

LCTPC Design: Cooling Discussions

Takahiro Fusayasu @ Saga Univ.
1/Dec/2017 LCTPC Collaboration Mtg.

Requirements

- ~1kW heat transfer from the detector (per half cylinder) (supposing power pulsing) at room temperature.
- Keep ΔT over the gas volume within $\sim 1^\circ\text{C}$.
→ Pad plane temperature should be uniform and close enough to the gas temperature.
- Less material compared to existing experiments

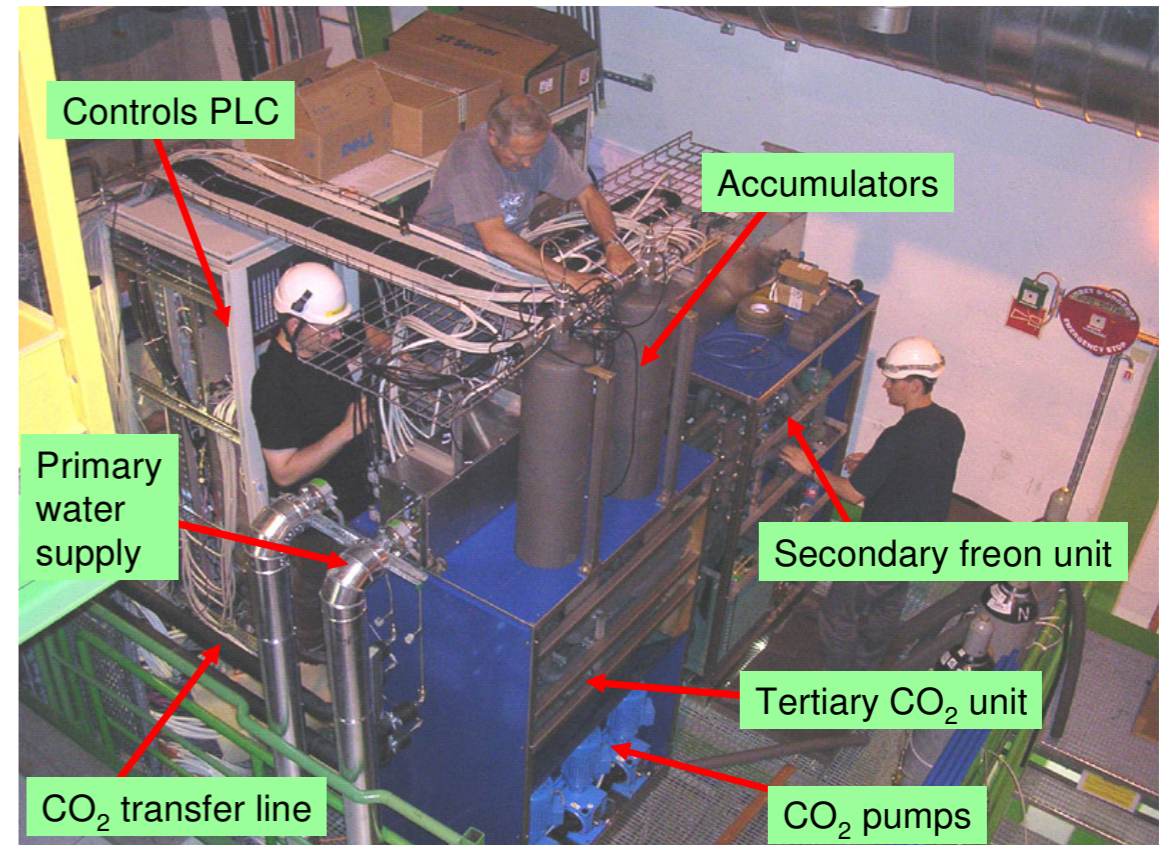
System: The case of other HEP experiments

- LHCb-VELO

$Q = 1500W$

$T = +8$ to $-30^{\circ}C$

(slides by Bart Verlaat @LCTPC
Collaboration Meeting, DESY, 22/
Sep/2009)

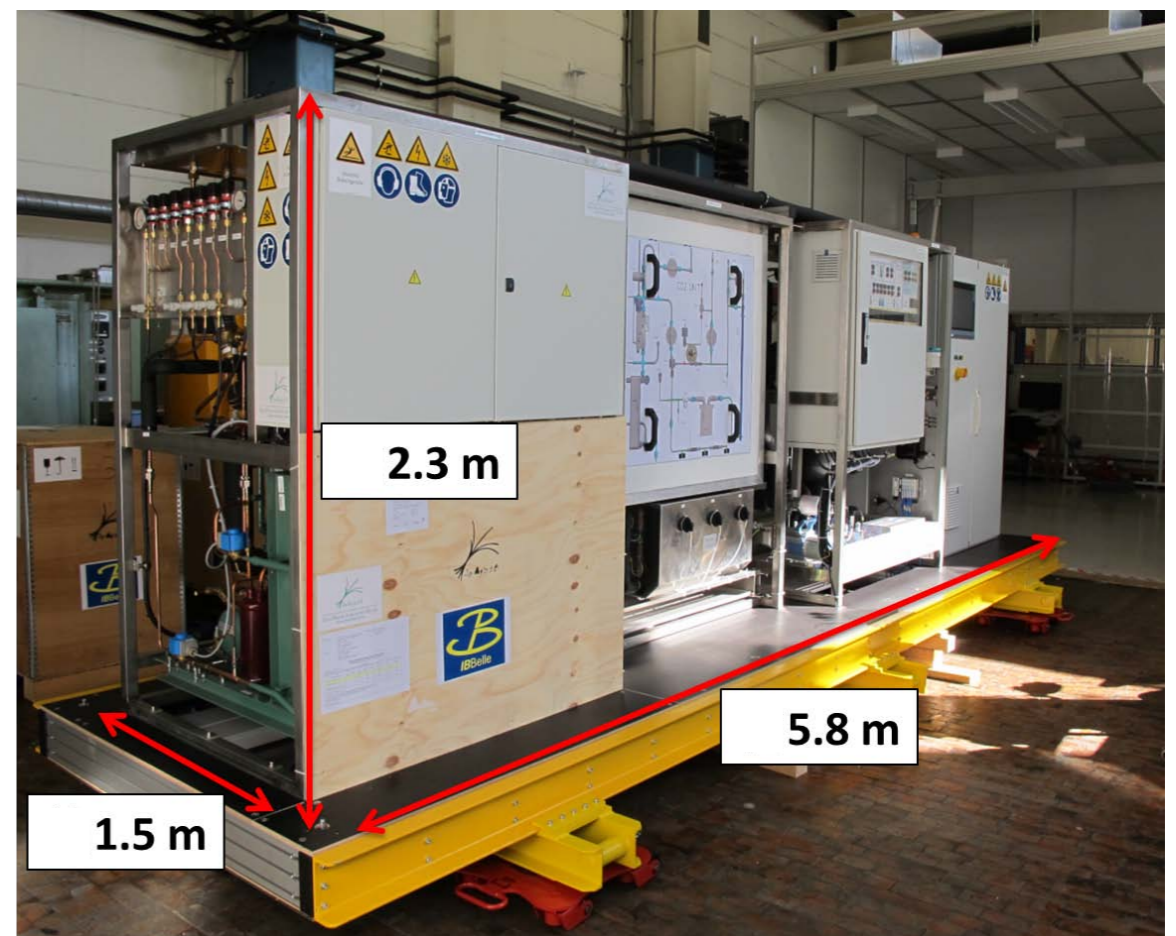


- IBBelle for Belle2 VTX

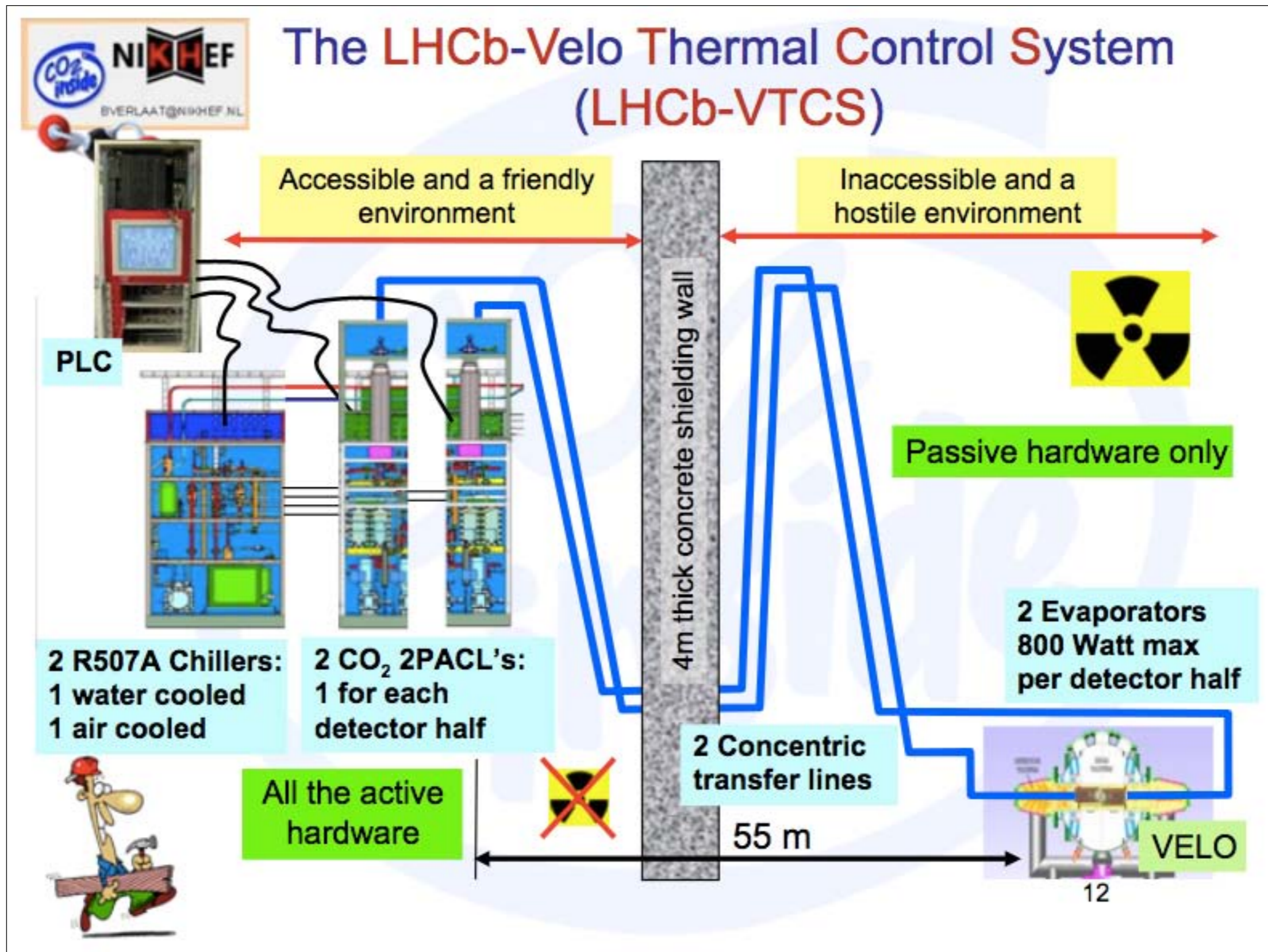
$Q = 1kW$

$T = -30^{\circ}C$

(C. Kiesling, Marco / IBBelle
Meeting, MPI, Sep. 20-21, 2012)



Delivery: The case of the LHCb VELO



Bart Verlaat @LCTPC Collaboration Meeting, DESY, 22/Sep/2009

Delivery: Initial Idea for LCTPC



TPC end plate cooling tube routing

Possible layout of the 6 loops option

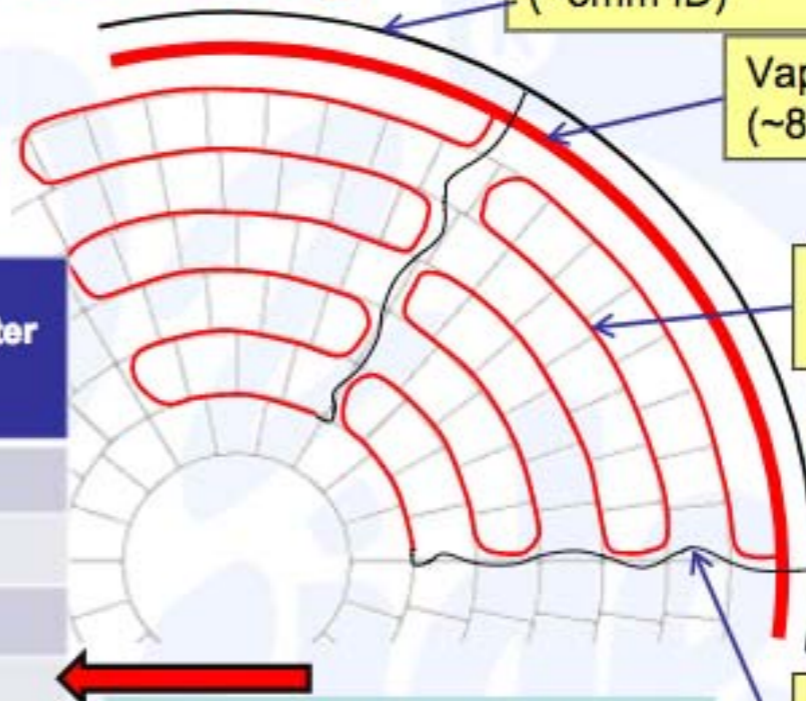
Liquid supply ring (~5mm ID)

Vapor return ring (~8mm ID)

Cooling tube (~2.5mm ID)

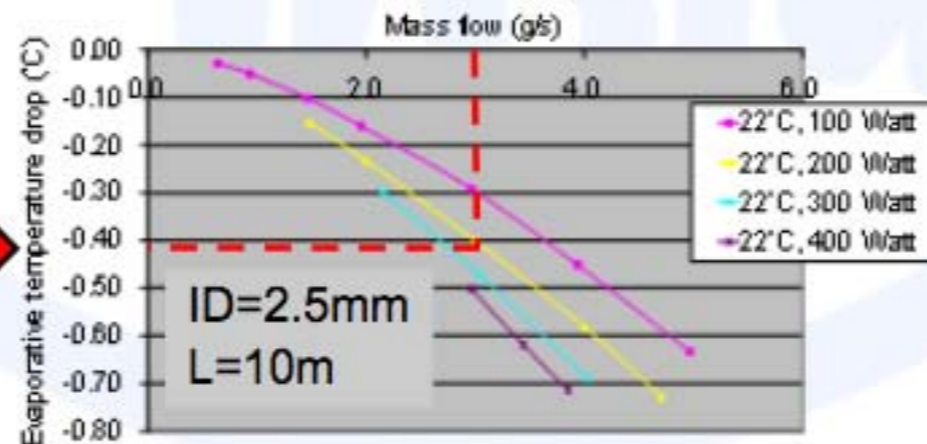
Inlet capillary (~1mm ID)
Restriction for flow distribution

	Qty Frames / loop	Heat load per loop (W)	Tube length (m)	Inner diameter (mm)
1 loop	200	1000	48m	6.2
2 loops	100	500	24m	4.3
4 loops	50	250	12m	3
6 loops	34	171	8m	2.2



Similar to AMS-TTCS

AMS test data (2001)
0.4°C temperature gradient



Thermal contact btw. chip and pipe

- Use of high thermal conductivity material (TPG)
- Development of micro-channel cooling plate
- in-PCB piping
- any idea else?

Summary

- CO₂ system → experiences at AMS, LHCb-VELO, ATLAS-IBL, Belle2-VTX, etc.
- Delivery → Need design for our TPC
- Heat contact → Technology choices