

Cryogenic Infrastructure

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Definition: all equipment needed for filling & maintaining the LN₂/LAr level in the cryostat, including all safety devices to avoid overpressure

Status: Piping & Instrumentation Design (PID) available from Air Liquide, including Hazard & Operability (HAZOP) study & estimate of the diameter of safety devices for the case of “LN₂ – Cu/ice – water” contact

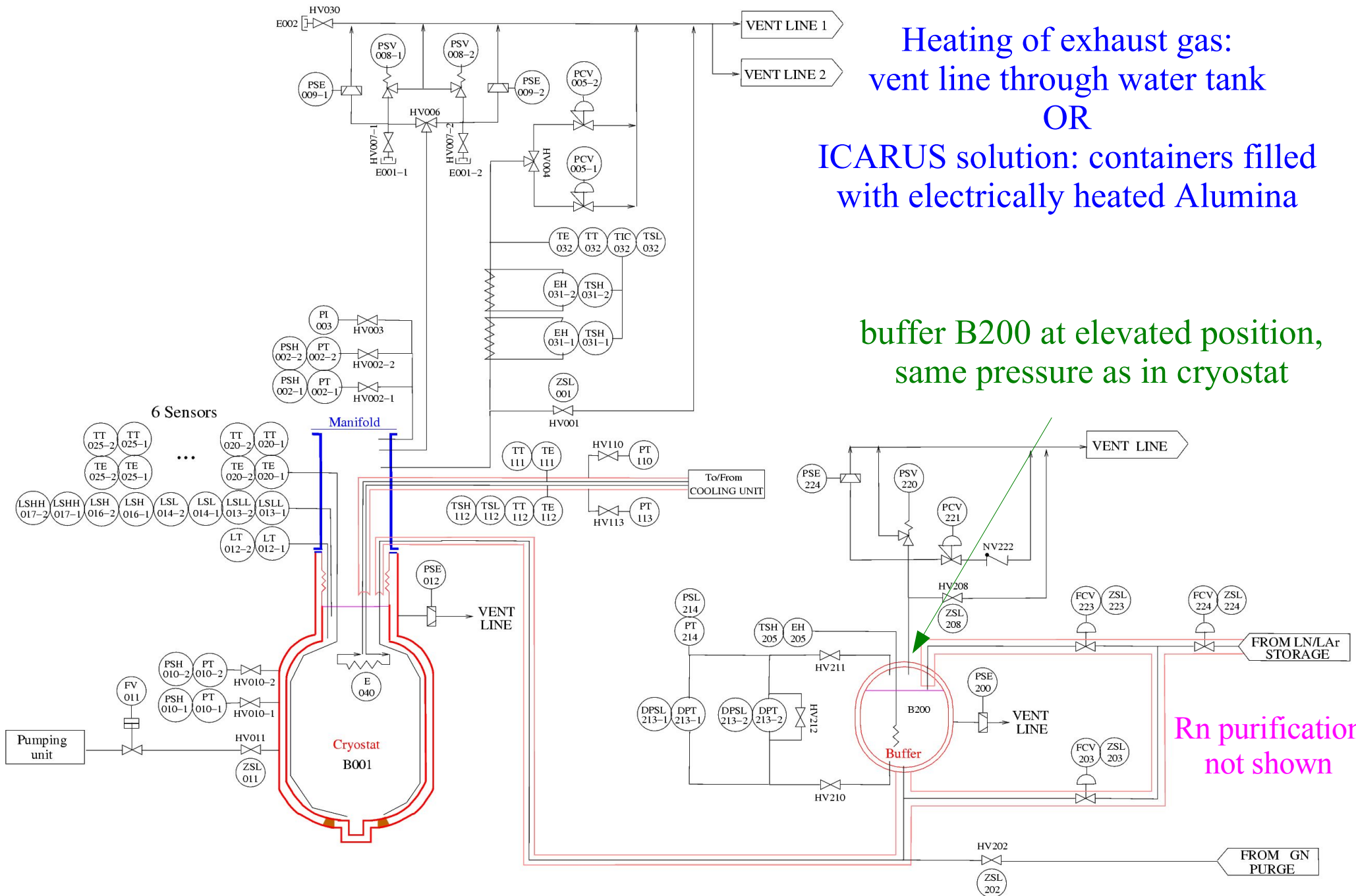
Open issue: we want an active cooling of the LN₂/LAr to avoid

- changes in level of filling (expect ~ 1 cm/h due to evaporation)
- reduce microphonics due to bubbling
- Rn contamination from fresh LN₂/LAr

Solution suggested by Air Liquide/Cryotherm is expensive (~200 k€)
--> we are looking for an alternative

also: how to heat exhaust gas? electrical heater or with water reservoir

PID à la Air Liquide



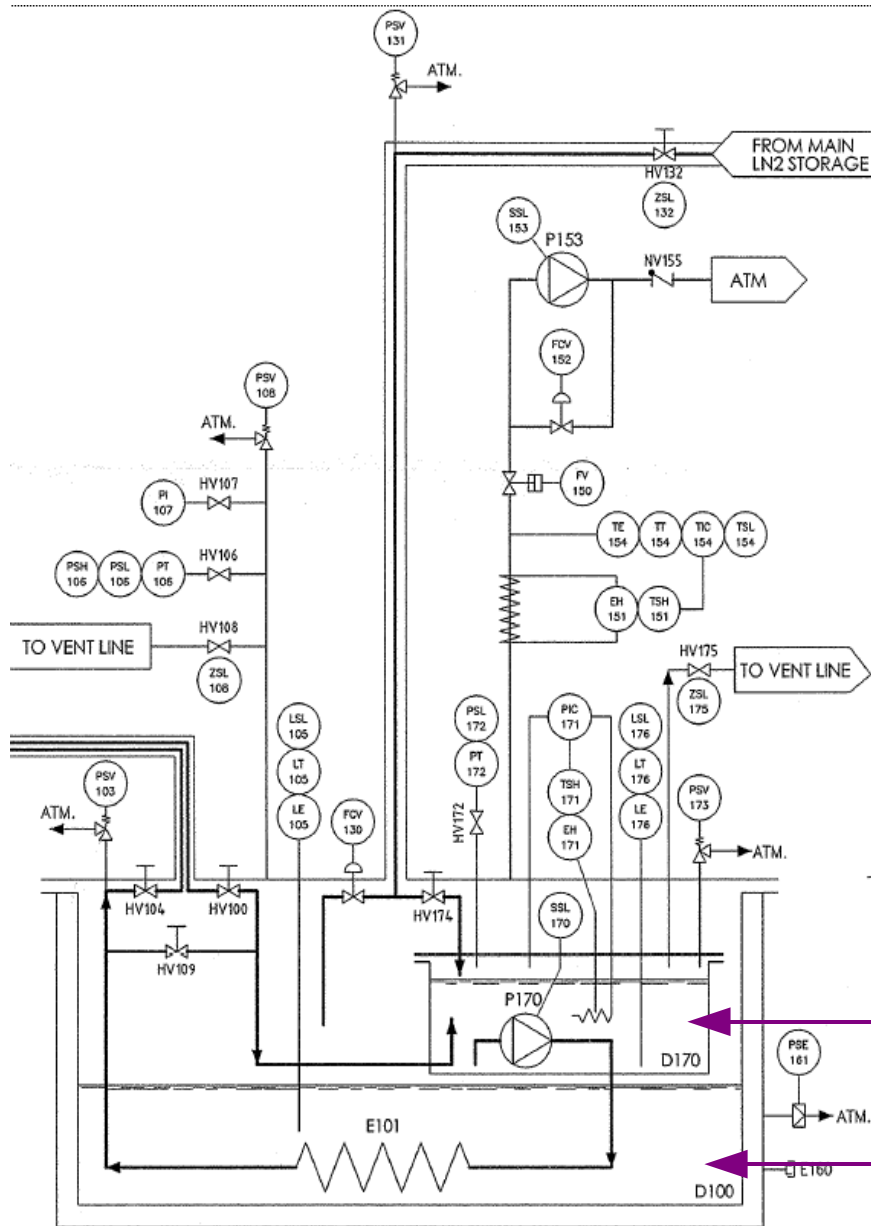
Heating of exhaust gas:
vent line through water tank
OR

ICARUS solution: containers filled
with electrically heated Alumina

buffer B200 at elevated position,
same pressure as in cryostat

Rn purification
not shown

Options for Cooling Unit (1)



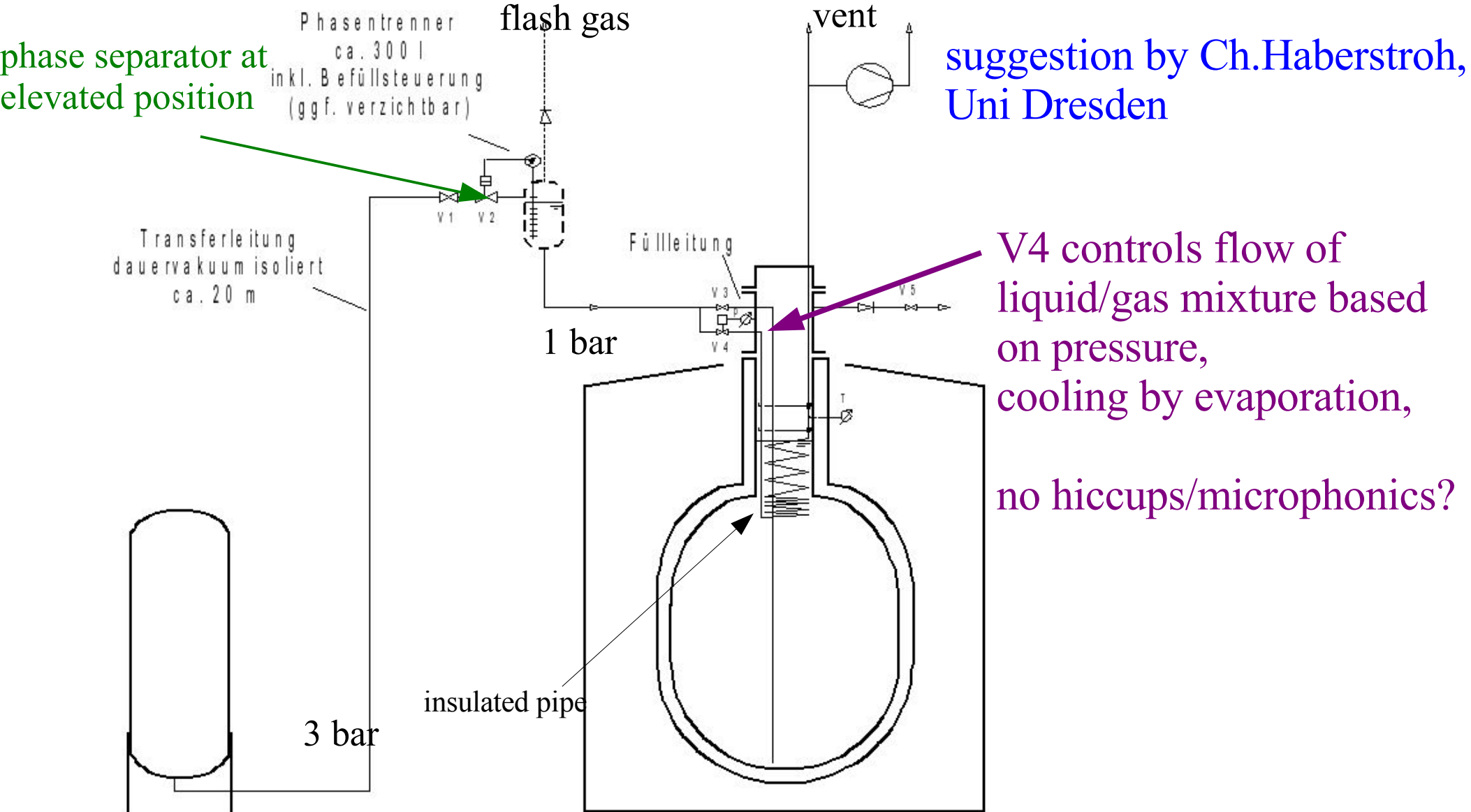
commercial system by Cryotherm
for LAr cooling, for LN2 not yet built

in cryostat:
 $T=81\text{K}$ for $p=1.5$ bar (abs)

Reservoir of LN2 with pump

bath: $T=74\text{K}$ for $p=0.6$ bar

Options for Cooling (2)



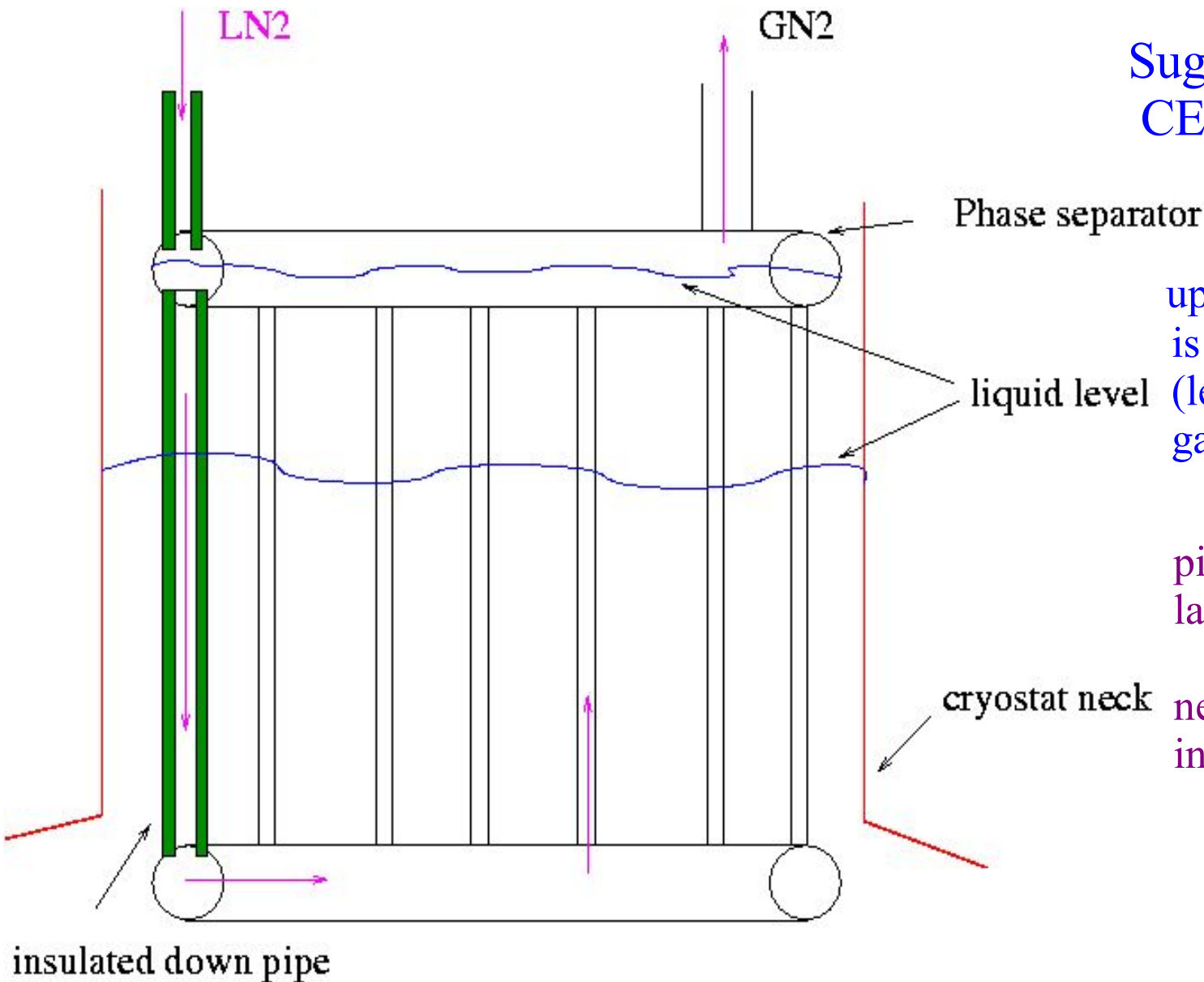
Options for Cooling (3)

Suggestion by G.Perinic,
CERN: thermosyphon

upward streaming fluid
is warmer with 5-10% gas
(less dense --> Δp)
gas&fluid separates on top

pipe dimensions too
large due to small Δp ?

need level measurement
in phase separator



Summary

- PID from Air Liquide available including dimensioning of safety valve.
 - What is the accident scenario for safety valve & rupture disk dimension?
 - Our proposal: safety valve for loss of insulation vacuum,
rupture disk for loss of one containment
 - Discussion with LNGS has started on this issue
- No final solution for cooling unit available at the moment,
once this issue is settled, tendering will start
- How to heat exhaust gas (in case of emergency)?
- LNGS will pay for storage tanks + pipes to experiment, MPI HD the rest