UNICOS: UNIFIED INDUSTRIAL COCONTROL SYSTEM

CPC (CONTINUOUS PROCESS CONTROL)

BASIC COURSE

SESSION 1: PROJECT SPECIFICATIONS

UNICOS-Continuous Process Control

CERN EN/ICE group

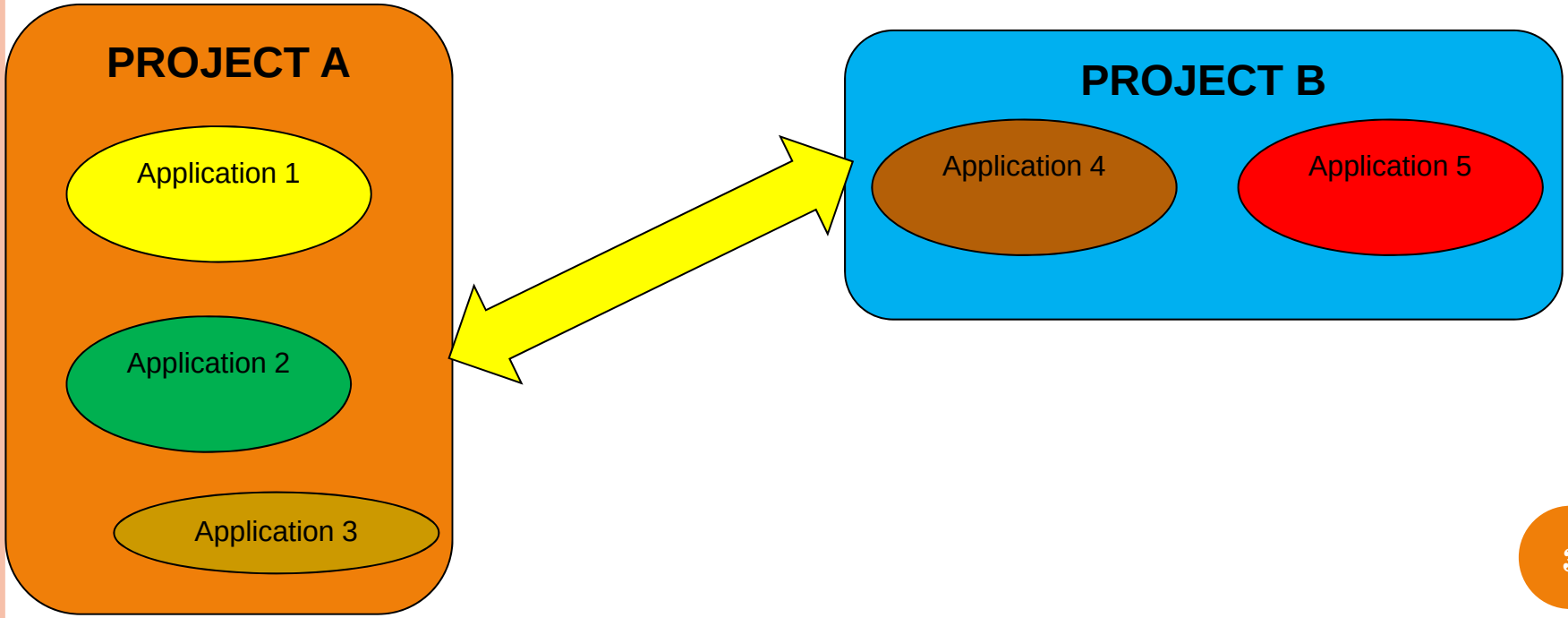
PROJECT SPECIFICATION: CONTENT

- **Introduction**
- **Hardware architecture** *[vsd]*
  - Contain the PLC/SCADA architecture
- **Electrical Diagrams** *[pdf]*
  - Contain electrical schema of the cubicle with all PLC I/O connections
- **P&ID** *[xml]*
  - Process and Instrumentation Diagram
- **Functional Analysis** *[docx]*
  - Describe the automatic behavior of the process
- **UNICOS Spec** *[xml]*
  - Used to generate PLC program and SCADA instances

INTRODUCTION

- **Project**:
  - One WinCCOA project where all data can be shared
  - Can be distributed projects sharing data at SCADA level

- **Application**:
  - One or several PLC



RULES TO RESPECT IN SPECIFICATIONS

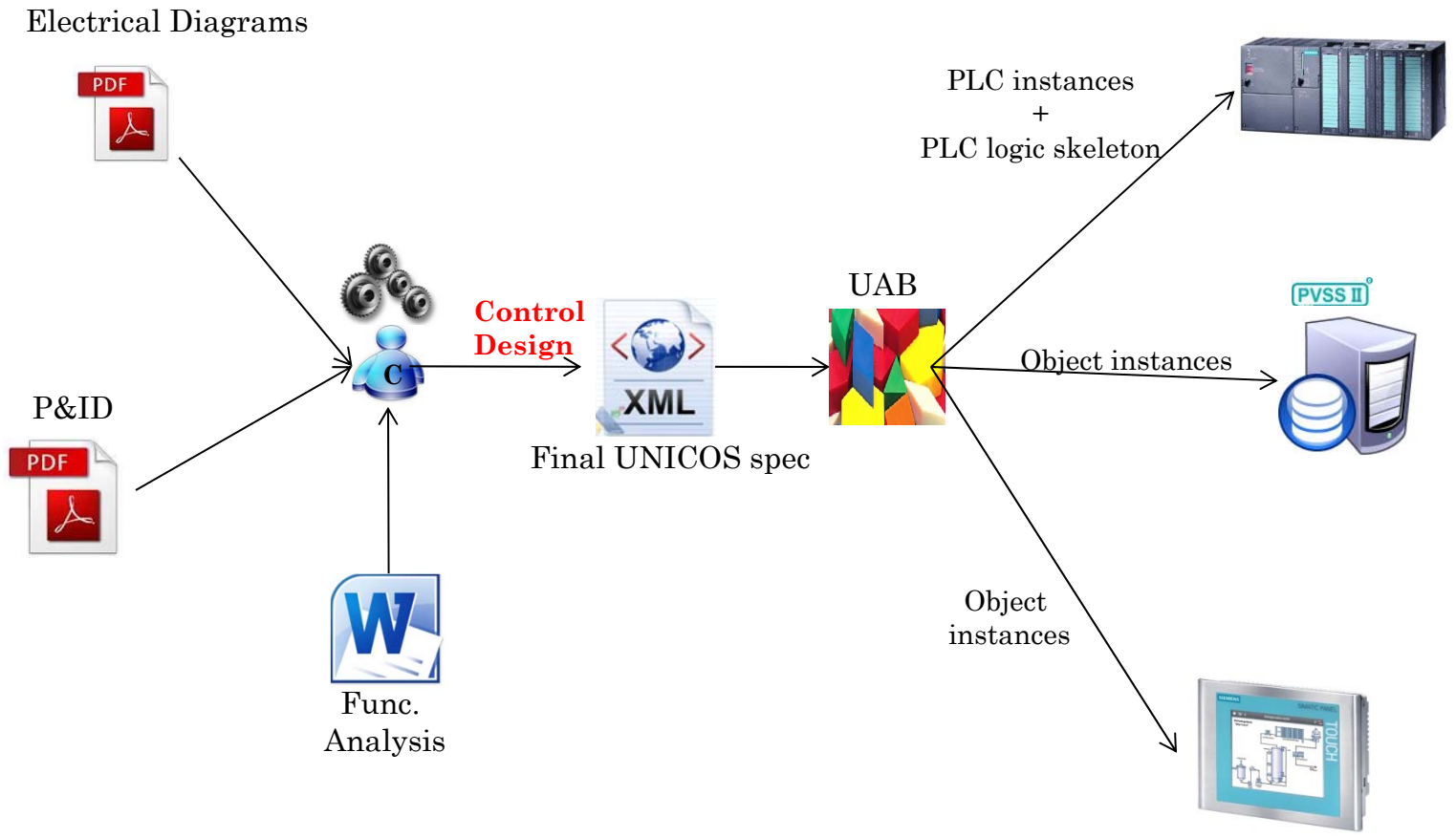
- Respect templates
  - Keep formatting
  - Keep numbering
- People involved in documentations have to be clearly mentioned
- Keep same language in all documentation (English preferred)
- Naming Convention is mandatory
  - For project name
  - For I/O
  - For actuators/controllers

TUTORIAL: QSDN

- **Q** = Cryogenics
- **S** = Surface
- **D** = Dewar
- **N** = Nitrogen

- We will keep this project example for the whole course
  - Simple (2 tanks with few input/output valves)
  - Easy to understand, no need to be cryogenists!
  - Real case
  - Related to superconducting accelerators

UNICOS-CPC TOOLS



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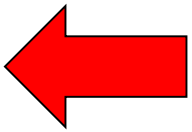

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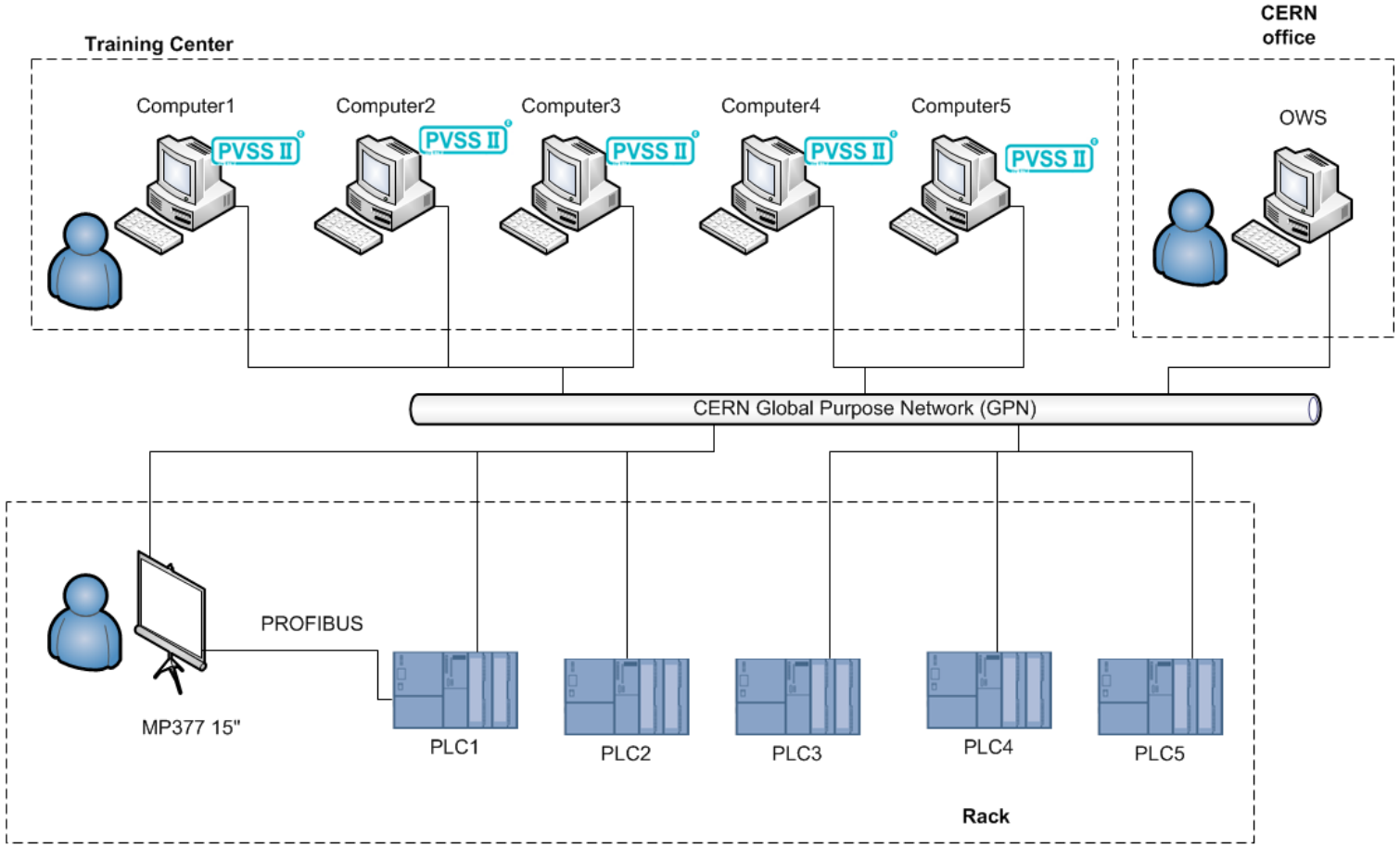
HARDWARE ARCHITECTURE

- One hardware architecture by project



Hardware Architecture for "TUTORIAL"		SIZE	FSCM NO	DWG NO	REV
					1.0
DRAWN	B. Bradu EN-ICE				
ISSUED	18/09/2012	SCALE	1:1	SHEET	1 OF 1

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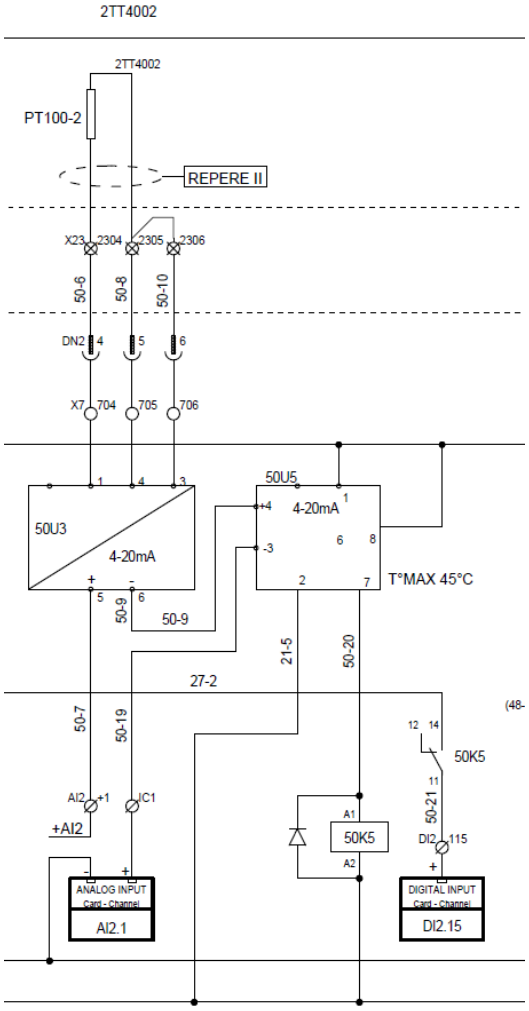
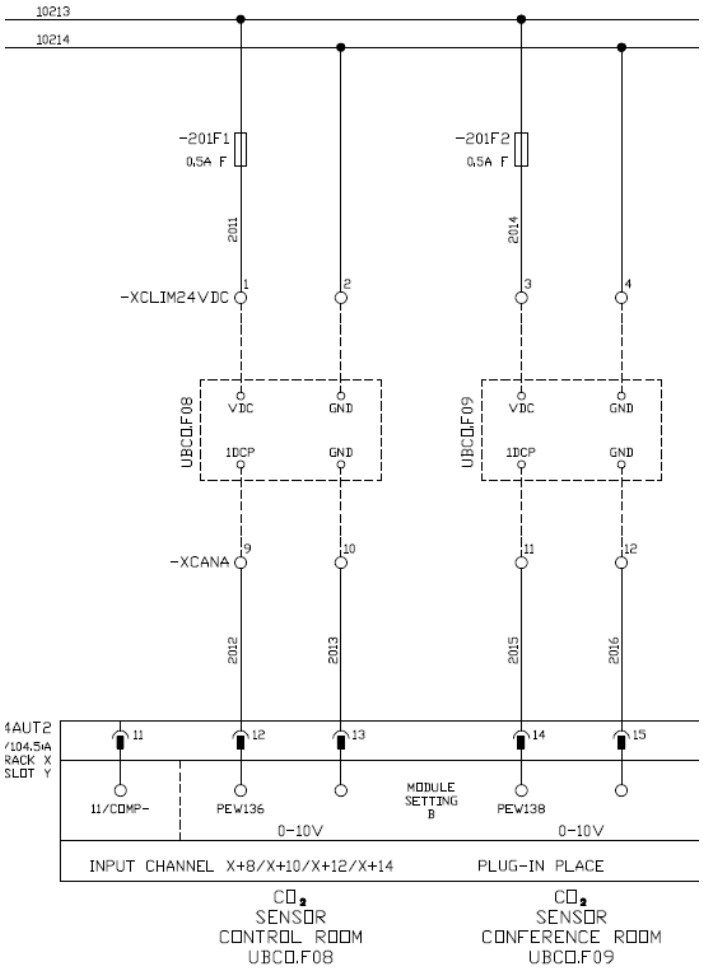
ELECTRICAL DIAGRAMS

- **Electrical diagrams allow developers to identify all I/O connected to a PLC with their addresses.**
  - ✓ **Examples for Schneider and Siemens PLC:**





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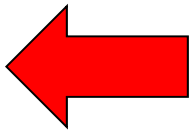
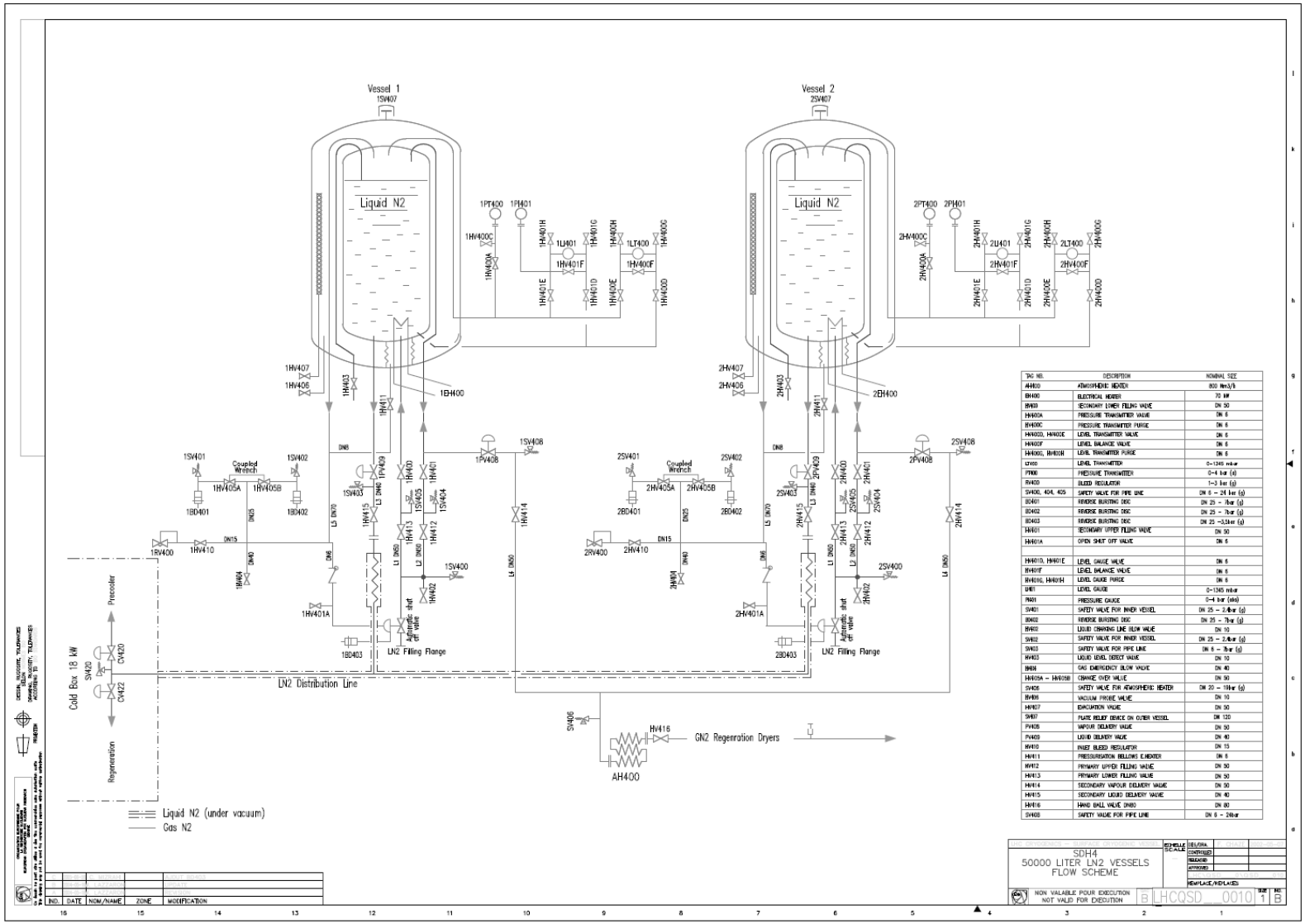


- **Functional Analysis** *[docx]*
  - Describe the automatic behavior of the process
- **UNICOS Spec** *[xml]*
  - Used to generate PLC program and SCADA instances

P&ID

- **Process & Instrumentation Diagram allows to identify sensors and actuators of the process and to have a general overview of the system**



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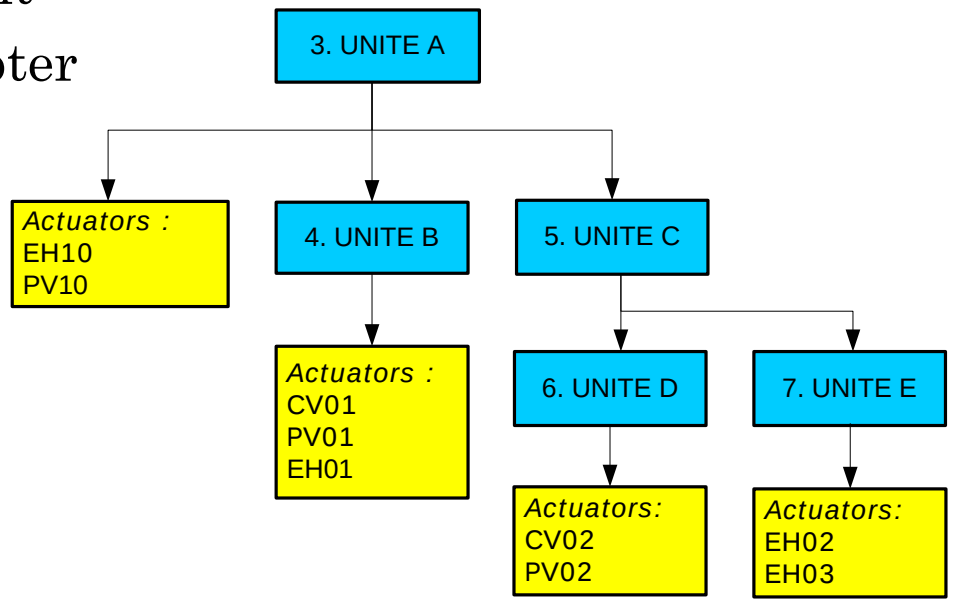
Functional Analysis

- Descriptive document
  - Oriented for Continuous Process Control (CPC)
  - Exhaustive document
  - No PLC language inside
  - No platform oriented
  - Structured English, drawings and diagrams can be used

- Describe the automatic behavior of the process
  - General description of process
  - Decomposition of the process into control units
  - Exhaustive descriptions of unit behaviors
  - Exhaustive descriptions of actuator behaviors
  - Exhaustive descriptions of regulation loops
  - Exhaustive descriptions of alarms and interlocks
  - Exhaustive descriptions of possibilities given to operators

FUNCTIONAL ANALYSIS

- Chapter 1: Introduction
- Chapter 2: Description of process
- Chapter 3,4,5, etc. : Control units
  - Follow the process decomposition (Plant Hierarchy)
  - One chapter per unit
  - 10 paragraphs/chapter

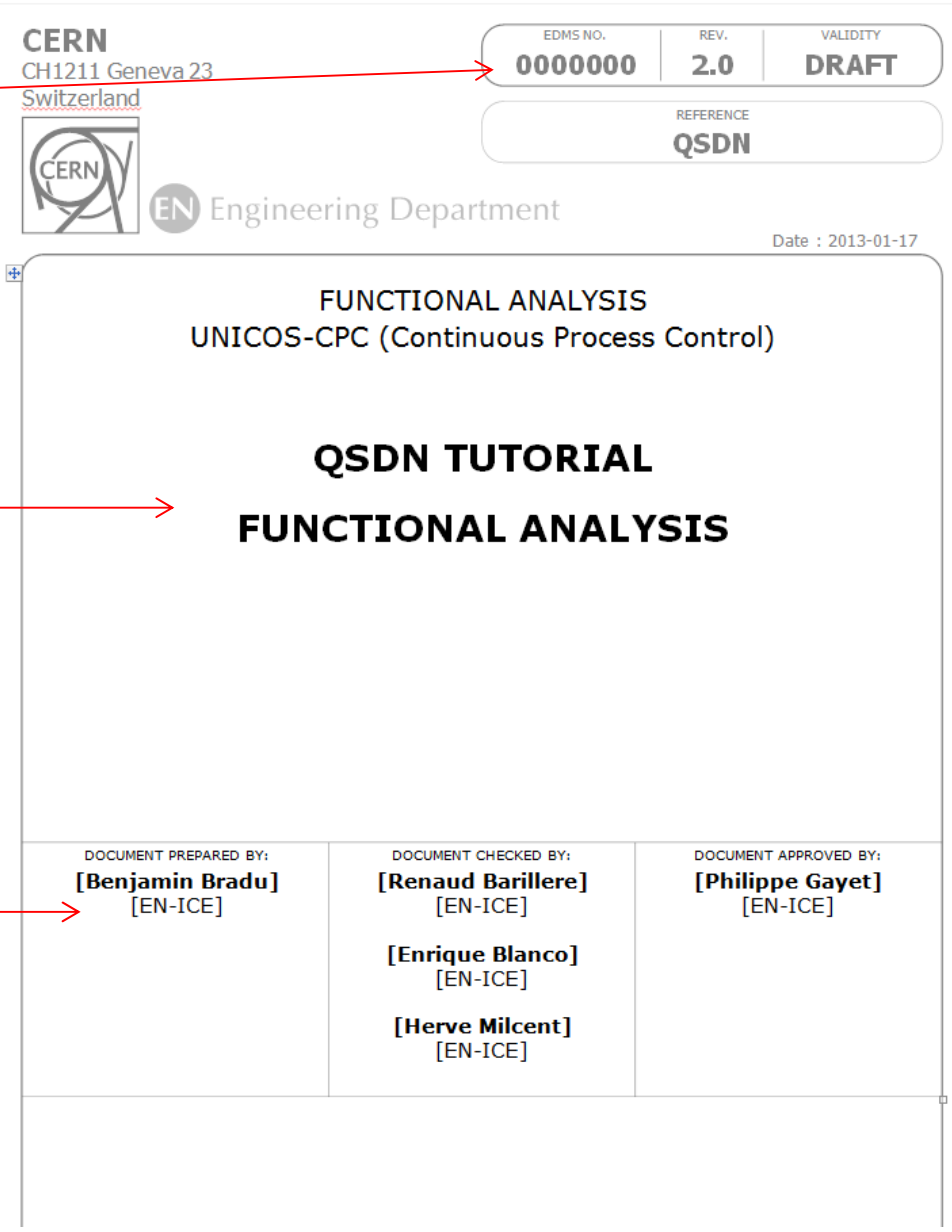


Title Page

EDMS Number and revision (CERN Database)

Application Name (Unique at CERN)

Name of involved People



CERN
CH1211 Geneva 23
Switzerland

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REFERENCE QSDN

EN Engineering Department

Date : 2013-01-17

FUNCTIONAL ANALYSIS
UNICOS-CPC (Continuous Process Control)

QSDN TUTORIAL

FUNCTIONAL ANALYSIS

DOCUMENT PREPARED BY:	DOCUMENT CHECKED BY:	DOCUMENT APPROVED BY:
[Benjamin Bradu] [EN-ICE]	**[Renaud Barillere]** [EN-ICE] **[Enrique Blanco]** [EN-ICE] **[Herve Milcent]** [EN-ICE]	**[Philippe Gayet]** [EN-ICE]

Document History

HISTORY OF CHANGES

REV. NO.	DATE	PAGES	DESCRIPTIONS OF THE CHANGES
1.0	20 May 2011	all	First Version (E. CIMETIERE)
2.0	03 Nov 2011	All	Add alarm/actuator logic and reorganization (B. Bradu)
2.1	18 Nov 2011	All	Last check and modig with Sabri (B. Bradu)
2.2	01 Dec 2011	All	Name modif (UMRM-F04) and re-organisation (B.Bradu)
2.3	07 Dec 2011	All	Rename FAHVCRR-001 as FSVE-005 (B.Bradu)
2.4	19 Jan 2012	12;18	UIMV interlock, UIMV=50% min, Controllers (B.Bradu)
2.5	20 Jan 2012	7	DO default general (B. Bradu)

TABLE OF CONTENT

TABLE OF CONTENTS

1. INTRODUCTION

- Brief explanation of the general context of the project
  - Can give main engineering data of the process (capacity, power…)

An example is given here for a functional analysis for the control system of the QSDN_TUTORIAL which is composed of 2 nitrogen storage vessels of 100 m^3 each.

This example has been extracted from a CERN existing process and adapted to perform a tutorial adding some actuators and functionalities.

1.1 TERMINOLOGY

- **Actuator:** defined as *control module* in IEC 61512-1:
  - A piece of equipment acting on the plant
  - Acts as a single entity from a control standpoint
  - Is the direct connection to the process and can embed sensors
  - Cannot execute procedural sequences
  - Examples: valves, motors, pumps, fans etc.
- **Unit:** defined as *unit* or *equipment module* in IEC 61512-1:
  - Collection of actuators and/or other units
  - Can carry out a finite number of minor processing activities
  - Contains all the necessary processing equipments to carry out these activities
  - Can execute procedural sequences
  - Examples: Compression station : 3 compressors + 4 valves
- **Controller:** Regulation algorithm able to control a process variable (ex: PID controller)
- **Object:** Unit or Actuator or Controller
- **Operational State**: unit can be setup in different operational states (ex: Cooling, Heating).

1.1 TERMINOLOGY

- **Interlock**: Asynchronous condition stopping an actuator or a unit or preventing from starting for security reasons. An interlock must not be used for normal operation but for abnormal behaviour. Software interlocks are not guarantying human security.

- The possible interlocks for a complete unit or for an actuator are:
  - **Full Stop Interlock (FS)**: Stop the unit/actuator (all dependent units/actuators are set to their fail-safe position) and wait manual acknowledgement before restarting.
  - **Temporary Stop Interlock (TS)**: Stop the unit/actuator (all dependent units/actuators are set to their fail-safe position) and restart automatically when the interlock disappears.
  - **Start Interlock (SI)**: Prevent the unit from starting (all dependent units/actuators stay in their fail-safe position).

- **Alarm (AL)**: It is an indication of a potential problem to aware operator in SCADA.
  - Each interlock is generating an alarm automatically

- **User command**: Specific operator order to specify a particular action.

- **Computed Variables**: Values computed from a set of I/O signals or from parameters.

2. Process Description

- 2.1 General consideration
  - Description of process, its objective and its task to perform
  - You can explain briefly the different behaviours of the system here in subparagraphs if necessary.

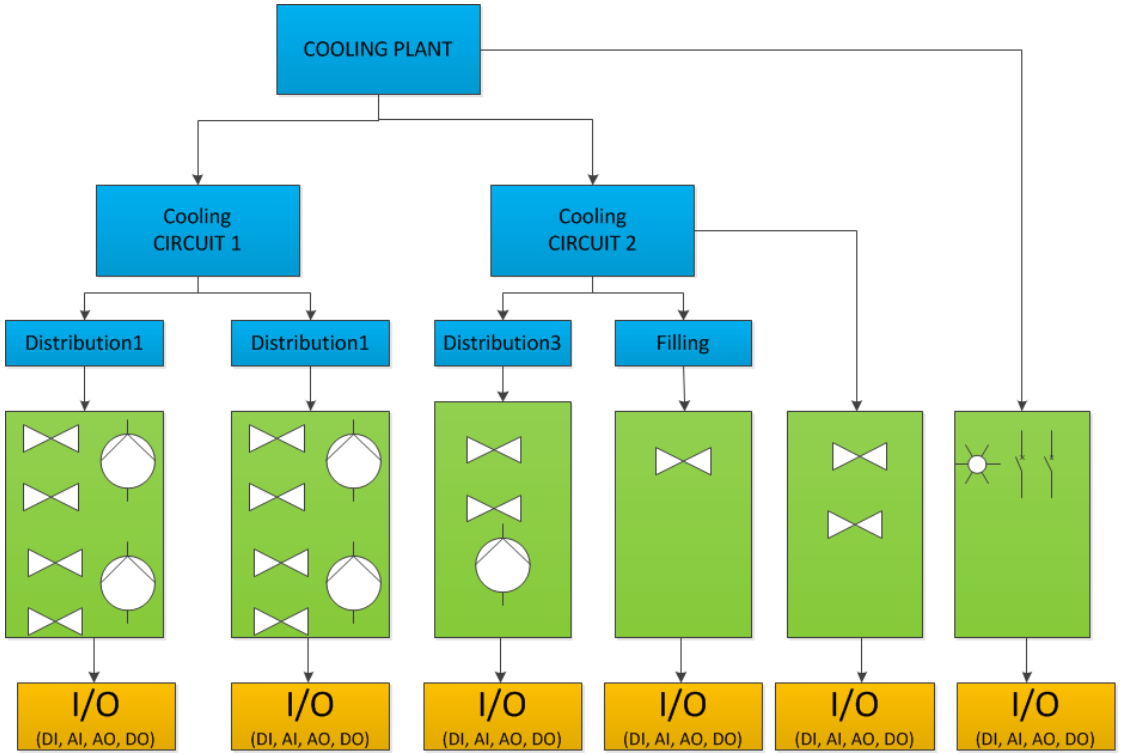
The QSDN represents 2 nitrogen storage vessels of 100 m^3 each. They can provide liquid nitrogen to cryoplants via 2 on/off valves (xPV409). Moreover, each vessel can be filled from a nitrogen truck and the internal pressure of vessels is regulated by an electrical heater xEH400. Each vessel has also a gas outlet xPV408 to provide warm gaseous nitrogen.

2. Process Decomposition

- The process decomposition must respect all the following constraints:
  - Top to Bottom
  - Modular
  - Hierarchical
  - Structured

- To make such process decomposition in units:
  - A unit always embeds at least one other unit or one actuator.
  - Always define a “top parent unit” representing the whole plant.
  - Split the plant in independent “child units” which could be operated individually.
  - Associate eventually actuators to the top unit if they cannot be attached to other units.
  - Repeat steps ‘b’ and ‘c’ until the units contain only actuators.

EXAMPLE OF PROCESS DECOMPOSITION



PCO (Process Control Object) ➔ Process unit

FIELD OBJECTS ➔ Actuators (OnOff or Analog)

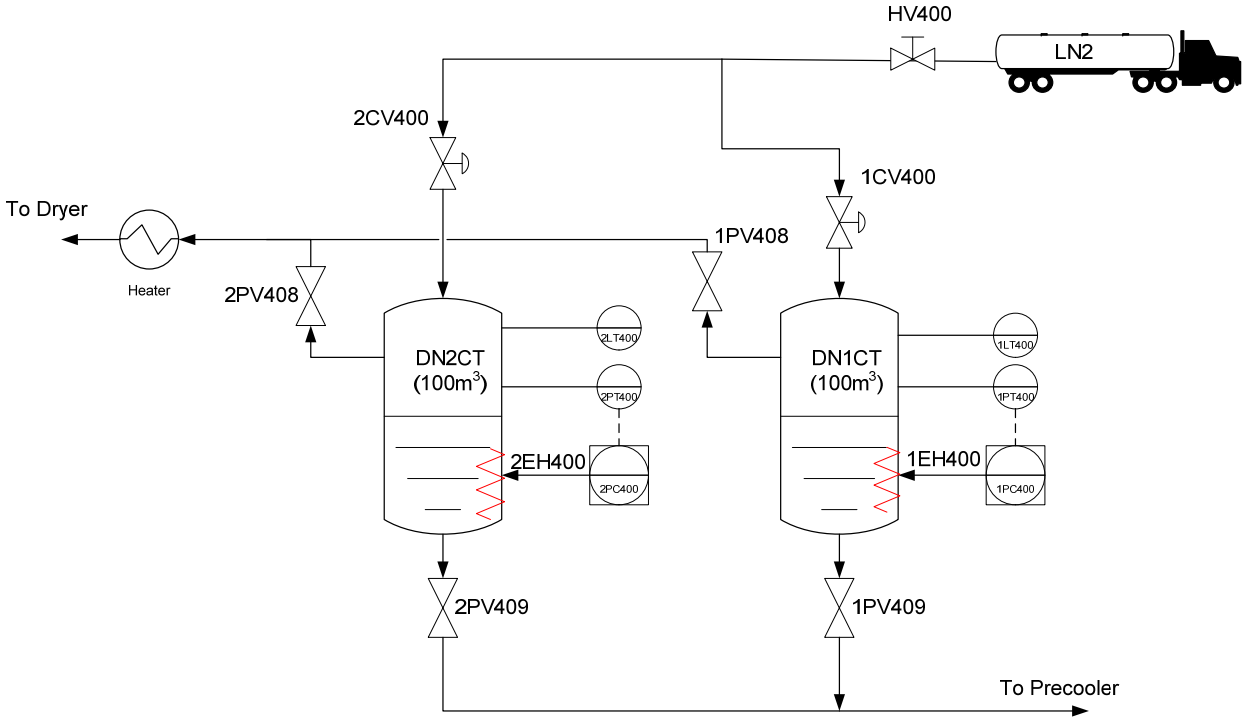
I/O OBJECTS ➔ Sensors ou actuator orders

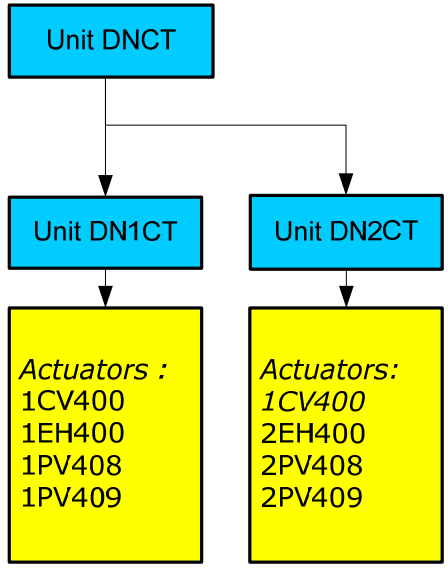
Run Order ALWAYS follow the hierarchy

Operators can interact at ALL levels

QSDN EXERCISE

- Make process decomposition
  - 2 filling valves
  - 2 liquid outlet valves
  - 2 gaseous outlet valves
  - 2 Heaters (control tank pressure)





X. UNIT

- X. Unit
  - Introduce briefly the unit and its aim

This unit represents the vessel number 1. Its internal pressure should be controlled.

- X.1. Controlled objects
  - X.1.1. Unit
  - X.1.2. Actuators
    - Specify range and speed
  - X.1.3. Controllers

Actuators

- 1CV400: Filling Valve
  - *Range: 0-100 %*
  - *Speed: 2%/s*
- *1EH400: electrical heater driven by PWM*
  - *Range: 0-72 kW*
  - *Speed: 1kW/s*
  - *PWM period = 2s (min pulse = 0.2s)*

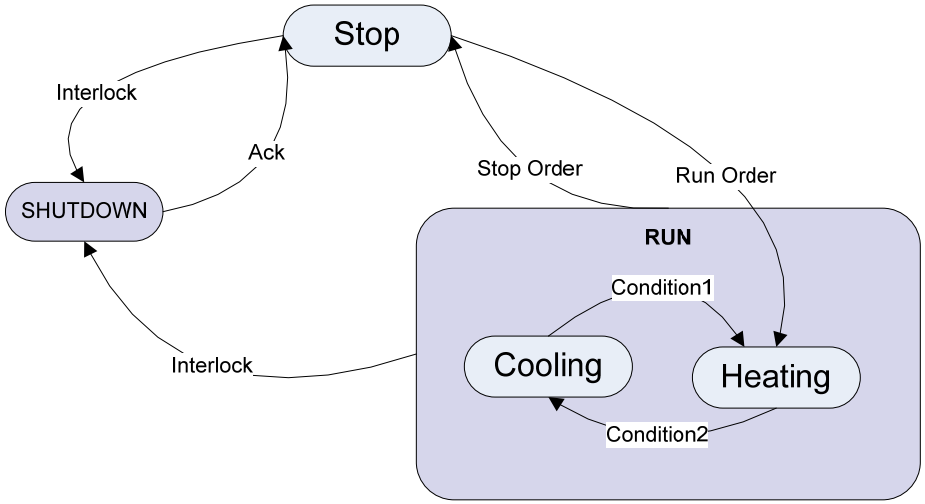
- *1PV408: onoff Valve going to dryer*
- *1PV409: onoff valve going to precooler*

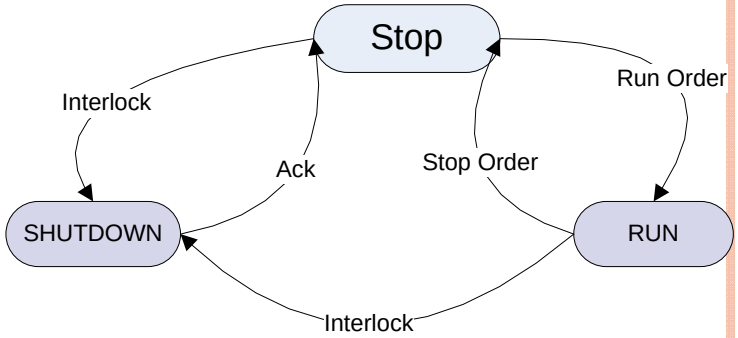
Controller

- 1PC400: Pressure Controller

X.2 OPERATIONAL STATES

- X.2 Define the operational states of the unit
  - Makes use of a process control diagram





- X.2.1. Define operational states

Mode « STOP » : everything is stopped and there is no interlock on the unit.

Mode « SHUT DOWN » : The process is stopped because an interlock was triggered and it has not been acknowledged

Mode « RUN » The motor is running and the temperature is controlled

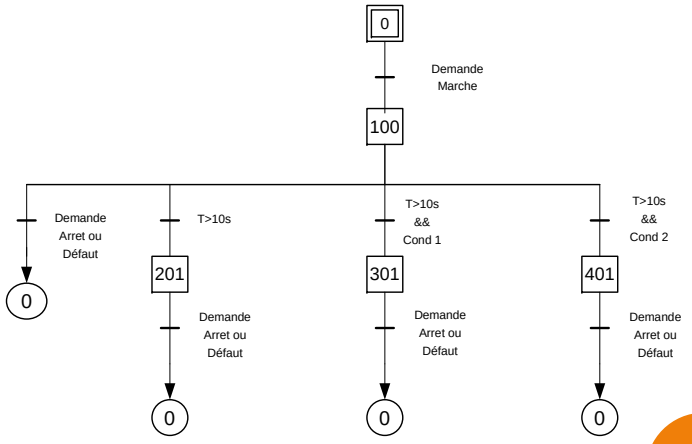
X.2 OPERATIONAL STATES

- X.2.2. Transition condition
  - Eventual complex transition

Condition1 = valves CVXX is openned more than 10 sec and the pressure PTXX is below 1 bar.

- X.2.3. logical sequence
  - Inside an operational states, you can define sequences
  - Text or sequential chart

When we enter in the state "Cooling":
- Open valve PV01
- Wait10s
- Start regulation PC01
- Wait CV01 >10%
- Close PV01



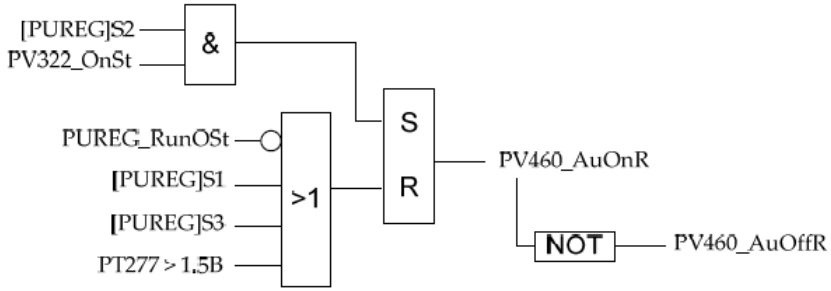
X.3 ACTUATOR BEHAVIOUR

X.3 Actuator Behaviour

- 3 possibilities according to the process
  - Behaviour = f(operational states) ➔ Table
  - Behaviour = more complex➔ Structured English or Block Diagrams

Unité / actionneurs	Stop	Mode1	Mode2	Mode3
Unit B	OFF	OFF	ON	ON
CV01	0%	10 %	Controlled by PC01 SetPoint = 2 bar	Controlled by PC01 SetPoint = 1 bar
EH01	0kW	1 kW	50kW	10 kW
PV01	OFF	OFF	ON	OFF

CV01
- *Position = 0% if UnitA=Stop and PT01<5 bar*
- *Position = 5% if UnitA=Stop and PT01>5 bar*
- *Position = 10% if Unit1= mode2 and PT01 <5 bar*
- *Position = 20% if Unit1= mode2 and PT01 >5 bar*
- *Regulée par PC01 if Unit1= mode2 or mode3*

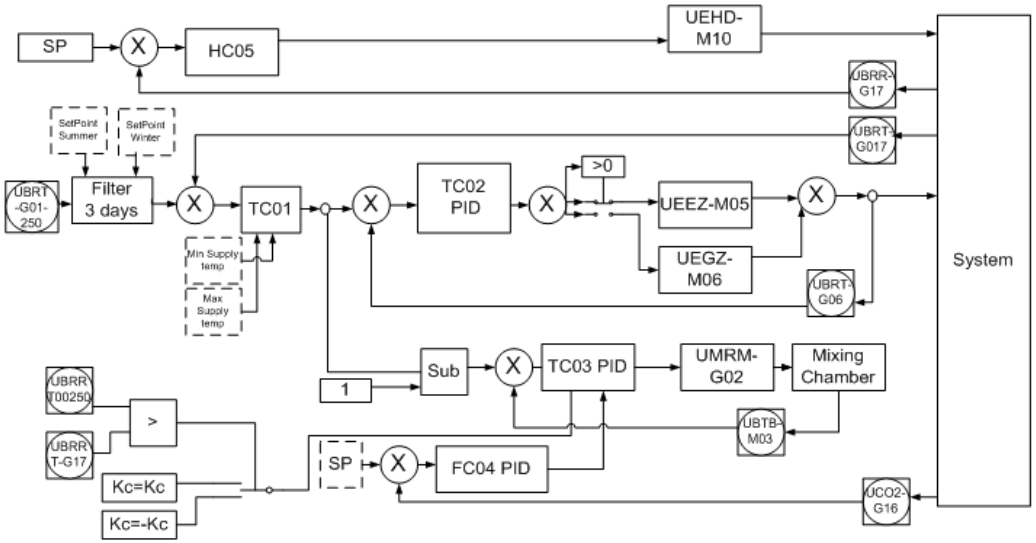


X.4 REGULATION LOOPS

- Description of regulation loops
  - Simple text description if simple loops
  - General schema if complexe cascades

TC02

- **Function**: Supply temperature regulation
- **Controlled variable**: UBRT-G06 (ºC)
- **Output Range:** -100%.. 100%
- **Reverse Action**:No
- **Controlled actuator**:
  1. UEEZ-M05 (0..100%)
  2. UEGZ-M06 (-100%..0%)
- **PID default parameters**: Kp/Ti = 0.7/600s
- **SP:** given by TC01
- **Set Point speed:** 1C/min



USER COMMAND AND PARAMETERS

- X.5. User commands and parameters
  - Dont contain standard user commands
    - Run/Stop Order on units/actuators
    - Setpoint/parameters/limits of controllers

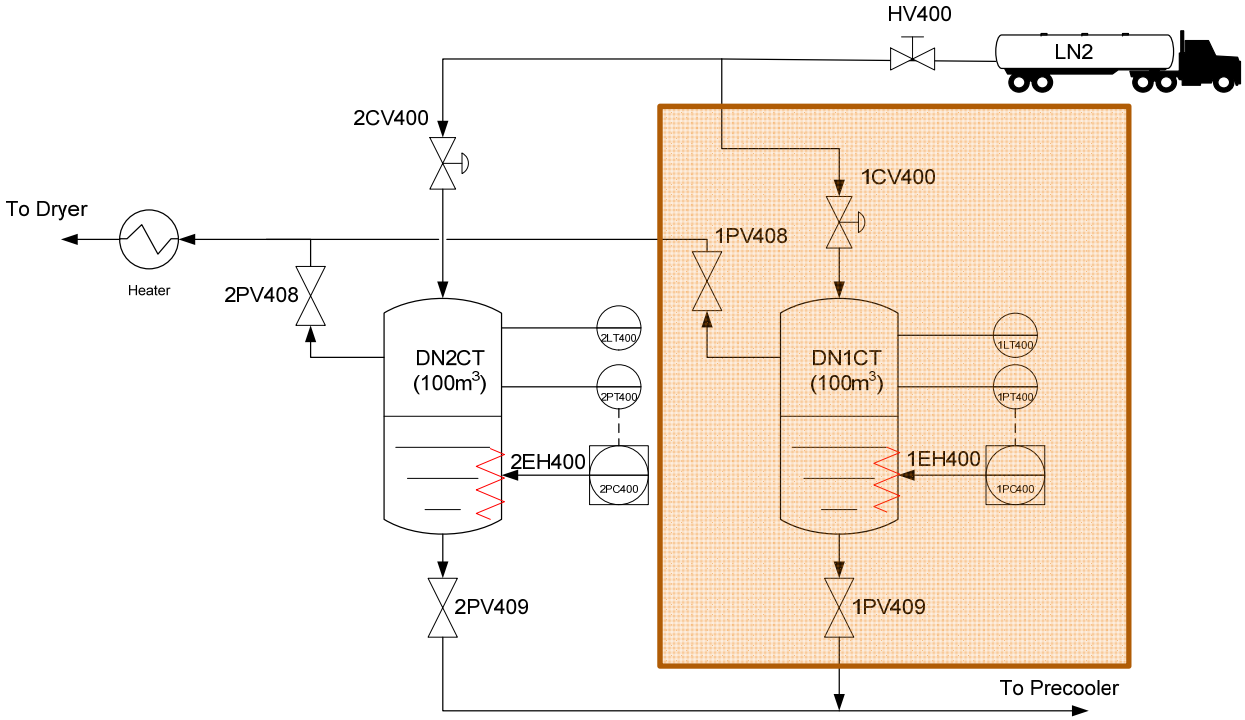
***DN1CT_Fill**: Operator order to fill-in vessel 1. When the vessel is in Run Mode, this button must be disabled.*

- X.6. Computed variables
  - Definition of calculation necessary to mak the installation working or to display in SCADA
    - Thermodynamic properties
    - Working time of a pump

Nom, description	Type	Unit	Calcul
LT1 Level in percentage	Real	%	LT1 = (M1 * 50)/100
P1_Time	INT	hr	Working time of the pump P1

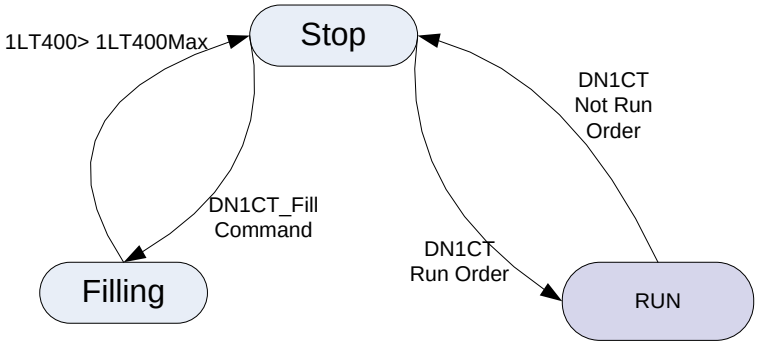
QSDN EXERCISE

- Draw Process Control Diagram for the vessel1 (DN1CT) and write associated actuator behaviors, regulation loop and user commands
  - The vessel is either disconnected, either connected via 1PV408/409.
  - When the vessel is disconnected, it can be filled with 1CV400 via a dedicated button (the valve is then closed when a certain level limit is reached).
  - During the connection of the vessel, valves should be opened first and then the heater control can be activated (and no sequence for disconnection).
  - During a vessel switch, both vessel should be connected together before the stopping of a vessel.
  - The pressure set-point should linearly move with the level (2.6 bar for 20 000kg and 2.9 bar for 4000 kg)



QSDN EXERCISE (ONE SOLUTION)

- **Operational states:**
  - **Stop** : The Vessel1 is disconnected
  - **Filling**: The Vessel1 is being filled
  - **Running**: The Vessel1 is connected to clients



- **Logical sequence**

When enter in RUN Mode:

- **Step 1 :** Start 1EH4001Ok, 1EH4002Ok, 1EH4003Ok
- Wait for at least 2 feedbacks in 1EH4001On, 1EH4002On, 1EH4003On
- **Step 2 :** Open 1PV408 and 1PV409
- Wait for feedbacks 1GH408 and 1GH409
- **Step 3 :** Start the Regulation on the controller 1PC400 to control the heater 1EH400

When the unit DN1CT received an order to stop and if DN2CT has an order to start (vessel switch)

- **Step 1**: Stop Regulation 1LC400
- **Step 2**: Stop 1EH4001Ok, 1EH4002Ok, 1EH4003Ok
- Wait 2PV108 and 2PV409 feedback On
- **Step 3 :** Close 1PV408 and 1PV409

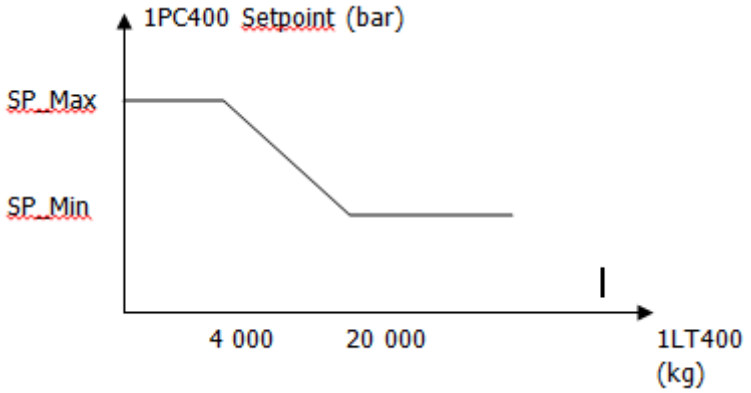
- **User commands:**
  - **DN1CT_Fill**: Operator order to fill-in vessel 1. When the vessel is in Run Mode, this button must be disabled.
  - **1LT400_Max**: Maximum Level to close the filling valve 1CV400 (30 000 kg per default)
  - **SP_Max**: Maximum pressure when 1LT400 = 4000 kg (2.9 bar per default)
  - **SP_Min**: Minimum pressure when 1LT400 = 20000 kg (2.6 bar per default)

QSDN EXERCISE (ONE SOLUTION)

- **Units/Actuators Behahiours**

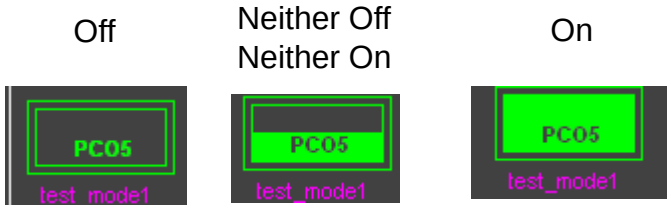
	Stop	Running	Filling
1PV408	Off	On	Off
1PV409	Off	On	Off
1EH400	0%	Controlled by 1PC400	0%
1CV400	0%	0%	100%

- **Regulation Loops**
  - **1PC400**
    - *Controlled variable: 1PT400 (bar)*
    - *Controlled actuator: 1EH400 (kW)*
    - *PID default parameters : Kc/Ti = 2/1500*
    - *Set-Point limits : 2-4 bar*
    - *Set-Point speed: 0.01 bar/s*
    - Reverse action = FALSE



STATUS AND EVENTS

- X.7 unit feedback
  - Allow to compute the unit feeback in SCADA
    - On: unit is considered as running
    - Off: unit is considered as stopped
  - Display in SCADA:



- X.8. Events
  - Can define significant events for a set of actuators

Overflow = tank level >90% and valve CV01 > 90%.

X.9. UNIT ALARM

- List and classify all alarms/interlocks having an impact on the **full unit.**
- **Consequences**:
  - The unit receives a stop request
  - All dependent actuators will pass to auto mode (except if they are forced)
  - After the stopping of the unit, all dependent actuators can be taken in manual mode again

Name	Condition	Action*	Message
UAVA_002_FS1	UMFV_M10 is in Full Stop	FS	Interlock Moto-Ventilateur UMFV.M10
UAVA_002_FS2	UBTA_M06_002 for 30s	FS	UAVA is FREEZING
UAVA_002_AL1	UAVA_UBAY_M03_002	AL	Filter UFPZ.03 full
UAVA_002_AL2	UAVA_UBAY_M05_002	AL	FilterUFFM.05 full
UBT2_M08_002_AL	UAVA_UBT2_M08_002 > 12C (H)	AL	Return chilled temperature too high

**FS = Full Stop Interlock ; TS = Temporary Stop Interlock ; SI=Start Interlock ; AL=Alarm*

X.10. ACTUATOR ALARMS

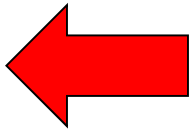
- List and classify all alarms/interlocks having an impact on a **single actuator.**
- **Consequences**:
  - The actuator goes in its fail-safe position
  - Impossible to send Manual/Forced actions on the actuator during interlock

Name	Condition	Action*	Message
UMFV_M10_002_FS1	UIAC_DisjO_017 AND UMFV.M10 Start Request for 3 sec	FS UMFV_M10	Breaker UIVM Open
UMFV_M10_002_FS2	UIVM_Def_026 and Start Request for 5sec	FS UMFV_M10	Default on Speed variator UIVM
UMFV_M10_002_FS3	UAVA_UMFVDef_M10_002	FS UMFV_M10	Thermal default
UMFV_M10_002_FS4	UAVA_UIOA_M10_002	FS UMFV_M10	Fan Emergency Stop
UMFV_M10_002_FS5	UMFV On & NOT (UAVA_UBAY_M10_002) for 30sec	FS UMFV_M10	Pressure Discordance on Fan
UMRM_M08_002_AL1	UMRM_M08 start request and no feedback On	TS UMRM_M08	Damper Open Discordance
UMRM_M08_002_AL1	UBTT_M09 > 30 C (HH)	AL UMRM_M08	Supply Temperature High

**FS = Full Stop Interlock ; TS = Temporary Stop Interlock ; SI=Start Interlock ; AL=Alarm*

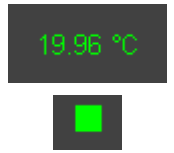
PROJECT SPECIFICATIONS: CONTENT

- **Introduction**
- **Hardware architecture** *[vsd]*
  - Contain the PLC/SCADA architecture
- **Electrical Diagrams** *[pdf]*
  - Contain electrical schema of the cubicle with all PLC I/O connections
- **P&ID** *[xml]*
  - Process and Instrumentation Diagram
- **Functional Analysis** *[docx]*
  - Describe the automatic behavior of the process
- **UNICOS Spec *[xml]***
  - **Used to generate PLC program and SCADA instances**



UNICOS-CPC OBJECTS

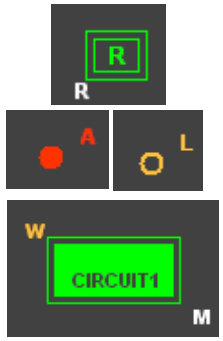
Widget examples



- **I/O Objects**
  - Analog Input *(e.g. temperature transmitter)*
  - Digital Input *(e.g. end contact)*
  - Analog Output *(e.g. control valve position order)*
  - Digital Output *(e.g. onoff valve position order)*

- **Field Objects**
  - OnOff Objects *(e.g. on/off valve)*
  - Analog objects *(e.g. control valve)*
  - Anadig objects *(e.g. valves controlled by on/off pulses)*
  - *AnaDO objects: OnOff + Analog (Motor with VFD, Thyristor, Heater, etc.)*
  - Local Objects *(e.g. manual valve)*

- **Control Objects**
  - Controller objects *(e.g. PID controller)*
  - Alarm Objects (*e.g. Temperature Too High*)
  - Process Control Objects : PCO (*e.g. Compressor Station*)



- **Interface Objects**
  - Digital/Word/Analog Parameters : Send a signal from SCADA to PLC (*e.g. Threshold*)
  - Digital/Word/Analog Status : Send a signal from PLC to SCADA *(e.g. stepper position)*

UNICOS-CPC SPEC: RULES

- Rules to respect in xml spec:
  - The extension of the file must be .xml
  - No special characters in names (underscore can be used)
  - To avoid problems of compatibility, when doing a copy/paste in excel, use the option "Paste Values" (Paste->Paste Values in the excel Home bar).
  - All red columns filled
  - Same language everywhere (English preferred)
  - All cells must be formatted as "text" (not number, scientific, etc.).
  - Object Names are Case Sensitive.
  - Do not modify the header (10 first lines).
  - Respect maximum number of char for Names:

Max. chars	PCO	I/O	Interface	Field	Alarms
Schneider	21	23	23	23	23
SIEMENS	19	24	24	19 (for Local objects is 21)	24

UNICOS-CPC SPEC: COLUMNS

- **Device:** General info Related to PLC&SCADA
  - Identification
  - Documentation
- **FE** (*Front-End*): Relative to the PLC only
  - Device Parameters
  - Device IO Config
  - Device Variables
  - Device Auto Request
  - Device Environmental Input

- **SCADA:** Relative to the SCADA only
  - Device Graphics
  - Device Functional
  - Data Archiving
  - Driver Data Smoothing
  - Device Alarm

- **Logic:** Relative to the logic of the device in PLC and in SCADA
  - Device Definition

FILL-IN THE UNICOS-CPC SPEC

1. Create all I/O from electrical schema (DI/DO/AI/AO/AIR/AOR)
2. Create all PCO according to your process decomposition in FA (Functional Analysis)
3. Create all parameters you need from FA in user commands (APAR/DPAR/WPAR/AOR)
4. Create all status you need to send to SCADA from FA in computed variables (AS/WS/AIR)
5. Create all actuators from DO/AO with P&ID (LOCAL/ONOFF/ANALOG/ANADIG/ANADO)
6. Create all Controllers from FA
7. Create all alarms/interlocks from FA in alarm tables (DA/AA)
8. Create SPARES objects everywhere to reserve PLC space in case of future modification. At least 10%.

QSDN Exercise: UNICOS Spec

- Create the UNICOS spec related to DN1CT
- Use CERN Naming Convention for cryogenics: QSDN_4_XXXXX
- DI:
  - 1LSL400: Vessel 1-Low Level Security Switch: I2.2
  - 1GH408/409: 1PV408/9 Openned: I4.7 / I5.1
  - 1GL408/409: 1PV408/9 closed: I5.0 / I5.2
  - 31Q1 : Circuit Breaker for 1EH400
- AI:
  - 1LE400: level of tank1 (0/1350mbar): PIW 108.
    - Computed level 1LT400: Corresponds to 0-38000 kg in the tank 1
  - 2LE400: level of tank2 (0/1350mbar): PIW 122
    - Computed level 2LT400: Corresponds to 0-38000 kg in the tank 2
  - 1GT400: Feedback Position of 1CV400 (0/100%): PIW132
  - 1PT400: Vessel 1- LN2 Vessel Pressure (0/4bar): PIW110
  - PT410: Air Supply (0/10 bar):PIW128
- DO:
  - 1PV408/9: open request of 1PV408/9: Q0.7/Q1.0
  - 1EH400DO: Digital command to electrical Heater 1EH400: Q1.4
- AO:
  - 1CV400AO: Order of 1CV400 (0-100%): PQW 108

QSDN Exercise: UNICOS Spec

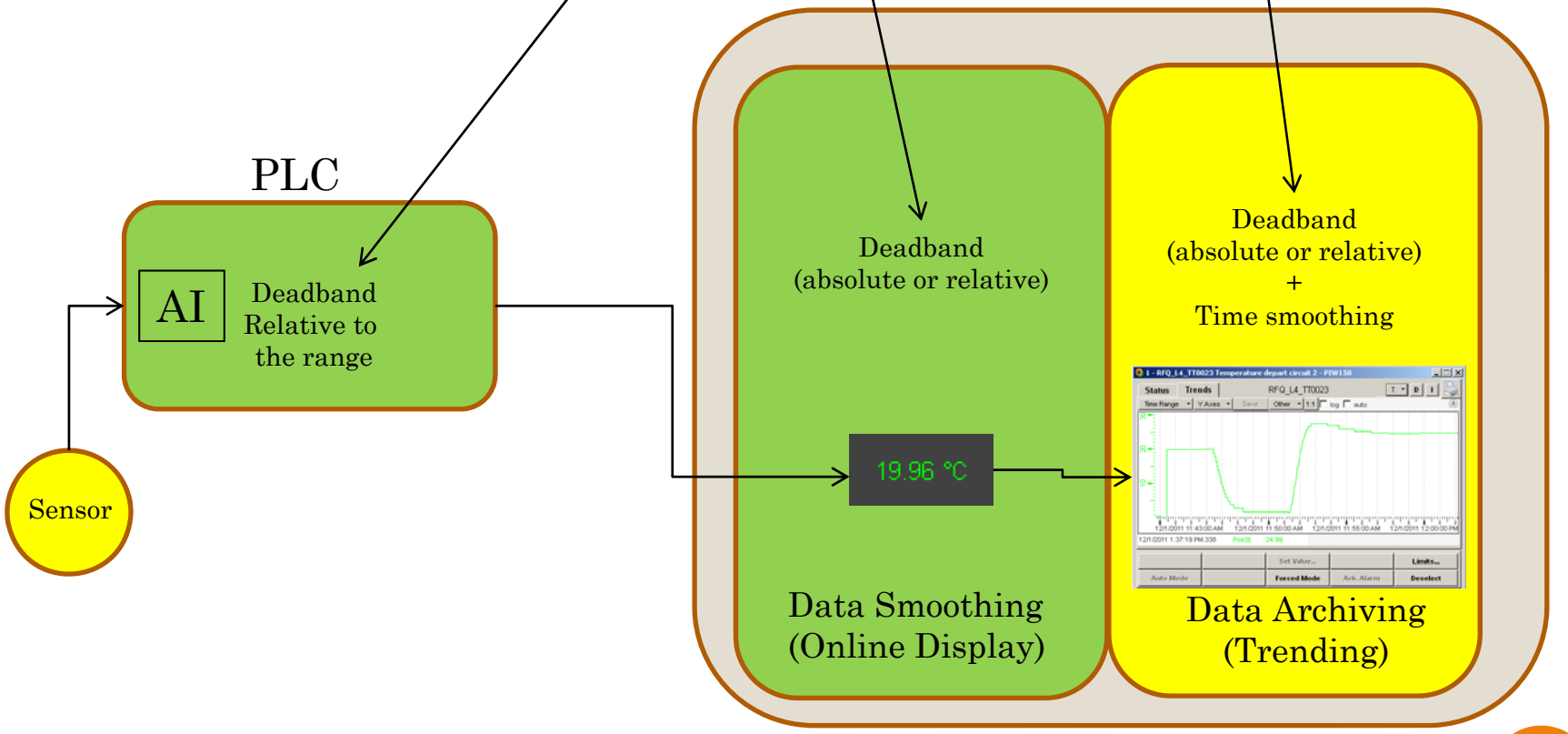
- Alarm/interlock on DN1CT :
  - Low Level of the tank: 1LT400 < 3 000 kg ➔ Alarm
  - Very Low Level of the Tank: 1LSL400=FALSE ➔ Full Stop
  - High Pressure in the Tank: 1PT400 > 3 bar➔ Alarm
  - Very High Pressure in the Tank: 1PT400 > 4 bar➔ Full Stop
- Alarm/Interlock on 1CV400 :
  - If DN1CT is connected➔ Temporary Stop
- Alarm/Interlock on 1EH400 :
  - If 31Q1=FALSE ➔ Full Stop
  - Low Level of the tank: 1LT400 < 1 000 kg ➔ Temporary Stop

DATA FILTERING

SCADADriverDataSmoothing	
Deadband Type	Deadband Value
Absolute	0.1

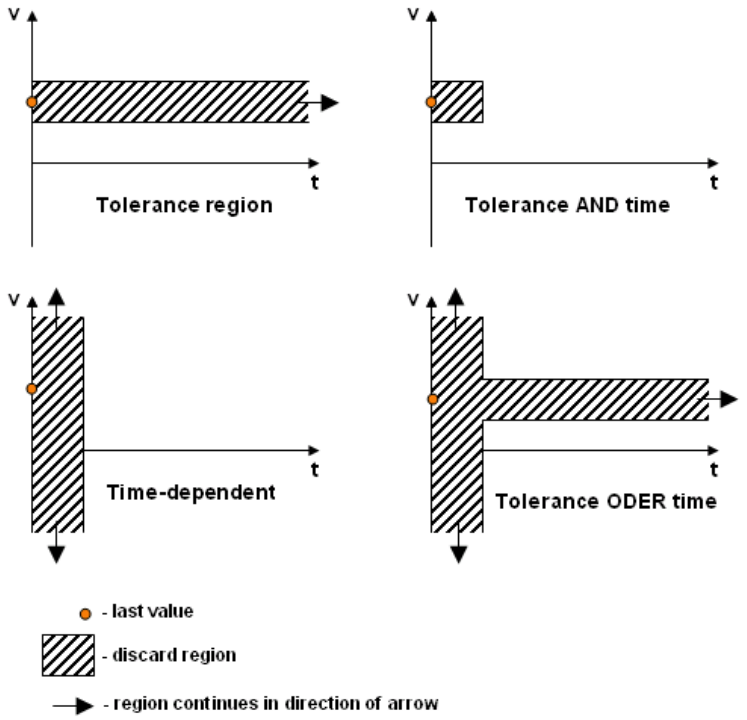
FEDeviceParameters				
Range Min	Range Max	Raw Min	Raw Max	Deadband (%)
0	10	0	27648	0.05

SCADADeviceDataArchiving				
Archive Mode	Time Filter (s)	Deadband Type	Deadband Value	B
Deadband AND Time	60	Absolute	1	



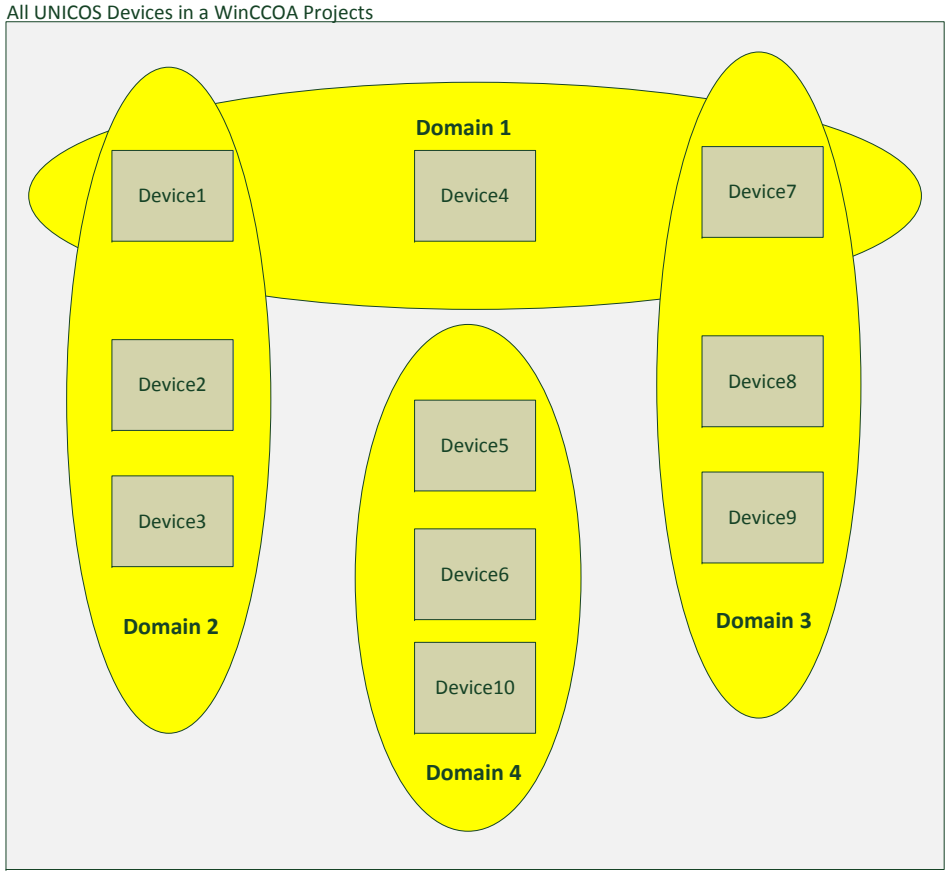
DATA ARCHIVING POSSIBILITIES

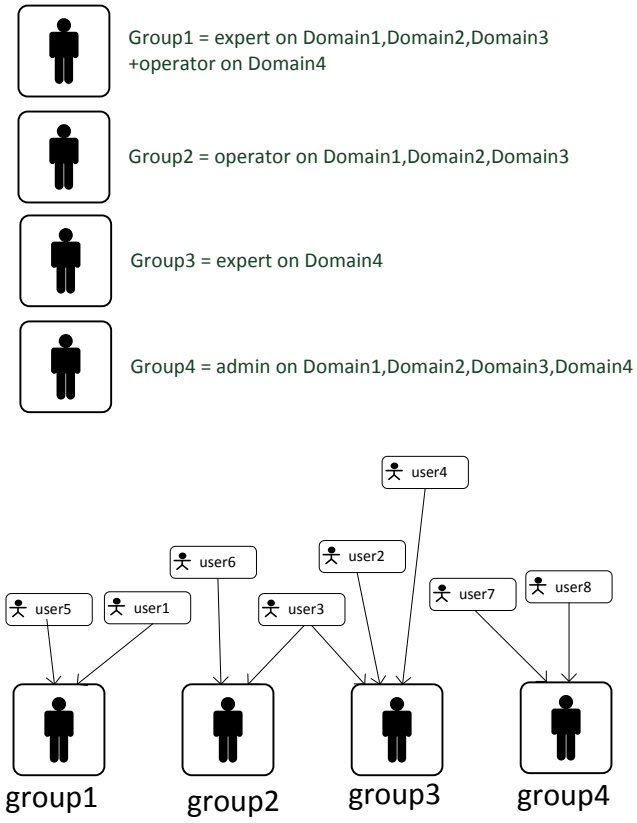
- Old/New: Take all new values
- Dead-band: Take the value only if a certain dead-band value is passed
  - Absolute
  - Relative to the previous values archived
- Time Smoothing: Take the value only if a new value arrived and if a certain time elapsed
- Combinations
  - Old/new AND Time
  - Old/New OR Time
  - Deadband AND Time
  - Deadband OR Time



Access Control Domains

- Groups and users are configured directly in WinCC-OA
- Privileges (operator/expert/admin) are setup per device type in UAB (generator)
- Access Control Domains are setup in the UNICOS spec for each device





Allow Restart

- FS interlock user configurable in spec: "Manual Restart after Full Stop":
  - **(1) FALSE**: the restart is possible when:
    - FS disappeared
    - After "acknowledgement" (can be done in advance while FS still active)

  - **(2) TRUE Even if Full Stop Still Active,** the restart is possible when:
    - FS disappeared
    - After "acknowledgement" (can be done in advance while FS still active)
    - After "Allow Restart" (can be done in advance while FS still active)
  - **(3)TRUE Only If Full Stop Disappeared,** the restart is possible when:
    - FS disappeared
    - After "acknowledgement" (can be done in advance while FS still active)
    - After "Allow Restart" (can be done only after FS disappeared)

Need to press "Allow restart" button

NEXT…

- When You are happy with:
  - Functional Analysis
  - UNICOS Spec

- You are ready to go to **U**NICOS **A**pplication **B**uilder
  - UAB