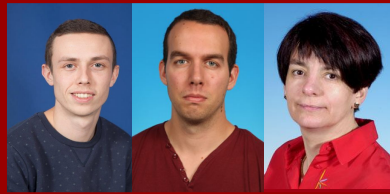


DE LA RECHERCHE À L'INDUSTRIE



nBLM

Control and Monitoring System



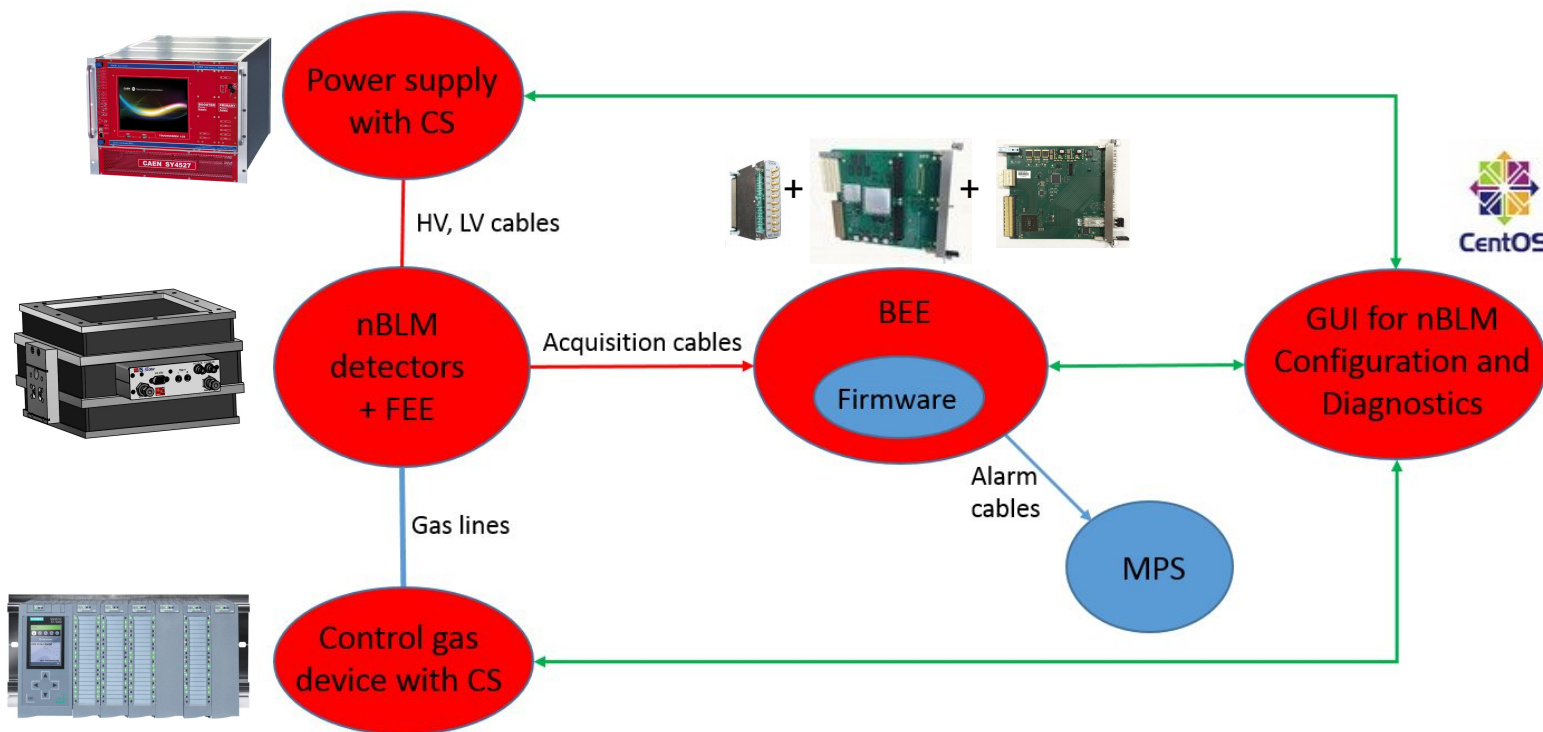
Yannick Mariette
2019 / 02 / 12



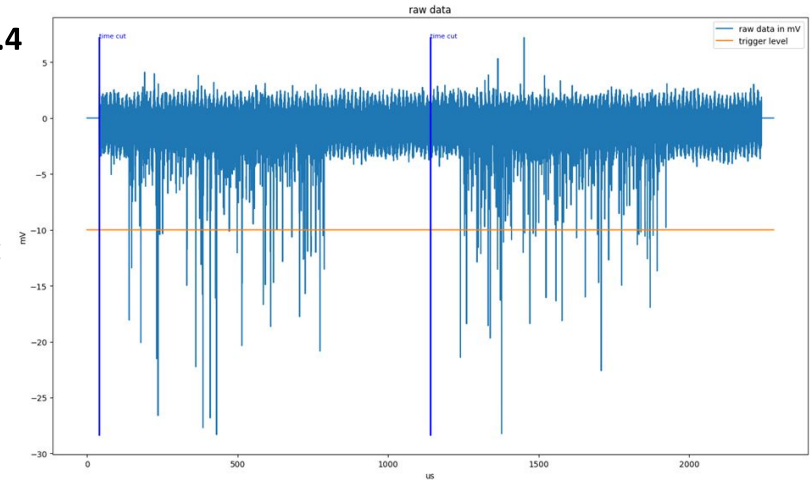
1. Facilities and interfaces overview
2. First firmware tests at CERN
3. HV tests
4. HV/LV control and monitoring
5. Gas control and monitoring
6. Neutron detection control and monitoring
7. New control system strategy
8. CS planning
9. Tests stand at Saclay
10. Views for Vertical Integration Tests

FACILITIES AND INTERFACES OVERVIEW

- ESSI
- ESS ERIC
- ↔ Ethernet cable for the control system



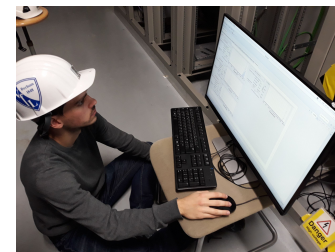
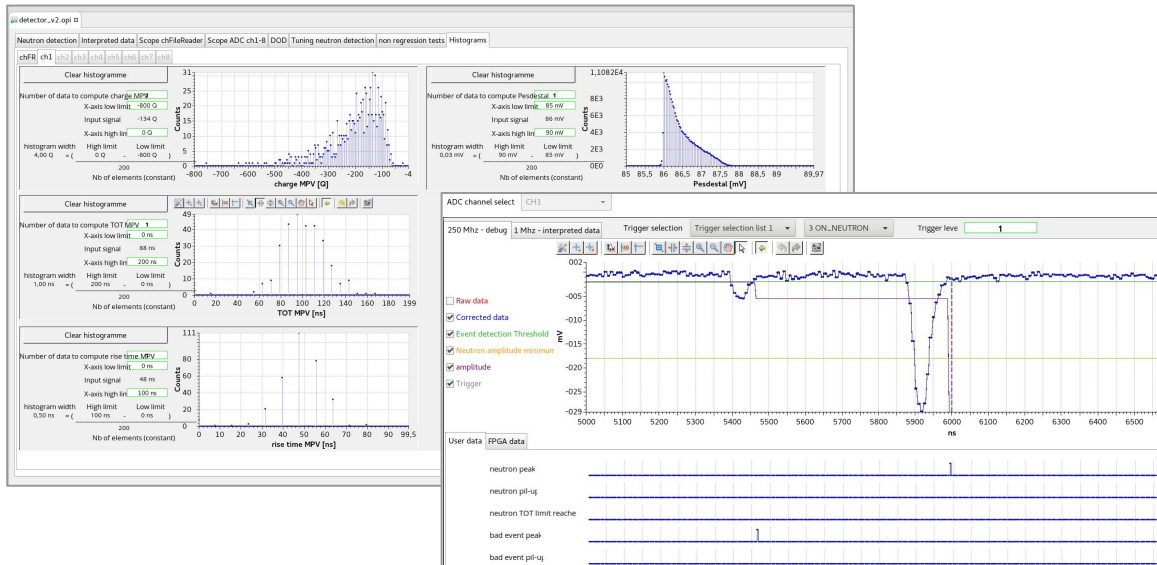
- During the CERN tests, we have tested the FPGA firmware **version 0.4**
- 3 seconds of raw acquisition
- As the pulse was less than 1 Hz, a file could contain 2 pulses
- We have done 3 runs (3 files)
- Python script to display data. With a trigger level the python script could concatenate and display interesting sections (see the adjacent picture, trigger level, pre-trigger and post-trigger could be set)

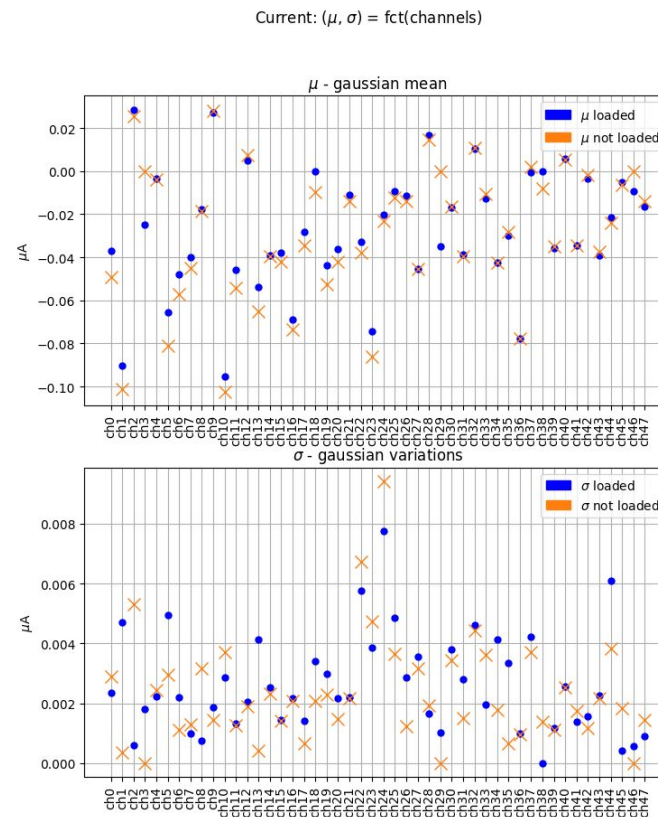
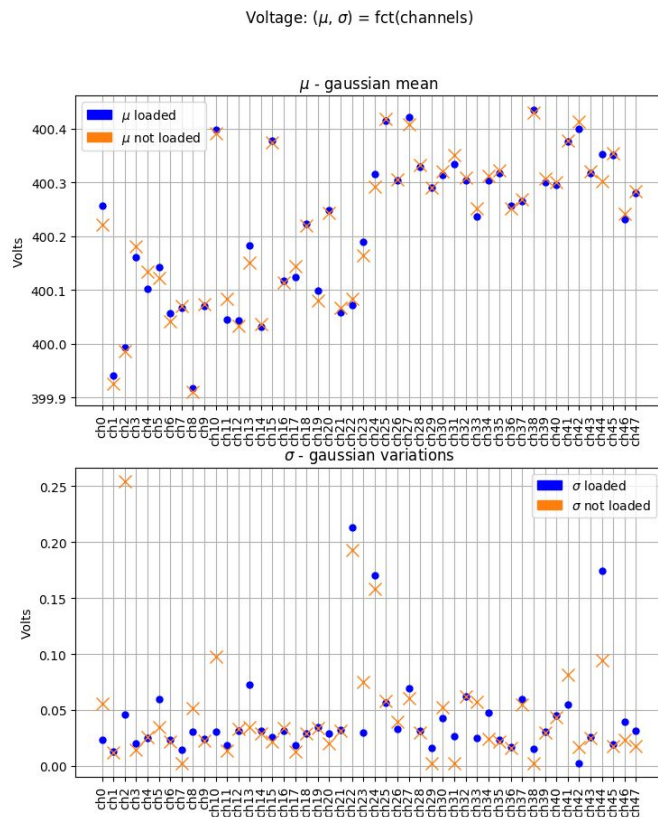


Work fine but many boot was needed before having a working acquisition system.

Dumping data into a file takes ~7 min

In parallel we used the ACT (Acquisition Chain Tester) for displaying several histograms in real time in order to try to discriminate neutron from gammas

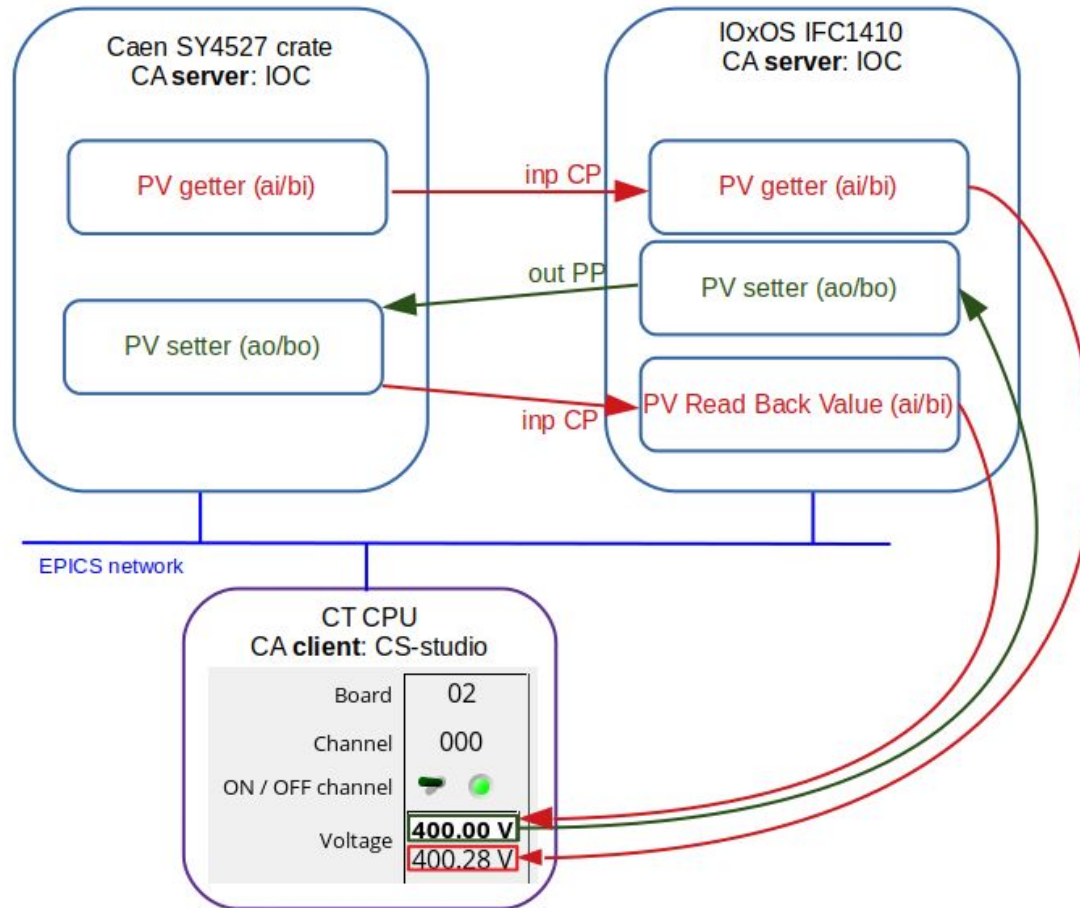




Goal: test High Voltage stability (voltage and current)

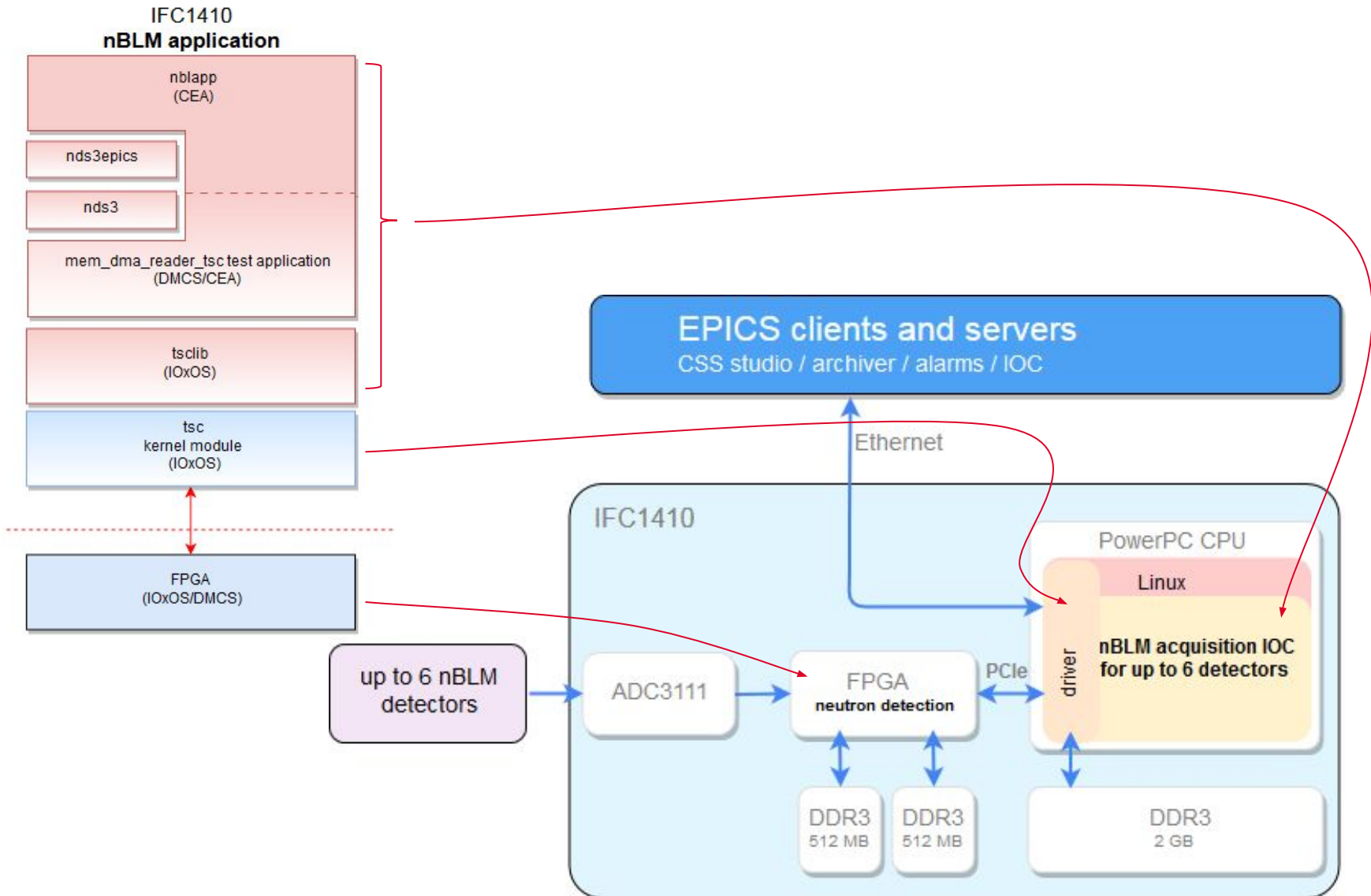
- We provided the tool to CEA/DEDIP to store and analyse data over a long time (EPICS archiver + python scripts)
- First test of the CAEN IOC in real situation: send our feedbacks to CAEN

High voltage – interposed IOC



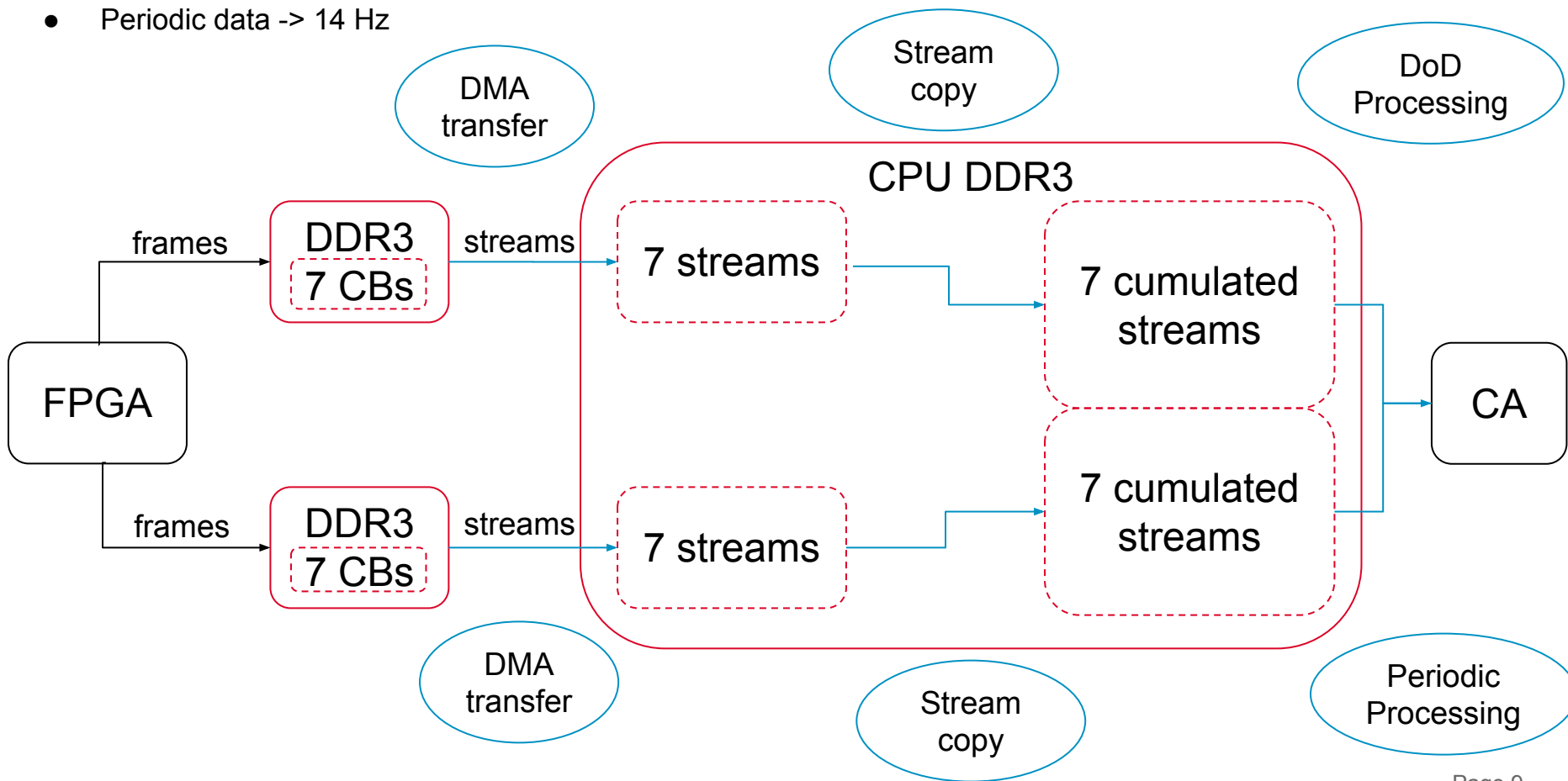
- Naming and Timestamping are not ESS compliant => interposed IOC
- Minor drawbacks:
 - SY4527 PV is still accessible by Channel Access
 - it doubles the number of PVs for controlling nBLM high voltages

- PLC factory not used
- S7PLC and Modbus server: compliant with ESS (S7PLC for monitoring and Modbus for setting)
- CEA tools:
 - PLC parser tool (CSS plugin): builds the communication IOC from a Siemens development environment
 - DXF2OPI tool (CSS plugin): autocad view conversion to CSS view
- First distribution rack integration: end of March

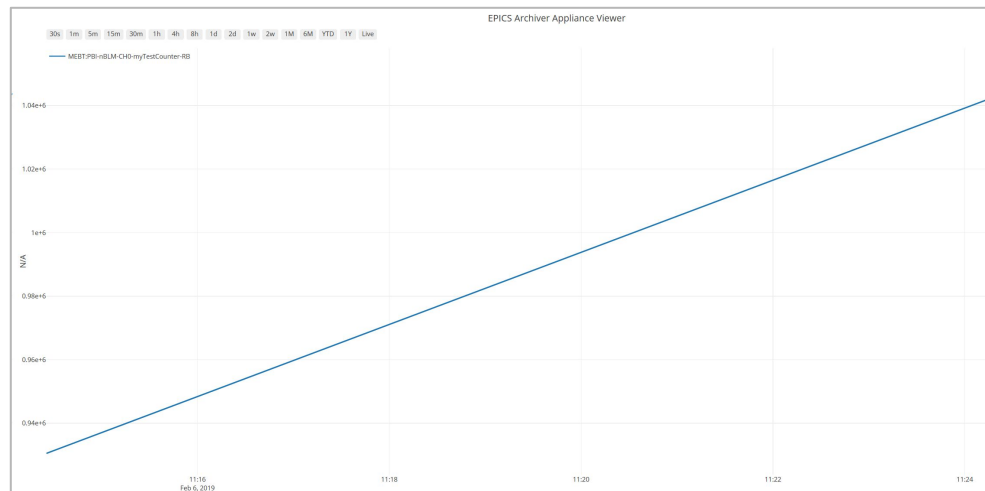


Type of data sample (bit structure associated to a CB channel)

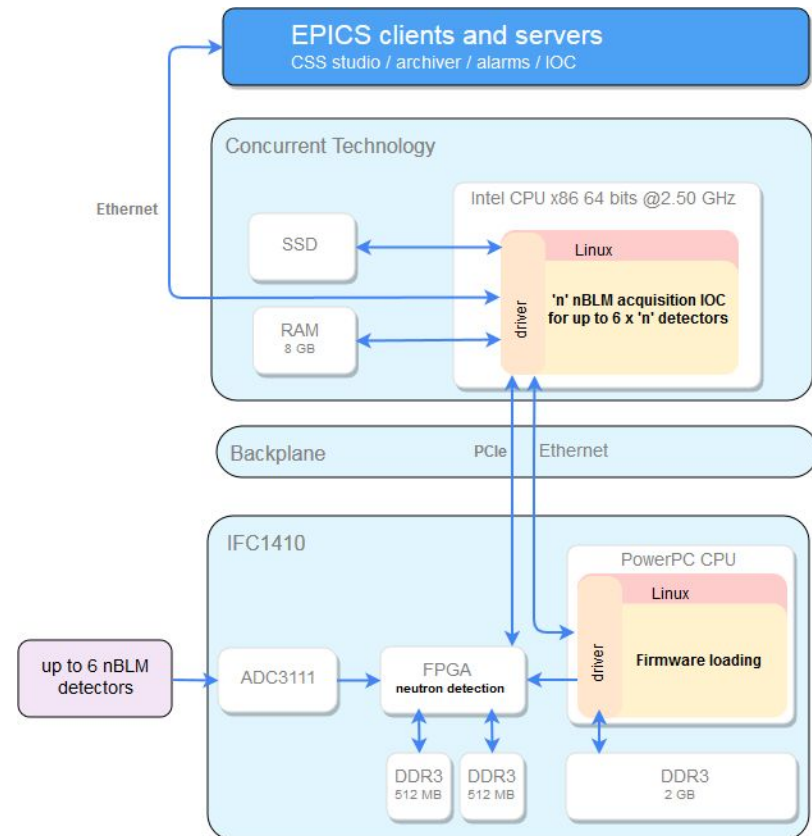
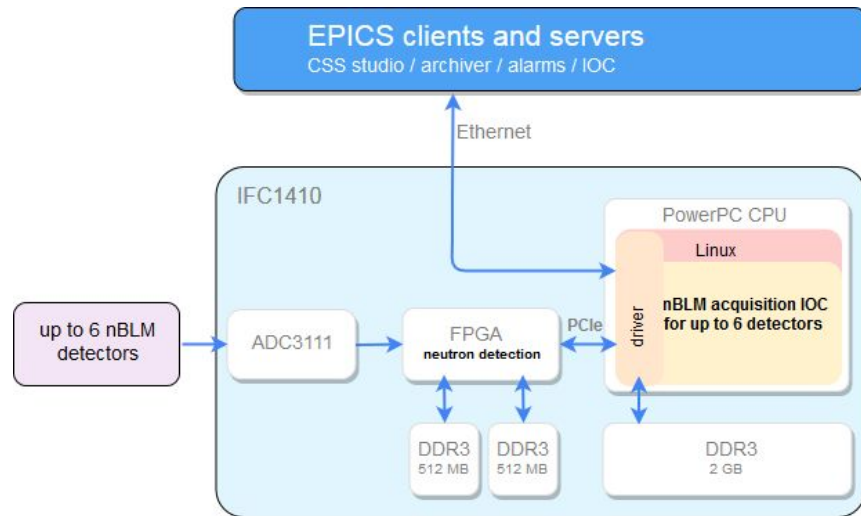
- Event info -> asynchrone
- Neutron count -> 1 MHz
- Raw data -> 250 MHz
- Periodic data -> 14 Hz



- With firmware v0.5 boot problem has disappeared
- Registers readback does not work for multiplexed registers
- Software/firmware stability : run with all circular buffers activated during 2 days
- 1 DMA transfer at once
- Software overcharge: many software DoD (with PVs instead files)
Periodic data at 100 Hz => linear counter in archiver

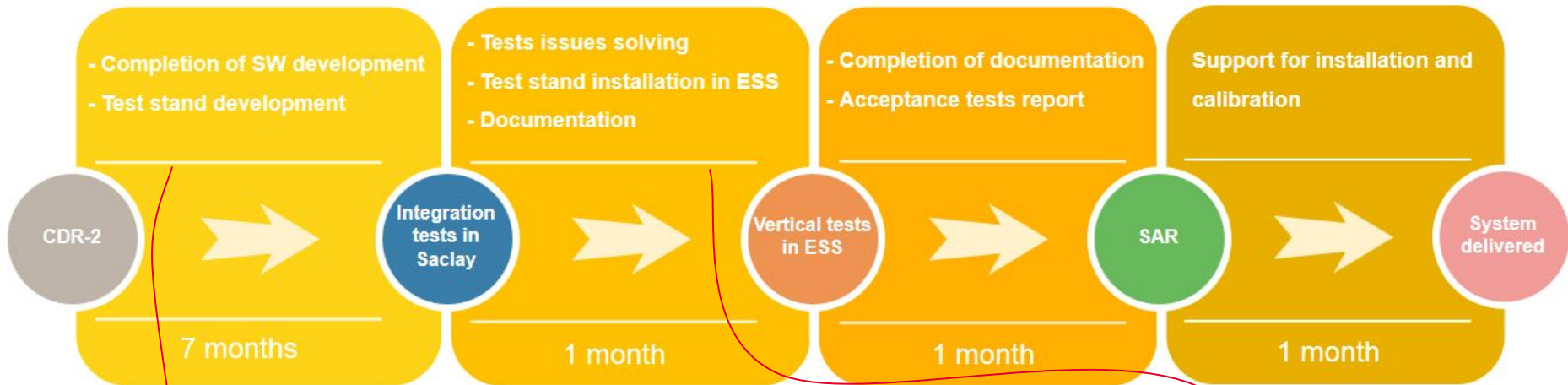


counter (100 Hz) when periodic data are pushed



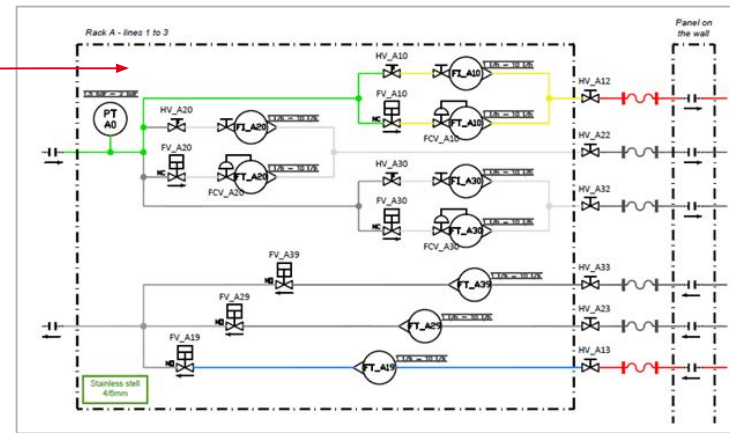
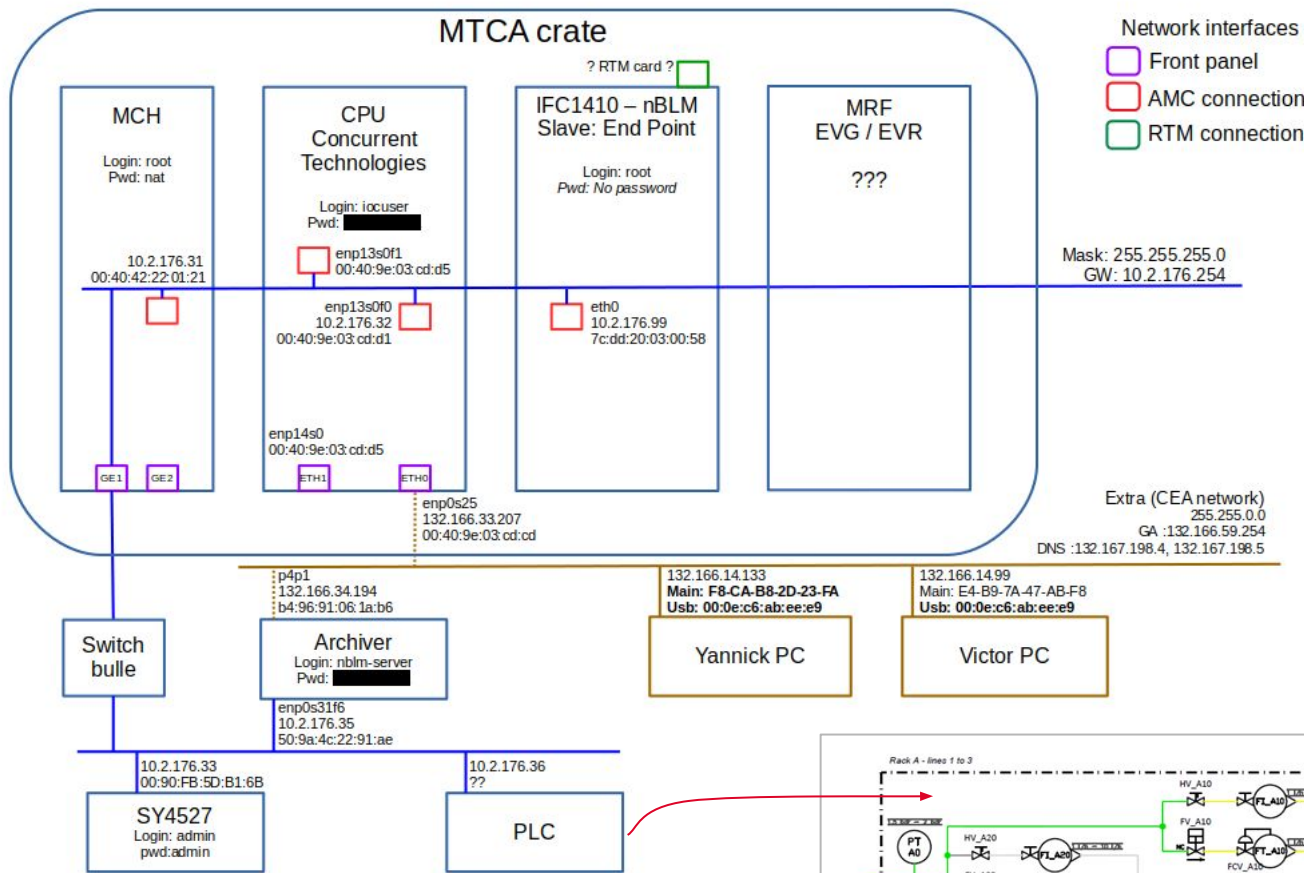
Questions/Tests will done by ICS:

- Is one CT CPU is enough powerful for up to 6 IFC1410 in a crate ?
- How many working DMA channel we have ? could we have one IOC per IFC1410 ?
- Performances: All IOs runs on CT (EVR, intermediate HV/LV, gas, neutron detection IOCs)



- **Move to new strategy (IOC on CT)**
- Completion of acquisition development : conversion, file transfer, firmware update adaptation
- MRF-EVR development and integration
- Completion of PLC process development
- Software development for PLC gas (communication and database)
- CSS development for a complete system
- Individual test for each subsystem development
- Acceptance tests development
- Saclay test stand preparation : archiver, EEE/alarm server, gas chassis, MTCA

- Migration to E³ (depends on complexity and ICS support)
- Migration with PLC factory (depends on complexity and ICS support)
- Correction of issues
- Documentation
- ESS test stand preparation and installation



- First step: Tests stand in Saclay
- Second step: Vertical integration tests

3 mains tabs:

nBLM neutron detection | Devices settings per detector | Line device settings



Number of samples	8478404
Sum of samples (Q)	898972550
Sum of squares of samples	1990487590
Negative saturations	15824
Positive saturations	21758
Neutron count	6256288

		Single neutron events		Pile-up events		Background events			
		Average	RMS	Min	Max	Average	RMS	Min	Max
Peak time	41	36	10	154	68	50	10	154	35
Peak value	-6669	642	-8825	-5012	-6651	9	-6674	-6647	-2872
TOT	111	95	37	277	257	11	250	277	104
Q during TOT	-593398	647277	-1638160	-108220	-1596995	38415	-1638160	-1525134	-242603
Event count	10000				10000				10000

Neutron count in nominal repetition rate

Neutron charge (Q) in nominal repetition rate

Histograms for all events

Type of data sample

- Periodic data -> 14 Hz
- Event info -> asynchrone
- Raw data -> 250 MHz
- Neutron count -> 1 MHz

+ HDF5 files for DoD

2nd tab: Devices settings per detector

kind

area

index

Gas line status

crate SY452

LV line status

HV status

mesh

drift

ACQ status

ADC311

clock

MCH MTCA

HV setting per detector

	mesh	drift
Board		
Channel		
ON / OFF channel	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Voltage	<input type="text"/>	<input type="text"/>
Maximum current	<input type="text"/>	<input type="text"/>
Current monitor	<input type="text"/>	<input type="text"/>
offset current	<input type="text"/>	<input type="text"/>
maximum voltage	<input type="text"/>	<input type="text"/>
ramp up	<input type="text"/>	<input type="text"/>
ramp down	<input type="text"/>	<input type="text"/>
time before trip	<input type="text"/>	<input type="text"/>
Restore config after power on	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
ramp down on kill/trip	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
channel on	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ramping up	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ramping down	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OVERCURRENT conditior	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OVERVOLTAGE conditior	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
UNDERVOLTAGE conditior	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
reached VMAX conditior	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OFF due to external TRIP line signa	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OFF due to internal OVERCURRENT conditior	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
disabled by board INTERLOCK protectior	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OFF due to exceeded power limit (>1.5W)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

kind

area

index

Gas line status

crate SY452

LV line status

HV status

mesh

drift

ACQ status

ADC311

clock

MCH MTCA

Board number

channel number

LV status

Voltage

Voltage connector

Current

ok, channel on

ch turned off

ch in over curren

ch in in over voltage

ch in under voltage

ch OFF because external trij

ch OFF because of over curren

ch disabled by board interlock protectio

ch off due to power failure

ch with connector over voltage detecte

temperature error (>85 or < 5°)

WARNING:
mapping
not sure

kind

area

index

Gas line status

crate SY452

LV line status

HV status

mesh

drift

ACQ status

ADC311

clock

MCH MTCA

ready

gas flow (A10)

gas flow (A19)

pressure

software warning

software error

hardware erro

Gas status

3rd tab: Line Devices settings

- per gas line
- per LV line (8 channels each)

!! in direct !!

LV board parameters and status

- power fall (local power supply)
- Firmware checksum error
- HVMax calibration error
- Temperature calibration error
- under temperature (<5°C)
- over temperature (>55°C)

Software interlocks

A (ch0-3) ● Forbiddsen ● Allow ●

B (ch4-7) ● Forbiddsen ● Allow ●

Switch on group n°

Switch off group n°

? Clear board alarms?

Channel \$(LV_CH)

On/OFF Temp

Voltage Status

Voltage connector ● ok, channel on

Current ● ch turned off **WARNING: mapping not sure**

● ch in over current

Voltage min ● ch in in over voltage

Voltage max ● ch in under voltage

Current limit ● ch OFF because external trip

Ramp up ● ch OFF because of over current

Ramp down ● ch disabled by board interlock protection

● ch off due to power failure

● ch with connector over voltage detected

● temperature error (>85 or <5°C)

Channel \$(LV_CH)

On/OFF Temp

Voltage Status

Voltage connector ● ok, channel on

Current ● ch turned off **WARNING: mapping not sure**

● ch in over current

Voltage min ● ch in in over voltage

Voltage max ● ch in under voltage

Current limit ● ch OFF because external trip

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● ch off due to power failure

● ch with connector over voltage detected

● temperature error (>85 or <5°C)

Channel \$(LV_CH)

On/OFF Temp

Voltage Status

Voltage connector ● ok, channel on

Current ● ch turned off **WARNING: mapping not sure**

● ch in over current

Voltage min ● ch in in over voltage

Voltage max ● ch in under voltage

Current limit ● ch OFF because external trip

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● ch off due to power failure

● ch with connector over voltage detected

● temperature error (>85 or <5°C)

annel \$(LV_CH)

On/OFF Temp

Voltage Status

Voltage connector ● ok, channel on

Current ● ch turned off **WARNING: mapping not sure**

● ch in over current

Voltage min ● ch in in over voltage

Voltage max ● ch in under voltage

Current limit ● ch OFF because external trip

Ramp up ● ch OFF because of over current

Ramp down ● ch disabled by board interlock protection

● ch off due to power failure

● ch with connector over voltage detected

● temperature error (>85 or <5°C)

MEBT & DTL1 line

Gas flow regulation

Interlocks

Bypassed: 0.00

Tripped: 0.00

Settings

Setpoint

10

7.00 L/h

Measure

10

3.00 L/h

Output

100

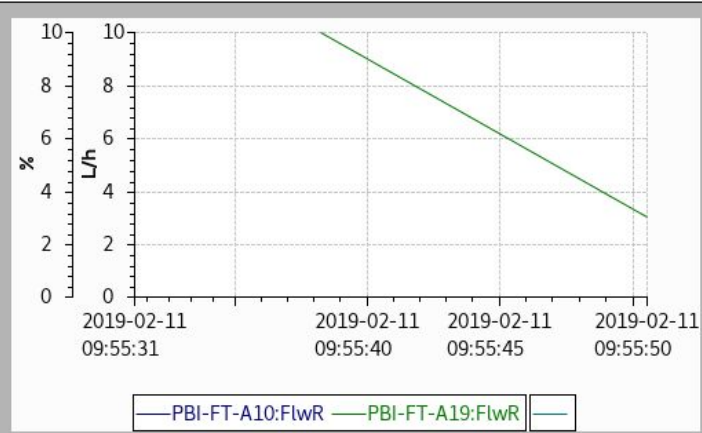
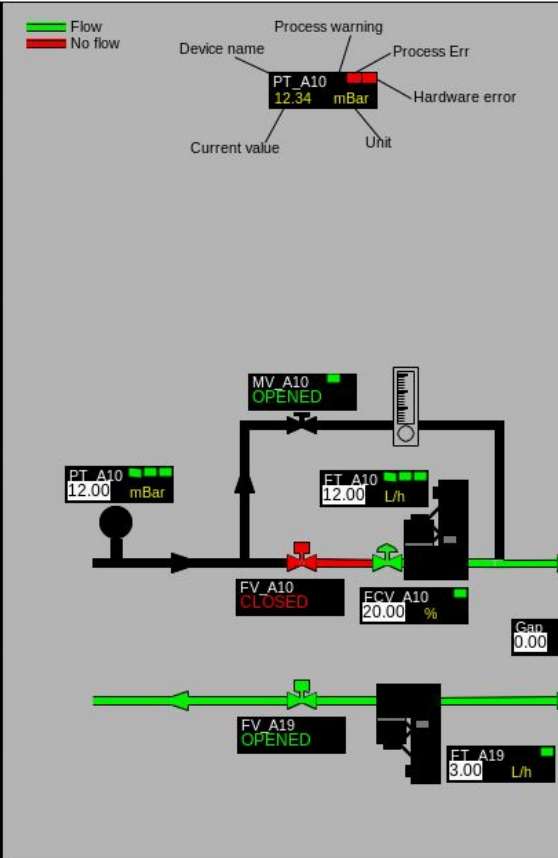
20.00 %

Low limit: 10.00 P: 0.00

High limit: 0.01 Ti: 0.00 Td: 0.00

Auto/Manu AUTO MANU

cea | CSS | mBLH



Thank you for your attention

Commissariat à l'énergie atomique et aux énergies alternatives
Centre de Saclay | 91191 Gif-sur-Yvette Cedex

Etablissement public à caractère industriel et commercial | R.C.S Paris B 775 685 019



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