



LUCASZ.

Light Use Cooling Appliance for Surface Zones

LUCASZ for LHCb UT

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LUCASZ performance overview



LUCASZ.

Light Use Cooling Appliance for Surface Zones

**Forum on Tracking Detector
Mechanics 2017**

CPPM Marseille, 5 July 2017
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- The LUCASZ project has been presented in this years mechanical forum in Marseille.
- For details about the performance please go the forums indico:
 - <https://indico.cern.ch/event/590227/contributions/2614157/attachments/1488191/2312099/Lucaszforum2017-V3.pdf>

Integrated 2-Phase Accumulator Controlled Loop

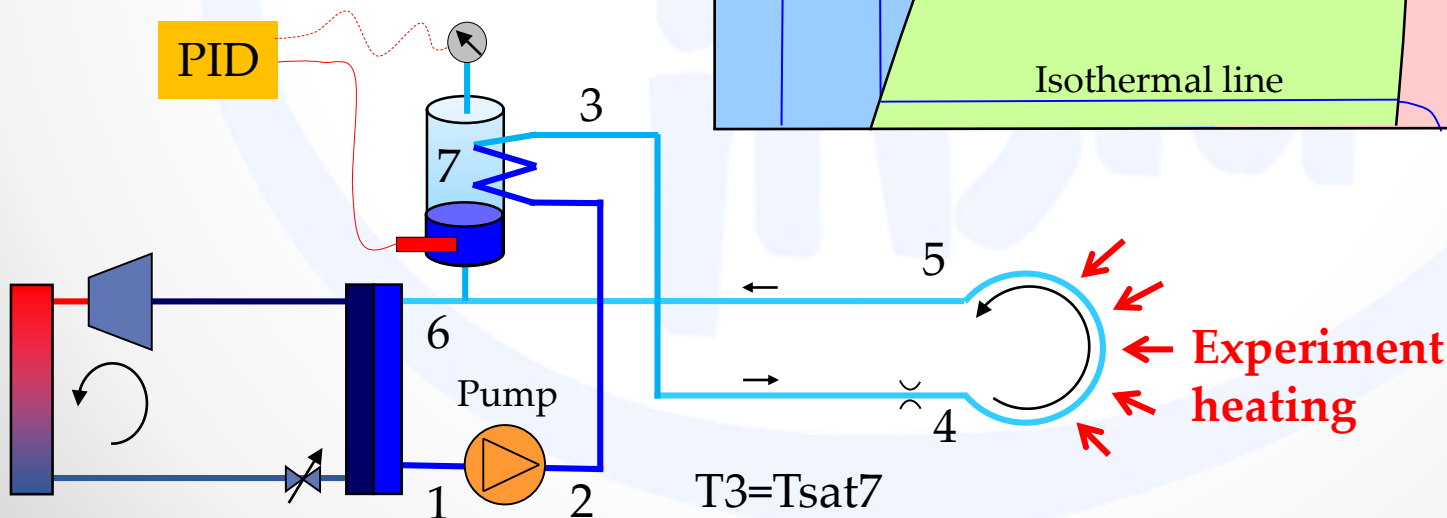
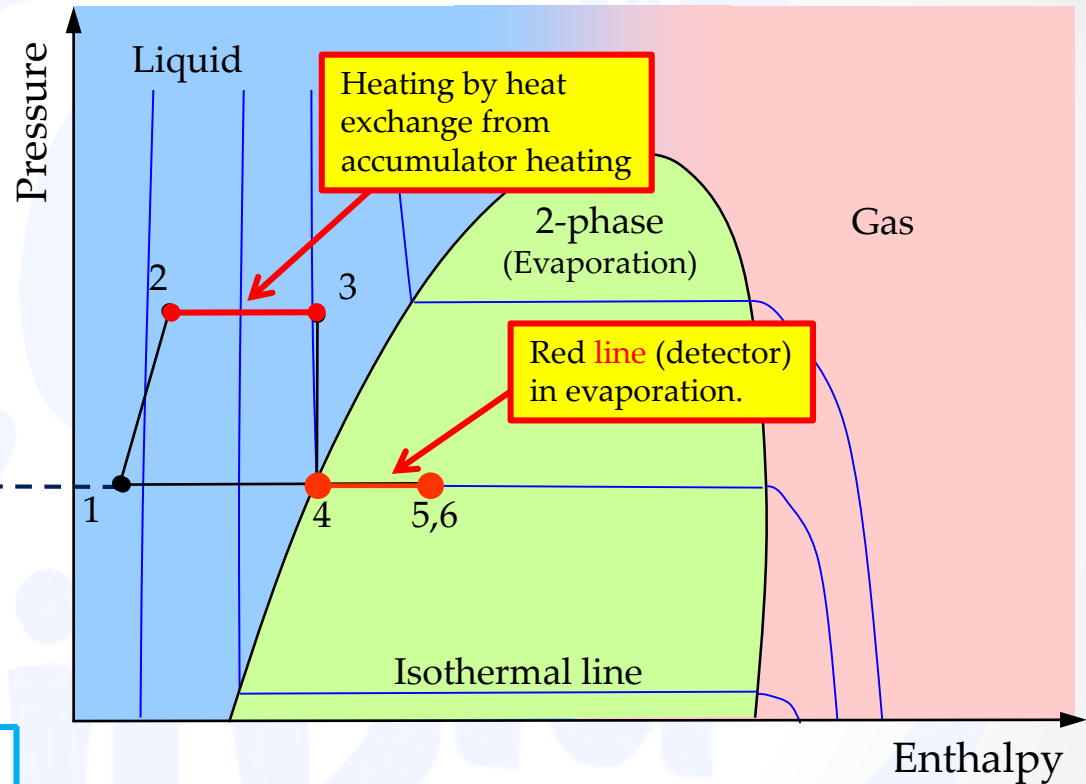
Advantages:

- Simple design
- Modular (strict separation of chiller and CO2 system)
- 1 controller for both saturation and liquid temperature
- No long transfer line needed

Disadvantage:

- Less power efficient (Constant heating against cooling)

Where the transfer line functionality is integrated in the accumulator control



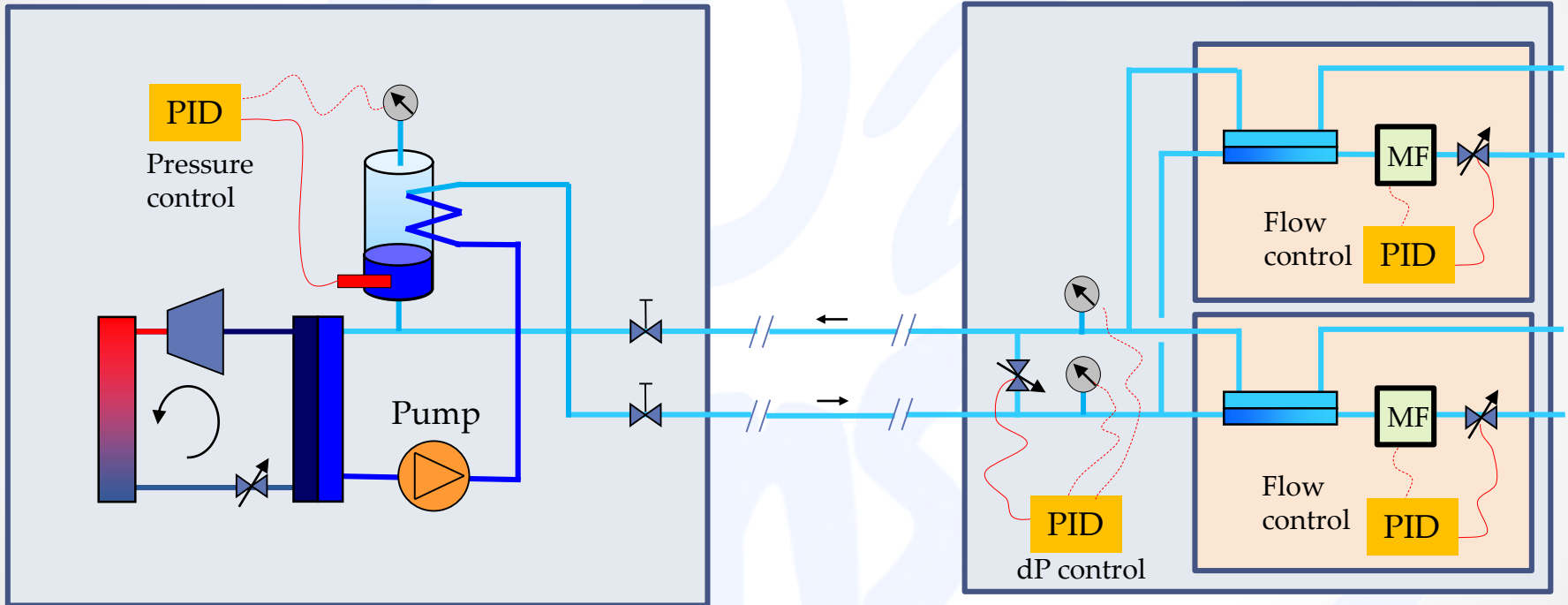
LUCASZ plant configuration

LUCASZ^{lite} Cooling Plant

- Can be used stand alone
- Expert use needed

LUCASZ Local Boxes

- Providing 2 cooling branches with a controlled flow
- Providing automatic procedures for connecting and disconnecting experiments
- Designed for unexperienced users



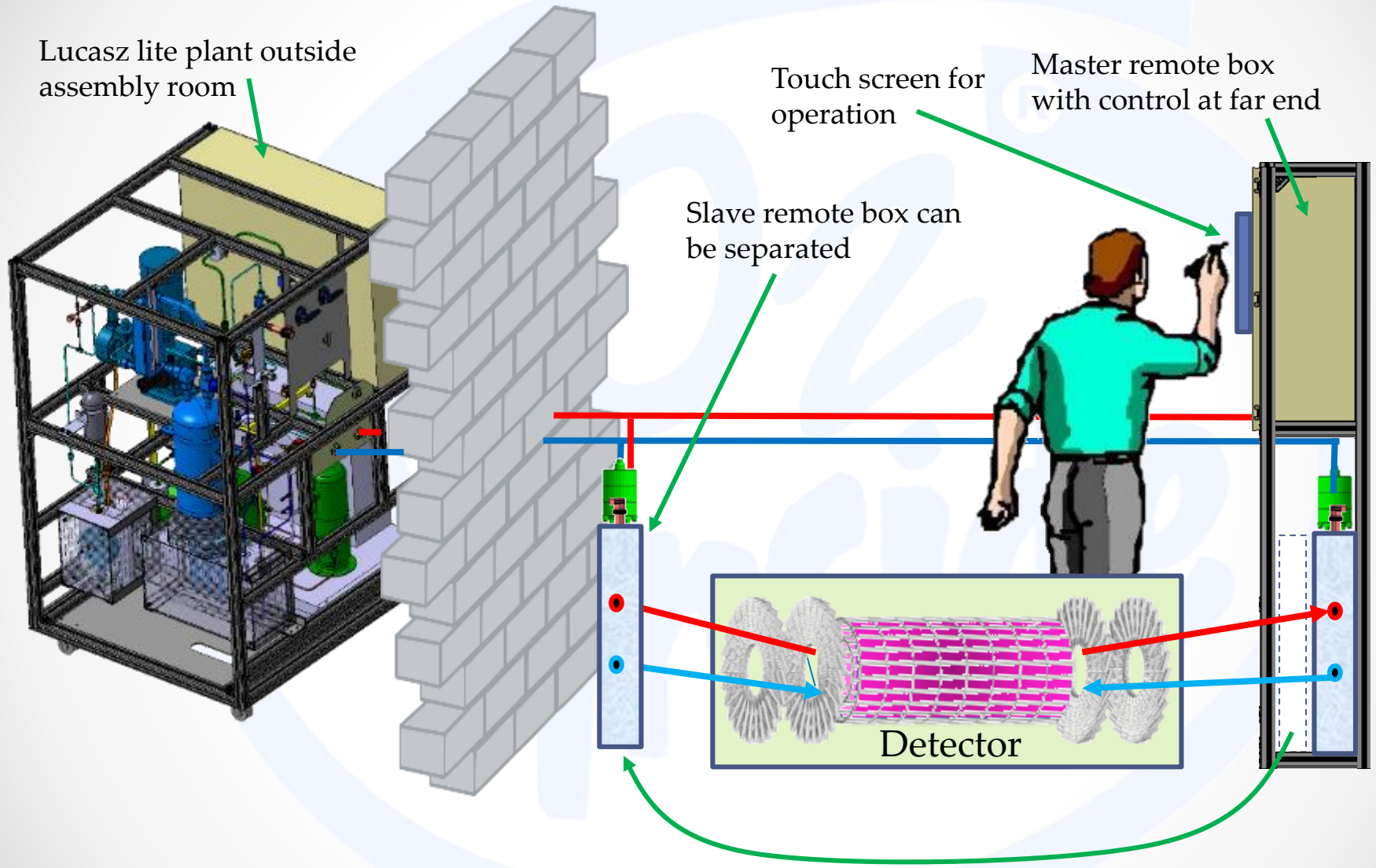
Fixed mass flow
(Manual setting)

Controlled temperature
(Liquid feed and 2-phase evaporation return)

- Pressure drop regulation in by-pass
- 2x mass flow controlled out put

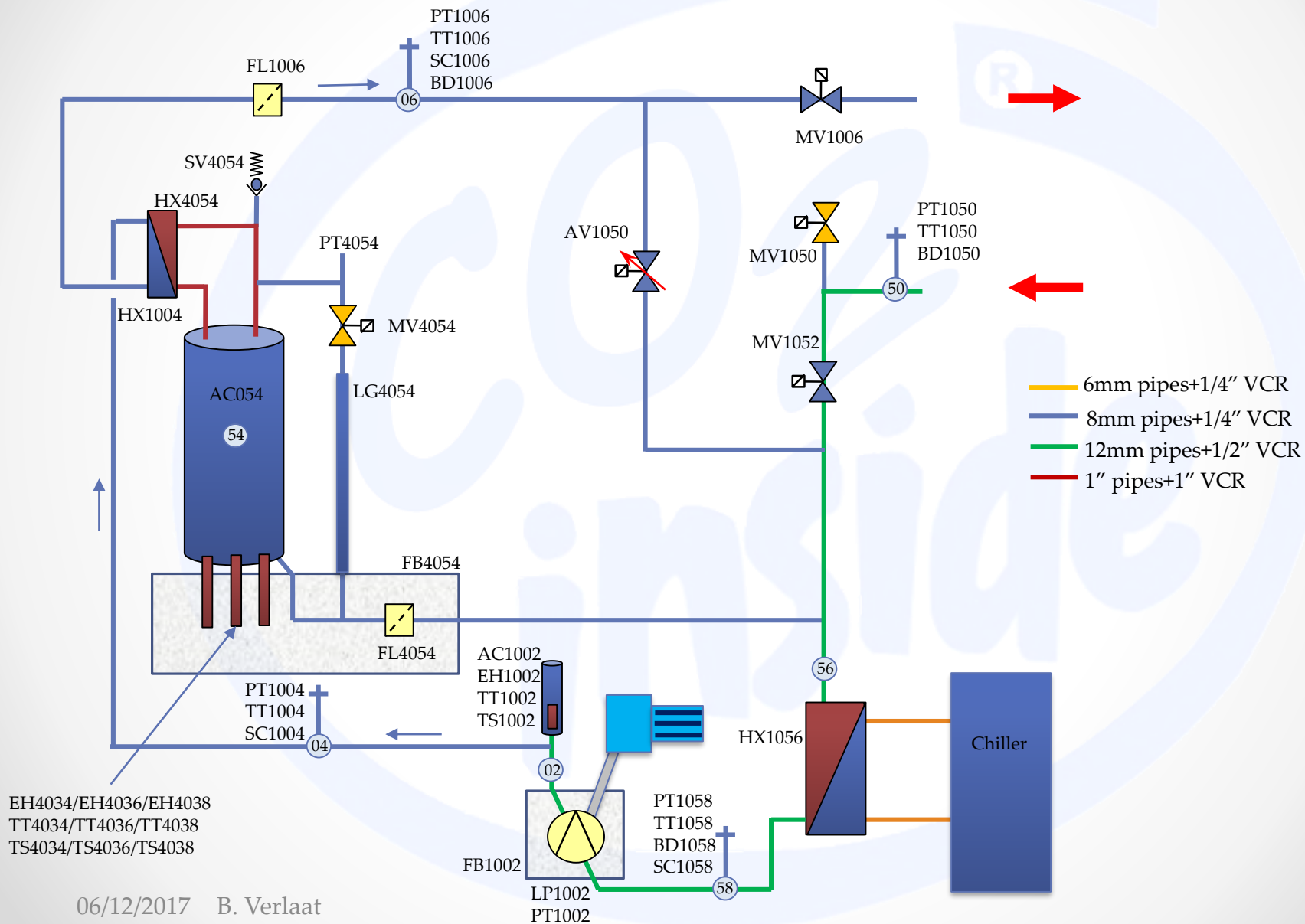
No local box have been
build so-far for the UT

LUCASZ remote configuration



LUCASZ^{lite} plant P&ID

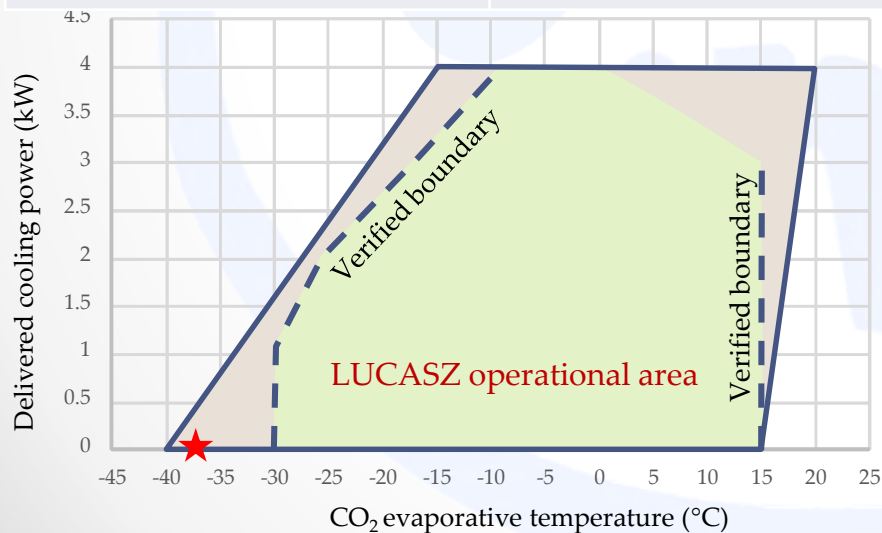
As build for the UT



Design Specifications and Verification of the Lucasz full version

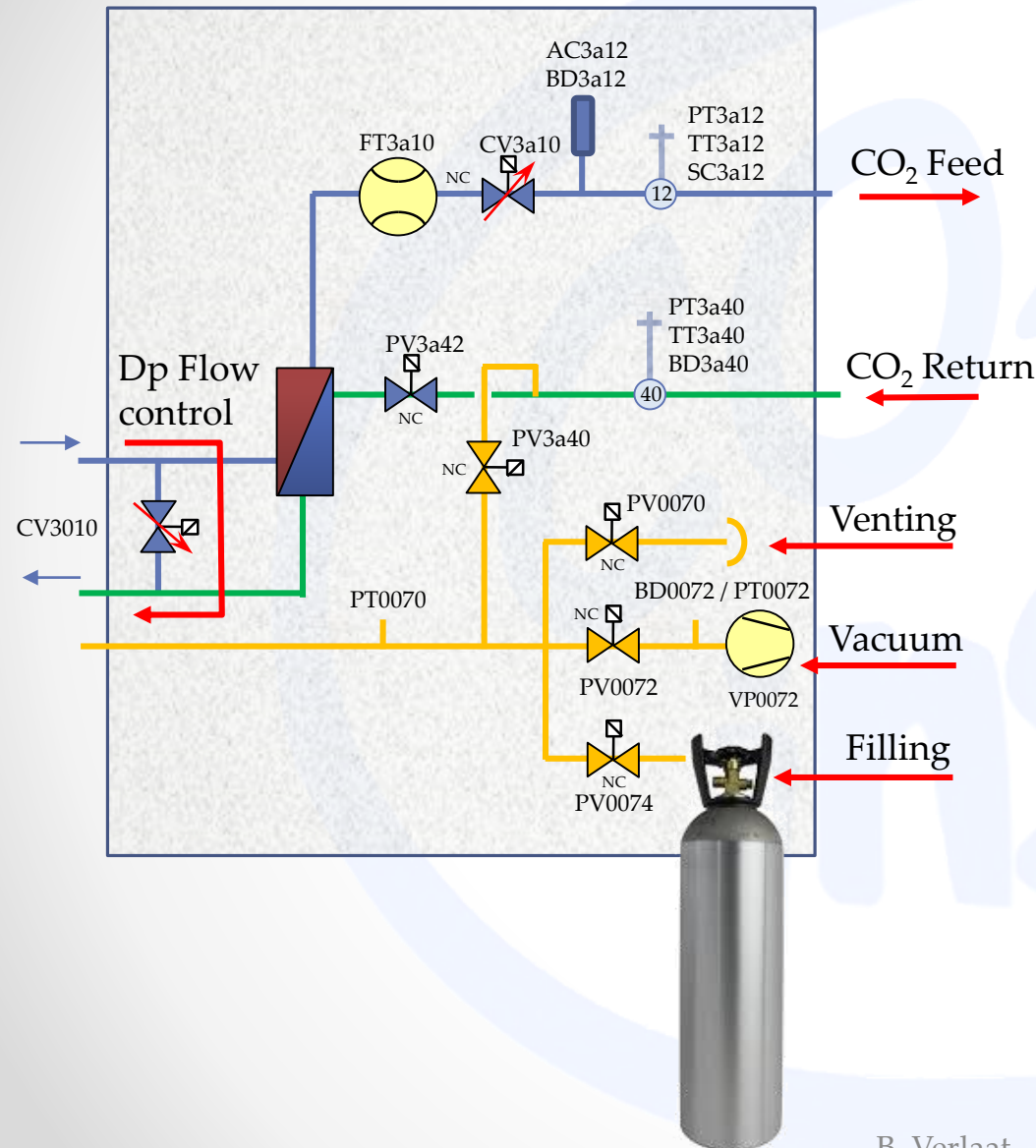
Feature	Performance
Cooling loop maximum flow	10g/s per loop ✓
Total plant flow	20g/s ✓
Min evaporating T	-30°C, depending on heat load, see graph →
Max evaporating T	+18°C ✓
Number of cooling loops	#2 ✓
Max DP across cooling loop	<15 Bar ✓
Cooling loop max power	2000 W ✓
Dimensions (LxWxH)	1125/1475* x 1300 x 1820 *Lite/Full version

The minimum temperature performance is not (yet) met in Lucasz-V1a (some modifications needed). 1st tests with V1b showed better performance (-38.5°C, no load)



The LUCASZ commissioning was successful, measured performance close to design performance

Lucasz full version has 2 local boxes



- Flow control per local box
- dP control of plant flow
- Heat exchanger to pre cool arriving liquid
- Touch screen operation
- Possibility to install the 2 boxes remote from plant and from each other
- Connection procedure
 - Vent
 - Vacuum
 - Fill gas from bottle
 - Open valves to system
 - Ready
- Disconnecting procedure
 - Close inlet valve / open return valve
 - Cool accu to -20 °C (20 bar)
 - Experiment is emptied by evaporation
 - Once empty remaining 20 bar gas is vented
 - Ready
- A damper vessel is present at inlet
 - Acts as expansion vessel for liquid trap (2x NC valves)
 - Flush the experimental lines from eventual liquid during vent

Connecting and disconnecting fully automatic

unicosHMI_1: CO2_P5_LUCASZ

CO2_P5_LUCASZ

WV_0001StepperLBa

System Status: verlaat 9:05:15 PM 12/5/2017

CS5b_358_SC5004_AL Subcooling after the con Alarm FALSE 28/28 4 Unack.

LUCASZ B STEPPER LBa

CO2 Operation SafetyPosition

LBa Operation

T0= LBa LBa NOT Run Order OR CO2 NOT CO2 Run Order

0 Safety position

1 Manifold Emptying

2 Venting

3 Vacuum

4 Separate from vac

5 Fill from bot

6 Leak test

7 Manifold Emptying

8 Connection completed

11 Evaporating

12 Preparation

13 Manifold Emptying

14 Venting

15 Disconnection completed

16 Equalizing

17 Liquefying

18 Operation

Connecting Transitions	Disconnecting Transitions	Operation Transitions
T11 = (LBa LBa Run Order Disconnecting AND LBb NOT LBb Run Order) AND NOT LBa_gas		
T12 = LBa_gas		
T13 = (LBa LBa Run Order Disconnecting AND LBb NOT LBb Run Order) AND LBa_gas		
T14 = 0.3 bara < 1.2 bara		
T15 = (PV3a40 Open AND PV3a42 Closed AND CV3a10 Closed) AND (PT3a12 0.1 bara = PT3a40 0.1 bara ± LBa_T3_Pt1 1.0 bara) AND PT3a12 0.1 bara < LBa_T3_Pt2 1.2 bara		

Overview	LocalBox	StepperLBa	StepperLBb	Alarms
Plant	Chiller			

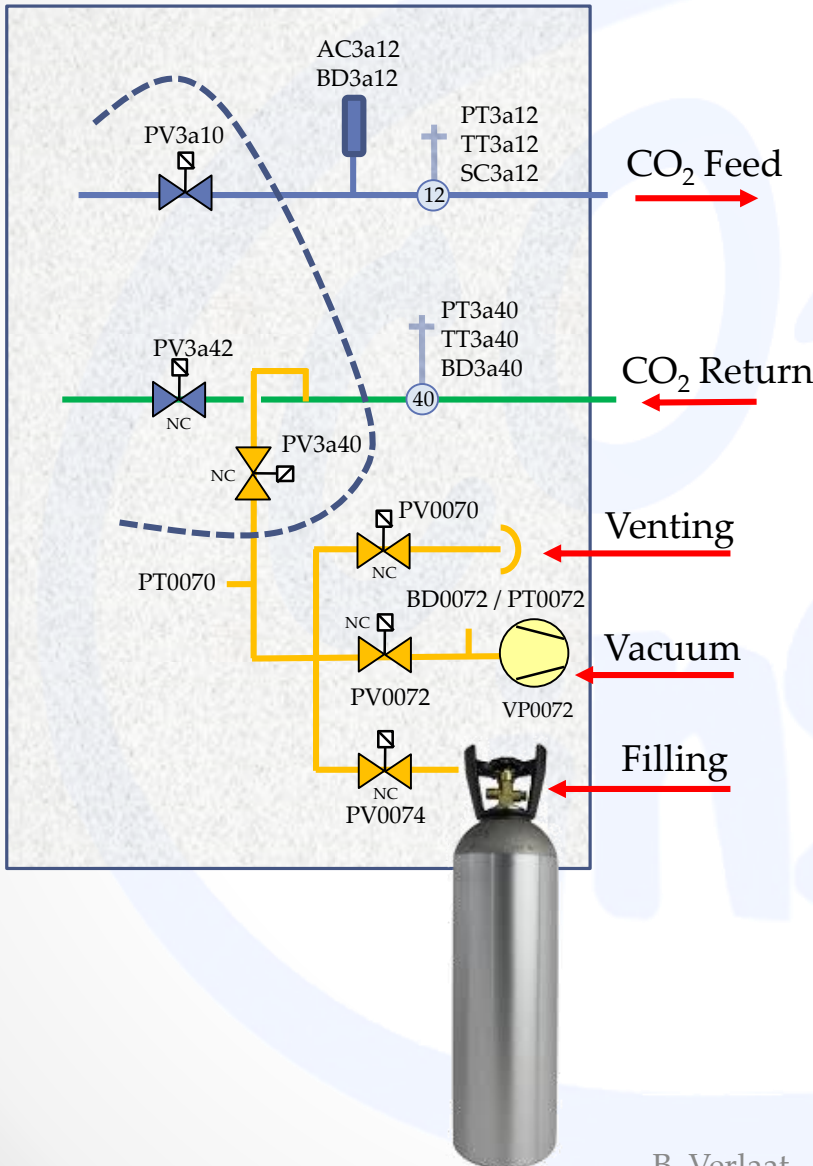
Remaining time

Device: CO2_P5_LUCASZ:CS5b_358_AC4054_Usr

2017.12.05 21:03:56.593 INFO Device=CS5b_358_AC4054_Usr: new value was set successfully.

2017.12.05 21:04:22.152 INFO Deselect Device=CS5b_358_AC4054_Usr

Simplified LUCASZ local box (The advised minimum need)



- 1 branch, flow fixed by pump stroke (manual adjustable)
- Valves can be made manual, but good step by step instructions are needed
- Costs of the simple box or manual box need to be evaluated
- 3 valves in the dashed area are also on the plant. If the connection is short they can be used as such.



- CMS unit
 - Fully constructed
 - Insulated
 - Under testing
- LHCb-Velo unit
 - Mechanically ready
 - Cabling on going
- LHCb-UT unit
 - Mechanically ready except from chiller installation
 - Cabling on going
- Foreseen finalization of the construction end 2017
- Testing of 2 LHCb units start in January
- Due to the sudden urgency of the CMS unit (unforeseen pixel extraction), we had to focus fully on the CMS unit.

CMS Lucasz under testing



LUCASZ operation for LHCb UT

