

BIS & SMP changes for Run 2

SPS – Extractions – Injections – LHC

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Outline

BIS changes

- New CPU MenA20 in VME chassis
- New BIS board CIBDS to include in the BIS loop
- New User system inputs (Point by Point...)
- Miscellaneous

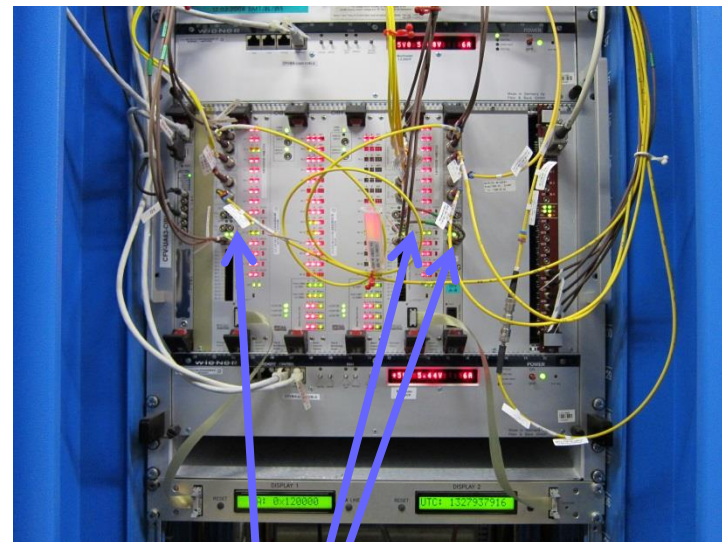
Overview of BIS commissioning steps

SMP changes

- SPS: new input energies
- SPS: From CNGS to AWAKE
- LHC: New squeezing factor
- LHC: Change Setup-Beam Flag equations

Overview of SMP commissioning steps

- LynxOS VME power PC replaced by Linux MenA20
- VME interface to modify in the BIS boards
- Affect boards in operation (SPS to LHC):
 - 7 CIBG (generator)
 - 58 CIBM (manager)



LHC BIC in UA63



VME chassis with new MenA20

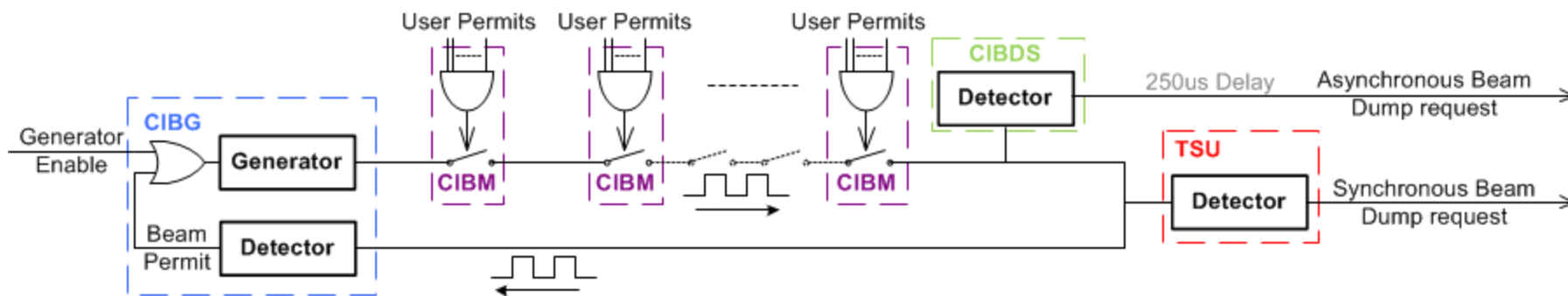


CIBM



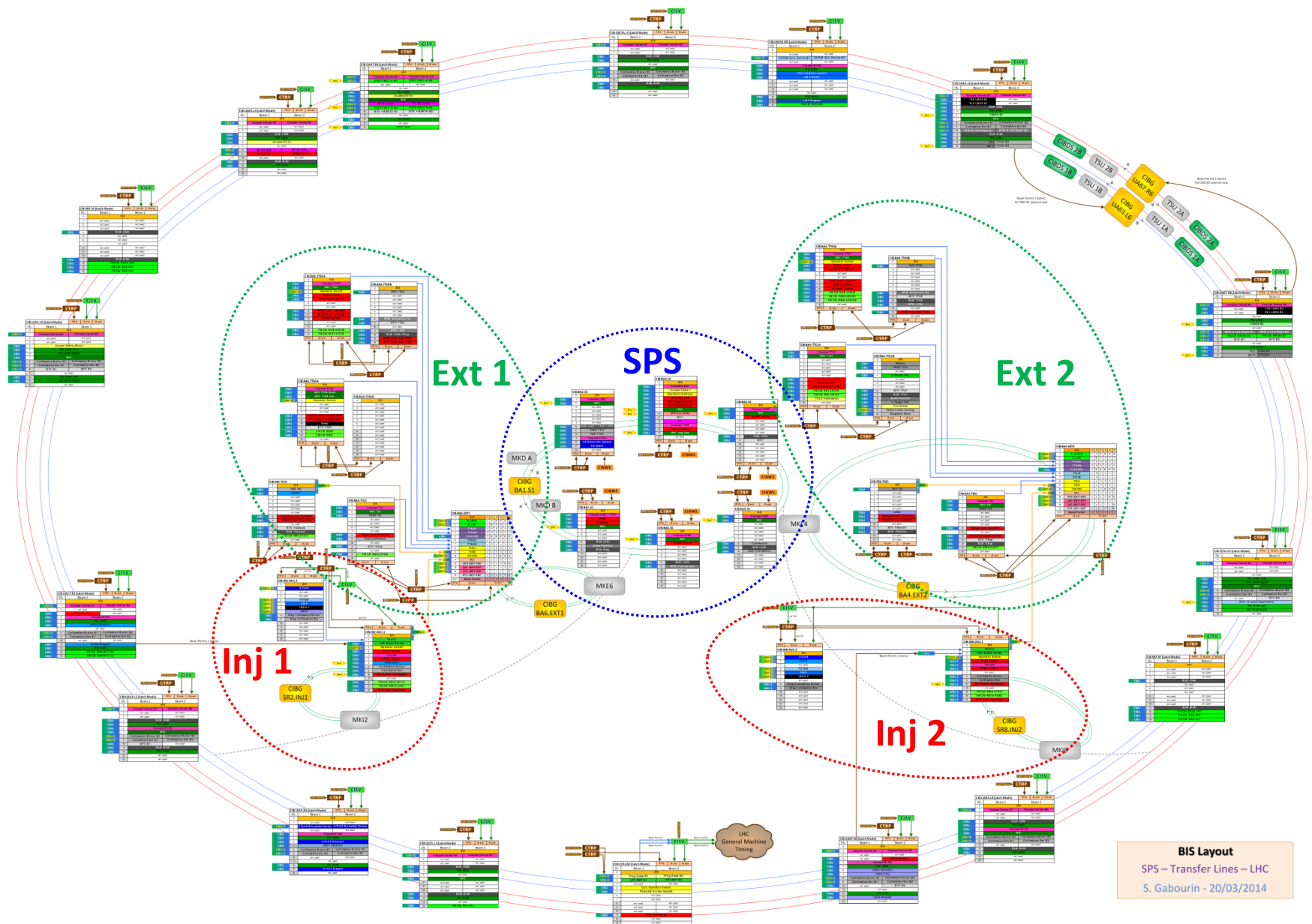
BIS changes – New BIS board CIBDS

- New CIBDS (Dumping System):
 - Included in the BIS Permit Loop
 - Direct link from BIS to Retriggering line
 - Triggers delayed/asynchronous dumps
 - 2 VME boards (1 per beam)
 - Installed in point 6 (UA63 and UA67)





BIS changes – New User systems





BIS changes – New User systems

In total 8 new inputs in SPS :

- New WIC system in **all SPS points**,
on unmaskable inputs

	PPS	Mark	Mask
	CIB.BA1.S1		
	0	SIS	
CIBU	1	Vacuum LSS1 + TT10	
CIBU	2	MKD	
CIBU	3	Q Kicker	
CIBU	4	WIC	
	5	not used	
	6	not used	
	7	not used	
CIBU	8	BLM LSS1	
CIBU	9	Beam Position	
CIBU	10	BLM Ring	
	11	not used	
	12	not used	
	13	not used	
	14	not used	

	PPS	Mark	Mask
	CIB.BA6.S6		
	0	SIS	
CIBU	1	Vacuum LSS6	
CIBU	2	WIC	
CIBU	3	MKE6 Status	
	4	not used	
	5	not used	
	6	not used	
	7	not used	
CIBU	8	BLM LSS6	
CIBU	9	BPM Turn by turn	
	10	not used	
	11	not used	
	12	not used	
	13	not used	
	14	not used	

- More in **BA3** :
 - Input 8: SPS Eco Mode (maskable)
 - Input 13: WIC ring line (maskable)
 - (SPS Interlock Mode Ions finally not added)

→ VME chassis almost full

→ Future merge of the MPS and move the WIC ring line to a non-maskable input

	PPS	Mark	Mask
	CIB.BA3.S3		
	0	SIS	
CIBU	1	Vacuum LSS3	
CIBU	2	Access Chain 1	
CIBU	3	Operators Buttons	
CIBU	4	MPS Dipoles	
CIBU	5	MPS Quadripoles	
CIBU	6	MPS Sextupoles	
CIBU	7	WIC	
CIBU	8	SPS Eco mode	
CIBU	9	BCT	
CIBU	10	RF	
CIBU	11	Vacuum TT30	
CIBU	12	ROCS Interlock	
CIBU	13	WIC ring line	
	14	not used	
	PPS	Mark	Mask





BIS changes – New User systems

In total 3 new inputs in Injectors :


- Injection 1 :

- Input 7: Alice ZDC
- Input 10: BETS MSI/TDI Beam 1

	PPS	Mark	Mask
	CIB.SR2.INJ1.1		
	0	SIS	
	1	INJ1-2	
CIBU	2	LHC Beam1 Permit	
CIBF-O	3	Operator Switch	
CIBU	4	MKI2 Status	
CIBU	5	Vacuum	
CIBU	6	MKI2 Erratic	
 CIBU	7	Alice ZDC	
CIBU	8	Collimation Motor	
CIBU	9	Collimation Env	
 CIBU	10	BETS M SI/TDI Beam1	
	11	not used	
CIBU	12	FMCM RB1H 29314	
CIBU	13	FMCM RM SI L2B1	
CIBU	14	M SI Conv Sum Fault	

- Injection 2 :

- Input 10: BETS MSI/TDI Beam 2

	PPS	Mark	Mask
	CIB.SR8.INJ2.1		
	0	SIS	
	1	INJ2-2	
	2	LHC Beam2 Permit	
CIBF-O	3	Operator Switch	
CIBU S	4	MKI8 Status	
CIBU S	5	Vacuum	
CIBU S	6	MKI8 Erratic	
	7	not used	
CIBU S	8	Collimation Motor	
CIBU S	9	Collimation Env	
 CIBU S	10	BETS M SI/TDI Beam2	
	11	not used	
CIBU S	12	FMCM RB1H 87833	
CIBU S	13	FMCM RM SI R8B2	
CIBU S	14	M SI Conv Sum Fault	



BIS changes – New User systems

In total 8 new inputs in LHC:

- **Point 1 :**

Removed inputs:

8	Collimation Motor B1	Collimation Motor B2
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Disabled on 20/07/11

CIB.US15.L1 (Latch Mode)		PPS	Mark	Mask
Ch.	Beam 1	Beam 2		
	SIS			
CIBU-D	Vacuum Valves B1	Vacuum Valves B2		
	not used	not used		
	not used	not used		
CIBU	BLM UNM			
CIBU	PIC UNM			
	not used			
CIBU	WIC			
	not used	not used		
	not used	not used		
	not used	not used		
CIBU	BLM M SK			
CIBU	PIC M SK			
	not used			
CIBU	FMCM RD1 LR1			

CIB.US15.R1 (Latch Mode)		PPS	Mark	Mask
Ch.	Beam 1	Beam 2		
	SIS			
CIBU-D	not used	not used		
	ATLA \$ Moveable Device	ATLA \$ Moveable Device		
	not used	not used		
CIBU	Vacuum B1 B2			
CIBU	PIC UNM			
CIBU	ATLA \$ Detector			
CIBU	LACF Detector			
CIBU-D	Collimation Motor B1	Collimation Motor B2		
CIBU-D	Collimation Env B1	Collimation Env B2		
	not used	not used		
	not used	not used		
CIBU	PIC M SK			
CIBU	ATLA \$ Magnet			
	not used			

- Input 8: Collimation motor merged with R1

- Input 7: LACF detector “disable” but conserved

- **Point 4 :**

- New DIDT FBCT

- Input 2: Unmaskable

- Input 9: Maskable

- Input 14: Test

- Input 7: WIC “disable” but conserved

CIB.UA47.R4 (Latch Mode)		PPS	Mark	Mask
Ch.	Beam 1	Beam 2		
	SIS			
CIBU-D	Vacuum Valves B1	Vacuum Valves B2		
CIBU-D	DIDT FBCT A B1	DIDT FBCT A B2		
	not used	not used		
	not used	not used		
CIBU	PIC UNM			
CIBU	Access E \$ R4			
CIBU	WIC			
CIBU-D	RF B1 UX45	RF B2 UX45		
CIBU-D	DIDT FBCT B B1	DIDT FBCT B B2		
CIBU-D	BTV + B \$ RTA B1	BTV + B \$ RTA B2		
	not used			
CIBU	PIC M SK			
	not used			
CIBU	DIDT Test			

Disconnected Jan 2011



BIS changes – New User systems

- Point 5 :

- Inputs 8 & 9: Collimation removed
- Input 13: CMS Magnet “disable” but conserved

Removed inputs:

8	Collimation Motor B1	Collimation Motor B2
9	Collimation Env B1	Collimation Env B2

CIB.USC55.R5 (Latch Mode)		PPS	Mark	Mask
Ch.	Beam 1	Beam 2		
0	SIS			
1	not used	not used		
CIBU-D	2	TOTEM Mov Device B1	TOTEM Mov Device B2	
	3	not used	not used	
CIBU	4	Vacuum B1 B2		
CIBU	5	PIC UNM		
CIBU	6	CMS Operator Switch		
CIBU	7	CMS BCM 2		
	8	not used	not used	
	9	not used	not used	
	10	not used	not used	
	11	not used		
CIBU	12	PIC M SK		
CIBU	13	CMS Magnet		
CIBU	14	FMCM RD1 LRS		

- Point 6 :

New inputs:

6	CIBDS B1
14	BETS TCDQ B2

CIB.UA63.L6 (Latch Mode)		PPS	Mark	Mask
Ch.	Beam 1	Beam 2		
0	SIS			
CIBU-D	1	Vacuum Valves B1	Vacuum Valves B2	
CIBU	2	TSU LBDs B1	not used	
CIBU	3	PLC LBDs B1	not used	
CIBU	4	BLM UNM		
CIBU	5	PIC UNM		
CIBU	6	CIBDS B1		
CIBU	7	WIC		
CIBU-D	8	Collimation Motor B1	Collimation Motor B2	
CIBU-D	9	Collimation Env B1	Collimation Env B2	
CIBU-D	10	BPM B Left/Right B1	BPM B Left/Right B2	
CIBU	11	BLM M SK		
CIBU	12	PIC M SK		
CIBU	13	BETS TCDQ B2		
CIBU	14	BETS TCDQ B2		

New inputs:

6	CIBDS B2
14	BETS TCDQ B1

CIB.UA67.R6 (Latch Mode)		PPS	Mark	Mask
Ch.	Beam 1	Beam 2		
0	SIS			
CIBU-D	1	Vacuum Valves B1	Vacuum Valves B2	
CIBU	2	not used	TSU LBDs B2	
CIBU	3	not used	PLC LBDs B2	
	4	not used		
CIBU	5	PIC UNM		
CIBU	6	CIBDS B2		
	7	not used		
CIBU-D	8	BPM A Left/Right B1	BPM A Left/Right B2	
CIBU-D	9	FMCM RM SD B1	FMCM RM SD B2	
CIBU-D	10	BTV B1	BTV B2	
	11	not used		
CIBU	12	PIC M SK		
CIBU	13	PLC TCDQ B1		
CIBU	14	BETS TCDQ B1		

- Input 6: New CIBDS Beam 1 → affects both beams
- Input 14: TCDQ Beam 2 → affects only Beam 2

- Input 6: New CIBDS Beam 2 → affects both beams
- Input 14: TCDQ Beam 1 → affects only Beam 1



BIS changes – New User systems

- Point 7 :

- Input 11: New Crystal Experiment

New input :

11	ECR (Crystal Experiment)	
CIB.TZ76.U7 (Latch Mode)		
Ch.	Beam 1	Beam 2
0	SIS	
CIBU-D	1	Vacuum Valves B1
	2	not used
	3	not used
	4	not used
CIBU	5	PIC UNM Left
CIBU	6	PIC UNM Right
CIBU	7	VVIC
CIBU-D	8	Collimation Motor B1
CIBU-D	9	Collimation Env B1
CIBU	10	not used
CIBU	11	ECR (Crystal Experiment)
CIBU	12	PIC M SK Left
CIBU	13	PIC M SK Right
	14	not used

Résumé:

- 8 new inputs in SPS: 6 un-maskable + 2 maskable
- No change in extractions
- 3 new inputs in Injections: 1 un-maskable + 2 maskable
- 8 new inputs in LHC: 3 un-maskable + 5 maskable
 - Plus 3 “disable”, ready for future use



BIS changes – Miscellaneous

- CIBG Arming: 1 FESA command to arm A and B loops simultaneously
→ to avoid the TSU or the CIBDS to arm only on 1 loop
- R2E : BIC relocation (from UJ56 to USC55)
- BIC Re-installation in TZ76 (due to works in the alcove)
- Spare fiber needed in point 6
- ...



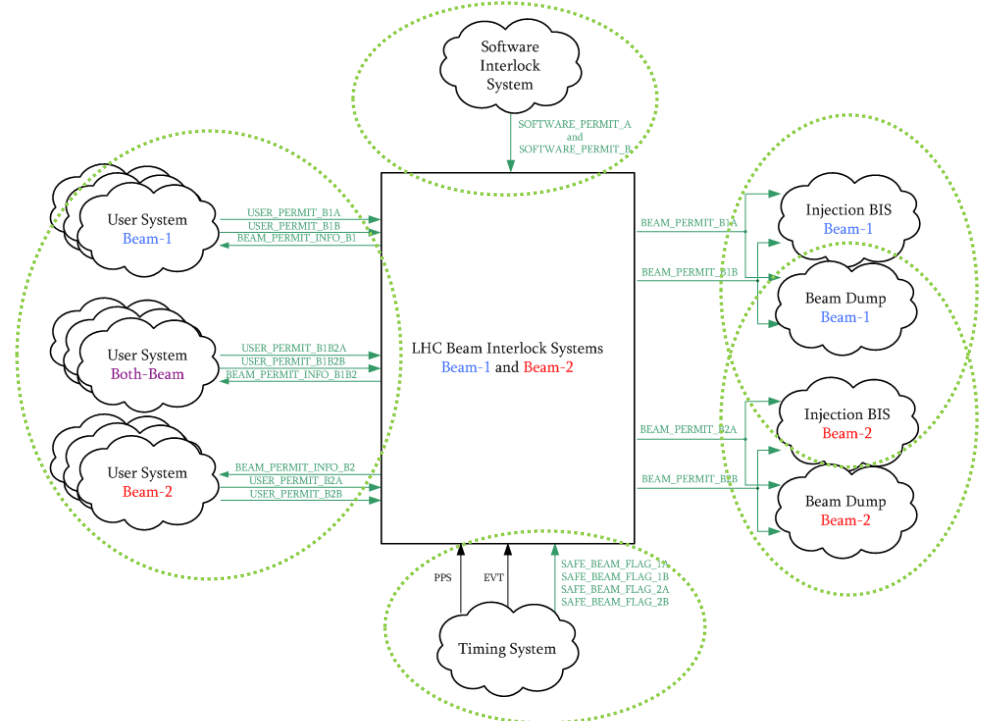
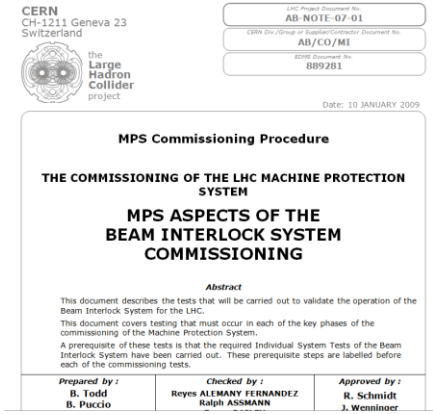
Overview of BIS commissioning

- TODO:

- 1- Update BICs (CPU-CIBG-CIBM-CIBO). In all machines - *April to Summer*
- 2- Commission the Users (New tester). In all machines - *May to Autumn*
- 3- Install CIBDS in BIS loop. In LHC - *April*

- Moreover:

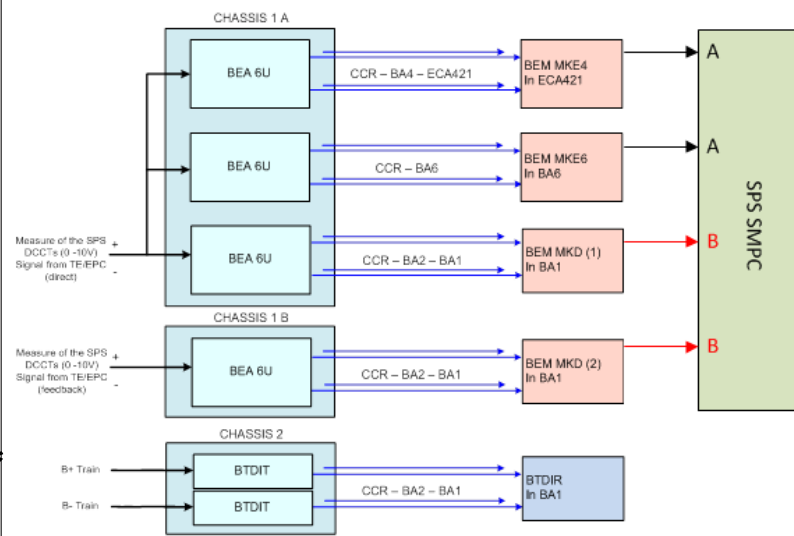
- Organize LHC Local BIS loop in Point 6 - *April*
- Measurement campaign of the optic fibres attenuation. In LHC - *Summer*
- Set the disable jumper for the LHC sector test - *November.*
- Other commissioning tests as described in the document “MPS aspects of the Beam Interlock System Commissioning”. This has to be slightly updated to consider the CIBDS.





SMP changes – SPS

- New redundant energies from BEM in BA1
 - Increases the availability (1 oo 4 logic).
 - Optic fibres already pulled between BA1 and CCR



- CNGS energy flag (~400GeV) replaced by AWAKE energy flag (~300GeV)



SMP changes – LHC

- Redefinition of the Setup Beam Flag equations
 - Nowadays 4 equations (Normal, Relaxed, Very Relaxed, Ions).
 - Need to redefine how many equations are needed.
 - Need to redefine the 64 couples (Energy, Intensity) to hardcode in the FPGA for each new equation.

- 2 additional squeezing factors (Beta*) transmitted via the SMP to the GMT

Nowadays 4 Beta* (1 for each IP) used into the calculation of the Energy Flags

Proposal to ensure adequate protection and an efficient setup

- 1) Normal SBF: 1.1e10 [ALL]
- 2) Restricted SBF: 1.4e11 x 1 bunch [Only Special Users]
- 3) Restricted SBF: 1.1e10 x 12 bunches [MDs with MP doc.]
 - SIS interlock on bunch intensity

Limiting intensities for different-level SBFs at 6.5 TeV and 7 TeV

	6.5 TeV	7 TeV
Normal	1.1e10	9.4e9
Restricted	1.4e11	1.2e11

07.03.2014 87th MPP Meeting 10

Courtesy V. Chetvertkova, 87th MPP – 07/03/14

- 2 additional squeezing factors (Beta*) transmitted via the SMP to the GMT

Safe Machine Parameters in LAB: Detailed View

Device Tree: SPS, LHC, C1SV, LAB

Board Info: Board Name: C1SX, Variant Name: GL, Slot Number: 6

Monitor FPGA Info: Version: 2.1, Revision: 2.0, ISE Version: 13.1.0, Percent used: 90%, UTC: 23-01-12 11:38:01

Control FPGA Info: Version: 0.6, ISE Version: 10.1.3, Percent used: 97%, UTC: 07-07-11 15:16:34

Subscription State: UPDATE:

Data Sources: Slow BCT Beam-1 A, Slow BCT Beam-1 B, Slow BCT Beam-2 A, Slow BCT Beam-2 B, BETS Beam-1 Link A, BETS Beam-1 Link B, BETS Beam-2 Link A, BETS Beam-2 Link B

Moveable Devices Allowed In / Stable Beams Generation: Physics Energy Calculation: Lower limit: 7864.20 GeV, Current: 448.44 GeV, Upper limit: 7002.00 GeV, Physics Energy: FALSE

Beam Mode: NO_MODE

Squeezing Factor IR1: 0.00 m, Squeezing Factor IR2: 0.00 m, Squeezing Factor IR5: 0.00 m, Squeezing Factor IR8: 0.00 m

Beam Squeezed Calculation: IR1: 0.04 m < 0.00 m < 400.00 m = FALSE, IR2: 0.04 m < 0.00 m < 400.00 m = FALSE, IR5: 0.04 m < 0.00 m < 400.00 m = FALSE, IR8: 0.04 m < 0.00 m < 400.00 m = FALSE

To Arbitrator: Beam-1 Intensity: 6.5535E14 [p], Beam-2 Intensity: 6.5535E14 [p], Machine Energy: 7864.20 GeV, Moveable Devices Allowed In: FALSE, Stable Beams: FALSE, Beta* IR1: 0.00 m, Beta* IR2: 0.00 m, Beta* IR5: 0.00 m, Beta* IR8: 0.00 m

To Extraction BIS: Setup Beam Flag: Beam-1: FALSE, Beam-2: FALSE, Beam Presence Flag: Beam-1: FALSE, Beam-2: FALSE



Overview of SMP commissioning

- Much simpler than the BIS → only 2 crates in the CCR
- A document explain already how to parameter the SMP (threshold values, force flags).
 - This will allow an easy definition of the commissioning tests.
 - It needs a refresh (only one Setup-Beam Flag equation is described, etc)
- The procedure should be defined in a doc “*MPS aspects of the Safe Machine Parameters Commissioning*” → To be created following the template

Document No. LHC-OP-MPS-0013 V.2v0		
CERN Div./Group or Supplier/Contractor Document No. TE-MPE-MI		
2009 Document No. 883620		

CERN TE DEPARTMENT
CH-1211 Geneva 23
Switzerland

Date: 2009-10-05

ENGINEERING SPECIFICATION

**SAFE MACHINE PARAMETERS SYSTEM
THRESHOLD & TRIM DEFINITIONS**

2009-10 OPERATION

Abstract

This document specifies the thresholds to be used in the generation of mission critical flags in the Safe Machine Parameters System of both the SPS and LHC.

The definition of these values is intended for the operation of LHC and SPS in 2009-10, a subsequent specification is required for operation beyond LHC hardware and beam related commissioning to 3.5 TeV.

This document also includes the description and specification of the trim settings which can be applied to the Safe Machine Parameters Systems.

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