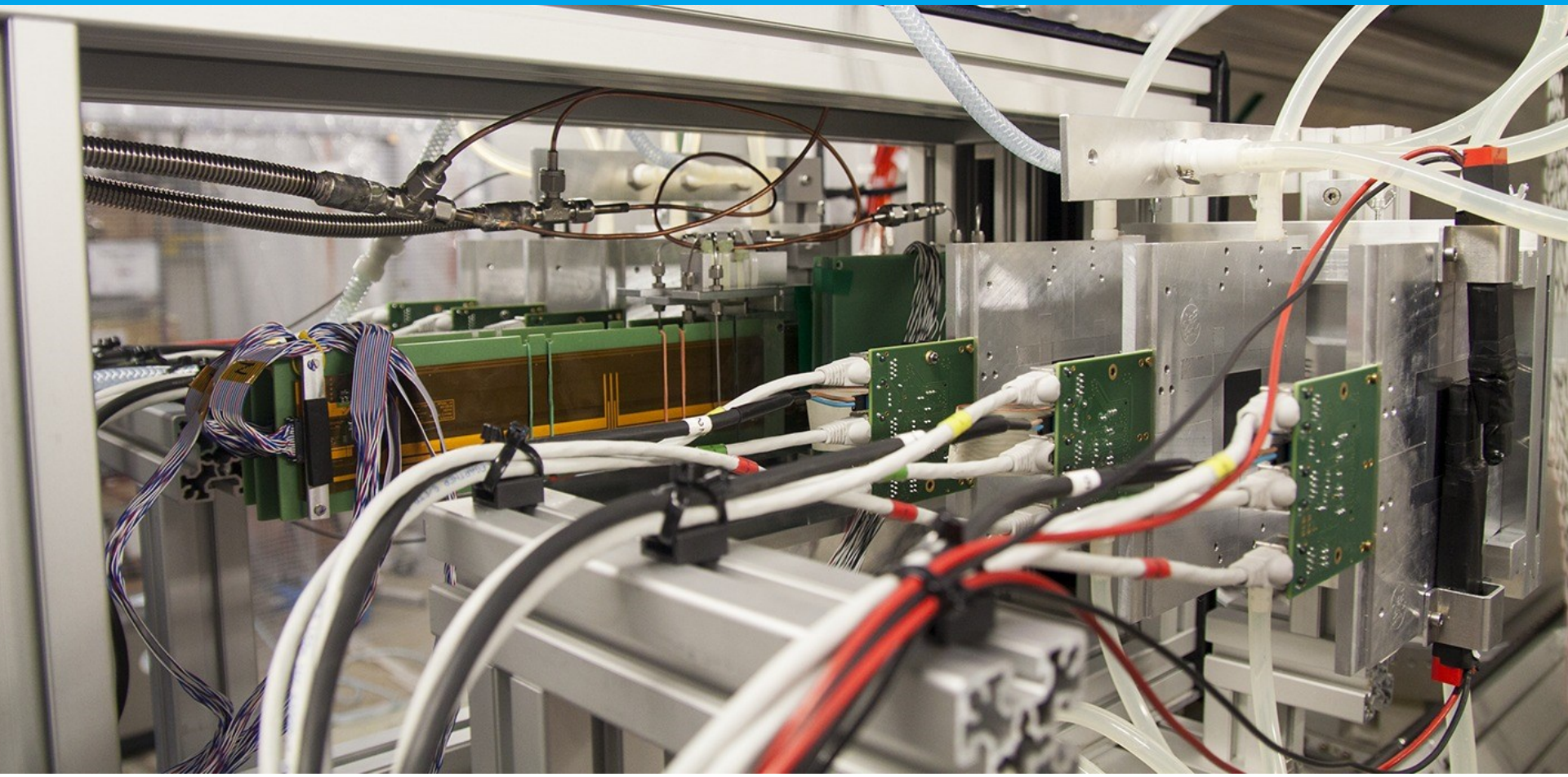
CO_2 Experience @ Belle2 VXD Test Beam



Reimer Stever
Beam Telescopes and Test beams
for Detector R&D, DESY Hamburg
30.06. – 02.07.2014

HELMHOLTZ ASSOCIATION

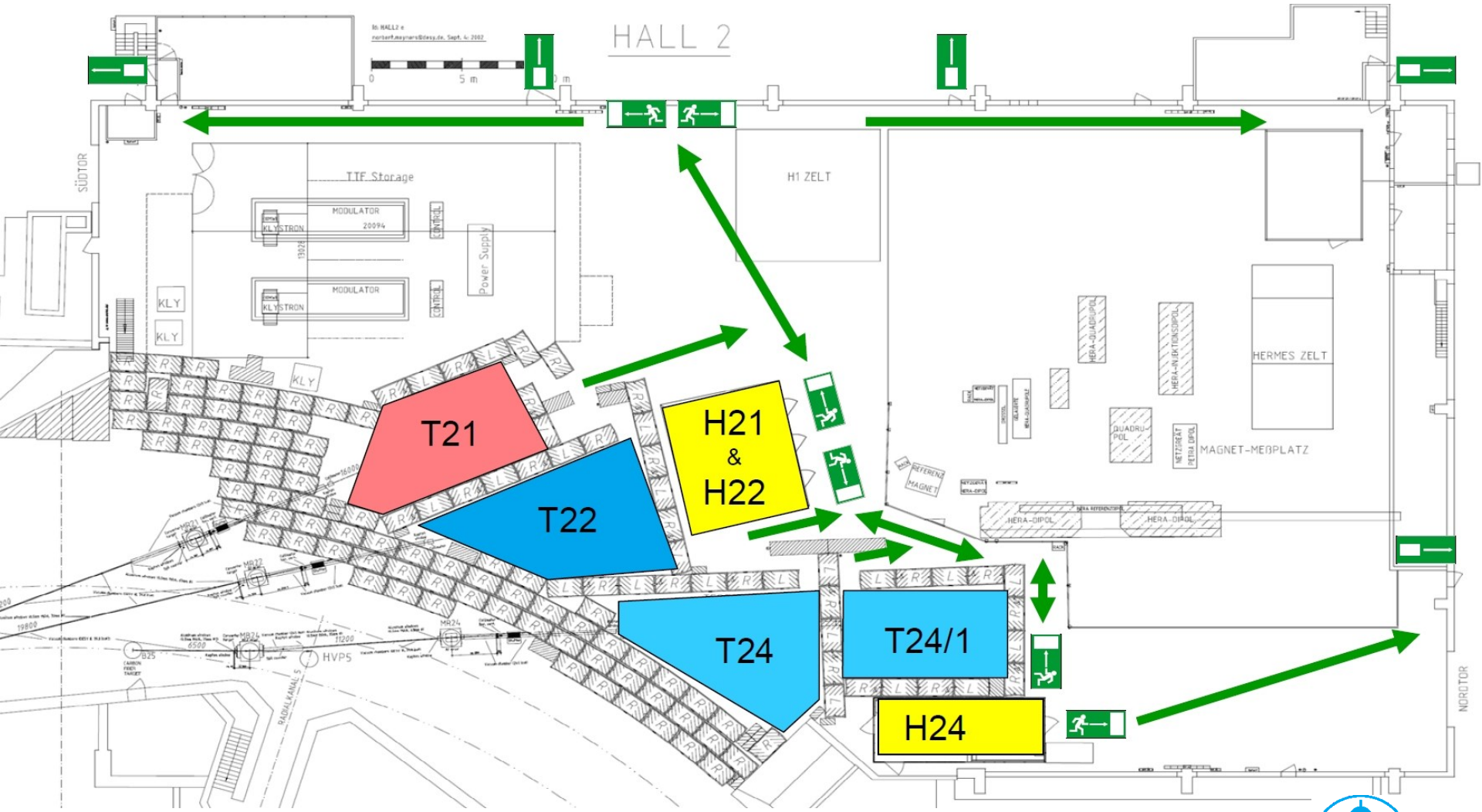
DESY

CO_2 Experience @ TB: Outline

- Belle2 VXD Test Beam
- CO_2 Cooling Scheme
- Magnetic field
- CO_2 Safety / Venting
- Cooling OK signal
- Chiller Error
- Pump Head leaking
- CO_2 supply temperature drift
- pump filter pressure drop

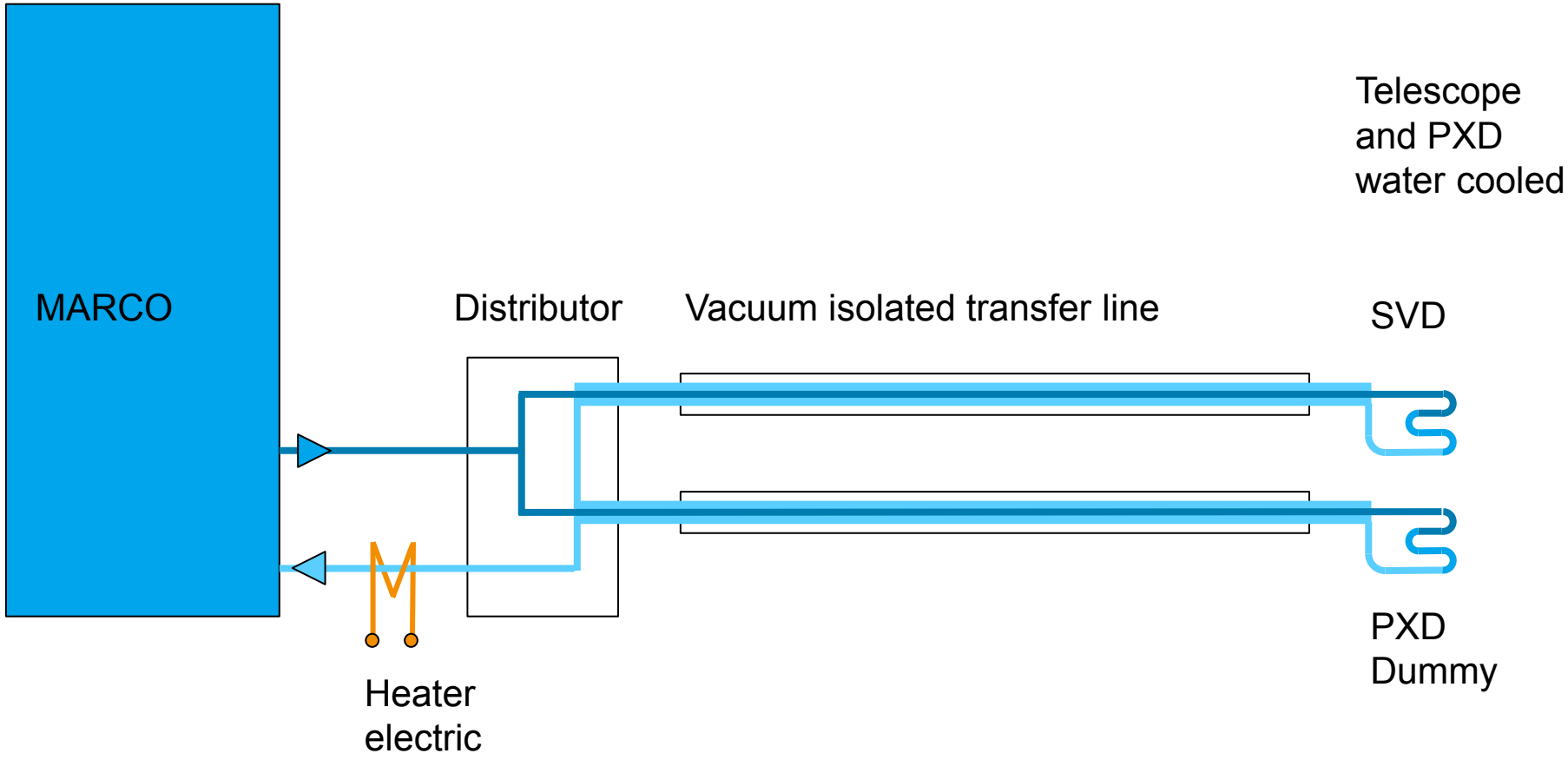
Belle2 VXD Test Beam

- took place from 3. - 26.January 2014 at Desy Halle2



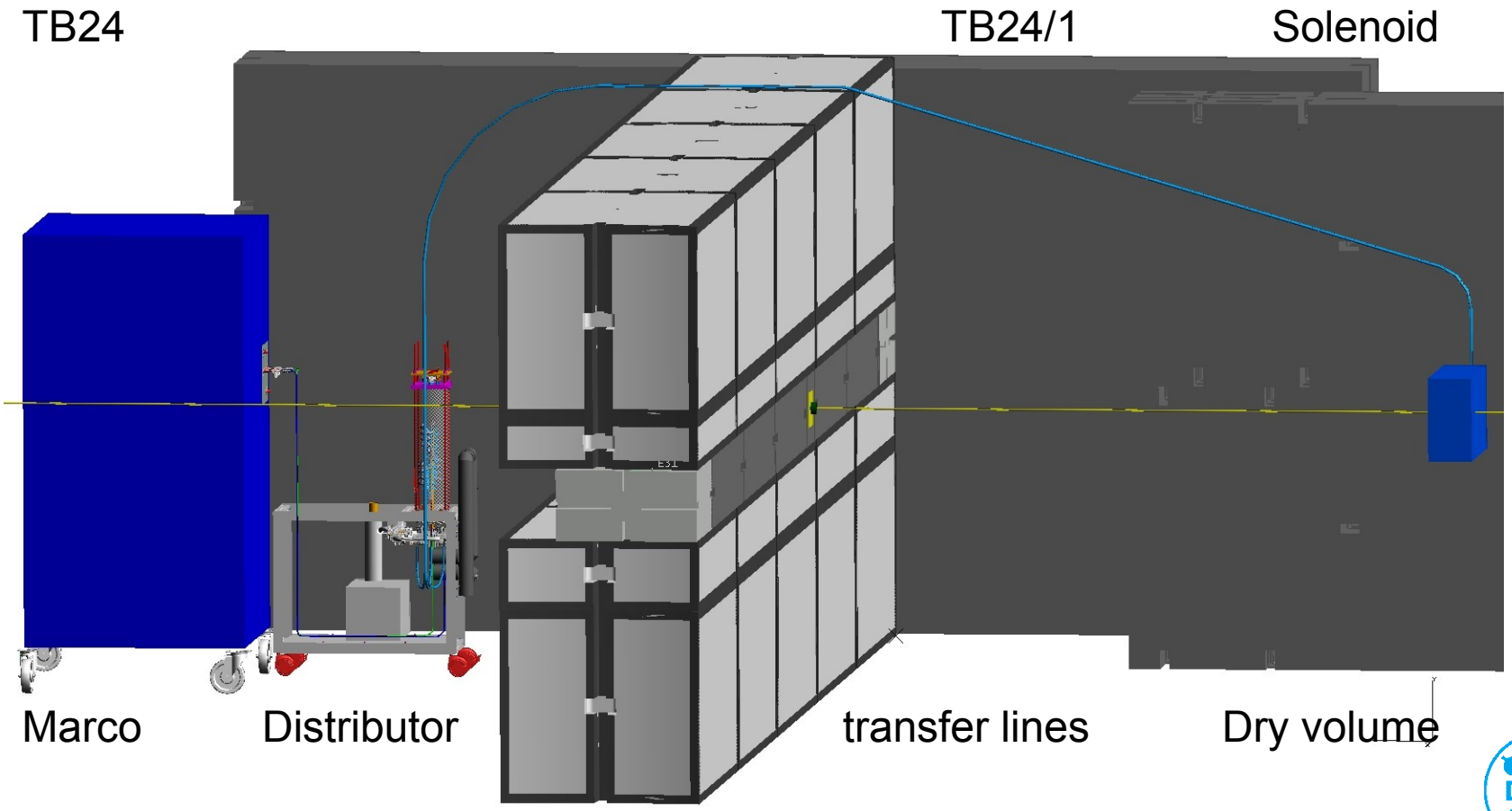
CO_2 Cooling scheme

- MARCO Multipurpose Apparatus for Research on CO_2
- cooling capacity: 1kW, temperature range: -40…20°C



Installing aggregates away from magnetic field

- To avoid influences of the strong magnetic field of the solenoid in TB24/1
- Marco and the distributors vacuum pump
  are located in the neighbouring section TB24
  with 12m of vacuum insulated transfer lines reaching over the wall.



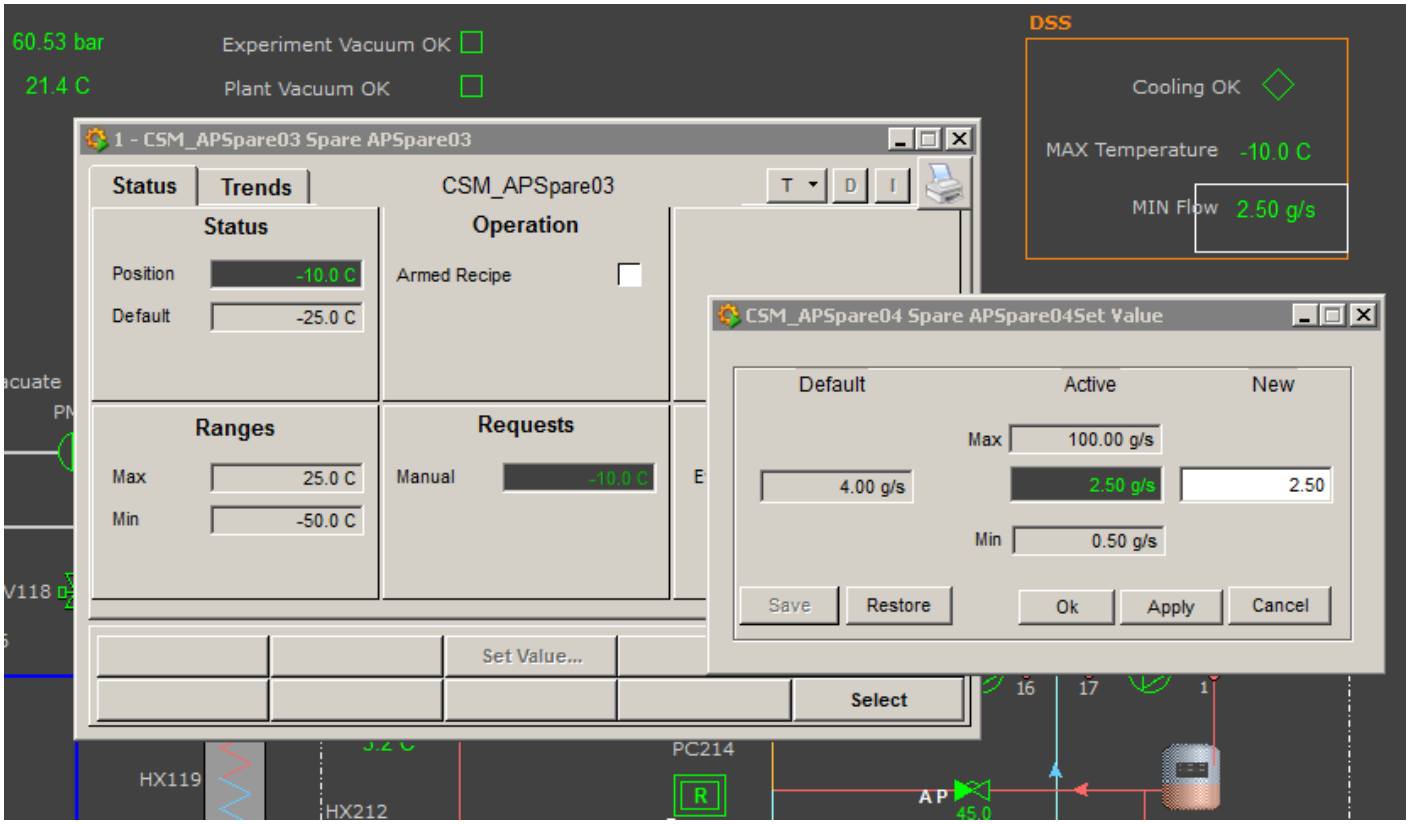
CO_2 Safety / Venting

- Because of the small amount of 5 litres liquid CO_2 expanding to 3 m^3 of gas
- compared to the huge volume of the area
- and a good ventilation in the underground cable tunnel
- no oxygen deficiency warner is needed.

- Venting the plant through the foreseen chimney
- caused an overpressure there and triggered an alarm.
- So technical emergency services had to be informed beforehand.

Overheating silicon sensors / Cooling OK signal

- To prevent powering the silicon sensors without cooling a relay was implemented that let through a 20mA Signal to the DAQ when
- the CO_2 temperature is below a temperature limit and
- the CO_2 mass flow exceeds minimum flow.

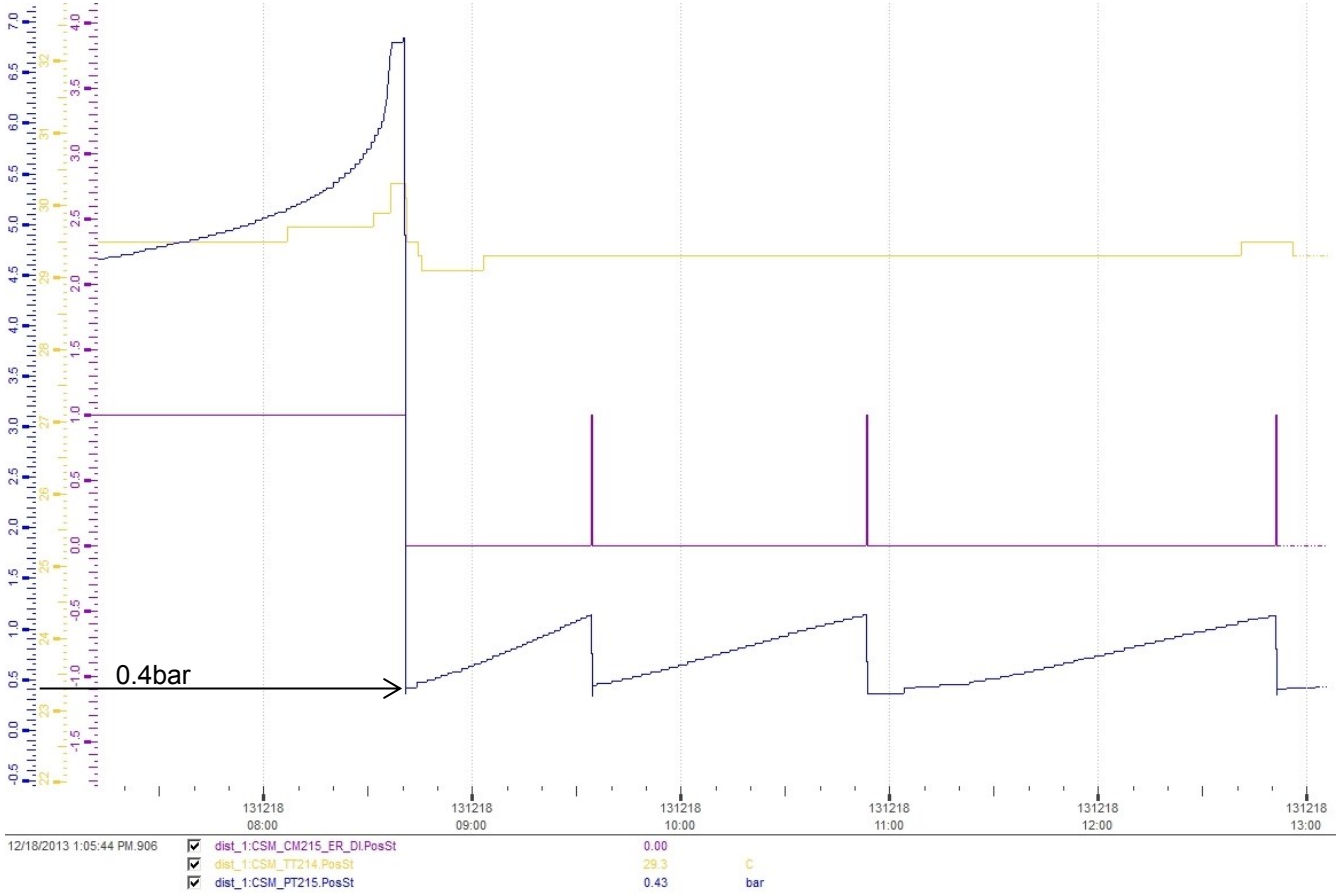


Chiller Error

- Already during installation in December starting Marco ended repeatedly with a time consuming chiller error:

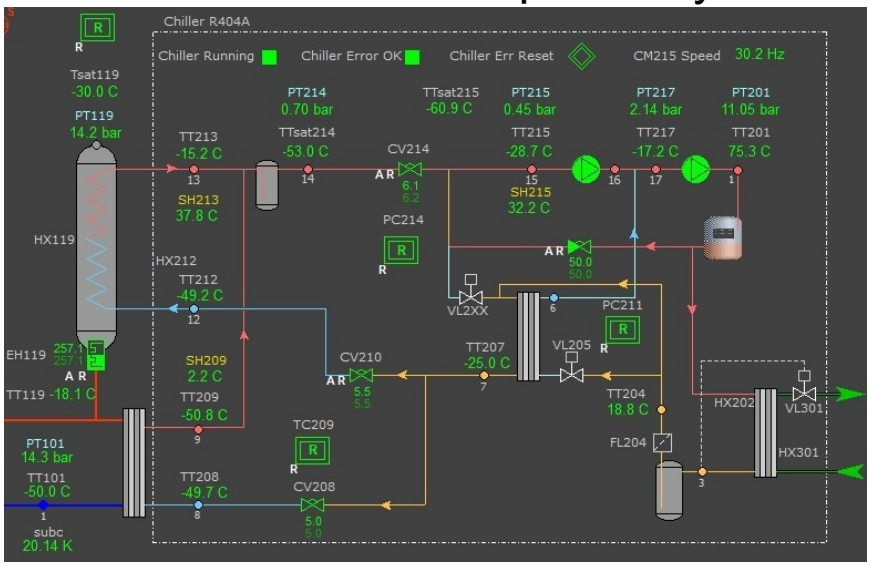
Chiller Error

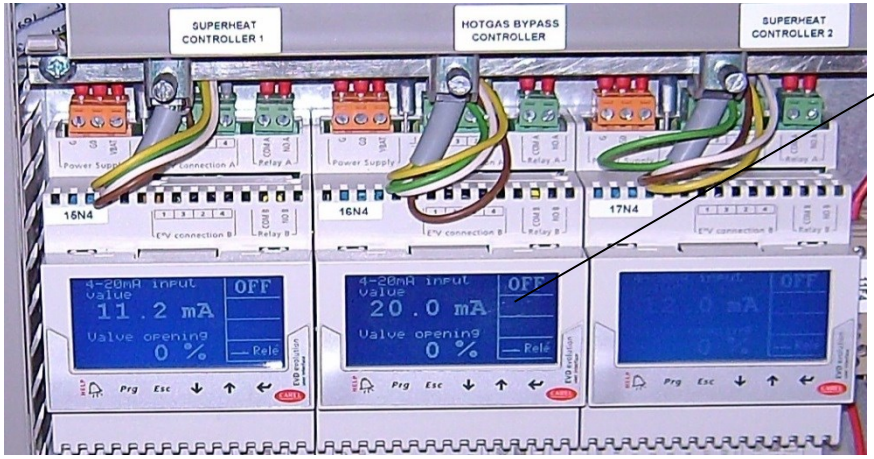
- A pressure of under 0.4bar in front of the chiller pump during start up indicates that the refrigerant might not be in fluid state.
- The compressor stops and waits for the pressure to rise to 1.2bar.

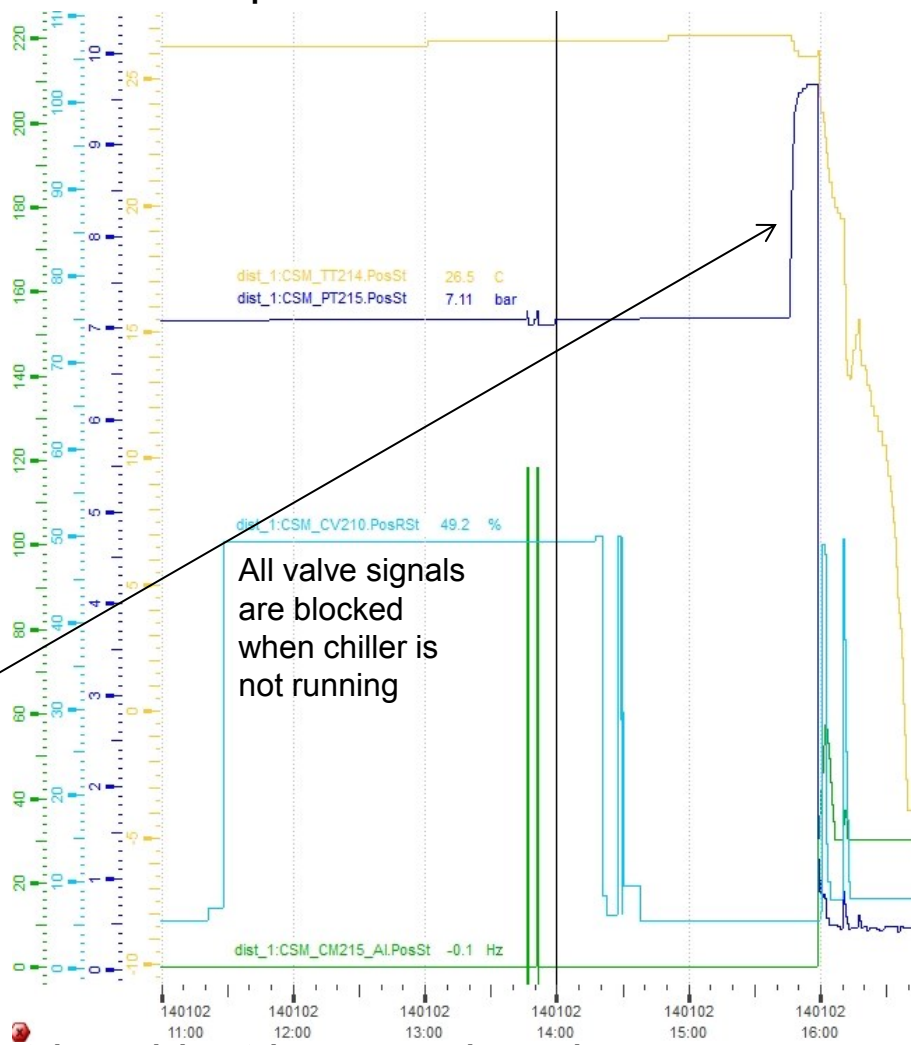


Chiller Error / manual relief

- Valves could not be opened by PVSS to increase pressure PT215



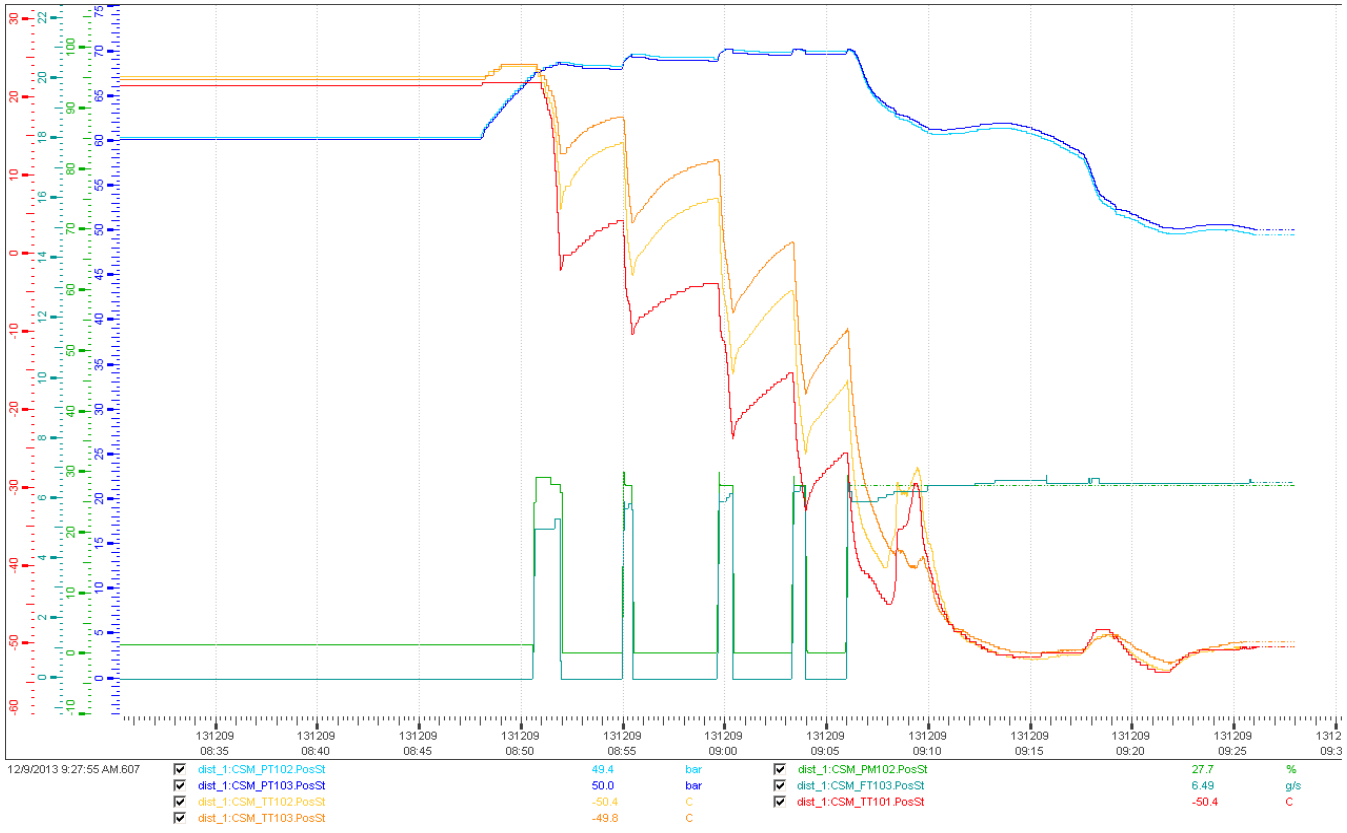




- But via the valve control unit in the electric cabinet in manual mode

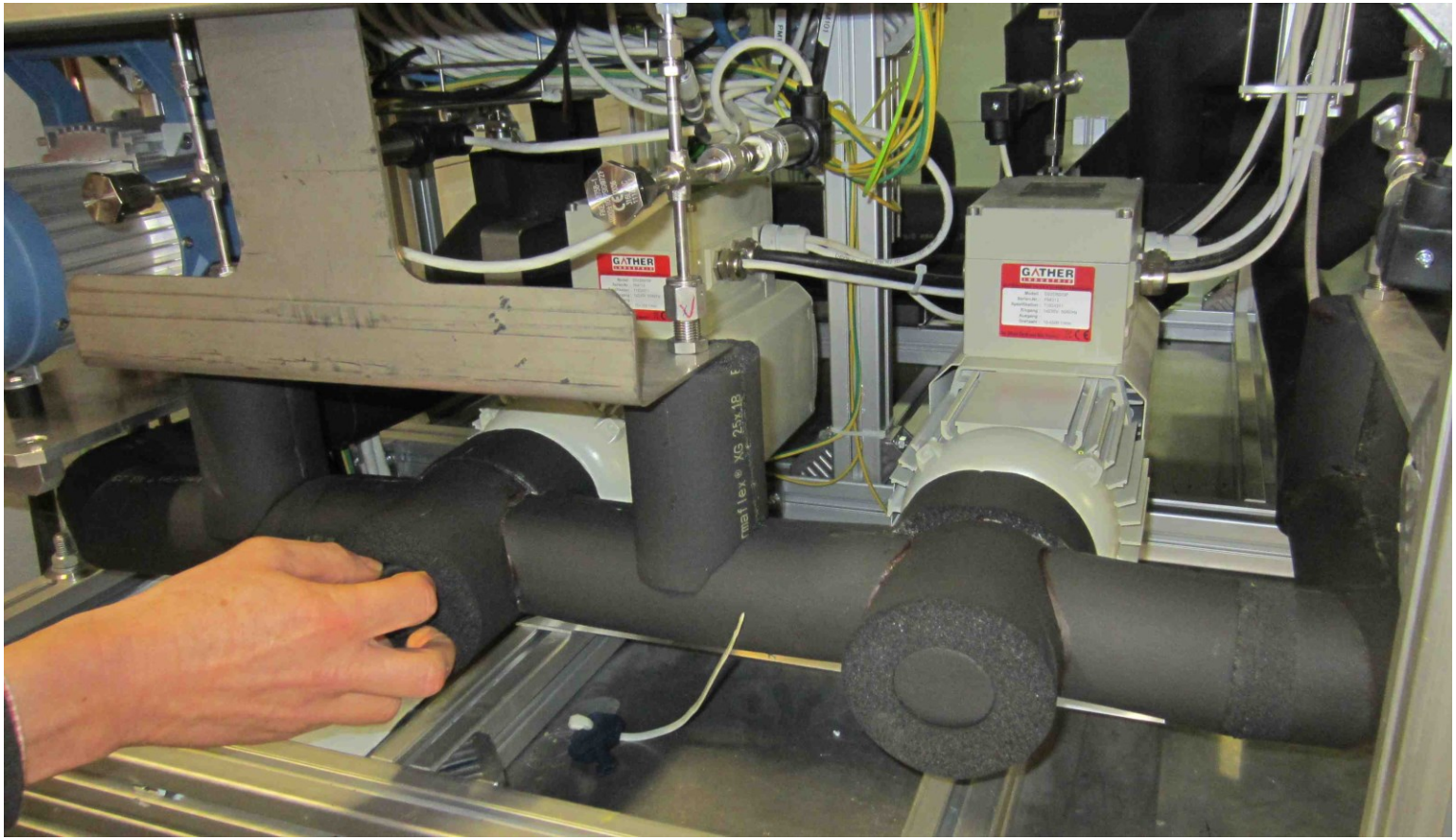
Pump Head leaking

- During start up the CO_2 pump head leaked.
- The rapid cool down from ambient to -50°C
- let the pump head shrink more than its fixation screws
- first I tried to slow the process down in a stop and go manner



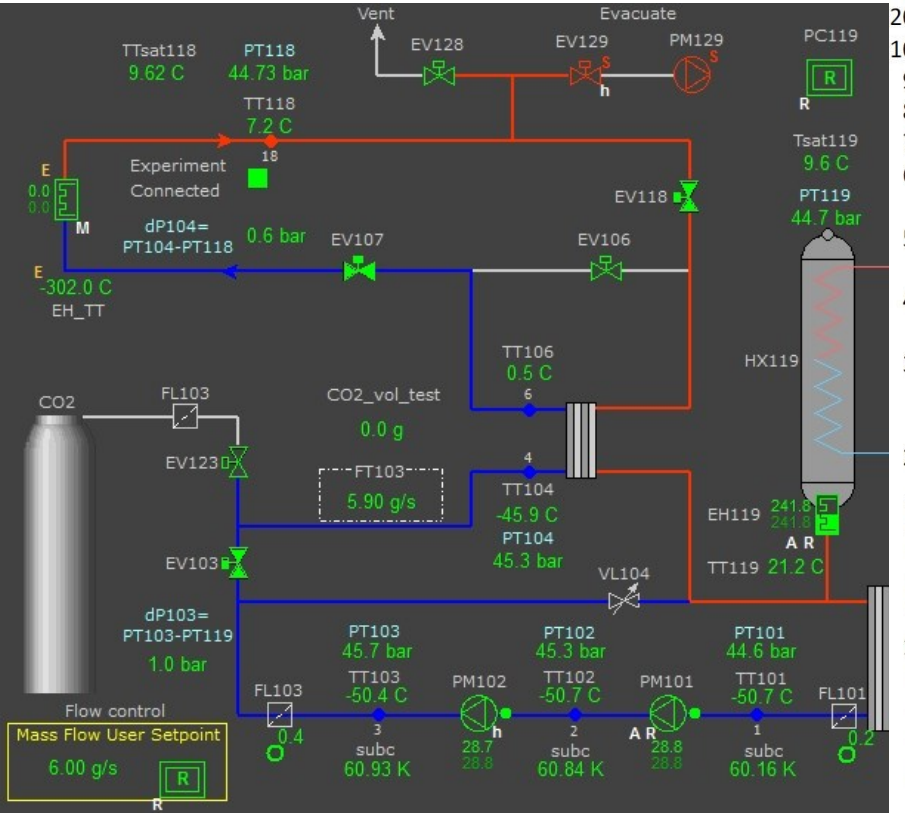
Pump Head leaking

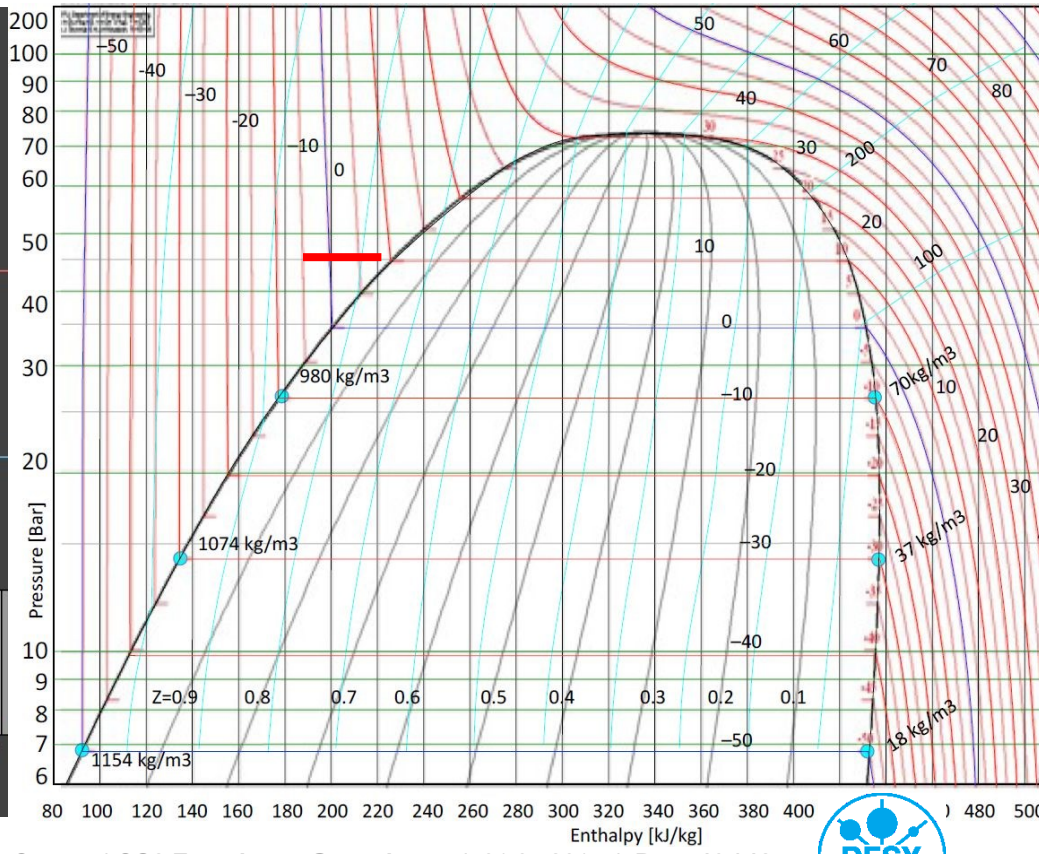
- but the chillers compressor may suffer by this.
- A firm tightening of the pump head screws helped.
- This should be done regularly.



CO_2 supply temperature drift / Electrical Heater needed

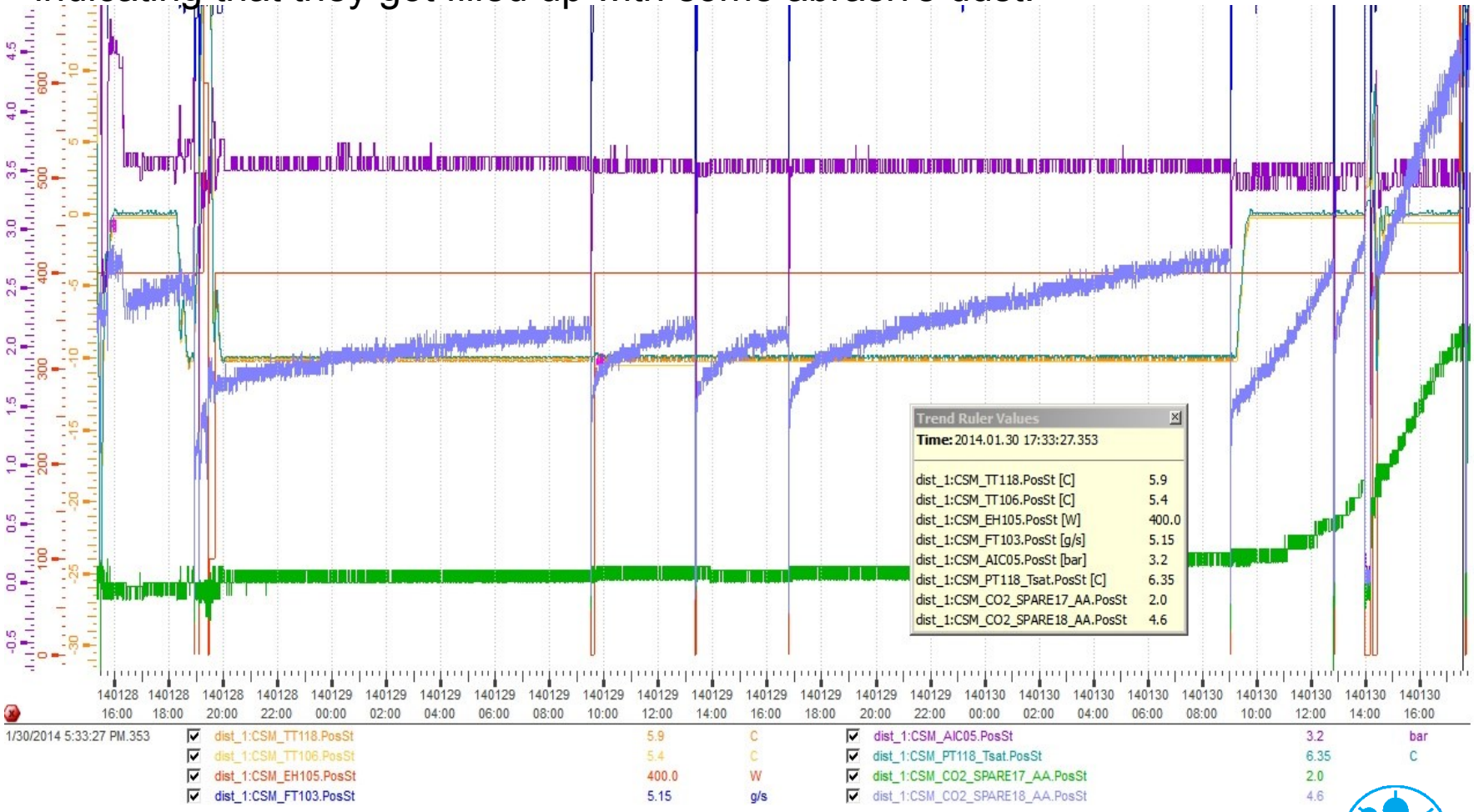
- With no or little heat load applied the CO_2 does not enter the 2-phase regime and stays fluid.
- In fluid state the temperature is not correlated with the pressure set by the accumulator and reaches lower values.
- To keep the inlet temperature stable additional heating of the experiment return flow is needed.





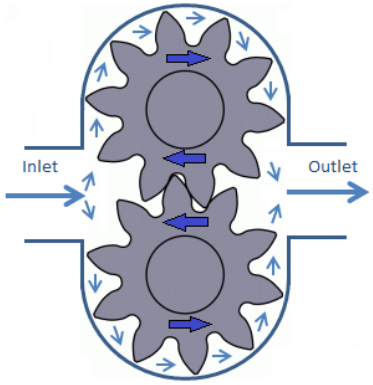
Increasing CO2 pump filter pressure drop

- After 2 overnight runs the pressure drop over the filter FL101 rose to 4.6bar. Also filter FL103 after the pumps showed 2bar pressure drop. indicating that they got filled up with some abrasive dust.

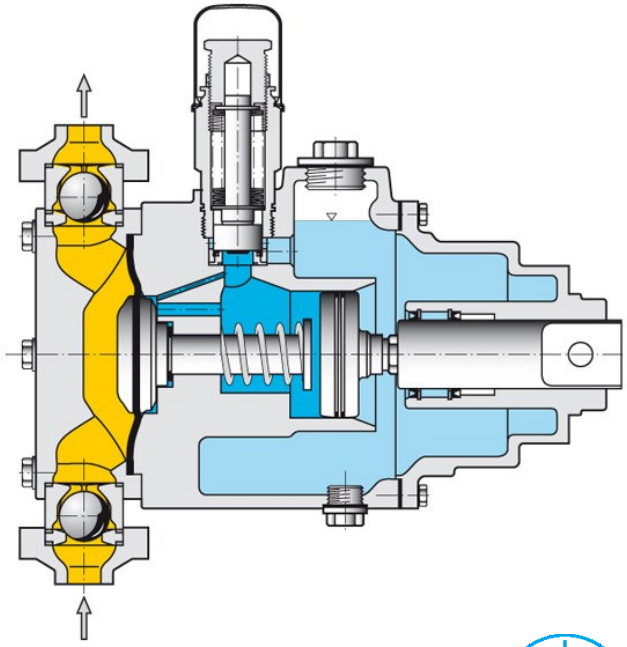


Alternative pump

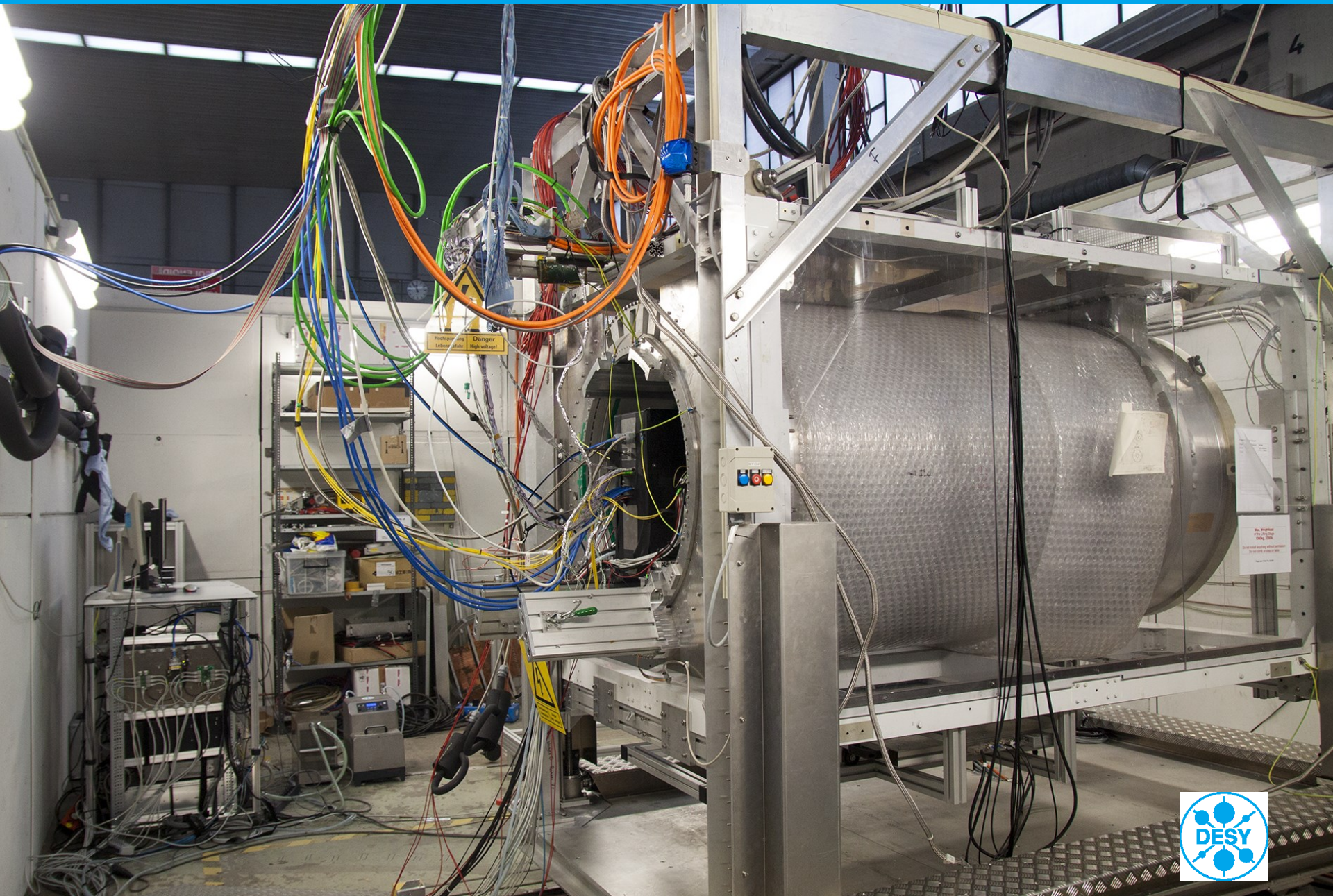
- The low viscosity of CO_2
- which is beneficial for a low pressure drop
- has only a weak lubrication capacity wearing off parts under friction.



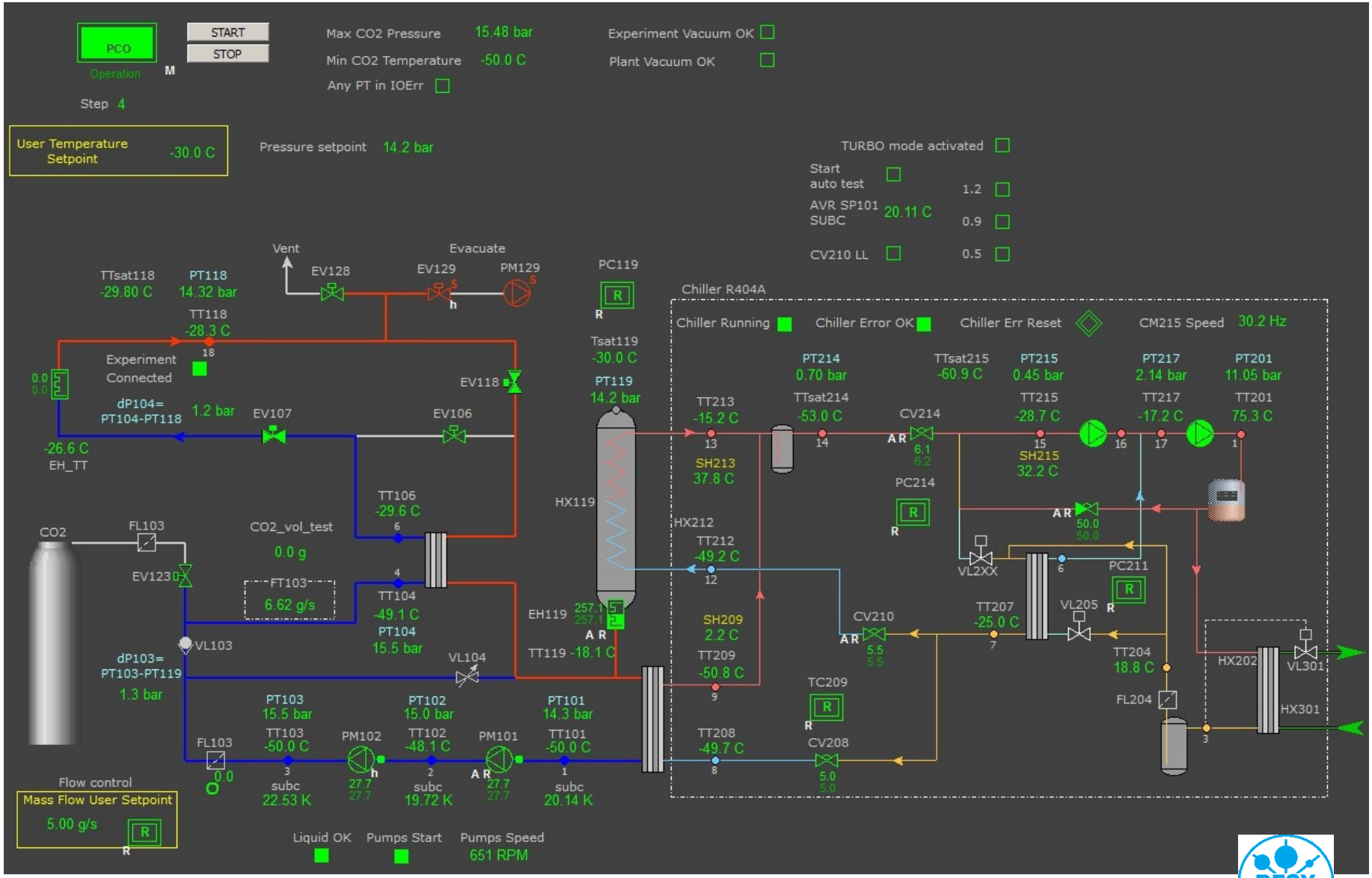
- A change of Marco's 2 Gather gear pumps to a membrane pump Lewa LDC M900 is under discussion, but
- high cost for it and a frequency converter
- and the time-consuming mechanical and electrical/control integration
- for now we stay with the Gather gear pumps and frequent filter changes and pump head monitoring and exchange.



Thank You for your Attention!



MARCO main control panel



Overshooting regulation @ large set point change