60kW Thermosiphon control system

Fourth thermosiphon workshop 19.11.2010

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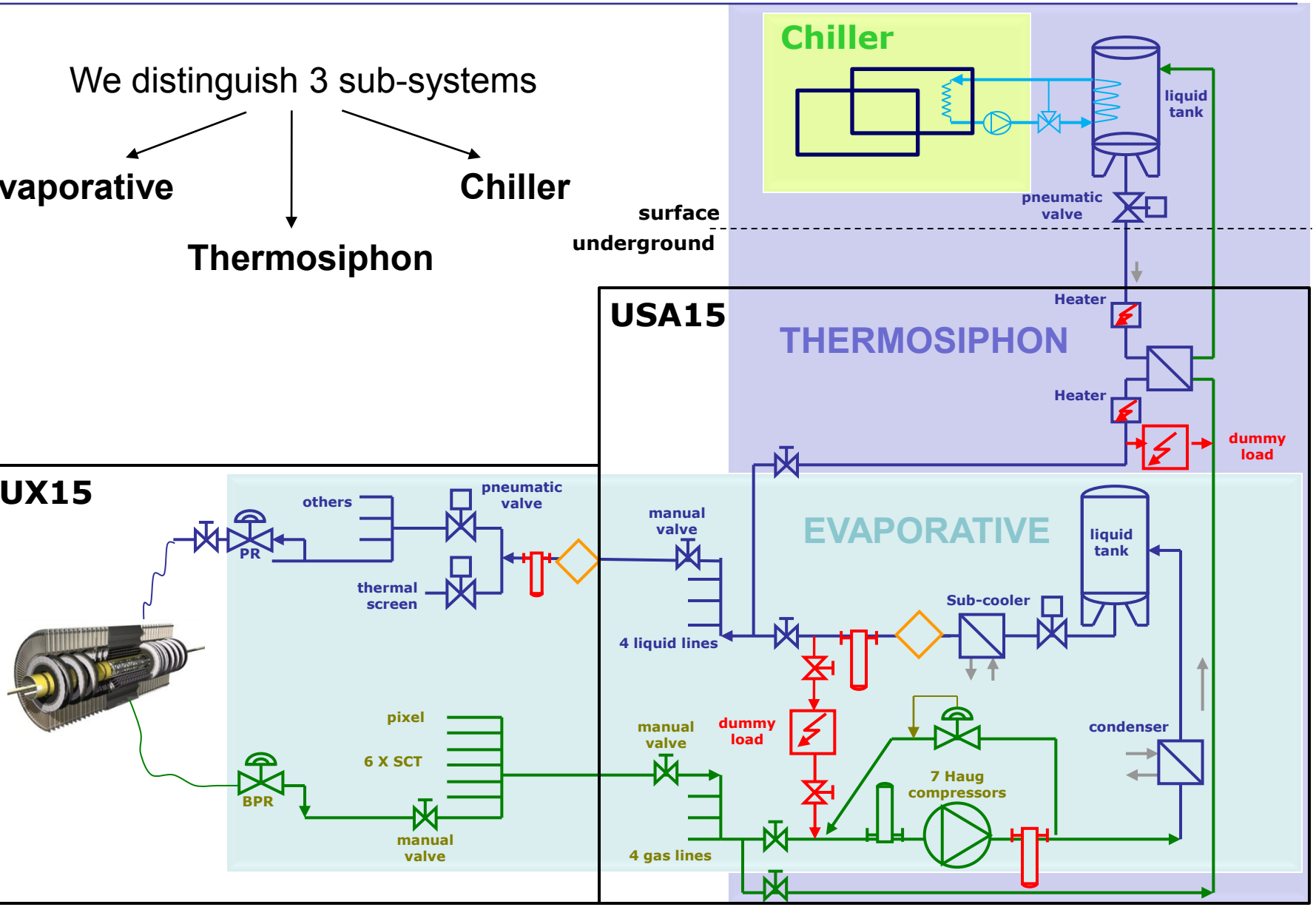
Split of the control system

We distinguish 3 sub-systems

- Evaporative
- Thermosiphon
- Chiller



Project requirements

Requirements:

1. Integrate new systems with existing evaporative cooling control system
2. Keep existing evaporative system as the backup solution, ready to run in case of fatal failure of the chiller
3. Use UNICOS framework for all new control systems
4. Program self standing independent systems with individual PLCs exchanging data in between.
5. Ensure stable long operation
6. Use Schneider PLCs

Thermosiphon requirements

Requirements:

- Distance between PLC and I/O up to **200**m
- Redundant power supplies
- Reliable communication between surface and USA15
- Racks connected to uninterruptible power supply – 20 min back up
- SCADA system with long term logging
- Schneider PLC and distributed I/O

Solution:

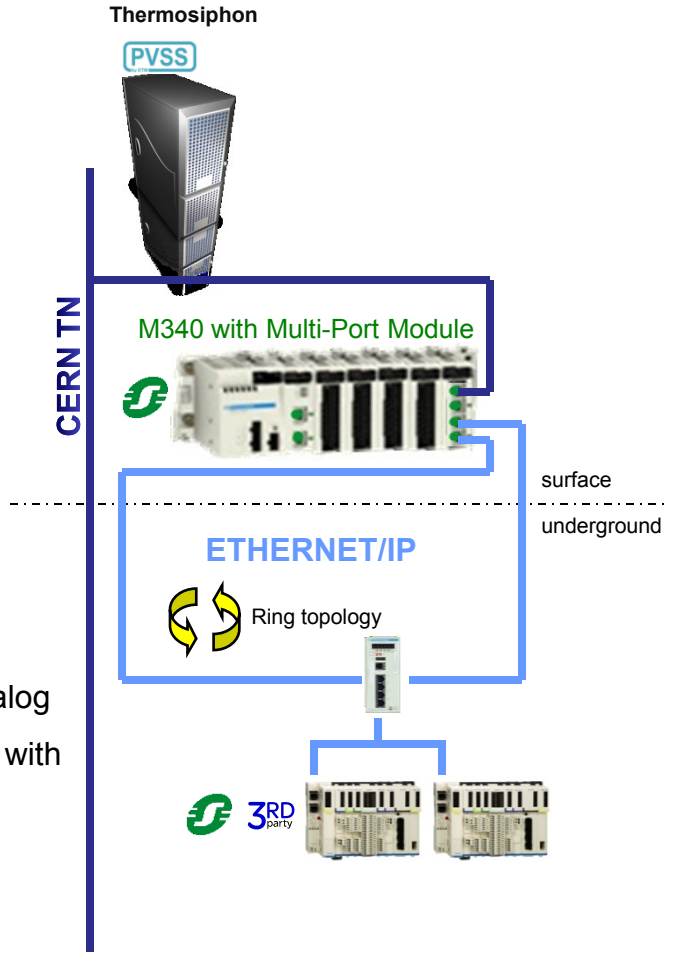
a) Software:

- UNICOS framework (CERN standard) & Schneider Unity v5.0
- PVSS 3.8 on Linux machine placed in BE/CO

b) Hardware

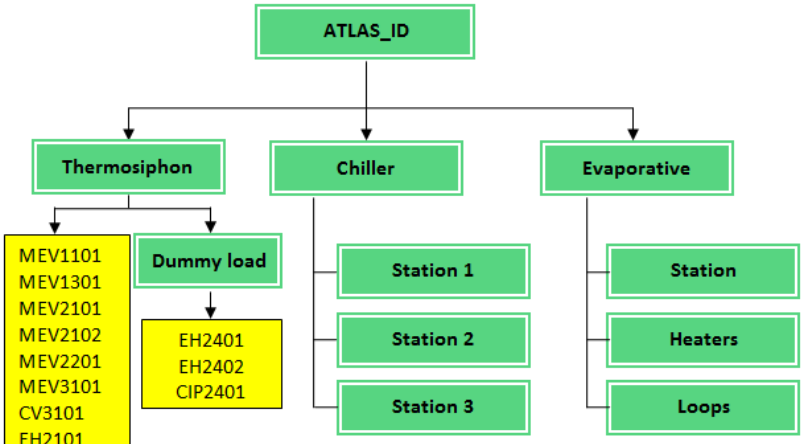
- M340 Schneider PLC with Ethernet/IP module with 4 ports,
  2 supporting ring topologies (Redundancy, RSTP, ring recovery)
- Ethernet /IP is a proven industrial Ethernet network solution
- Ethernet/IP IO head from Schneider or Beckhoff allow i.e. the reading of Analog Input IOError and connection it to UNICOS Objects (which was not possible with PROFIBUS)
- The main advantage is increase of communication performance, diagnostic.
- Data are available in all Ethernet/IP PLC by configuration (no code).

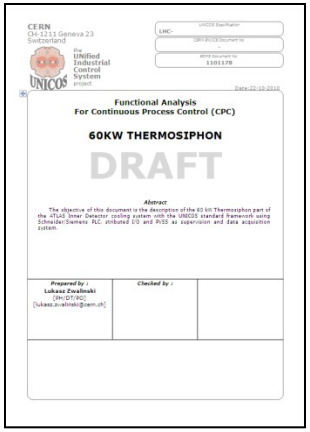
EN/ICE is currently validating such architecture with RF people, good results at time being. A test with IT people will be organized to check the compatibility with TN (today).



Thermosiphon

- The functional analysis is under preparation EDMS 1101178
- Dependent logic is not yet fully specified, details will come from 2kW thermosiphon test stand
- Conditions to be monitored by the PLC (from mini Thermo.):
  - the sub-cooling of the liquid has to be higher than 2-3K to prevent the flow to stop circulating
  - the liquid pressure has to be higher than the saturation pressure calculated from a local temperature to prevent having a gas in the liquid line
  - the temperature difference between the outlet vapour temperature and evaporation temperature should be higher than 5K to prevent having liquid in the gas line
- Alarms & Interlocks – to be defined

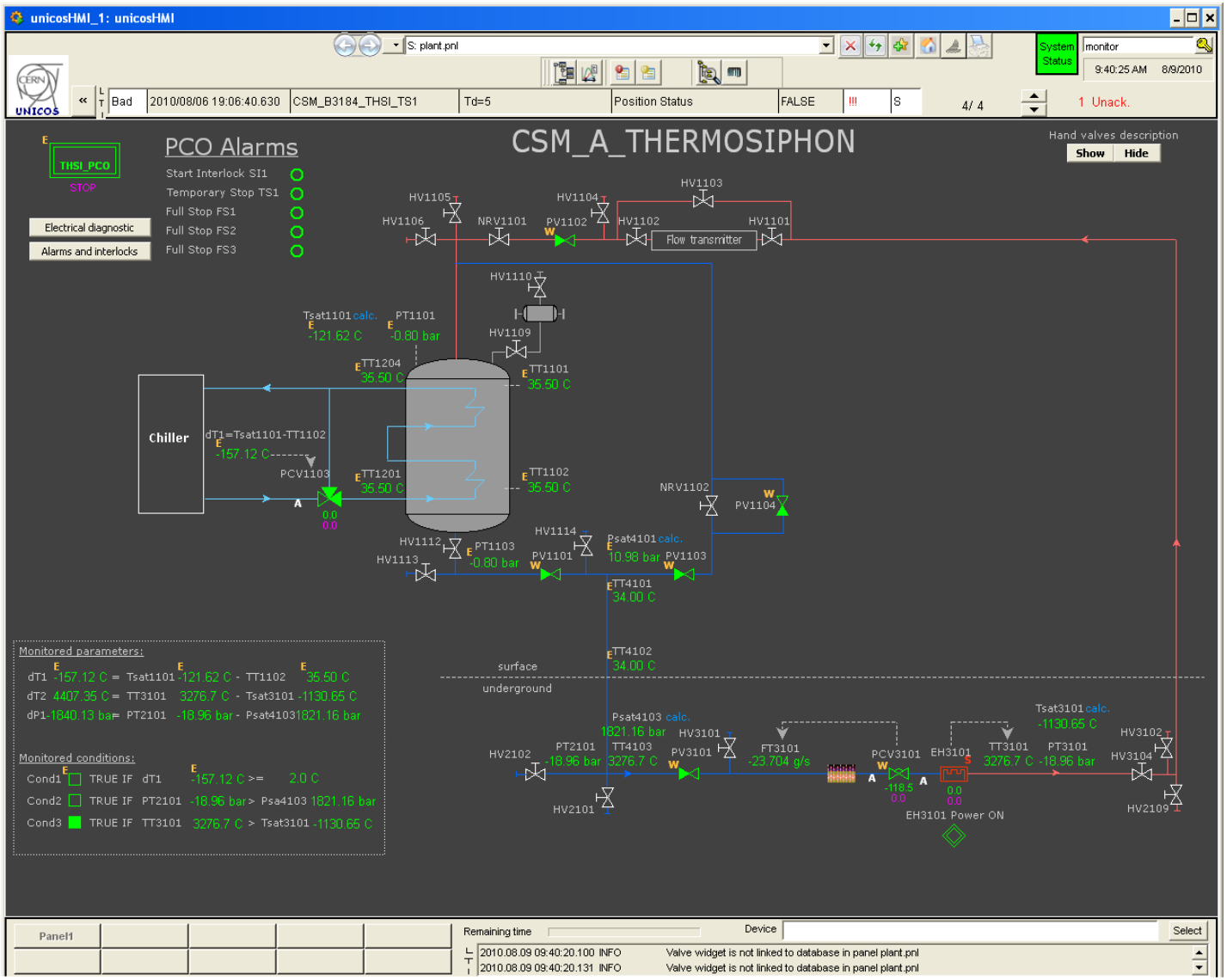




I/O type	Object number		Spares		Total		Total
	Surf.	Under.	Surf.	Under.	Surf.	Under.	
Analog	1	2	5	5	6	7	13
OnOff	1	3	5	5	6	8	14
AnaDig	0	4	5	5	5	9	14
Controller	1	6	5	5	6	11	17
PCO	2		4	4	-	-	10

I/O type	Channel numbers		Spare channels		Total		Total
	Surf.	Under.	Surf.	Under.	Surf.	Under.	
Analog Input PT100	13	8	7	4	20	12	34
Analog Input 4-20mA	3	7	13	9	16	16	32
Analog Output	1	2	7	6	8	8	16
Digital Input	7	24	25	8	32	32	64
Digital Output	7	24	25	8	32	32	64

Thermosiphon user interface main panel

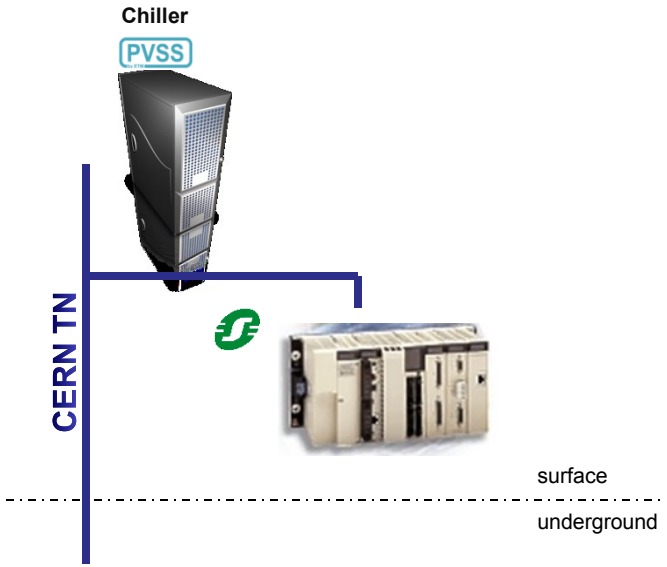


- All panels and sub panels created for 2kW thermosiphon test stand will be re-used for 60kW
- All required dependent logic conditions and calculations will be tested on 2kW unit
- UNICOS projects (chiller and thermosiphon) will be integrated in one homogenous SCADA system

Main PVSS panel - for 2kW Thermosiphon test stand

Chiller requirements

Requirements:
- SCADA system with long term logging
- Schneider PLC and distributed I/O
- software which conforms CERN standard

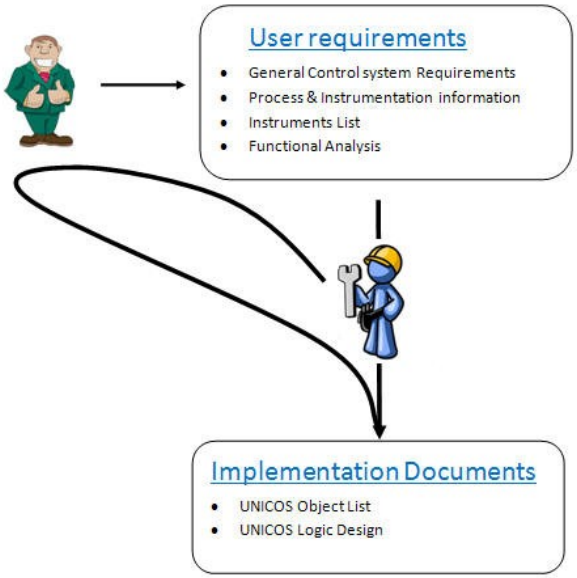


Solution:

a) Software:
- UNICOS framework (CERN standard)
- Schneider Unity v5.0
- data server: Linux machine with PVSS 3.8 placed in BE/CO

b) Hardware
- Supplier provides:
  - control & electrical cabinets cabled up to the terminal blocks
  - all sensors and actuators respecting CERN standards
- CERN provides PLC, I/O cards
- CERN will prepare the control software

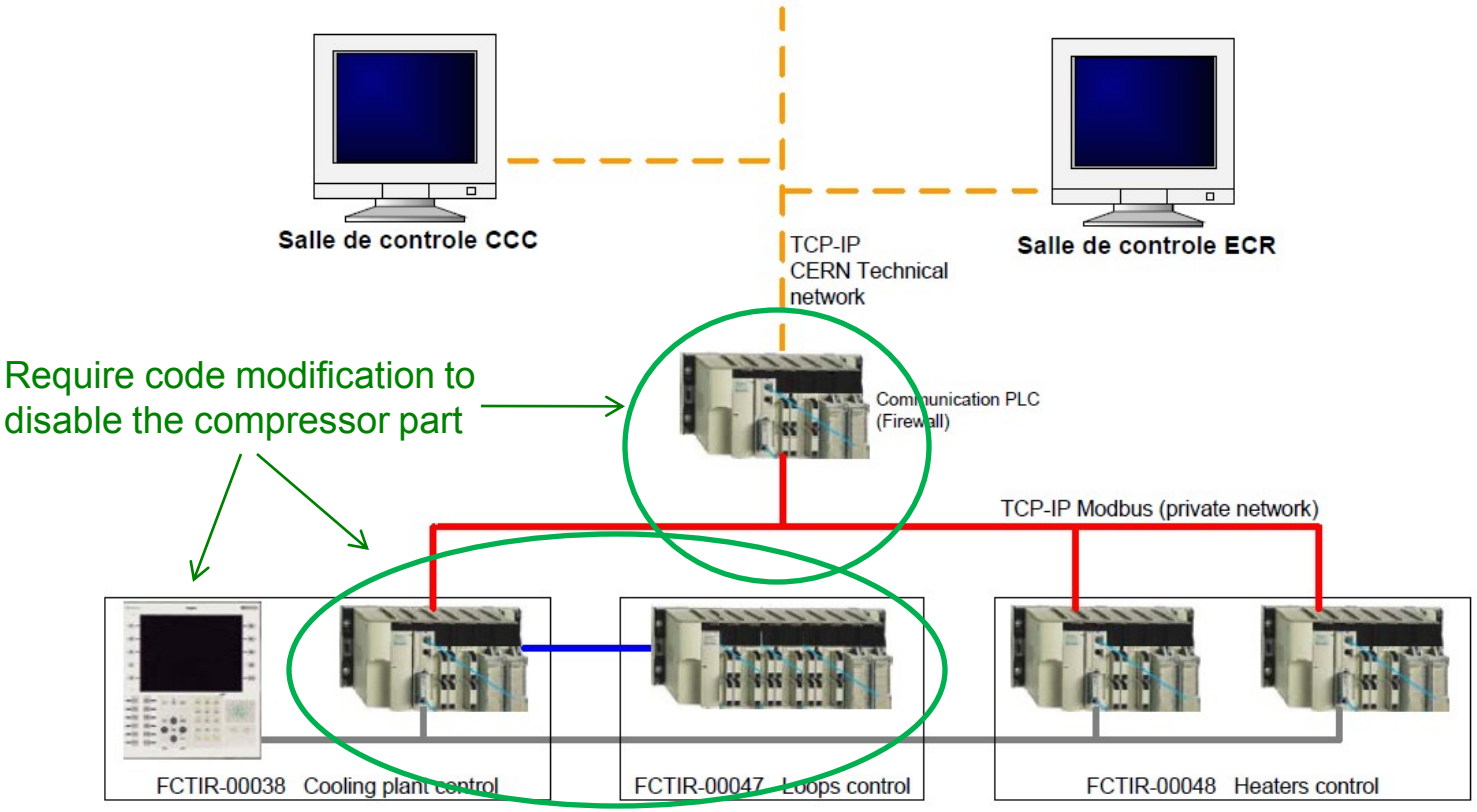
c) Other
- Supplier provides documents: General Control System Requirement, Functional Analysis, Process & Instrumentation information, Instrument List
- CERN provides templates for the documents listed above http://j2eeps.cern.ch/wikis/display/EN/Specifications



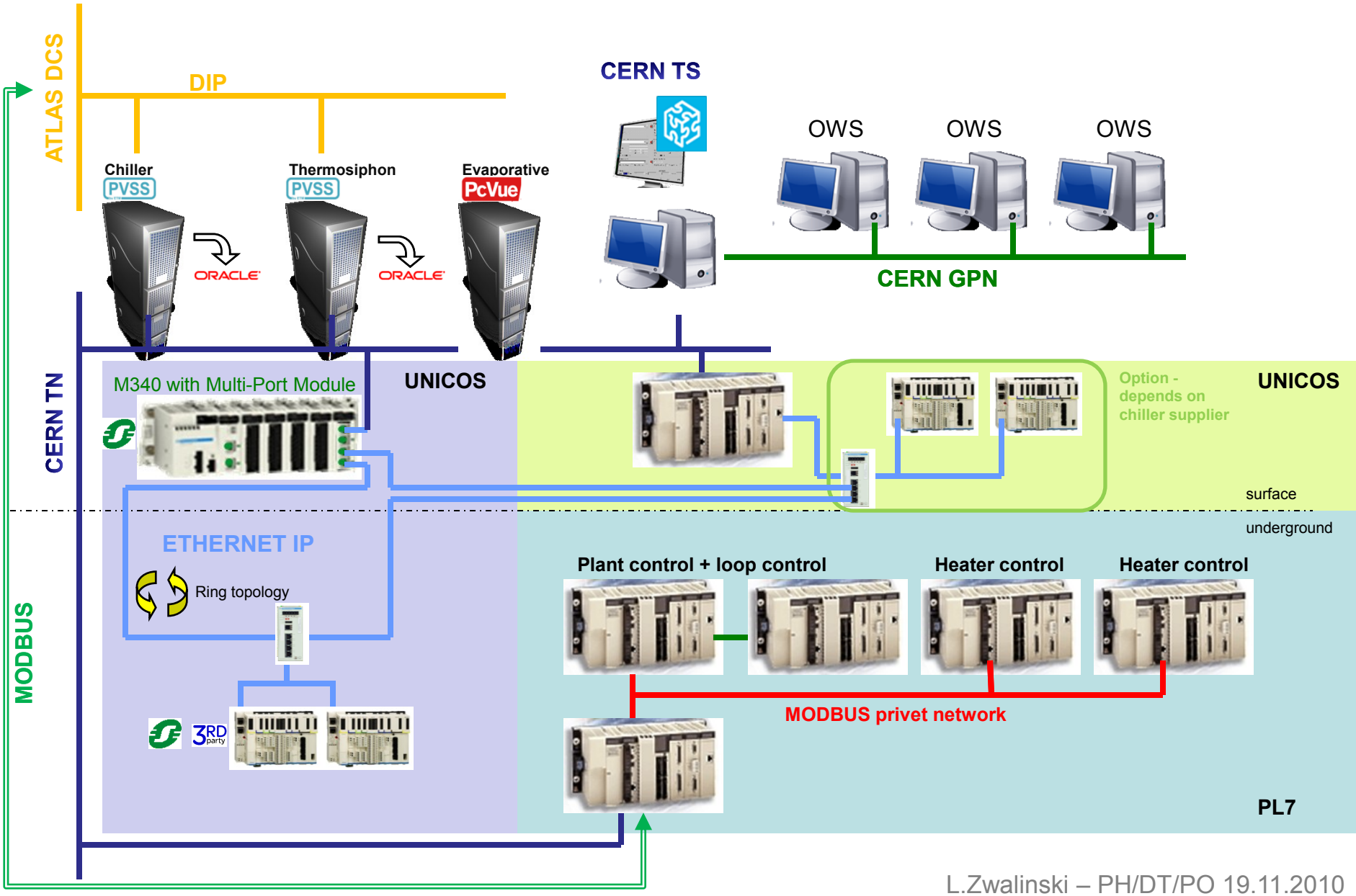
Current ATLAS ID evap. cool. control system architecture

- 3x Schneider PL7 PLCs connected in privet network
- One communication PLC distributing data for SCADA system

ARCHITECTURE AUTOMATES:



Overall architecture



Conclusions

- The control systems of the **Thermosiphon** and **Chiller** will be done with **UNICOS** framework
- The evaporative system stay in **PL7**
- **EN/ICE** will provide support to build up the UNICOS systems
- We will have two different SCADA systems **PVSS** and **PCVUE**
- All selected architecture will be tested in laboratory conditions with **mirror** machine.

  (To verify all the communication issues we will prepare the laboratory test stand with reproduced Evaporative PL7 PLCs and new UNICOS PLCs)