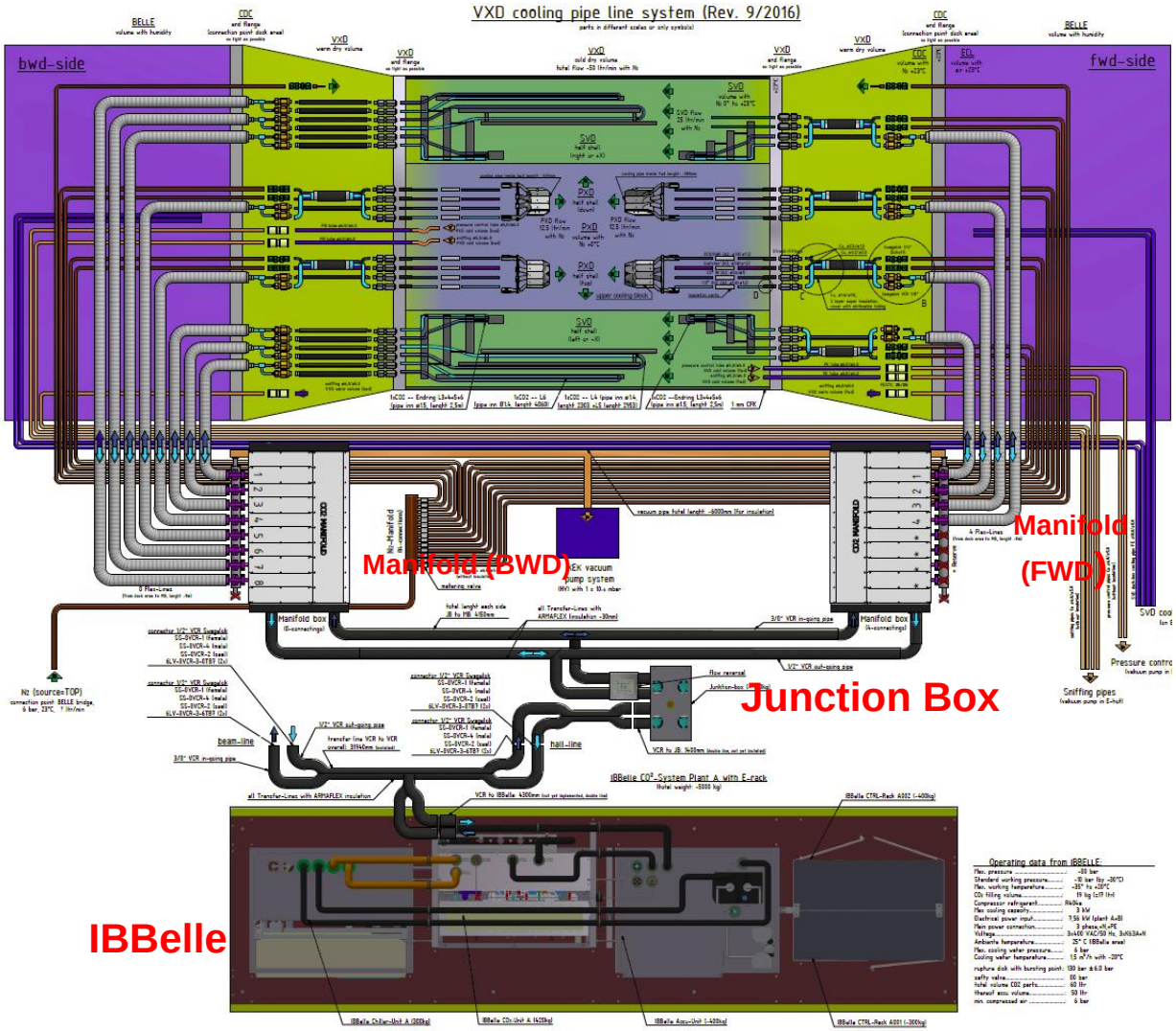
Status CO_2 Cooling

IBBelle: copy of the ALTAS IBL cooling plant for cooling of Belle II VXD (PXD and SVD)

CO_2 System



VXD needs 12 cooling circuits: 4 PXD, 8 SVD

The CO_2 flow is split in the manifolds into these 12 branches (BWD: 8, FWD: 4)

Vacuum insulated flex lines transport the CO_2 to the dock boxes (connection to detector)

Furthermore: 14 N_2 lines for gas cooling (copper tubes)

Phase 2:
BWD: 4; FWD 3
(other lines will be blocked)

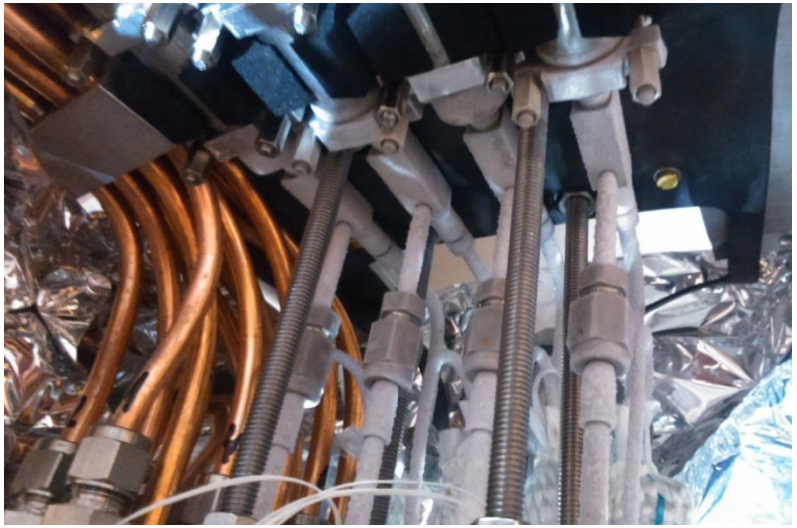
Commissioning of IBBelle at KEK

Construction and commissioning at MPP in 2016

Shipment to KEK in October 2016

IBBelle, transfer Lines, Junction Box, Manifoldes installed in 2016
=> demonstrated 3000W cooling power at -30°C

Flexlines. Dock boxes,
N_2 installed January 2017 (DESY)
=> all 12 lines are cooled



April: IBBelle emptied and disconnected from transfer lines for roll in

May: re-connection, filling
$\Rightarrow$ Restarted without problems

Since then: various improvements

Addition of a heater system

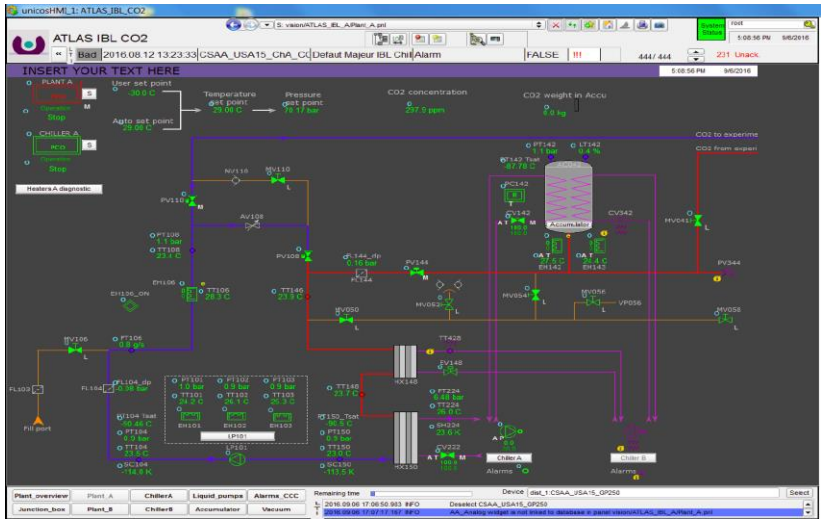
EPICS Control

So far we used a temporary WinCC OA licence to control IBBelle
The license expired May 1st
Switched over to EPICS (tested before in parallel)
EPICS is the general VXD slow control system

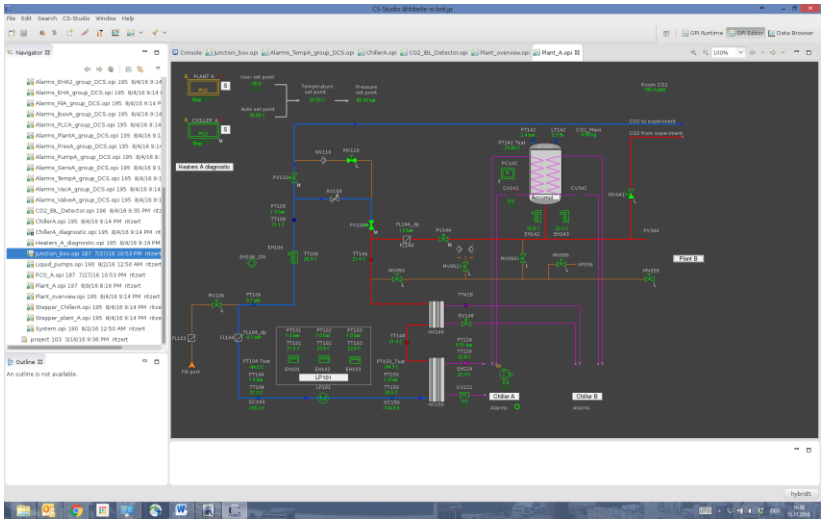
Wish list for EPICS:

- **Error logger**
- Better monitoring and reset of alarms

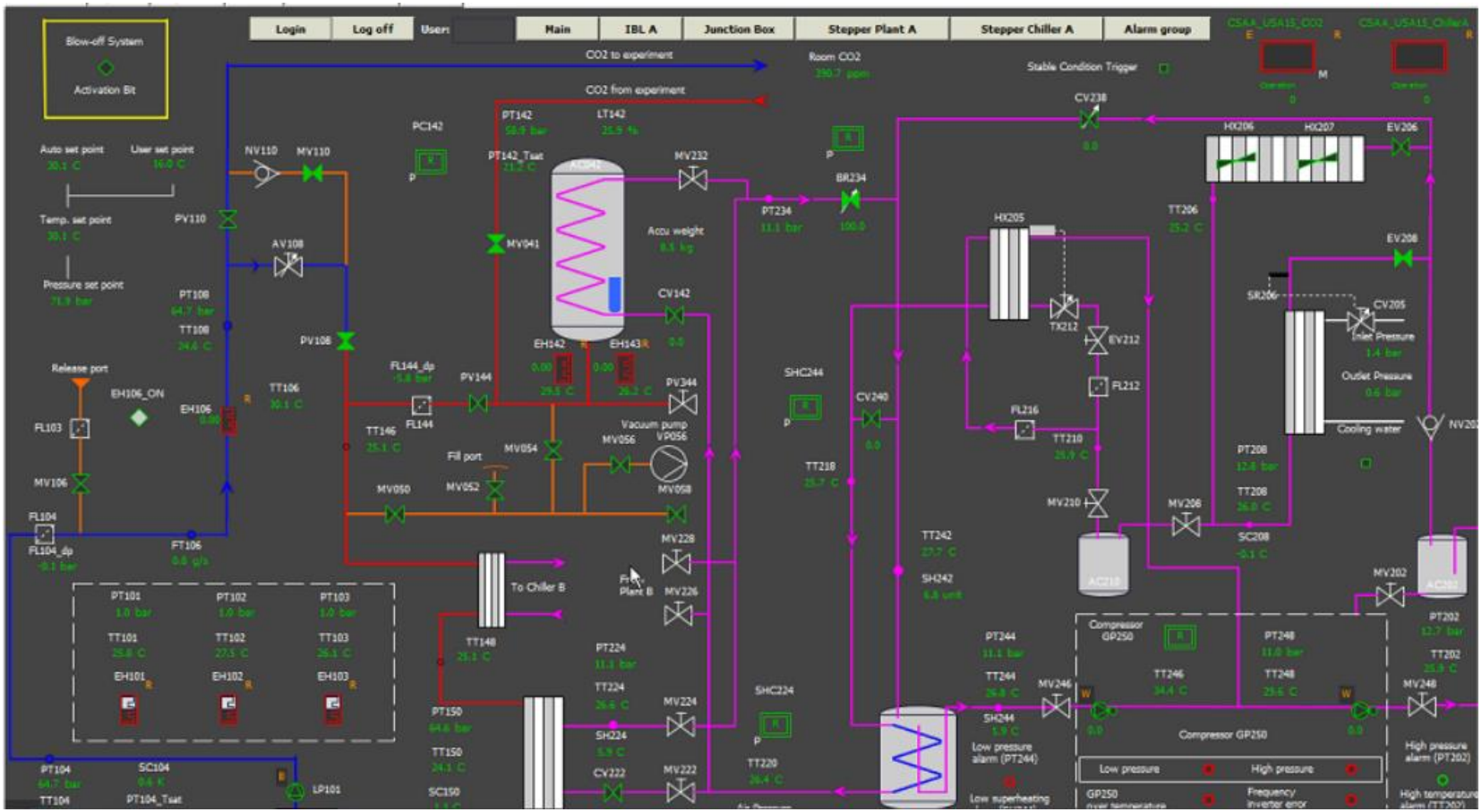
WinCC OA



EPICS/CS-Studio



Control Panel



The touch panel on IBBelle running WinCC flexible was updated to allow full control of IBBelle. Using Siemens SmartServer it can be controlled remotely

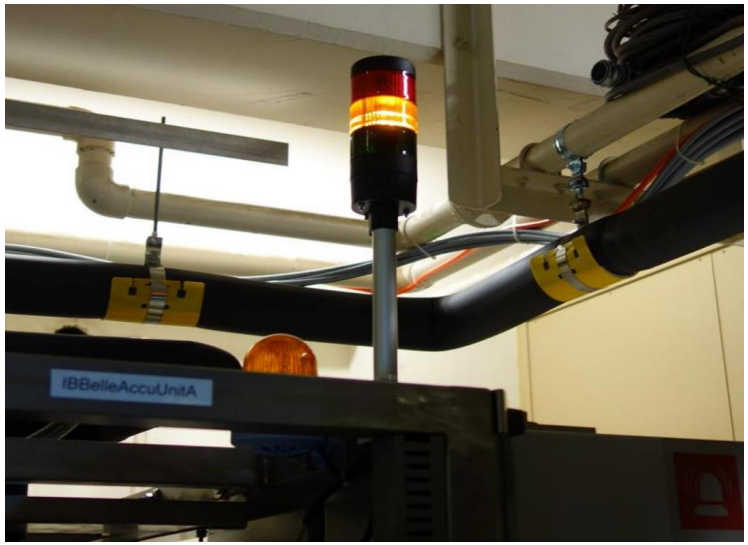
=> 2nd control path in parallel to EPICS

Interlocks

IBBelle issues 2 interlocks to the Triest interlock box:

1) Unit interlocked (internal fault).
2) Unit off or running and CO_2 circulating, but temperature set point not yet reached.
3) Running and temperature set point reached = NOT (2)

Interlock status is displayed on the unit



Two interlocks can be accepted:

1) Complete shut down.
2) Warm operation (Provide cooling but CO_2 temperature above dew point).

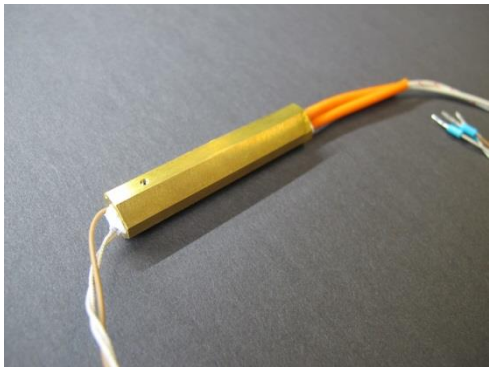
Heaters and NTC sensors

Each CO_2 branch will be equipped with a 100W heater (inlet) and a NTC sensor (outlet)

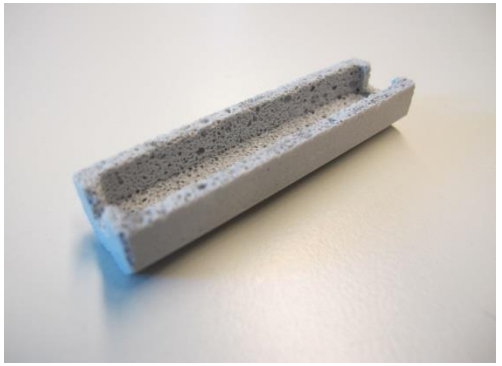
- Temperature monitoring of each individual branch.
- During commissioning: dummy power.
- With detector: can control onset of CO_2 evaporation.

Control and interlock system for heaters installed

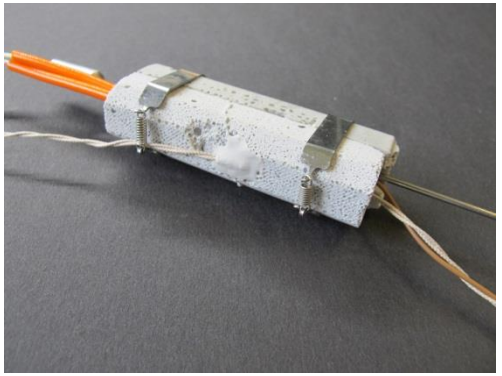
Heaters automatically interlocked if T > 100°C



Heater with metal case to clip on CO2 tube

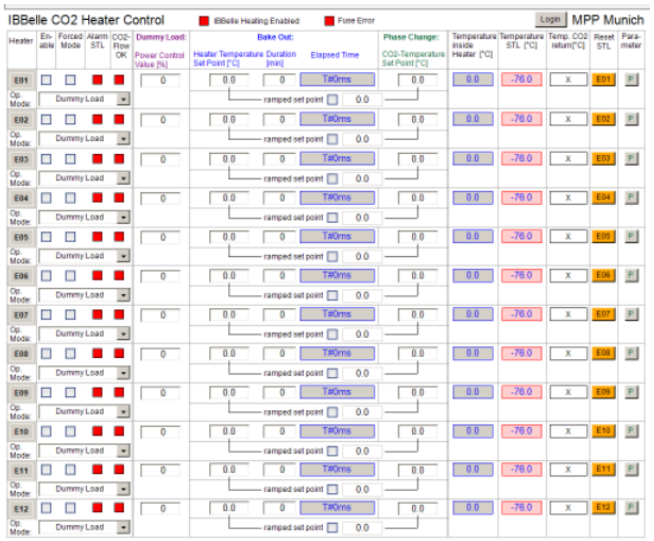


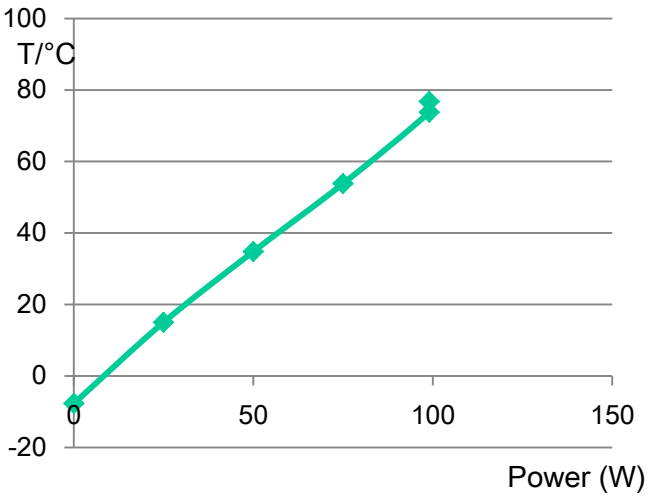
Foam ceramics insulation (1/2 shell)



Heater with Insulation and sensor

Heater Control



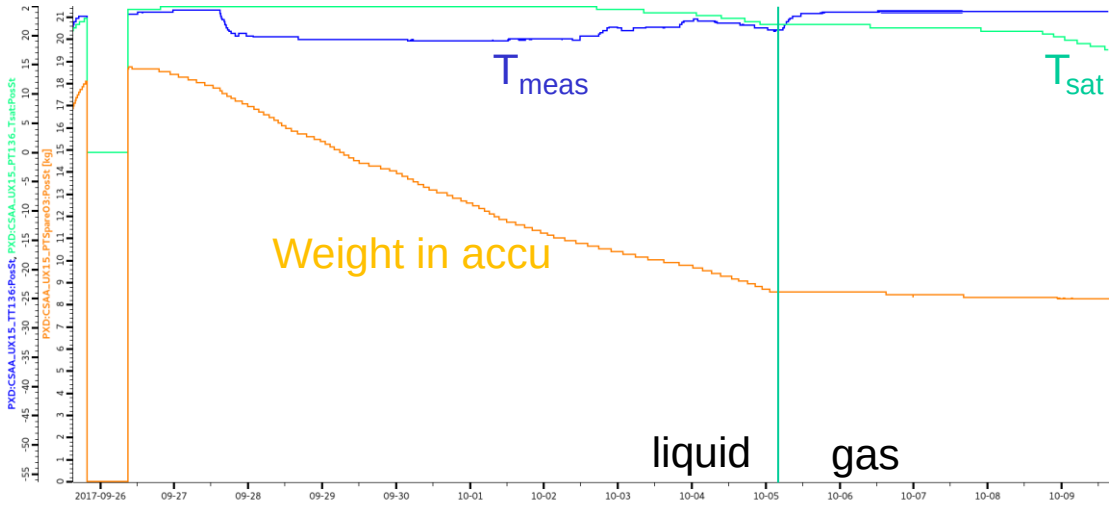


- Control cabinet installed
- Heaters tested (90% efficiency of power transfer)
- Interlock to avoid overheating
- Despite power pulsing: no noise emission (0-crossing switch)
- Heater installation with detector in November

Siemens 3RF2330-1AA04 power switch

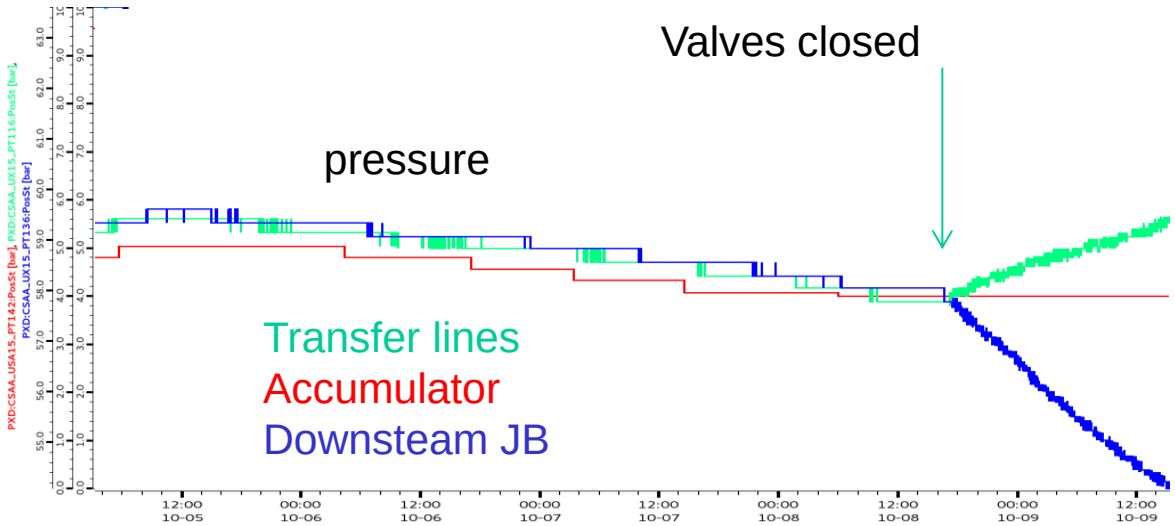
Leaks

Leaks come and go during work at piping (Roll in, Dock box installation



Initial loss during warm up
By liquid flowing in lower parts of tubing

Once all CO2 is gaseous, weight
loss indicate leaks



Close all valves and control pressure in different sections

Small leak in section downstream of junction box (manifolds, flexlines, docks)
~ 26 g/day @ 58 bar
(section needs to be opened anyway for VXD connection)

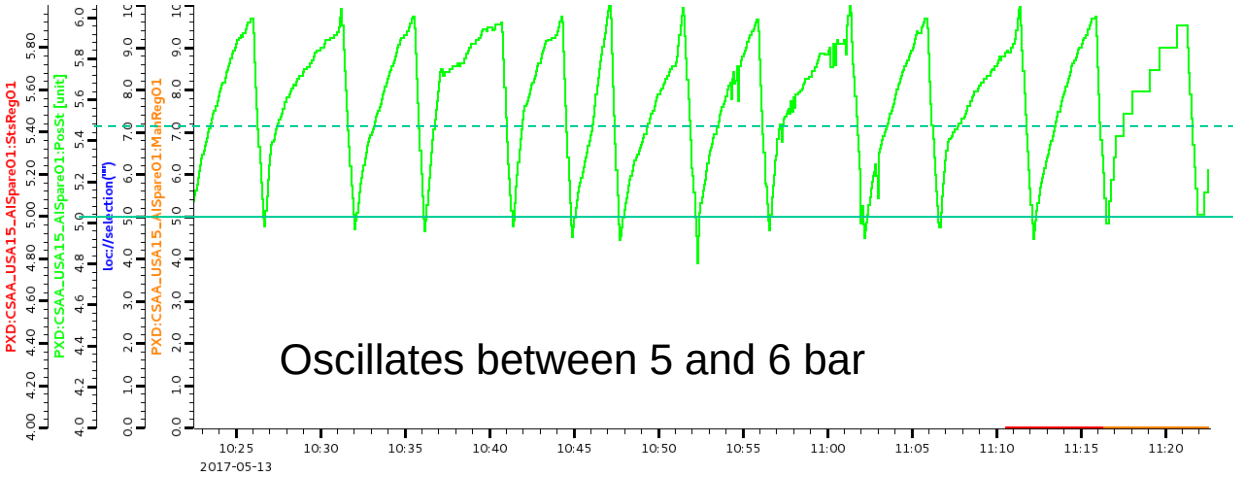
Presently IBBelle is filled with gas only for leak monitoring

Issues

Pressurized air in Tsukuba halls
Oscillates between 5-6 bar

Pneumatic valves need > 5.5 bar
Ocasionaly interlocks IBBelle

=> Install buffer vessel



Oscillates between 5 and 6 bar

Instabilities of 400 V 3-phase

Compressor and pump is protected gainst phase loss by a switch
Trips when Belle II solenoid is charged
(Stable again once solenoid is fully charged)

=> Active filter (expensive) or UPS (affordable)

Summary

- Reconnection after roll in ok.
- EPICS control works
- **IBBelle is able to cool >3000 W @ -30°C (required: 1100 W).**
- **All 12 parallel branches are serviced.**

To be done:

- Install and commission heater system
- Add buffer tank to compressed air
- Fix 400V instabilities
- Connect to VXD after installation
- Test: Leaks, CO_2 circulation (warm)
- Once dry volume established: cool down