Cryogenic Infrastructure

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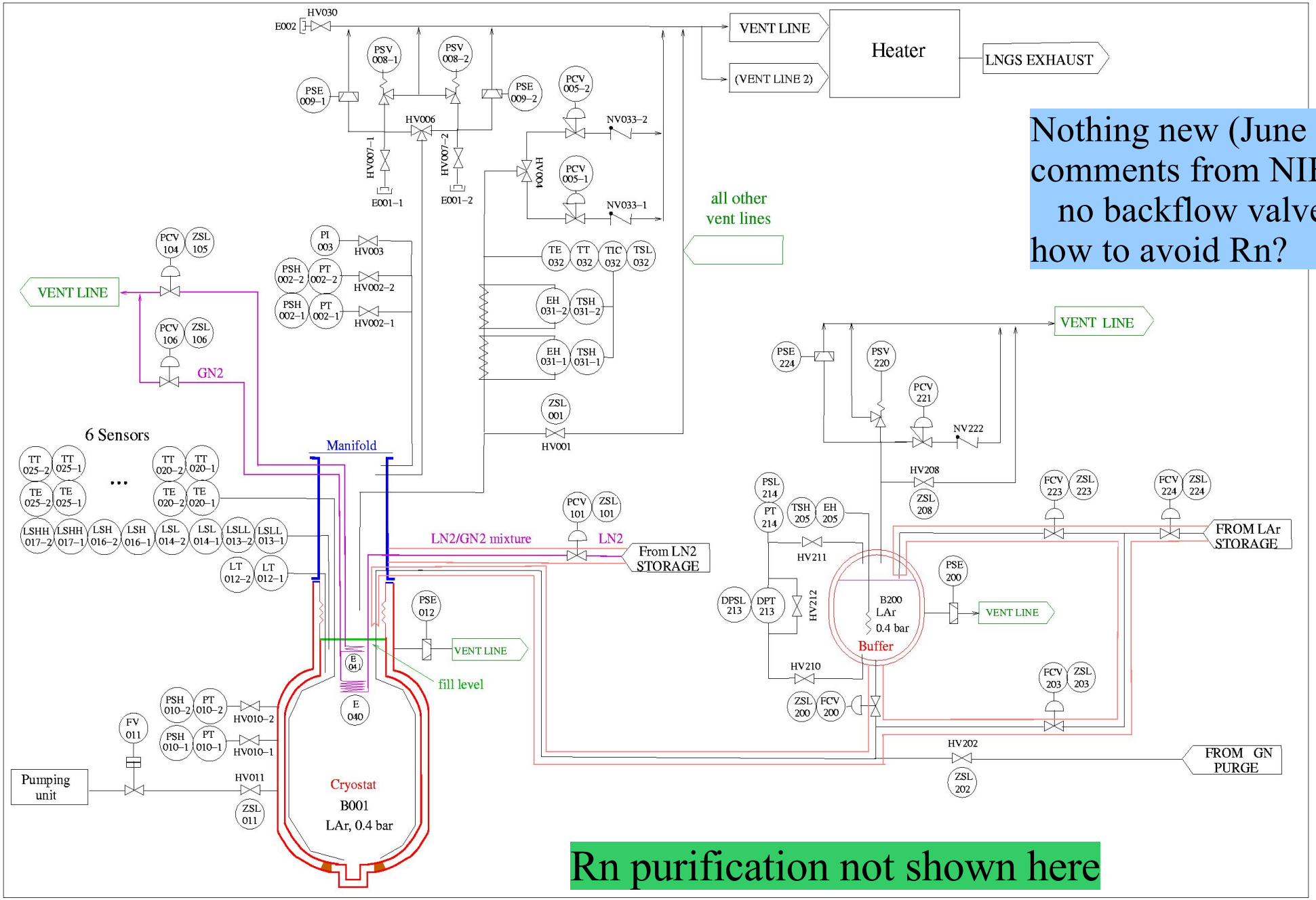
Content
- reminder of PID drawing for cryostat
- cryogenic control valves
- exhaust gas heating
- interface to Penthouse gas system
- tender

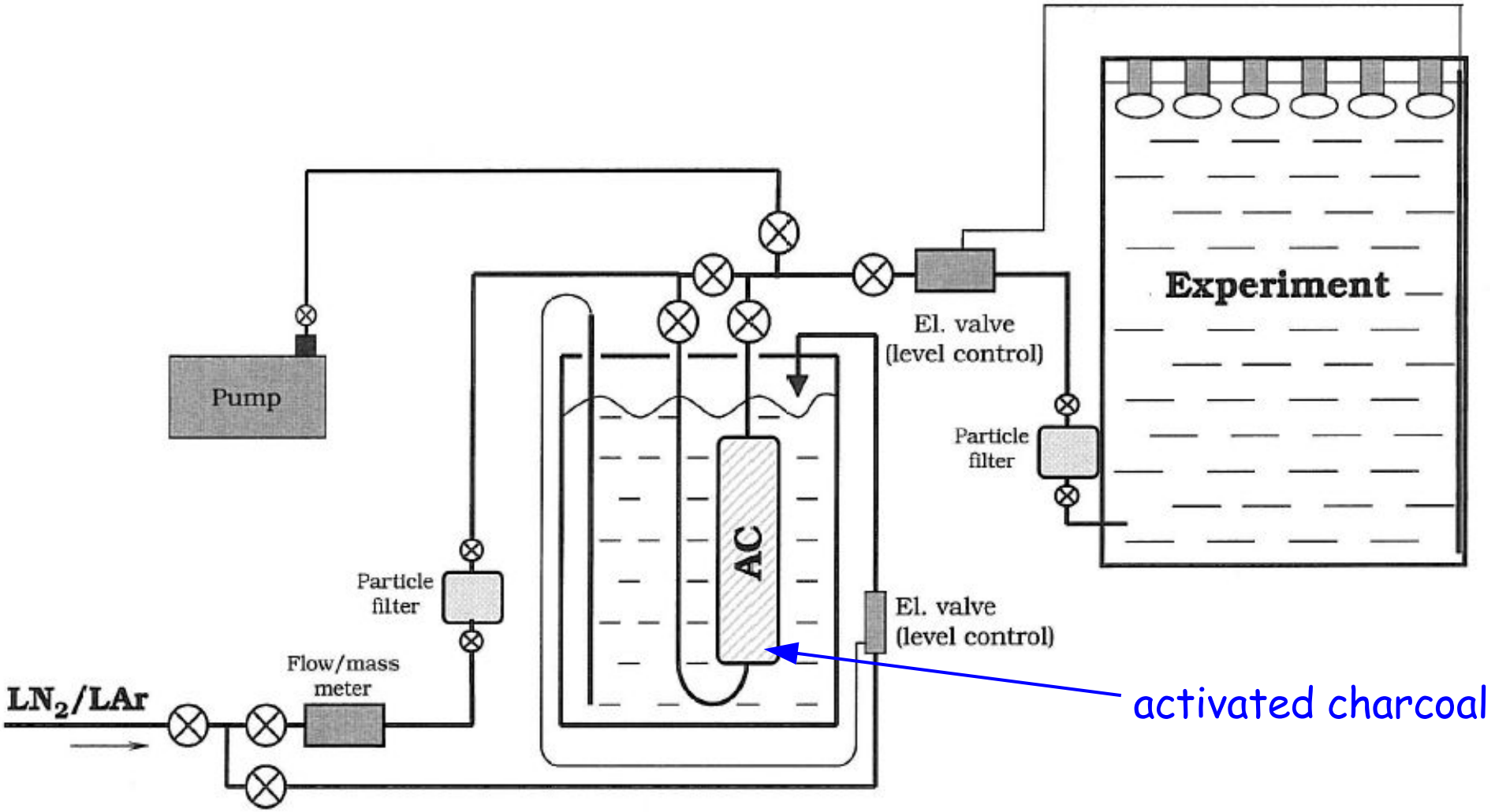
Piping and Instumentation Design



Nothing new (June 06)
comments from NIER:
no backflow valves
how to avoid Rn?

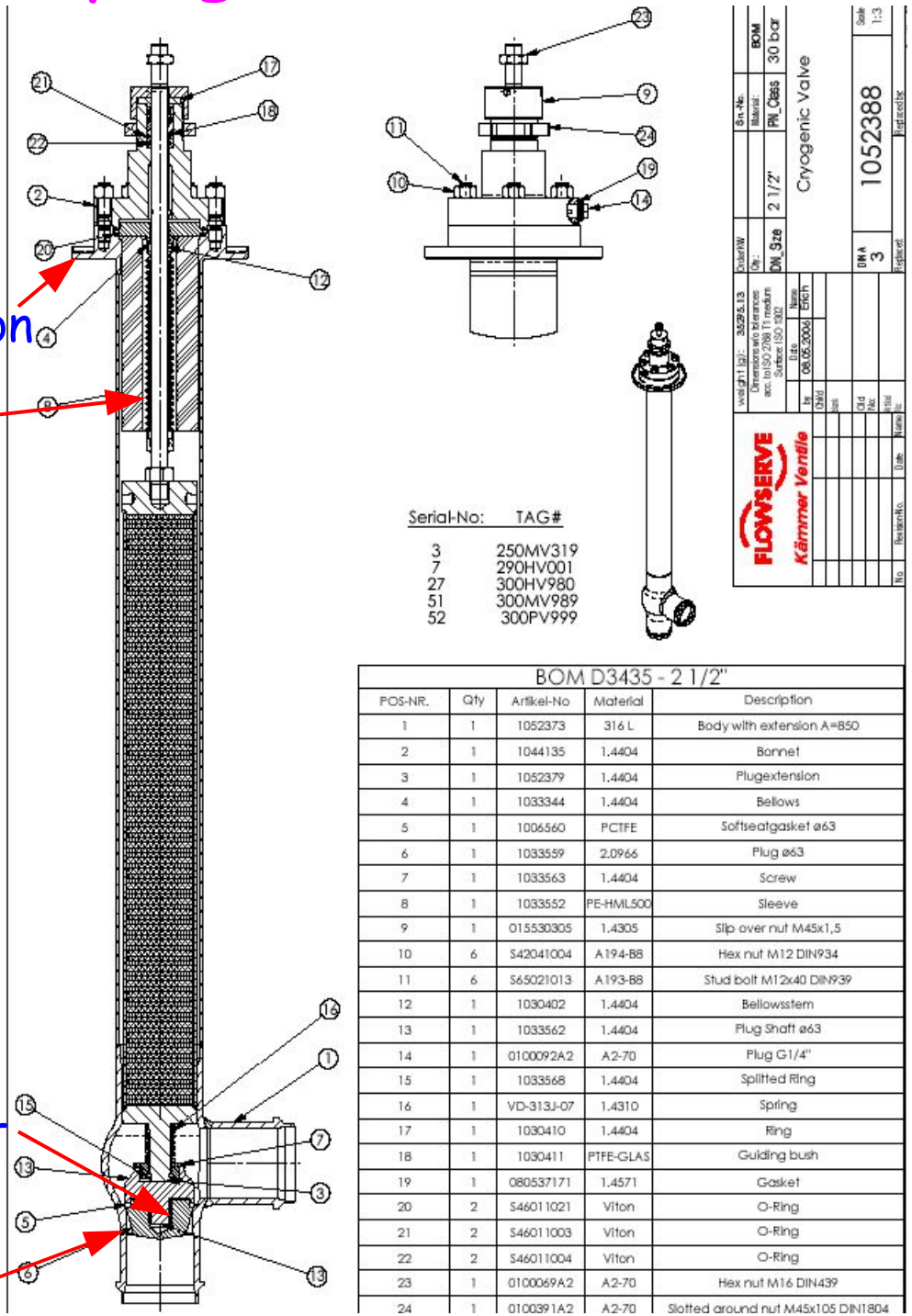
Rn purification not shown here

Radon purification plant



consensus: want a small unit for refilling,
design needs optimization (valves,...) & integration into PID

Cyrogenic Control Valves



Serial-No: TAG#

3	250MV319
7	290HV001
27	300HV980
51	300MV989
52	300PV999

Cryogenic Valve — 1052388 — DN 3 — 2 1/2" — PN_Class 30 bar — DN_Size — BOM — FLOWSERVE Kämmer Ventile

BOM D3435 - 2 1/2"

POS-NR.	Qty	Artikel-No	Material	Description
1	1	1052373	316 L	Body with extension A=850
2	1	1044135	1.4404	Bonnet
3	1	1052379	1.4404	Plugextension
4	1	1033344	1.4404	Bellows
5	1	1006560	PCTFE	Softseatgasket ø63
6	1	1033559	2.0966	Plug ø63
7	1	1033563	1.4404	Screw
8	1	1033552	PE-HML500	Sleeve
9	1	015530305	1.4305	Slip over nut M45x1,5
10	6	S42041004	A194-B8	Hex nut M12 DIN934
11	6	S65021013	A193-B8	Stud bolt M12x40 DIN939
12	1	1030402	1.4404	Bellowsstem
13	1	1033562	1.4404	Plug Shaft ø63
14	1	0100092A2	A2-70	Plug G1/4"
15	1	1033568	1.4404	Splitted Ring
16	1	VD-313J-07	1.4310	Spring
17	1	1030410	1.4404	Ring
18	1	1030411	PTFE-GLAS	Guiding bush
19	1	080537171	1.4571	Gasket
20	2	S46011021	Viton	O-Ring
21	2	S46011003	Viton	O-Ring
22	2	S46011004	Viton	O-Ring
23	1	0100069A2	A2-70	Hex nut M16 DIN439
24	1	0100391A2	A2-70	Slotted round nut M45x105 DIN1804

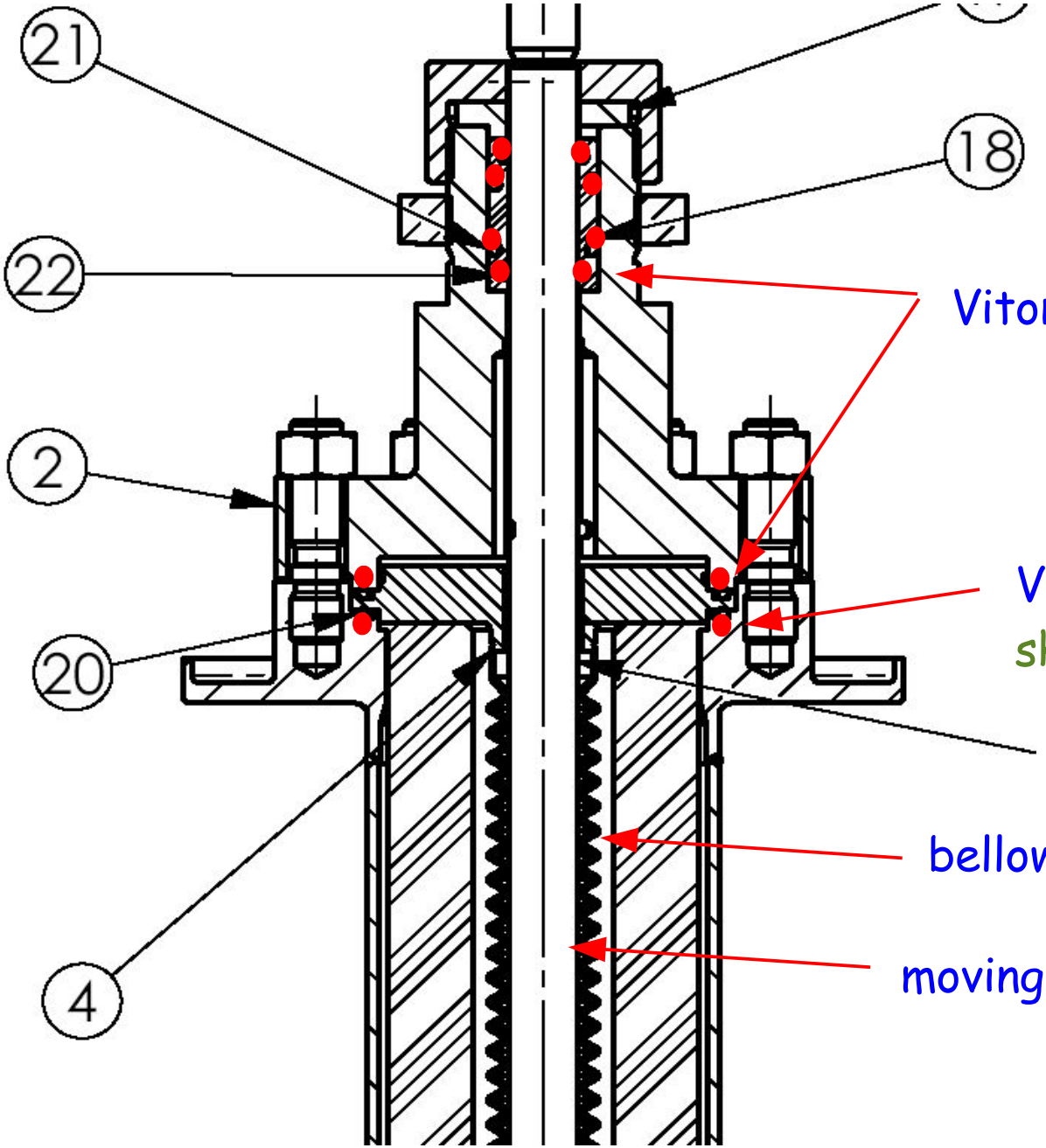
what do we want?

- radon tight against atmosphere, how?
- open/close or linear flow regulator
- cross section ?
- vacuum insulated ?
- metall or soft (PCTFE, Vespel) seat?
- screwed or welded?

what is available?

- lots of valuable help by G. Perinic, CERN
- discussion with Hardy & Grzegorz

Cyrogenic Control Valves Detail



Viton seals, if bellow leaks (He)

Viton seal against atmosphere
should be replaced by metal seal

bellow

moving up/down

Exhaust Gas Heating

example calcuation external heat exchanger

HTRI

Final Results Page 2

Released to the following HTRI Member Company:
Gerd Lannewehr
Gerd Lannewehr

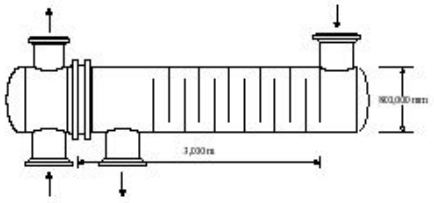
Xist Ver. 5.00 10.11.2006 08:22 SN: 1500212265 **SI Units**
Wärmetauscher Argon/Wasser am Kryostat Gerda
Max Planck Institut Kernphysik
Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Process Data		Hot Shellside		Cold Tubeside	
Fluid name		Water		Argon	
Fluid condition			Sens. Liquid		Sens. Gas
Total flow rate	(kg/s)		22,8898		4,0000
Weight fraction vapor, In/Out	(--)	0,000	0,000	1,000	1,000
Temperature, In/Out	(Deg C)	20,00	16,00	-180,00	5,00
Temperature, Average/Skin	(Deg C)	18,0	16,72	-87,5	16,09
Wall temperature, Min/Max	(Deg C)	13,24	18,66	12,23	18,10
Pressure, In/Average	(kPa)	150,002	146,332	150,002	146,998
Pressure drop, Total/Allowed	(kPa)	7,340		6,007	
Velocity, Mid/Max allow	(m/s)	0,29		17,62	
Mole fraction inert	(--)				
Average film coef.	(W/m2-K)		3177,38		74,16
Heat transfer safety factor	(--)		1,000		1,000
Fouling resistance	(m2-K/W)		0,000000		0,000000

Overall Performance Data

Overall coef., Reqd/Clean/Actual	(W/m2-K)	54,96 /	60,10 /	60,10	
Heat duty, Calculated/Specified	(MegaWatts)	0,3839 /			
Effective overall temperature difference	(Deg C)	67,4			
EMTD = (MTD) * (DELTA) * (F/G/H)	(Deg C)	67,50 *	0,9985 *	1,0000	

See Runtime Messages Report for warnings.



Exchanger Fluid Volumes

Approximate shellside (L)	894,6
Approximate tubeside (L)	1819,6

Shell Construction Information

TEMA shell type		BEU		Shell ID	(mm)	800,000
Shells Series	1	Parallel	1	Total area	(m2)	105,290
Passes Shell	1	Tube	2	Eff. area	(m2/shell)	103,644
Shell orientation angle (deg)		0,00				
Impingement present		No				

Heater à la Icarus not possible:

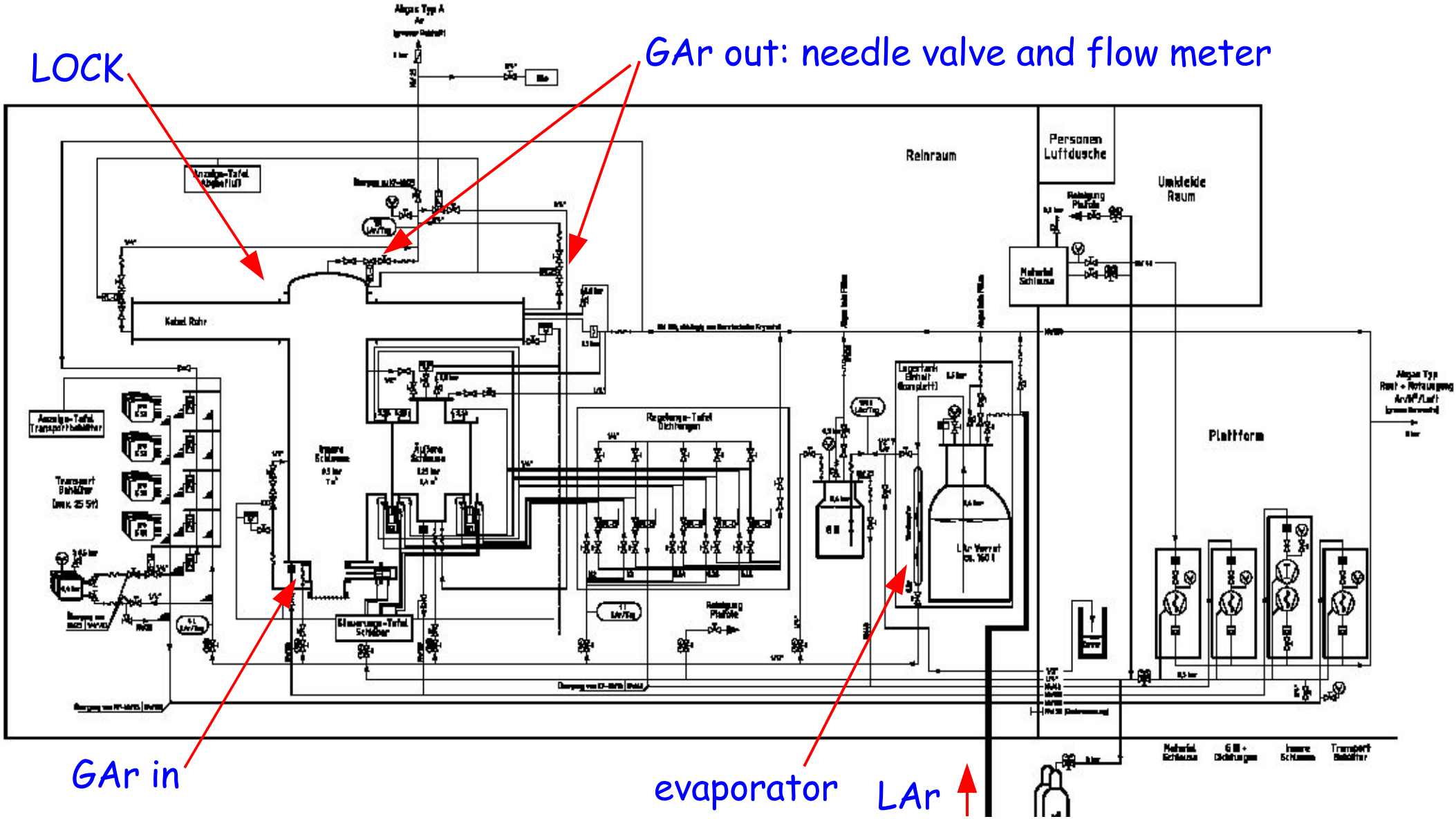
- 6 containers of h=5m, Ø=0.8m, filled with silicate half-spheres, electrically heated
- in case no electric cooling of LAr,
- for 700 Nm^3/h LAr gas flow
- cost 150 kEuro

GERDA needs 8000 Nm^3/h heater

only known option: water reservoir

1) external heat exchanger
   4 kg/s of LAr = 8600 Nm^3/h
   --> 22 kg/s water, Ø=0.8m, h=5m
   105 m^2 heat exchanger surface
2) internal heat exchanger
   - same construction
   - 330 m of Ø=0.1m pipe
3) pipes on outer surf. of water tank
   Ø=10m, h=3.3 m

Current Design of Penthouse Gas System



(variable) flow of GAr for Rn purging will modify gas pressure of cryostat
--> gas flow rate should be controlled by SPS of cryostat

Tendering

What is needed for start of tendering:

- feedback from NIER / LNGS concerning modifications of PID
- finalize PID:
  - include Rn purification
  - connection to penthouse gas system,
  - location of LAr & LN2 storage tanks
  - location of Rn purification, valves, ...
  - specify valves
  - pipe diameters, ...
- write tender document
- buy material delivered by MPI

Start tender early next year (German wide tendering)

Exhaust gas heater is a separate project:

- currently all (water) solutions 1-3 are dimensioned & conceptually designed
- should decide early next year (?)