

Linac4

H₂ injection system

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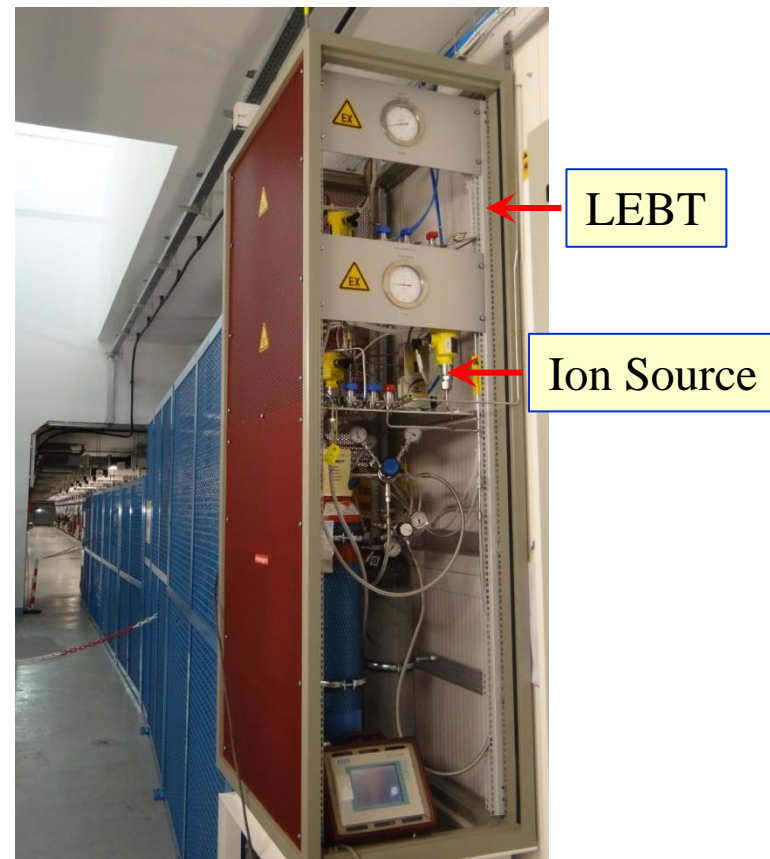
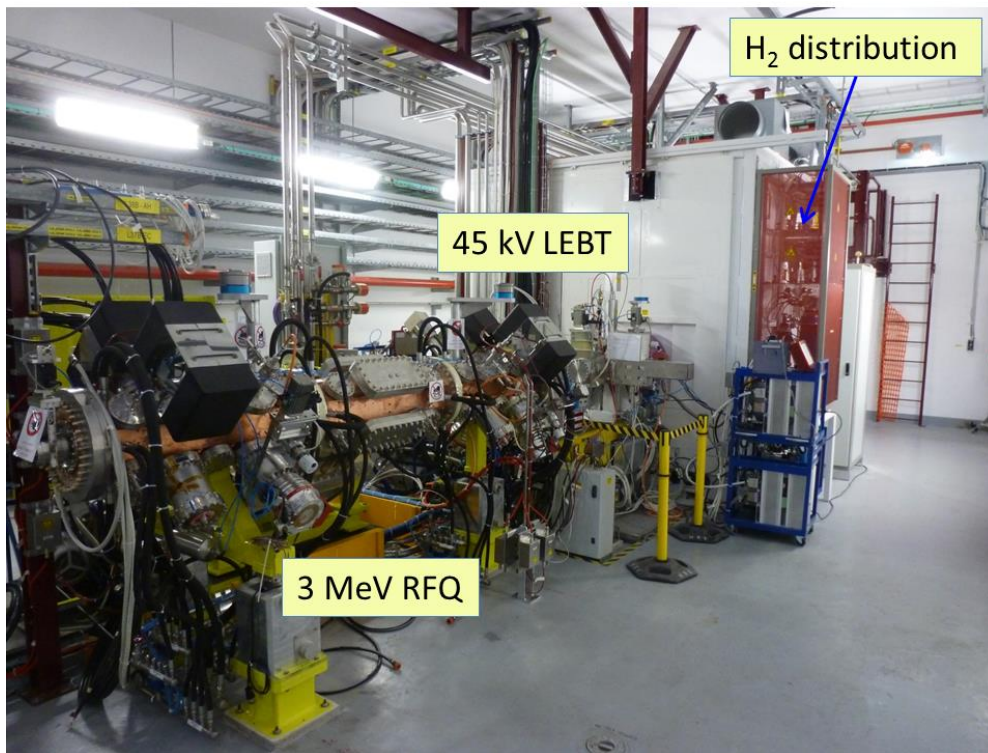
Outlook

- Introduction
- H2 supply systems: description
- Software Controls and User Interface
- Performances
- Budget analysis
- Conclusions

Linac4 H₂ supply system

- Two identical systems: 3 MeV Test Stand and Bldg400:
- Each system contains H₂ gas supply for Ion Source and LEBT
- H₂ supply at 3 MeV Test Stand operational since August 2012
- H₂ supply at Linac4 Bldg400 operational since August 2013

Introduction



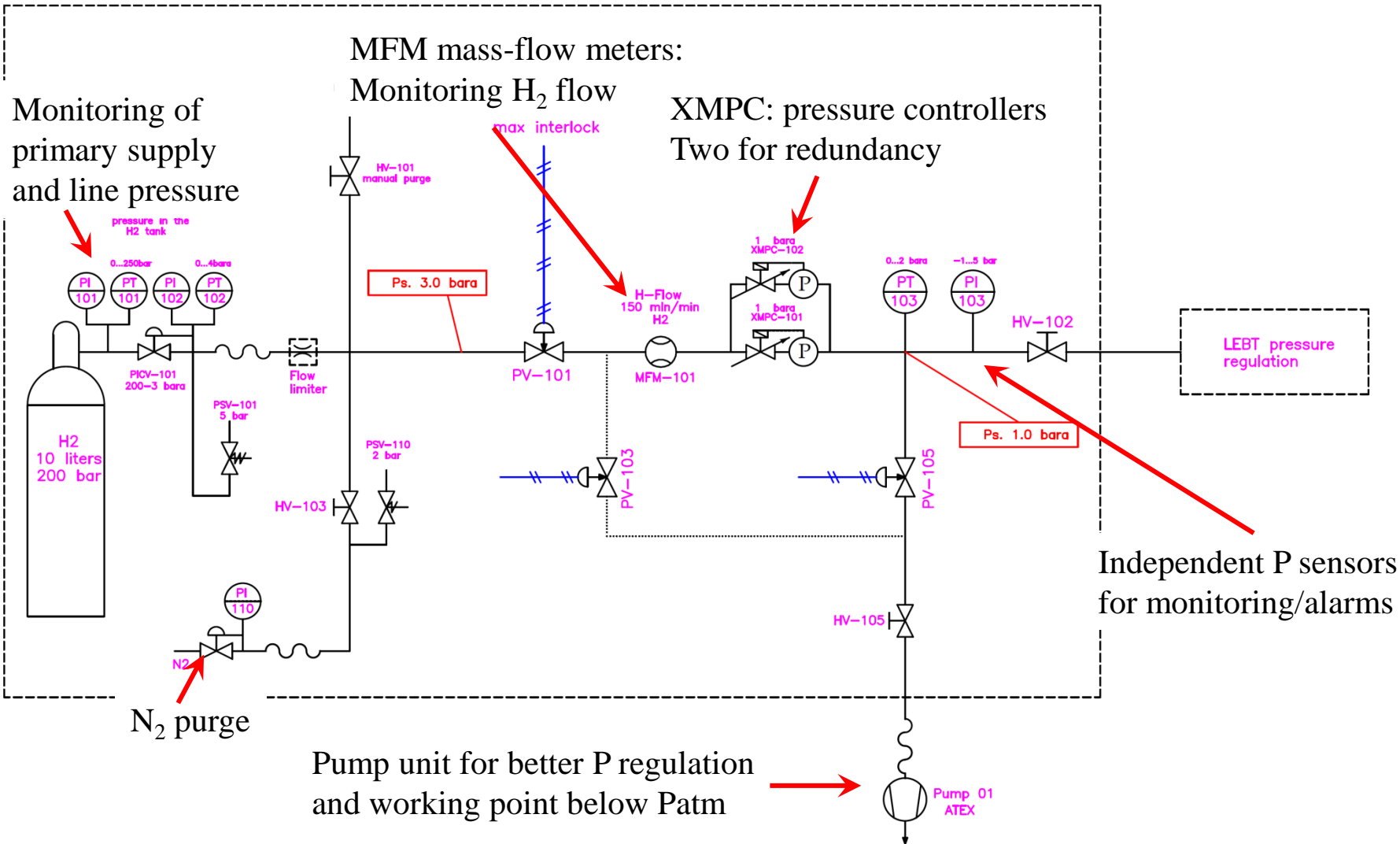
The team involved

PH-DT-DI/GasService..... Patrick Carrié, Roberto Guida, Albin Wasem
EN-MEF.....Fabrice Fayet, Mats Wilhelmsson
EN-ICE..... Silvia M. Izquierdo Rosas, Jacques Rochez

Linac4.....Jacques, Richard, Edgar, Michael

LEBT H₂ supply

H₂ supply systems



Software controls

- Remote monitoring and control
- Application running on PLC with remote interface in PVSS
- Local touch screen is available
- Alarms propagated via email/sms
- Prepared following the standard used for gas systems at LHC experiments

Operational States

Stop – (maintenance, modifications)–all the actuators in their fail-safe positions. H₂ has been evacuated from the system.

Stand-by – (allows interventions on other systems) –The gas system is stopped with all the actuators in their fail-safe positions, H₂ has not been evacuated.

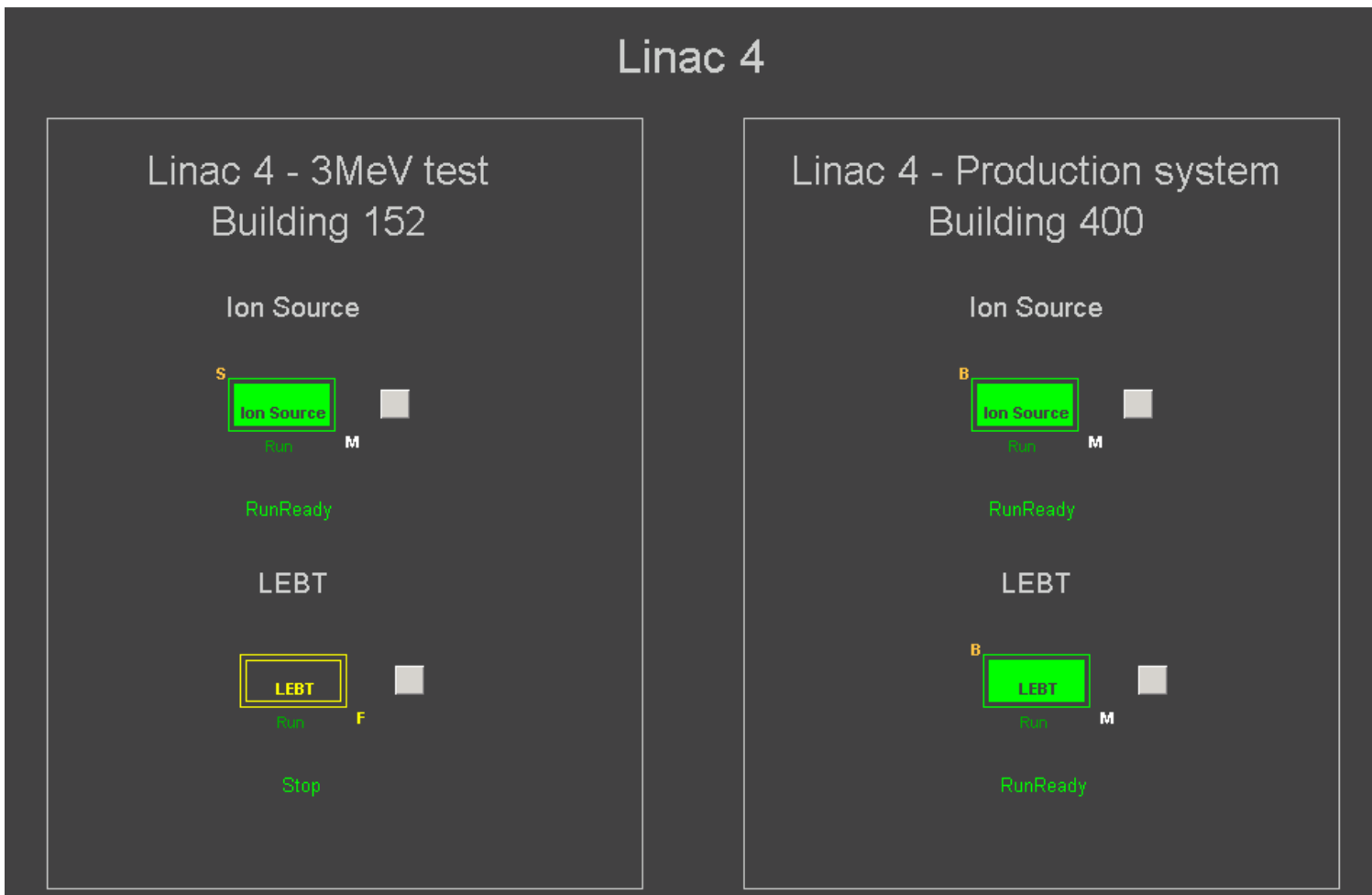
Evacuate – (improve gas purity at H₂ filling) – H₂ is evacuated from the gas system until a certain pressure threshold is reached.

Run – (normal gas system operational state): The gas system is running and all the parameters are stable and within the defined limits for this operational state.

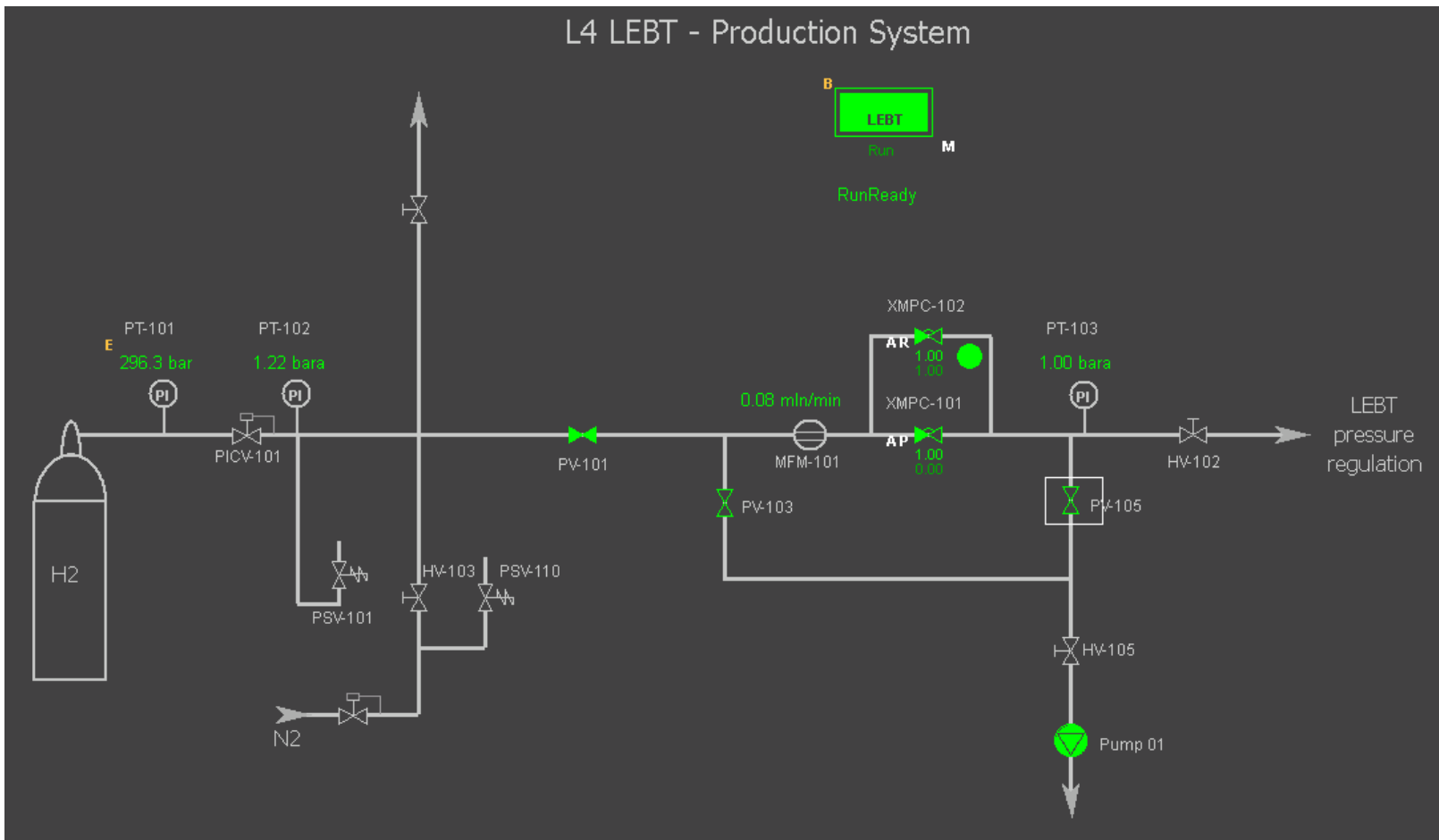
Software controls - Interface

User interface

Controls and Interface



Software controls - Interface



Controls and Interface

Controls and Performances

Safety and Alarms:

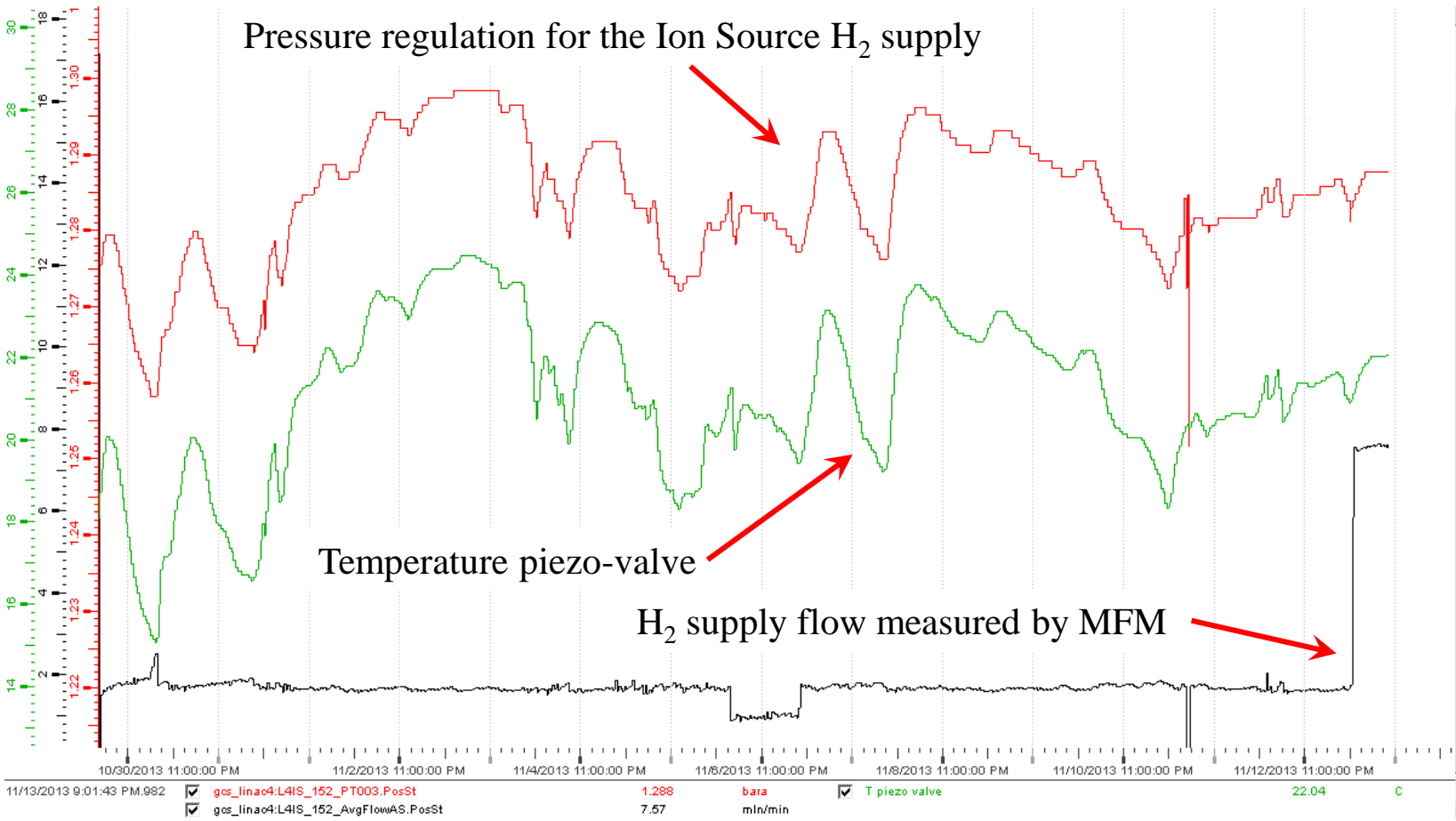
- Detection of abnormal consumption:
 - At supply level → pressure drop in H₂ cylinder
 - At P regulation level → H₂ flow monitoring
- Several alarms implemented for system stop, unstable regulation, failure of components, measurements out of range, ...

Performances:

- Stable operation (the system at the 3 MeV Test Stand is operational since one year)
- Gas density regulation is better than 0.5 mbar at 25 °C
- System tested with Pressure set-point for operation from 100 mbara to 1800 mbara
- About 15 minutes for achieving set-point with standard regulation from vacuum to 1300 mbara (room for improvement)

Performances – gas density regulation

System performances





Budget analysis

Budget for construction

	Price (CHF)	Team
Ion source	20 k	PH-DT-DI/gas team
LEBT	12 k	PH-DT-DI/gas team
Pipes/connectors	4 k	PH-DT-DI/gas team
Pressure regulators	5 k	EN-MEF-SI
manpower (mechanical and electrical)	7 k (165 hours)	PH-DT-DI/gas team
Functional analysis	-	PH-DT-DI/gas team
PLC and I/O modules	4 k	EN-ICE-PLC
Software PLC and PVSS	-	EN-ICE-PLC

About 55 kCHF (including manpower) per rack

Conclusions

- Two H₂ (or other gases) supply racks have been built for 3 MeV Test Stand and final Linac4 system at Bldg400
- Each rack contains fully independent H₂ supplies for Ion Source and LEBT
- Fundamental to study/record the stability of the 4 systems over the coming months/year
- Construction based on experience from gas systems for the LHC experiments which demonstrated extremely high availability (>99.9% power cuts excluded) over the last years
- Spare parts, maintenance, manpower, ... needed for operation to be reviewed in few months
- Each system has already an on-site redundancy to cope with unexpected failures