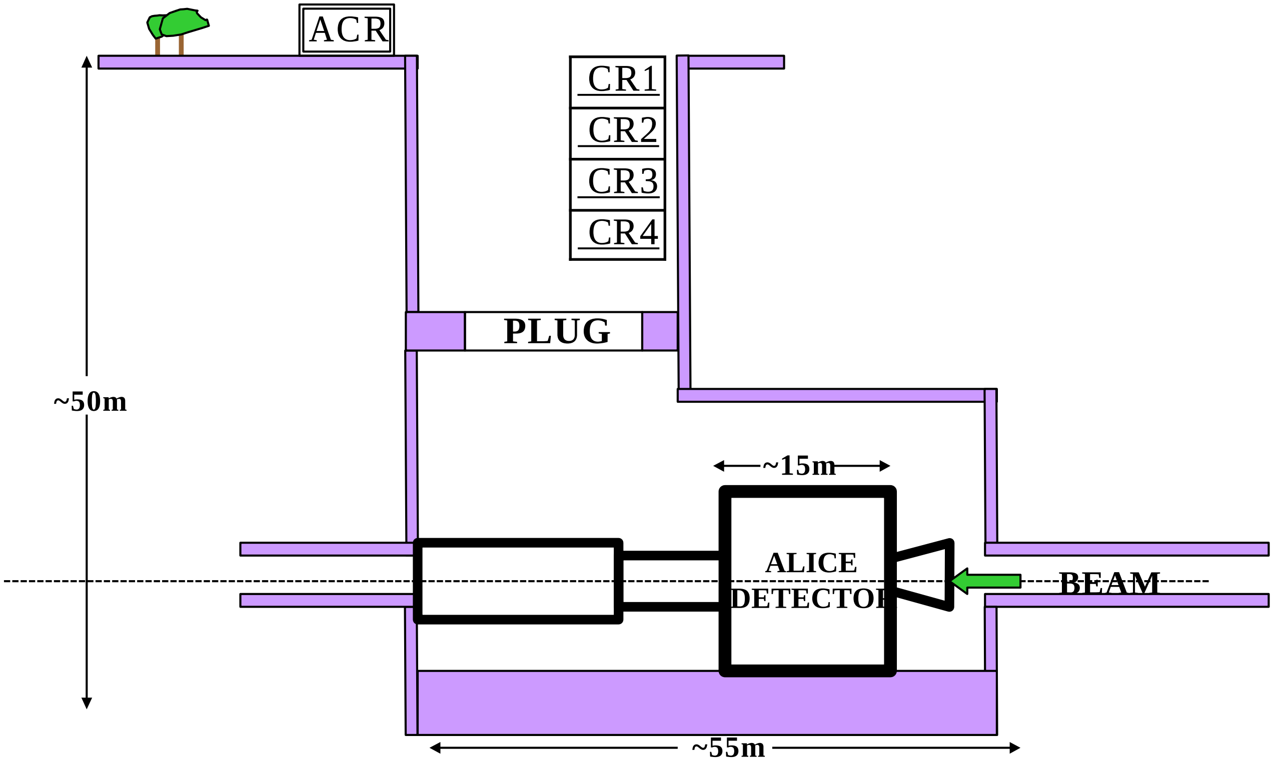
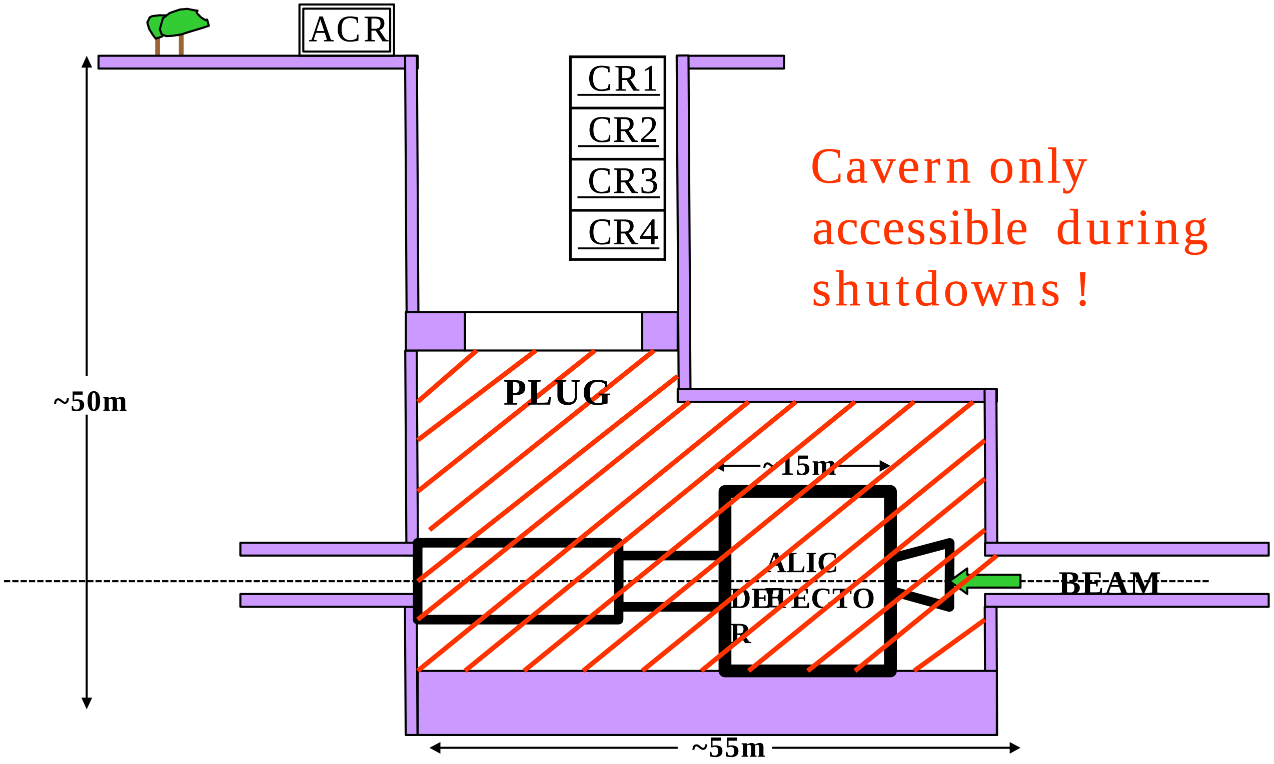
Alice TPC DCS

ALICE underground



2

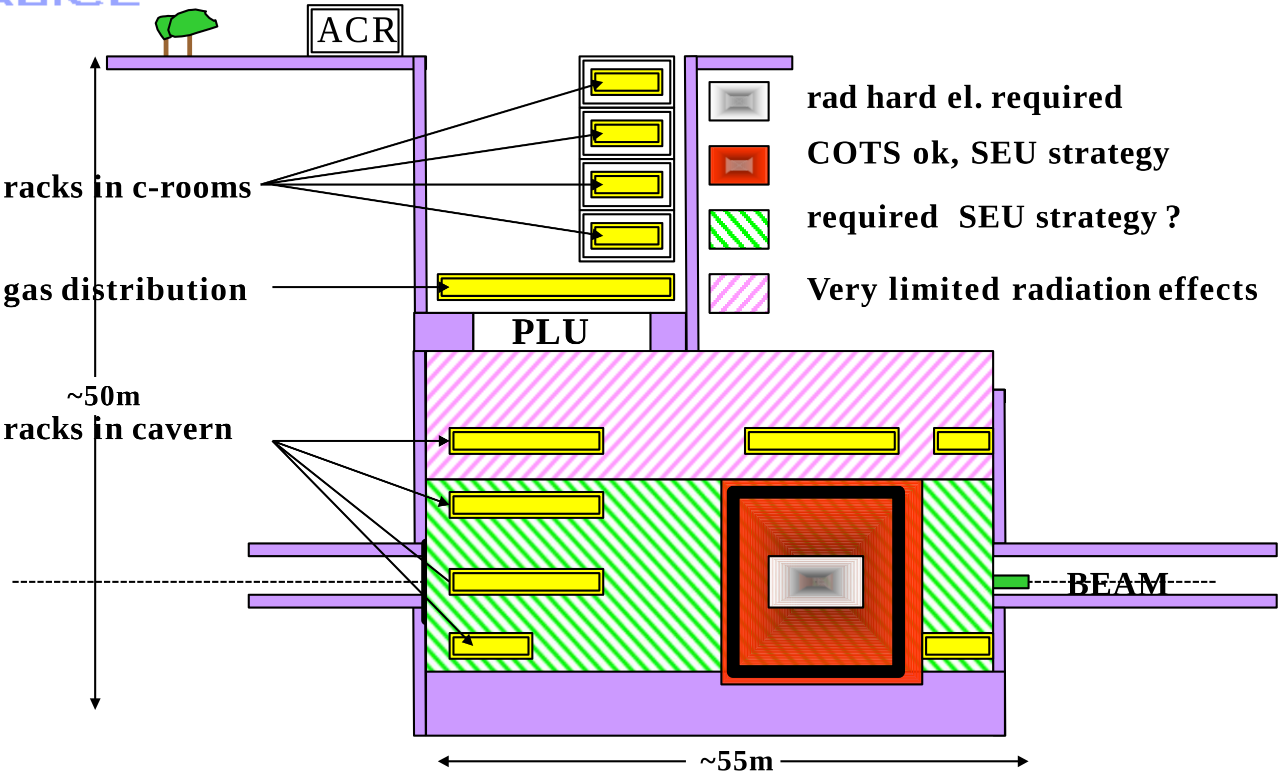
Access



Cavern only accessible during shutdowns !

3

Radiation



ACR
racks in c-rooms
gas distribution
PLU
~50m
racks in cavern
BEAM
~55m
rad hard el. required
COTS ok, SEU strategy
required SEU strategy ?
Very limited radiation effects

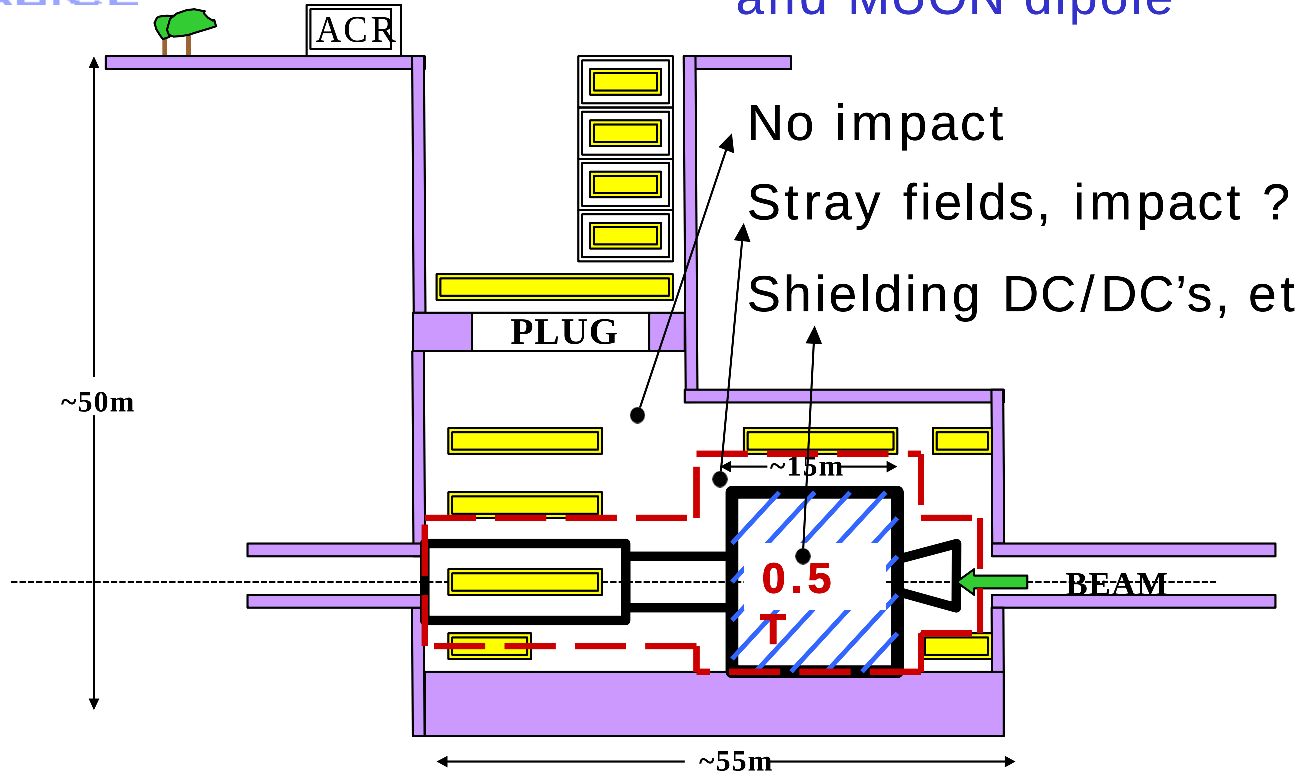
Magnetic field

Two main magnets L3 and MUON dipole

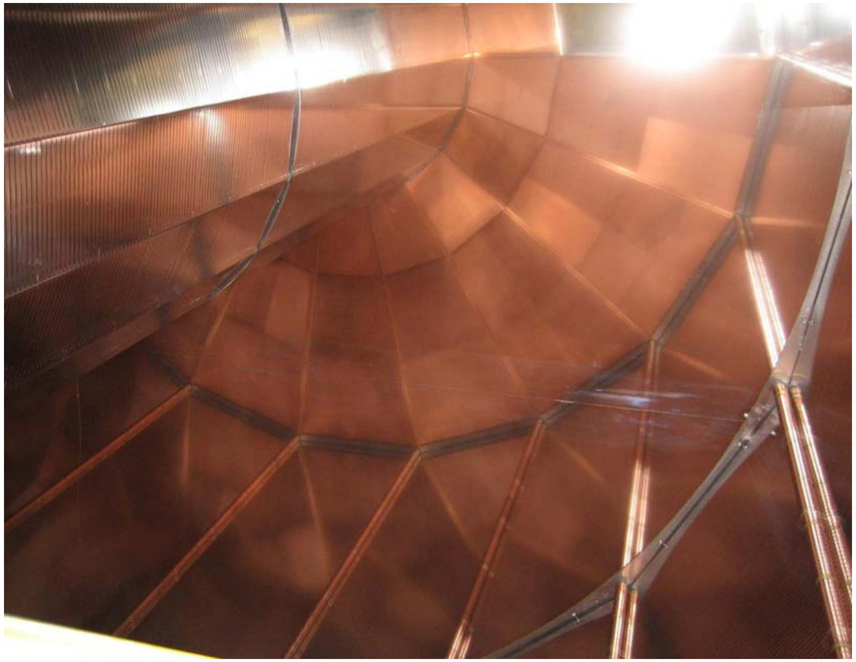
No impact

Stray fields, impact ?

Shielding DC/DC's, etc



Alice TPC



Volume: 88 m3
Diameter: 5 m
Drift length: 2x2.5 m
Drift field: 400 V/cm (100 kV)
Drift time ~100 µs

Temperature homogeneity: 100 mK RMS

Time Projection chamber
Multiwire proportional chambers
(upgrade: GEM)
Segmented cathode read out: 557568 ch.

TPC DCS overview

- 118 HV (wire chamber)
- 100 kv field gage
  - current monitoring
- Gas system
  - recirculating system
- Gas quality monitor
  - gas chromatograph
  - drift velocity monitor
- 2 cooling plants
  - 48 loop
    - individual temperature
    - PLC pressure interlock system
  - 4 loop
- Temp Monitor
  - 500 Pt 1000
    - absolute calibrated
    - mK resolution
- FEE monitor & control
  - 218 RCU
  - 4356 FEC
    - 128 channel
- BusyBox
- Gating pulser
- LV
  - 19 Wiener Pl512
    - 4 ch
- Laser Control
  - 2 Lasers
  - Cameras + mirror control
  - Embedded events in runs
- Calibration pulser
- 12 distributed SCADA systems
- 12+4 PCs

Gas system

Control Backup Mixer Purifier CO2 Distr Analys Pump

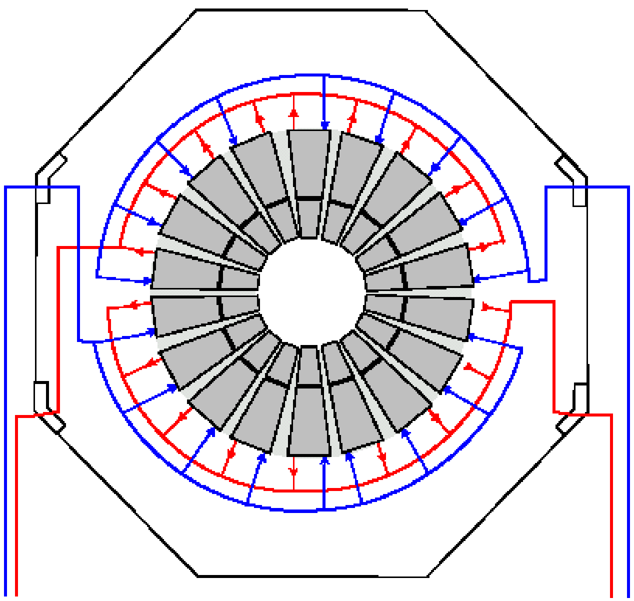
TPC Gas System at SLXL2

- Recirulating gas system -> recover Ne
- Purifier (removal of H_2O and O_2)

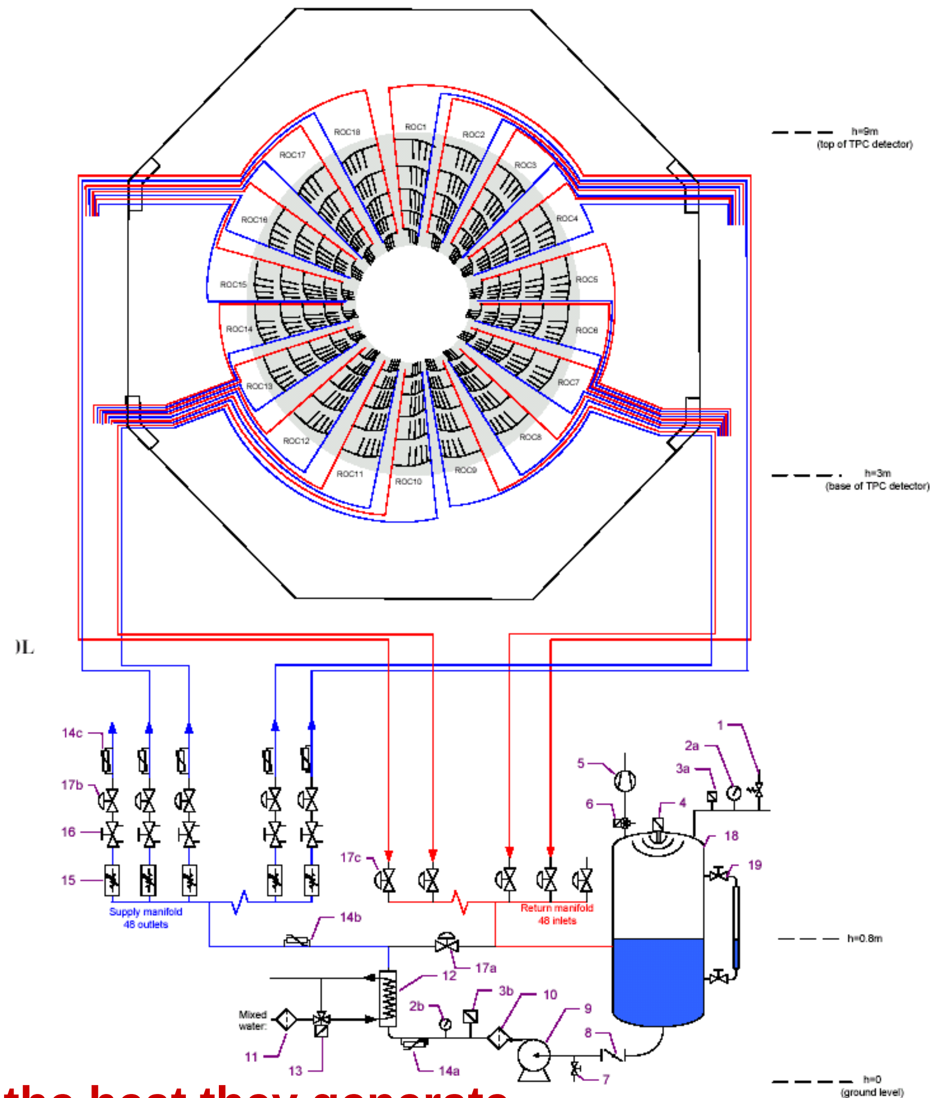
Cooling system

FEE cooling

- 27 kW to be removed
- Leakless water cooling systems

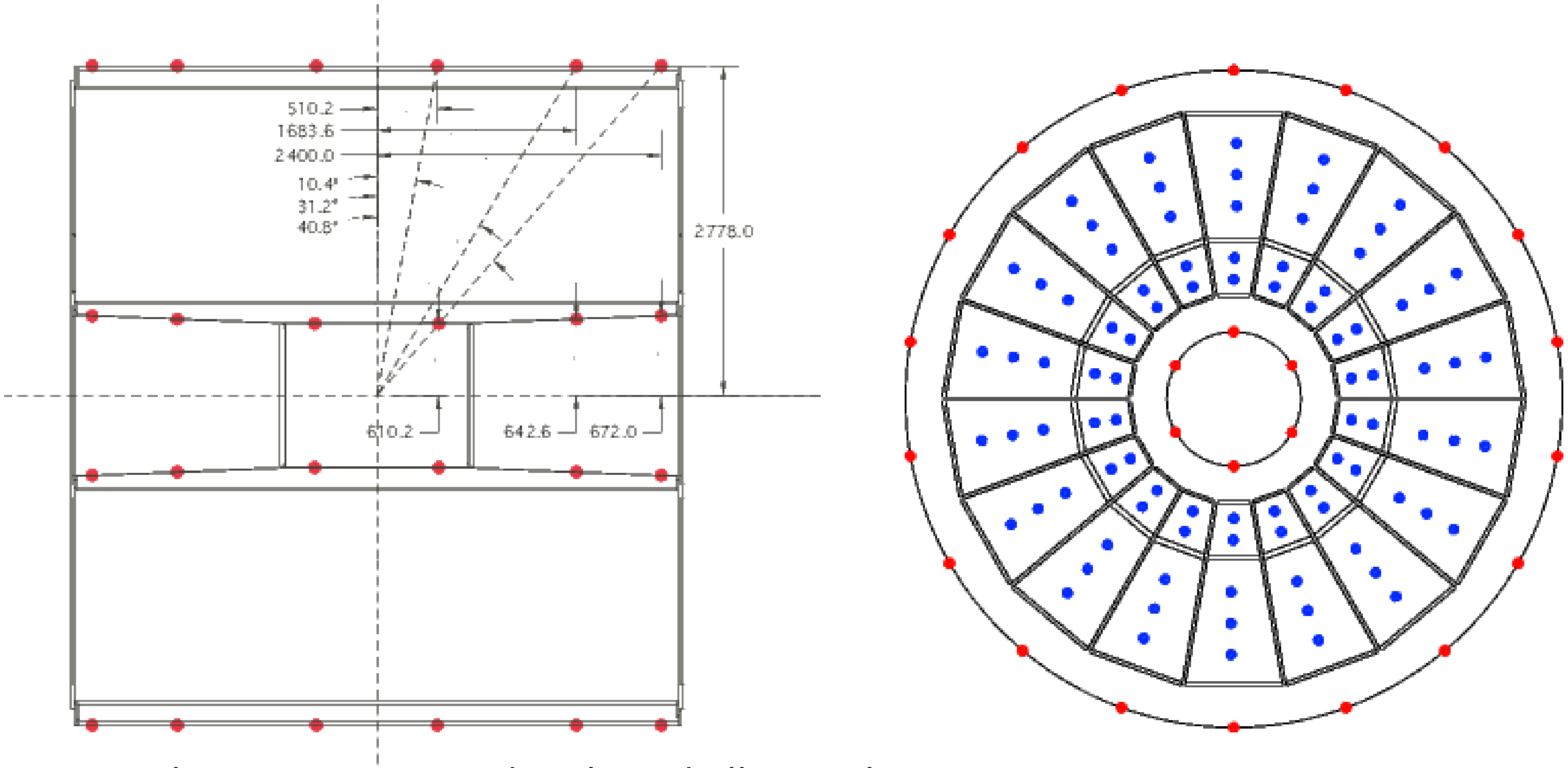


ROC padplane thermal screen



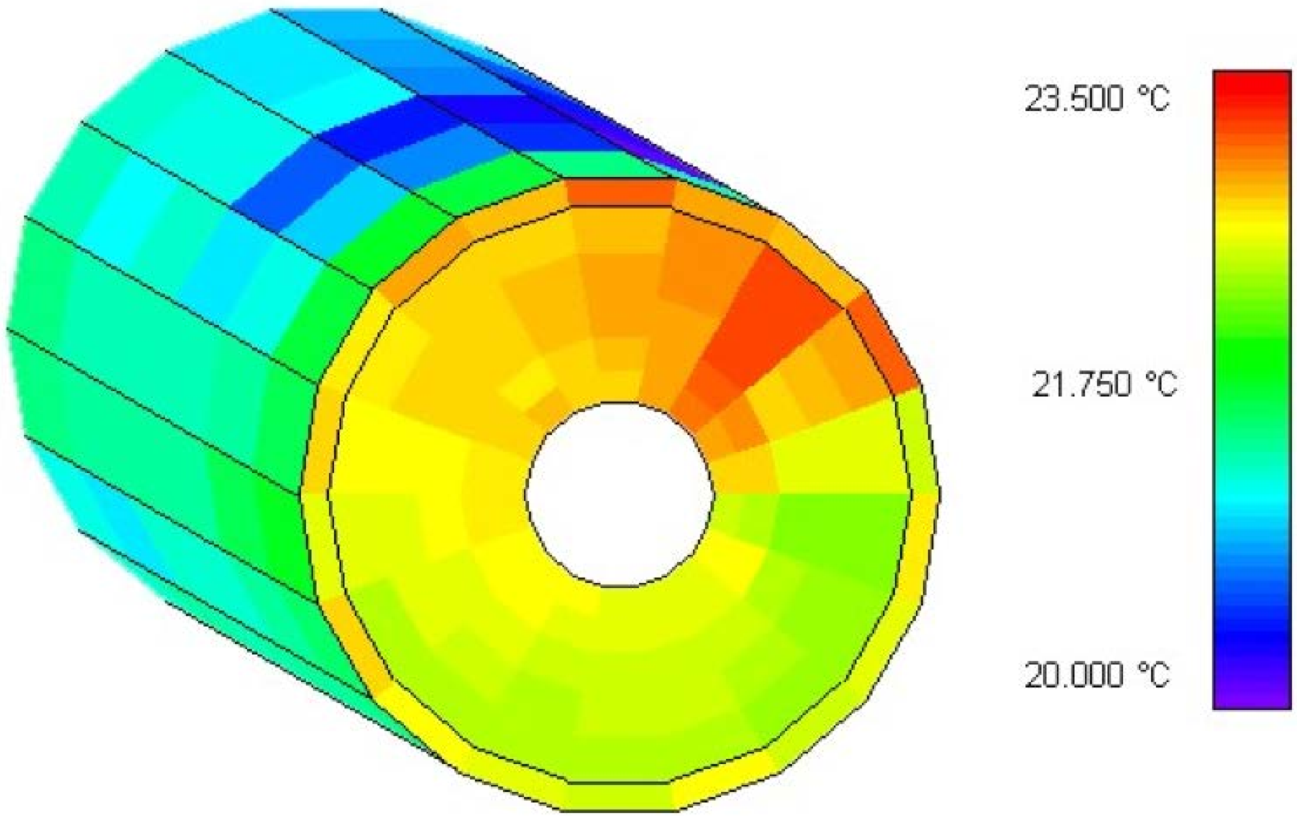
Rule: Each detector to remove all the heat they generate

Temperature monitoring system



- About 500 sensors distributed all over the TPC
- calibrated within a few mK
- ELMB (predecessor of FTLMC)

Temperature monitor



TPC DCS history

- beginning 2001
  - Hardware qualification
  - URDs
- test beam 2004
  - Hardware
  - Control prototypes
- TPC pre-instalation 2005/2006
- pre-commissioning 2006
  - 48h operation of 5% of TPC
    - interlock for water cooling
- detector installation 2007
  - full hardware
  - final control system
  - commissioning
- ready for beam 2008
- first collision 2009
- since 2009 continuous operation of TPC by shift crew
  - experts on call

URD Template 12.2001

Template version 2 (19 December 2001)

DCS User Requirements Document for My-Detector

Version x (dd month yyyy)

1. Introduction

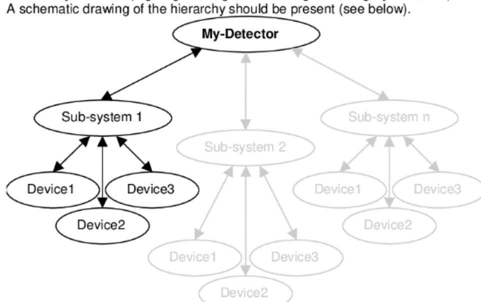
Here goes a short general introduction to My-Detector, maybe with a picture (< 1 page).

2. Description of My-Detector

Here goes a more detailed description of My-Detector focussing of the equipment or elements to be controlled by the DCS, maybe with schematic drawings (< 2 pages).

3. The Control System

Here goes a description of the control system clearly identifying the various sub-systems in the DCS of My-Detector (e.g. High Voltage, Low Voltage, Cooling System, etc.).
A schematic drawing of the hierarchy should be present (see below).



The first part (I) should hold all the information and requirements per sub-system.
The second part (II) should cover the information and requirements on the control system as a whole: interaction between the sub-systems, operational aspects of the control system.

I. Description and Requirements of the Sub-systems

1) **Sub-system 1**

Here goes a detailed description of Sub-system 1. It should at least cover the following items:

a) **Functionality**
Here goes a description of the functionality of the sub-system.

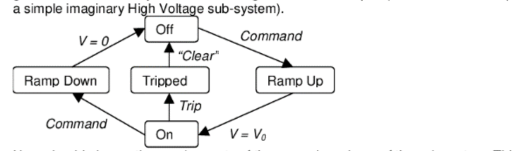
b) **Device or Equipment**
Here goes a description of the device(s) or equipment to be controlled that make up the sub-system. It should at least list the following items:
Location:
Define the final place where the device or equipment to be controlled will be physically installed.
Documentation:
List (links to) documentation of the device or equipment to be controlled.

c) **Parameters**
Here goes a description of all parameters to be controlled, with the type of parameter, ranges, precision, time resolution etc. If there is a group of parameters with all identical characteristics and requirements one description can do, clearly indicating the number of identical parameters (e.g. in the case of a set of identical HV channels). Also give any constraints that apply to these parameters (e.g. maximum cable lengths between device and ADC).
Refer to the appendix for help on filling this paragraph.

1. **Parameter 1**
2. **Parameter 2**
...
n. **Parameter n**

d) **Interlocks and Safety aspects**
Here goes a description of the interlocks that can be received or generated. Describe their nature (hardwired, software). Describe also interaction with other sub-systems or equipment outside of My-Detectors responsibility.

e) **Operational and Supervisory aspects**
Here goes a description of all aspects related to operation of the sub-system, its behaviour, constraints, etc. It should also describe the errors and alarms that can be generated in the sub-system. A state diagram would be helpful (see below an example for a simple imaginary High Voltage sub-system).



Here should also go the requirements of the supervisory layer of the sub-system. This could cover: a list of parameters to be archived (with archiving rate or deadband), ideas on user interfaces, ideas on what events should be logged (commands, errors etc.).

2) **Sub-system 2**

a) **Functionality**

b) **Device or Equipment**

Location:

Documentation:

c) **Parameters**

1. **Parameter 1**
2. **Parameter 2**
...
n. **Parameter n**

d) **Interlocks and Safety aspects**

e) **Operational and Supervisory aspects**

3) **Sub-system 3**
...
n) **Sub-system n**

URD Template 12.2001

II. Requirements on the Control System

The following aspects should be covered, related to the control system as a whole.

a) Interlocks and Safety aspects

Here goes a description of the interlocks that can be received or generated. Describe their nature (hardwired, software). Describe also interaction with equipment outside of My-Detectors responsibility.

b) Operational and Supervisory aspects

Here goes a description of all aspects related to operation of (the control system of) My-Detector, its behaviour, constraints, etc. It should also describe the errors and alarms that can be generated in My-Detectors control system. A state diagram would be helpful. Here should also go the requirements of the supervisory layer of the control system as a whole. This could cover: ideas on user interfaces, ideas on what events should be logged (commands, errors etc.).

4. Timescales and Planning

Here goes the timescale of the project, including milestones (e.g. prototype tests, test beams etc.).

1) Design

Based on this URD a detailed solution should be projected for each sub-system and the prototyping can start. Once the prototype solution is working on the process and field level it will be linked up to PVSS and integrated into the supervisory layer environment. Indicate the latest date for these stages to be completed.

	HV [mm/yy]	LV [mm/yy]	Cooling [mm/yy]	Gas [mm/yy]	FEE [mm/yy]	[mm/yy]	[mm/yy]
Process control solution projected							
Process control solution prototyped							
Process control linked to PVSS							

2) Production and Purchasing

The controls components (PLC's I/O units, field buses and interfaces, etc) can only be purchased in quantities once the devices to be controlled (HV and LV power supplies, cooling and FE electronics equipment, etc.) have been fixed and a final prototype controls solution exists. Please indicate for each sub-system the latest date at which the purchasing and test of devices and controls components must be completed.

	HV [mm/yy]	LV [mm/yy]	Cooling [mm/yy]	Gas [mm/yy]	FEE [mm/yy]	[mm/yy]	[mm/yy]
P/P of devices to be controlled							
P/P of controls components							
P/P tests							

3) Installation

Some detectors will be pre-assembled and tested on the surface before they are installed in the pit. Indicate where this will take place (SXL2?). Give the pre-assembly and tests period and indicate if and which controls sub-system should be available. Indicate as well the period of the final installation of the detector in the pit. Preliminary dates for pre- and final installation as they appear in the overall ALICE planning, are given below:

	Pre-installation		Final installation	
Project	**Start**	**Finished**	**Start**	**Finish**
TPC	Dec-01	Oct-04	May-05	Nov-05
HMPID	Sep-03	Feb-05	May-05	Jul-05
MUON	Sep-03	Jan-05	Apr-04	Jul-05
ITS	Nov-03	Feb-05	Jun-05	Oct-05
ZDC	Apr-04	Jul-04	Oct-04	Mar-05
PMD	Apr-04	Sep-04	Sep-04	Mar-05
PHOS	Apr-04	Sep-04	Dec-04	Jun-05
CASTOR	Apr-04	Sep-04	May-05	Jun-05
FMD/T0/V0	Apr-04	Sep-04	Aug-05	Aug-05
TOF	May-04	Nov-04	Jan-05	Jun-05
TRD	May-04	Aug-04	Feb-05	Jun-05

Pre-assembly in: SLX2	HV [mm/yy]	LV [mm/yy]	Cooling [mm/yy]	Gas [mm/yy]	FEE [mm/yy]	[mm/yy]	[mm/yy]
Pre-assembly and test - start							
Pre-assembly and test - end							
Is a control system needed (yes/no)?							
Final installation in the pit - start							
Final installation in the pit - end							

4) Commissioning

Commissioning will normally start once the detectors are installed in the pit; individual sub-systems first, then full detector and finally full experiment.

	HV [mm/yy]	LV [mm/yy]	Cooling [mm/yy]	Gas [mm/yy]	FEE [mm/yy]	[mm/yy]	[mm/yy]
Individual sub-systems - start							
Individual sub-systems - end							

	start [mm/yy]	end [mm/yy]
Full detector		
Full experiment		31/12/2005

5) Operation with beam

For completeness, these are the LHC milestones.

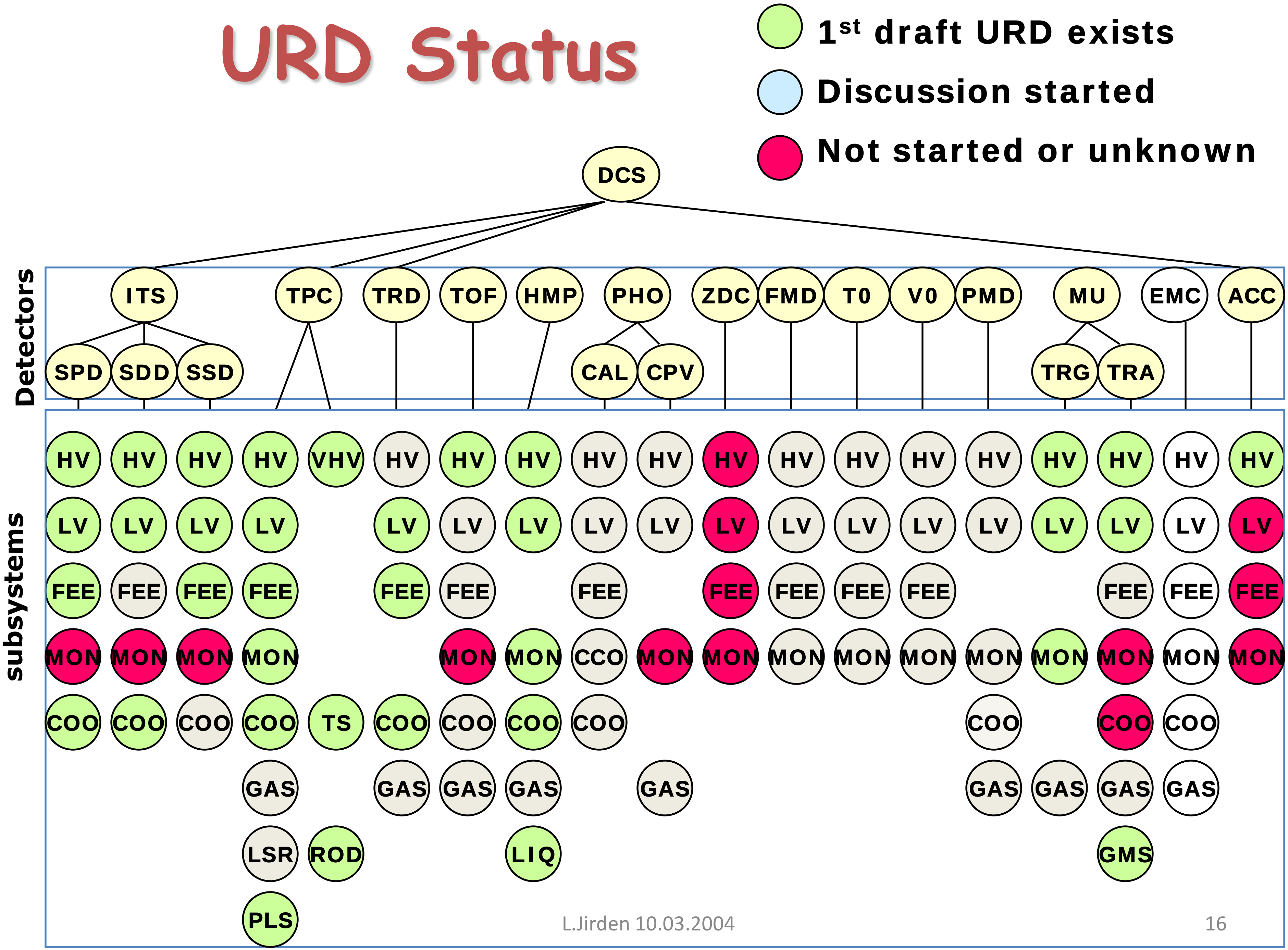
1st test with beam	01 / 02 / 2006
Pilot run (1 month)	01 / 04 / 2006
PP physics run	01 / 08 / 2006
Pb-ion physics run	01 / 03 / 2007

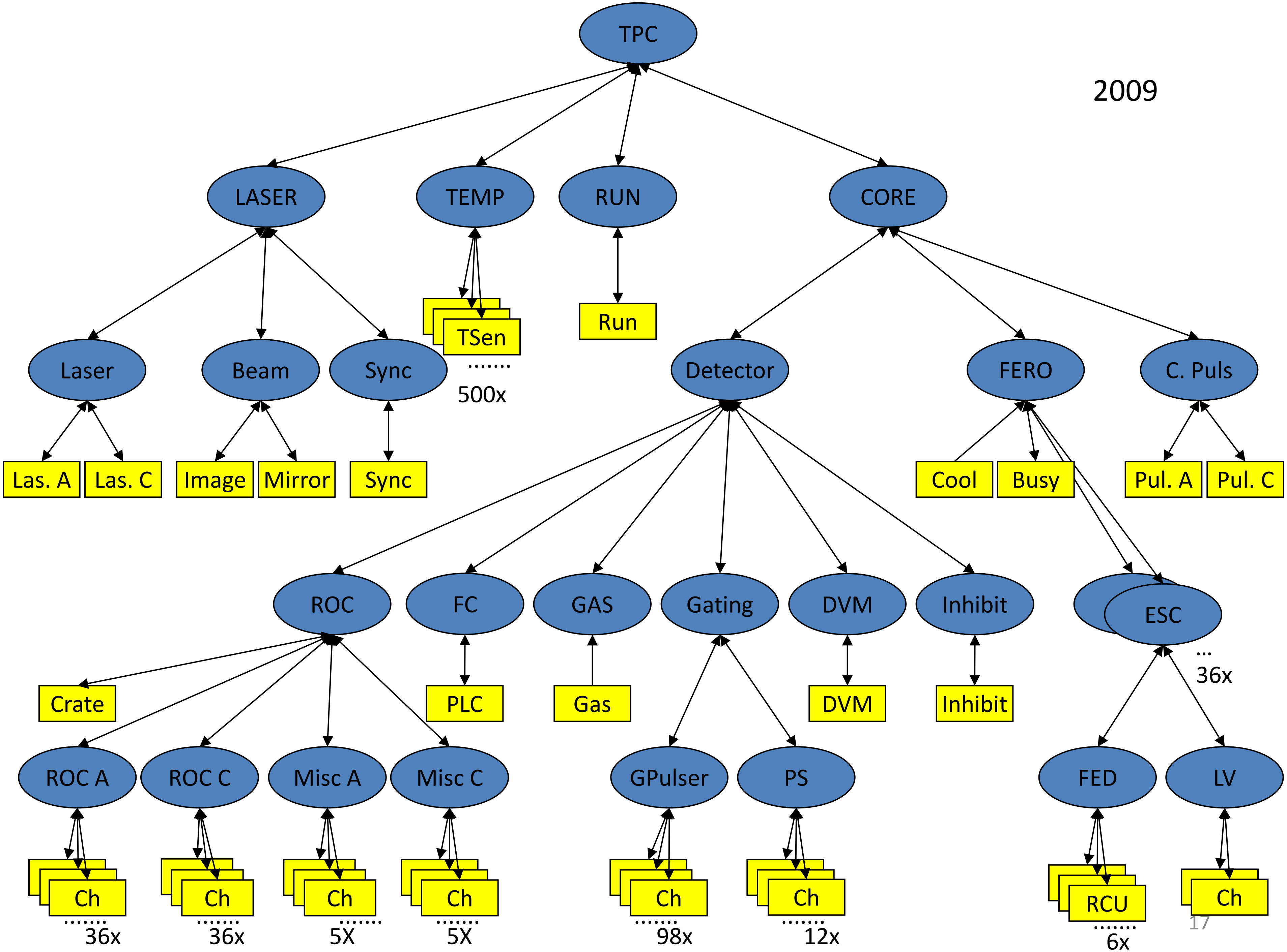
6) Tests and Test beam

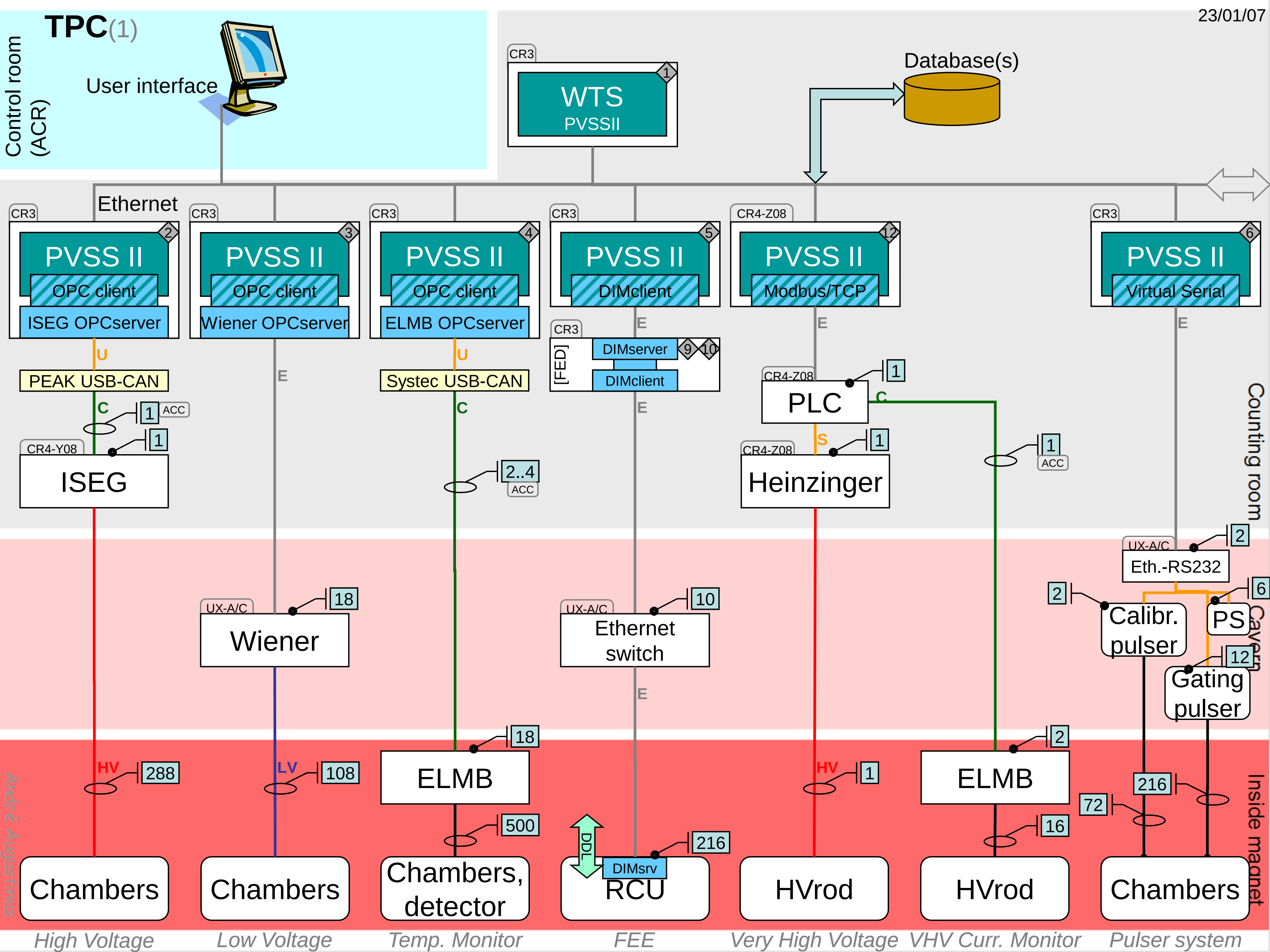
Please indicate if and when you plan to perform tests (with or without test-beam) and if you wish to test prototype control solutions at this occasion. In this case please indicate which sub-systems you wish to test.

	start [mm/yy]	end [mm/yy]	List of sub-system control prototypes to test
1st test period			
2nd test period			
3rd test period			

URD Status

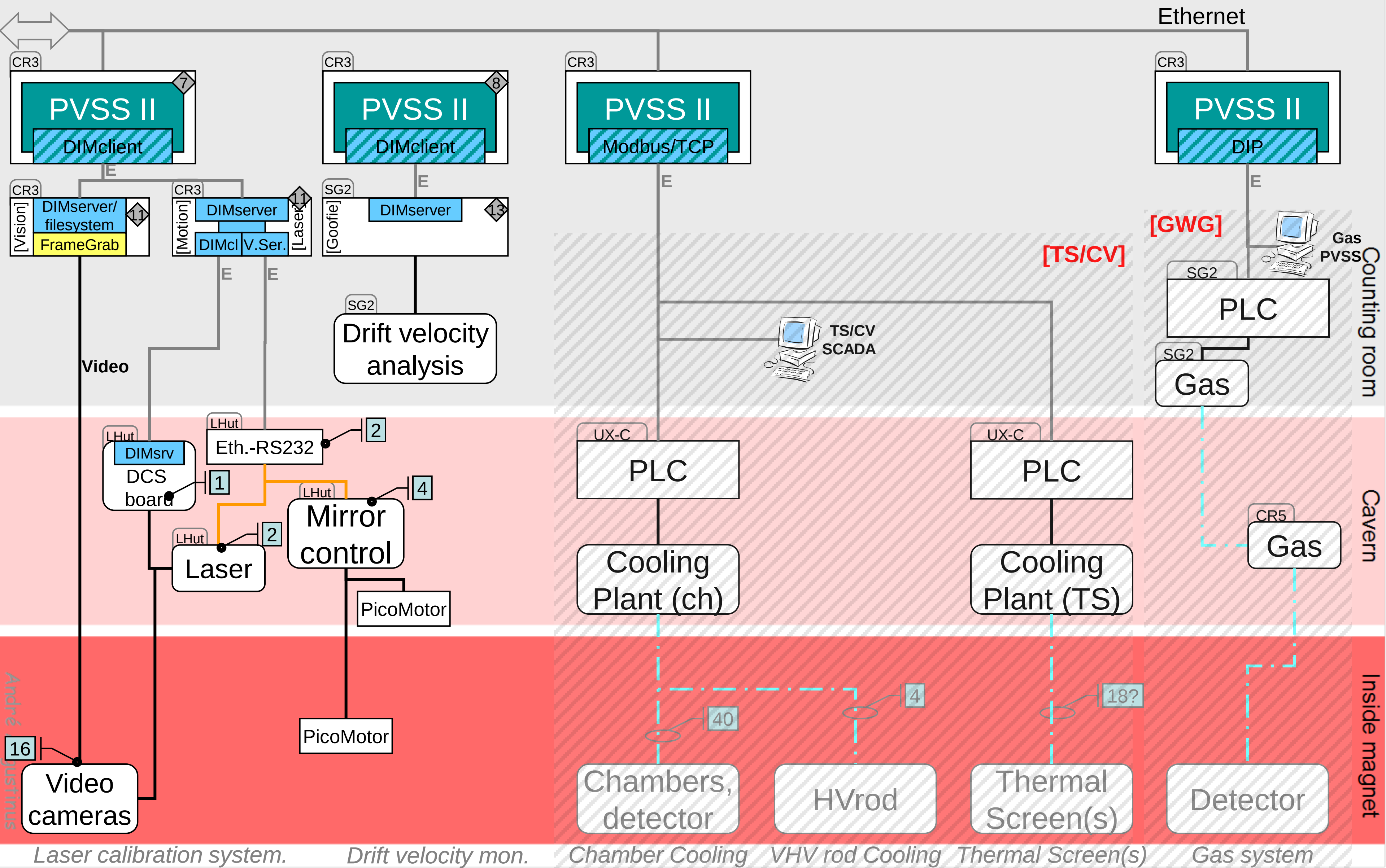

1st draft URD exists
Discussion started
Not started or unknown
DCS
Detectors
ITS
TPC
TRD
TOF
HMP
PHO
ZDC
FMD
T0
V0
PMD
MU
EMC
ACC
SPD
SDD
SSD
CAL
CPV
TRG
TRA
subsystems
HV
VHV
LV
FEE
MON
CCO
COO
TS
GAS
LSR
ROD
LIQ
GMS
PLS


TPC
2009
LASER
TEMP
RUN
CORE
Laser
Beam
Sync
TSen
....
500x
Run
Detector
FERO
C. Puls
Las. A
Las. C
Image
Mirror
Sync
Cool
Busy
Pul. A
Pul. C
ROC
FC
GAS
Gating
DVM
Inhibit
ESC
...
36x
Crate
PLC
Gas
DVM
Inhibit
ROC A
ROC C
Misc A
Misc C
GPulser
PS
FED
LV
Ch
....
36x
Ch
....
36x
Ch
....
5X
Ch
....
5X
Ch
....
98x
Ch
....
12x
RCU
....
6x
Ch


TPC(1)
23/01/07
Control room (ACR)
User interface
CR3
WTS
PVSSII
Database(s)
Ethernet
CR3
PVSS II
OPC client
ISEG OPCserver
CR3
PVSS II
OPC client
Wiener OPCserver
CR3
PVSS II
OPC client
ELMB OPCserver
CR3
PVSS II
DIMclient
CR4-Z08
PVSS II
Modbus/TCP
CR3
PVSS II
Virtual Serial
PEAK USB-CAN
Systec USB-CAN
CR3
[FED]
DIMserver
DIMclient
CR4-Z08
PLC
CR4-Z08
Heinzinger
CR4-Y08
ISEG
ACC
2..4
Counting room
UX-A/C
Eth.-RS232
Calibr. pulser
PS
Gating pulser
UX-A/C
Wiener
UX-A/C
Ethernet switch
Cavern
ELMB
ELMB
HV
LV
HV
288
108
18
500
DDL
216
DIMsrv
RCU
72
Inside magnet
André Augustinus
Chambers
Chambers
Chambers, detector
HVrod
HVrod
Chambers
High Voltage
Low Voltage
Temp. Monitor
FEE
Very High Voltage
VHV Curr. Monitor
Pulser system

TPC(2)

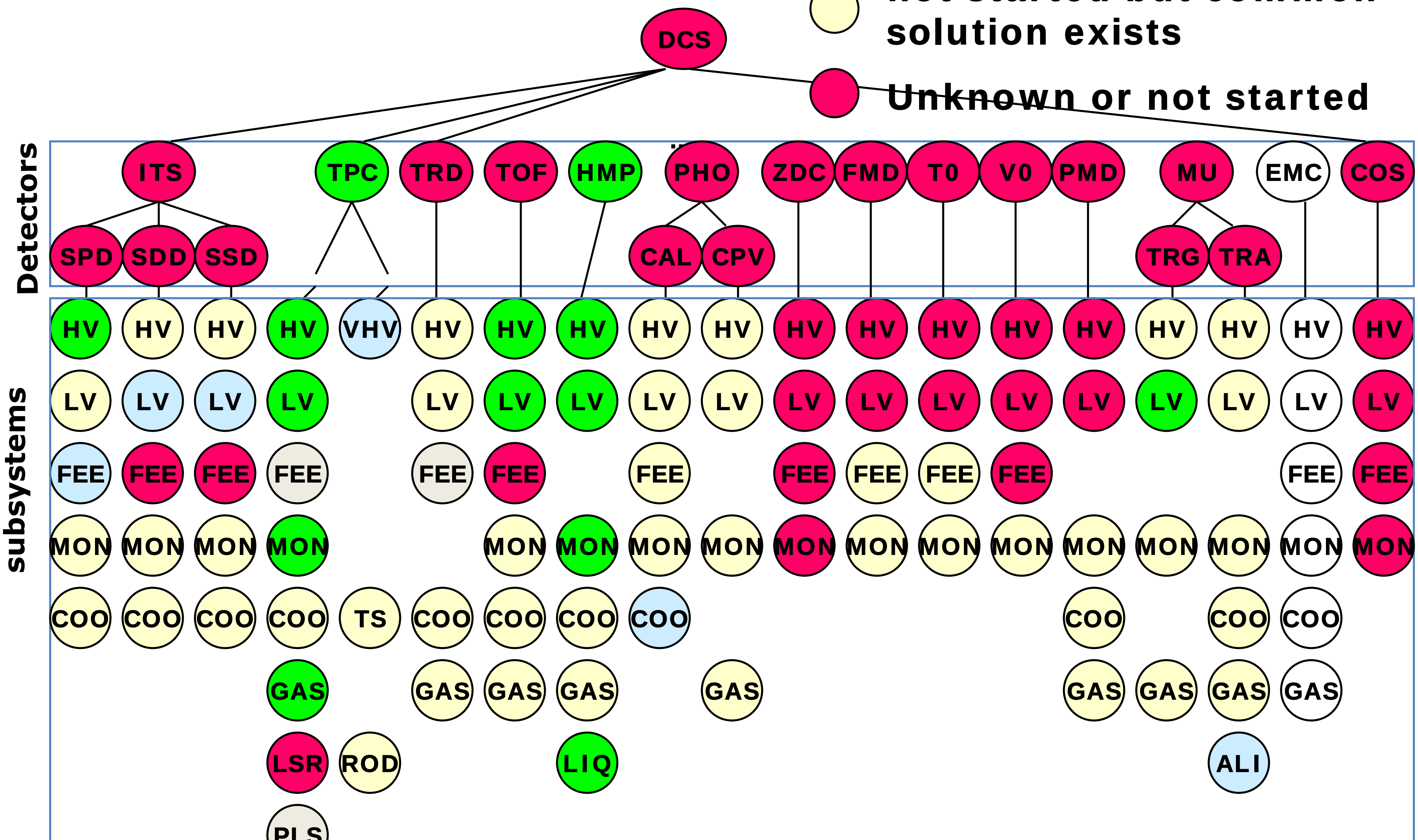
29/01/07



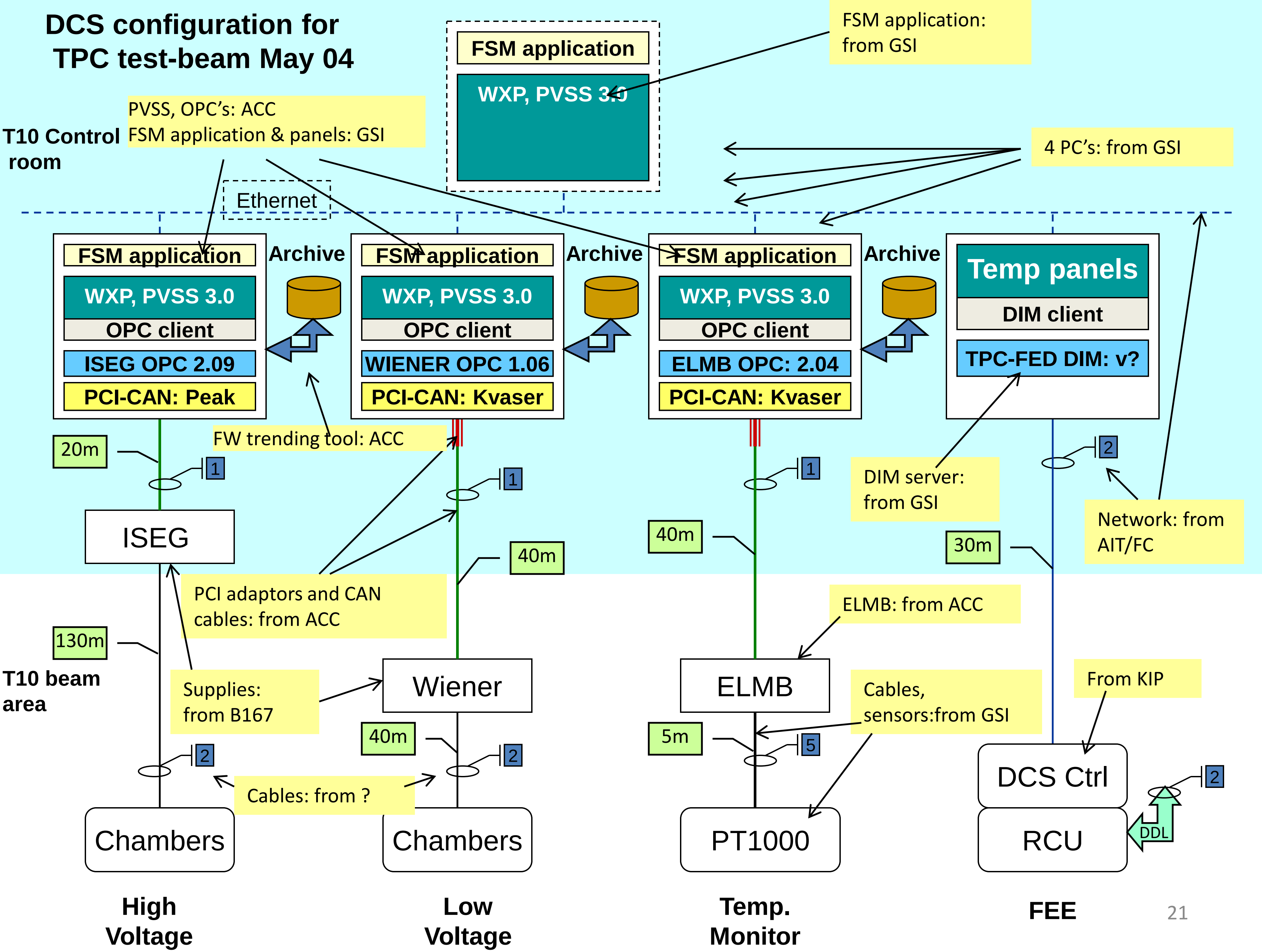
Ethernet
CR3
PVSS II
DIMclient
CR3
PVSS II
DIMclient
CR3
PVSS II
Modbus/TCP
CR3
PVSS II
DIP
E
CR3
[Vision]
DIMserver/ filesystem
FrameGrab
11
CR3
[Motion]
DIMserver
DIMcl
V.Ser.
[Laser]
11
SG2
[Goofie]
DIMserver
13
7
8
[TS/CV]
[GWG]
Gas PVSS
SG2
PLC
SG2
Gas
TS/CV SCADA
SG2
Drift velocity analysis
Video
LHut
DIMsrv
DCS board
1
LHut
Eth.-RS232
2
LHut
Mirror control
4
LHut
Laser
2
PicoMotor
PicoMotor
UX-C
PLC
Cooling Plant (ch)
UX-C
PLC
Cooling Plant (TS)
CR5
Gas
40
4
18?
16
Video cameras
Chambers, detector
HVrod
Thermal Screen(s)
Detector
Counting room
Cavern
Inside magnet
André Augustinus
Laser calibration system.
Drift velocity mon.
Chamber Cooling
VHV rod Cooling
Thermal Screen(s)
Gas system

Prototyping status

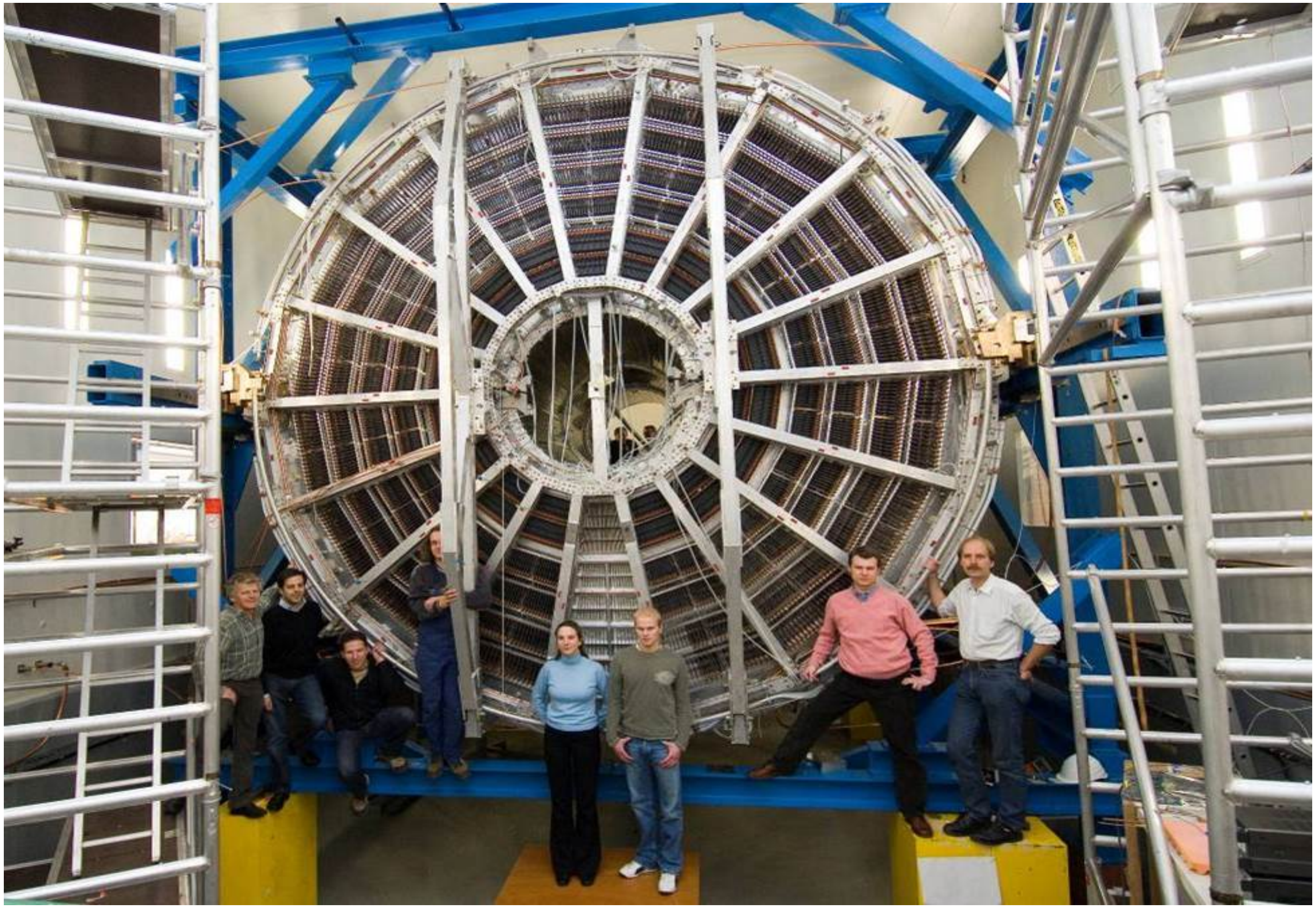
- 1st version implemented
- started
- not started but common solution exists
- Unknown or not started



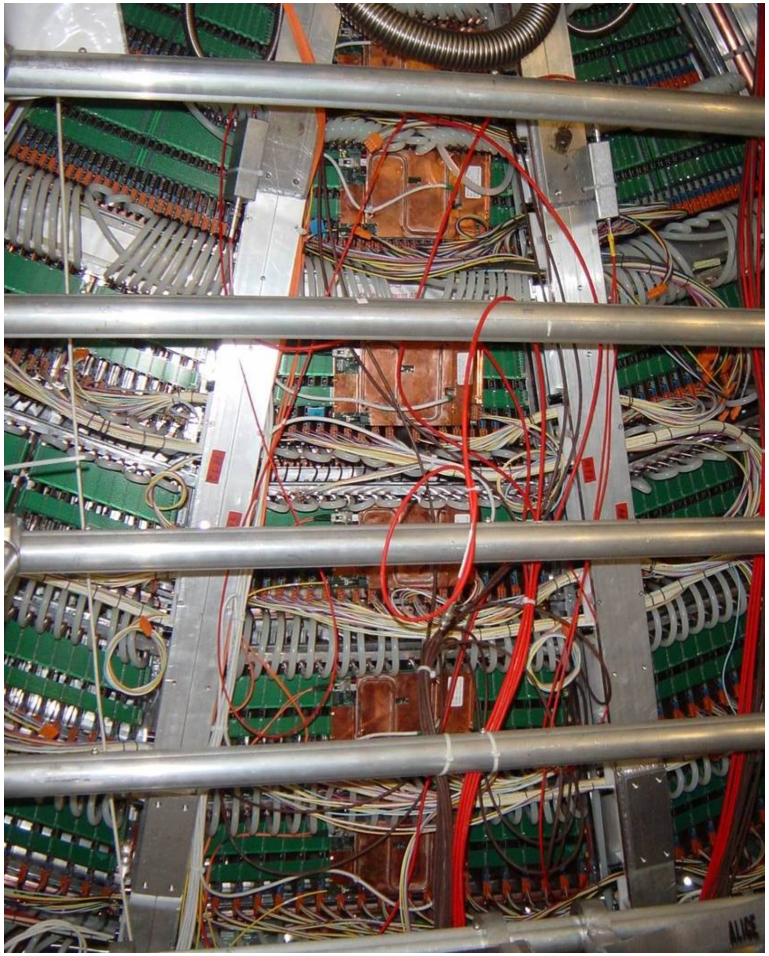
DCS configuration for TPC test-beam May 04



TPC pre-installation 2006



Pre-comissioning



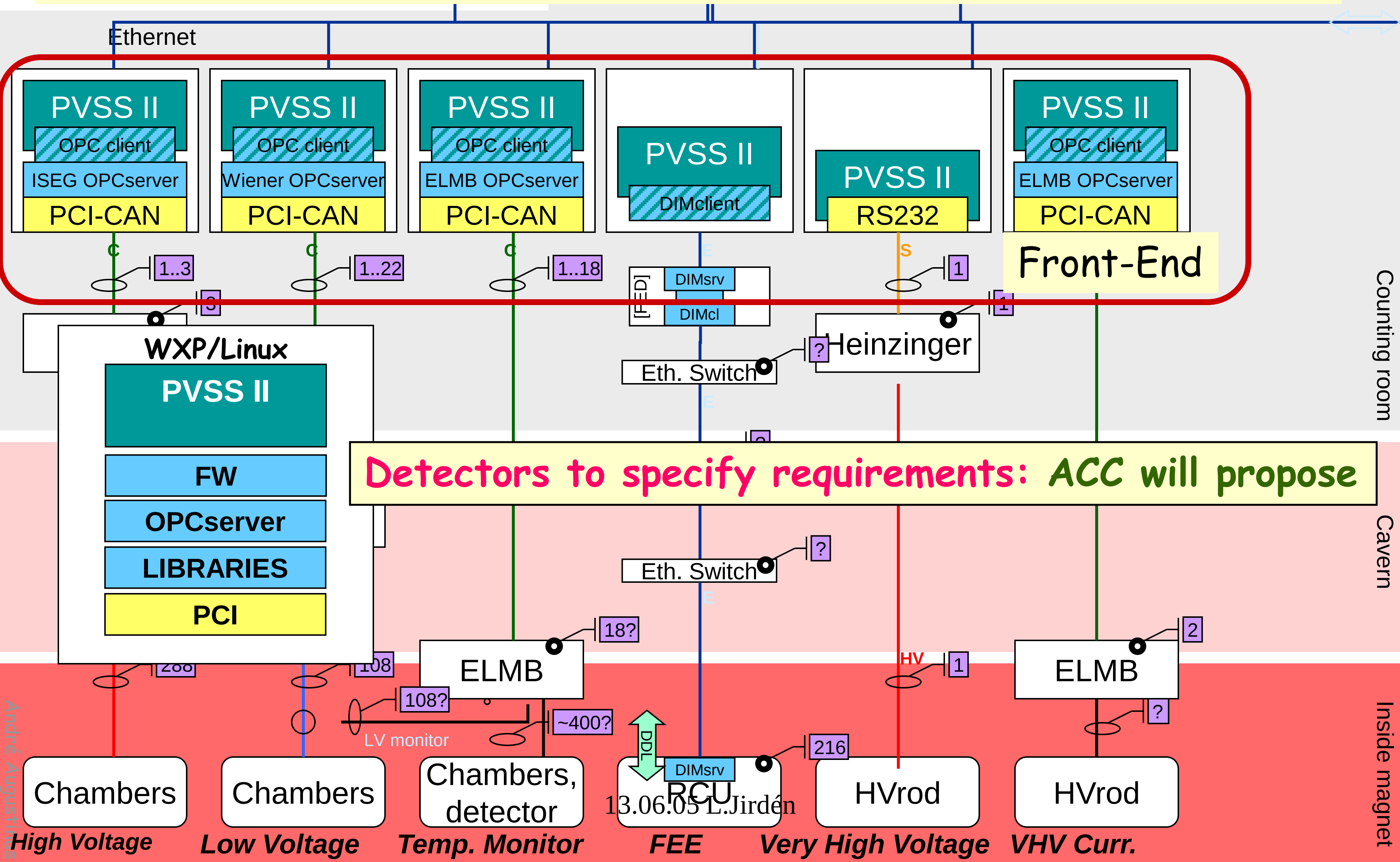
Responsibilities

- ACC (and its CERN partners) will provide
  - DCS H/W Infrastructure
  - Back-End System
  - Common Services
  - Interface to TRG, DAQ, HLT, LHC via ECS
  - S/W Infrastructure for Detector Applications
- Detectors will provide
  - Detector Sub-System Devices and Cabling
  - Detector Specific Networking (Ethernet switches)
  - Detector Applications for each Sub-System
  - Detector Specific Services
  - Integration of all Detector Sub-Systems to a full Detector Control System
  - Interface to the Alice Detector Control System layer

ACC will provide:
DCS H/W infrastructure

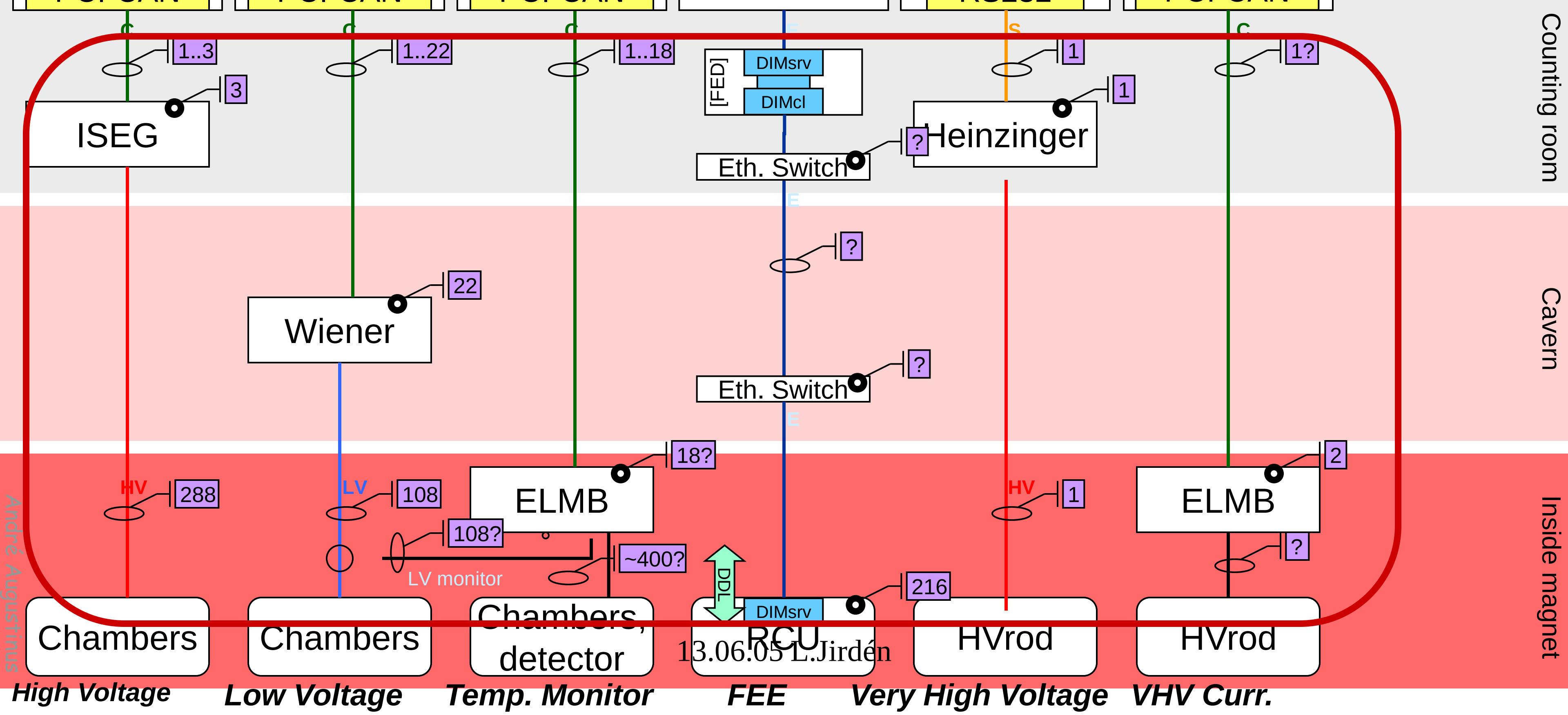
- DCS Racks in CR3
  - 1 for Back-end PC's
  - 1 for ELMB power
  - 6 for Front-end (detector) PC's
- Network
  - DCS network ports in all racks with DCS computers & devices
    - detectors to specify requirements: "rack content meetings"
- Computers
  - Back-end: prototype installation exists
  - Front-end: detectors to specify requirements: ACC will propose
  - PCI interfaces: detectors to specify requirements: ACC will propose
- Peripherals
  - Printers, displays, etc

ACC WILL PROVIDE:
SOFTWARE INFRASTRUCTURE FOR F-END's

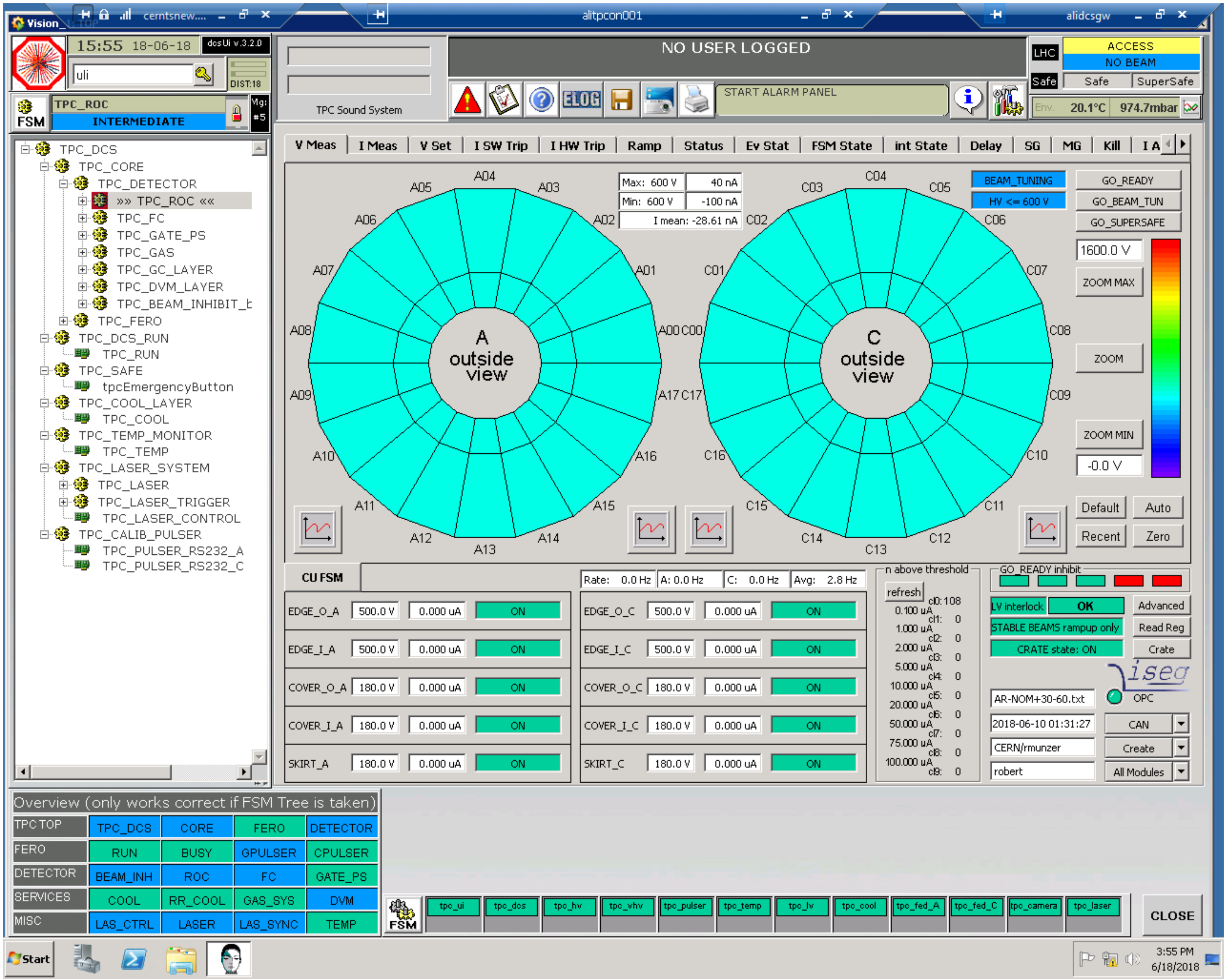


DETECTORS will provide

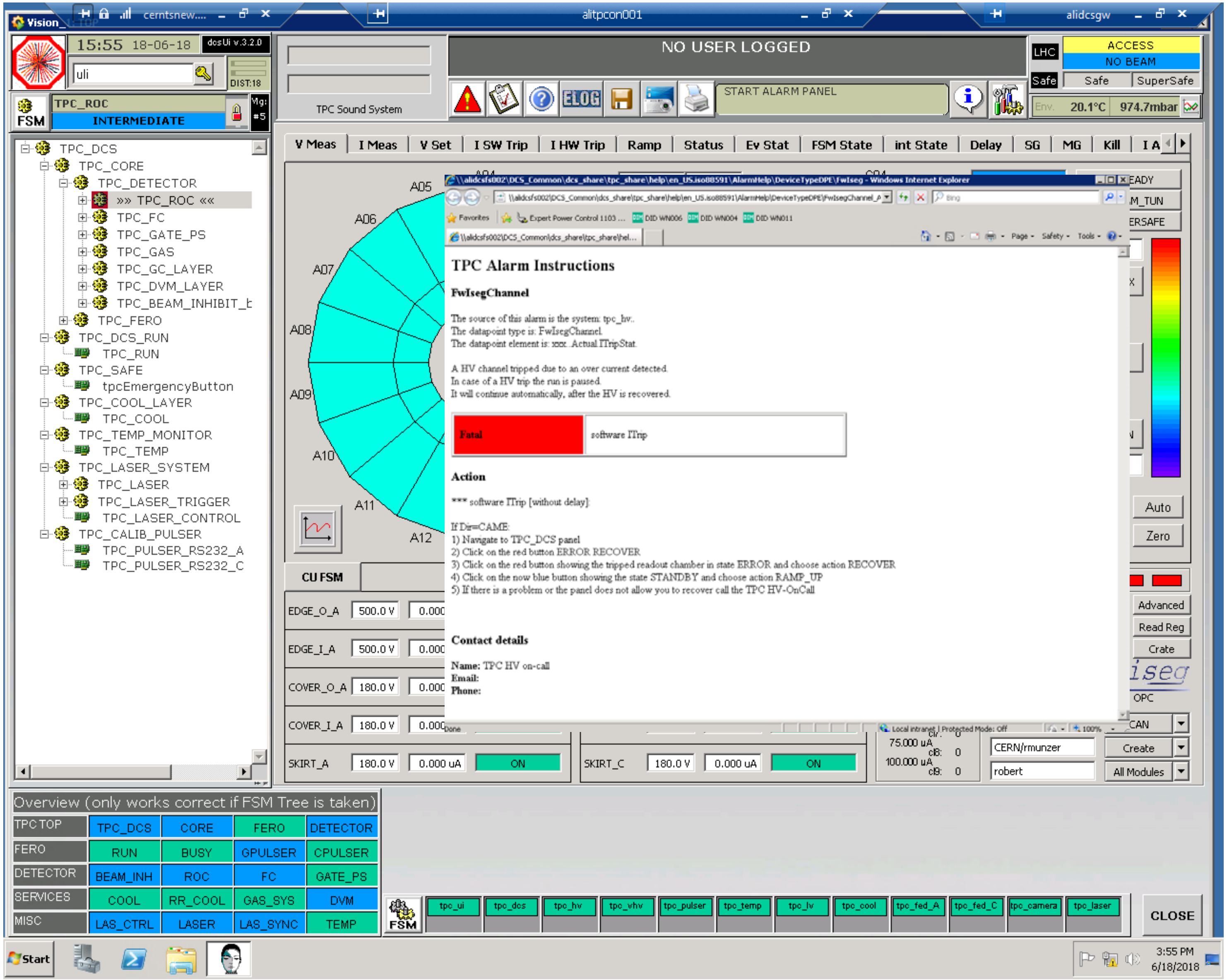
* SUB-SYSTEM DEVICES; HVPS, LVPS, etc
* ELMB's and ELMB + CAN power by ACC
* CABLES; CAN and Interlock cables by ACC
* SPECIFIC NETWORKING; switch to RCU, etc.
* DETECTOR SPECIFIC SERVICES (GAS, COOLING)



User interface



User interface



Conclusion

- Access control
  - remote access
  - Rules for expert intervention
- Hierarchy by FSM
- Alert system
  - instruction for shifters
- Interlock
  - soft
  - plc
  - hard
  - device
- Archive
  - selected data for reconstruction

- Internal Log files
- Automatic logbook entries
- TPC integrated in DCS (and ECS)
  - External Configuration tool (add on)
- Standard 24/7 operation by common DCS shifter
  - expert start-up
  - expert on-call

- successful long term operation (>10a)