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Linac4 BIS Configuration for the 160 MeV Phase

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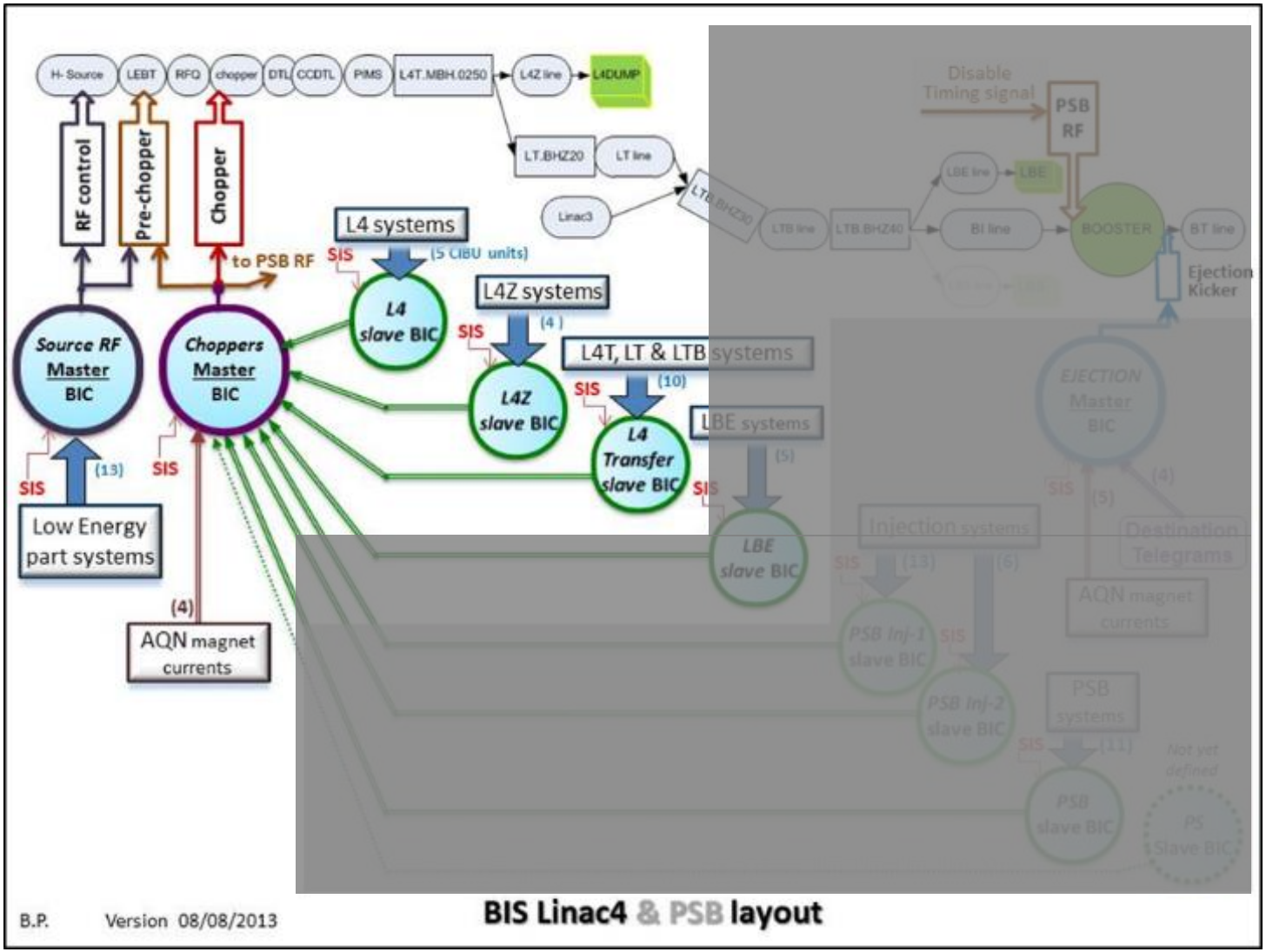
Acknowledgements to Christophe Martin, Bettina Mikulec, David Nisbet, Markus Zerlauth, Daniel Wollmann

General Considerations - MPS

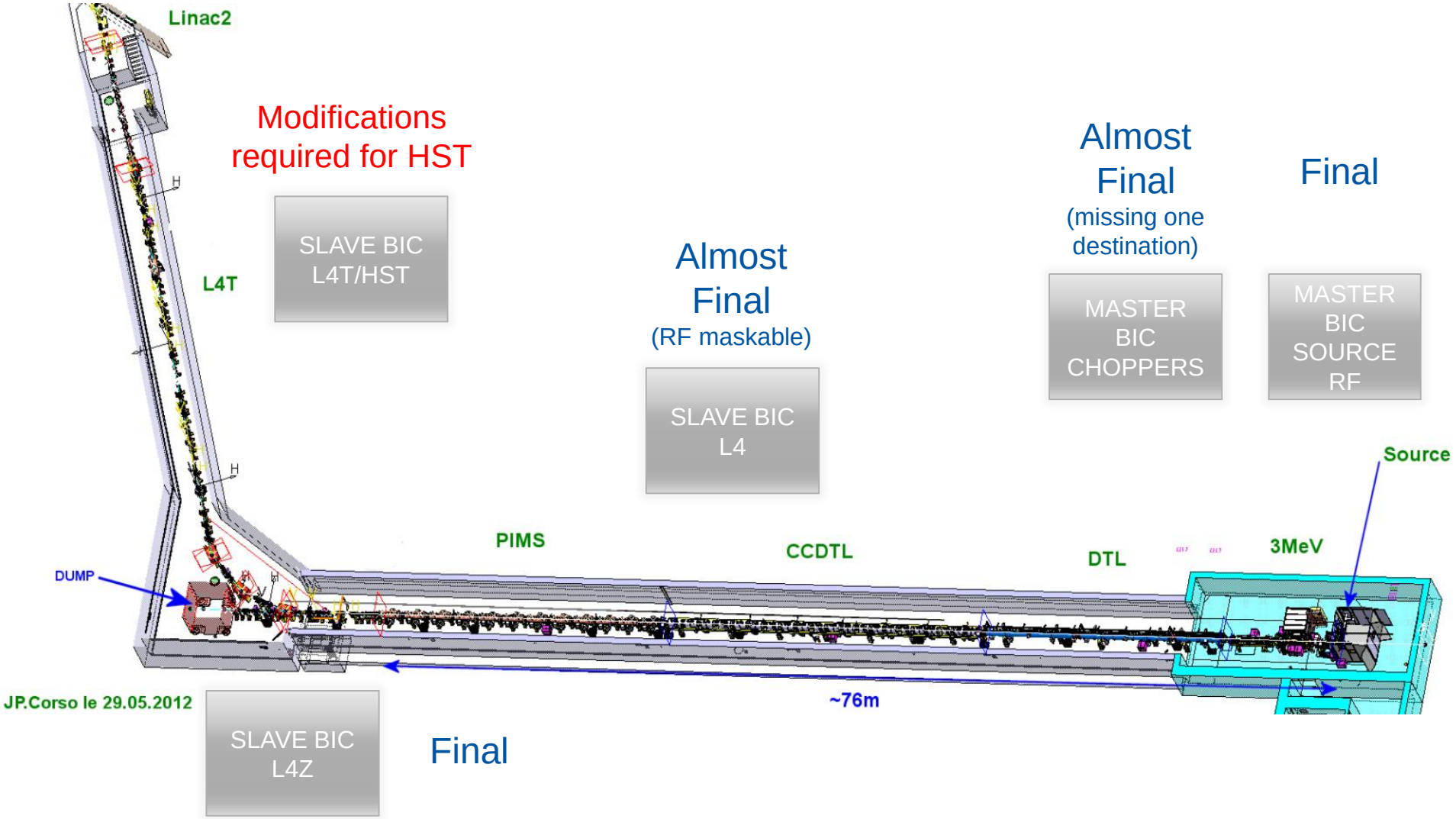
- BIS for the 160 MeV phase should be as close as possible to final (also on the user side)
- All MPS-relevant inputs are considered mandatory at this stage
- Nevertheless, the BIS configuration should allow performing all required actions for efficient commissioning
- Different requirements on pulse length for different destinations to be taken into account

LINAC4 BIS : 160 MeV + HST



The Linac4 BIS architecture for the 160 MeV phase requires 2 additional BICs wrt 100 MeV phase

LINAC4 BIS : 160 MeV + HST



The Linac4 BIS architecture for the 160 MeV phase requires 2 additional BICs wrt 100 MeV phase

Master BIC RF Source: the real situation

			Interlock Element	Ch.	
1	1	1	SIS	0	✓
0	0	1	Source Start	1	✓
1	1	x	~~Source Internal~~	2	➡ Not Ready (mask inside the user's PLC)
1	1	x	~~Source HV~~	3	➡ Not Ready before FGC3 available (monitored in the SIS)
1	x	x	Pre-chopper	4	✓
1	0	0	Source Beam Stoppers Out/Moving	5	✓
0	1	1	Source Beam Stoppers In	6	✓
1	x	x	Chopper	7	✓ Variable timing implemented (voltage not yet monitored)
1	x	x	L4 Low-Energy Watchdog	8	✓ Need to change the logic following new BCT position
1	x	x	L4 Low-Energy Vacuum Valves	9	✓
1	x	x	L4L.ChopperQuads	10	✓ Wide thresholds (I_magnet in range [20A, 200A])
1	x	x	RFQ	11	✓ Does not include LLRF
1	x	x	~~CCC Operator Veto~~	12	➡ Not Present (before commissioning dump)
1	x	x	L4 Operator Veto	13	✓
x	x	x	*Not used*	14	
1	1	1	H^- Source Beam_Permit	OUT	➡ - RF control ✓ - Pre-chopper ✓

Master BIC Chopper : the real situation

				Interlock Element	Ch.	
1	1	1	1	SIS	0	✓
1	1	1	0	Source Beam Stoppers Out / Moving	1	✓
0	0	0	1	Source Beam Stoppers In	2	✓
1	1	1	x	Linac4 OK	3	✓
0	0	1	x	AQN L4T.MBH_DUMP	4	✓
x	x	1	x	L4Z OK	5	✓
1	1	0	x	AQN L4T.MBH_LT	6	✓
1	1	x	x	Linac4 Transfer OK	7	✓
0	1	x	x	AQN LTB.BHZ40_LBE		→ Forced to "TRUE"
x	1	x	x	LBE OK		→ Forced to "TRUE"
1	0	x	x	AQN LTB.BHZ40_PSB		→ Forced to "FALSE"
1	x	x	x	PSB Injection 1 OK	11	
1	x	x	x	PSB Injection 2 OK	12	
1	x	x	x	PS OK	13	
x	x	x	x	*Not used*	14	
1	1	1	1	Choppers Beam_Permit	OUT	→

First 3 out of the 4 destinations are required for the 160 MeV + HST phase:

- Beam to stopper
- Beam to L4 Dump
- Beam to HST (replacing LBE destination)

Inputs not required: permits are forced to the required level in order to allow decoding the third destination "Beam to HST"

- RF control ✓
- Pre-chopper ✓
- PSB RF **X**

Slave BIC L4 : the real situation

	Interlock Element	Ch.
1	SIS	0
1	External Conditions	1
1	L4 Vaccum Valves + L4T.WGS.0101	2
1	BLMs L4+L4Z	3
x	*Not used*	4
1	WIC L4	5
x	*Not used*	6
x	*Not used*	7
1	L4 RF	8
x	*Not used*	9
x	*Not used*	10
x	*Not used*	11
x	*Not used*	12
x	*Not used*	13
x	*Not used*	14
1	H^- Source Beam_Permit	OUT

✓

➡ Forced to “TRUE”, not required for the 160 MeV

✓

✓ BLMs available, thresholds to be hardcoded

➡ Temporary watchdog removed

✓

- L4 RF moved on “Maskable” input for 160MeV commissioning phase (as for previous phases)
- What’s the long term view?

Does not include LLRF

➡ - Master RF Chopper

Slave BIC L4Z : the real situation

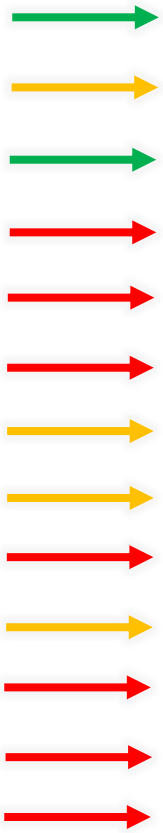
	Interlock Element	Ch.	
1	SIS	0	✓
1	L4Z Dump OK	1	✓
1	L4 Z Dump WD	2	✓
1	L4Z Vaccum Valve	3	✓
x	*Not used*	4	
x	*Not used*	5	
x	*Not used*	6	
x	*Not used*	7	
x	*Not used*	8	
x	*Not used*	9	
x	*Not used*	10	
x	*Not used*	11	
x	*Not used*	12	
x	*Not used*	13	
x	*Not used*	14	
1	L4Z OK Beam_Permit	OUT	

Slave BIC L4T : the real situation

	Interlock Element	Ch.
1	**SIS**	0
1	**L4T WD**	1
1	**L4T Beam Stopper Out**	2
1	**AQN LT.BHZ20**	3
1	**AQN LT.BHZ30**	4
1	**AQN L4T.MBV**	5
1	**BLMs L4T+LT+LTB**	6
1	**LT + LTB Vacuum Valves**	7
1	**L4T.VVGS.1751 Vacuum Valve**	8
1	**WIC L4T**	9
1	**WIC LT+LTB**	10
X	*not used*	11
X	*not used*	12
X	*not used*	13
X	*not used*	14
1	**Transfer Line OK**	OUT

Slave BIC L4T : the real situation

	Interlock Element	Ch.
1	**SIS**	0
1	**L4T WD**	1
1	**L4T Beam Stopper Out**	2
1	**AQN LT.BHZ20**	3
1	**AQN LT.BHZ30**	4
1	**AQN L4T.MBV**	5
1	**BLMs L4T+LT+LTB**	6
1	**LT + LTB Vacuum Valves**	7
1	**L4T.VVGS.1751 Vacuum Valve**	8
1	**WIC L4T**	9
1	**WIC LT+LTB**	10
x	*not used*	11
x	*not used*	12
x	*not used*	13
x	*not used*	14
1	**Transfer Line OK**	OUT



	Interlock Element	Ch.
1	**SIS**	0
1	**L4T WD (L4L.BCT.4013 and L4H.BCT.1073)**	1
1	**L4T Beam Stopper Out**	2
1	**External Dump OK**	3
1	**H^0/H^- Dump OK**	4
1	**H^0/H^- Current Monitor**	5
1	**BLMs L4T until HST**	6
1	**Vacuum Valves between L4T.MBH% and HST end**	7
1	**Injection Foil Status**	8
1	**WIC L4T (for magnets until HST end)**	9
1	**BSW3/4 Status**	10
1	**Destination HST**	11
1	**Linac4 Foil OUT**	12
x	*not used*	13
x	*not used*	14
1	**Transfer Line OK**	OUT

✓ Orange Inputs: consider different elements than final (WIC, BLMs, VV, WD)

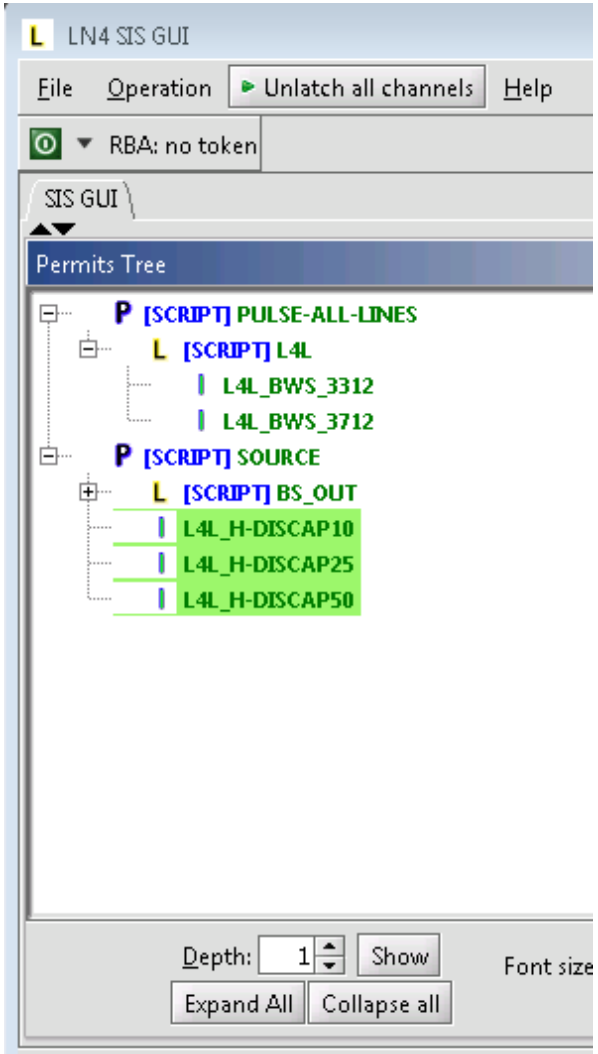
✓ External dump is the commissioning dump (max 100 us)

✓ Destination HST: timing module and SIS will limit pulse length to 100-150 µs

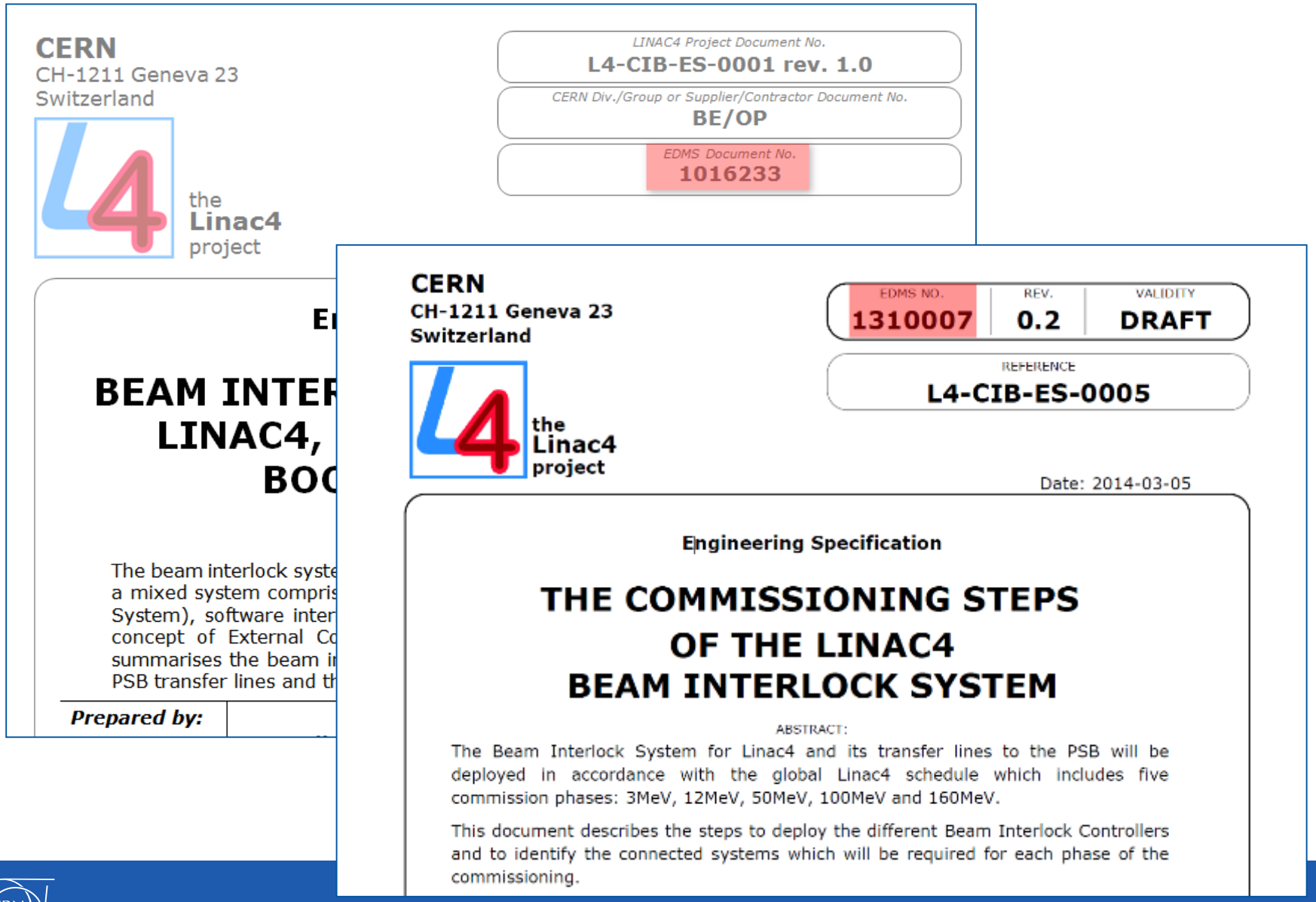
✓ IF DEST = HST then L4 foil must be OUT, otherwise the stripped H- could be lost in the bending magnets

SIS for LINAC4

- Operational
- BI requirements
  - Comprehensive list received from F. Roncarolo
  - All SEM grids and Wire Scanners shall limit max beam pulse
  - SIS shall limit beam pulse length to 100us if device in beam
  - BTV?
- New requirements for HST?
  - Limit pulse length depending on destinations?



BIS Commissioning



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the Linac4 project

LINAC4 Project Document No.
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BE/OP

EDMS Document No.
1016233

BEAM INTER
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System), software inter
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EDMS NO.	REV.	VALIDITY
1310007	0.2	DRAFT

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Engineering Specification

THE COMMISSIONING STEPS OF THE LINAC4 BEAM INTERLOCK SYSTEM

ABSTRACT:

The Beam Interlock System for Linac4 and its transfer lines to the PSB will be deployed in accordance with the global Linac4 schedule which includes five commission phases: 3MeV, 12MeV, 50MeV, 100MeV and 160MeV.

This document describes the steps to deploy the different Beam Interlock Controllers and to identify the connected systems which will be required for each phase of the commissioning.

Conclusion

- Operation at 160MeV allows testing the BIS in the (almost) final configuration for Linac4
- Important to have also user inputs in the final configuration
- 2 additional slave BICs installed, L4T slave requires modifications for HST
- Requirements on pulse length for different destinations to be enforced (SIS?)
- When should we foresee the ‘final’ configuration?


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