CRYOGENICS OPERATIONS 2008

CRYOGENICS OPERATIONS 2008

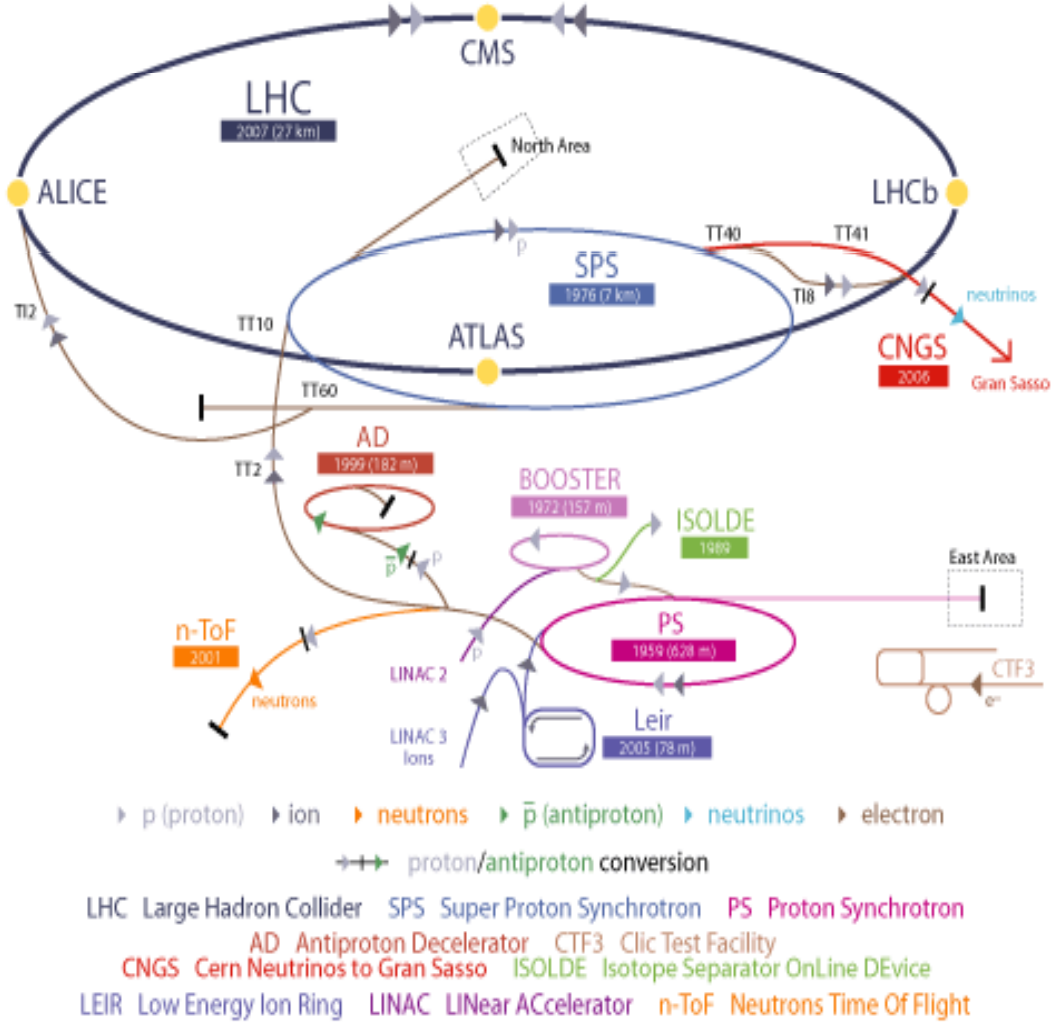
Organized by CERN

UNICOS UPGRADE PROJECT OF THE CERN OBSOLET CRYOGENICS CONTROL SYSTEMS:
a suitable control framework for cryogenics operation

Marco Pezzetti

Cryogenic apparatus @ CERN

Le complexe d'accélérateurs du CERN



Cryogenic test facility and centralized cryogenic service:

- **LHC SM18 Series test benches**
- **163 Area Test bench**
- **Physics Detectors (NA)**
- **SPS detectors, Test bench**
- **SPS Test bench**

⇒ 16 CERN cryoplants to be refurnished….

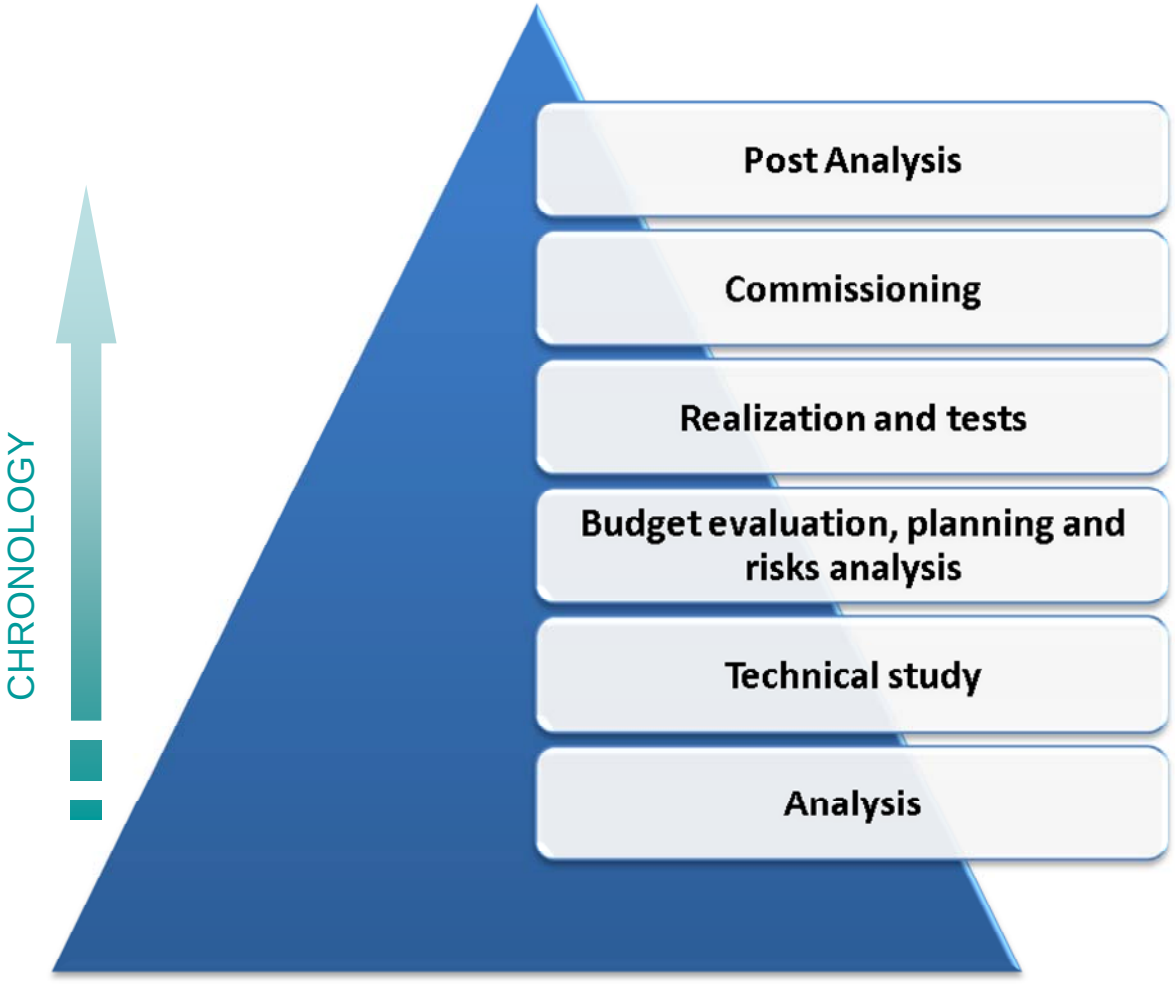
Why a renovation project ?

- No longer ensured the reliability need for cryogenic operation.
- Use the LHC experience & features of the CERN UNICOS control system standard (based on several years of operation on cryogenic)
- **Homogenous and efficient user interface for operation**

  (Homogenize GUI user interface & Access control with different privileges level)
- **Long term maintenance by reduced CERN control teams**
- Integrates the Industrial Control to the accelerator control infrastructure and services (alarms, Logging,..)

Project overview

Organization and Generalities



1- Initial **analysis**:
- Instrumentation & Electricity
- Control Logic
- Operation and safety

2- **Evaluate** budget, planning and risks
3- **Technical solution**
4- Tests and **preparation**
- Process logic test
- SCADA Communication
- HW preparation

5- **Commissioning**
6- Feedback analysis

Analysis represented the most important step : around 60% of preparation time

p1

Etude de l'installation et du projet
Intégration dans l'équipe de travail et dans le projet
Prise de connaissance du standard CERN-UNICOS
Schéma d'implantation
Etude électromécanique
Etude de l'ancienne logique de fonctionnement ABB pour élaborer un code standard

Définition de l'architecture « Hardware »
Définir le matériel nécessaire
Définir et dessiner l'implantation dans les racks
Conception des schémas électriques des racks
Suivi de la construction et du câblage

Programmation
Création des bases de données UNICOS
Définition des programmes de gestion en Structure Programme
Travail d'équipe : application standard pour tous types de compresseurs du CERN
Ecriture des programmes pour les PLCs
Test de la logique de fonctionnement sur simulateur

UNICOS control procedure standardized

P&ID
Instrumentation list & UNICOS Data Base

Ethernet connection with IT/CS
Electrical needs definition
Electrical interface with TS/EL Instrumentation
Electrical schematics

PLC & I/O Architecture, DB
Logic Description & UNICOS logic

Analysis of Functional Logic
Production of UNICOS Specification
(Including Logic and Data-Base description)

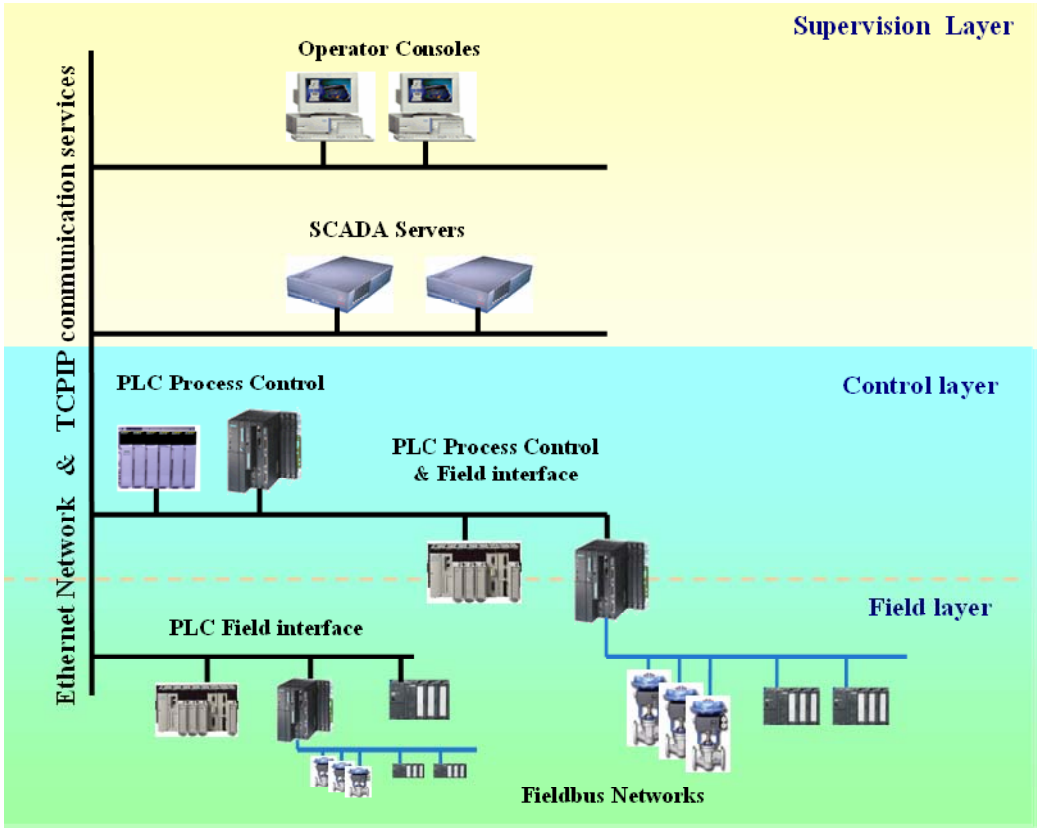
PLC UNICOS source code production

PARALLEL generation of controls Data-Base and source code PLC – SCADA Supervision

PLC and Supervision machines provision
Supervision synoptic and data server

Installation, Reception and Commissioning
…..and maintenance of the applications

UNICOS architecture applied



Supervision layer

PVSS SCADA (Supervision Control And Data Acquisition)

Process control layer

PLC either Schneider or Siemens

Field layer

Different field bus protocols

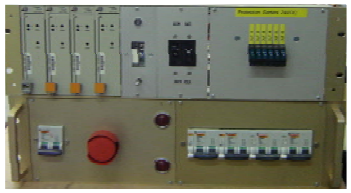
Hardware : Standard & optimisation

1990.. / 2007

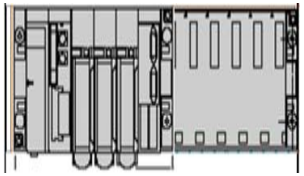
2008 / ….

Hardware : Standard & optimisation

Rack modification to install new DC and AC power supply distribution



Rack modification to install new phoenix modules

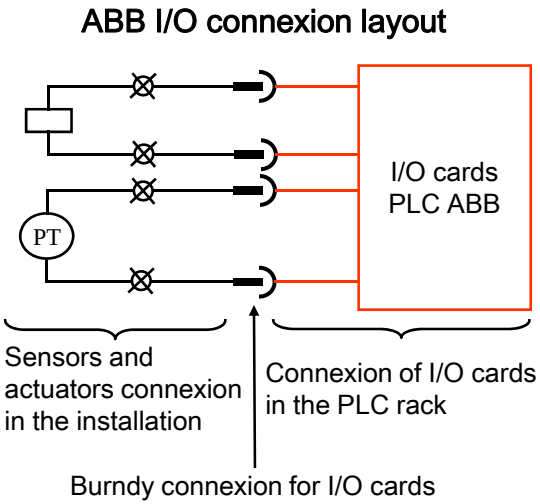


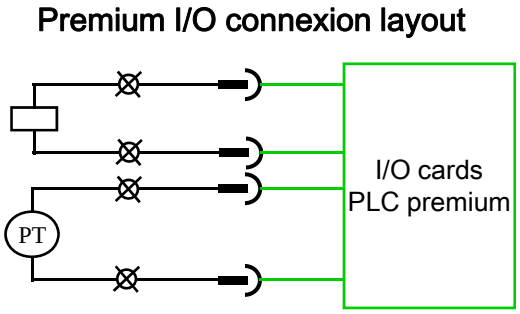
Rack modification to install new PLC backplane

No modification in existing IO répetition and power distribution for equipments.

Definition of INTERFACE

Hardware : Standard & optimisation





New PLC rack under construction

Burndy socket to I/O connexion

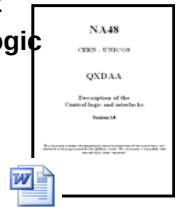
Note: the new connexion of I/O PLC doesn't change the cabling of the sensors and actuator of the installation.

CERN Central Liquefier : during the installation…

Control system production

Functional **Logic** description **spec**ification :

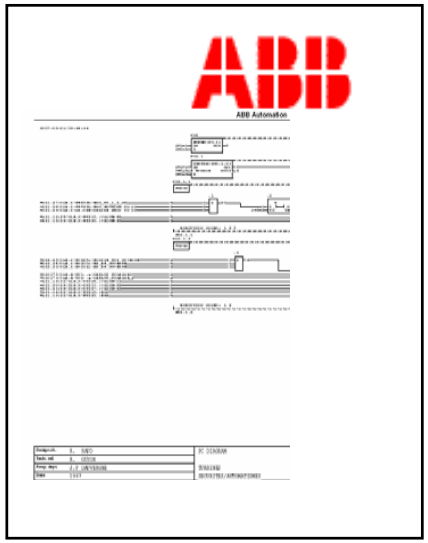
- **Global and Dependant Object Logic**
- **Options Modes**
- **Interlocks**



Process Logic Spec

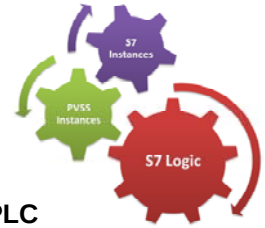
Data base specification based on three layers:

- I/O : **A**nalog and **D**igital **I**nputs and **O**utputs
- Field : **Local**, **OnOff**, **Analog**, **Anadig**, PID **Controller**
- Process**: P**rocess **C**ontrol **O**bjects and Alarms



Data Base Spec

Instances and Logic Generator



SCADA Instances

PLC Files

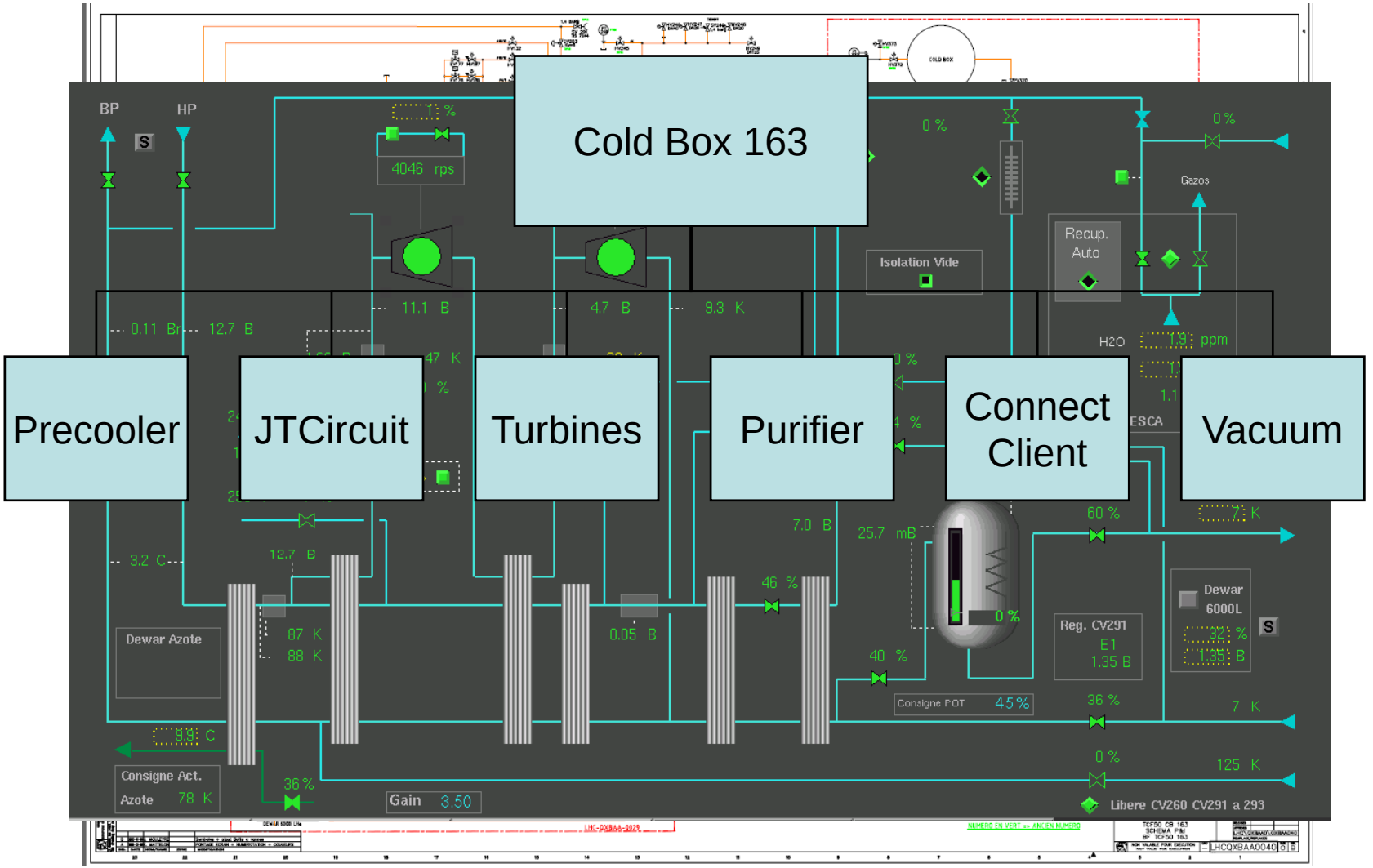
Generation of placeholders for Process logic

Deployment

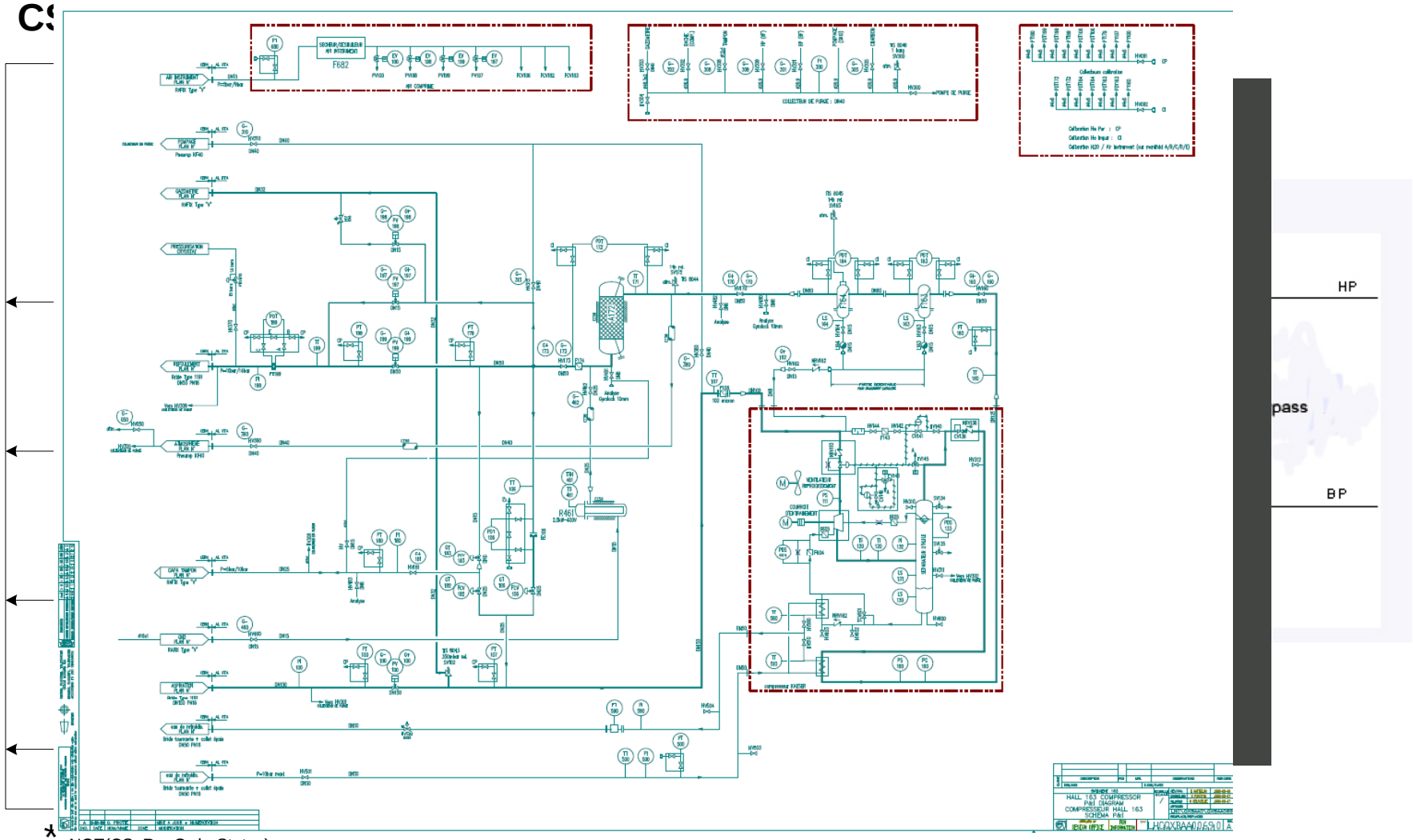
Data Server

Siemens & Schneider

Standardized control solution applied



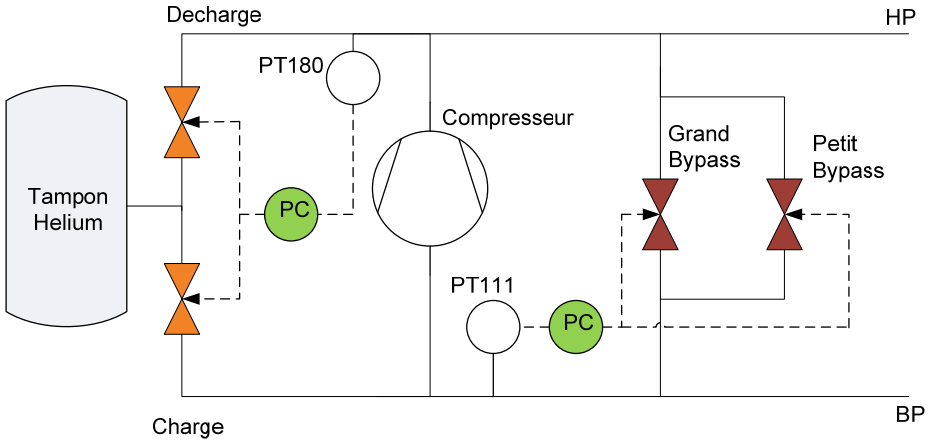
Standardized control solution applied



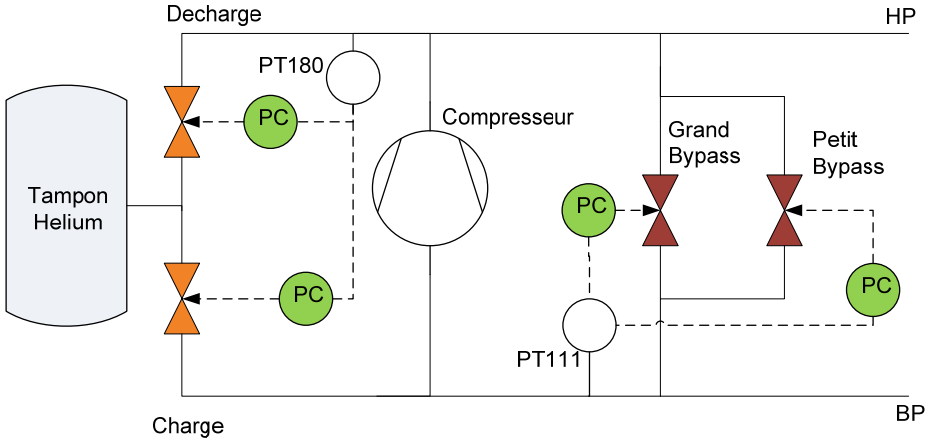
NOT(CS_RunOrderStatus)

LHC Standardized control solution applied

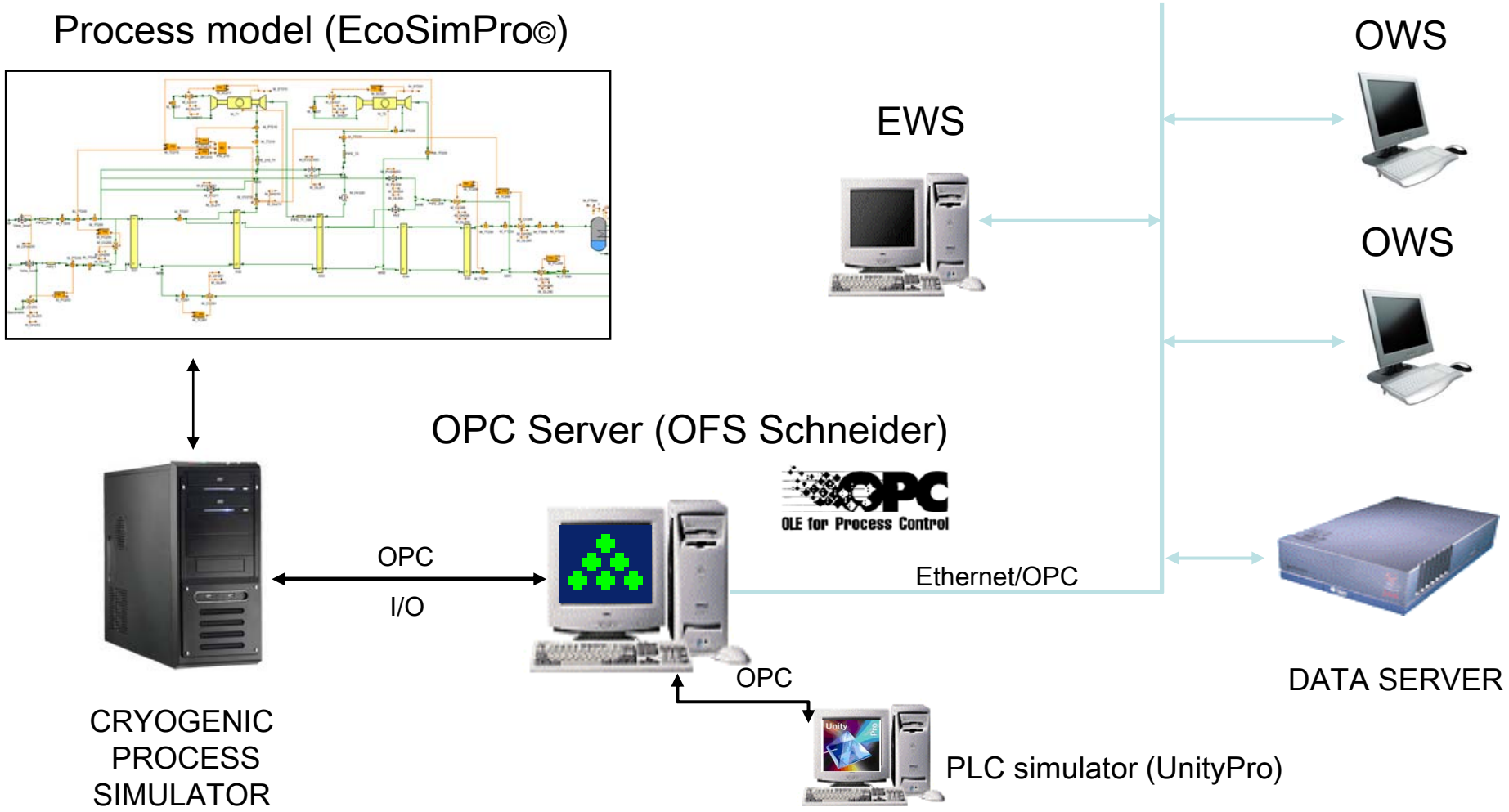
Old regulation



New regulation (LHC standardisation)



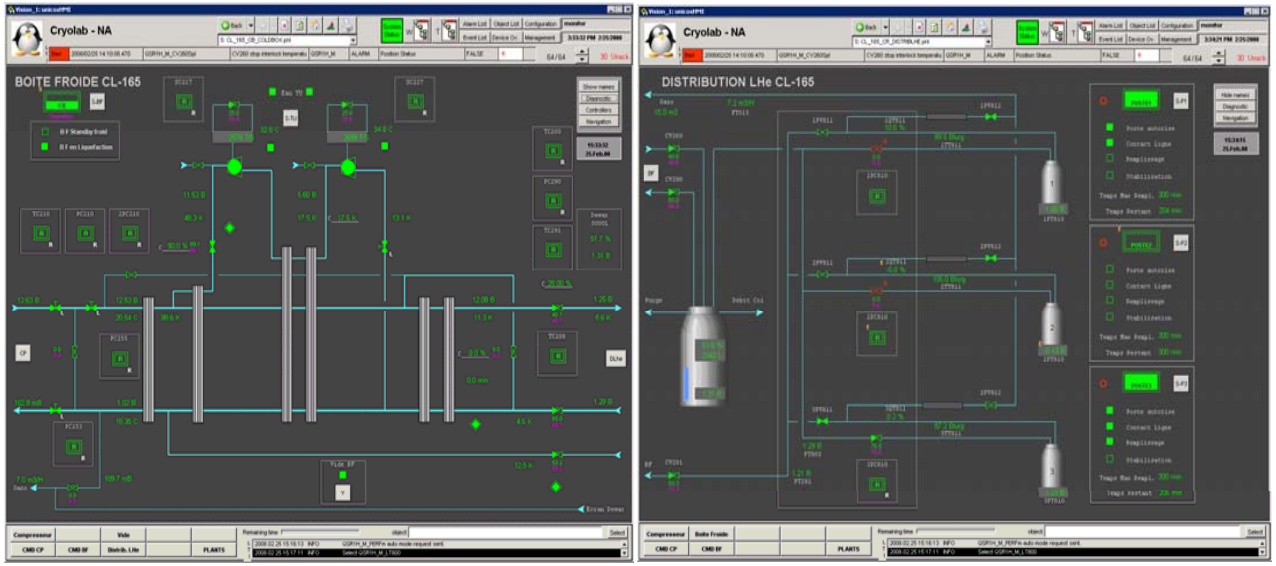
Virtual commissioning…

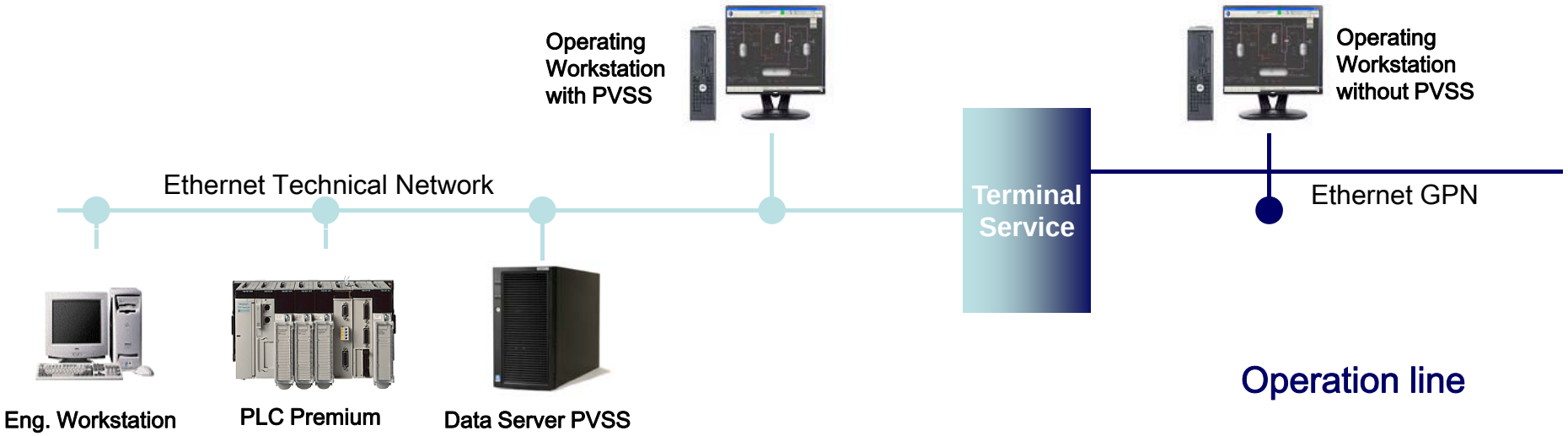


Remote access supervision and operation…

Remote access to the **PLC** for upgrade and process logic modifications

➢**Remote** access to **supervision** by Terminal Service





Conclusion

- Hardware in UNICOS is supported by electrical specifications procedure
- UNICOS Software, need an heavy study on the UNICOS functionality but is a CERN standard for at least the next 15 years…

- CERN Central liquefier & NA62 migration experience :
- Electrical work (offline – online): very good results
- Cryo process logic extraction = at the beginning some difficulties but… UNICOS embedded object functionality bring an outstanding facility into the processes
- Commissioning time reduced

<u>UNICOS migration procedure can be largely extended</u>

<u>for obsolete cryogenic control system</u>

Operation impact minimized, time & cost reduced = optimal control upgrade

A special thanks to….

Accelerator Technology Department

Control Electricity

-CO

OD section and ALLS

TS transport service

“CERN Apprentis” program

……CRG-CE project associates and students