BLM electronics failure mode cases for the selected proposal on LHCBLM sunglasses

MPP 29.10.2011

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Overview

- Selected proposal

- Hardware involved

- Functionality to be modified

- Failure modes

Selected proposal

Overview of Proposals

1. Use LIC detectors and appropriate Threshold values where necessary

2. Use LIC detectors and modification in CS firmware

3. Move relevant monitors to separate crates and modify the CS firmware

4. Modify both TC and CS firmware; control logic with a new monitor flag

   * Schemes 2-4 require external signal to notify for incoming injection

Scheme 2 details

Scheme 2: **Special Energy Level**

- Replace the monitors getting the additional particle shower with LIC detectors

- Set 'relaxed' thresholds for the first energy level on the replaced monitors.
  - NOTE: currently 1st energy level is practically unused

- Modify Combiner card (BLECS) to receive inj. trigger and send to the BLETCs the energy level '0' for a fixed time period after the injection.

Plus: no modification of the beam permit lines

Minus: energy monitoring by SIS will need a modification

System overview
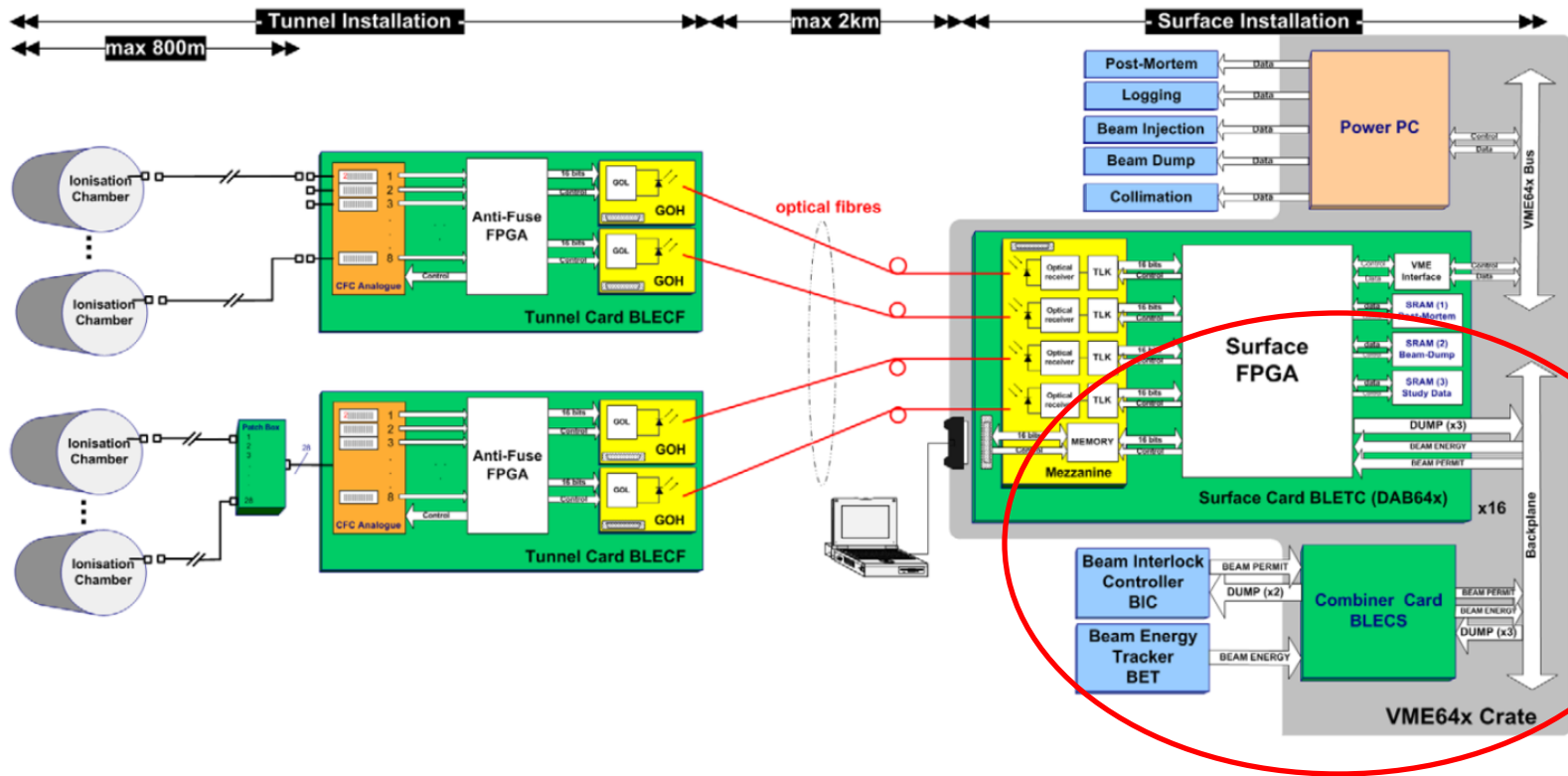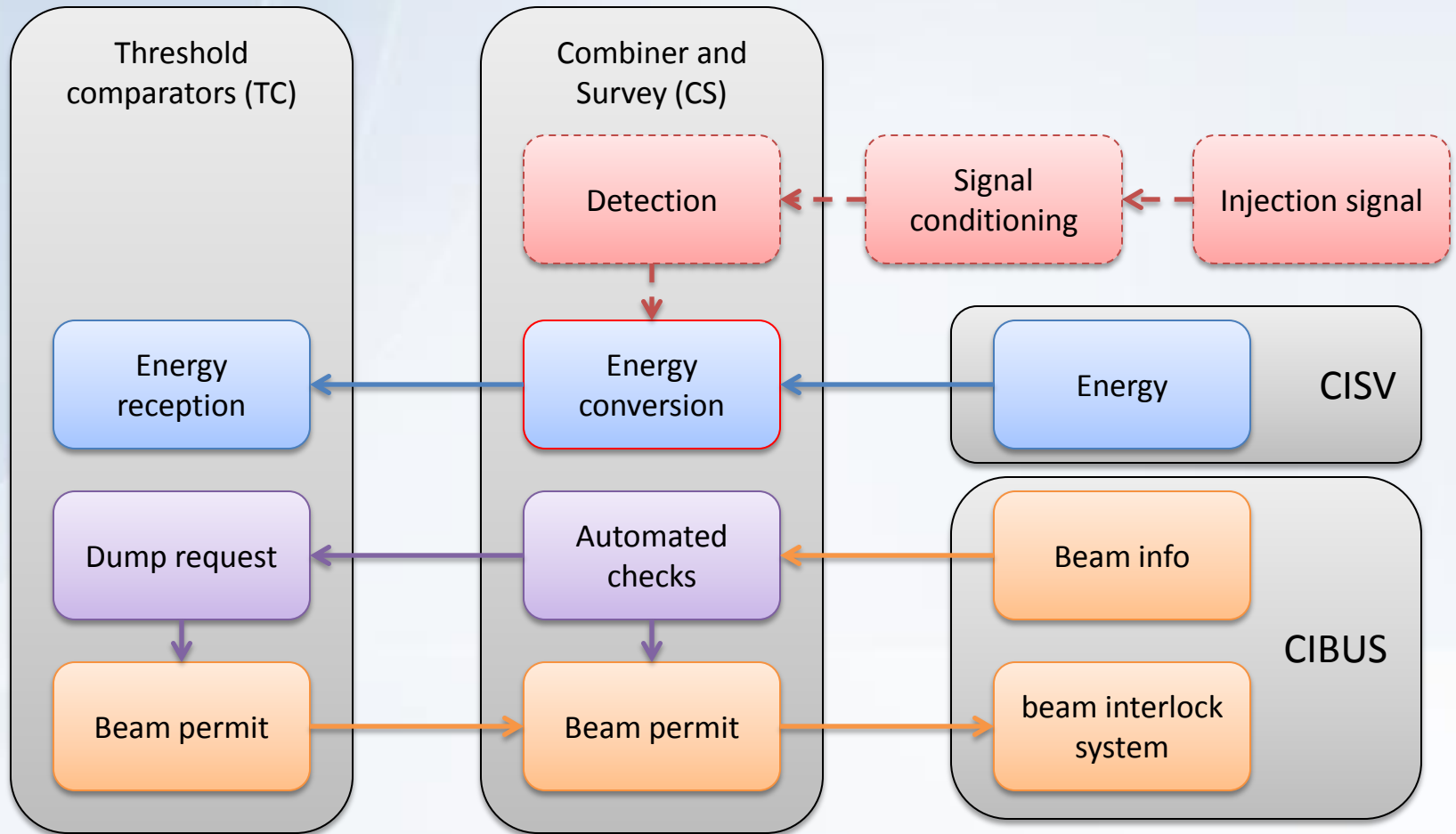
Automated checks overview

Function	Automated check	Checked every	hardware	Decision by
BL HV supply	SIS	60s	CF + TC	SIS
BL HV supply	Connectivity check	24h	CF + TC + CS	CS
BL energy storage	Connectivity check	24h	CF + TC + CS	CS
BL signal cable	Connectivity check	24h	CF + TC + CS	CS
Optical links	continuous	40us	CF + TC	TC
BPL TC to CS	Internal beam permit	24h	TC + CS	CS
BPL crate to crate	Internal beam permit	24h	TC + CS	CS
BPL crate to BIS	External beam permit	On demand	CS + CISV	BIS system
Settings check	MCS consistency	24h	TC + CS	LSA engine, result in CS

BL: Beam Loss detector, HV: High Voltage, BPL: Beam Permit Lines, BIS: Beam Interlock System, LSA: LHC Software Architecture, CF: Current to Frequency card, TC: Threshold Comparators card, CS: Combiner and Survey card,
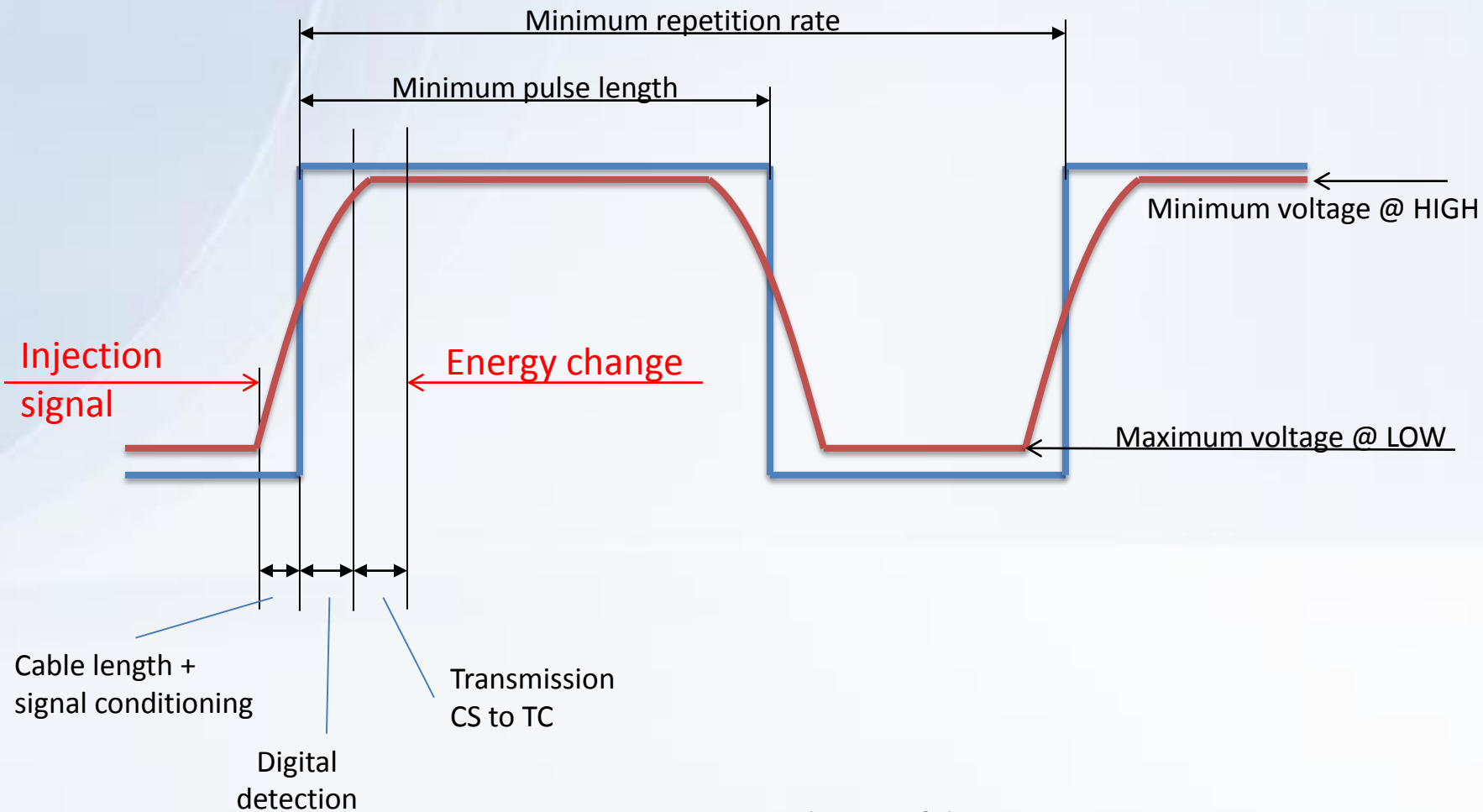
CS critical functionalities

- Beam permit lines combination

- Beam energy
  reception, conversion and broadcasting

- Regular system checks including
  Conformity of the cabling (connectivity check)
  Ability of the TC to request beam dumps
  (internal beam permits check)

Additional input to the BLM system

Injection signal specs (analog signal expected)

Minimum repetition rate

Minimum pulse length

Injection signal

Energy change

Minimum voltage @ HIGH

Maximum voltage @ LOW

Cable length + signal conditioning

Transmission CS to TC

Digital detection

CS firmware update

- Code frozen since 23.02.2010
- No major update foreseen
- A new version will required a new validation

- On the list:
  Logging for energy fast change (below 1Hz)
  Holding energy changes from at least 1s
  Connectivity check measurement analysis improvement
  Time out to exit the MCS check

Failure modes

	Redundancy	Failure cases	BLM Action	Consequence
Injection signal	Possible on BLM side	No signal when injection, signal missed.	-	Energy not modified √
	"	One or more triggers & energy > 450 GeV	-	Energy not modified √
	"	Constant re-trigger & energy = 450GeV	Case 1: Stay continuously in injection condition	Continuous modified energy X
	"	Constant re-trigger & energy = 450GeV	Case 2: Goes ones in injection and wait certain time	Multiple injection condition if re-trigger after the dead time ~
Energy CISV to CS to TC	Yes	value corruption (error on the CRC)	Use the redundant line	- √
	"	line stuck (0 or 1)	Use the redundant line	- √
	"	both lines corrupted continuously (error on the CRC)	Energy goes in error after 120ms	Energy at 7 TeV √
	"	Transmission stops (both lines stuck)	Energy goes in error after 120ms	Energy at 7 TeV √
	"	No new value (toggle bit stuck)	Energy goes in error after 120ms	Energy at 7 TeV √
CS or TC picks the wrong energy from CISV (SEU…)	Energy repeated every (ms)	Energy higher	System more sensitive to losses	Dump by SIS √
	"	Energy Lower	System less sensitive to losses	Dump by SIS ~ √

Summary

- LIC detectors installation
- Injection notification signal to be specified and safely routed to the BLM crates
- CS firmware update
- Validation of the new hardware configuration & firmware
- Thresholds management for the injection condition