

Liquid Nitrogen vs. Liquid Argon

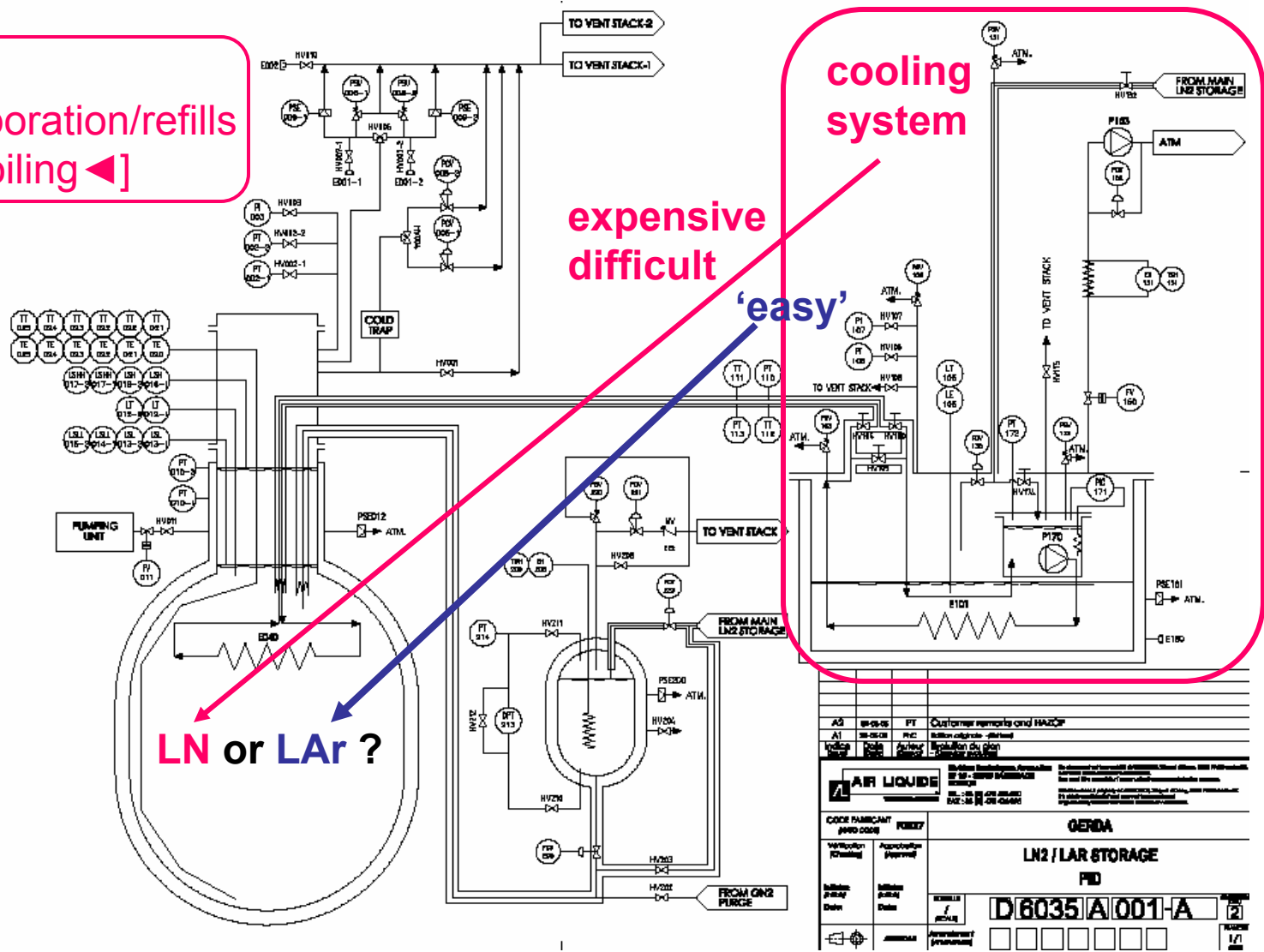
Some Cryogenic Aspects

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GERDA PID

purpose:
minimize evaporation/refills
[▶ nucleate boiling ◀]

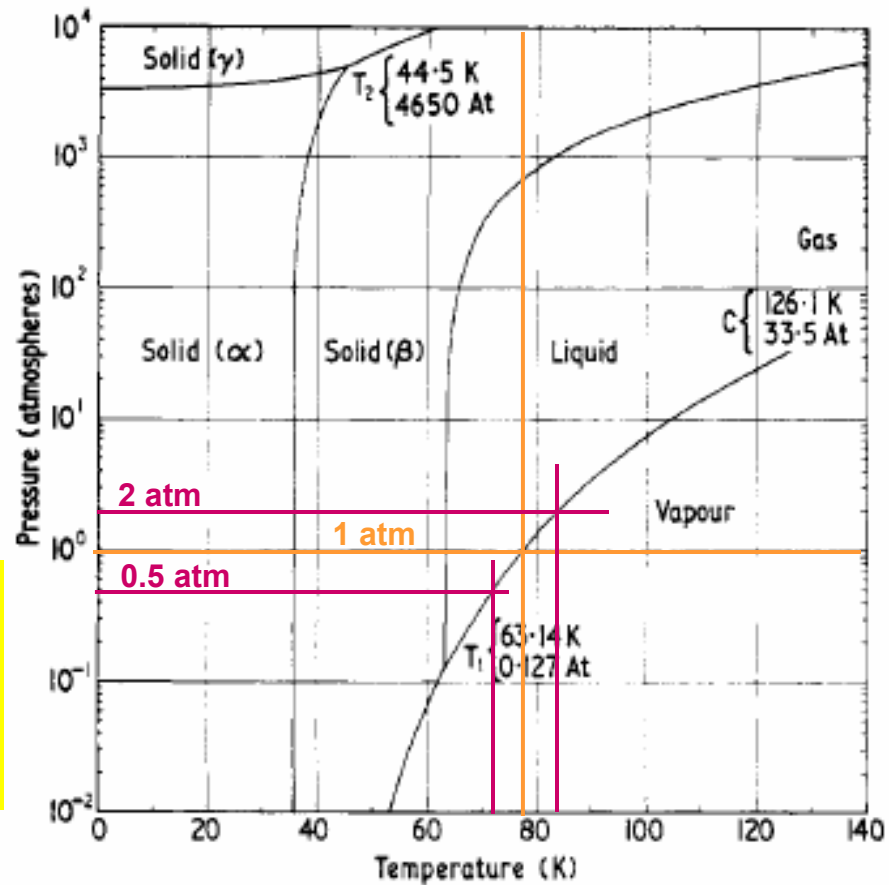


Cooling of LN or LAr by LN

	T_{boil}	T_{melt}
LN	77.4	63.1
LAr	87.3	83.8

T in K at 1 atm.

- ▶ LAr by LN: straightforward :
 $\Delta T = 9.9 \text{ K}$ (beware of Ar ice!)
- ▶ LN by LN : generate ΔT by Δp !



pT diagram of nitrogen
(from E.M.Wray)

Commercial Cooling Systems



LIN closed loop cooling system



Technische Daten / Technical Data

	Dim.	1	2	Typ / Type		
				3	4	5
Kühlleistung Cooling power	W	2000	2000	4000	2500	4000
Kühltemperatur Cooling temperature	K	78-90				56-78
Max. Fördermenge Max. Flow Rate	l/h	500	2000	3000	1400	3000
Max. Druckdifferenz Max. Pressure Differential	bat	3,5	2	2	3,4	2
Max. Betriebsüberdruck Max. Operating Pressure	bar	13	13	13	10	20
Abmessungen / Dimensions						
Gesamthöhe / Total Height	m	1,90	2,00	1,90	1,80	1,90
Gesamtbreite / Total Width	m	0,60	0,60	0,60	0,70	0,60
Gesamtlänge / Total Length	m	1,10	1,80	1,30	1,10	1,30

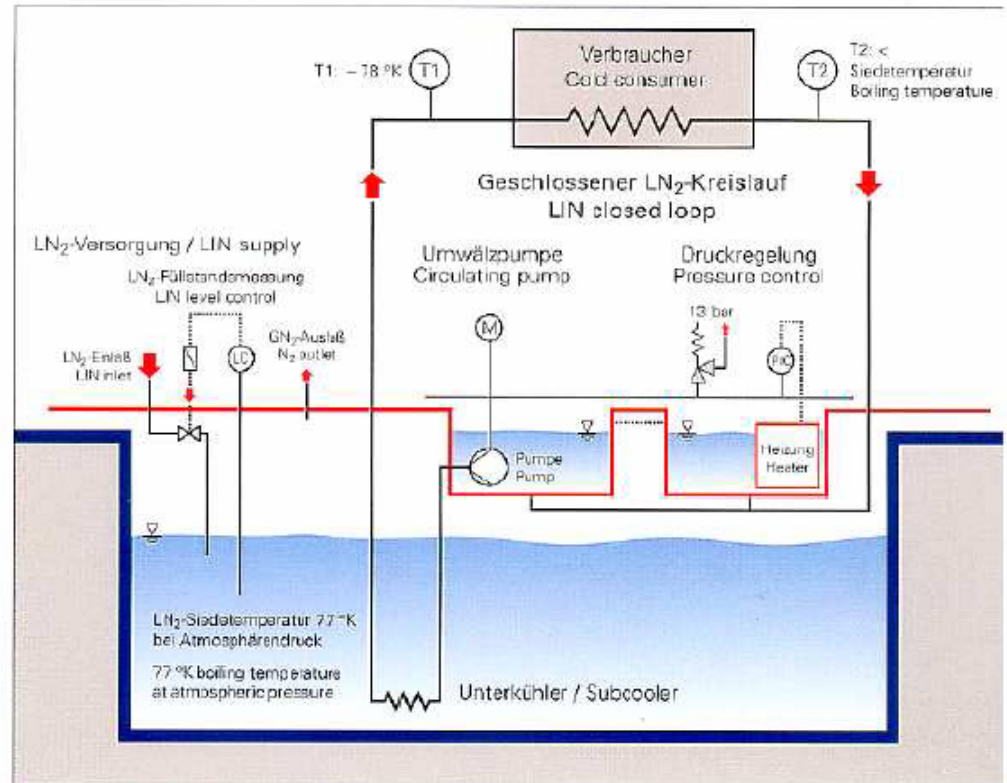
this type not yet built ↑

Principle of Closed Loop Cooling System



Advantages

- No boiling liquid at the consumer
- Vibration-free operation
- Permanent operation
- Closed-loop system
- Low LIN consumption
- High efficiency
- Large cooling power reserve
- High flexibility
- Fully automatic operation
- High reliability
- Mobile by easy-running castors with locking device
res. forklift truck-slots
- Only electric and LIN connection required



Conclusions

	LAr	LN
cryoliquid cost	—	+
cooling system	++	—
cooling cost	+	0
storage tanks	1+1	1
safety aspects	++	0

◀ consultant's opinion