

Commissioning: Injection Protection System

- Individual System Tests
- Global Tests
- Verification of Protection

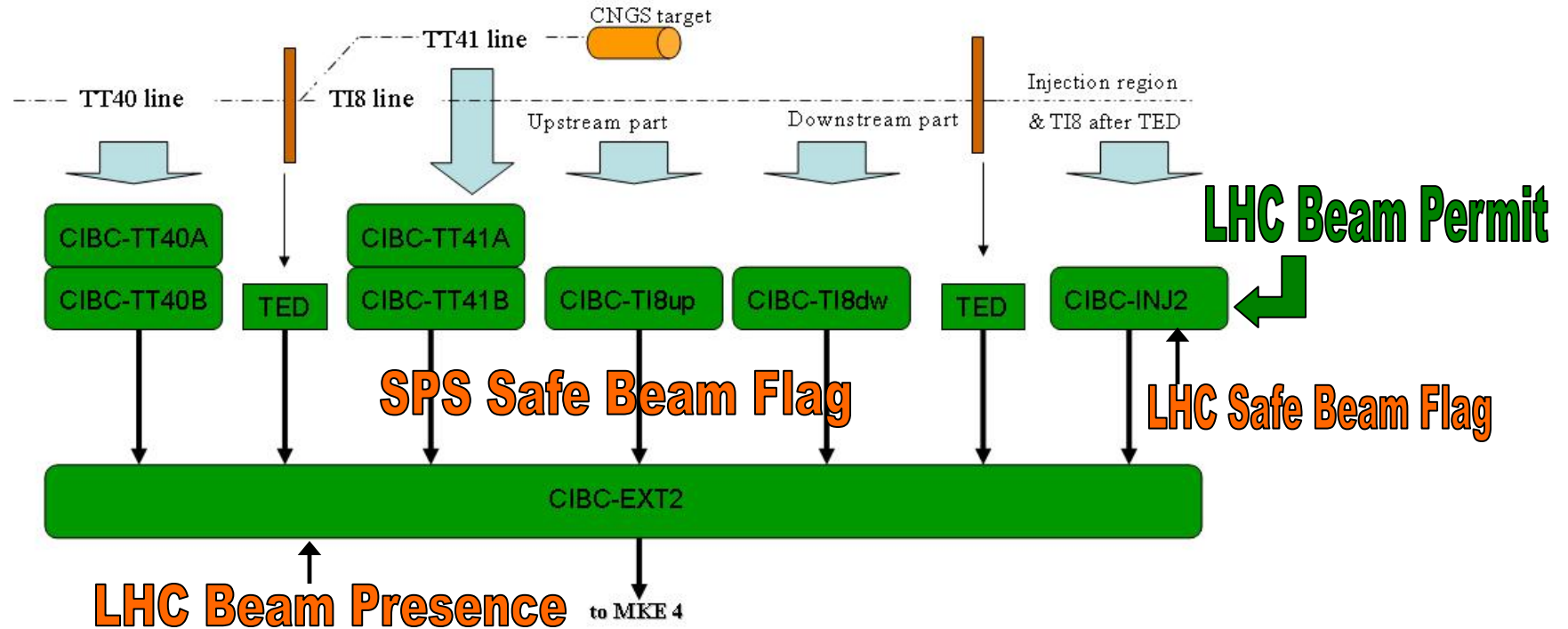
For the time being just strategy...

Work in progress

We are not discussing...

- Generation and testing of the generation of the flags:
 - Issue of 1 BCT only for SPS safe beam flag
 - LHC...same thing apparently
 - Beam presence at most 1 ms before injection
 - redundancy
- MCS
 - Needed for collimators, MKIs,...

Interlocking



- Three different interlock systems for injection process

Individual Tests: Injection BIC

- Need to commission: ...injection permit... without beam

CIB.SR2.INJ1	1	YES	UNmaskable	Operator Switch
CIB.SR2.INJ1	2	YES	UNmaskable	LHC Beam1-Permit
CIB.SR2.INJ1	3	YES	UNmaskable	not used
CIB.SR2.INJ1	4	YES	UNmaskable	MKI2 Status
CIB.SR2.INJ1	5	YES	UNmaskable	Vacuum
CIB.SR2.INJ1	6	NO	UNmaskable	not used
CIB.SR2.INJ1	7	YES	UNmaskable	ALICE_ZDC
CIB.SR2.INJ1	8	YES	Maskable	Collimation Motor-Control
CIB.SR2.INJ1	9	YES	Maskable	Collimation Env_Param
CIB.SR2.INJ1	10	NO	Maskable	not used
CIB.SR2.INJ1	11	NO	Maskable	not used
CIB.SR2.INJ1	12	NO	Maskable	not used
CIB.SR2.INJ1	13	YES	Maskable	FMCM on MSI
CIB.SR2.INJ1	14	YES	Maskable	MSI Convertor Sum Fault

Done like elsewhere

Needs to be discussed here

Needs to be discussed here

Done along with vacuum prot. com.

Needs to be coordinated with exp.*

Needs to be discussed here

Done along with collimator prot. com.

Done like in transfer lines

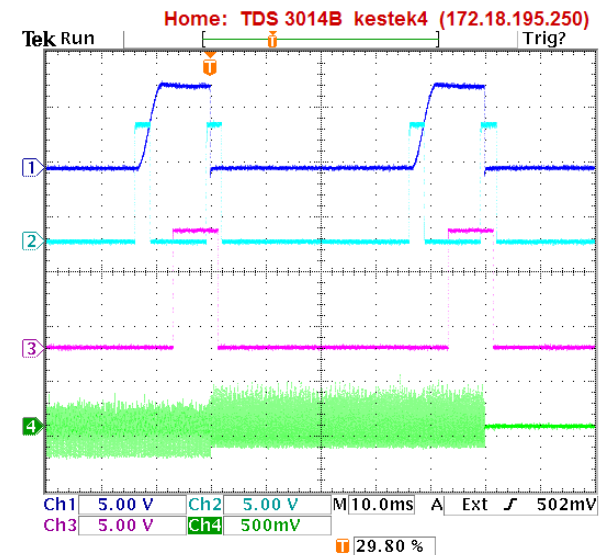
Done like in transfer lines

- Individual tests... individual system has to be ready, check response on BIC: **need injection region closed in LHC**

* LHCb entry to ring BIC not to injection BIC

Individual Tests: MKI

- BIC entry: MKI status
 - Combines
 - MKI status
 - Inhibit form LBDS during arming process
- Plus:
 - BETS – cold check-out
 - Watchdog link from point 6: needs RF synchronization sorted out with LBDS – phase A.2
- Protection against failure scenarios: re-triggering for erratic on one of the modules
 - cold check-out
- Need to define list and tests with Etienne...



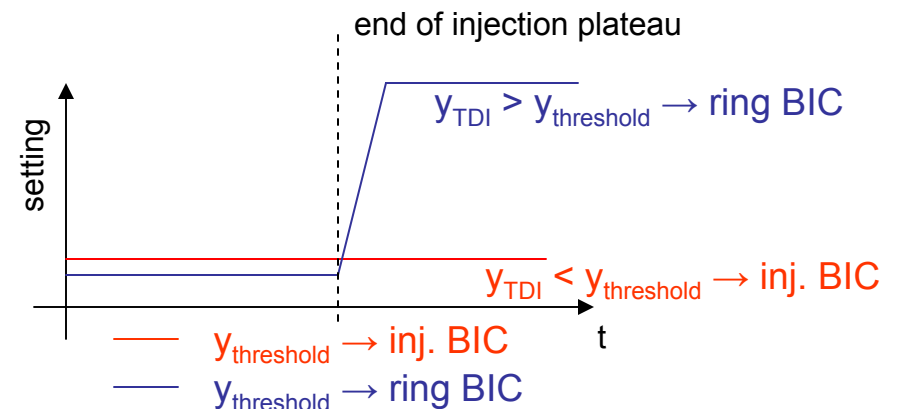
Situation in SPS: 2 x extraction permit,
LHC only one injection permit

29 Aug 2006
16:56:02

Individual Tests: Passive Protection

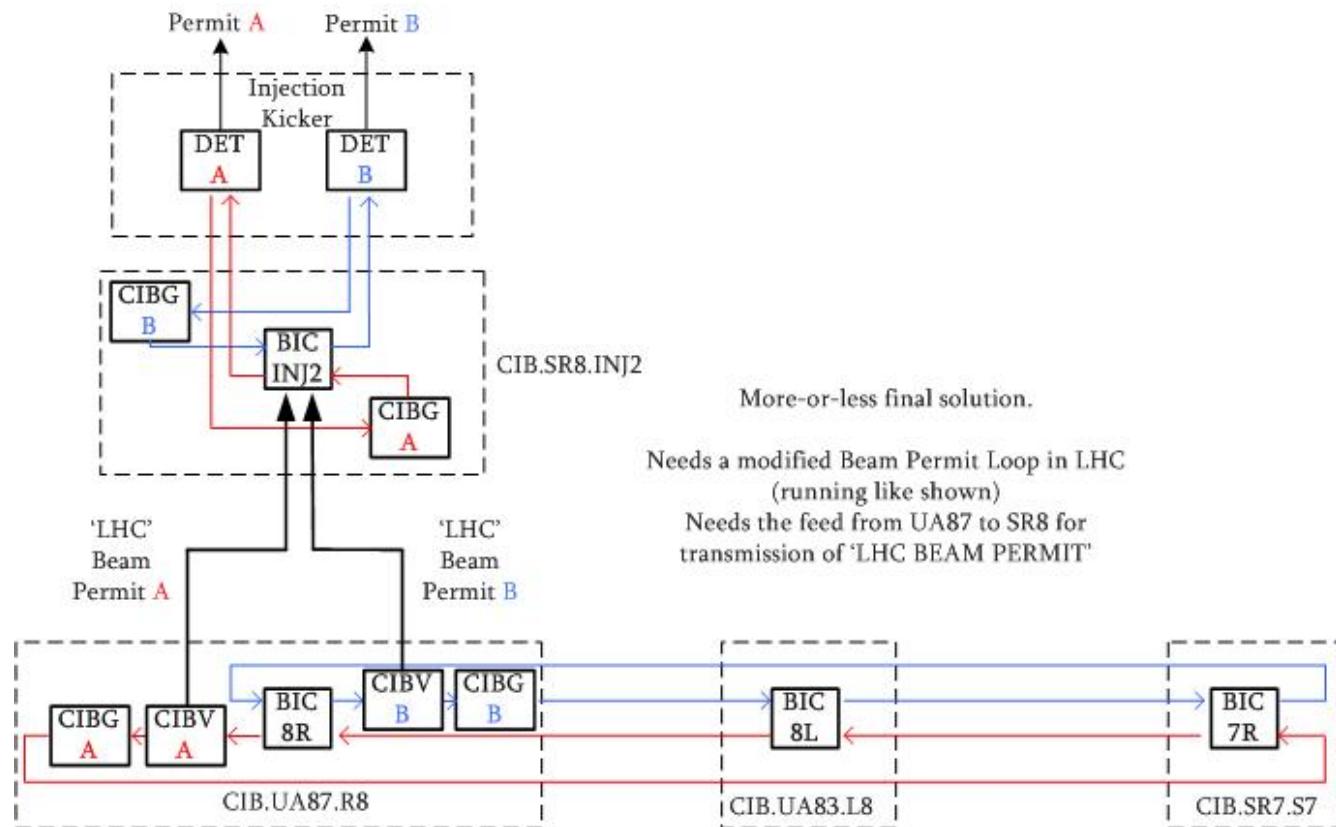
- BIC entry: collimator motor control
- Tests without beam – individual system tests:
 - move jaws beyond threshold
 - change thresholds

- TCDIs
- TDIs
 - Also input to LHC ring BIC
 - Also to be tested here?
- TCDDs
 - moveable in point 2
- TCLIs
 - Also input to LHC ring BIC



“Individual Tests”: LHC Beam Permit

- Still need to have discussion with B. Puccio and B. Todd
 - We’ll have a meeting this Friday
 - Need something similar to LBDS system for frequency detection,...



Global test: SPS Master BIC (1)

- **Have to decide: with or without beam in the LHC**
 - If 100%, then can only be carried out “very late”: phase A.3
 - Otherwise: as soon as injection BIC is ready...(fake LHC beam permit, fake beam presence)
- **Requirements:**
 - Transfer line BICs fully commissioned
 - Injection BIC fully commissioned
 - additional hardware: beam mode at BIC: 400 GeV or 450 GeV
 - SPS
 - Supercycle with CNGS and LHC (to 450 GeV)
 - with beam: SPS safe beam flag
 - 1 shift only for testing, no users
 - LHC
 - need LHC beam permit: could be faked at this stage to get true on Injection BIC – or disable?
 - Injection regions closed:
 - MSI/MBIAH in access chain
 - Beam Presence Flag:
 - Fake probably to test both possibilities

Global Tests: SPS Master BIC (2)

- Test logic of Master BICs
 - all combinations to be tested...OR logic
 - old tables in spec...need to be updated...Friday meeting

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LHC Project Document No.
LHC-CI-ES-0002 ver.1.0
CERN Div./Group or Supplier/Contractor Document No.
AB/BT
EDMS Document No.
602470

Date: 2005-07-15

Functional Specification

**INTERLOCKING BETWEEN SPS, CNGS, LHC
TRANSFER LINES AND LHC INJECTION**

Inputs	User permits			Dumps				SPS/LHC					Output		
	1	2	3	4	5	6	7	8	9	10	11	12	13	1	2
Mode	LSS6 extraction/TT60 user permits	TI 2 upstream and downstream user permit	LHC IR2 injection user permits	TED upstream 'IN beam'	TED upstream 'OUT of beam'	TED downstream 'IN beam'	TED downstream 'OUT of beam'		LHC beam permit	LHC beam presence flag	LHC safe beam flag	SPS safe beam flag	LHC beam type (timing signal)	SPS LSS6 extraction permit	LHC IR2 injection permit
1. Beam to LSS6/TT60 TED	1	x	x	1	0	x	x		x	x	x	x	x	1	0
2. Beam to TI 2 TED	1	1	x	0	1	1	0		x	x	x	x	1	1	0
3. Low intensity beam to LHC	1	1	1	0	1	0	1		1	x	x	1	1	1	1
4. High intensity beam to LHC	1	1	1	0	1	0	1		1	1	0	x	1	1	1

Defining protection settings - Verification of overall protection (1)

- **Must be part of the LHC Beam Commissioning**
 - Needs beam
 - TL optics measured: phase A.1 parasitically
- **Entry conditions**
 - LHC: aperture known
 - Transfer line: optics known
 - collimator control system
 - BLM concentration + application for LHC (SPS “done”)
 - “Study data”: triggered acquisition for losses at injection
- **TCDIs:**
 - \geq phase A.3, \leq phase A.5
 - needs BCTs in LHC: centering, alignment, set to measured optics
 - thresholds of BLMs on TCDIMs and TCDIs: requirement clean injection
 - calibration: lost particles vs. mGy
 - also on MSI

Defining protection settings - Verification of overall protection (2)

- TDIs + TCLIs:

- phase A.4: define required settings as function of measured aperture
- phase A.4: beam size @ TDIs, TCLIs; centering
 - in case reproducibility is an issue: establish beam based setting-up methods in phase A.4/A.5
- thresholds of BLMs on TDIs, TCDDs, TCLIs: should be requirement clean injection...but BLMs on ring BIC...SIS (IQC)?
- phase A.5: beam based synchronised set-up of ALL collimators
 - Collimation hierarchy: primary collimators, secondary collimators, absorbers

- Verification – simulate injection failures:

- Injection kicker failure simulated with: 2 correctors (before and after MKI): verify that arc shadowed
- Phase space coverage of TCDIs: different correctors in the lines
- ...

Issues

FLAGS...

- LHC safe beam flag toggle: how? (Friday meeting)

TDI Position - MKI

- Should make sure that TDI in “protect” as long as MKI is on
 - SEQUENCER
 - should be OK protectionwise: needs injection permit to charge

BLMs – TDI

- Will be discussed in the Friday meeting...

Different operational scenarios: e.g. polarity changes for LHCb

- Re-commissioning of all settings?