Gianluca Gemme

LN2 PLANT DESIGN
CRYOTRAP INTERFACE

Design parameters

- Cryogen — Liquid Nitrogen
- Volume — 200 l (one trap)
- Heat load — 300 W (one trap)
- Trap cold mass — 500 Kg
- Number of traps — 4
- Liquid nitrogen input — 7.10 l/h
- Evaporated GN2 — 4.5 Nm^3/h (in standard operation)
- LN2 for cool-down — 650 l
- Working hours (between refilling) 840 h (35 days)

- Operating life — 10 yrs
- Liquid nitrogen cost — 0.094 €/l

Plant general features

- Liquid nitrogen tanks
- Liquid nitrogen transfer lines
- Automatic valve for the regulation of the liquid flow into the trap
- System for the regeneration and baking of the traps (hot GN2)
- GN2 exhaust lines (LN2 evaporation, cool-down, regeneration and baking)

Liquid nitrogen tanks

Super insulated vacuum tank

Self consumption ~0.04 - 0.05 %/day

Cost € 46,000 (10,000 l)

€ 75,000 (20,000 l)

Standard vacuum tank

Self consumption ~0.3 %/day

Cost € 32,000 (10,000 l)

€ 46,000 (20,000 l)

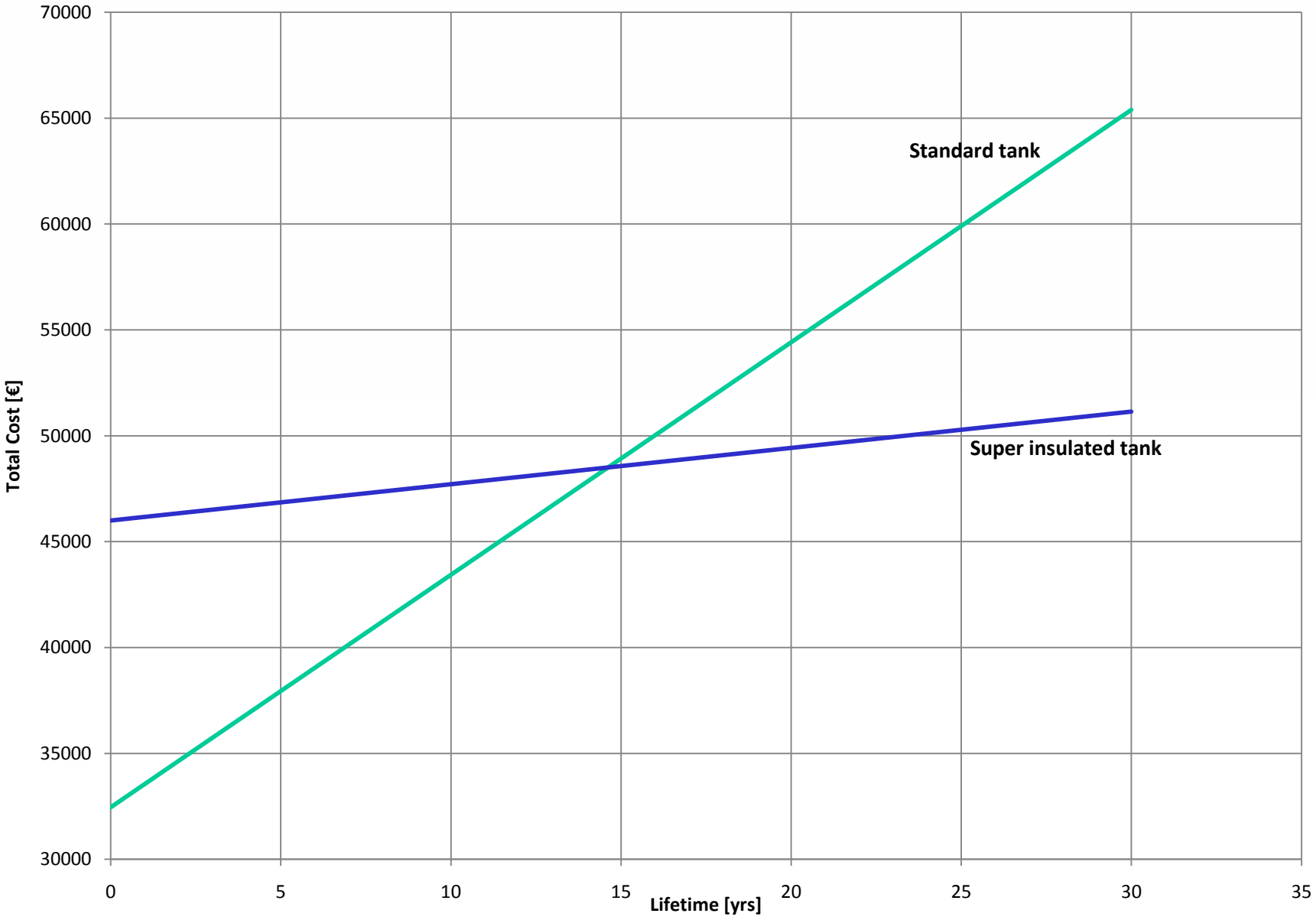
Rented tanks

Standard vacuum tank

High cost over 10 yrs (approx € 10,500/month)

Maintenance included

Tank self-consumption

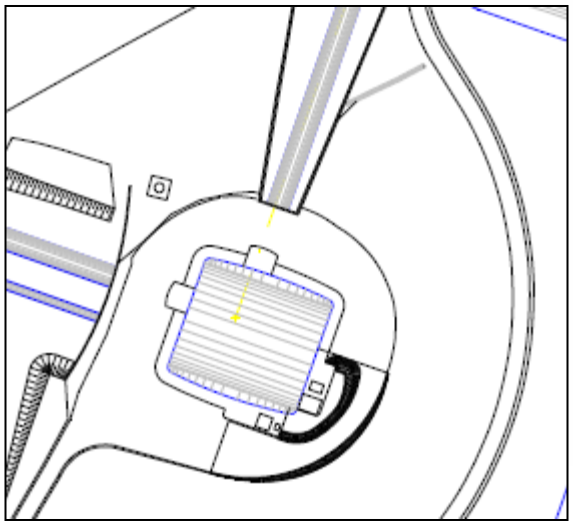


Tank position

Central building

1 tank 20,000 l

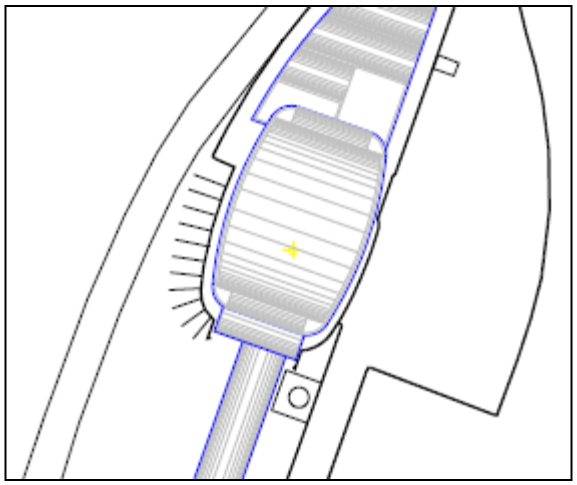
2 cryogenic lines approx 50 m lenght



End buildings

1 tank 10,000 l for each building

1 cryogenic line approx 22 m lenght



Liquid nitrogen transfer lines

Super insulated lines under vacuum

Stratified flow (gas-liquid separation)

Low self consumption

Low pressure drop

Linea DN15

dp/m = 1.60E-03 *mbar/m*

Linea	L [m]	Qtot [W/m]	Qgiunto [W/g]	Q [W]	dp tot [mbar]	*Auto-consumo azoto liquido* l/h	Ltot 10 anni
T1_N	54	0.36	1.7	34.7	0.09	0.81	71388
T2_N	22	0.36	1.7	14.2	0.04	0.33	29084
T1_W	52	0.36	1.7	33.5	0.08	0.78	68744
T2_W	22	0.36	1.7	14.2	0.04	0.33	29084

Totale = 198299 l

Inner conduit Φ 21.3x1.65 mm ASTM A312 Tp 304

Outer conduit Φ 60.3x1.5 mm AISI 304

Design pressure 16 bar

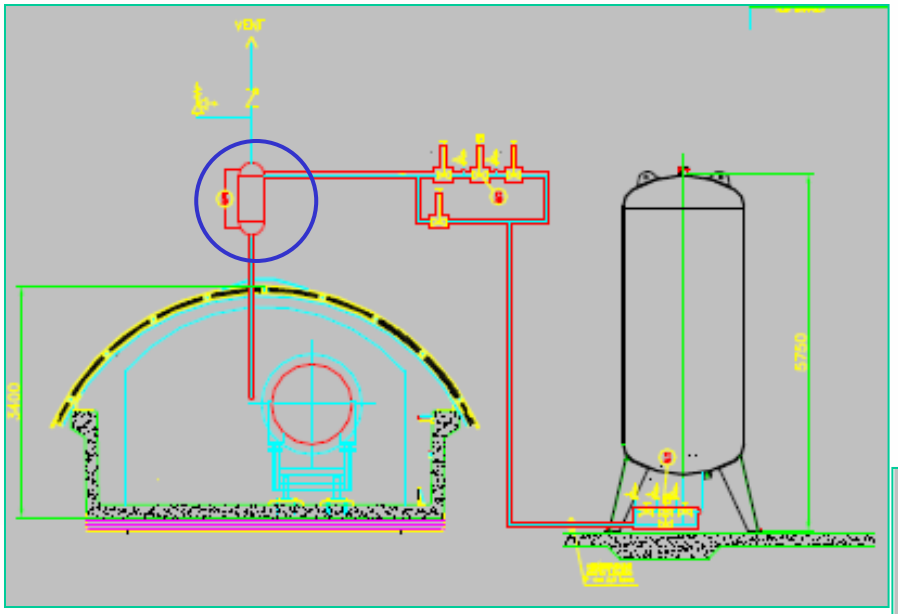
Working temperature -196 °C

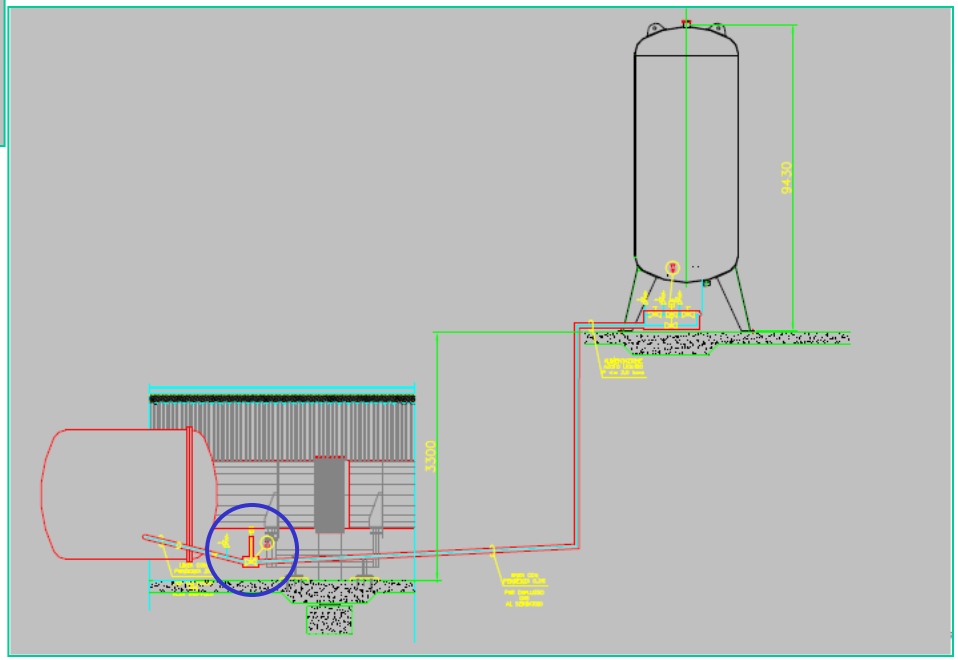
Linear heat loss 0.4 W/m

Linear weight 3.7 Kg/m

Liquid nitrogen transfer lines

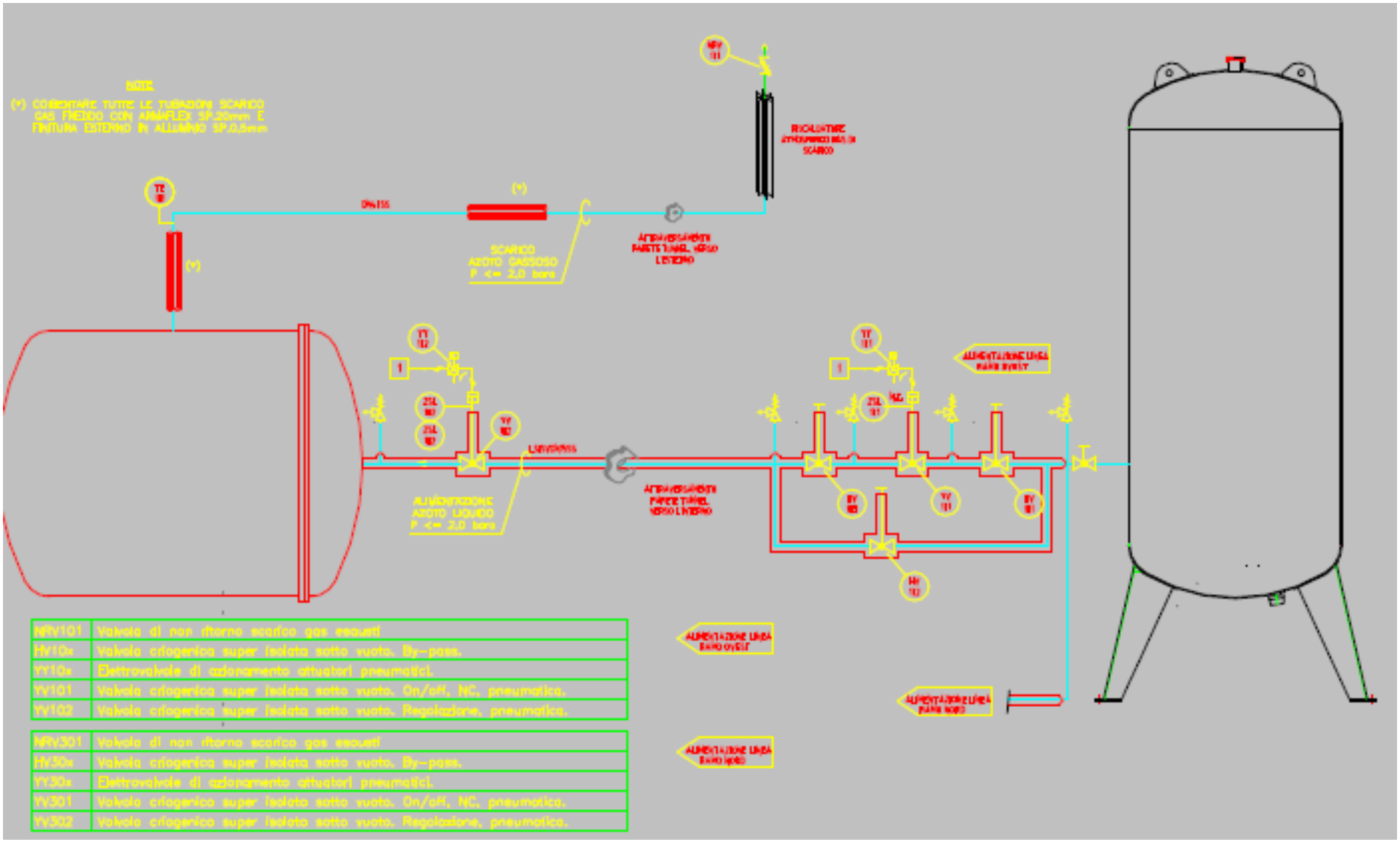
End building



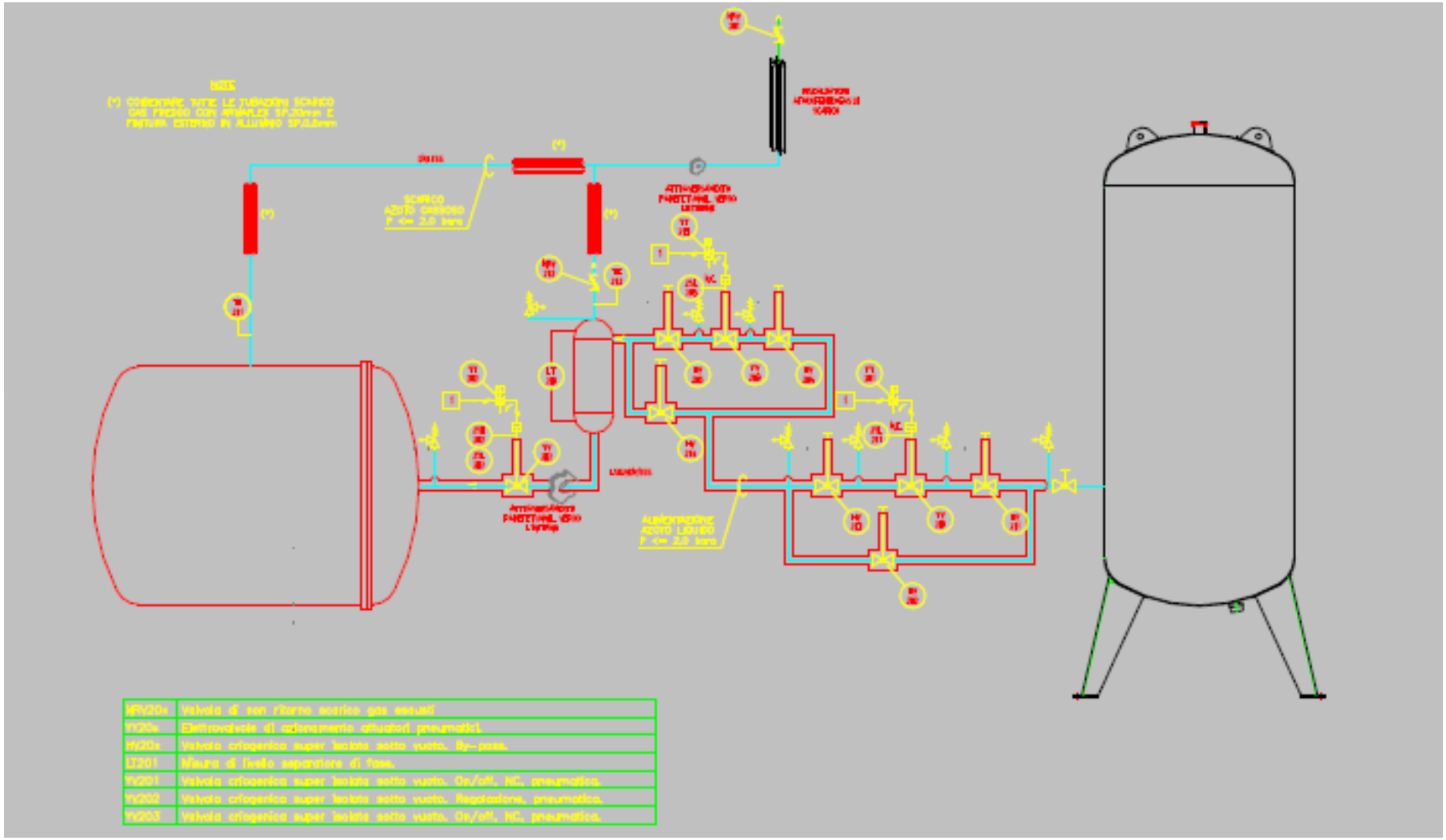


Central building

Central building



End building

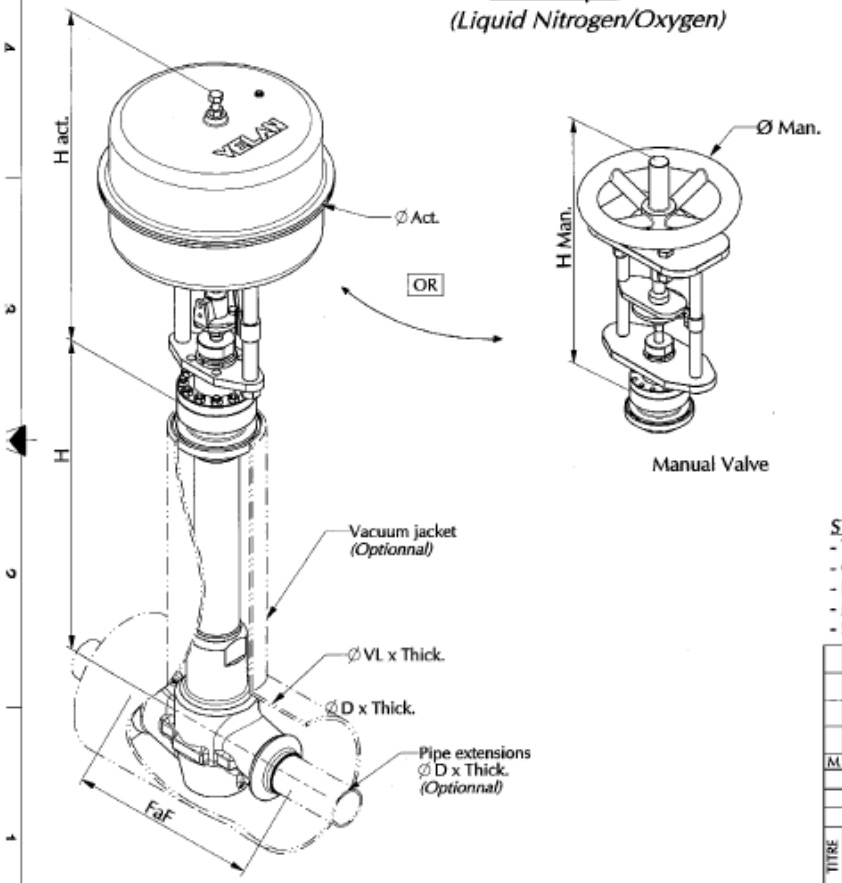


Cryogenic valve

STRAIGHT CRYOGENIC VALVES

Low temperatures

(Liquid Nitrogen/Oxygen)



Manual Valve

DN	Ø D x Thick.	Ø VL x Thick.	FaF	H	Differential Pressure	Ø Act. NF	Ø Act. NO	H Act. (approx)	Man. Ø	Man. H	Weight Valve	Weight With Actuator
6	12 x 1											
8	13.7 x 1.65											
10	17.2 x 1.6		105	350		160	160	380	125	300	4	10
15	21.3 x 1.6	114.3 x 2.11										
	21.3 x 2											
20	26.9 x 1.6					160		420				
25	33.4 x 1.65	114.3 x 2.11	155	397	< 15 bar		160		125	450	6	12
	33.4 x 2.77				> 15 bar	210		450				
32	42.16 x 1.65											
	42.4 x 2											
40	48.3x1.65	219.7 x 2.77										40
	54x2		260	512		310	310	520	250	470	24	
50	60.3x1.65											45
50+	60.3x2											
65	73x3.05		340	564	< 15 bar			620		450	40	60
	73x2.11				> 15 bar	415		800				100

STANDARD:
- Ts : 77K to 350K
- Class 300
- Pneumatic actuator
- Manual handwheel
- Soft seal

OPTIONS:
- Vacuum jacket or thermal collar
- Accessories: digital positioner, solenoid valve limit switches, flow reducer, and filter regulator
- Other dimensions and accessories on request

Dimensions: mm
Weight: kg

M.Ind	MODIFICATIONS	DATE	DESSINE	DATE	VERIFIE	DATE	APPROUVE
B	Ajout DN40 à 65	16/01/08	D.VACHOT	16/01/08	A.ARROUDJ	16/01/08	N.CREPIN
A	Etablissement	13/04/07	D.VACHOT	13/04/07	A.ARROUDJ	13/04/07	N.CREPIN

AFFECTATIONS | PLANS SIMILAIRES

TITRE: STRAIGHT NITROGEN CRYOGENIC VALVE

N°: 2Z3042

MATIERE | ECHELLE

PL.BRUT | MASSE

VELAN S.A.S. 90, rue Challemel Lacour 69367 LYON CEDEX 07 FRANCE

LN2 flash

- The trap works at atmospheric pressure
- At the level of the regulating valve, on the tank side, we have in the worst case (central building) 1.3 bar g
- This causes a sudden expansion across the valve with the formation of 0.12 g/s of GN2 (0.08 m^3/h)
- This is much less than the gas produced into the trap (4.5 m^3/h)
- No problem from the point of view of the operation of the system
- Vibrations?
- A phase separator can anyway be installed

Regeneration and baking

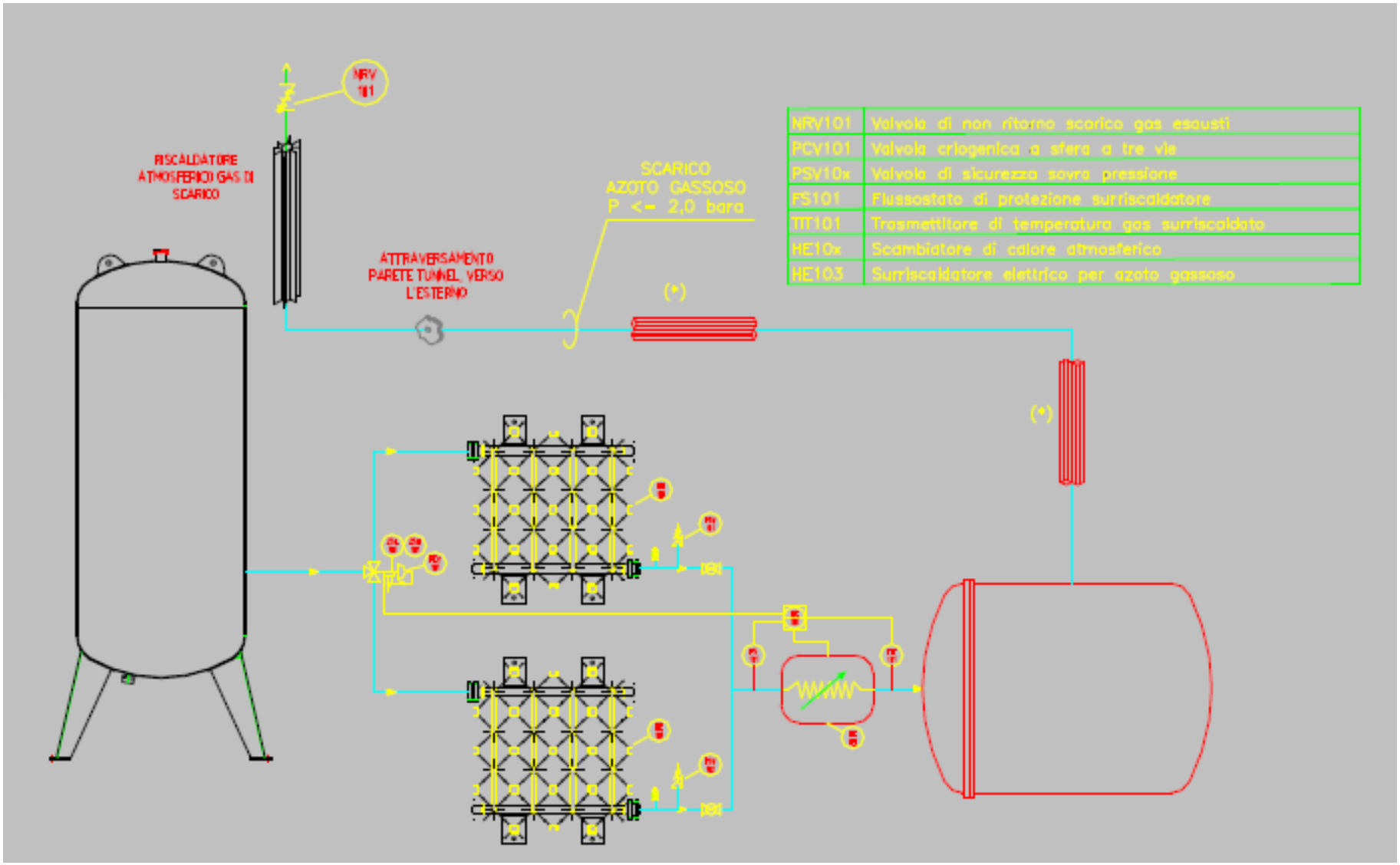
Regeneration (rare event)

Temperature	**50 °C**
Duration	**4 days**
Transient	**6 hours**
Gas load	**415 Nm^3/h (transient)**
	50 Nm^3/h (regime)
LN2 consumption	**3,800 l + 1,870 l/d**

Baking (very rare event)

Temperature	**160 °C**
Duration	**4 days**
Transient	**22 hours**
Gas load	**170 Nm^3/h (transient)**
	50 Nm^3/h (regime)
LN2 consumption	**5,800 l + 1,870 l/d**

Regeneration and baking



Gas exhaust lines

- Max load
  - **500 Nm^3/h cool-down**
  - **415 Nm^3/h regeneration and baking**
- Design pressure 0.5 bar g
- Design temperature -196 - +150 °C
- Nominal diameter DN80

Overall LN2 consumption

	Ed. Centrale	*Torre Nord*	*Torre Ovest*
L linea [m]	106	22	22
Autoconsumo linea [l/g]	38.39	7.97	7.97
Consumo trappola [l/g]	340.8	170.4	170.4
Taglia serbatoio	20000	10000	10000
Autoconsumo serbatoio [l/g]	56	32	32
Periodo rifornimento [gg]	35	35	35
Consumo totale sul periodo [l]	15232	7363	7363
Consumo per messa a freddo [l]	1680	840	840
Totale inventario [l]	18592	9043	9043

Refilling of the tanks

One refilling per week during maintenance

The time needed will be

45’ for the 20,000 l tank

30’ for the 10,000 l tank

LN2 plant/trap interfaces

- One DN15 liquid nitrogen input line
- One DN80 vent line
- One DN80 hot gas input line

- Liquid nitrogen level (input to cryogenic valve)