

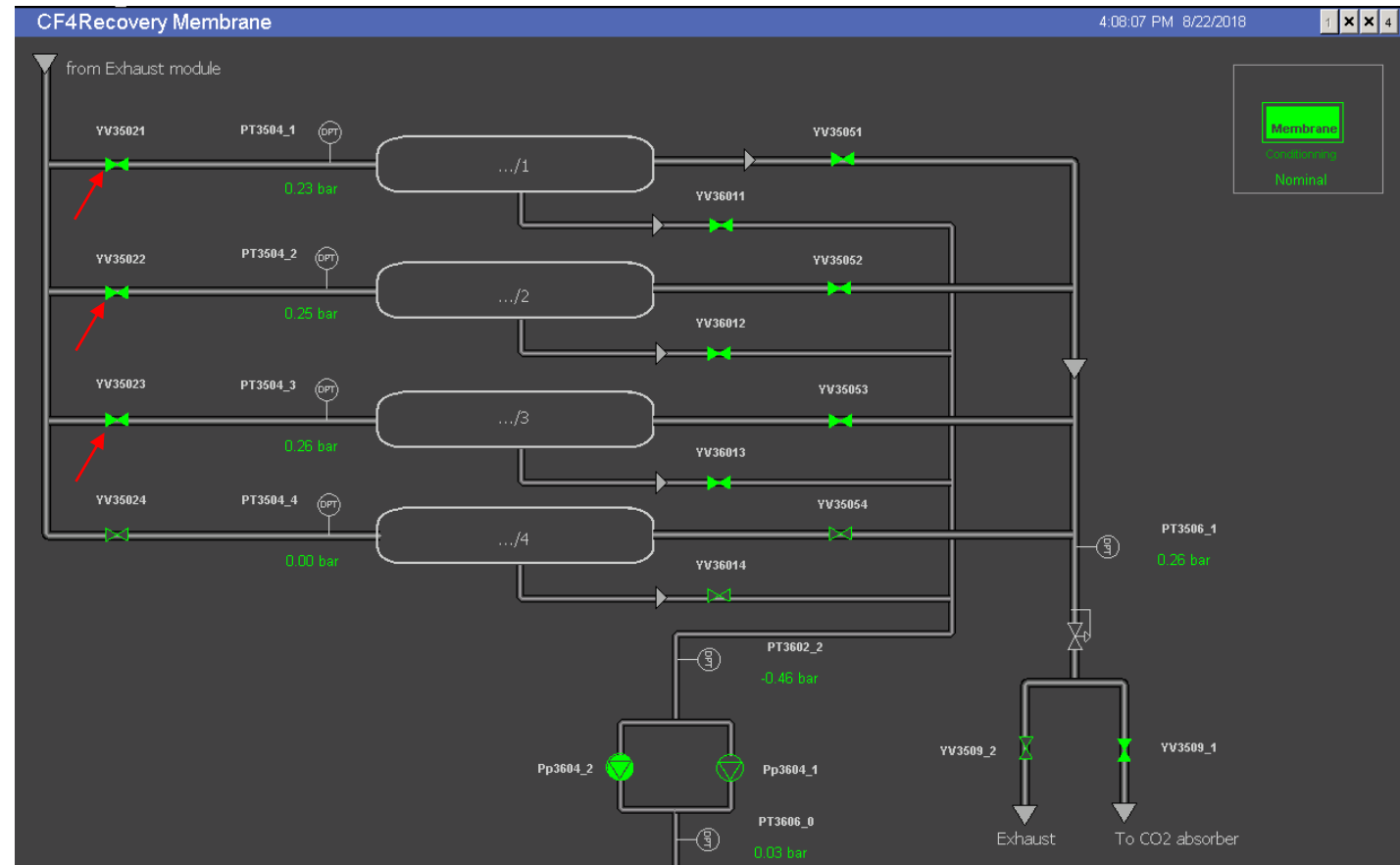
# CF4 ANALYSIS

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IMPROVEMENT AND CHANGING DONE AT CMS SITE

# REVIEW BEFORE CHANGING PARAMETERS

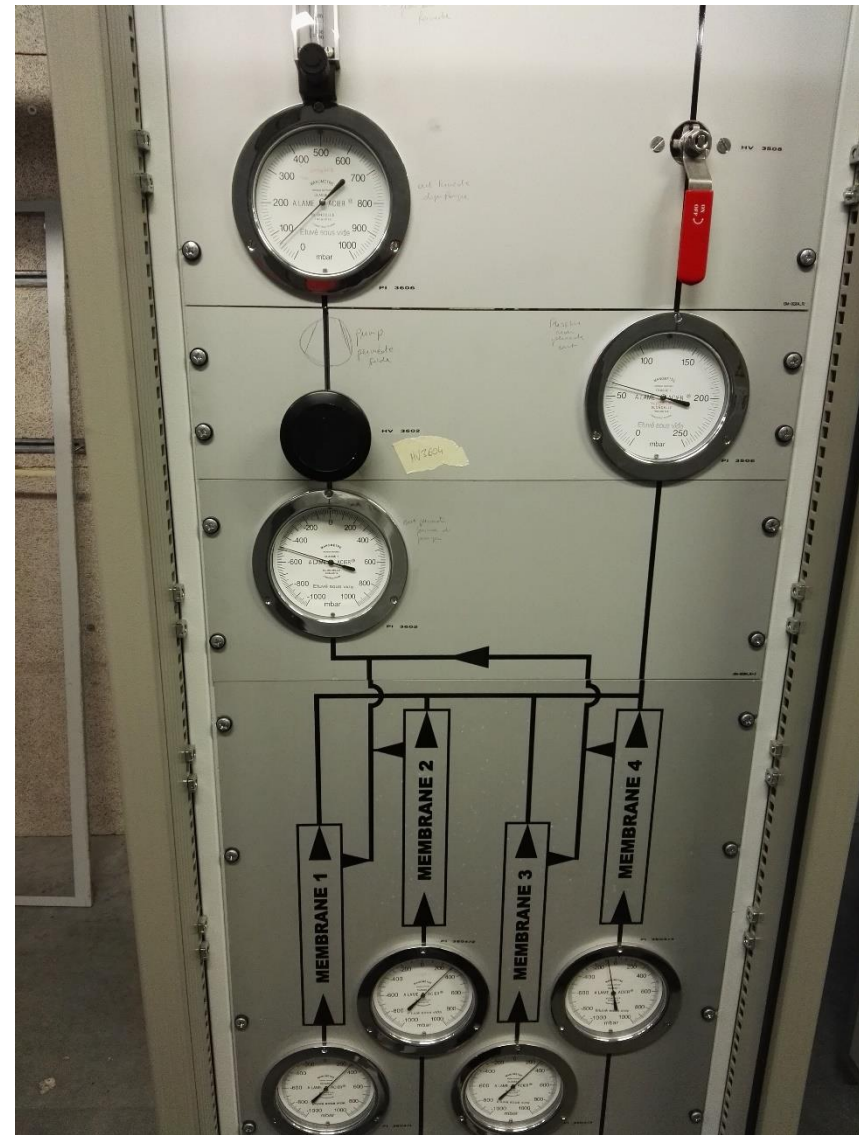
Before changing parameters three membranes were involved and the flow was 600l/h NOT evenly divided between the three membranes because membrane1 had only 150l/h instead of 200l/h.



Three membranes involved

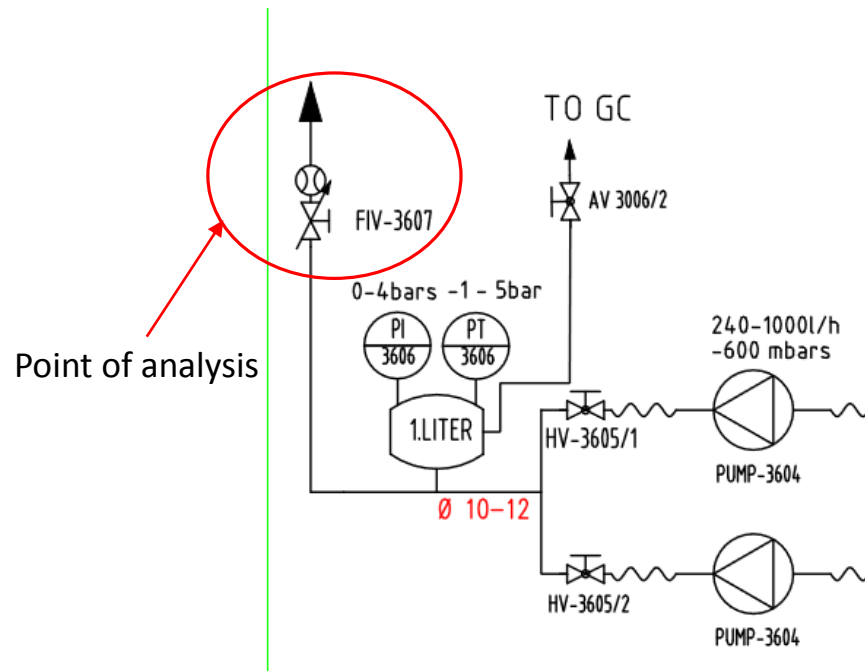


Initial flow exhaust



Situation at rack1

# GC ANALYSIS WITH 3 MEMBRANES



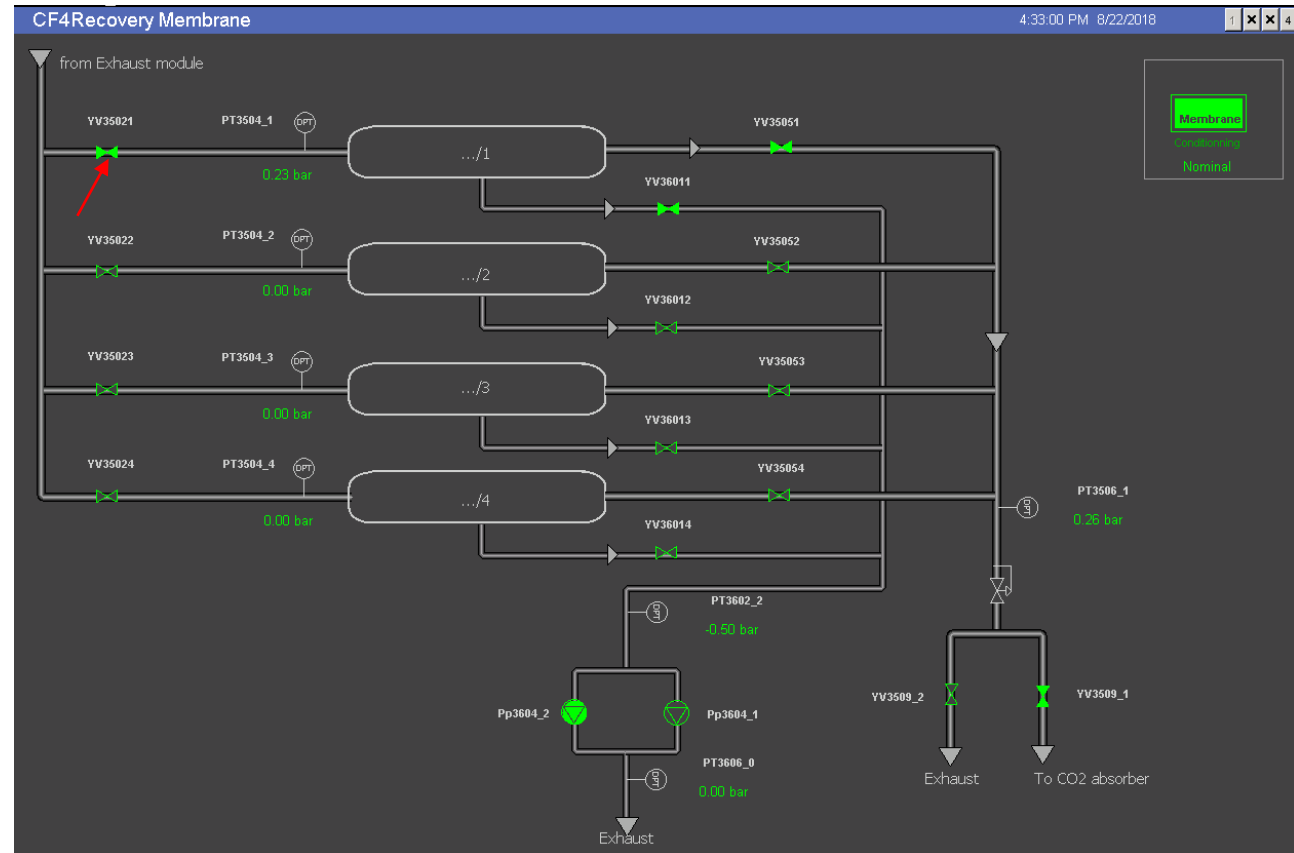
## Membrane 1, 2, 3

<b>GAS</b>	<b>QUANTITY</b>
Ar	42.47%
CF4	1.50%
CO2	54.47%
O2	123 ppm
N2	7616 ppm

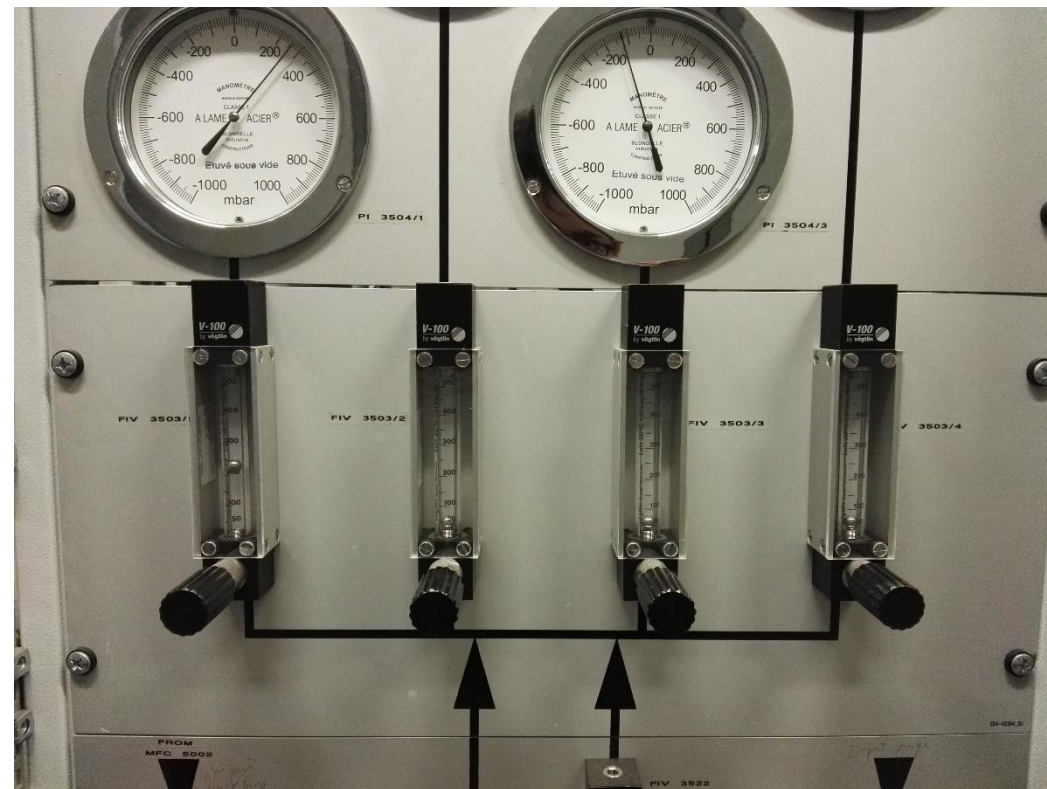
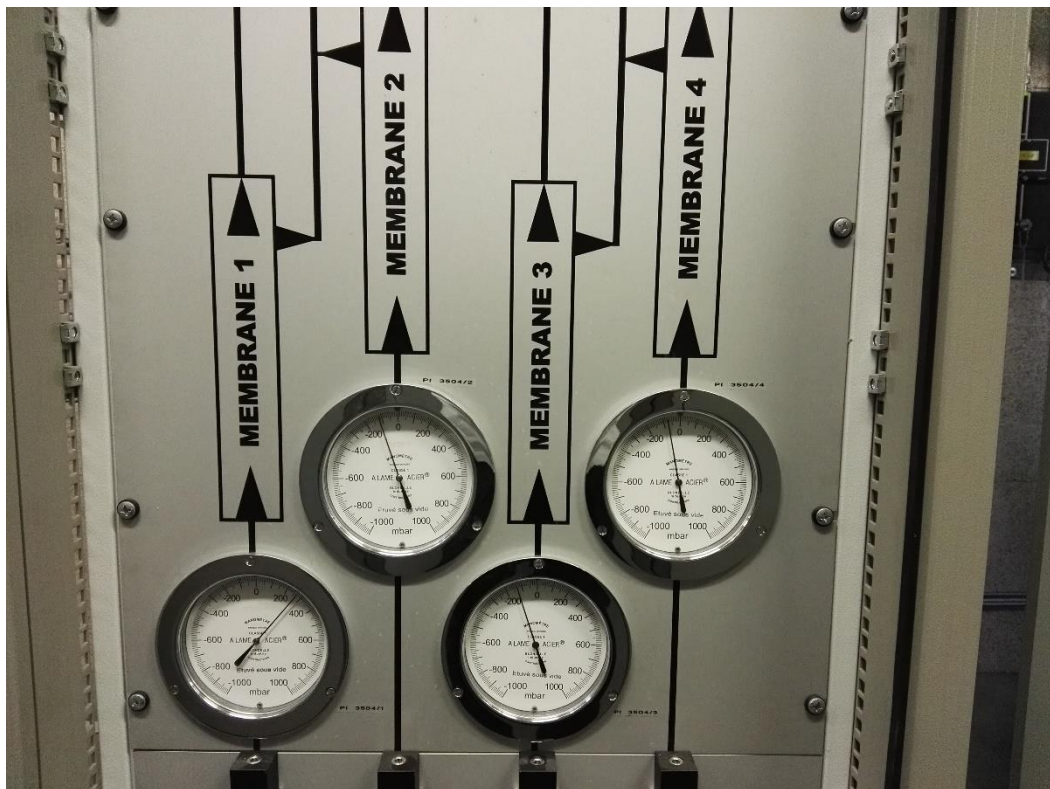
# MEMBRANE 1

First step ---> 22/08/2018

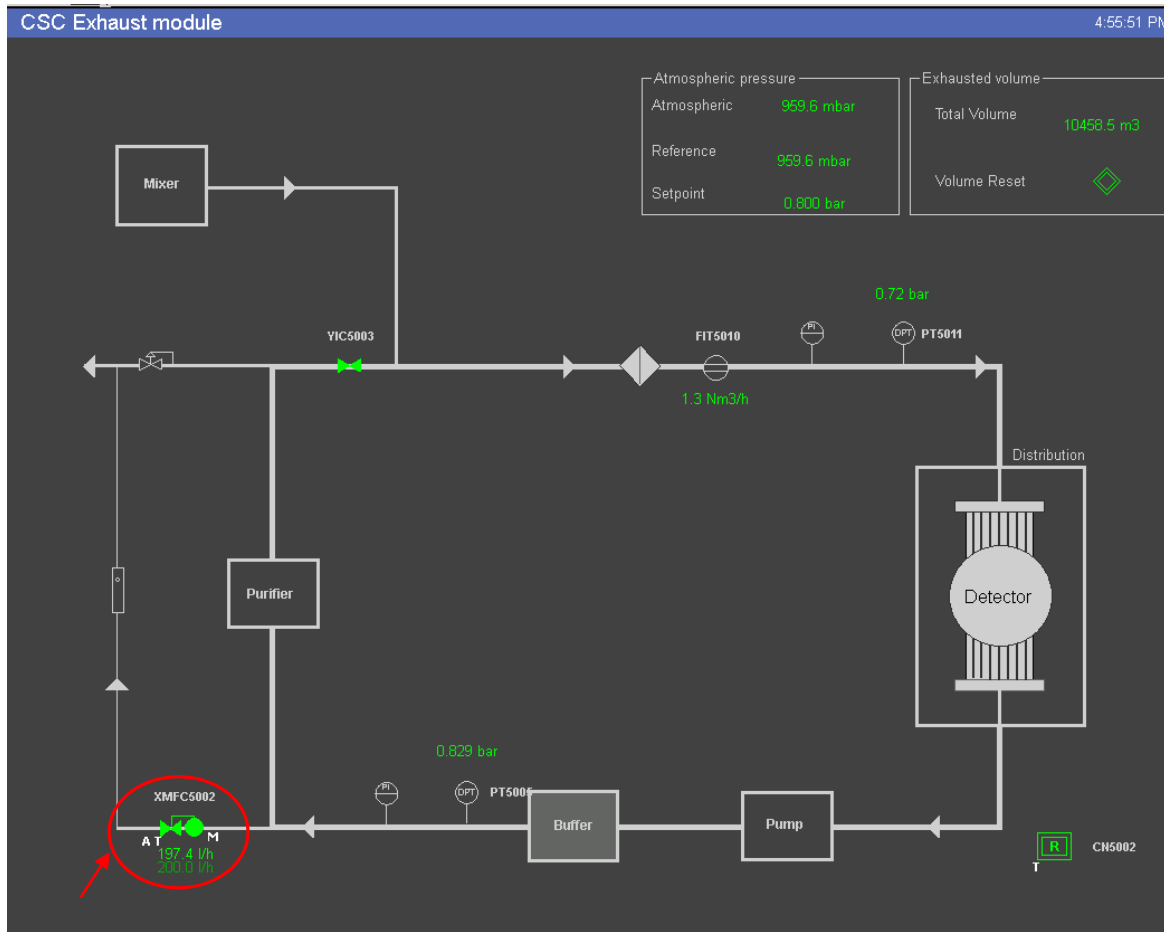
- ✓ Close membrane 2 and 3. Leave only membrane one working. Then reduce flow from 600 l/h to 200 l/h to pass the same flow of when all three membranes were active.



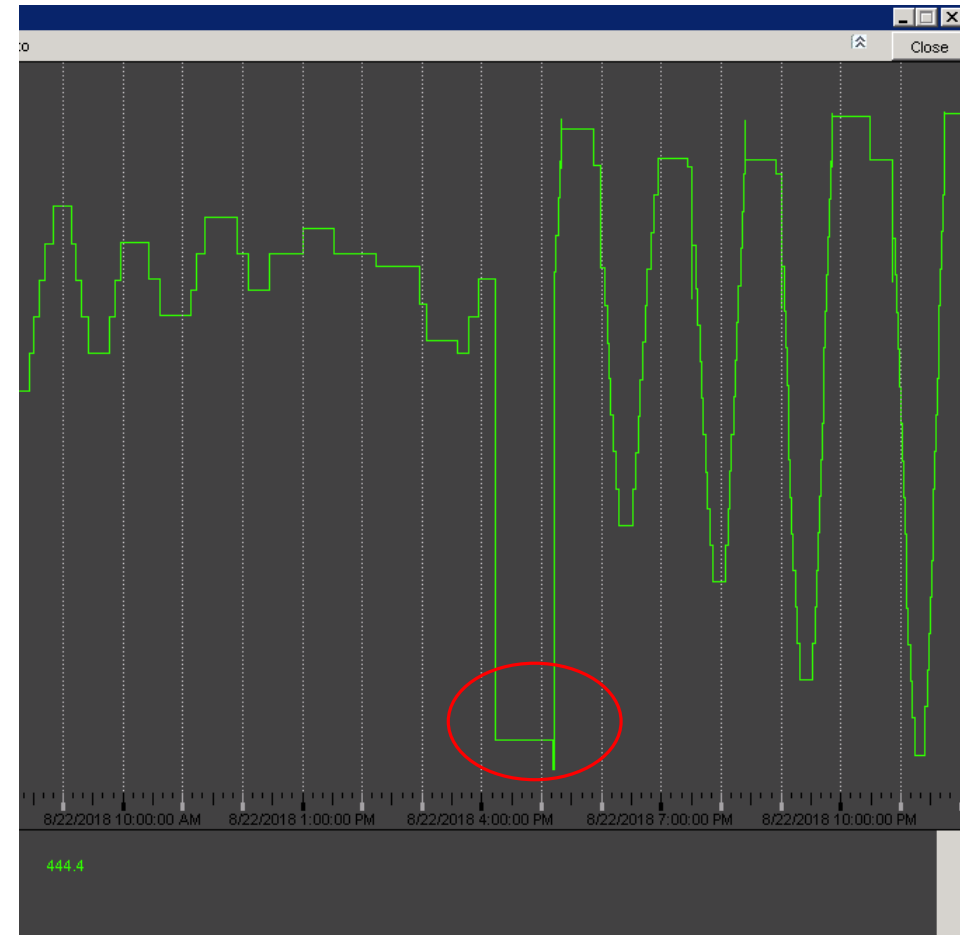
Membrane1 involved



Rack1 after changing. Only membrane 1 with flow



Flow 200l/h at exhaust



Decreasing of flow between 4pm and 5pm

# GC ANALYSIS WITH M1

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- ✓ Check the efficiency of the membrane with gas chromatograph.

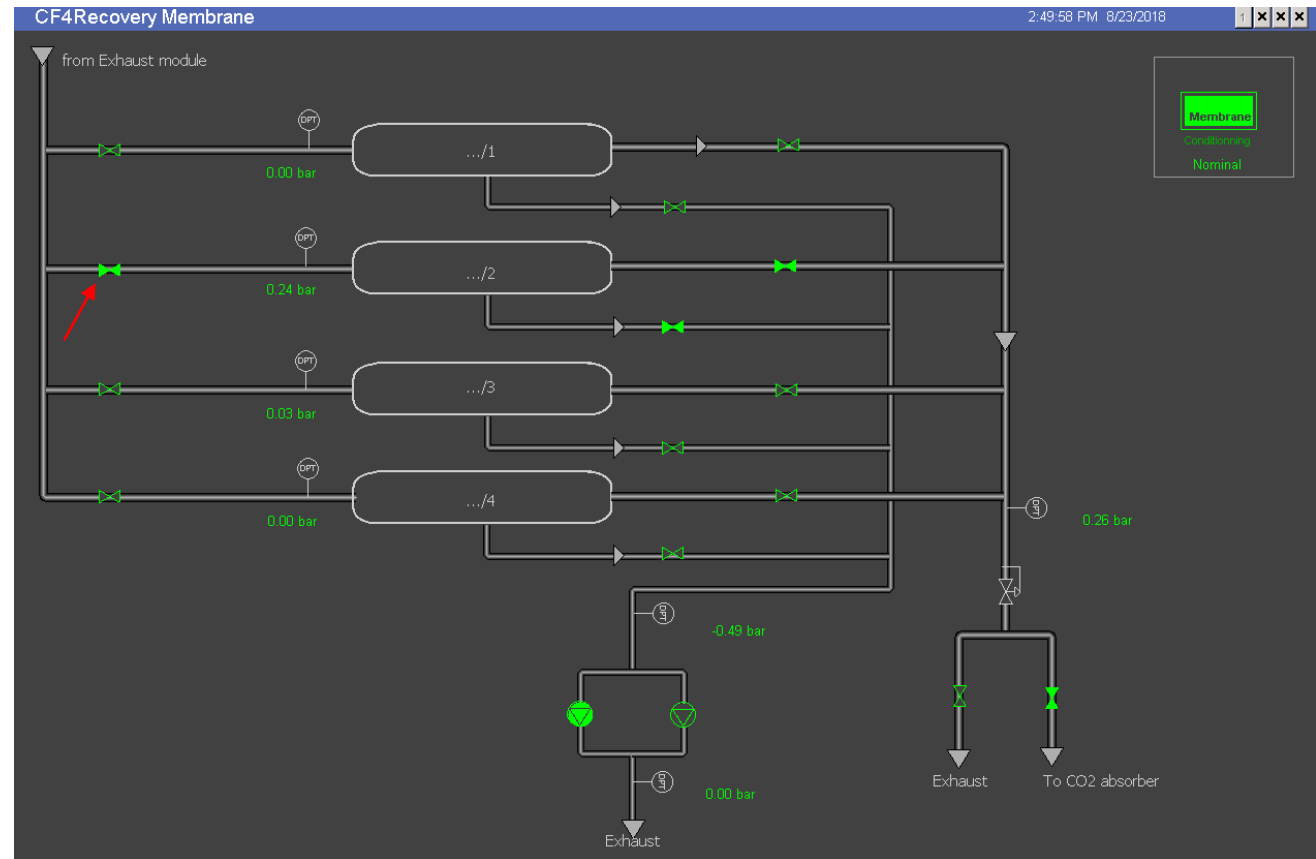
Membrane 1	
<b>GAS</b>	<b>QUANTITY</b>
Ar	42.51%
CF4	2.54%
CO2	52.72%
O2	113 ppm
N2	7680 ppm



# MEMBRANE 2

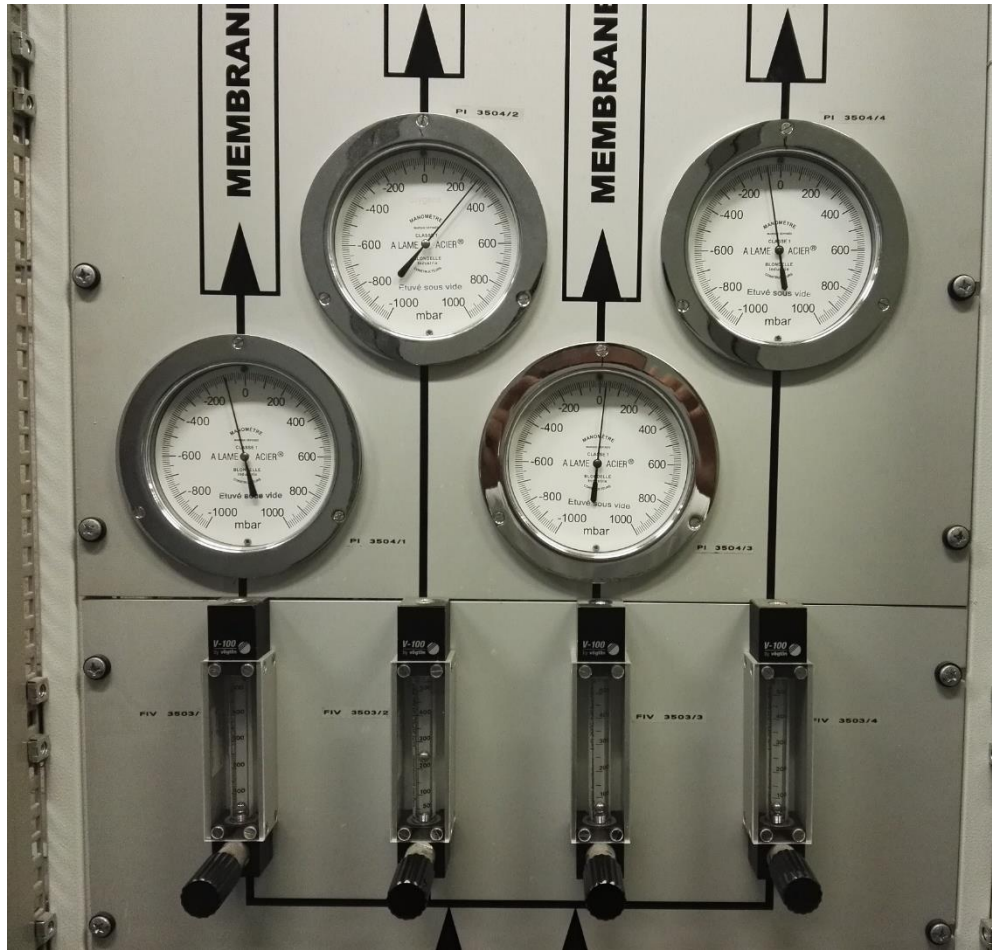
**Second step** ---> 23/08/2018

- ✓ Close membrane 1 and 3. Leave only membrane two working. Then reduce flow from 600 l/h to 200 l/h to pass the same flow of when all three membranes were active. The same process of M1.

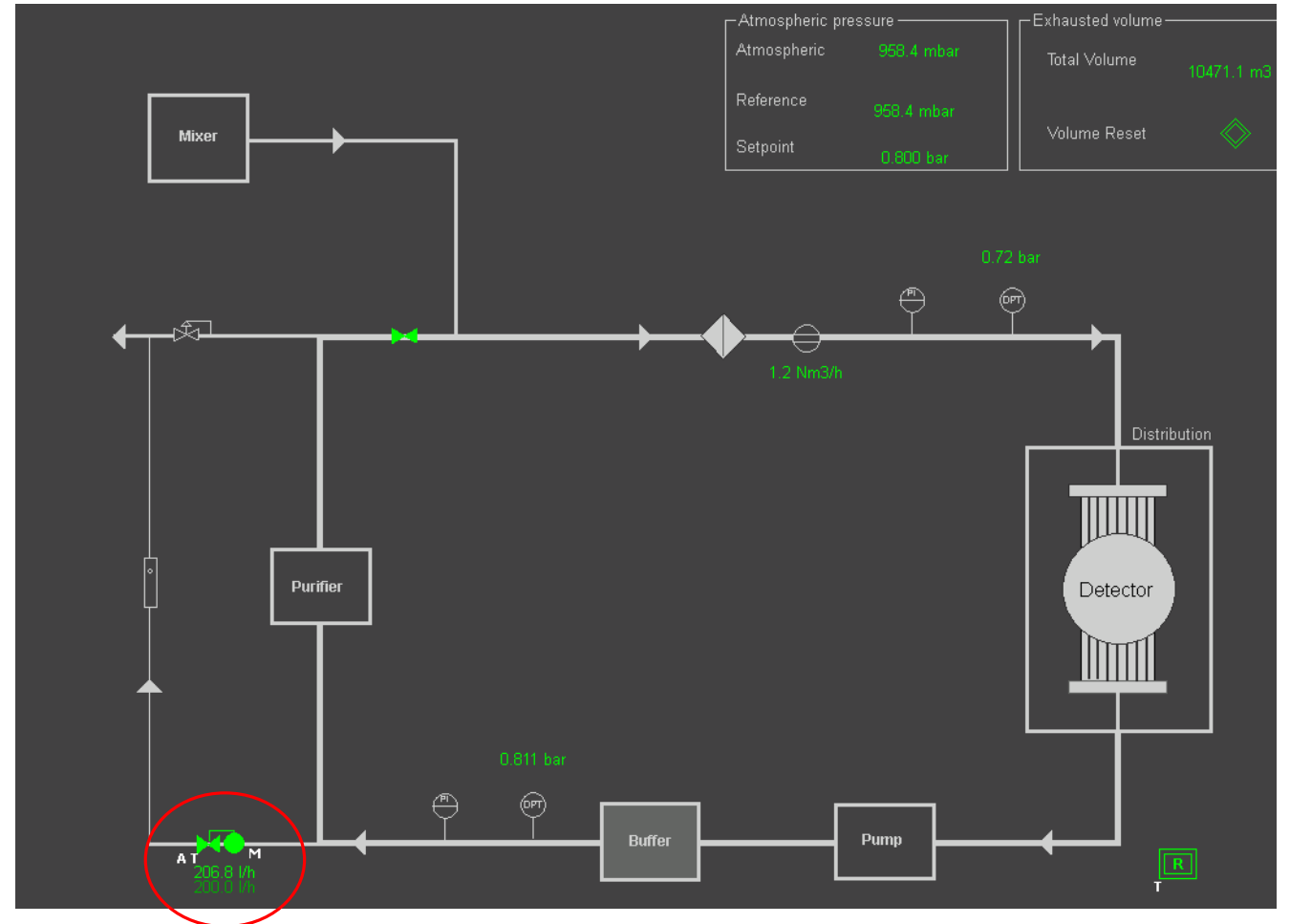


Membrane2 involved

Only membrane2 in function.



Exhaust with M2



# GC ANALYSIS WITH M2

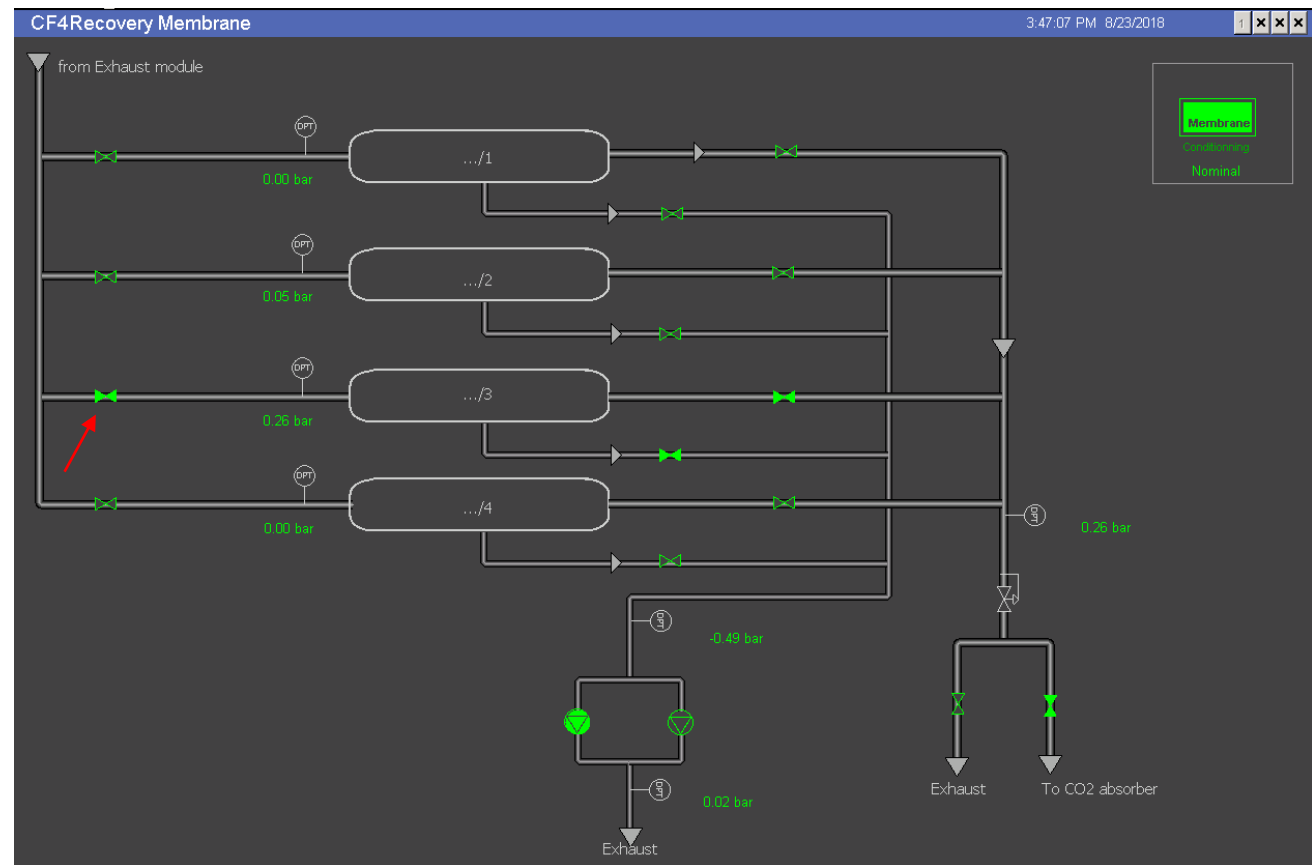
---

Membrane 2	
<b>GAS</b>	<b>QUANTITY</b>
Ar	43.08%
CF4	0.60%
CO2	55.70%
O2	127 ppm
N2	7620 ppm

# MEMBRANE 3

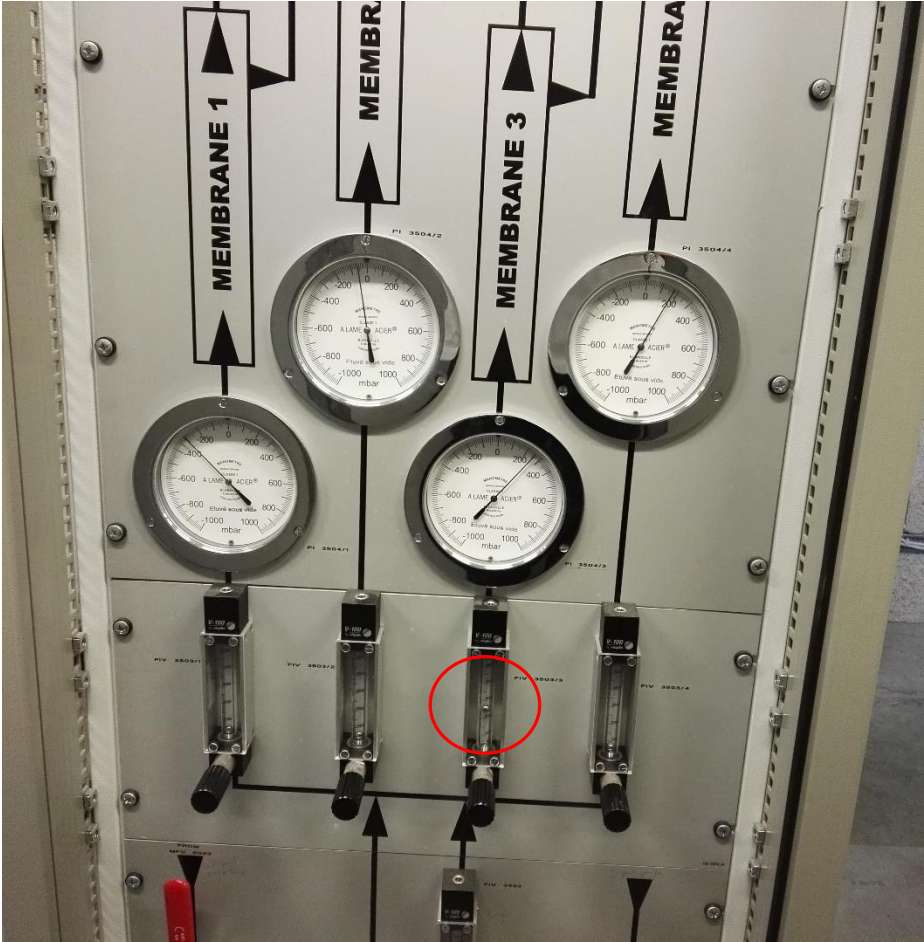
Third step ---> 23/08/2018

- ✓ Close membrane 1 and 3. Leave only membrane three working. Then reduce flow from 600 l/h to 200 l/h to pass the same flow of when all three membranes were active.

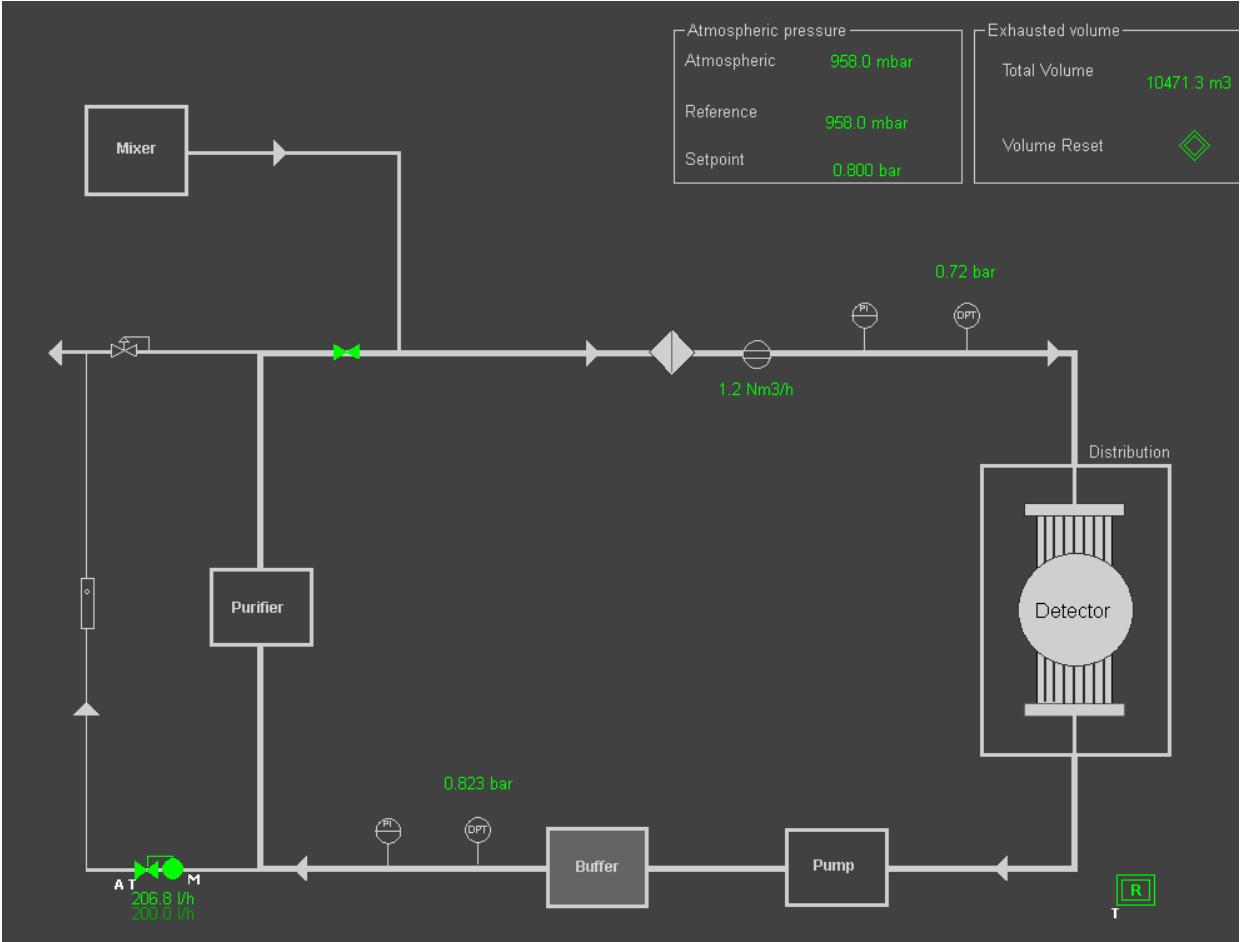


Membrane3 involved

Only membrane3 in function.



Exhaust with M3



# GC ANALYSIS WITH M3

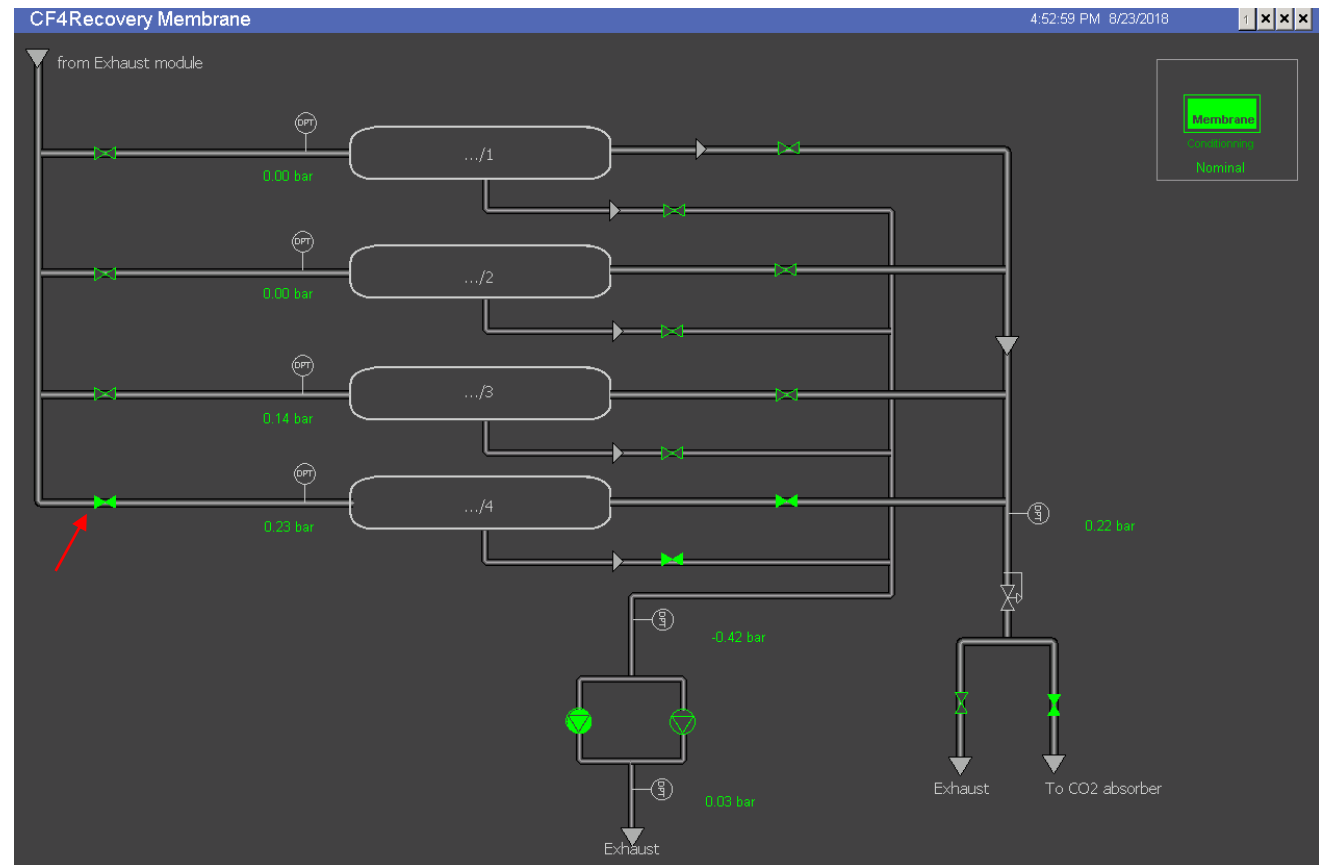
---

Membrane 3	
<b>GAS</b>	<b>QUANTITY</b>
Ar	42.52%
CF4	0.61%
CO2	55.27%
O2	117 ppm
N2	7434 ppm

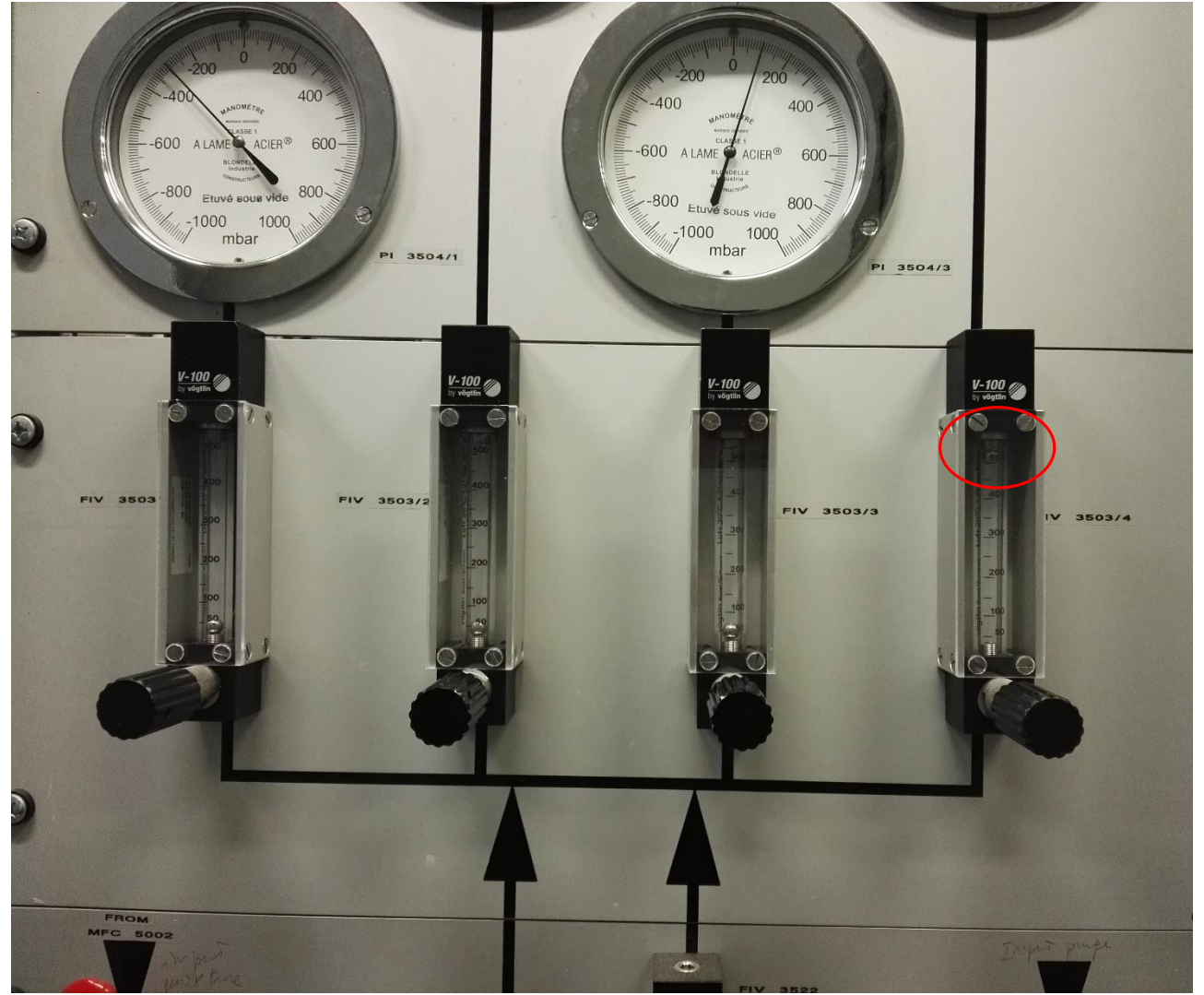
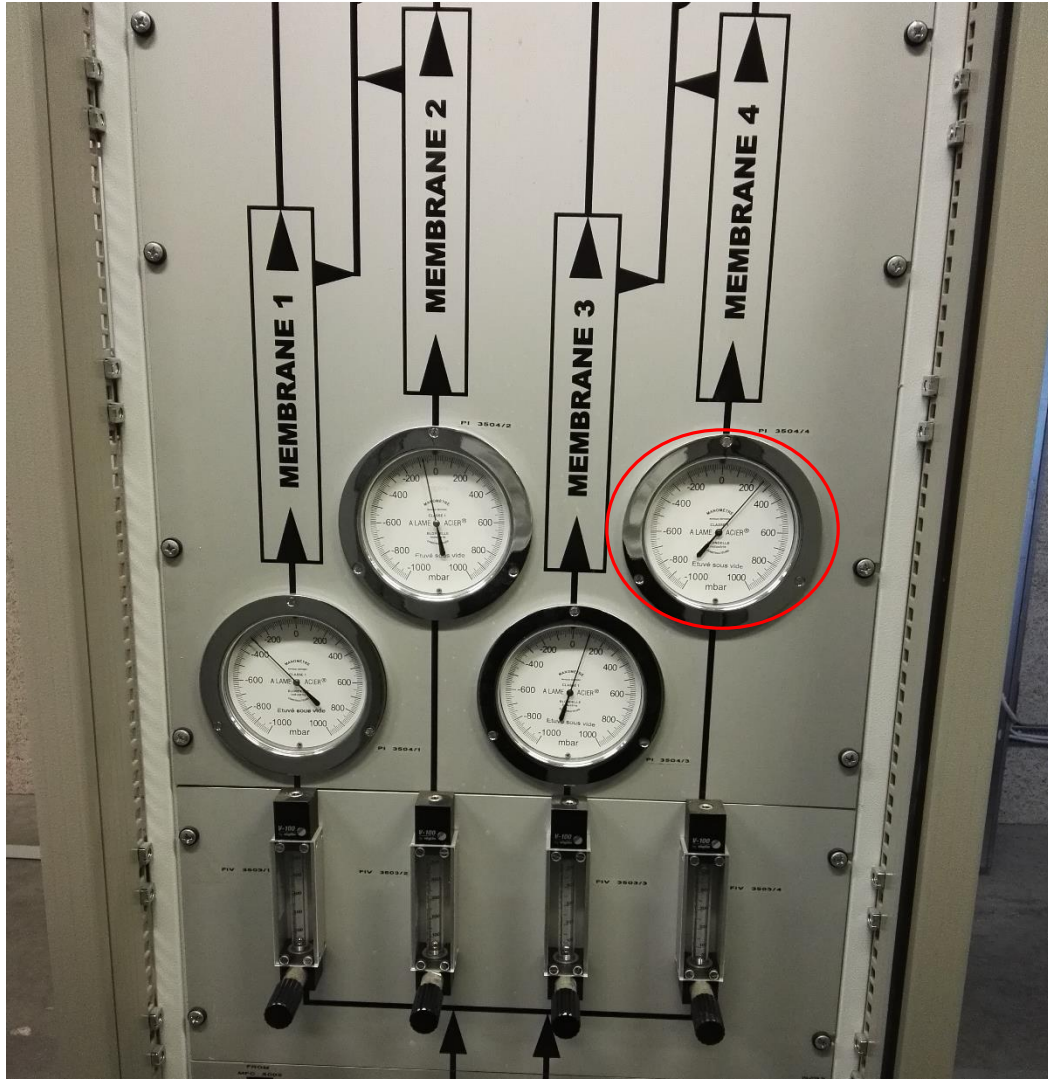
# MEMBRANE 4

Fourth step ---> 23/08/2018

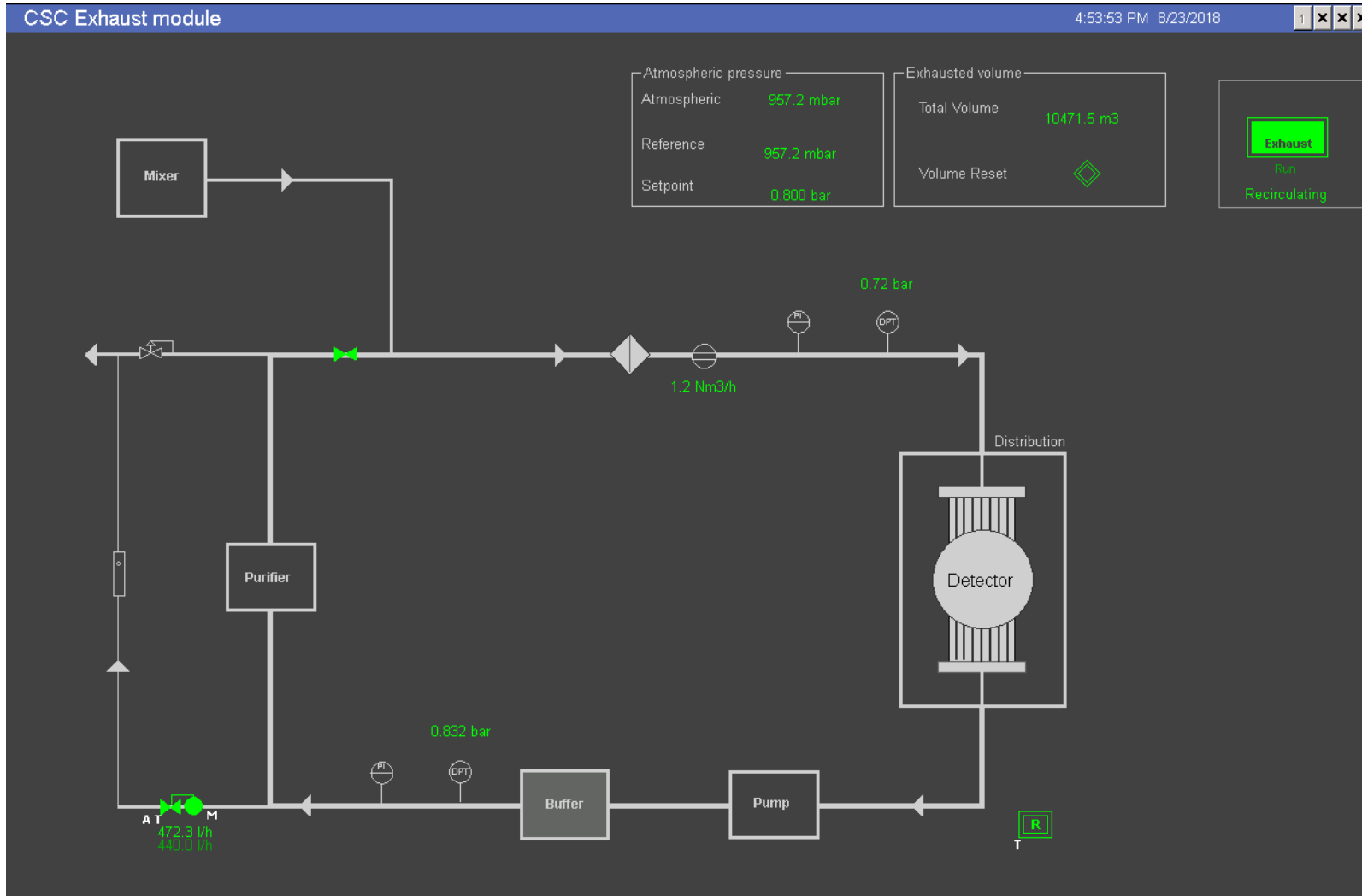
- ✓ Close membrane 1, 2 and 3. Leave only membrane four working. Then reduce flow from 600 l/h to 440 l/h because this membrane is bigger than the others. Flow has to be 2.2 times higher.



Membrane4 involved





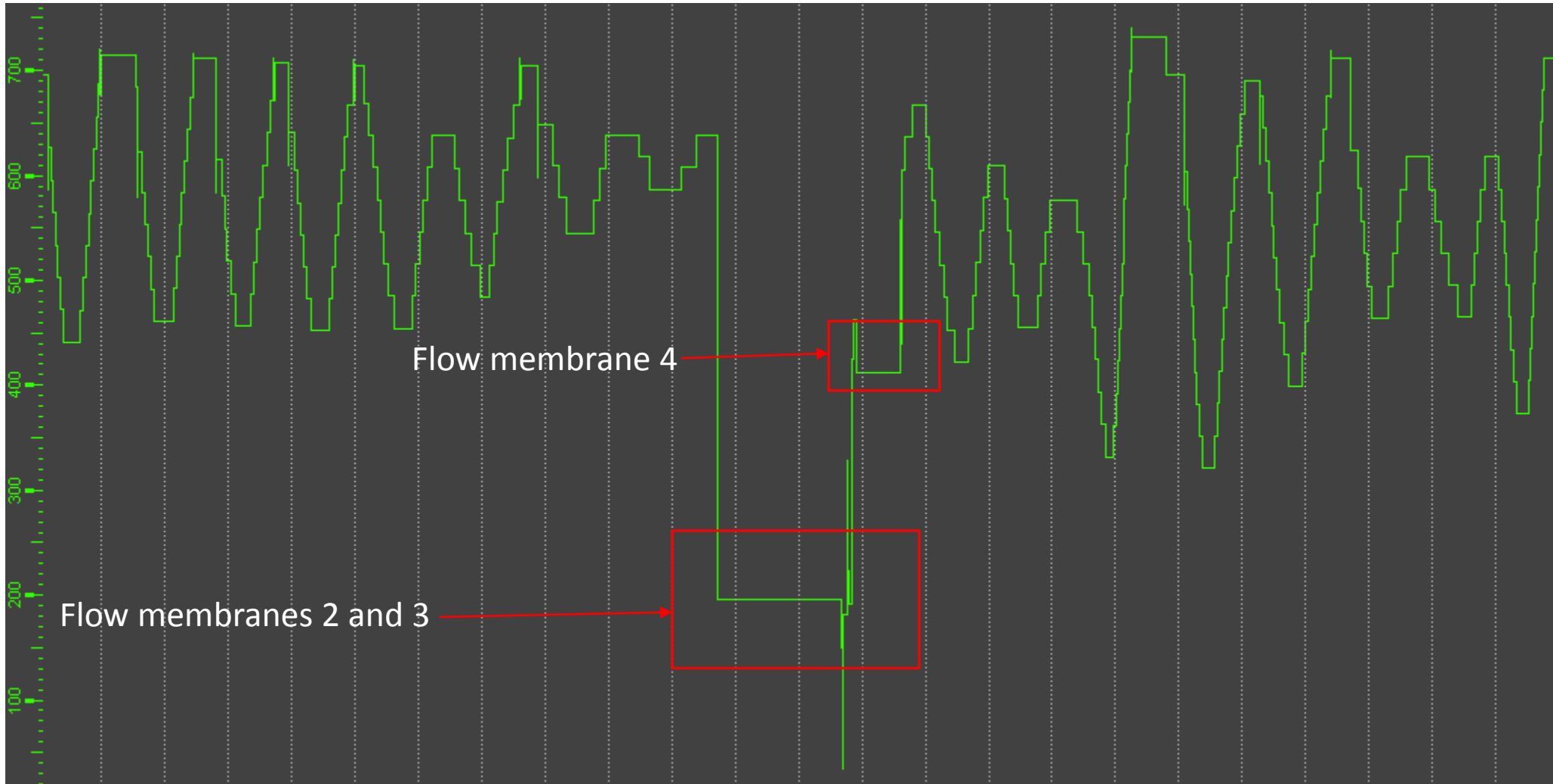


440 l/h of exhaust

# GC ANALYSIS WITH M4

---

Membrane 4	
<b>GAS</b>	<b>QUANTITY</b>
Ar	42.52%
CF4	0.59%
CO2	55.17%
O2	120 ppm
N2	7523 ppm



# MEMBRANE 1,2,3

---

**Fifth step** ---> 24/08/2018

- ✓ Redo other analysis with three membranes involved but with the flow evenly divided into M1, M2 and M3 (200, 200, 200). This because the first analysis were done with different flow between the three membranes (150, 300, 300). With an equal flow in M1, M2 and M3 we expected an higher concentration of CF<sub>4</sub> because we increase flow in M1 which is the less efficient membrane but CF<sub>4</sub> percentage decrease. This probably because we didn't check correctly the flow during first analysis.

# GC ANALYSIS WITH M1, M2 AND M3

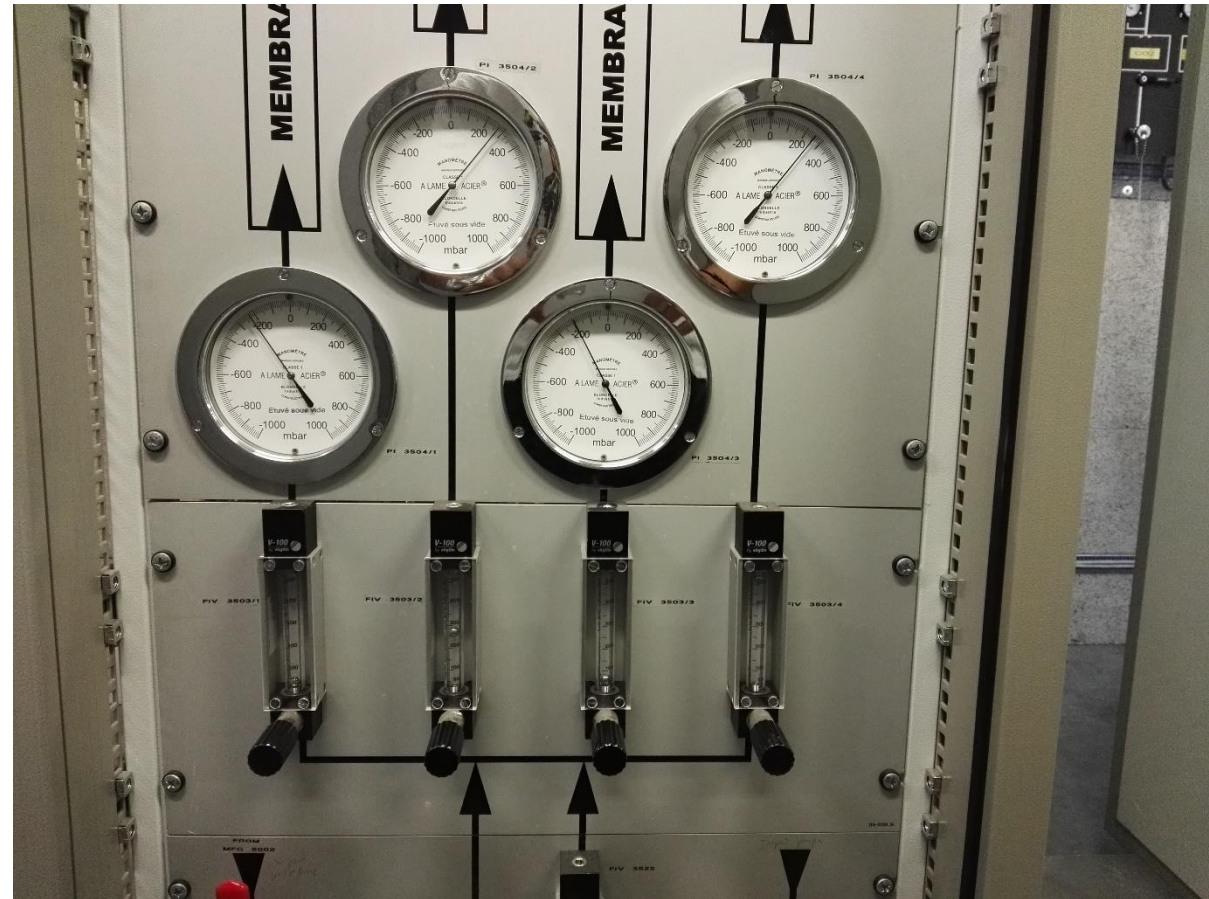
---

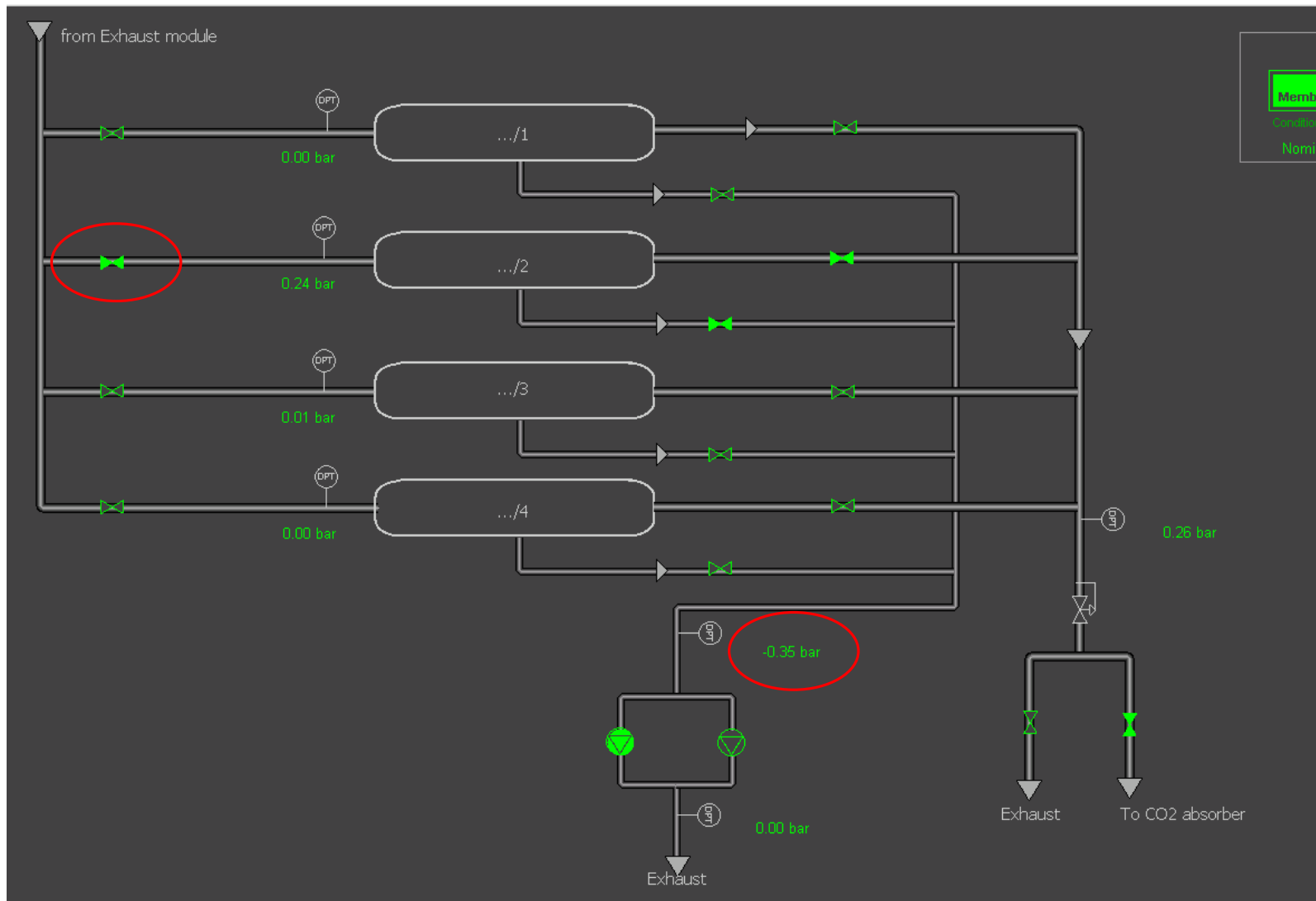
Membrane 1, 2, 3	
<b>GAS</b>	<b>QUANTITY</b>
Ar	43.46%
CF4	1.31%
CO2	56.47%
O2	130 ppm
N2	8087 ppm

# M2 (-350mbar)

Sixth step ---> 24/08/2018

- ✓ After done analysis with different membrane settings we changed permeate pressure from -480mbar to -350mbar and do GC analysis to understand if percentage of CF<sub>4</sub> decrease. Less CF<sub>4</sub> percentage means more efficiency.





M2 on. Permeate pressure at -350mbar

# GC ANALYSIS WITH M2 (-350mbar)

---

Membrane 2	
<b>GAS</b>	<b>QUANTITY</b>
Ar	40.61%
CF4	0.56%
CO2	58.19%
O2	123 ppm
N2	7178 ppm



# M2 (-200mbar)

---

**Seventh step** ---> 24/08/2018

- ✓ After done analysis with different membrane settings we changed permeate pressure from -350mbar to -200mbar and do GC analysis to understand if percentage of CF4 decrease. This solution seems the best as we can see from the next slide but N2 ppm decrease a lot so there are many consideration to do.

# GC ANALYSIS WITH M2 (-200mbar)

---

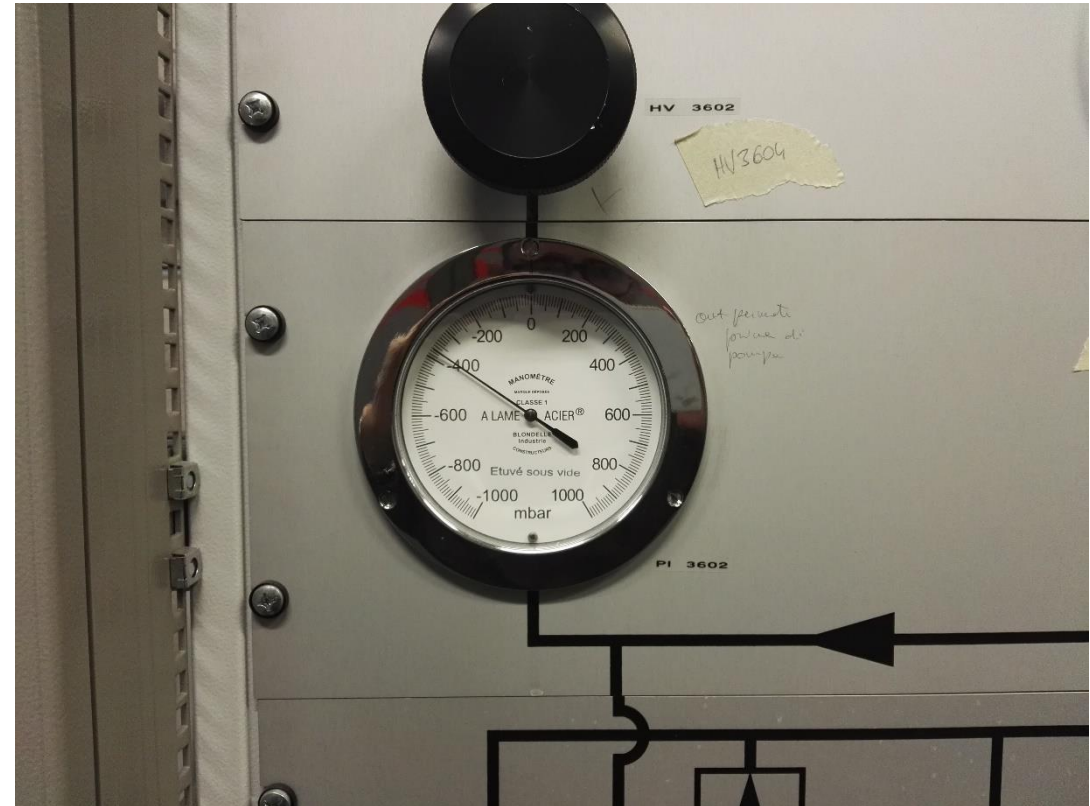
Membrane 2	
<b>GAS</b>	<b>QUANTITY</b>
Ar	38.91%
CF4	0.51%
CO2	60.37%
O2	120 ppm
N2	6685 ppm

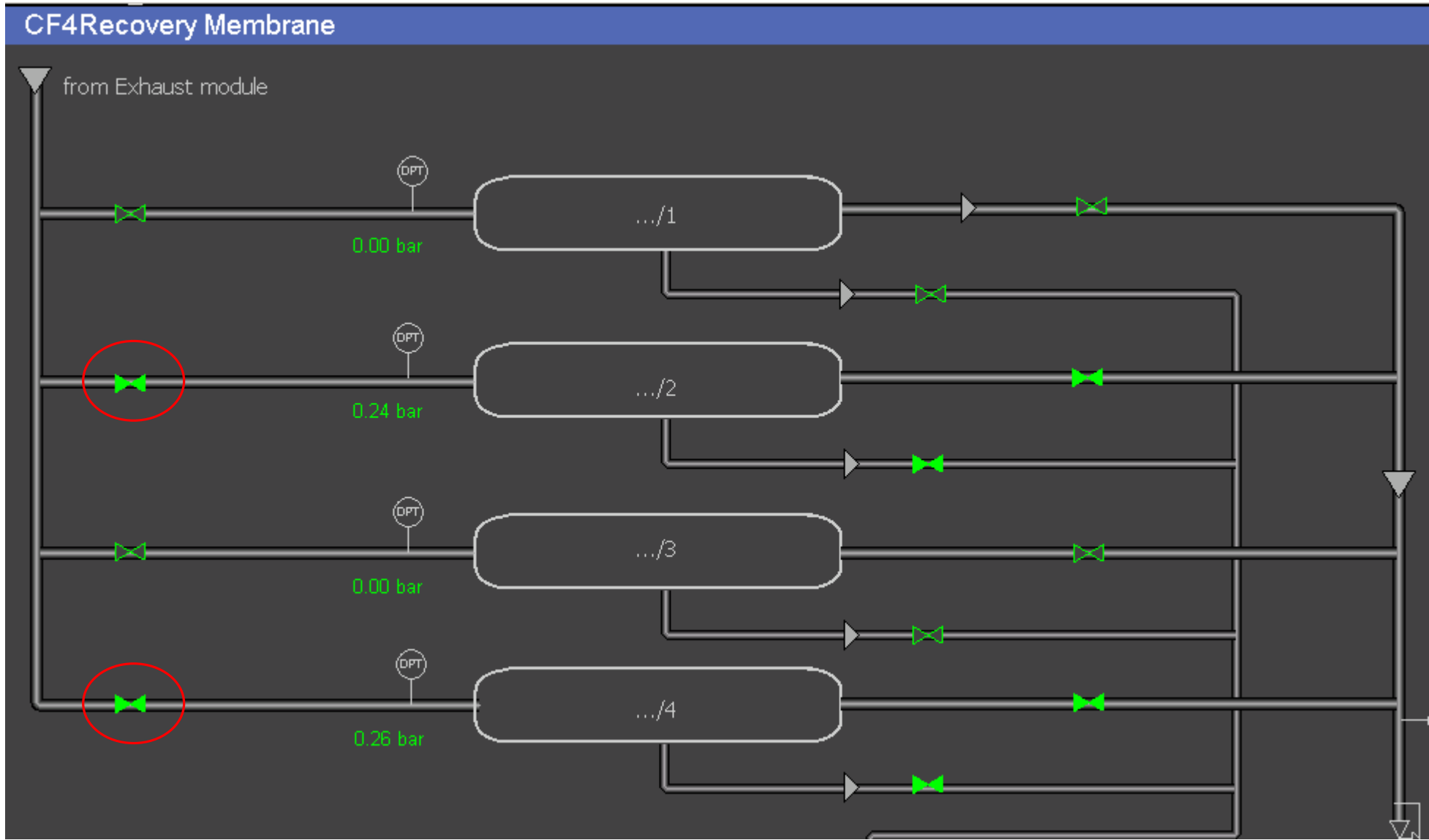
# MEMBRANE M2 AND M4

---

**Eight step** ---> 27/08/2018

- ✓ After done analysis with different pressure we return at -360mbar and do GC with M2 and M4 involved (not M1 because we calculated it is the membrane with the lower efficiency).





M2 and M4 on

# GC ANALYSIS WITH M2 AND M4

---

Membrane 2 and 4	
<b>GAS</b>	<b>QUANTITY</b>
Ar	43.00%
CF4	0.60%
CO2	56.72%
O2	145 ppm
N2	7401 ppm

# FLOW WITH DIFFERENT MEMBRANE SET UP

<b>M1</b>	<b>M2</b>	<b>M3</b>	<b>M4</b>	<b>Permeate Pressure</b>	<b>Flow</b>
Rotameters Value				(mbar)	(l/min)
150	300	300	0	-480	9.60
250	250	250	0	-480	10.06
250	0	0	0	-480	3.15
0	250	0	0	-480	3.28
0	0	250	0	-480	3.15
0	0	0	>500	-480	6.96
0	250	0	0	-350	2.96
0	250	0	0	-200	2.75
0	250	0	>500	-360	9.30

# CF4 ABSORBER

---

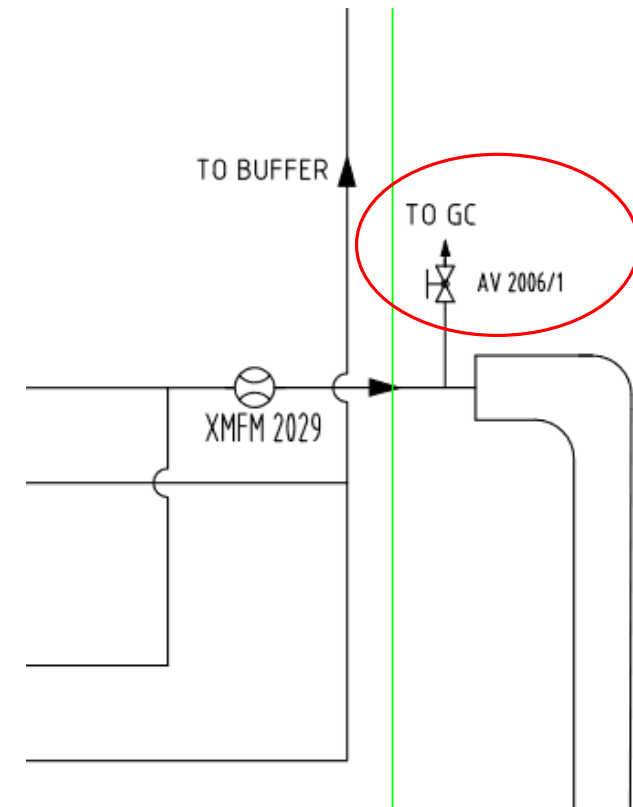
**Ninth step** ---> 27/08/2018

- ✓ Analysis done at CF4 absorber. Valve AV 2006-1. Membrane 2 on with a flow of 200 l/h and membrane 4 with 440 l/h.



# GC ANALYSIS IN CF4 ABSORBER

CF4 Absorber	
GAS	QUANTITY
Ar	24.42%
CF4	73.81%
CO2	0.02%
O2	28 ppm
N2	10098 ppm





# GC ANALYSIS IN CF4 ABSORBER 2

---

CF4 Absorber	
<b>GAS</b>	<b>QUANTITY</b>
Ar	23.22%
CF4	78.09%
CO2	0.04%
O2	61 ppm
N2	31688 ppm

Three times higher than the measure before. Too much N2.

# GC ANALYSIS IN CF4 ABSORBER 3

---

**Tenth step** ---> 04/09/2018

- ✓ Analysis at CF4 absorber were remade to check why during the previous test N2 concentration was 30 000 ppm.

The results:

CF4 Absorber	
<b>GAS</b>	<b>QUANTITY</b>
Ar	68.70%
CF4	30.08%
CO2	0.0064%
O2	64 ppm
N2	10267 ppm

# BATTERY

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**Eleventh step** ---> 04/09/2018

- ✓ Analysis at the battery. Battery B connected directly to the GC. Battery analysis can be done once battery per time because there is only one channel.

In the next slides is reported the procedure to follow for battery analysis.





- 1) 1- HV 4813 is located in the mixer rack



2) HV 4810 is located after HV 4813



3) HV 4811 for the GC



4) HV 4812 for the GC



- 5) Valve for the battery. When this valve is open is necessary to reduce pressure under 1 bar to not damage GC



# GC ANALYSIS IN THE BATTERY

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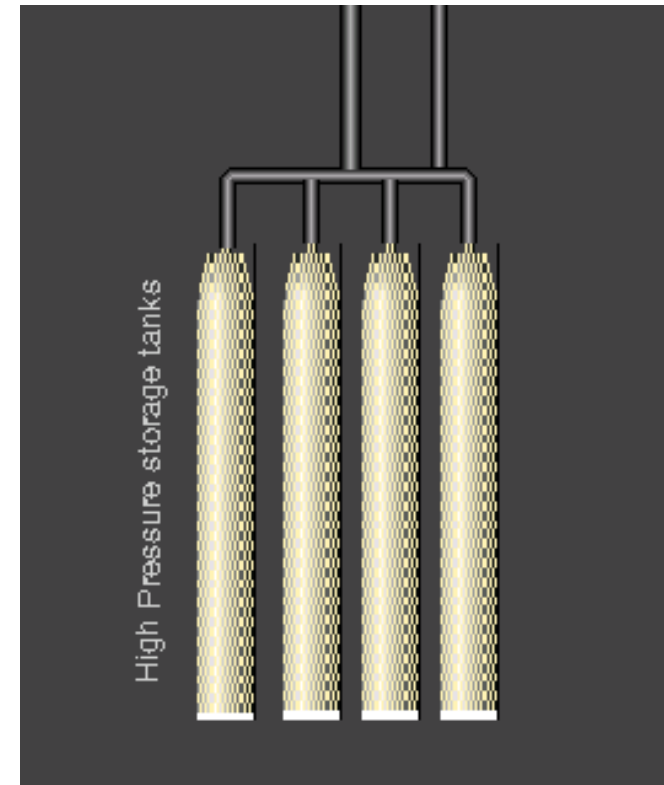
CF4 Battery1	
<b>GAS</b>	<b>QUANTITY</b>
Ar	29.50%
CF4	76.10%
CO2	0.0026%
O2	97 ppm
N2	12629 ppm

# CF4 INJECTION

---

**Twelfth step** ---> 12/09/2018

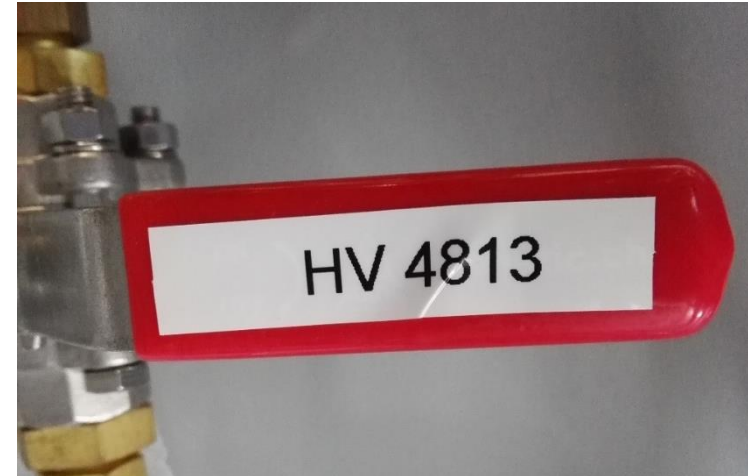
- ✓ Start injection from battery B. The pressure of the battery is 99.49 barg.
- ✓ Expected recuperation time ~2 months.



# INJECTION PROCEDURE

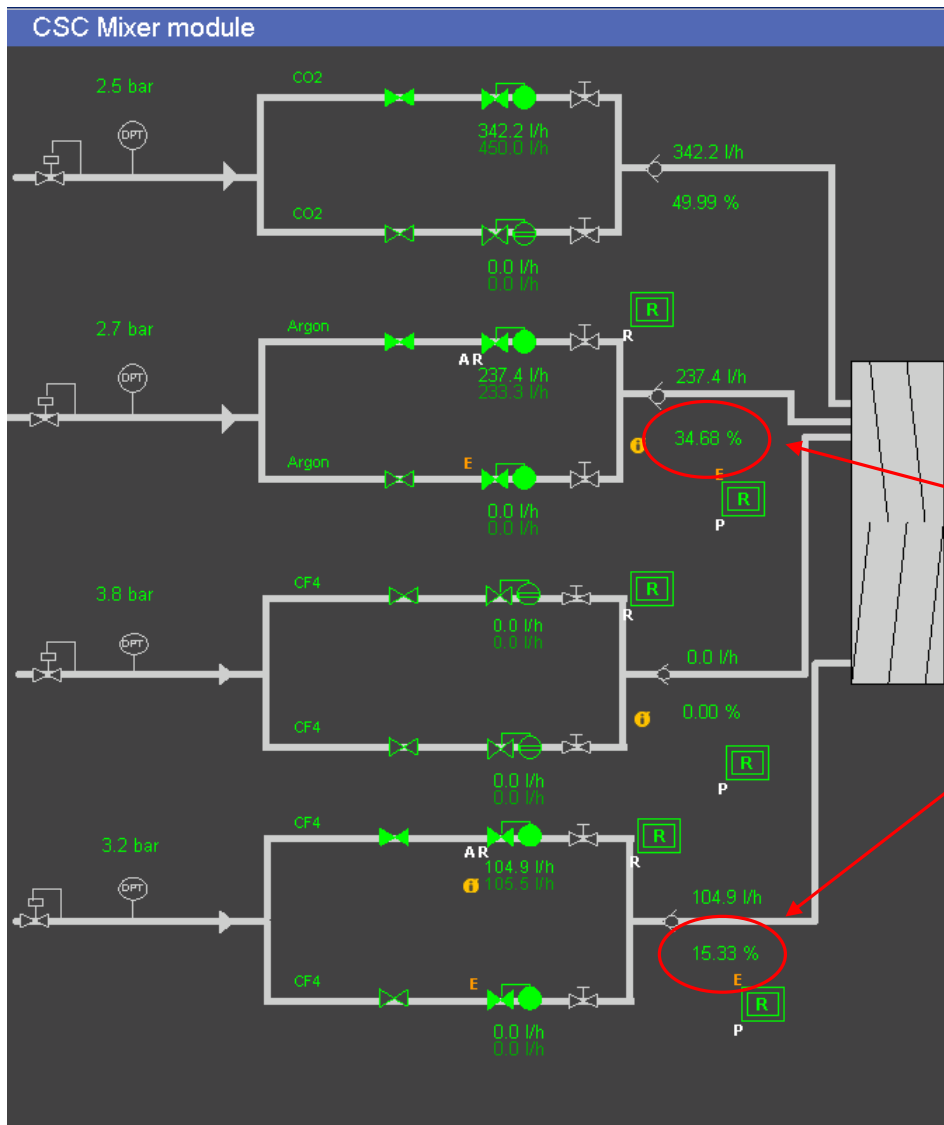
---

First: open valve HV4813



Second: Increase pressure in the mixer (CF4 part) up to 3 bar





Percentage of Argon and CF4 to start injection

PCO: CMSCSC\_Mx\_MxPCO      Recipe Class: CMSCSC\_Mx\_Parameter      Initial: TRUE

Application: CMSCSC      Recipe: CMSCSC\_Mx\_Parameter\_Default

PCO: CMSCSC\_Mx\_MxPCO

Recipe class: CMSCSC\_Mx\_Parameter

**Recipes**

CMSCSC\_Mx\_Parameter\_Def

Class:	CMSCSC_Mx_Parameter		
Last Activated:	CMSCSC_Mx_Parameter/CMSCSC_Mx_Parameter_Default		
Status:	[Active]		
Class Desc.:	Parameter Description		
Rcp. Desc.:	Parameter Description		
Creator:	gthomas	Creation time:	2017.01.24 14:28:12.0
Last modifier:	dauriaa	Last modification tim	2018.09.12 11:50:35.9
Last activator:	dauriaa	Last activation time:	2018.09.12 11:50:44.6
Last saved in DB	gthomas	Last saved in DB tim	2018.02.13 15:02:32.0

Index	Alias	Description	Value	Unit
3	CMSCSC_Mx_L4DirFlowSp	(Direct) Line 4 flow setpoint :	0.0	l/h
4	CMSCSC_Mx_L2FillRatioSp	(Fill) Line 2 (slave) ratio regula	40.000	%
5	CMSCSC_Mx_L3FillRatioSp	(Fill) Line 3 (slave) ratio regula	10.000	%
6	CMSCSC_Mx_L4FillRatioSp	(Fill) Line 4 (slave) ratio regula	0.0	%
7	CMSCSC_Mx_L2PurgeFlowSp	(Purge) Line 2 flow setpoint :	0.000	l/h
8	CMSCSC_Mx_L3PurgeFlowSp	(Purge) Line 3 flow setpoint :	0.000	l/h
9	CMSCSC_Mx_L4PurgeFlowSp	(Purge) Line 4 flow setpoint :	0.0	l/h
10	CMSCSC_Mx_L2RunRatioSp	(Run) Line 2 (slave) ratio regula	34.620	%
11	CMSCSC_Mx_L3RunRatioSp	(Run) Line 3 (slave) ratio regula	0.000	%
12	CMSCSC_Mx_L4RunRatioSp	(Run) Line 4 (slave) ratio regula	15.38	%
13	CMSCSC_Mx_L1DirFlowSp	(Direct) Line 1 flow setpoint :	50.000	l/h
14	CMSCSC_Mx_L1FillFlowSp	(Fill) Line 1 (master) flow setp	1500.000	l/h
15	CMSCSC_Mx_L1PurgeFlowSp	(Purge) Line 1 flow setpoint :	200.000	l/h
16	CMSCSC_Mx_L1RunFlowSp	(Run) Line 1 (master) flow set	450.000	l/h
17	CMSCSC_Mx_SmallFlow	Small flows threshold (values	1.000	%

Activation Timeout: \_\_\_\_\_

Selection Time: \_\_\_\_\_

```

[2018.09.12 11:50:36] Sending recipe data to the PLC LHCPCS_CMS: _unPlc_CFP_3570_GCSCMSCSC
[2018.09.12 11:50:39] All recipe data sent to the PLC LHCPCS_CMS: _unPlc_CFP_3570_GCSCMSCSC
[2018.09.12 11:50:43] Recipe activation completed in PLC: LHCPCS_CMS: _unPlc_CFP_3570_GCSCMSCSC
[2018.09.12 11:50:43] Unlocking recipe buffers...
[2018.09.12 11:50:44] Device unlocked: _unPlc_CFP_3570_GCSCMSCSC_CPC_RcpBuffers

```

Percentage of Argon and CF4 to start injection, view from control panel

# PROBLEM AT CF4 ABSORBER

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On 16<sup>th</sup> September there was a problem with YV2103 at CF4 abs because the valve was set in manual due to automatic. So it did not open until we putted it in automatic the day after.

Efficiency for 2 days has been conditioned by this error.

