The Gas System of the CYGNO experiment

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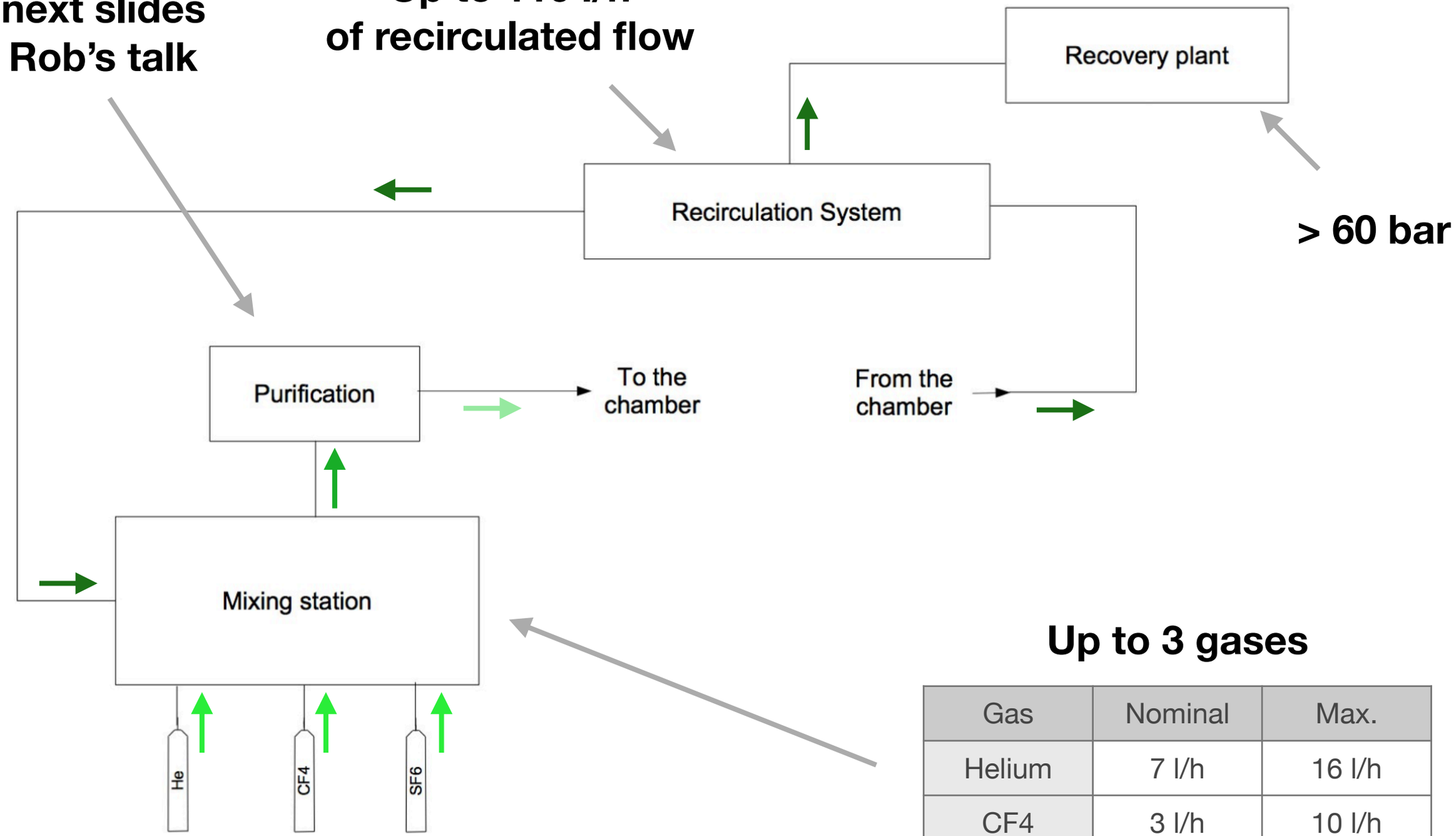
INFN Roma

Gas system functions

See next slides and Rob's talk

Up to 110 l/h of recirculated flow



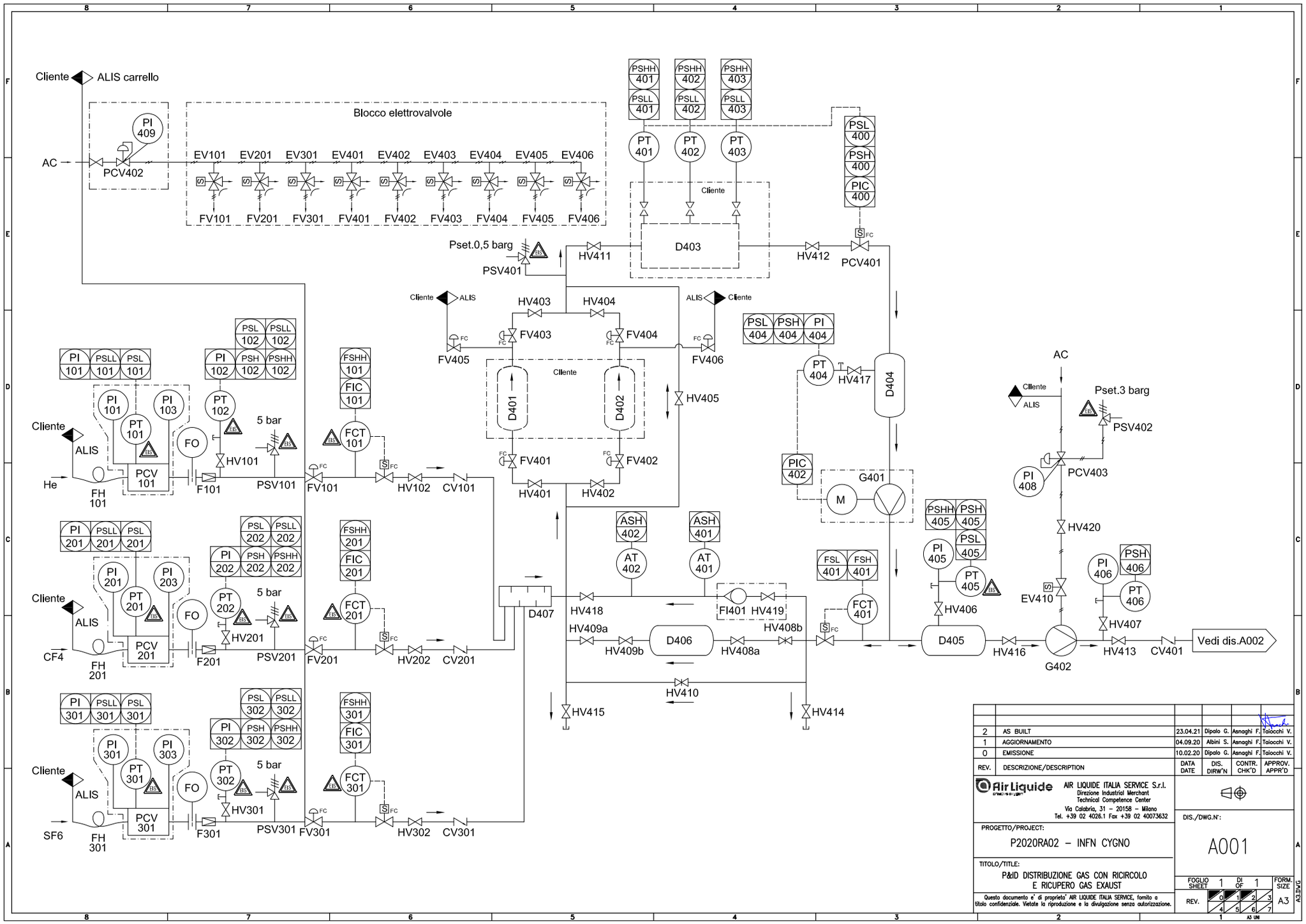
Up to 3 gases

Gas	Nominal	Max.
Helium	7 l/h	16 l/h
CF4	3 l/h	10 l/h
SF6	< 0.5 l/h	1 l/h

Gas system history

- Order request (RDA): **Sept. 2019**
- Order approval by INFN executive board: **Dec. 2019**
- Tender setup by INFN central administration: **Feb. 2020**
- Tender period: **Feb. - Mar. 2020**
- Tender adjudication: **Jun. 2020 - Air Liquide Italia Service S.r.l.**
- Order by INFN central administration: **Sep. 2020**
- Variation order request: (enhanced remotization and purest mass flow controller option): **Nov. 2020**
- Variation order approval by INFN executive board: **Feb. 2021**
- Delivery: **Jun. 2021** — one component damaged during the transportation
- Delivery and installation of the spare part: **Jul. 2022**
- Tests by INFN staff and software bug fixes by AirLiquide: **Aug. - Oct. 2022**

Technical drawing



REV.	DESCRIZIONE/DESCRIPTION	DATA DATE	DIS. DIRW'N	CONTR. CHK'D	APPROV. APPR'D
2	AS BUILT	23.04.21	Dipalo G.	Asnaghi F.	Taiocchi V.
1	AGGIORNAMENTO	04.09.20	Albini S.	Asnaghi F.	Taiocchi V.
0	EMISSIONE	10.02.20	Dipalo G.	Asnaghi F.	Taiocchi V.

Air Liquide
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PROGETTO/PROJECT:
P2020RA02 – INFN CYGNO

TITOLO/TITLE:
P&ID DISTRIBUZIONE GAS CON RICIRCOLO E RICUPERO GAS EXAUST

DIS./DWG.N°:
A001

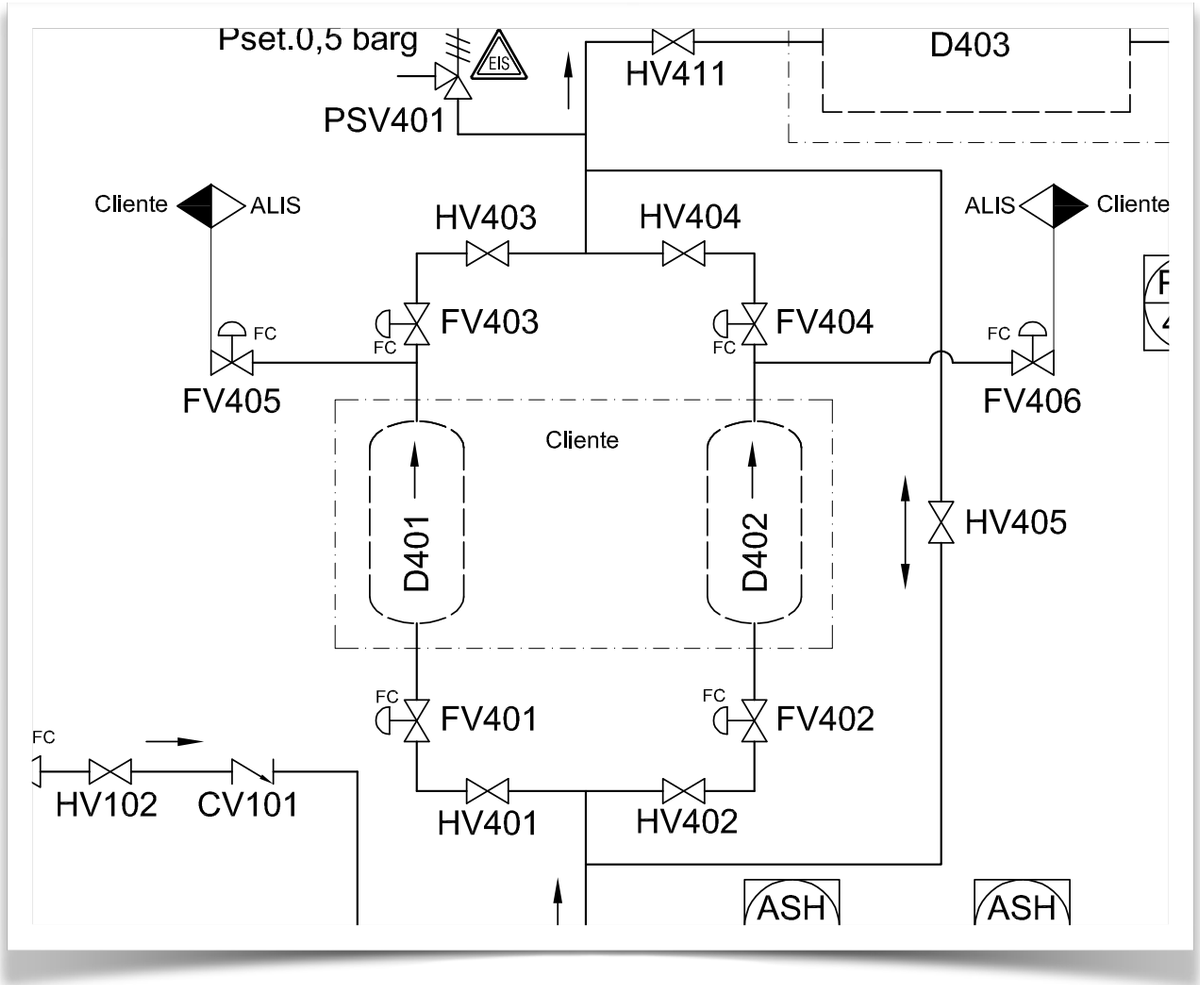
FOGLIO SHEET 1 DI OF 1
REV. 0 1 2 3 4 5 6 7
FORM. SIZE A3

A3.DWG

Some pictures

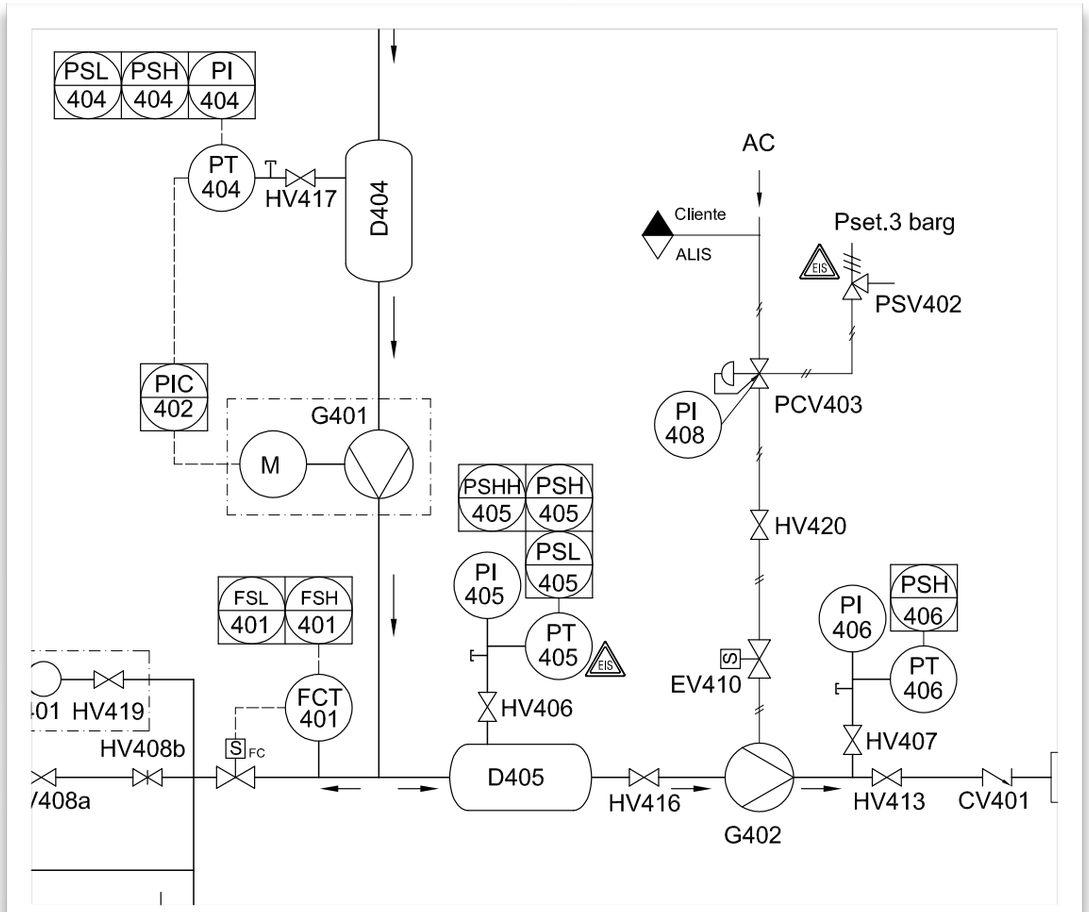
Some technical details - Purification

- System for purification and filter regeneration with Vacuum Swing Adsorption (see Rob's talk)
- Two lines, one in operation, the other in regeneration:
  - remotely switchable
- Filters (D401, D402) and monitoring devices (pressure sensors, etc.) not yet included



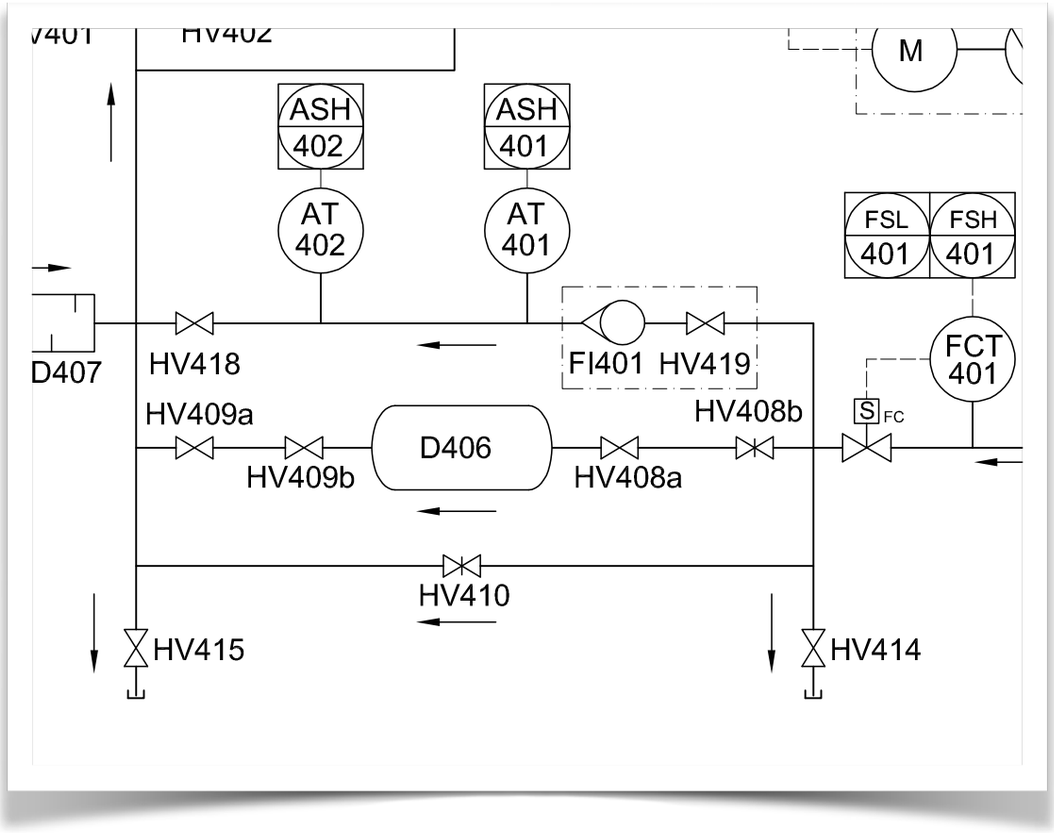
Some technical details - Recirculation & Recovery

- G402 booster:
  - recovery of exhaust gas
  - intermittent operations, keeping the pressure in the D405 buffer within a settable range
  - outlet pressure up to 60 bar was reached during our tests (larger pressure should be reachable, we just didn't try)
- G401 recirculation pump:
  - special execution to guarantee the minimum inlet pressure that is recommended for the booster operation, 2-3 bar(g)
  - indeed, we could more safely operate down to 1 bar(g)



Some technical details — Gas Analysis

- Moisture and oxygen sensors (AT401, AT402) already installed in the recirculation loop
- One parallel line for additional analysers:
  - CF4 concentration analyzer (thermal conductivity analyzer) already ordered



O_2: GE Oxy.IQ

0…10 ppm (±2% acc.)
to
0…1% (±1% acc.)

Moisture: Vaisala DMT143

10…40000 ppm
(acc. 1 ppm + 20% of reading)

Remaining issues

- There is an interference of the booster with the pneumatic valves installed around the system (they use the same compressed-air source):

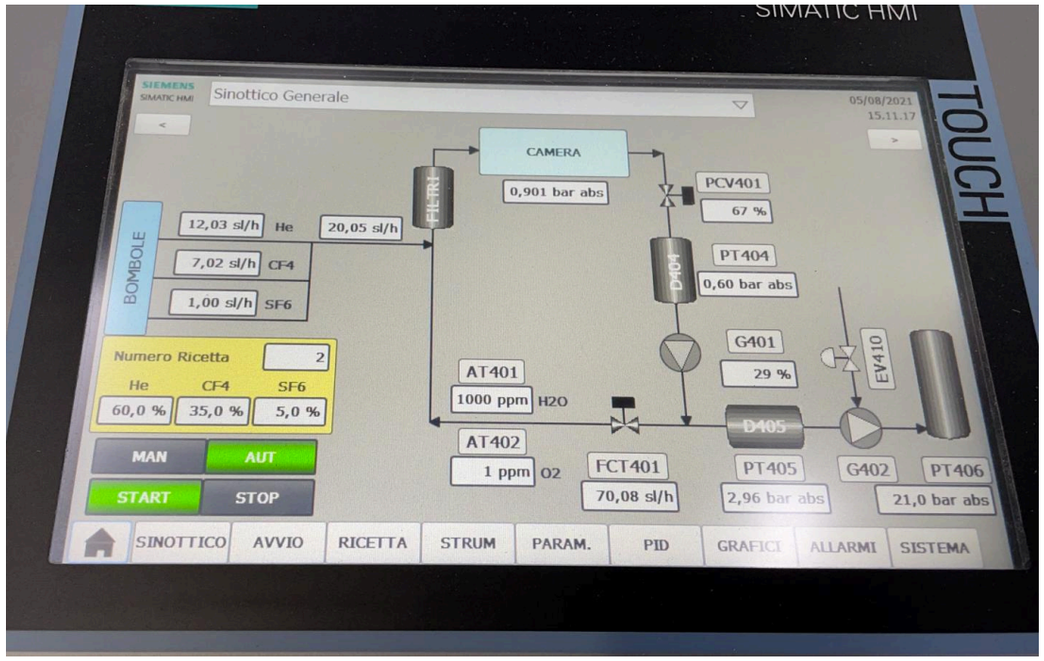
  - test to be performed with a check valve to prevent pressure loss in the pneumatic valves when the booster draw a large air flow

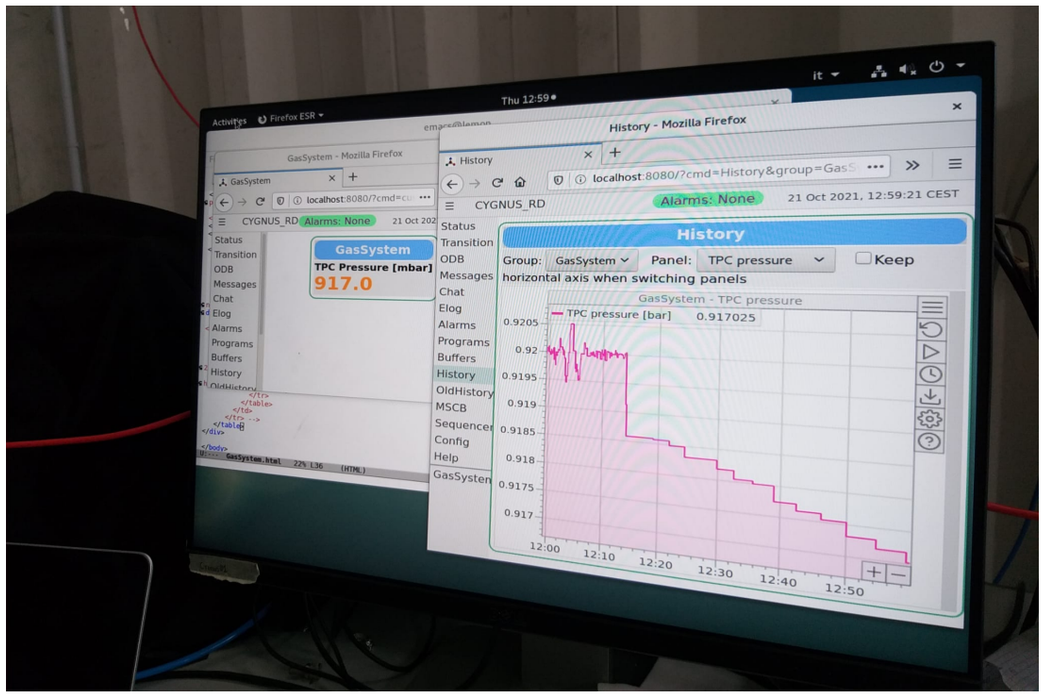
- Some electrical instabilities were experienced during the tests:

  - need a long-term test

Human Machine Interface & Remote Control

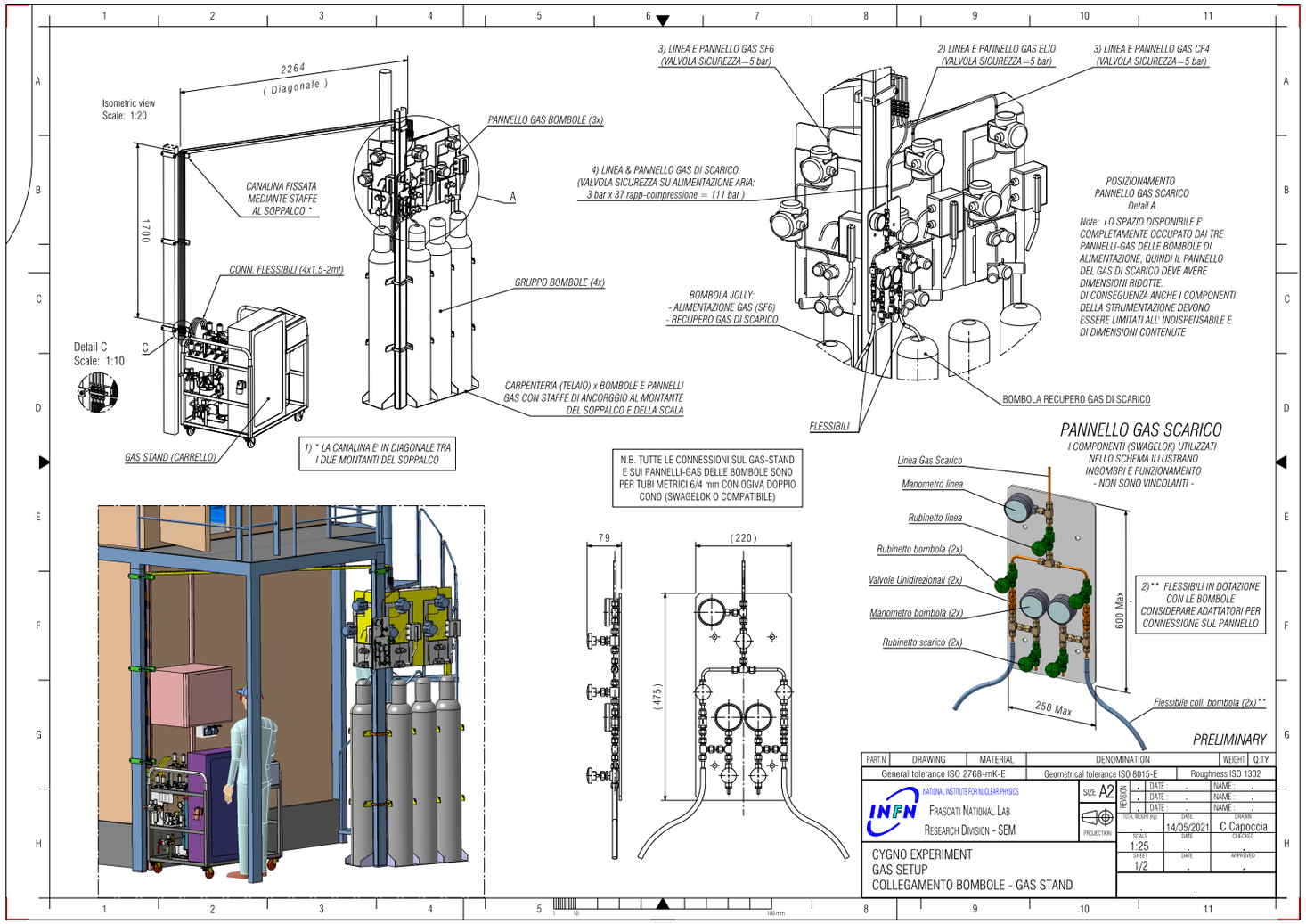
- Human interface: touch screen installed in the system
  - the same control pages can be forwarded to a remote Windows machine (ethernet connection)
- But we want to control the system from MIDAS…
  - the system runs an OPC-UA server with TPC network protocol
  - no OPC-UA interface was available in MIDAS - we wrote our own





Installation

- The system will be installed underground and connected to the gas bottles through flexible steel tubes
- Tender on going for the construction of a high pressure panel to connect the gas recovery bottle



Greenhouse gas disposal

- A few companies have been contacted and are willing to provide a CF_4 gas disposal service

- Technical and commercial details to be defined:
  - rent/purchase of bottles
  - collection frequency and temporary storage
  - certifications
  - …

To-do

- Hardware:
  - complete the underground installation
  - test the proposed solutions to the interference between the booster and the pneumatic valves
- Software:
  - develop a complete MIDAS web page to control the most relevant features of the system

Credits

- INFN technical staff:
  - hardware tests and installations
- GSSI students + Rita
  - help in hardware tests and development of the remote control
- Giovanni:
  - coordination and administrative support