Management of Critical Settings (MCS)

Summary of present thinking concerning **requirements** and **scope**

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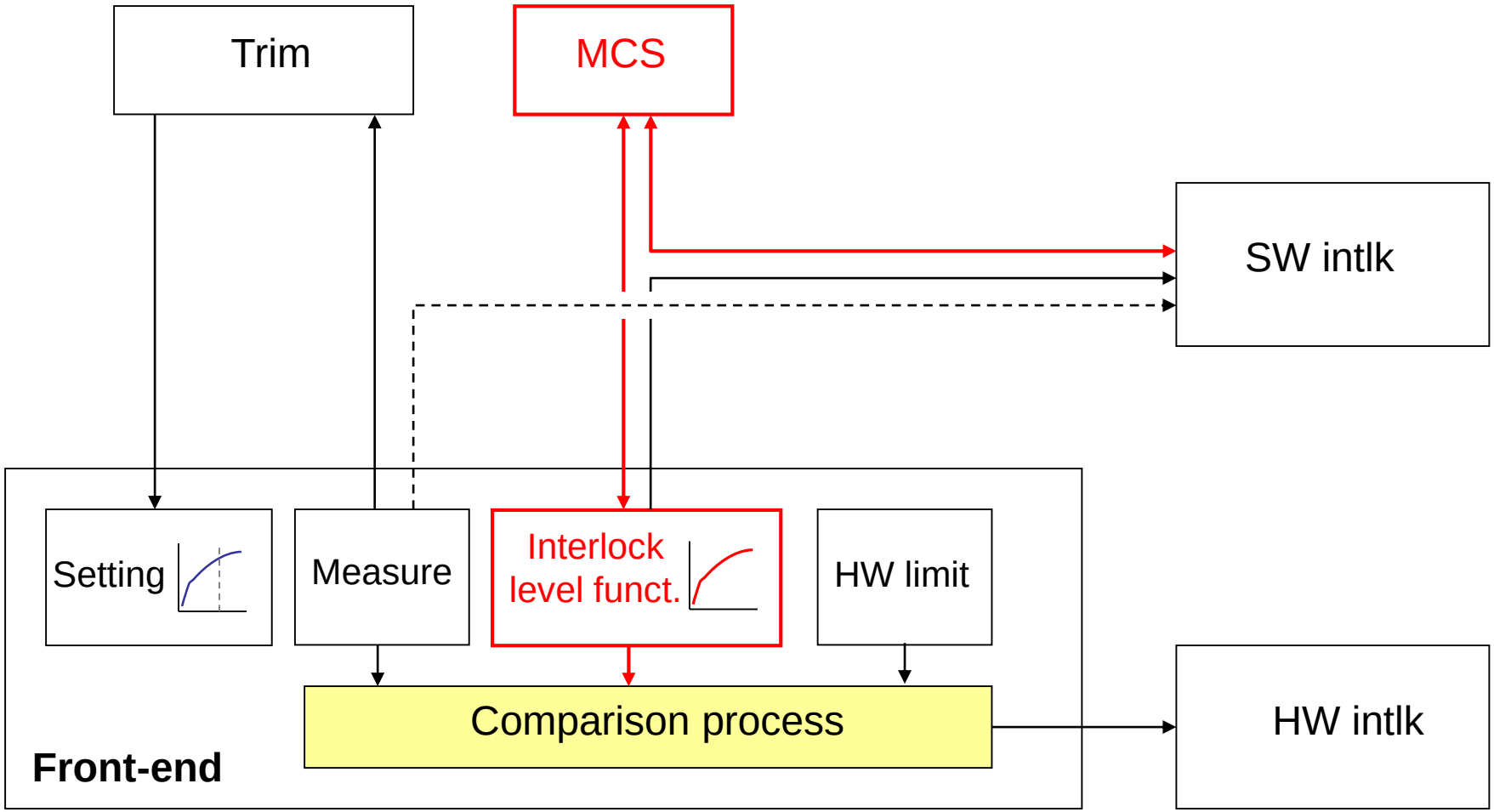
Introduction…

- Beam Interlock System to protect LHC
- For User Permit of a hardware system: **comparison** between **measured** equipment **parameter** and **interlock setting**
- If interlock setting is wrong (too high), safety cannot be guaranteed
- Interlock settings are **hard-coded where possible** and cannot be changed without local reprogramming
- For some systems interlock settings need to be changed occasionally
  - Reference position for bumped beam position in SPS BPCE
  - MKE/MKI PFN charging voltage
  - MSE/MSI current
  - BLM thresholds
  - Collimator settings
- Software needed **to manage interlock settings** of safety-critical equipment, and some parameters in a secure way → MCS.

Simple context diagram



Assume **HW limits are "hard-coded"** in equipment front-ends

General requirements for MCS

- Very well defined (and limited) scope
- “Secure” management (i.e. NOT via standard LSA TRIM functionality)
- Recording of all changes, with reason for change and person responsible

Access to MCS – Security aspects

- Modification of interlock settings via MCS restricted to minimum set of experts
  - each expert can only modify a subset of parameters
  - individual logins
  - requirement of additional signatures

- Bypassing the MCS **must not** be possible
  - Interlock settings which will be managed by the MCS should not be modifiable in any other way.

  - E.g. **public key digital signature**: MCS signs data with private key, equipment only accepts data being signed correctly (check with public key).

Required Functionality

- Provide **repository to store interlock settings**
- **Manage changes of interlock settings** for different machine configurations in a secure way and record all changes with reason and person responsible
- **Send interlock settings** to hardware
- After sending, **read back interlock settings from hardware**, compare with database, log results of comparison and **generate a software interlock in case of error**.

Cycle and Configuration Aspects

Systems might be sensitive to changes of LHC configuration or SPS cycle → different interlock settings

- **LHC configurations**: ion run, proton run, TOTEM run, different polarities of experimental magnets,…
- **SPS cycles**: CNGS, LHC,…

- SPS: fast cycling → settings for all different cycles resident in front-ends
- LHC: MCS only sends **one** set of interlock settings for the current configuration

Interlock Setting Functions…

For some LHC systems interlock levels change during a fill according to LHC mode, energy, β^* or time…e.g.:

- TCDQ jaw positions (for asynch. dump protection)
- Collimator jaw positions (for aperture limit definition)
- LHC beam loss levels

→ MCS manages, stores, sends and reads **interlock setting functions**

Examples:

- collimators and protection devices: interlock setting functions of
  I. energy and β^*
  II. conventional “FGC + timing” (or equivalent) approach

- LHC BLMs: energy input to generate interlock setting at front-end

Expected Frequency of Use

MCS should only handle key machine protection related interlock levels and parameters

- limited functionality
- restricted to only these machine elements

The interlock settings should only be modified infrequently during

- initial commissioning
- setting-up
- recovery from interventions
- machine stops
- …

<u>For the LHC:</u>

MCS will send down and check interlock settings from the repository **before every LHC fill**

- to minimize risk of data corruption due to re-boot of front-ends,…

Could be locked afterwards:

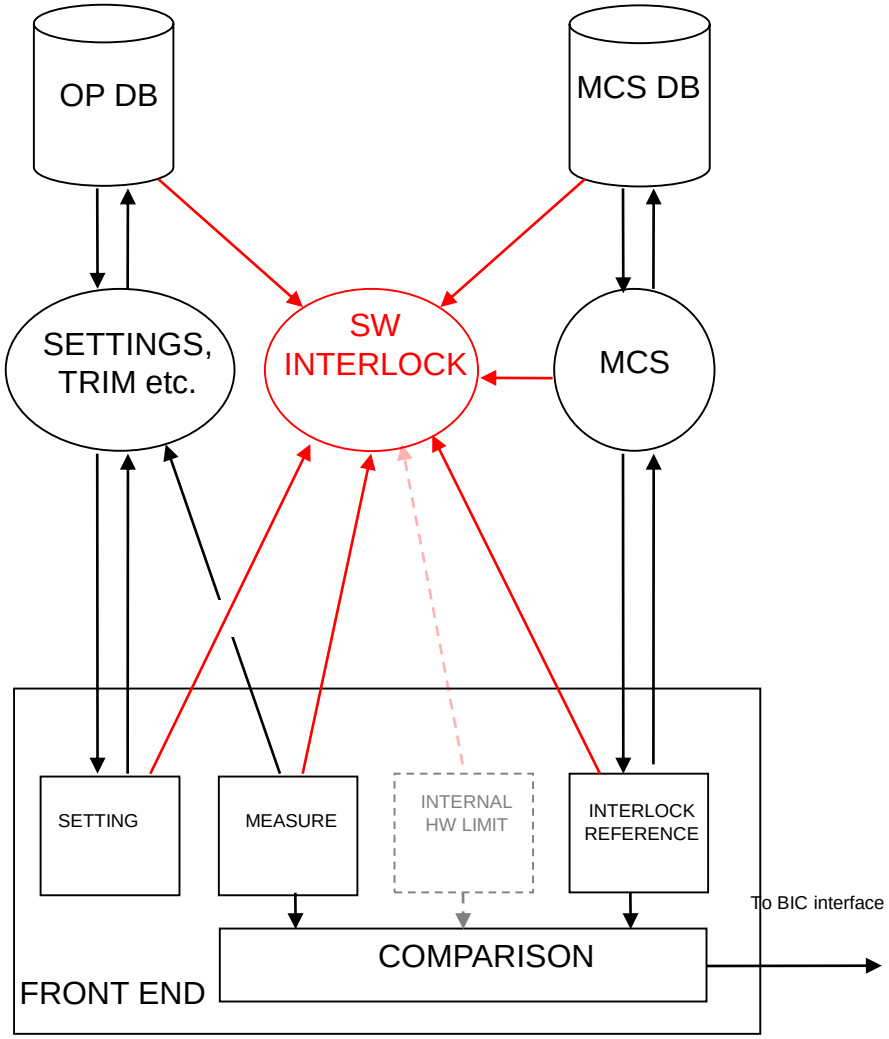
- e.g. requirement of “no beam/extraction permit” for sending.

MCS & Software Interlocking System

The **software interlocking system** will **periodically compare** the interlock settings between the **values** in the equipment **front-ends and the MCS.**

To provide additional protection against

- data corruption
- uncontrolled access and modification of settings directly inside the front-ends



Equipment Systems Concerned (1)

- **Movable protection devices and beam cleaning collimators**
  - functions of energy and β^* or timing
  - normalized or absolute interlock settings

- **Warm magnet ROCS surveillance**
  - in the SPS and transfer lines
  - different interlock settings resident in front-ends for different SPS cycles

- **SPS extraction septa girder position**

- **Kicker magnets**
  - charging voltage, kick delay and pulse length for
    - MKE
    - MKI

Equipment Systems Concerned (2)

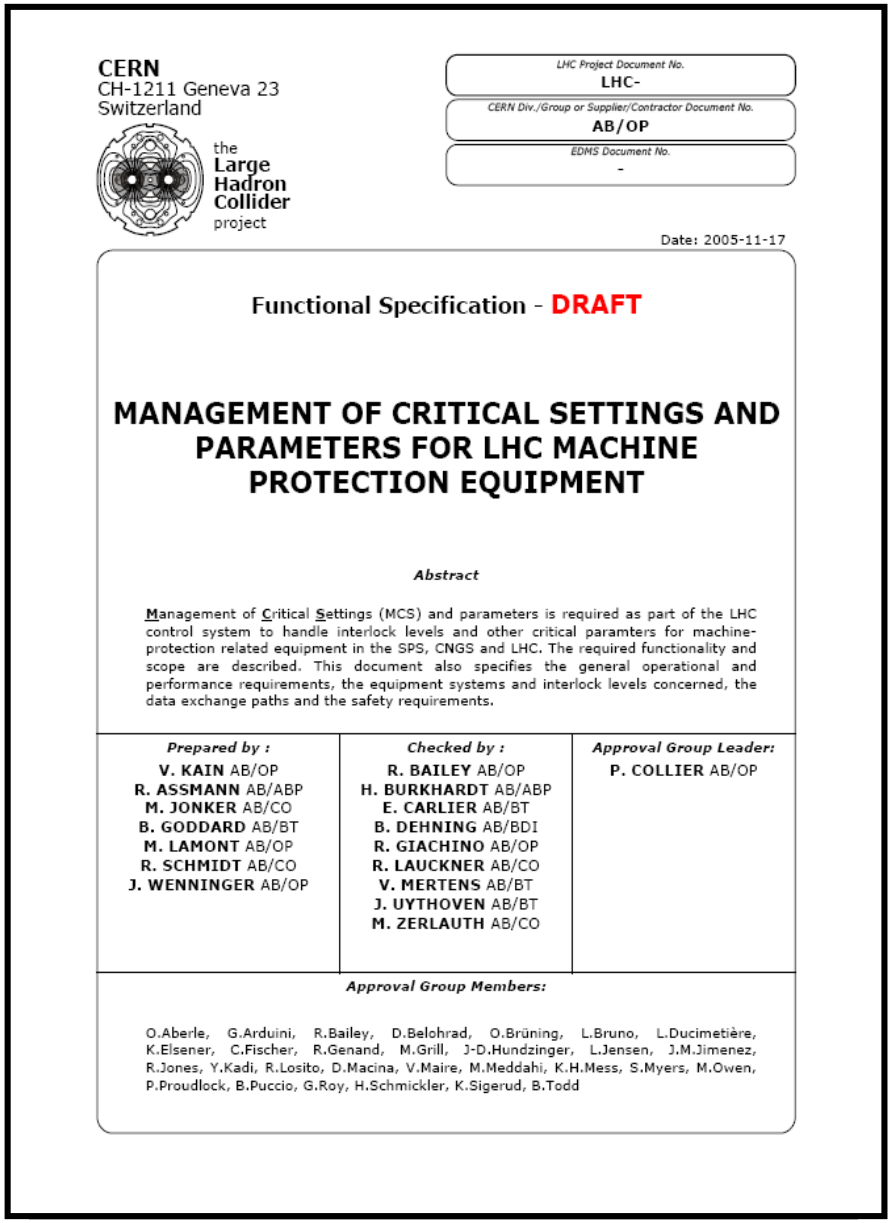
- **Beam instrumentation**
  - BPCE418/618: bumped beam position in SPS extraction region. LSS4: different settings for CNGS and LHC
  - Beam excursion in IR6: orbit in beam dumping region
  - BLMs:
    - transfer line: interlock inhibits next extraction
    - LHC: interlock settings depending on integration time and energy. Management is not yet completely defined.

- **RF**
  - The frequency offset limits will be managed in the MCS.

- **LBDS XPOC**
  - BLM readings, BPM trajectory readings, abort gap monitor readings, etc. are compared to references to verify the integrity of the dumping process and allow the next fill.

Summary & Outlook…

- MCS is a key element of the machine protection system
- MCS manages interlock settings and other parameters in a secure way
- Its effective use will depend on software interlocking system and sequencing
- A functional specification is being prepared
- Implementation issues to be addressed now
- First version of system should be ready for the 2006 SPS extraction-, transfer and injection tests.



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Functional Specification - DRAFT

MANAGEMENT OF CRITICAL SETTINGS AND PARAMETERS FOR LHC MACHINE PROTECTION EQUIPMENT

Abstract

Management of Critical Settings (MCS) and parameters is required as part of the LHC control system to handle interlock levels and other critical paramters for machine-protection related equipment in the SPS, CNGS and LHC. The required functionality and scope are described. This document also specifies the general operational and performance requirements, the equipment systems and interlock levels concerned, the data exchange paths and the safety requirements.

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