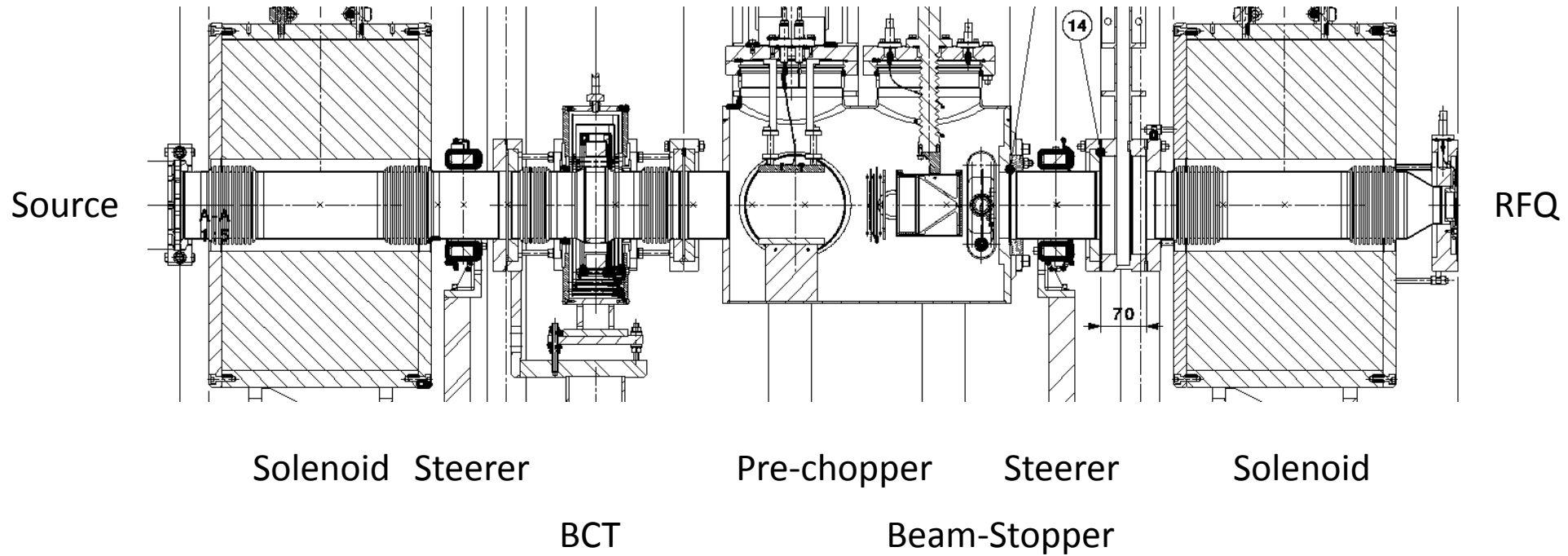
Operation Scenarios

- More than one operational scenario:
  - Standard operation MODE1.
    - Requires best transmission to deliver 25mA out of the RFQ.
    - Pulse length of beam is varied by the pre-chopper (and chopper).
    - Beam settings to RFQ are for maximum transmission (25mA), and static.
    - Autopilot varies the source intensity (via source RF).
  - Low transmission mode (7-8mA out of RFQ) MODE2.
    - Source intensity lowered to minimum (limitation to ignite and maintain a plasma).
    - Beam settings to RFQ lose beam in the LEBT. The settings are static.
    - Autopilot should be disabled.
  - Machine Development for source/LEBT/RFQ MODE3.
    - E.g. attempting higher currents and different settings.
    - This mode would only be used if justified.

Function Specification - Flow Diagram
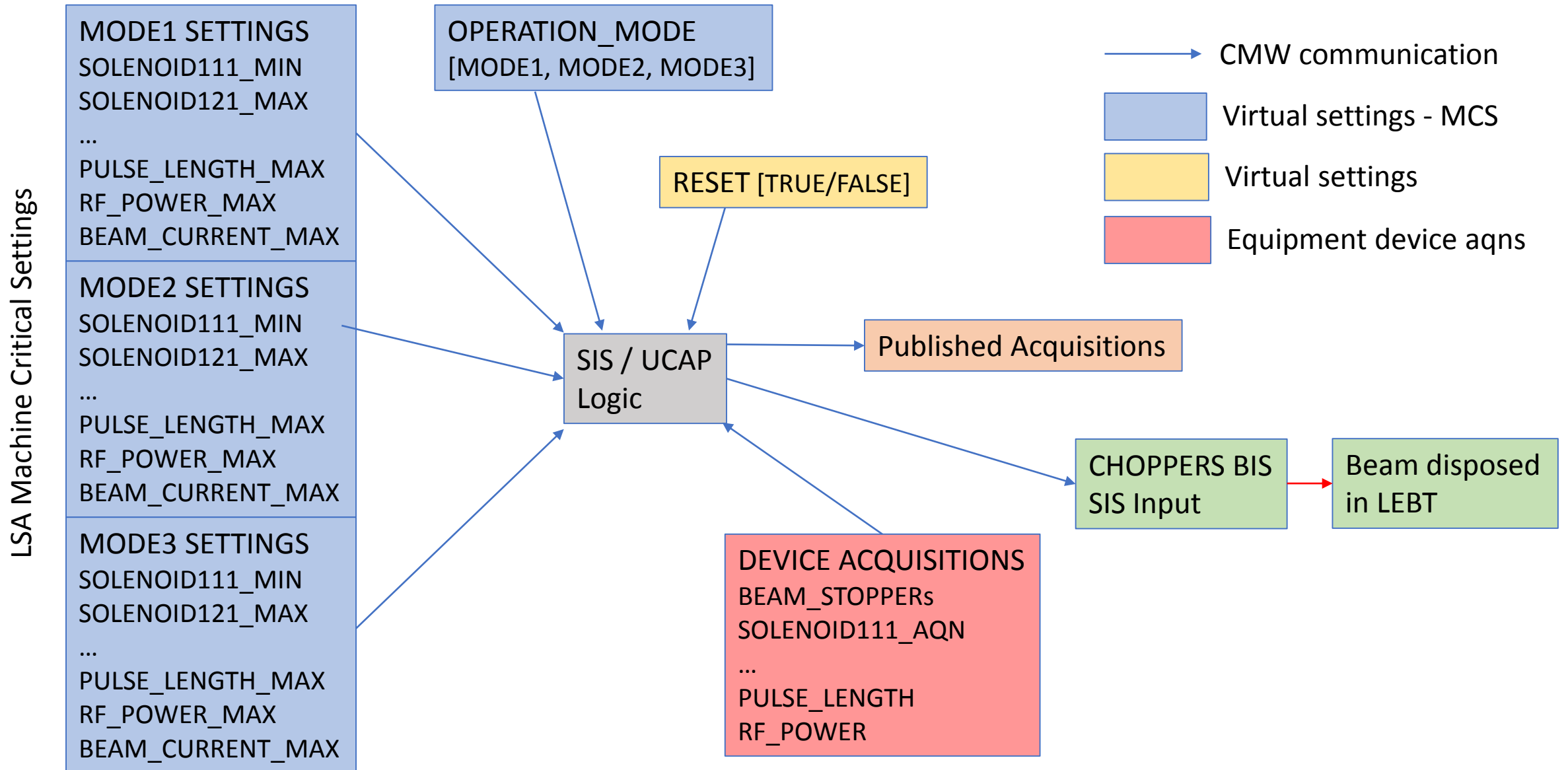
Functional Specification - Logic Description

- Acquire all **Settings Parameters** and **Acquisitions**.
- If beam stopper is IN, do nothing (beam permit is True).
- Check if acquisitions out of range (OOR) for the given mode? => increment bad-pulse-counter.
- If bad-pulse-counter > max – stop the next pulse using the BIS.
- Bad-pulse-counter -> 0 once per hour, if beam is not stopped.
- Increment life-time-counter
- If life-time-counter > max – stop the next pulse using the BIS.
- If counter reset requested: bad-pulse-counter or life-time-counter -> 0.
- In a mode switch, all counters will be set to 0.

Who has control (RBAC/MCS)?

	RBAC /MCS
Min / Max Settings	MCS for Linac Supervisors
Operation Mode	MCS for Linac Supervisors
Reset Counters	No RBAC - Operator
UCAP Node Configuration	RBAC role for Linac4

Settings

- The following tables give the proposed values for the min/max settings.

Mode1 Operation

Mode 1 _ OP	Window	Central Value	Comment
solenoidLEBT111_Mode1_Min/Max	+/-0.5 A	86.4	
solenoidLEBT121_Mode1_Min/Max	+/-0.5 A	107.7	
steererLEBTH111_Mode1_Min/Max	+/-0.5 A	TBC	Central value to be set after 3MeV beam tests.
steererLEBTV111_Mode1_Min/Max	+/-0.5 A	TBC	Central value to be set after 3MeV beam tests.
steererLEBTH121_Mode1_Min/Max	+/-0.5 A	TBC	Central value to be set after 3MeV beam tests.
steererLEBTV121_Mode1_Min/Max	+/-0.5 A	TBC	Central value to be set after 3MeV beam tests.
einzelLens_Mode1_Min/Max	+/-1050.0 V	29000.0	
	Value		
tailclipperTime_Mode1_Max	276.0e6 ns		i.e. 1ms pulse
rfPower_Mode1_Max	50000		W
watchDogLowLossMinTrans_Mode1_Min	65		%
lifetime_Mode1_Max	100000000 (100M)		(>3 years)
beamCurrentLEBT	-45.0 mA		

Mode2 Low Intensity

Mode 2 __ LOW INTENSITY	Window	Central Value	Comment
solenoidLEBT111_Mode2_Min/Max	+/-0.5	62.25	
solenoidLEBT121_Mode2_Min/Max	+/-0.5	115.0	
steererLEBTH111_Mode2_Min/Max	+/-0.5	TBC	Central value to be set after 3MeV beam tests.
steererLEBTV111_Mode2_Min/Max	+/-0.5	TBC	Central value to be set after 3MeV beam tests.
steererLEBTH121_Mode2_Min/Max	+/-0.5	TBC	Central value to be set after 3MeV beam tests.
steererLEBTV121_Mode2_Min/Max	+/-0.5	TBC	Central value to be set after 3MeV beam tests.
einzelLens_Mode2_Min/Max	+/-1050.0	29000.0	
	Value		
tailclipperTime_Mode2_Max	275.1e6		i.e. 0.1 ms pulse
rfPower_Mode2_Max	30000		W
watchDogLowLossMinTrans_Mode2_Min	35		%
lifetime_Mode2_Max	3000		(1 hour)
beamCurrentLEBT	-25.0		

Mode 3 Machine Development

Mode 3 __ MD	Window	Central Value	Comment
solenoidLEBT111_Mode3_Min/Max	+/-0.1	0.0	
solenoidLEBT121_Mode3_Min/Max	+/-0.1	0.0	
steererLEBTH111_Mode3_Min/Max	+/-0.1	0.0	
steererLEBTV111_Mode3_Min/Max	+/-0.1	0.0	
steererLEBTH121_Mode3_Min/Max	+/-0.1	0.0	
steererLEBTV121_Mode3_Min/Max	+/-0.1	0.0	
einzelLens_Mode3_Min/Max	+/-0.1	0.0	
	Value		
tailclipperTime_Mode3_Max	275.0e6		i.e. 0 ms pulse
rfPower_Mode3_Max	30000		W
watchDogLowLossMinTrans_Mode3_Min	100		%
lifetime_Mode3_Max	1		(1 hour)
beamCurrentLEBT_Mode3_Min	-45.0		

Settings

- In the previous tables, the "windows" in Mode1 and Mode2 are to be considered critical, and changes should be documented with an update to the specification.

- Central values can be updated by Linac4 Supervisors, and should include and entry in the logbook.

- All values will be reassessed during the start of Linac4 operation.

- The Mode3 MD settings: These are to be adjusted for any MD, depending on the objective. The settings in the table are default values that will be programmed at the beginning, and will not allow beam.

Closing Remarks

- Specification surveys upstream of the RFQ.
- Settings for will be protected through Machine Critical Parameters.
- Specification written up in EDMS L4-CIB-ES-0007 (In Work).
- Tibor will explain more on the implementation.