

### Machine Protection Panel April 2022

### LHC BLM: STATUS OF MP SYSTEM COMMISSIONING BEFORE FIRST BEAM

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### **UPDATE ON NEW INSTALLATIONS**

### Diode Boxes installation in LSS3

#### Signal Drop at IP3

- During the Loss Maps Validation several BLM signals drop to zero at DS of R3
- The issue has been reported twice in Run 2:
  - <u>BIBML-990</u> on 2015/05/05 & <u>BIBML-1344</u> on 2017/05/23
- Specificities of the location
  - HV cable is ~ 3km (all other locations < 200m)</li>
  - Very long signal cables (~ 800m)







- Installed 36 Diode boxes in LSS3
- Validated at the lab and
- Tested with modulation of the detector's bias supply at LHC installation.

### Additional Signal Filters

### ■ Filters added to the following detectors:

- On top of the QBBI interconnects (cell 8/9 left of IR2), i.e.
  - BLMBI.08L2.B0T10\_MBB-MBA\_07L2
  - BLMBI.09L2.B0T10\_MBB-MBA\_08L2

■ Filters prepared for future installation (if needed):

- For Beam 1 detectors on Q7/Q8 right of IR8, i.e.
  - ► BLMQI.07R8.B1I10\_MQM
  - BLMQI.07R8.B1I20\_MQM
  - BLMQI.07R8.B1I30\_MQM
  - BLMQI.08R8.B1I10\_MQML
  - BLMQI.08R8.B1I20\_MQML
  - BLMQI.08R8.B1I30\_MQML

### CryoBLM Installation at 9L5 and 9R7

- Installation completed with two CryoBLM detectors per point
- Additional external Diamond detectors for cross-check
- All detectors in DC measurement mode with standard LHC electronics
  - BLECF modules integrating at 40 μs
- Could be modified in the future for AC measurements







# INTERLOCK INHIBIT AT INJECTION

### Interlock Inhibit Firmware

#### Interlock Inhibit Functionality Interlock daisy chain from BLETC 1 to BLECS Crate BLETO BLECS .... 4 (I) BOBR Termination Crate 3 Crate BLECS Crate BLETO BLET( BLETC .... Legend: Unmaskable beam permit CIBU Maskable beam permi BIS Unmaskable Beam Info CIBU network Maskable Beam Info Maskable

#### Run 2

- Special firmware version at two 'injection' crates
- Would be active only if
  - Energy < 491 GeV, i.e. first two energy levels
  - ► Timer is set > 0
  - Injection event received
- Would act only to the channels defined as 'MASKABLE'

#### Run 3

- Deployed in all LHCBLM crates
  - Same firmware version/binary since 2015
- Newer version under development;
  - mostly ready, some issues with the 'Sanity Checks' holding us back
- Conditions to become active remain the same
- Roll-back to version without this functionality is very quick, i.e. link old version and reboot.

### Interlock Inhibit Software

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### Two new properties to set and monitor the function

#### ■ InjectionInhibitSetting

Set the timer value for the inhibit

### InjectionInhibitAcquisition

- Timer Setting
  - Shows the value configured for this crate
- Timer Countdown
  - MSB is high when the function is active
  - The remaining bits show the value of the timer as it decreases

### Injection Interlock Inhibit

#### Prerequisite before any test

- Decide which crates & detectors need the functionality
- For the identified crates:
  - Set Timer (some value other than zero) to those crates
  - > Change flag of all channels that should not be blindable to 'UNMASKABLE'
  - Change flag of all channels that should be blindable to 'MASKABLE'
- Tests with pilot beam
  - During commissioning of injection protection system
  - Create losses above dump threshold
  - Modify blindout time
  - Record interlock input from blindable/non-blindable crates
  - If losses above dump threshold cannot be reached, lower the monitor factor of blindable crates BLMs
- Tests with trains
  - 288 b or what is being used for scrubbing
  - Tighten TCDIs from 5 sig to 4.5 sig (likely settings for Hilumi)
  - Tighten monitor factor

Criteria for successful test:

- Functionality: 'blindable' detectors DO NOT interlock within given blindout time and losses above threshold
- Redundancy: 'non-blindable' detectors DO interlock in case losses go above threshold on those, while blindable ones do not interlock
- Inhibit time: setup the necessary blindout time not critical, can be adjusted later

21/04/2022

# **KNOWN ISSUES**

### Crate Missing Messages

- Fixed display warns regularly with messages that one of the crates is 'down'
  - Frequency ~ 5-6 messages per 24h
  - Crates are random
- Data in NXCALS do not have gaps
- Could not find correlation with any activity/action
  - Not a critical issue but could mislead
  - Will continue investigation

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## XPOC & PM Buffers

- XPOC and PM buffers remain frozen or do not get restarted causing missing data
- Functionality (simplified):
  - Two memories serve XPOC-b1, XPOC-b2 and PM
  - BeamDumped1 & 2 freeze the buffers
  - Server waits if there is also a GPM1 before restarting them to read the additional data
  - Buffers are restarted if all actions completed or wait time reached.
- Issue seems like a 'race condition'
- Did not manage to reproduce it
  - Additional debugging info added to the design

File Configuration Tabs Window						
Selected BLETC/BLEC	Global BLECS Diagnostics	Global BLECS Tests	Connectivity SRAM	Capture Tests	SIS Tests	
	PM1	PM2	CD	IOERROR	Energy	FlashCRCFailed BLECF HV STATUS
HC.BLM.SR1.L	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		>491400	
HC.BLM.SR1.C	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~		4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		>491400	
HC.BLM.SR1.R	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~		4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		>491400	
HC.BLM.SR2.L	<b>0000000000000</b>		4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		>491400	
HC.BLM.SR2.C	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~		6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6		>491400	
HC.BLM.SR2.R	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6		>491400	
HC.BLM.SR2.I					>491400	
HC.BLM.SR3.L					>491400	
HC.BLM.SR3.C			~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
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HC.BLM.SX4.L	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6		6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
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HC.BLM.SX4.R	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR5.L	000000000000		0 0 0 0 0 0 0 0		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR5.C	000000000000		0 0 0 0 0 0 0 0		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR5.R	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	~ ~ ~ ~ ~ ~ ~ ~ ~		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR6.L	000000000000000000000000000000000000000	0000000000	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR6.C	000000000000		<u></u>		<491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR6.R	000000000000				>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR7.L	000000000000		0 0 0 0 0 0 0 0		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR7.C	00000000000		0 0 0 0 0 0 0 0		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR7.R					>491400	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
HC.BLM.SR7.E					>491400	000000000000000000000000000000000000000
HC.BLM.SR8.L			<u> </u>		>491400	6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
HC.BLM.SR8.C	000000000000		<u> </u>		>491400	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
HC.BLM.SR8.R			<u> </u>		>491400	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
HC.BLM.SR8.I			~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~		>491400	
BLMLHC_BLM2					<491400	• • • • • • • • • • • • • • • • • • •
HC.BLMCMS.BCM2					>7864200	

## **Collimation Data**

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3::Timing										
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- Few packets are missing regularly from the 100 Hz data
- Issue identified to be with the readout and validation of all the settings
  - VME bus is occupied for 20-30 ms reading the flash memory contents
  - Part of the new functionality that checks everything at 1 Hz

#### New version to be deployed

- Will remove (for now) the check for the BLECS settings; settings will continue to be checked before each injection
- Keep this function only for the BLETC, i.e. thresholds, names, flags and all critical parameters
- Need deployment window from OP
  - Could be today or any of the next days

## SYSTEM CHECKOUT

### System Checkout

### Hardware Checkout completed:

- All detector connection vs LSA verified
- Thresholds & flags have been updated
  - Verified all settings & tools are in good state
- Energy level distribution in the crate
  - Ramps show correct threshold selection
- Interlocks are generated & propagate to the CIBUs
  - All bypass for LS2 development removed

### Machine Checkout parts pending:

- SIS interlocks for missing HV, crate or corrupted settings
  - Need an hour in the CCC with help from OP



### Special systems (modified LHCBLM types)

- CMS: Beam Condition Monitoring
  - Complete system w/ LHC interlocks to be supported
  - Support threshold management
  - Outside the LHC Controls environment with add. complexity to diagnose issues
- ATLAS: Beam Condition Monitoring
  - Processing electronics
  - Support threshold management
  - Custom firmware (circa 2011 unmaintainable)
- SPS: detectors and electronics are deployed mostly for MDs
  - Detectors at LSS2, LSS4 and LSS5
  - Electronics at BA2 and BA5
- CHARM: detectors and electronics for spill monitoring
  - Complete system to maintain
  - Not interlocked