LHC Vacuum Supervisory application updates during LS2

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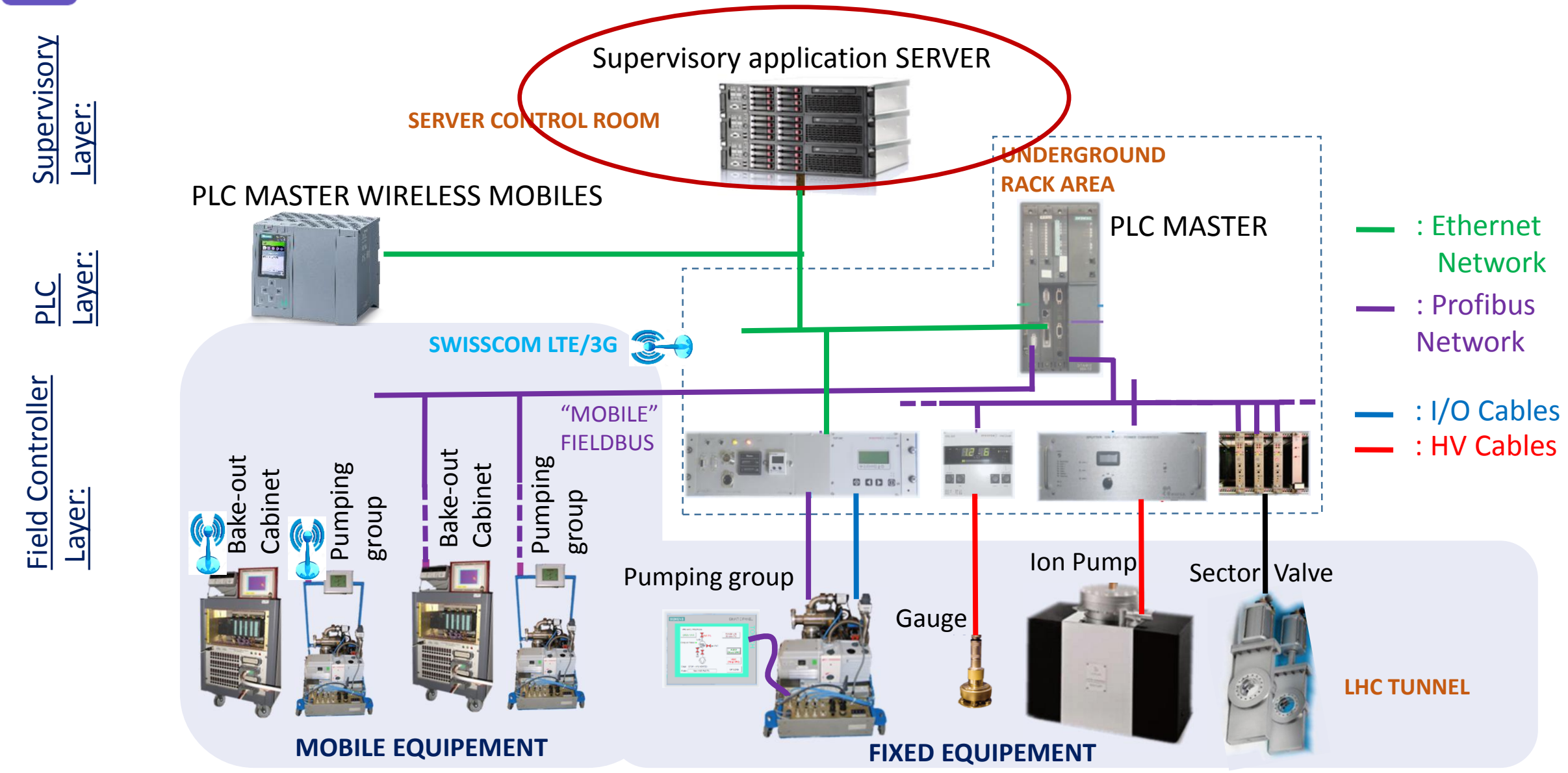
Introduction: Vacuum controls architecture

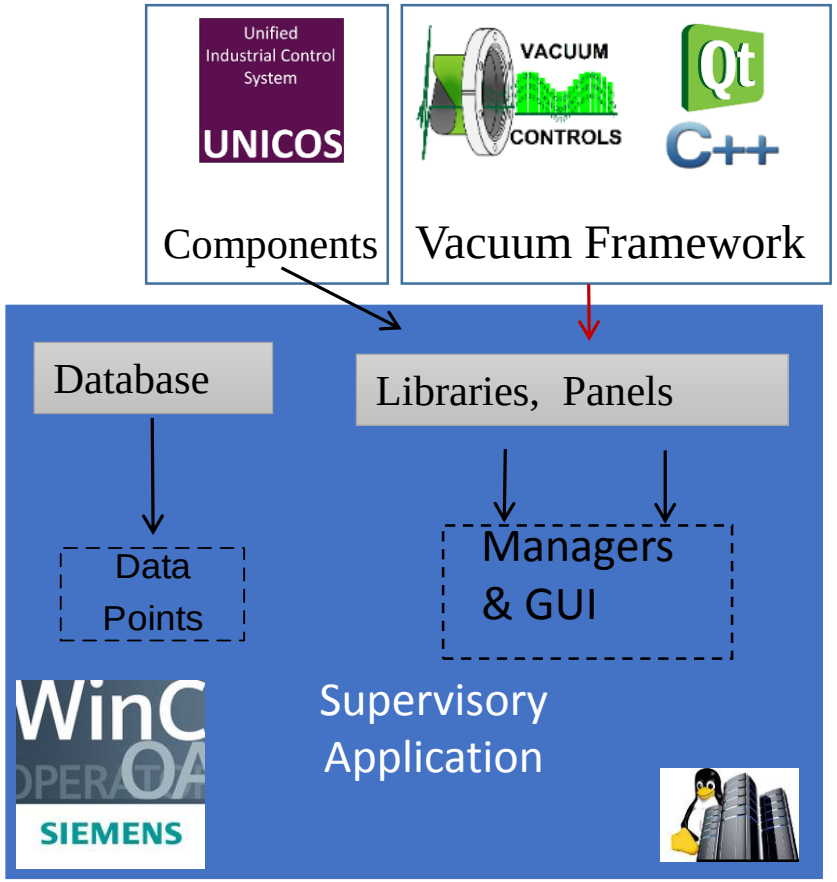


Introduction: Vacuum supervisory application

- What are all these acronyms you may have heard/read?:
  - PVSS: old product name from ETM gmbh
  - WinCC OA: new product name after SIEMENS bought ETM
  - **SCADA**: generic name

« Supervisory Control And Data Acquisition »

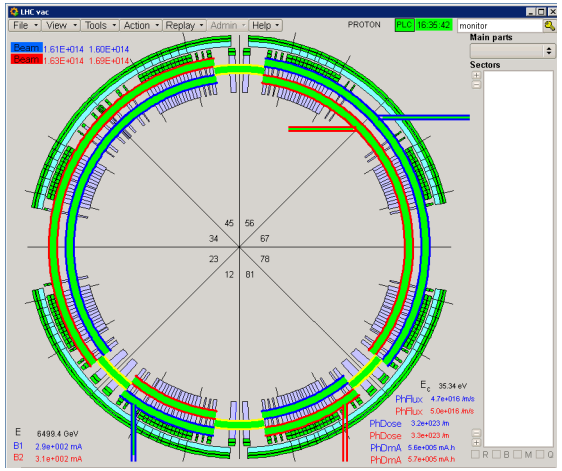
- What is the vacuum SCADA application?:
  - Siemens commercial product with on top:
    - Dedicated managers and drivers developed by Siemens for CERN
    - Unicos Components
    - Vacuum Framework



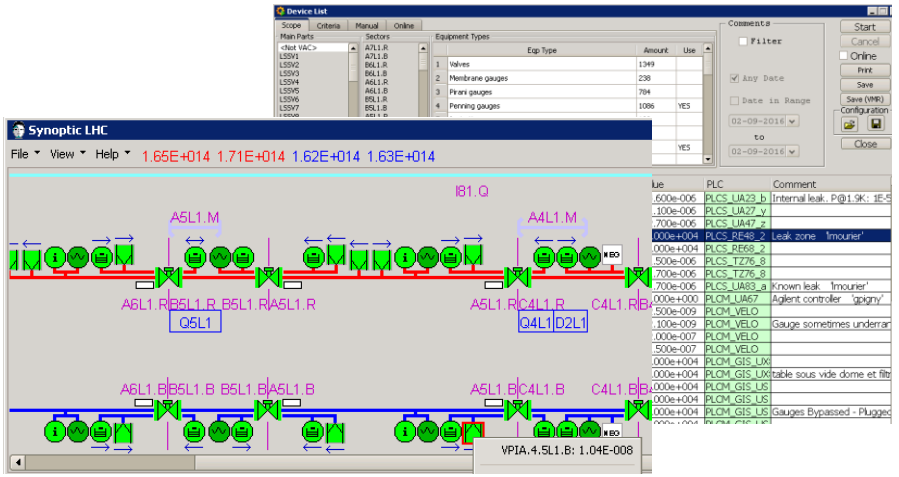
Introduction: Vacuum Supervisory application

Control And Data Acquisition

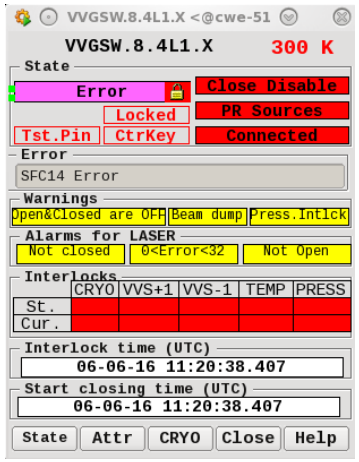
It is more than a supervisory application: The swiss army knife for the vacuum control system.



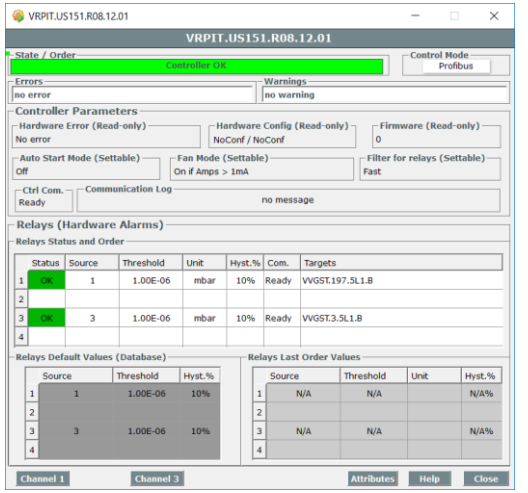
Final State view



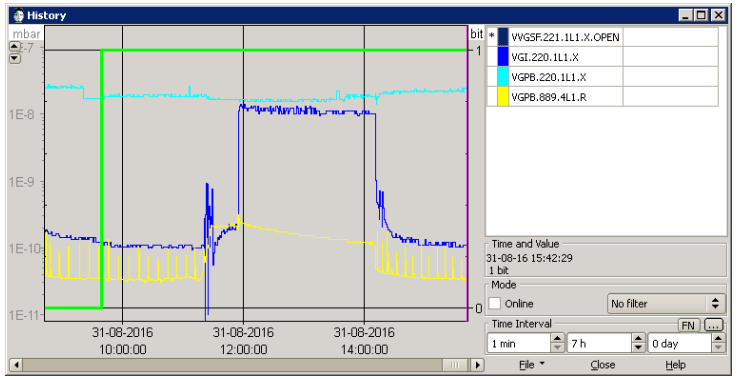
Monitoring



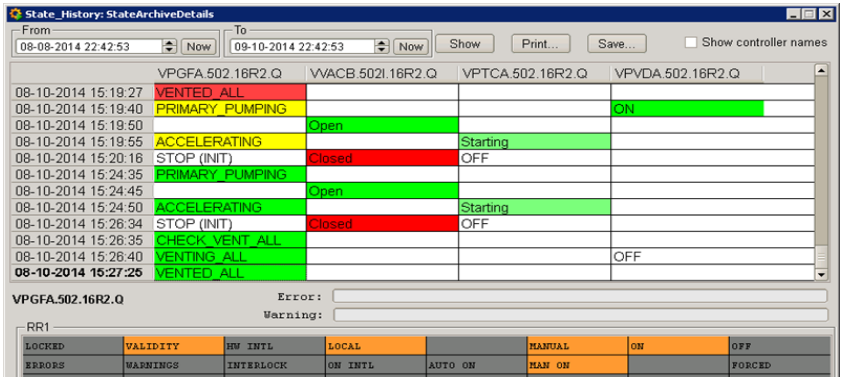
Remote Control



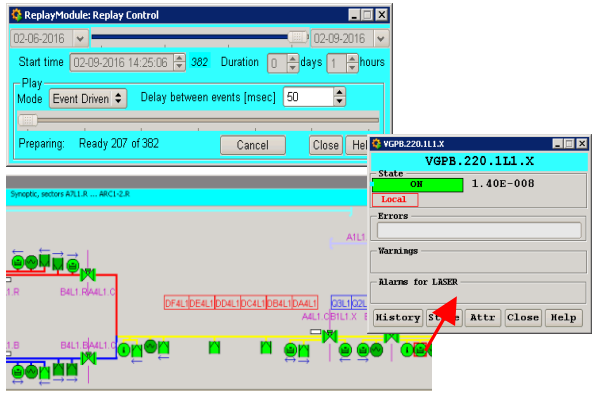
Parametrizations



Archiving & Trending



Diagnostics



Replay

...

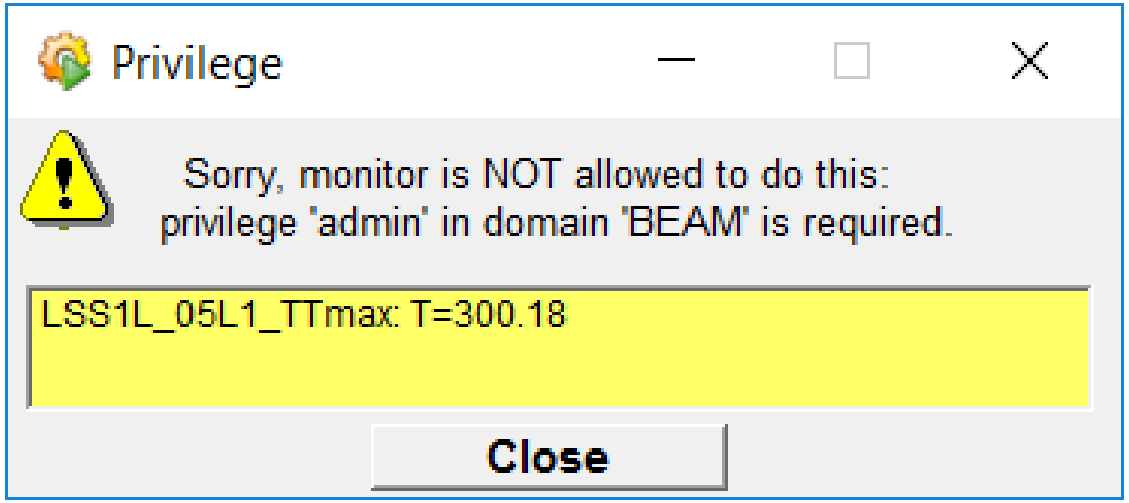
Access Control: Safety first

In control systems, safety is first a matter of a hardware design, installation and procedures (connectors, cabling, controllers, PLC processes, lockout procedures…). This is out of the scope of this presentation.

We will mention another aspect of safety related to the supervisory application :

Access Control

Why you get the below message?



Access Control: Domain and Privilege

Most boring slide

Access Control is managed using:

Domain: Classification to group devices that are operated by a dedicated group of users.
Domain is related to a system (or sub-system), an area, a device type (or a group of device types) or a mix of previous.
Example:

- "BEAM" domain for the generic devices installed on Beam vacuum,
- "NEG" domain for NEG controller devices.

Privilege: Level of "accreditation" to operate a device, in the vacuum supervisory application there are 4 levels:

- monitor (access to diagnostic features, no action)
- operator (basic actions)
- expert (advanced actions)
- admin (critical actions)

Access Control: Privileges

Most useful? slide

ACTIONS	PRIVILEGE LEVEL REQUIRED
Instrument switch on/open or off/close Process start/stop	operator
Process setup and mode change	expert
Instrument force on/open	expert
Instrument block off and release block off	admin
TPG300 and Ion Pump controller parameters (**VVS Interlocks**)	admin
Ion Pump switch on when **Beam info**	admin
VVS Open Order at **Cryo Temperature > 5K**	admin
VVS Open Order when **Access Zone state is "ACCESS"**	admin
VVS Close Order when **Beam info**	admin

Static

Dynamic

Block off order is a Remote order disable, it blocks only any remote order from SCADA,
it **does not guarantee the instrument is not powered** and it **does not avoid any local actions**

Access Control: Group of users

Groups of users:

- insulation
- piquets
- beam
- SY/BI LHC experts

Domains&Privileges:

INSULATION
- operator → Switch ON/OFF
- expert → Force actions

BEAM
- operator → Switch ON/OFF
- expert → Force actions

INJECTION
- operator → Start/Stop
- expert → Setup

Actions:

Updates: Why?

You may have received the below e-mail, what is behind this email?

To: Vacuum-Controls-Users-LHC (Users of the LHC Vacuum Control Systems) <Vacuum-Controls-Users-LHC@cern.ch>
Subject: [LHC] Vacuum Controls update: MONDAY (3rd February 2020)

Dear Colleagues,

An update of the LHC Supervisory Application and its PLCs is scheduled on Monday, the 3rd of February 2020 at 9am.

LHC VACUUM CONTROLS UPDATE:

**

Purpose:

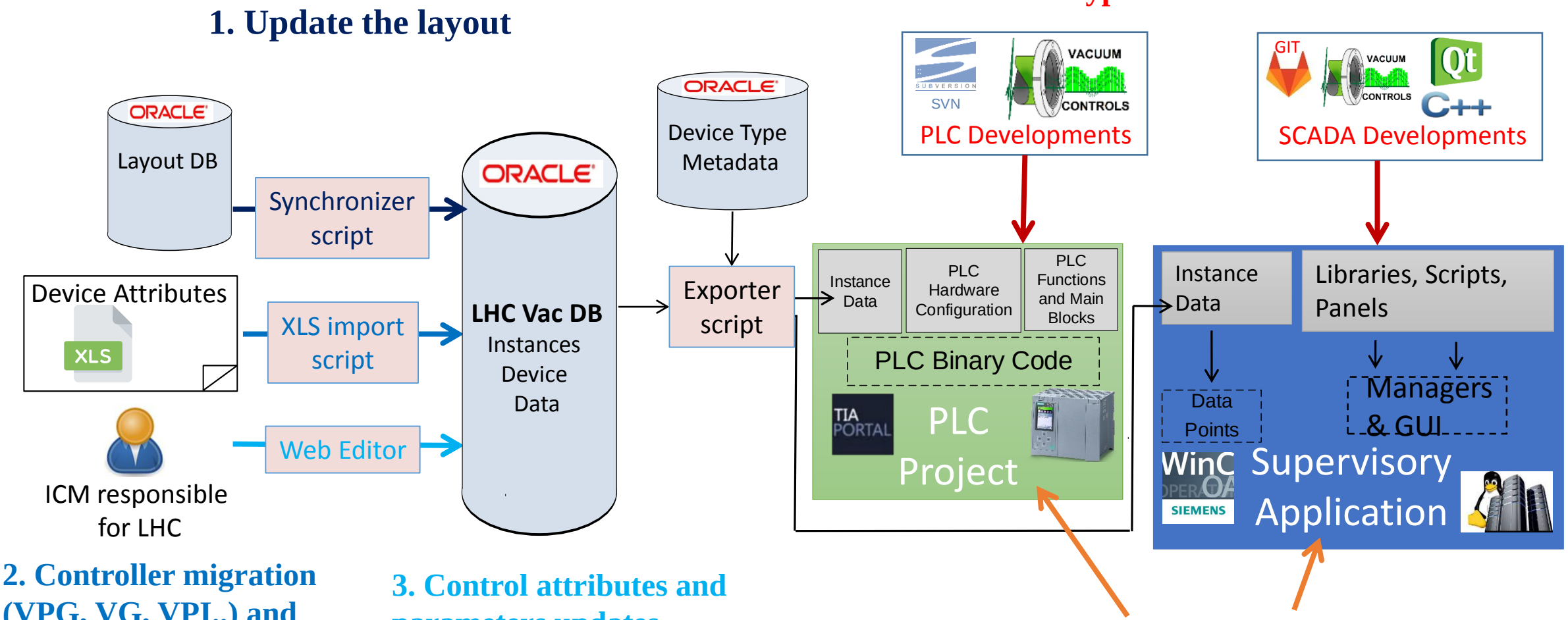
- INSULATION VACUUM - Octant 5-8: New controls for pumping groups, I/O gauges and Cryo Alarms
- INSULATION VACUUM : New VPG Animations and menus
- INSULATION VACUUM : New Alarms for Cryo table panel
- BEAM VACUUM - Arc45 Right, Arc78 Right: New controls for I/O gauges
- BEAM VACUUM - LSS6-7-8: New Agilent VPI controlers and new Profibus interface for Sector Valves

Concerned Services :
Vacuum SCADA application LHC_3.15
PLCs
Fixed pumping groups and by-pass valves

Services back :
SCADA Application @ 18h30
PLCs, Fixed pumping groups and by-pass valves @ 18h30

Best Regards,
Vacuum Controls team

Updates: Why and How?

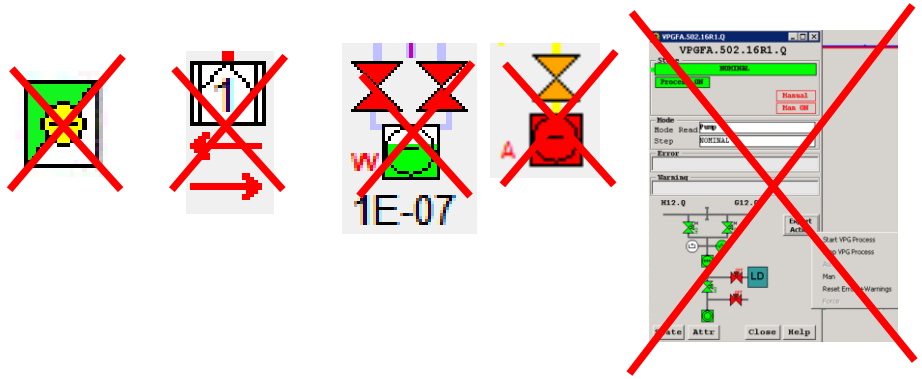


The Flop: First implementations of new device types

The issue:

First implementations of the remote control and animation for new pumping groups and I/O gauges in 2019 and early 2020 updates.

- Missing statuses and actions
- Wrong details panel implementation
- Incoherent device icon's animation in synoptic
- …



Why ?

- Change of the device control behaviour that makes the previous remote control and animation not possible to reuse.
- Different approach and requirements between Beam vacuum and Insulation vacuum
- **No standard and no specifications**

First implementation of new device types:

The solution

Restart from scratch :

- Specifications proposal
- Meetings
- Official approval procedure
- New development and deployment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TE Technology Department

TE-VSC

2317395 v.5.0

Date:2020-05-27

Technical Note

Device Widget Animation in Vacuum Supervisory Applications

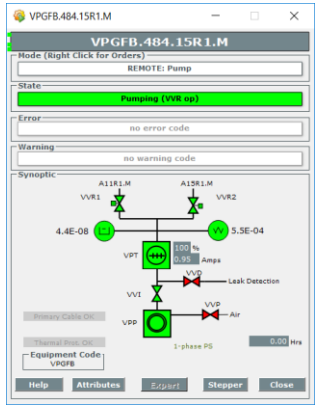
Abstract:

This document specifies a common approach for the animation of vacuum device widgets used in synoptic panels. The animation will be very similar (with some exceptions) whether the device is a pump, a gauge, a valve, an alarm or a process.

Prepared by :	Checked by :	Approved by:
S. Blanchard, ICM	R. Ferreira, ICM P. Gomes, VSC A. Rocha, ICM	G. Bregliozzi, BVO J. Perez Espinos, DLM G. Pigny, ICM

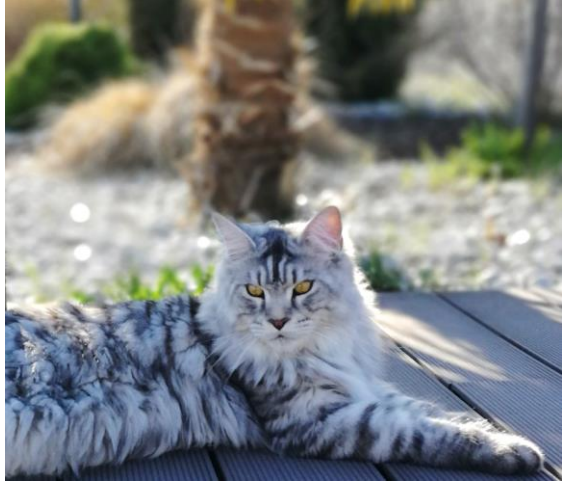
6 versions
to finally find
a compromise!

https://edms.cern.ch/document/2317395/6



Standardization
of device animation
in the supervisory application

The Top: The proof of the scalability



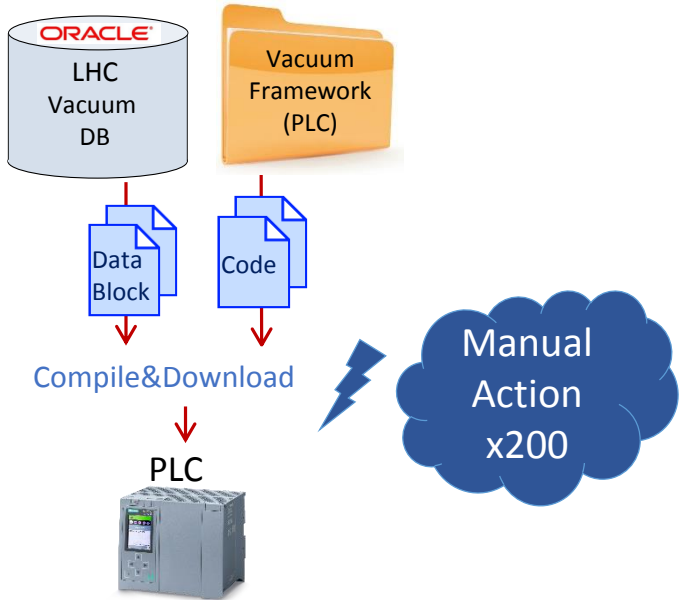
Unprecedent (since the LHC installation) success full growth of the LHC supervisory application:

- Increase of “application variable”(**data point**) number: 700k to **1.5M**
- Increase of **PLC** number: 150 to **290**
- Integration of the remote control for **wireless mobiles**
- Integration of much **complex** (parametrization) **controllers**:
  - I/O gauge controller (ad hoc)
  - Ion pump controller (Agilent™)
  - …
- Integration of a much complex layout with the new **Layout DB 2.0**

The Top: New strategy for Pumping Group updates

Pumping groups have individual PLC controller. It is more than 200 PLCs that may require update during Technical Stops.

Standard Update Process (before new strategy)

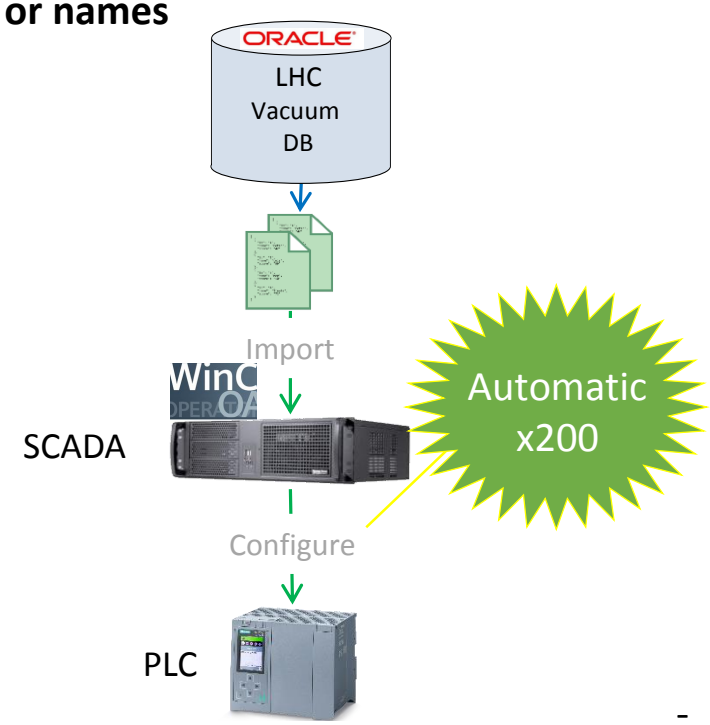


- Always need to **stop** and vent pumping groups, even if only changing equipment names or process parameters
- Update procedure always **very long**

new strategy

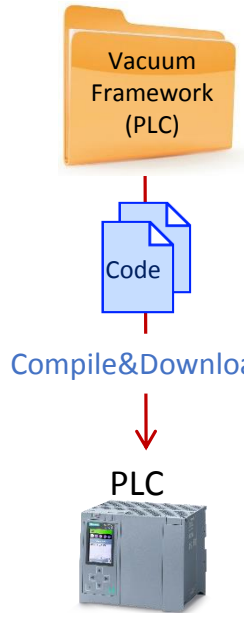
New Update Process

To change parameters or names



- **The most common** type of update during Technical Stop
- **No stop** of pumping
- **Fast** update

To modify or deploy new functionalities

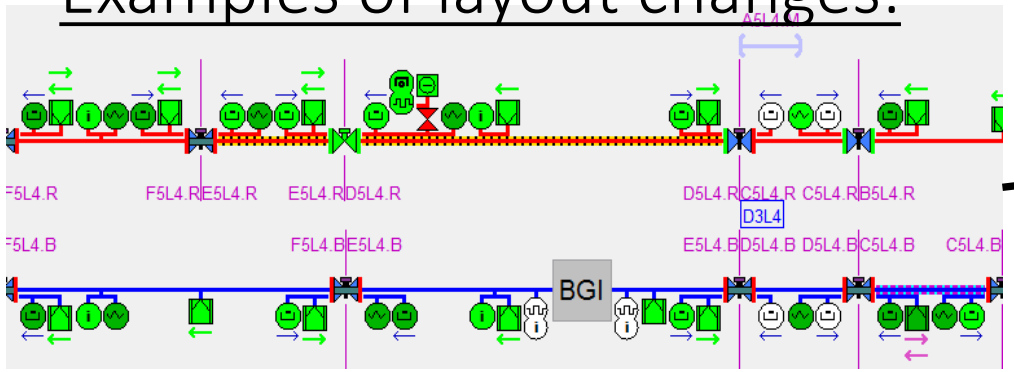


- **Rare during Technical Stop**, only when new functionalities or bugfixes are required
- Long and requires stopping the pumping groups

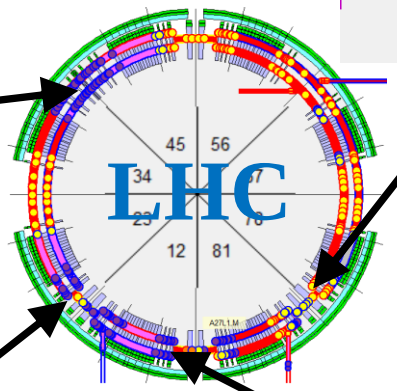
The Top: 40 new or updated sectors

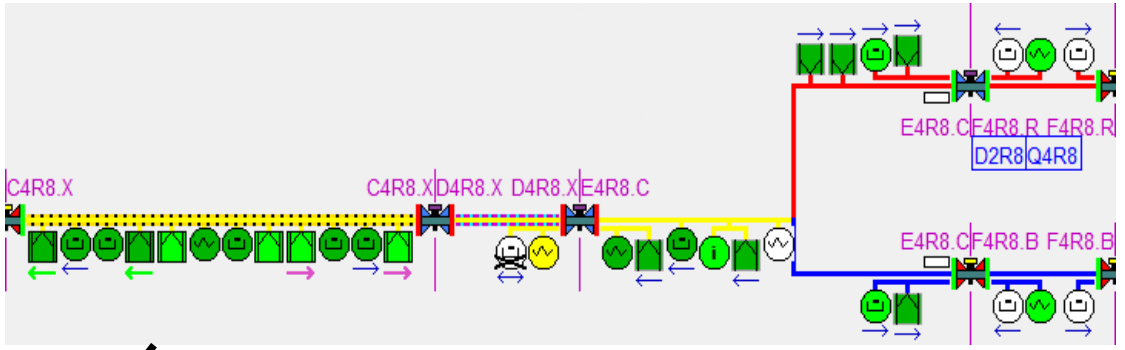
Layout significantly changed in 40 sectors.

Examples of layout changes:

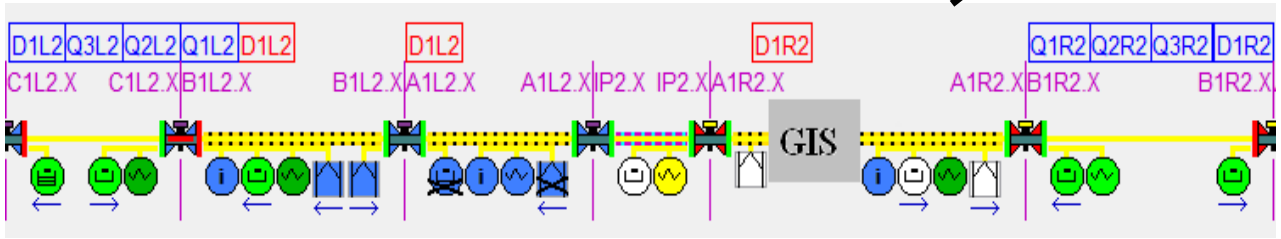


RF Point 4

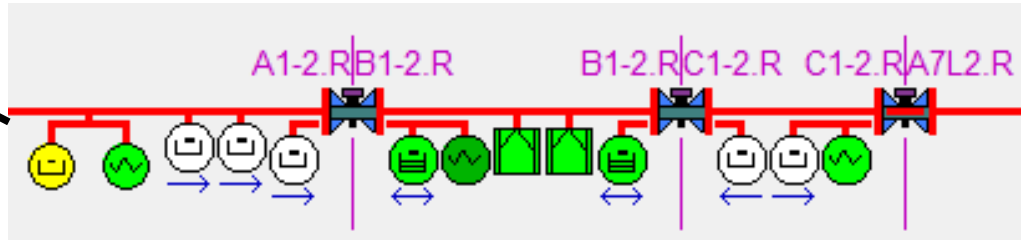




Recombination sectors Point2&8



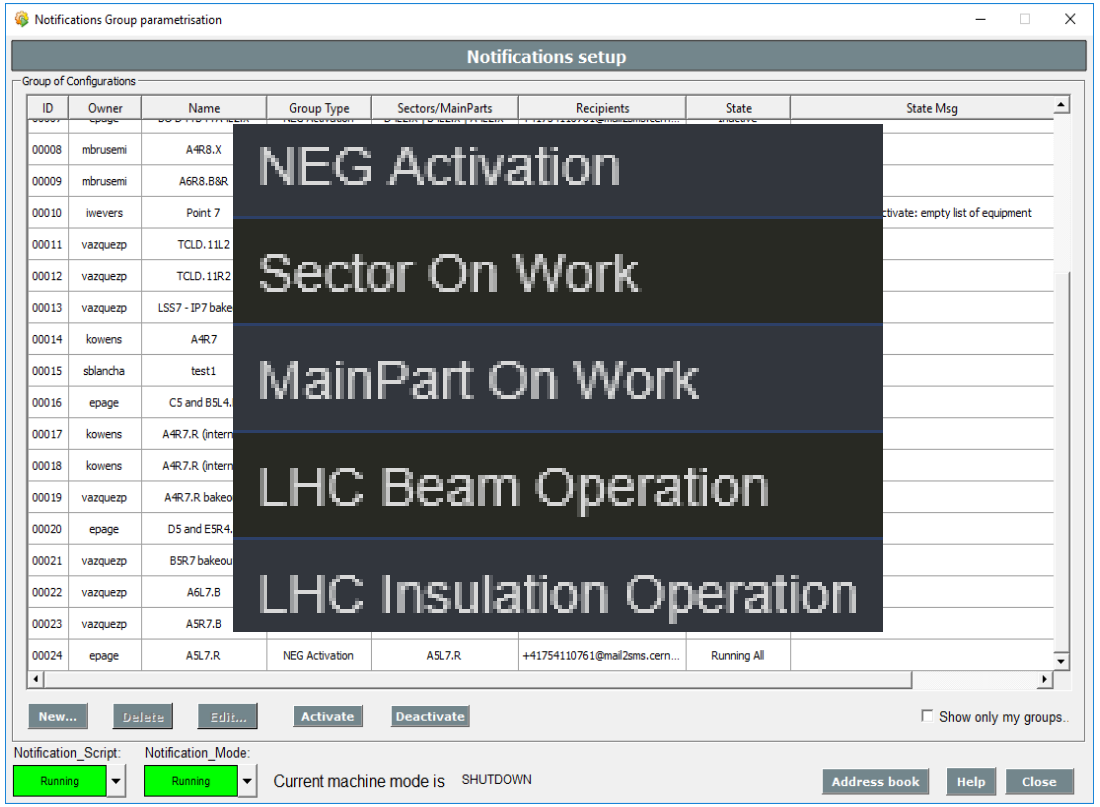
New layout around experiments



ARC Beam Sectors A, B, C

The Top: Predefined Notifications

Unique Parameter:



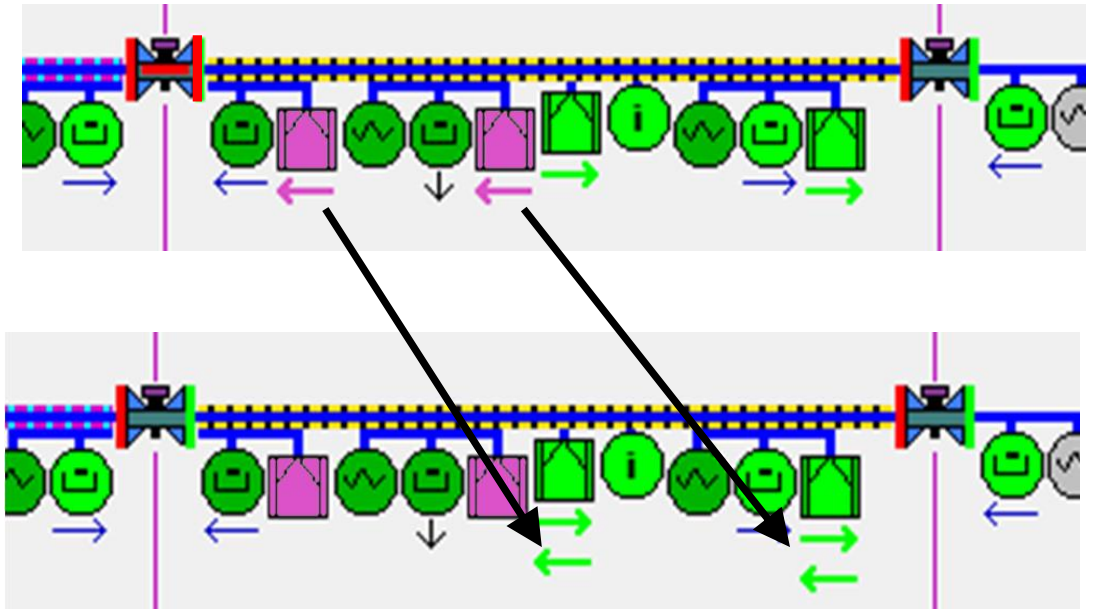
SMS
&
e-mail

The Top: Ion Pump control & Sector Valve Interlocks

- Sector valves are interlocked by Pennings and Ion Pumps.
- The **interlock** is represented by an “arrow” on the synoptic.
- For Ion Pumps the “**arrow**” is **animated** and **dynamic**.

With the full parametrizations of the interlock generated by the Ion Pump, it is possible to **change the source**.

In case of a pump **failure** an expert can remotely change the interlock source to a **valid** pump.



Summary

- The Vacuum Supervisory application is (one of) the **biggest** industrial control application at CERN
  - 1.5 Million Data Points
  - More than 290 PLC for fixed equipment
  - More than 250 PLC for mobile equipment
- Access control policy improved
- **Standardization** of animation
- Successful **layout** updates:
  - Significant changes in 40 sectors
- Successful new **controllers' migration**
  - Fixed pumping group
  - Wireless mobile pumping group
  - I/O Gauge
  - Ion pump controller (Agilent)
  - Sector Valves controller
  - …
- Successful deployment of **new and improved features**
  - Wireless pumping group integration
  - Sector Valve interlock animation
  - Notification system
  - …

All these efforts to arrive soon at the below machine state !