

# Summary of 4<sup>th</sup> LHC-CP Workshop

## Session 4 & 5 : Hardware Commissioning



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AB Seminar  
19 June 2003

## Sessions aim & presentations

**AIM** → Control of systems involved with Sector Commissioning from 2005 on.

### PRESENTATIONS

#### Session 4

- |                                |            |
|--------------------------------|------------|
| P1. Introduction               | R. Saban   |
| P2. Sector Temperature Control | E. Blanco  |
| P3. Vacuum                     | I. Laugier |

#### Session 5

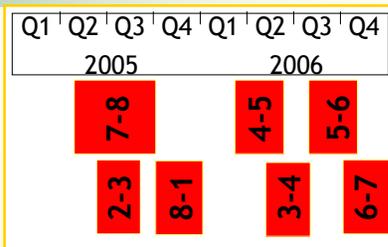
- |                        |            |
|------------------------|------------|
| P4. Power Converters   | Q. King    |
| P5. Quench Protection  | H. Milcent |
| P6. Machine Interlocks | B. Puccio  |

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## P1: Introduction

### Sector h/w commissioning

- resources ubiquity.
- sector order / time to be revised.
- AB/OP deployed for h/w commissioning.



### H/w commissioning phases

- Individual System Tests:** qualification for operations of individual systems of a sector (vacuum, cryogenics, QPS, interlocks...)
- Sector hardware commissioning:** each sector commissioned as a whole, up to the powering to nominal current of all circuits.

Parts of control system can profit from individual system test scheme.

**YES!**

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## P1: Introduction - cont.

**Hardware Commissioning WG** { Started in April '03.  
Organised as sub-groups meeting sequentially.

### HCWG : the mandate

Analysis & design  
↓  
Work in the field

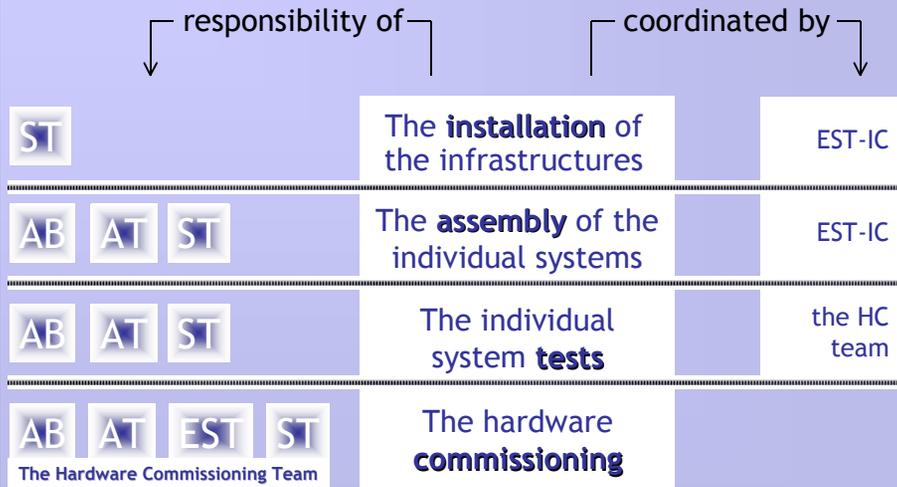
group  
team

- defining the commissioning programme
- coordinating the tests for the qualification of the individual systems
- following-up the preparation work of the assemblers and the specialised teams checking their systems
- carrying-out and coordinating the hardware commissioning
- carrying-out validation and specific studies on the first commissioned sector
- bridging between hardware commissioning and operation with beam

Roberto Saban, EST Division 1 Hardware Commissioning - CP Workshop - June 13, 2003

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## the rôles during installation & commissioning



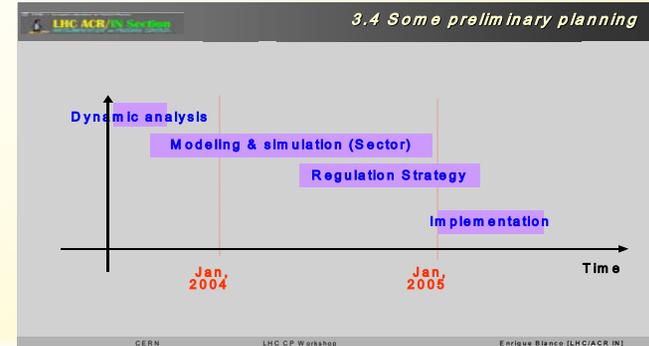
Roberto Saban, EST Division

Hardware Commissioning - CP Workshop - June 13, 2003

## P2: Sector Temperature Ctrl

**Aim** → to keep LHC superconducting magnets temperature constant under strict operating constraints.

- ❖ **Complex system dynamics** (highly non-linear, inverse response...). Control: one loop/cell. **Model-Based Predictive Control** + PID.
- ❖ **Coupling between cells** → Sector more complex than String.



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## P3: Vacuum

- ❖ Local control during commissioning + leak detection, mobile equipment (pumping group + PLC).

### Vacuum Milestones

QRL Installation	21/07/2003
QRL Insulation Vacuum (tests)	1/10/2003
QRL Insulation Vacuum (commissioning)	11/11/2003
Magnets Insulation Vacuum (tests)	01/06/2004
Magnets Insulation Vacuum (commissioning)	01/06/2004
Beam 1 & 2 Vacuum (tests)	01/06/2004

### Control Milestones

Racks, Cables, UPS	21/07/2003
Ethernet in UJ76, RE78, RE82& UA83	21/07/2003
PVSS Server	21/07/2003
Alarm, logging & Interlocks	11/11/2003
Wireless Ethernet in the tunnel	?

13/6/2003

I. Laugier AT/VAC

13/6/2003

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## Conclusion

- All the vacuum system for sector 7-8 will be under control in due time!
- Our first experience with SPS will be used.
- For us, nothing really new!!!

LHC-CP Workshop: Vacuum control System

13/6/2003

I. Laugier AT/VAC

## P4: Power Converters

### H/w commissioning

- 1712 Power Converters
- First sector 7-8: Q4 2004
- Last sector 1-2: Q4 2006



3.5 converters /working day to test, transport, install, integrate with services & commission.

### H/w access

- Local** (serial interface + PC )
- Remote** (WorldFIP & Gateway).

### Aim

To run self-tests, calibration, observe, diagnose & correct faults.

- ❖ Big investment in remote diagnostics: Diagnostics Interface Module.
- ❖ Circular buffer + trigger freezing memory contents + timestamp.

**Demonstration:** lab system remote access & operation.

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## P5: Quench Protection

**QPS: AB/CO-AT/MEL collaboration.**

### H/w components

- Controller:** WorldFIP agent.
- Gateway:** LynxOS on VME/PC (**TBD**). Must be ready for surface tests by 01/2004.
- Supervision:** **TBD** by 07/2003.
- Interface with Alarms/Logging/PM :** **TBD** in which layer, must be operational by 06/2004.

**Surface tests:** starting early 2004.

**Tunnel installation:** from June 2004.

**H/w commissioning:** April 2005 (+ Controls "shopping list")

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## Conclusions

- Design of on-the-field controllers has been completed
- Design of the architecture layout has been done
- Milestones are defined and known by AB/CO through the TC
  
- No major showstoppers but time/resources are limited
- Project still on-time but not a lot of "marge de manœuvre"

## P6: Machine Interlocks

**Interlock Systems: Beam / Powering / Warm magnets.**

### BEAM

- 16 Beam Interlock Controller. Response time ~ 10  $\mu$ s.
- H/w control ("Matrix"), s/w supervision.
- **TBD:** **a)** Interface Client / BIC; **b)** Interfaces with Logging / Alarms / PM; **c)** Architecture (3-tier).

### POWERING

- 36 Power Interlock Controller. Response time ~ 10 ms.
- Siemens PLC platform.
- **TBD:** **a)** Interfaces with Alarms / Logging / PM; **b)** S/w Interfaces with Cryo / QPS; **c)** NTP time stamping.

### WARM MAGNETS

- LEP-like principle, Siemens PLC platform.
- **TBD:** **a)** Interface with Supervision; **b)** Interfaces with Alarms / Logging / PM.

## Hardware Commissioning

### Beam Interlock:

- ◆ Dedicated Beam Interlock commissioning could be partially done.
- ◆ Two phases:
  - 1) Single test for client/BIC interface
  - 2) Before injecting beams: mandatory test of the whole system with all Interlock clients and the closed Beam Permit Loops.
- ◆ Strategy discussed into MPWG ⇒ Sketch proposed to HCWG

### Powering Interlock:

- ◆ "PIC test system" for Q4/03
- ◆ Tests procedures "similar as" the String2 one
- ◆ Commissioning dates according HCWG schedule

### Warm Magnets Interlock:

- ◆ Procedure & dates must be discussed in the HCWG...

LHC CP-4 Session 5.3 on Hw Com<sup>9</sup>: Machine Interlocks

## Conclusions & outlook

- ❖ Controls infrastructure needed at any step during commissioning

**BUT**

- ❖ Controls is a system *per se* → needs commissioning time!

⇒ **An AB/CO commissioning WG to be started.**

- ❖ Requirements for AB/CO are clear & known.
- ❖ Decision for parts (interfaces, implementation choice...) of some systems still **TBD**.

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