Commissioning of the transfer line interlock systems

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First ideas and questions concerning the commissioning…

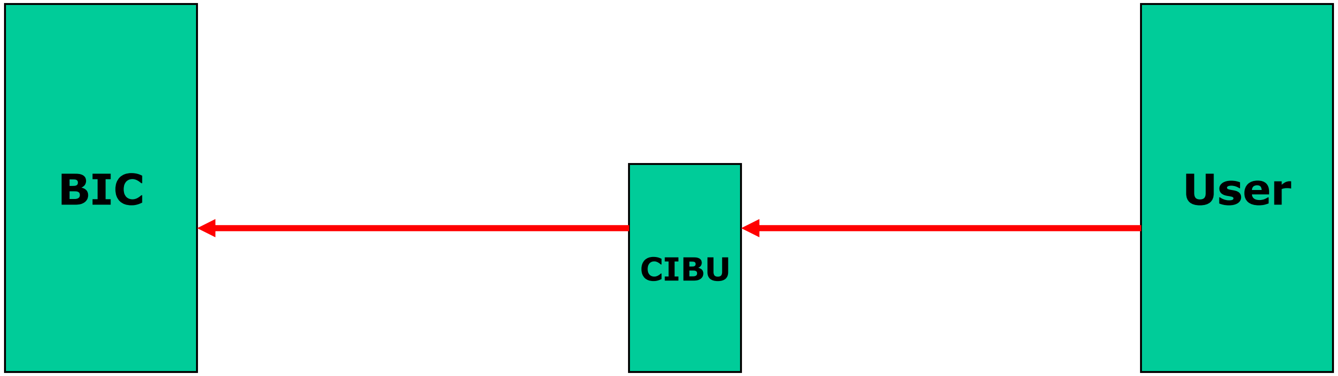
…and what has to be written for the specifications.

I will not present a list of tests, but rather discuss aspects like

- required resources (beam, timing,….)
- responsible persons
- number of tests
- questions concerning certain tests that I have defined

for the various systems that are involved, since this is an important (central) part of the specification and has implications on the organization.

BICs and Clients (Users)



First comments :

- Commissioning of CIBU & standards BIC are not within my scope.

  → refer to BIC commissioning procedures.

  Possible exception : master BIC with its complicated logic.
- The basic connection test USER→BIC must be done for all users and is separated from the actual interlock logic tests.
- Concentrate on the interlock logic tests.

Scope

So far I have not included the following systems :

- TL collimators → collimators comm. spec ????
- Protection devices like TDI → collimators comm. spec ????
- Injection kicker.

→ I basically stop at the downstream TED in TI2/8.

Test definitions

For all systems it is possible to specify tests (class A) that are usually in the form :

- Equipment is in state A – USER_PERMIT = true.
- Change to state B – USER_PERMIT must switch to false.
- Verify that USER_PERMIT switched to false within appropriate delay.
- …

Such tests can be rather well defined, but they are assuming a system that is up and running normally.

But there are tests (class B) where one does not change the equipment state as described above, but where the whole user system is checked to be failsafe (i.e. USER_PERMIT is always FALSE is such situations) :

- Stop surveillance processes.
- Unplug or reset equipment & electronics cards.
- …

It is impossible to specify such tests without in depth knowledge of the system.

And the list of tests can be very long …

→ I propose not to specify details of such tests, but to require that for each equipment the system engineer is responsible for performing appropriate tests.

The User Zoo

From now on the discussion is restricted to class A tests.

Users can be classified according to a number of criteria that constrain the tests required for the commissioning in 4D space-time.

The classifications is defined by the requirements for the USER_PERMIT generation, i.e. does the USER_PERMIT and/or its tests depend on

- timing,
    - machine timing for synchronization & triggering
    - time-stamping for delay verification…
- settings (references, tolerances, thresholds),
- beam,
- ‘nothing’ – ‘fully self-contained’.

The number of channels to test is another criteria.

User	Mach. timing	Time-stamp	Settings	Beam	Large sys.
PC surveillance	X	X	X		XX
FMCM		X	(X)	X	
WIC		X			X
MSE(T) magnet		X			
MSE(T) girder		(X)	X		
Extr. kicker	X	X	X		
Bumped beam pos.	X	X	X	X	
BLMs	X	X	X	X	X
TL beam pos.	X	X	X	X	X
Screens	X	X			X
Beam intensity	X	X	X	X	
PPDs & TEDs		(X)			
Vac. Valves		(X)			X
CNGS target		X			
CNGS horn		X			
Had. stop cooling		(X)			

(x) : rough timing information desired (~1 second ?).

Who’s in charge ?

Suggestion …

1. A ‘interlock team’ of (1 or more) responsible for the overall commissioning.
    1. Test coordination.
    2. Test documentation.
    3. Perform complicated tests involving beam, settings and timing (together with system responsible).

2. One or more responsible persons for each system → report to interlock team.
    1. Responsible for Class B tests.
    2. Responsible for Class A tests in the case of large systems.

Who performs tests…. /1

Almost all Class A tests that I have defined so far can be performed from the control room by the ‘interlock team’ since from there we have :

- Control over the equipment,
- Access to the BIC history buffers.

There is one possible exception : the FMCM (lack of remote control).

For *LARGE* systems that require no beam, no machine timing and no precise stamping, I propose that the systematic Class A tests should be performed by the system engineer who verifies that the input to the CIBU behaves correctly.

Candidate systems :

- WIC
- Vacuum system

For such systems, tests by the interlock team are limited to :

- Limited tests on randomly selected equipment to test the ‘whole chain’.
- Verification of delays (time-stamping) with BIC history buffer.

Who performs tests…. /2

For *SMALL* systems that require no beam, no machine timing and no settings, I propose to perform (or repeat in some cases) all tests by the interlock team.

Candidate systems :

- PPDs (TBSEs & CNGS shutter)
- TEDs
- CNGS target
- CNGS horn

Question :

- How accurate show we determine the delays ? ~ 1 second OK ?
- If < 1 second → need accurately stamped logging …

I propose that all other systems should be tested in detail by the interlock team since they require beam and/or machine timing and/or precise stamping.

Settings

A signification fraction of the systems require interlock settings.

I assume that the management of the settings (archiving and history) is tested.

In most cases the settings depend on the SPS cycle (and therefore also on the beam).

What level of testing do we require ?

I propose :

- Complete tests for each individual setting value are performed **for ONE cycle** to ensure that settings are applied correctly and associated to the right channel/equipment (mapping).
- For all other cycles, the test is restricted to one setting per USER_INPUT.
- Note that a priori, it is possible to develop automatic test SW for some systems, in particular PC settings – to be evaluated.

Beam tests

Two BDI systems require beam for tests and are at the same time relatively large / distributed over long distances : BLMs and BPMs (for CNGS).

For each system we want a priori to test each individual channel.

For the BPMs it is relatively easy to create small or moderate trajectory distortions and to verify that each channel is reacting accordingly.

For BLMs a test of each individual BLM implies that we must create beam loss around each of them.

- Note that the detectors are tested in the lab and the cabling is tested with a current source. This leaves the thresholds as main 'item' to test.

Question :

Do we want to test each BLM with REAL beam loss ?

Beam tests - FMCM

The FMCM must obviously be tested just with the power converter alone.

A beam test can provide very useful and quantitative information on the FMCM performance.

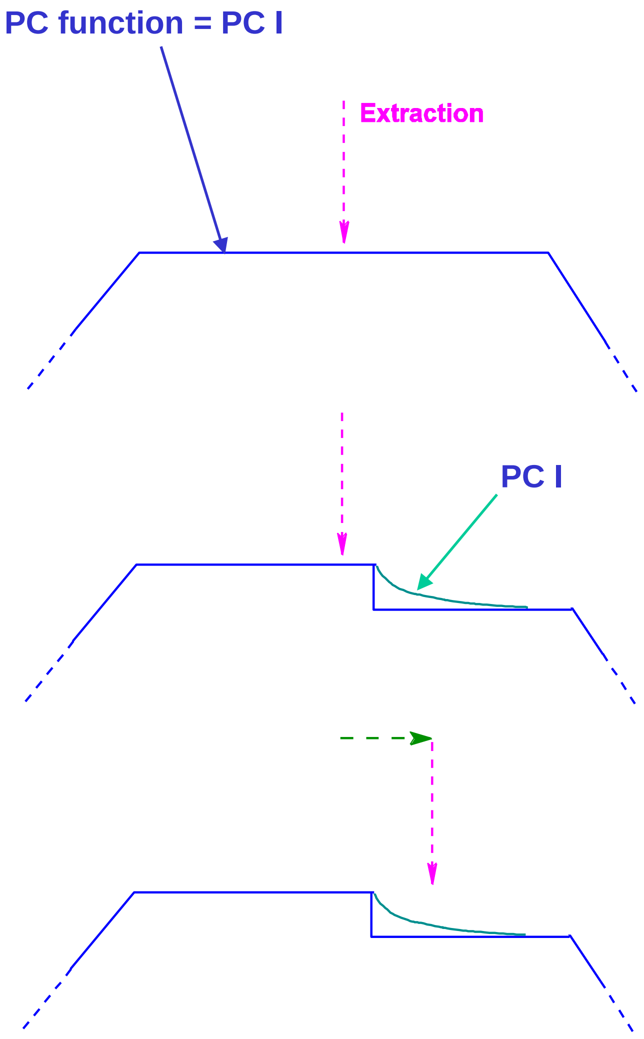
Possible test scheme :

1. Start from a normal situation – no FMCM interlock.
2. Trim a step into the PC current function after the extraction time such that the FMCM generates an interlock.
3. Shift the extraction time in steps into the region of the PC step. Record the trajectory at each step (as long as the FMCM does not interlock).

   Step size : 1 ms (timing system) / 23 μs (kicker delay)

This test determines / estimates the maximum excursion of the beam before the FMCM triggers.

Can be lengthy – but probably worth the effort !



Documentation

I have no precise idea (yet) on that point…

The documents should be in EDMS, easily accessible.

The variety of systems and tests is quite large – not obvious to find a simple solution to document all tests.

I propose a light solution to encourage people to write up the tests, including as much as possible class B tests.