Slide 1

VACUUM CONTROL SYSTEM

———

SOLUTION for the LHC

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LHC Vacuum Group

Slide 2

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Slide 3

Vacuum Equipment

- u **4 Vacuum Systems !**
  - n 2 Independent Beams Vacuum
  - n Insulation Vacuum for the QRL
  - n Insulation Vacuum for the Magnet Cryostats

- u **Large number of Equipment !**
  - n ~ 1200 Gauges (Pirani, Penning, Ion.,Piezo, Full Range, …)
  - n ~ 330 Valves (Sector,By-Pass, …)
  - n ~ 400 Ion Pumps
  - n ~ 70 Pumping Groups
  - n ~ 40 Sublimation Pumps
  - n ~ 60 Mobil Equipment (mainly diff. types of VPG)
  - n + Bake-Out Equipment

Slide 4

Vacuum Specificities

- u **Vacuum must stay under control without beam and during machine shut-down**
- u **Different Users**
  - n Vacuum specialists
  - n TCR & PCR
  - n Cryo Control Room
- u **Mobil Equipment**
- u **Many annual modifications of vacuum layout**
- u **Compatibility with other Vacuum Systems (PS, SPS, …)**
- u **Large dynamic range, Press. $\in [10^{-12} .. 10^{+3}]$**
- u **Local Control during Commissioning & Leak detection**
- u **Automatic Mode (VPG, Penning Gauges)**

User's Requirements

- u **Quick & easy access to the equipment from anywhere**

- u **"Fast" response time**

- u **Global commands**

- u **Short & Long term Logging (+ Tools)**

- u **Alarms (+ Tools)**

- u **Log. scale for Pressure trends & profiles**

- u **"Real Time" Pressure trends (MD, ...)**

Specialist's Requirements

- u **Control System Reliable, Safe & Fast**

- u **Low Cost**

- u **Same Control System for all machines (SPS, LEIR, ...)**

- u **Use of recommended & supported components (PLC, Fieldbus, Middleware, Scada)**

- u **Use of General Services (Alarms, Logging, UTC, ...)**

- u **Easy to maintain**

- u **Easy to follow the changes of the vacuum layout**

- u **Easy to incorporate new vacuum devices from any manufacturers**

Main Choices

- u **HARDWARE :**
  - n Siemens PLCs : S7/400, S7/300 & DP I/O
  - n Profibus-DP Fieldbus for Mobil Equipment

- u **SOFTWARE (PLC level) :**
  - n Modular & configurable
  - n Fully "Data driven"

- u **COMM. :**
  - n TCP-IP
  - n OPC Server (Applicom card, Sofnet, ...)
  - n Other solutions (drivers) to be evaluated

- u **SCADA :**
  - n PVSS

Main Key Points

- u **Minimize the number of hardware & software components**
  - n Small number of different PLC modules
  - n Small number of (reusable) software routines

- u **Maximize data transfer efficiency**
  - n Transfer only useful data
  - n Filter analogue values at PLC level
  - n Prioritize alarms at PLC level (+ reduction)
  - n Optimize OPC transfer (transactions, buffer size, ...)
  - n Minimize OPC items & SCADA datapoint elements

- u **Minimize Configuration work**
  - n PLCs Data Blocs, PVSS Datapoint Elements & OPC groups/items generated from the DataBase

Devices & Models

u **Modelisation of Vacuum Devices**
  - n Limited number of models
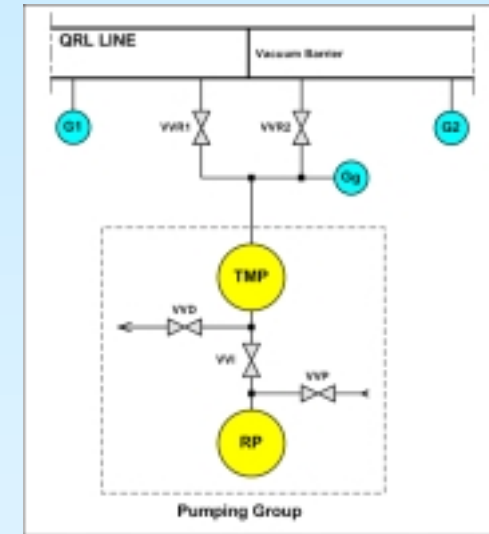 - n Functional description

u **Types of devices**
  - n Simples devices : Gauge, Valve, Ion Pump, …
  - n Complexes devices : Pumping Group, …
  - n Set of devices : "All VPI of Sector xyz", "Valves Chain",…
  - n *"Software"* devices : Interlocks,Alarms …
  - n Industrial Controllers

Ł **Each Device is fully described by its "Data Bloc"**

Ł **Each Model is handled by its "Function Bloc"**

Devices – VPG

Device "Data Bloc"

u **Device info**
  - n Name, Family, Type, Position, …
  - n Vacuum System, Vac. Sector, …
  - n Controller & Master links, …

u **Hardware info**
  - n I/O addresses, Rack, …
  - n Fieldbus parameters (number, address)

u **Scada info**
  - n Read & Write Data Blocs numbers
  - n Read & Write Data Blocs offsets
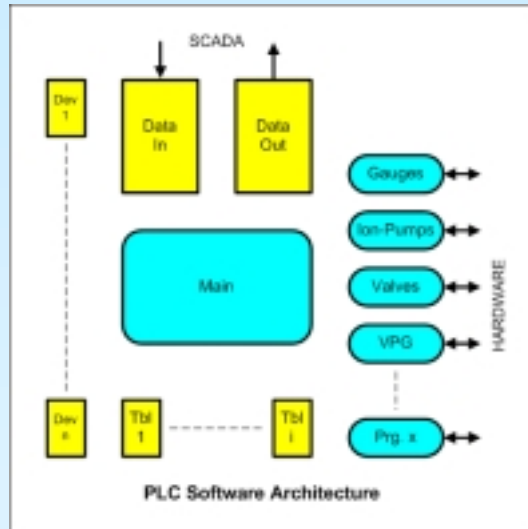
u **Specific info**
  - n Alarms, Interlocks, …
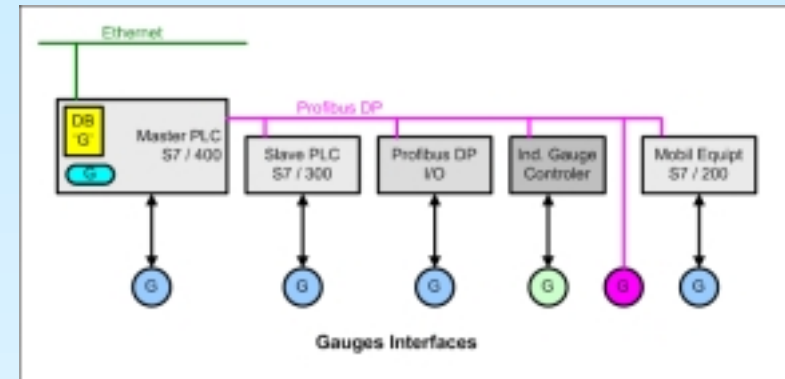

Global Architecture

PLC Software Arch.
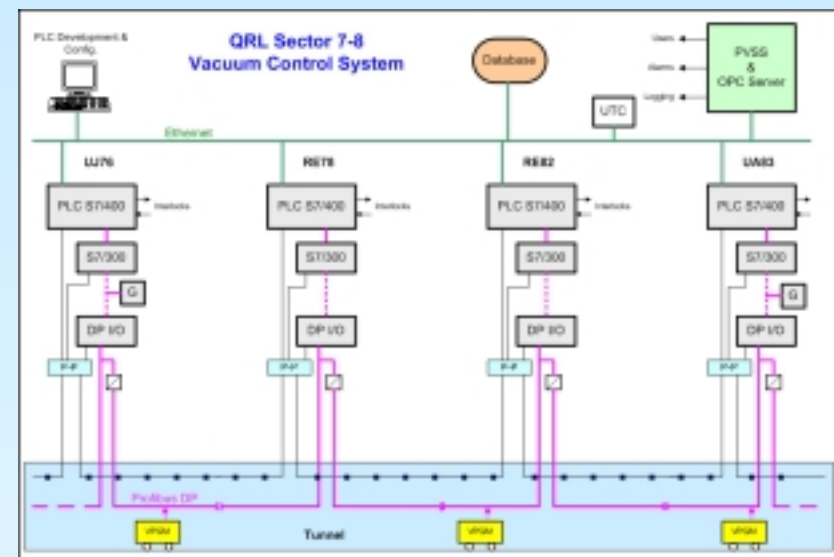
PLC Software Architecture

Ex.: Gauge Interface

Gauges Interfaces
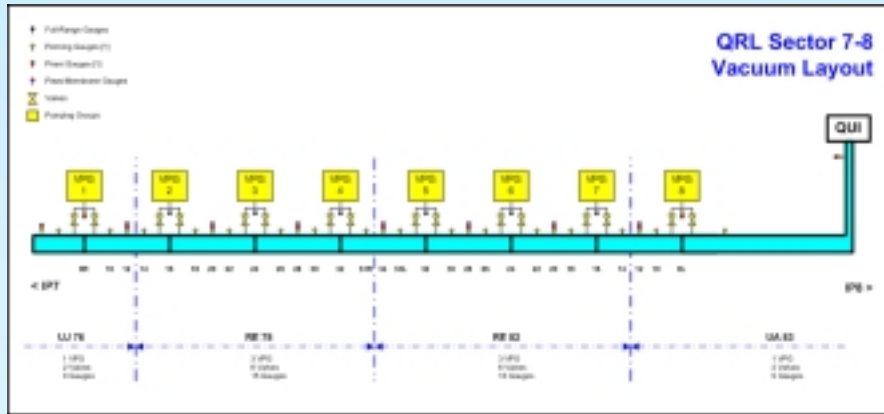
QRL STATUS

QRL for Sector 7-8

u **Cryogenic Distribution Line   ~ 3.3 km**

u **Insulation Vacuum Press. ~ 10^{-3} to 10^{-6} mBar**

   n 1'100 m^3 to Pump !

   n 8 Pumping Groups, 16 "By-Pass" Valves

   n 51 Gauges (Pirani, Penning, Piezo, Full-Range)

   n Mobile Equipment (Mainly Pumping Groups)

**Few equipment but all the infrastructure
for the LHC will be installed !**

QRL – Vacuum Equip[t]

QRL Sector 7-8
Vacuum Layout

QUI

QRL – Infrastructures & Milestones

- u **Racks, UPS, Cables (Control & Profibus)**
  - n Before 16th June 03
- u **Ethernet in UJ76, RE78, RE82 & UA83**
  - n Before 16th June 03
- u **PVSS licenses (UI), Servers (PC)**
  - n Before 16th June 03
- u **Alarms, Logging, Interlocks & UTC Systems**
  - n Before 1st nov. 03
- u **Wireless Ethernet in the tunnel**
  - n [Before 1st nov. 03]

QRL – Current Status

- u **Hardware :**
  - n Cabling : Layout nearly ready, design of prototype of interconnections system in progress
  - n PLC :   Nearly OK

- u **Software**
  - n PLC : Nearly OK, excepted for mobil equipment
  - n SCADA : In progress (in collaboration with LHC/IAS & IT)
  - n Interfaces with Alarms & Logging Systems : To be developed (in collaboration with SL/CO, MR & LHC/IAS)
  - n Interlocks : HW with Cryo
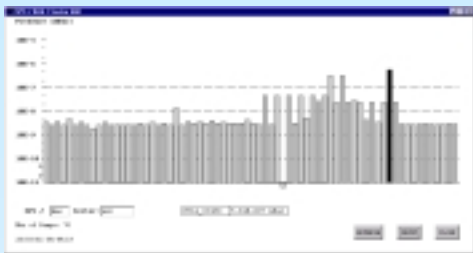 - n Database : To be developed

SPS – Current Status

- u **~ 1400 Ion Pumps & 800 Power Supplies**

- u **8 Master PLCs & 30 DP I/O Stations**

- u **PVSS : 2'200 Datapoints (2 DP types)**
        7'600 Datapoint Elements

- u **OPC : 8 Channels**
        3'200 OPC Items
        1s Acquisition Rate
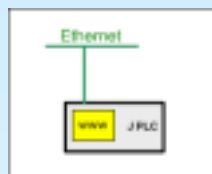
SCADA Vers 0.1

Conclusion

u   **1st experience with SPS, Now !**

u   **The Vacuum Control System for the QRL, sector 7-8, will be ready in due time !**

u   **Strong Collaboration with Support (PVSS, OPC, …) & Control (Alarms, Logging, Timing) Groups**

u   **« Y a plus qu' à . . . »**

Vacuum Control System

The Next Generation

THANK YOU !