Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

Operation Feasibility of 50 mbarg Design Pressure

Mark Adamowski

LBN TPC Test at CERN Team Meeting

19 November 2014

Set-points and Operating Pressure

	Pressure			gap	
	mbar g	psig	psia	psi	
OP non-fire 2 RV	58.0	0.84	15.54		116% of Design P
				0.044	tiny gap, both RV's open on event
OP non-fire 1 RV	55.0	0.80	15.50		110% of Design P
				0.073	
design P	50.0	0.73	15.43		
	↕			0.22	gap set to minimize RV/RD pop risk
controlled vent	34.8	0.51	15.21		
				0.30	
operating setpoint	14.1	0.20	14.90		
	↕			0.22	gap set to minimize vac RV open risk
RV vac setpoint	-1.10	-0.016	14.68		
vac design P	-1.50	-0.022	14.68		

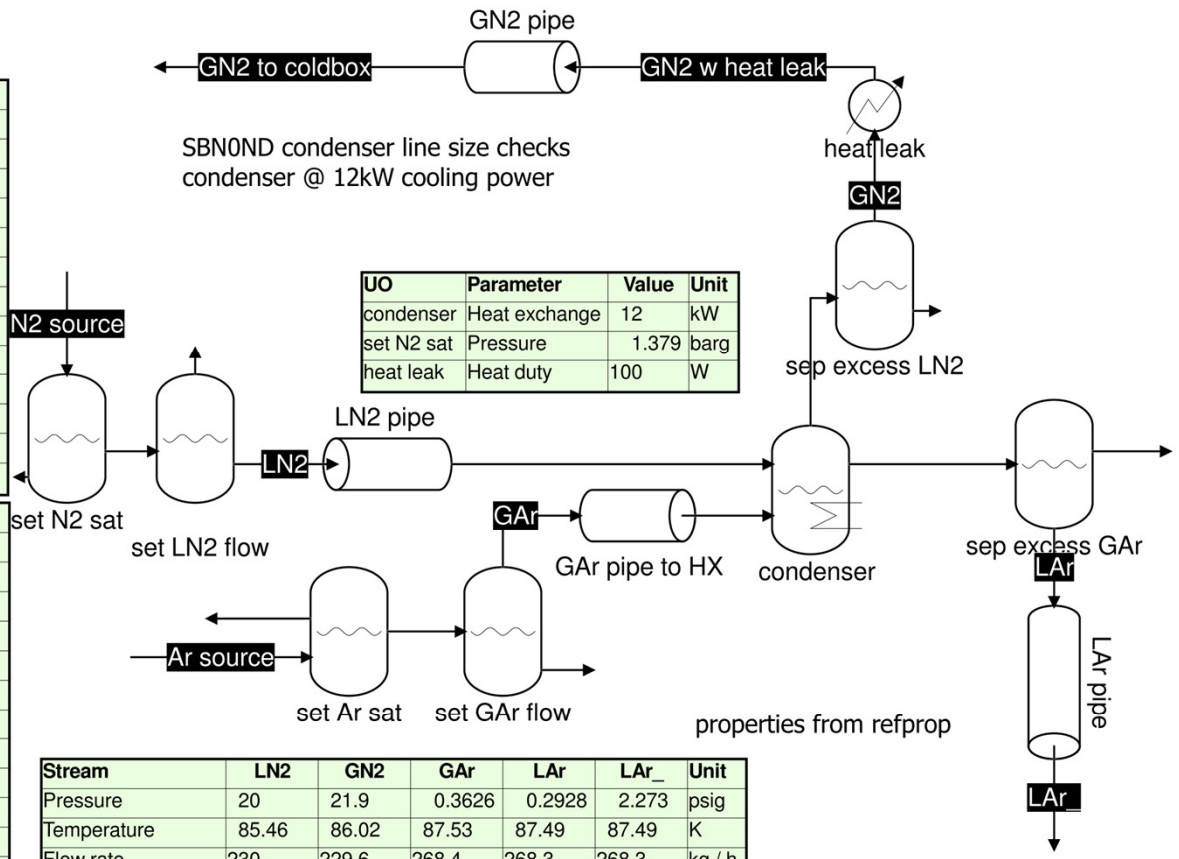
< indicates user input value

< indicates calculated value

Vent Size Check

GAr pipe to HX		
Parameter	**Value**	**Unit**
Pipe ID	3	in
Pipe Length	10	m
Eqv Length of fittings	50	m
Average Velocity	9.101	ft / s
P Drop Friction	0.05305	psi
Elevation Change	2	m
P Elevation change	-0.01676	psi
Abs Roughness	0.04572	mm
Darcy Friction Factor	0.01977	
Reynolds Number	1.733e+05	
Num Parallel Pipes	1	
Calc Status	Isothermal Comp Flow	

LAr pipe		
Parameter	**Value**	**Unit**
Pipe ID	2	in
Pipe Length	10	m
Eqv Length of fittings	50	m
Velocity	0.08652	ft / s
P Drop Friction	0.00292	psi
Elevation Change	-1	m
P Elevation change	1.983	psi
Abs Roughness	0.05	mm
Darcy Friction Factor	0.03515	
Reynolds Number	7217	
Calc Status	Liquid - calc OK	



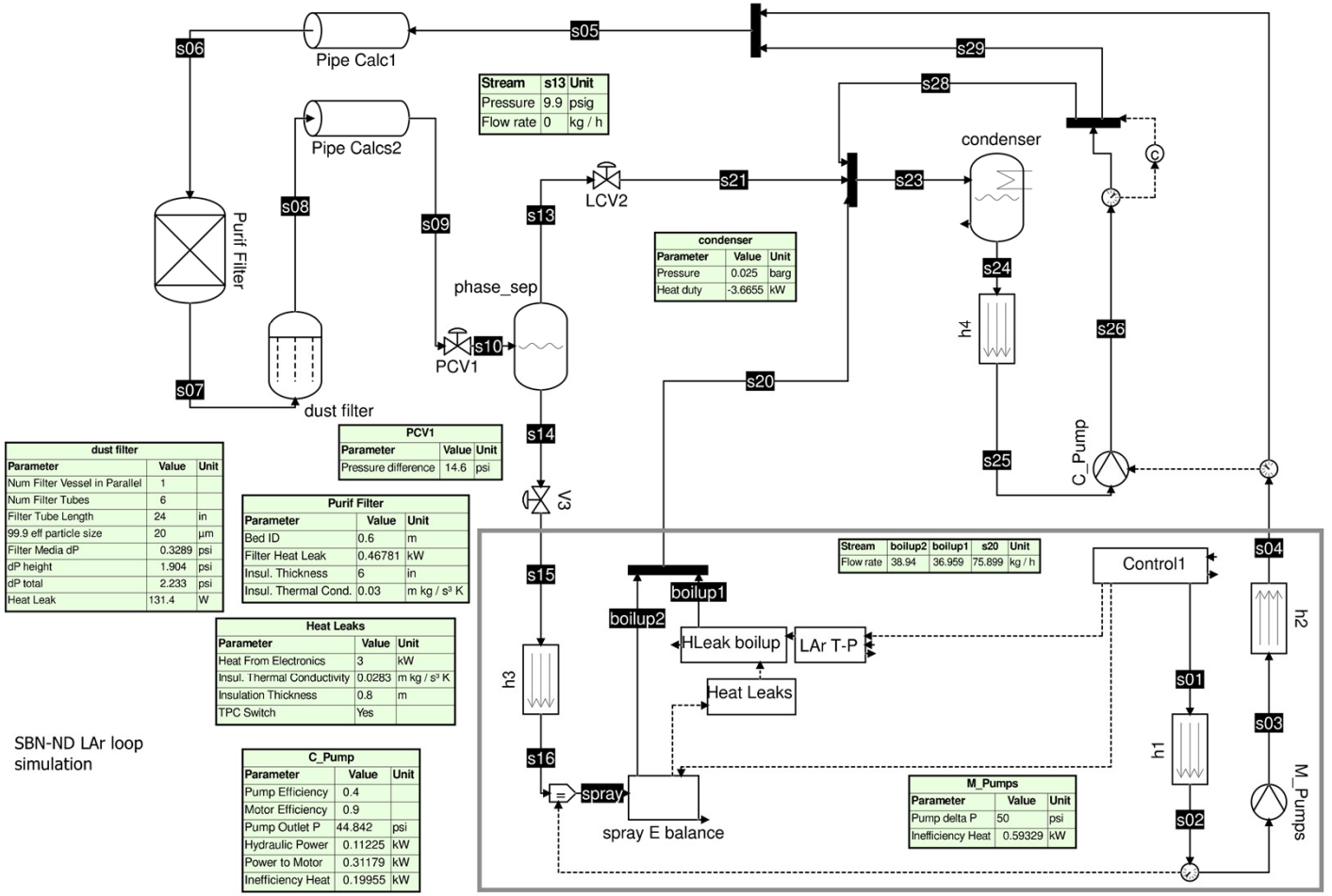
UO	Parameter	Value	Unit
condenser	Heat exchange	12	kW
set N2 sat	Pressure	1.379	barg
heat leak	Heat duty	100	W

Stream	LN2	GN2	GAr	LAr	LAr_	Unit
Pressure	20	21.9	0.3626	0.2928	2.273	psig
Temperature	85.46	86.02	87.53	87.49	87.49	K
Flow rate	230	229.6	268.4	268.3	268.3	kg / h
Mole frac argon	0	0	1	1	1	
Mole frac nitrogen	1	1	0	0	0	
Vapor phase						
Mole phase fraction	0	1	1	0		
Liquid phase						
Mole phase fraction	1	0	0	1	1	

Q & A

Supplemental Slides

LAr Loop Check – Cryostat to Filters and Back



Stream	s13	Unit
Pressure	9.9	psig
Flow rate	0	kg / h

condenser		
Parameter	Value	Unit
Pressure	0.025	barg
Heat duty	-3.6655	kW

PCV1		
Parameter	Value	Unit
Pressure difference	14.6	psi

dust filter		
Parameter	Value	Unit
Num Filter Vessel in Parallel	1	
Num Filter Tubes	6	
Filter Tube Length	24	in
99.9 eff particle size	20	µm
Filter Media dP	0.3289	psi
dP height	1.904	psi
dP total	2.233	psi
Heat Leak	131.4	W

Purif Filter		
Parameter	Value	Unit
Bed ID	0.6	m
Filter Heat Leak	0.46781	kW
Insul. Thickness	6	in
Insul. Thermal Cond.	0.03	m kg / s³ K

Heat Leaks		
Parameter	Value	Unit
Heat From Electronics	3	kW
Insul. Thermal Conductivity	0.0283	m kg / s³ K
Insulation Thickness	0.8	m
TPC Switch	Yes	

C_Pump		
Parameter	Value	Unit
Pump Efficiency	0.4	
Motor Efficiency	0.9	
Pump Outlet P	44.842	psi
Hydraulic Power	0.11225	kW
Power to Motor	0.31179	kW
Inefficiency Heat	0.19955	kW

Stream	boilup2	boilup1	s20	Unit
Flow rate	38.94	36.959	75.899	kg / h

M_Pumps		
Parameter	Value	Unit
Pump delta P	50	psi
Inefficiency Heat	0.59329	kW

Stream	s01	s02	s03	s04	s06	s07	s08	s09	s10	s16	Unit
Pressure	0.3626	9.88	59.88	30.15	26.24	31.2	28.97	24.6	10	37.48	psig
Vapor phase											
Mass phase fraction	0										
Liquid phase											
Mass phase fraction	1	1	1	1	1	1	1	1	1	1	

Stream	s16	spray	s02	Unit
Flow rate	7674.4	7674.4	7598.5	kg / h
Pressure	37.484	9.8798	9.8798	psig
Temperature	88.164	88.239	87.534	K
Liquid phase				
Mole phase fraction	1	1	1	

Control1		
Parameter	Value	Unit
Cryostat Pressure	0.025	barg
Number of Pumps	1	
Single Pump Capacity	24	US gal / min