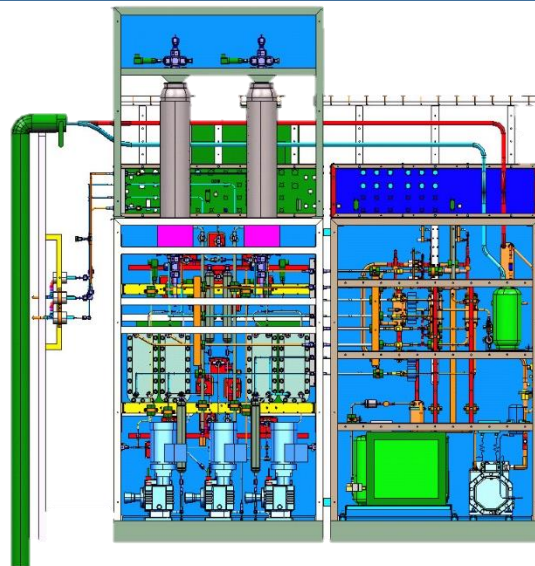# Redesign of the VELO Thermal Control System for Future Detector Development

S. Lunt†, University of Cape Town, Cape Town, South Africa
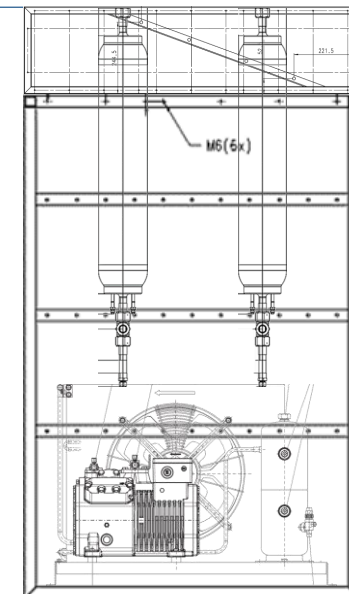B. Verlaat, L. Zwalinski, CERN, Geneva, Switzerland

ICALEPCS 2021

Base system

- Cooling system from LHCb's Vertex Locator Thermal Control System (VTCS)

Fluid systems

- Added I2PACL mode
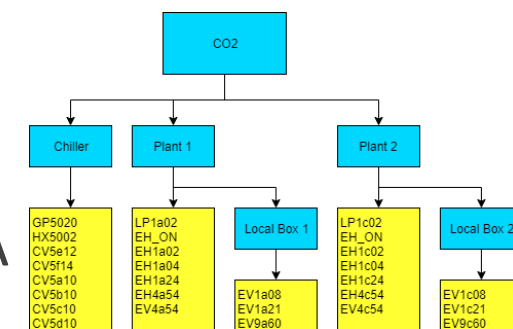- Reduced the system dimensions
- Replaced chillers

Electrical systems

- Significant electrical redesign
- Simplified, accessible panel
- Reused as much as practical from the VTCS
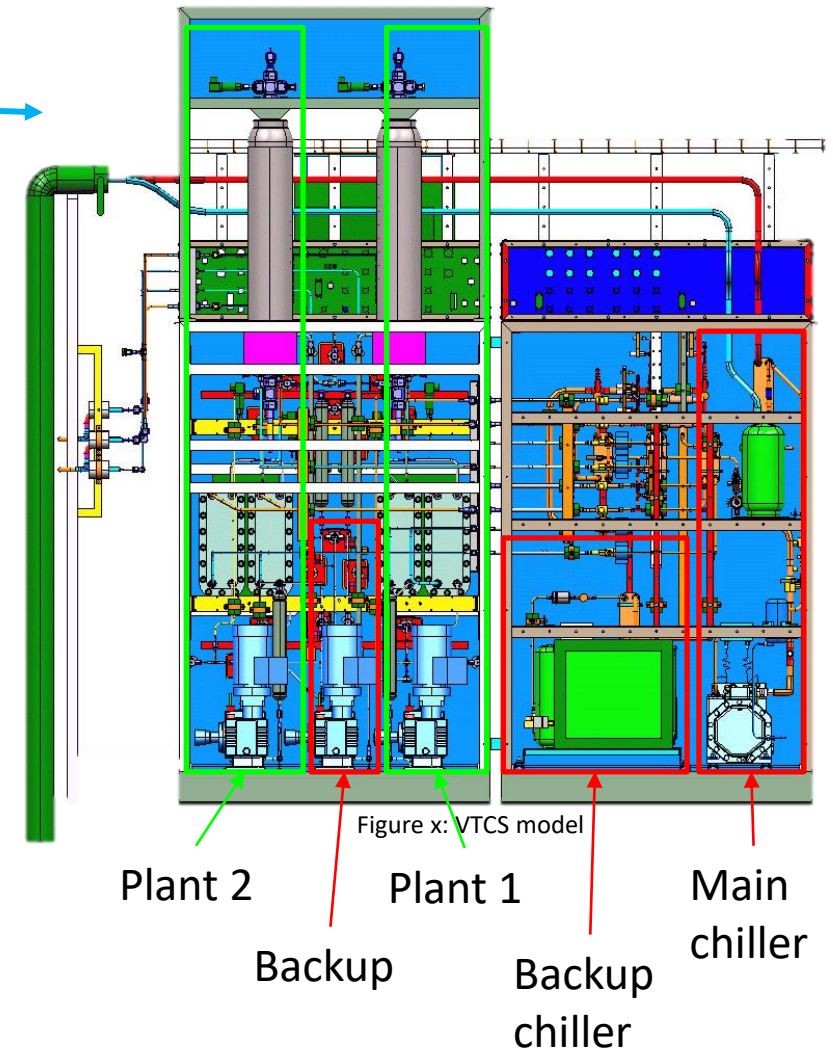- New or spare components used where needed

Control systems

- New UNICOS based control system
- WinCC OA used for SCADA
- Integration with CERN's control environment

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Detector Technologies Cooling System (DTCS)

- Developed from the VTCS after it was retired
  - Two independent two-phase accumulator controlled loop (2PACL) systems
  - Redundant layers for detector safety
- Major system components be reused:
  - Accumulators
  - Pumps
  - Heat exchangers
  - Heaters
  - Frames
  - Pipes and valves
  - Electrical components

Figure x: VTCS model

Plant 2   Plant 1   Main chiller

Backup   Backup chiller

Fluid Systems

Local box provides the connection to the device under test

Figure x: chiller rack side and font view

Backup chiller heat exchanger used to add integrated 2PACL mode

Accumulators moved for compactness and easier fixation

Chillers replaced with a single air-cooled unit following a common DT design

Chiller R449a refrigerant lines

Figure x: CO_2 P&ID diagram

Only two changes were made to the CO_2 system:
- Backup pump and piping was removed
- Addition of the I2PACL selection valve and piping

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Electrical Systems and Instrumentation

- Electrical system was made much more accessible
- Components were reused where possible
- In other cases new or spare stock was used

Instrumentation was kept apart from the PT100s

Where needed they were replaced with in flow sensors for improved performance

PLC is retained
- CPU upgraded
- Extra cards removed
- Analog output added

Screen discarded. System will be operated remotely through Siemens WinCC OA

Complete electrical redesign with new panel constructed to replace old system
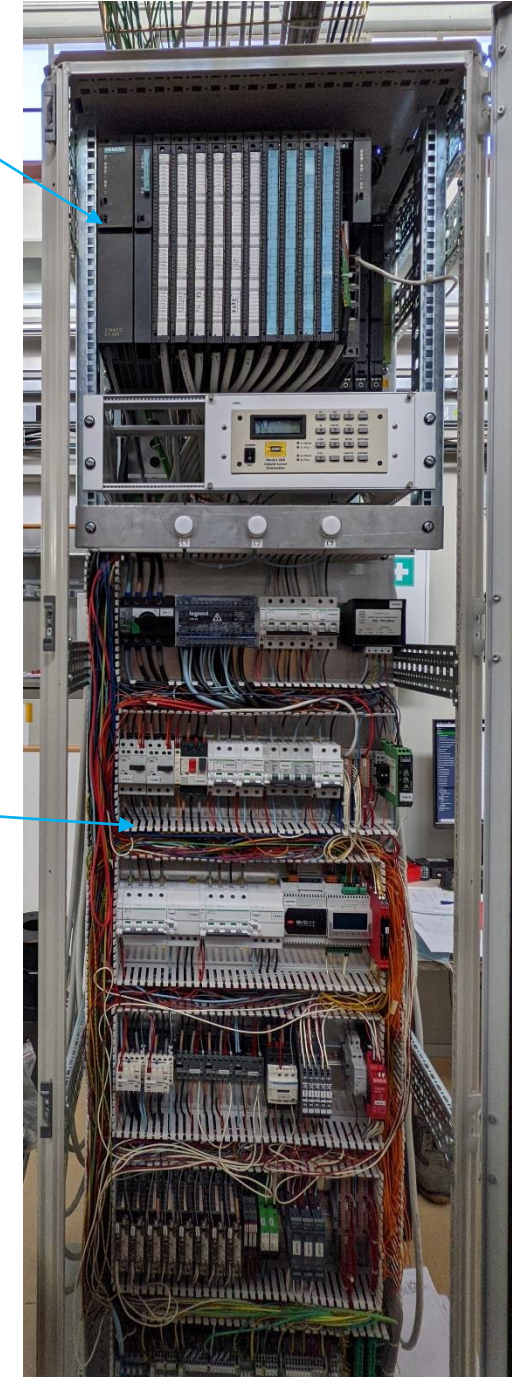
Sensors for unused hardware are removed

Figure x: In-flow temperature sensor.

Figure x: Original electrical hardware.

Figure x: Current electrical hardware.

Control system

- Developed using CERN's Unified Industrial Control System (UNICOS)
- Each CO_2 plant can run independently of the other
- The chiller is started automatically when either or both CO_2 plants are requested to run
- The Local box requires the parent plant to be running to connect, disconnect or test devices.
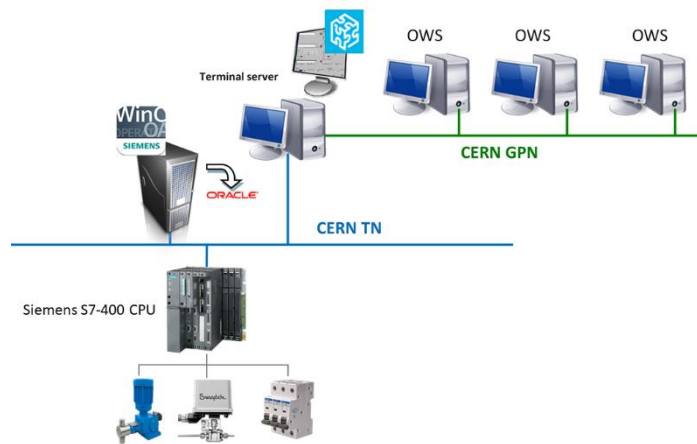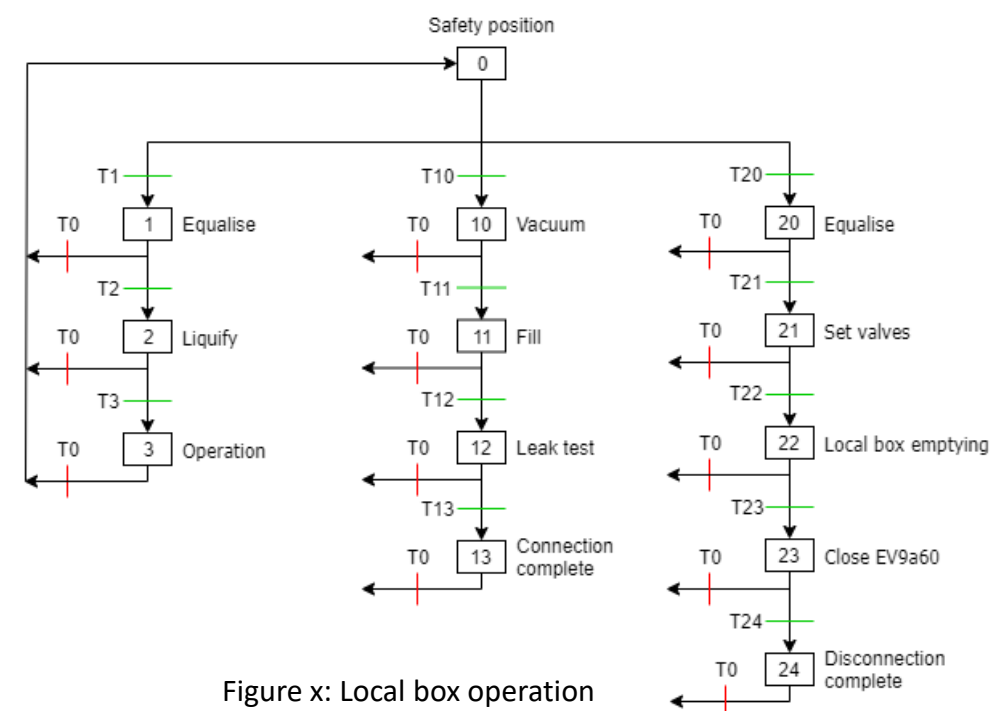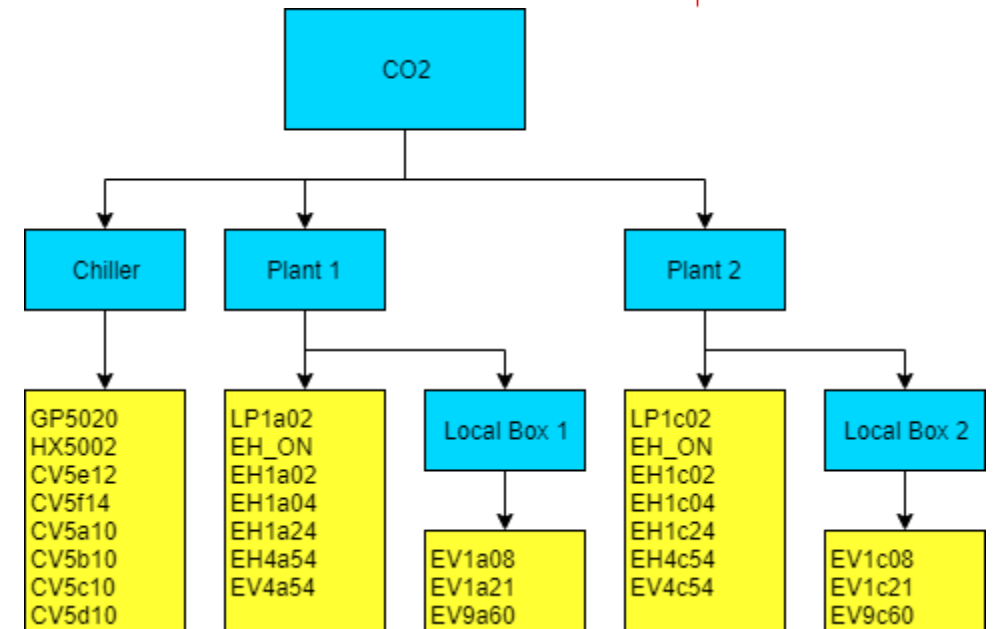
Figure x: Local box operation

Figure x: Control system architecture

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Figure x: Process Control Object structure

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