



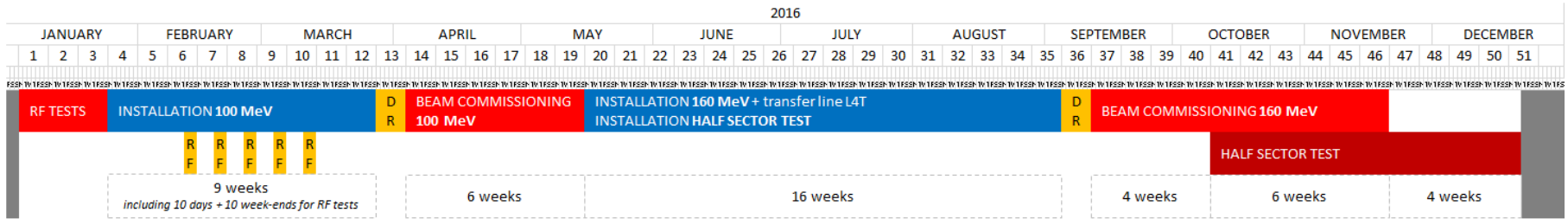
Linac4 MPS commissioning

100MeV Phase

David Nisbet
MPP, 18 March 2016

Acknowledgements to Christophe Martin, Stephane Gabourin,
Andrea Apollonio , Markus Zerlauth, Daniel Wollmann

LINAC4 schedule



YETS 2015-2016 in the injectors

YETS 2015-2016 in the LHC

EYETS

Legend

- No Access - RF Tests or Beam Commissioning
- No Access - Half Sector Tests
- No Access - RF Tests (RF) or Dry Run (DR)
- Access - Installation
- Year-End Technical Stops in the accelerators chain (injectors and LHC)

- Displacement of the test bench from 50MeV to 100 MeV location
- Installation of the RF cavities CCDTL 1, 2, 3
- RF conditioning of the RF cavity CCDTL 4
- RF conditioning (check) of the RF cavities CCDTL 1, 2, 3, 5, 6, 7 and PIMS 1

- 100 MeV**
- Source
 - LEBT
 - RFQ
 - MEBT
 - DTL 1-2-3
 - CCDTL 1-2-3-4-5-6-7
 - PIMS 1
 - Test bench
 - Beam Dump

- Remove the test bench from 100 MeV location
- Transport of the RF cavities PIMS 2, 3, 4, 5, 8, 9
- Installation of the RF cavities PIMS 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
- RF conditioning of the RF cavities PIMS 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
- Installation of the Half Sector Test

- 160 MeV**
- Source
 - LEBT
 - RFQ
 - MEBT
 - DTL 1-2-3
 - CCDTL 1-2-3-4-5-6-7
 - PIMS 1-2-3-4-5-6-7-8-9-10-11-12
 - Main Dump
- Half Sector Test**

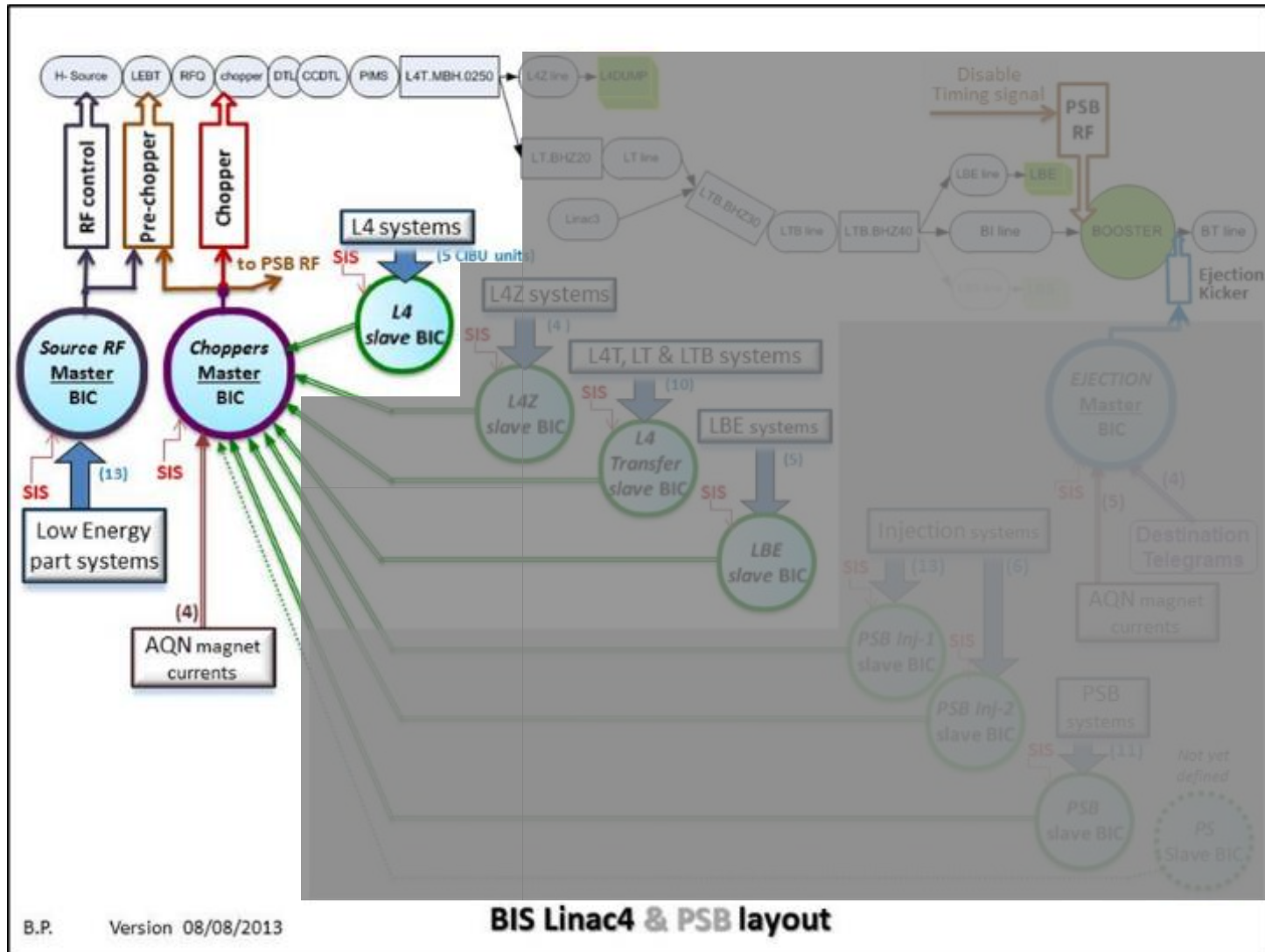
Status and outlook

- Hardware commissioning
 - 100MeV CCDTL1-2-3 conditioning recently completed
 - 'Dry Run' commissioning from 28th March
- Beam commissioning
 - 100MeV beam from 6th April (see next slide)
- Beam commissioning continues at 160MeV from October 2016
 - The Half Sector Test will begin before the end of 2016

100MeV commissioning plan

- As presented at the LINAC4 BCC of 17/3/2016
- 6-13 April: Re-commission RFQ + DTL1-3 up to 50MeV
 - Can chopper dump be used for initial phase of ~0.5days when RFQ is commissioned?
- 13-24 April: Commission CCDTL1-4 up to 80MeV
 - Stop at 80MeV due to delay with LLRF controls hardware
- 25 April – end: Commission CCDTL5-7 and PIMS1 up to 105MeV

LINAC4 BIS : 100 MeV



The Linac4 BIS architecture for the 100 MeV is the same as for the 50 MeV

Master BIC RF for 100 MeV : the real situation

			Interlock Element	Ch.
1	1	1	SIS	0
0	0	1	Source Start	1
1	1	x	Source Internal	2
1	1	x	Source HV	3
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
1	x	x	L4 Low-Energy Watchdog	8
1	x	x	L4 Low-Energy Vacuum Valves	9
1	x	x	L4L.ChopperQuads	10
1	x	x	RFQ	11
1	x	x	CCC Operator Veto	12
1	x	x	L4 Operator Veto	13
x	x	x	Not used	14
1	1	1	H- Source Beam_Permit	OUT



Not Ready (mask inside the user's PLC)



Not Ready before FGC3 available



Fixed window; Chopper voltage not yet monitored;



Wide thresholds (I_magnet in range [20A, 200A])



Does not include LLRF



Commissioning Dump ✓



- 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	8
x	1	x	x	LBE OK	9
1	0	x	x	AQN LTB.BHZ40_PSB	10
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



Only the 2 first out of the 4 destinations are required for the 100 MeV phase:

- Beam to stopper
- Beam to Dump



Forced to "TRUE"
 Forced to "TRUE"
 Forced to "FALSE"

Inputs not required for the 100 MeV phase; permits are forced to the required level in order to allow decoding the second destination "Beam to Dump"

not considered (destination LBE & PSB)

- 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 Vacuum 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 100 MeV

Functional check for all 100MeV valves

Forced to "TRUE", BLMs not yet present

Functional check for all 100MeV circuits

L4 RF moved on "Maskable" input for 100MeV commissioning phase (as for previous phases)

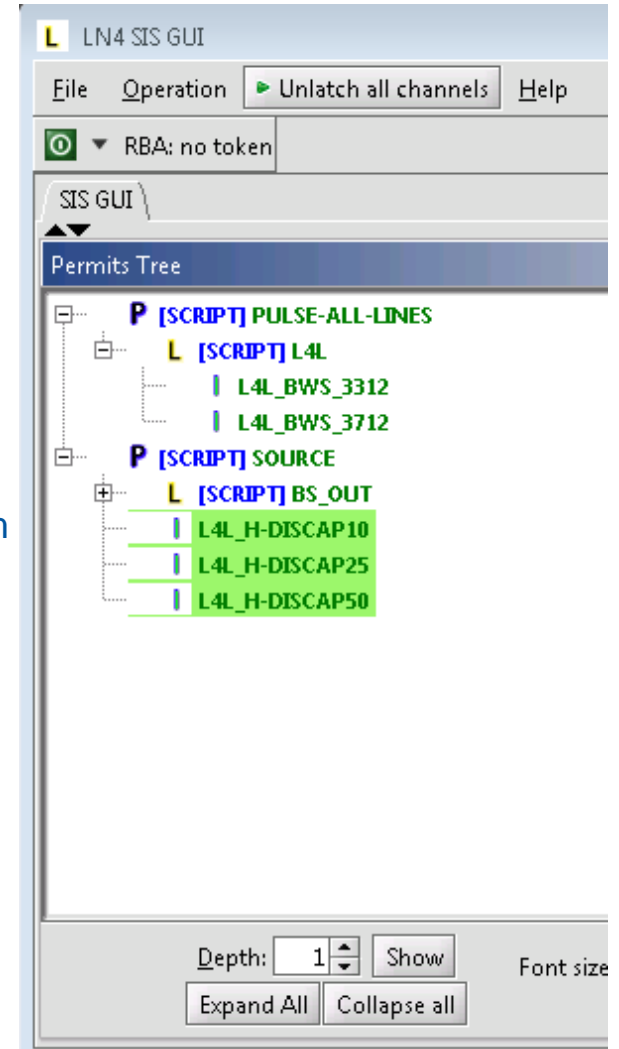
Functional check for all 100MeV cavities

Does not include LLRF

- Master RF Chopper

SIS for LINAC4

- Operational (see screen shot from yesterday)
- BI requirements
 - Comprehensive list received from F. Roncarlo
 - All SEM grids and Wire Scanners shall limit max beam pulse
 - SIS will limit beam pulse length to 100us if device in beam
 - Devices to be included and tested in SIS
- Observe that Source HV is often masked
- New requirements?
 - LLRF monitoring?
 - Power converter monitoring?



BIS Commissioning

CERN
CH-1211 Geneva 23
Switzerland



the
Linac4
project

LINAC4 Project Document No.

L4-CIB-ES-0001 rev. 1.0

CERN Div./Group or Supplier/Contractor Document No.

BE/OP

EDMS Document No.

1016233

CERN
CH-1211 Geneva 23
Switzerland



the
Linac4
project

EDMS NO.

1310007

REV.

0.2

VALIDITY

DRAFT

REFERENCE

L4-CIB-ES-0005

Date: 2014-03-05

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.

BEAM INTERLOCK LINAC4, BOC

The beam interlock system is a mixed system comprising hardware (Beam Interlock System), software interlock (Beam Interlock System) and the concept of External Control System. This document summarises the beam interlock system for the PSB transfer lines and the

Prepared by:

Machine protection issues

- BLMs are not available for operation at 100MeV
 - Mitigation proposed (and accepted) is to implement a watchdog between the BCT after the 3MeV dump and the commissioning dump.
 - Thresholds and operation procedure still to be defined, for example relative or absolute losses for the watchdog?
 - The commissioning team also desire to be able to adjust thresholds depending on commissioning phase
- Is the absence of LLRF from the BIS a problem?
 - Consider adding additional monitoring to the SIS
- H- Source connections to the BIS and SIS are either masked or constant 'Beam Permit'
 - Review of the Source BIS and SIS functionality required

Conclusion

- Operation of LINAC4 at 100MeV builds on the 50MeV experience
- Some requirements for 100MeV are still to be finalized:
 - Brief use of Chopper dump during RFQ recommissioning?
 - Watchdog technical implementation, operation and thresholds?
 - LLRF monitoring ?
 - H- Source operation with BIS and SIS?
- The 'Dry Run' week will be the opportunity to verify all users are interfacing correctly to the BIS and SIS
- Care required with the phased energy increase (eg beam dump moved, additional systems, etc)

