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# **Upgrade, IST and Powering tests of the PIC and FMCM systems**

I. Romera on behalf of TE-MPE-MS

# Outline

- **PIC**
  - Main upgrades and consolidation activities
  - Commissioning campaign
- **FMCM**
  - Main upgrades and consolidation activities
  - Commissioning campaign
- **Resources**



# Powering Interlock System PIC



# R2E consolidation

- Relocation of 9 out of 36 PICs to UL14/16 & USC55
- Cabling campaign:
  - Well coordinated and executed on time by EN-EL
  - Interlock cables connecting main clients (PIC-QPS-PC) were fully validated in the course of an IST campaign
  - Few cabling errors discovered were fixed on time
- Planning:
  - No constraints and enough time allocated
- Re-installation:
  - Carried out by Jean-Louis and Yan, being a good hands-on training for Yan
  - Yan is currently the only technician with enough expertise on the PIC to intervene in case needed
- Changes in Layout and Logging DB well prepared and anticipated (ECR 1306496 )



PIC installation in UL16

# Access vs Powering

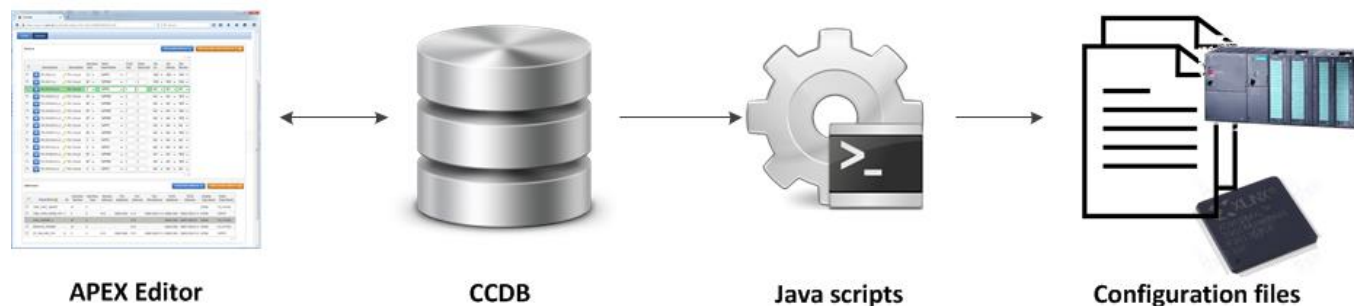
- New system to **increase dependability of access interlocks vs powering** of magnet circuits (used during commissioning and operation)
- PLC-based system as **interface between LASS and SIS**
- **ECR released**: “Change of the interlocking of Powering and Access Systems”
- Lengthy process to get the change **approved by the CSAP and DSO**
- **Excellent collaboration between different groups:**
  - **GS-ASE**: Dry-contacts providing status of access conditions
  - **TE-MPE**: PLC-based system and FESA class (summer student project 2013)
  - **BE-OP**: Interlock logic implementation in SIS
  - **EN-ICE**: Controls integration in PIC SCADA
- **System installed and fully operational since May 2014**
- **Commissioning completed during the DSO tests and successfully operating during the Powering Tests**



Access Powering Interlock

# Controls consolidation

- Main goal is to **improve the long-term maintenance** of the system (in view of future installations: SM18, FAIR?...)
- Full **review of the SCADA** application by EN-ICE (**lengthy process but still ready for the HWC => new engineer responsible of the control system**)
- Consolidation of our **configuration management system to remove our private controls configuration DB and achieve more self-control over the full configuration process**
- CCDB integration + APEX editor + Java scripts in collaboration with BE-CO



Flowchart of Configuration Management System

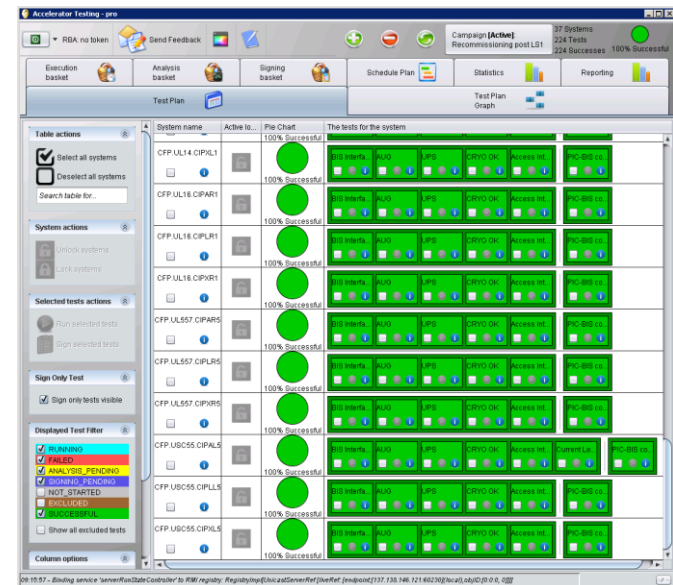
# Powering Tests

- More than **5000 PIC tests** executed during the HWC campaign
- **Joint effort with EN-ICE invested in automation paid-off, however existing implementation is far from being ideal (more than 1000 tests signed manually).** Main reasons:
  - Automated analysis on main circuits deliberately disabled by default
  - **TE-MPE:**
    - Lack of documentation on **how to handle new QPS classes** led to insufficient time for testing new Labview modules
    - **Timing issues and missing QPS buffers** led to continuous failures on the automated analysis in the early commissioning phase
  - **EN-ICE:**
    - **Issues to retrieve signals from Logging DB** even if interlock signals present in the DB
    - **Slow response on logging data extraction** made the signing process lengthy
    - **Issues to communicate with ACC\_TEST** (impossibility to retrieve the correct test type)
- **Automation is vital => Test validation ensured by 1 engineer (available 16h/day during ~ 4 months + involved in other activities)**



# Additional MPS tests

- Main objective was to **validate the interface with the BIS**
- **Electrical tests of 32 CIBUs** carried out at the end of the powering tests => **thanks to the BIS team for their availability!**
- **Functional tests** to validate fault propagation from individual circuits to the BIS
- **PIC configuration reviewed** (e.g. ROD/F as MASKABLE inputs to the BIS)
- **New automated sequence integrated in ACC\_TEST that allowed the automatic execution and validation of ~1000 tests (in collaboration with BE-CO)**
- **Conditions for the test are very difficult to achieve due to cross link between sectors => To be improved in PIC v2.0**






# Validation of UPS distribution network

- Test campaign to **validate the redundant UPS power distribution** for the LHC equipment systems (**successful collaboration with EN-EL**)
- **Test procedure on EDMS (1405966)** released prior to the test campaign
- **Tests revealed important non-conformities on MPE systems and other MP systems across different departments:**
  - **BIS:** Controller in TZ76 powered by a single UPS network
  - **PIC:** Controllers in UL557 and TZ76 powered by F4 network (Required action by EN-EL)
  - **QPS:** About 30 non-conformities found. Some equipment not ready for the tests...
- **Full report available on EDMS (1505860)**
- This task was **not planned ahead LS1** and took **many weeks of full time work**

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EDMS NO. <b>1505860</b>	REV. <b>0.1</b>	VALIDITY <b>DRAFT</b>
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 **LHC**

REVISIONS  
**LHC-ED-TR-0001**

Date: 2015-09-21

**TEST REPORT**

**Validation Results of Redundant UPS Power Distribution for LHC Equipment Systems after LS1**

**A B R E V I A T I O N S :**

This document describes the outcome of the test campaign carried out to validate the correct powering of the critical users' equipment fed by UPS and to ensure that machine protection is not compromised even when using a complete redundant power distribution network.

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# Fast Magnet Current Change Monitors

## FMCM



# Main activities

- **Controls upgrade**

- Full renovation of the existing control system in the SPS – Transfer Lines
- A new BE-CO standard solution chosen to replace the obsolete ROCS-MUGEF
- 4 Kontron computers in charge of providing controls to 9 FMCMs in BA4, BB4, BA6 and BA7
- Cabling installation well executed by EN-EL and IT-CS
- New communication driver (BE-CO) => several iterations to get it working on Linux OS
- FESA layer upgrade for Linux OS (MPE-MS)

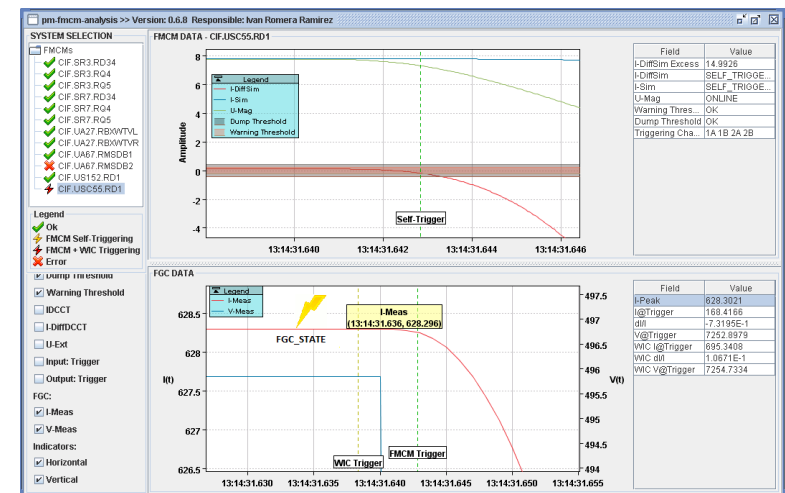
- **R2E relocation**

- 1 FMCM relocated from UJ56 to USC55
- Cabling campaign well coordinated and executed
- Joint effort with EPC for development of new D1 converters
- Infrastructure ready but PC will only be installed later...



# Commissioning

- **26 monitors installed** in the LHC and SPS – Transfer Lines
- **Electrical tests** of CIBUs => **Well planned in advance with BIS team**
- **Tests without beam**
  - **Validation of dump thresholds** and correct propagation to the BIS (with LHC-OP)
- **Tests with pilot beam (currently in progress)**
  - Validation of **correct trigger and propagation to BIS** at 450Gev and 6.5TeV (EOF)
  - Verify **beam excursion and beam losses** observed before going to high energy beams
- **Good knowledge transfer to OP**
- **Test tracking integrated in ACC\_TEST**



# Resources

- **1 Engineer (also involved in other activities...)**
  - PIC shifts during the CSCM / Powering Tests
  - MP3 shifts during Powering Tests
  - Coordination of redundant UPS power distribution network
  - Involvement in SW activities (PM modules for MPS, configuration management, ...)
- **2 Technicians**
  - Installation and technical support
- **Support from the MPE-MS / Software team for software projects**



# Summary

- **What worked**
  - Good preparation and planning
  - Documentation of changes + ECR ahead LS1
  - Implementation smooth and correct
  - Improvements in automation
- **What could be improved**
  - 1 engineer responsible for all activities
  - Double load with MP3/PIC shifts
  - PIC automated analysis only worked in 2/3 of cases

