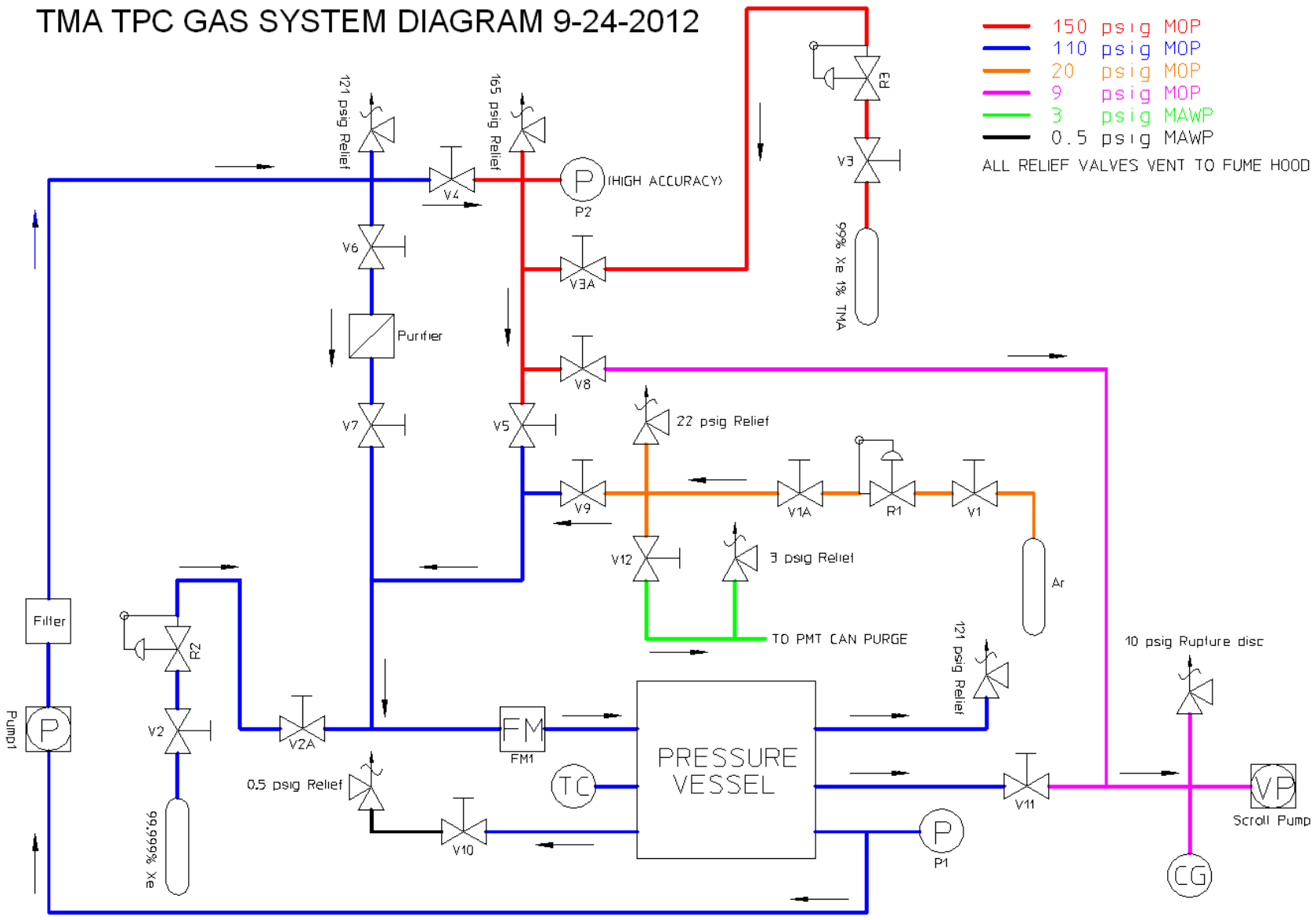
HPXe Mixed gas TPC
Gas system operation

Index

Notes:

1) The pressure transducers read in psia. All regulator gauges read in psig.
2) P2 is more accurate than P1. Read all critical pressures from P2.
3) Make certain you have enough Xe before doing a system fill, as there is no way to change the Xe cylinder without venting the chamber. If the high pressure gauge on R1 < 560 psig, you will not be able to fill to 8 bar.

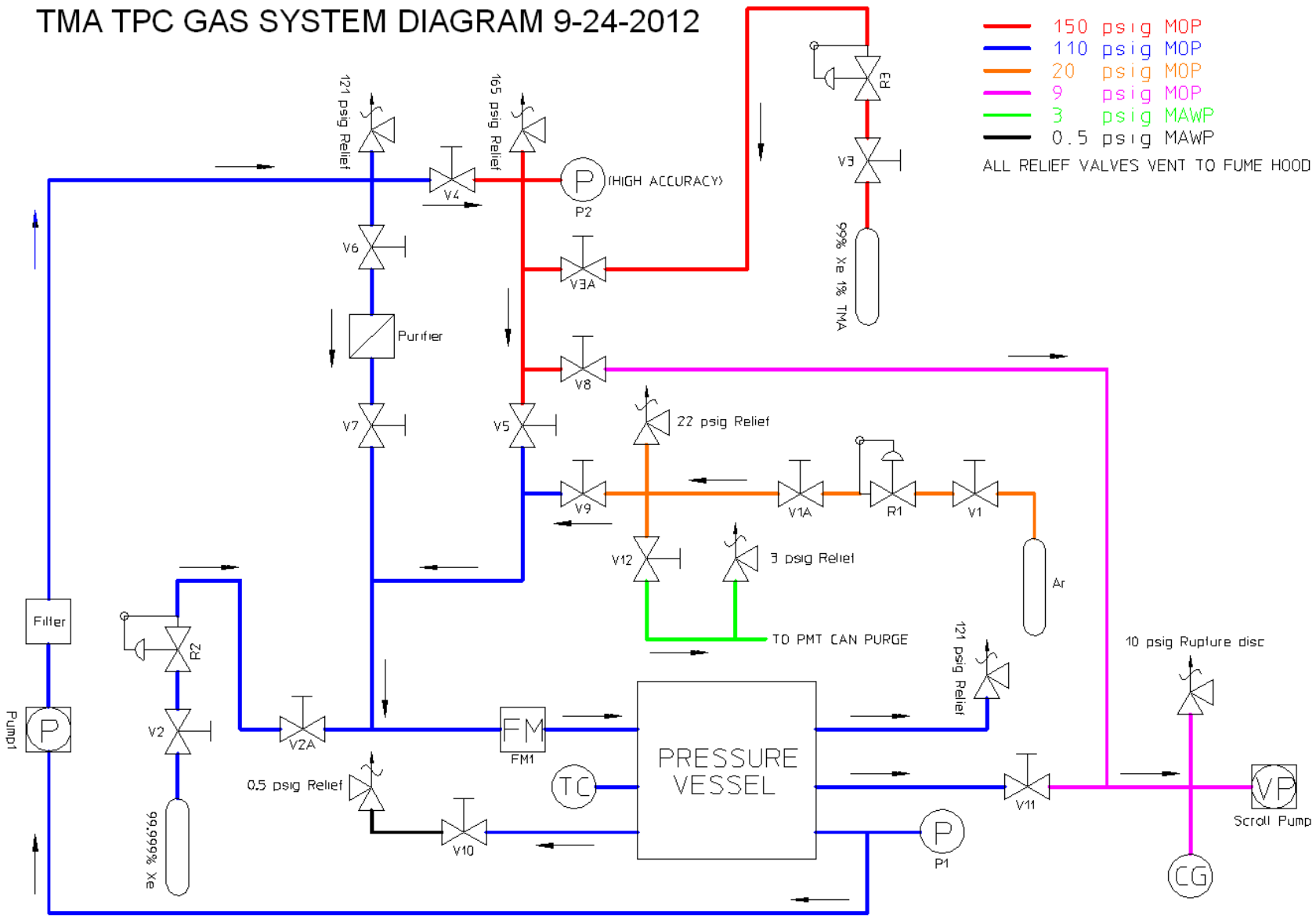

TMA TPC GAS SYSTEM DIAGRAM 9-24-2012
150 psig MOP
110 psig MOP
20 psig MOP
9 psig MOP
3 psig MAWP
0.5 psig MAWP
ALL RELIEF VALVES VENT TO FUME HOOD
121 psig Relief
165 psig Relief
(HIGH ACCURACY)
P2
V4
V6
V3A
R3
V3
99% Xe 1% TMA
Purifier
V8
V7
V5
22 psig Relief
V9
V1A
R1
V1
V12
3 psig Relief
Ar
TO PMT CAN PURGE
Filter
Pump1
R2
V2
V2A
FM
FM1
0.5 psig Relief
V10
TC
PRESSURE VESSEL
121 psig Relief
10 psig Rupture disc
V11
P1
VP
Scroll Pump
CG
99.999% Xe

In operation, the procedures are sequential, unless otherwise indicated. There are steps inserted for checking valve status, **Valves** listed in **bold red** are **closed**; Valves listed in non-bold green are open.

1. Complete system pump-down from air and purge

a. Open V10.
b. Close V1, V2, V3, V6, V7, V10 and V12. Open R1, R2, and R3 two turns each after engagement. Turn off flowmeter.
c. Open V1A, V2A, V3A, V4, V5, V8, V9 and V11. DO NOT open V6 and V7.
d. Once P1 < 17 psia, close V10
e. **V1** V1A **V2** V2A **V3** V3A V4 V5 **V6 V7** V8 V9 **V10** V11 **V12**
f. Turn on the scroll pump.
g. When the convectron gauge reads < 100 mtorr, open V7*
h. Pump for another 5 minutes.
i. Close V1A, V7*, V8 and V11. Back off R1. Leave the scroll pump running.
j. Open V1. Set R1 to 15 psig. Open V1A
k. When P1 > 25 psia, start pump1. Open V6*. Close V9.
l. Run pump1 for another 5 minutes.
m. Shut off pump1.
n. Open V10. When P1 < 17 psia, close V6 and V10.
o. Slowly open V8, then open V7* and V11.
p. Pump for 5 minutes after the convectron gauge reads < 100 mtorr.
q. Close V8, V11.
r. Open V6*, V9.
s. When P1 > 25 psia, start pump1. Close V9.
t. Run pump1 for another 5 minutes.
u. Shut off pump1.
v. Open V10. When P1 < 17 psia, close V6 and V10.
w. Slowly open V8, then open V7 and V11.
x. Pump for at least 60 minutes after the convectron gauge reads < 100 mtorr
y. Close V2A, V3A, V8 and V11
z. Leave the scroll pump running.
aa. V1 V1A **V2 V2A V3 V3A** V4 V5 **V6** V7 **V8 V9 V10 V11 V12**
bb. Proceed to step 2.

***If the getter has been pumped-down after TPC operation and left under vacuum, do not open V6 or V7 until the final pump-down (step w.)**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V1A
R1
V1
V12
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Ar
TO PMT CAN PURGE
Filter
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121 psig Relief
10 psig Rupture disc
Pump1
V2
V2A
FM
FM1
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TC
PRESSURE VESSEL
V11
VP
Scroll Pump
V10
P1
CG
99.999% Xe

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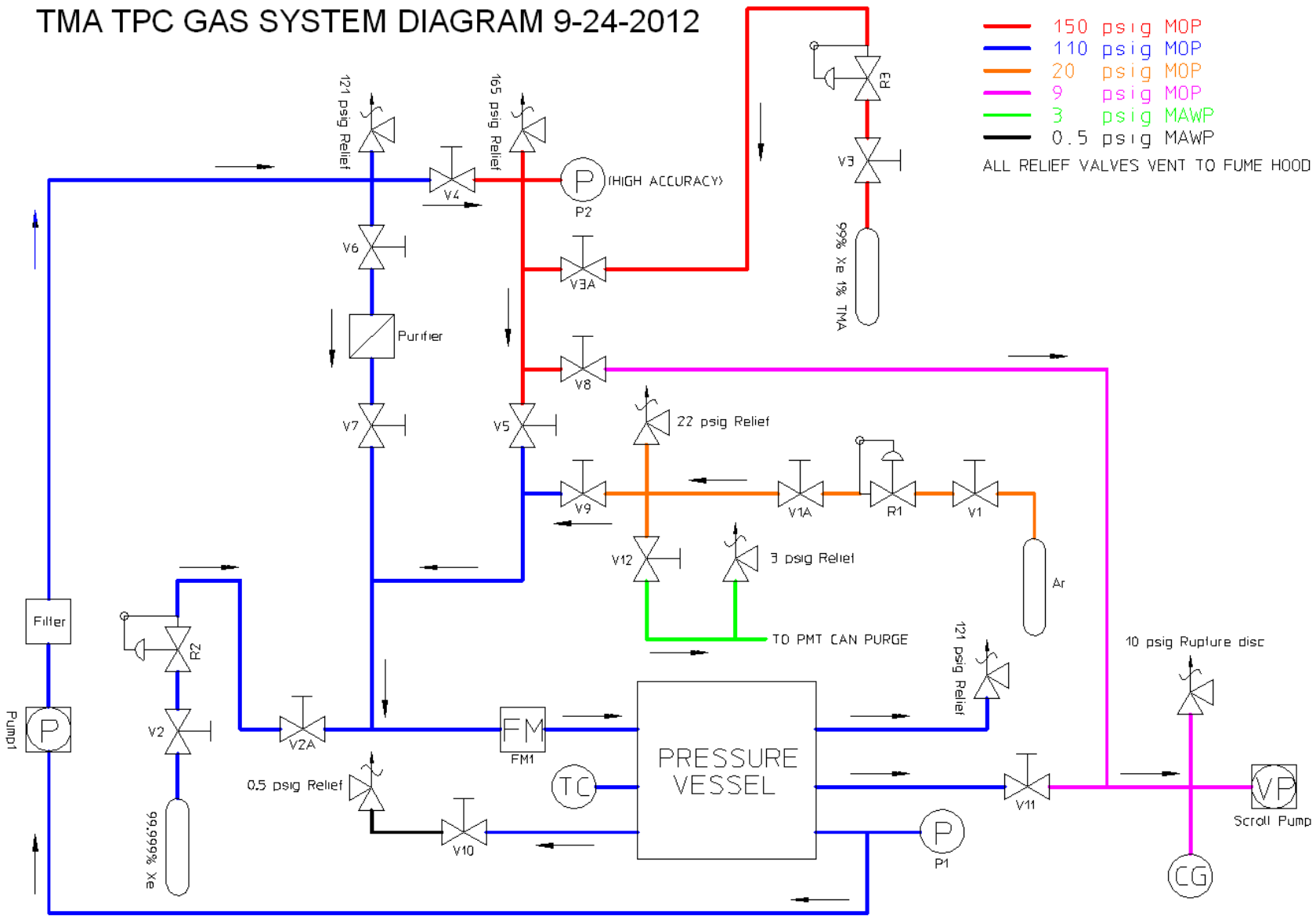
2. Pure xenon fill after pump-down

a. V1 V1A **V2 V2A V3 V3A** V4 V5 **V6** V7 **V8 V9 V10 V11 V12**
b. Back off R2.
c. Open V2 and V6.
d. Set R2 to 5 psig greater than the fill pressure (in psig). Note that fill pressures as-measured by the transducers are in psia.
e. Open V2A.
f. When P2 reads the desired pressure, close V2, V2A, V6 and V7.
g. V1 V1A **V2 V2A V3 V3A** V4 V5 **V6 V7 V8 V9 V10 V11 V12**
h. If no mix gas is used, shut down the scroll pump and proceed to step 4.
i. Proceed to step 3.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V6
V3A
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Purifier
V8
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V5
22 psig Relief
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121 psig Relief
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V2A
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FM1
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PRESSURE VESSEL
V11
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Scroll Pump
V10
P1
CG
99.999% Xe

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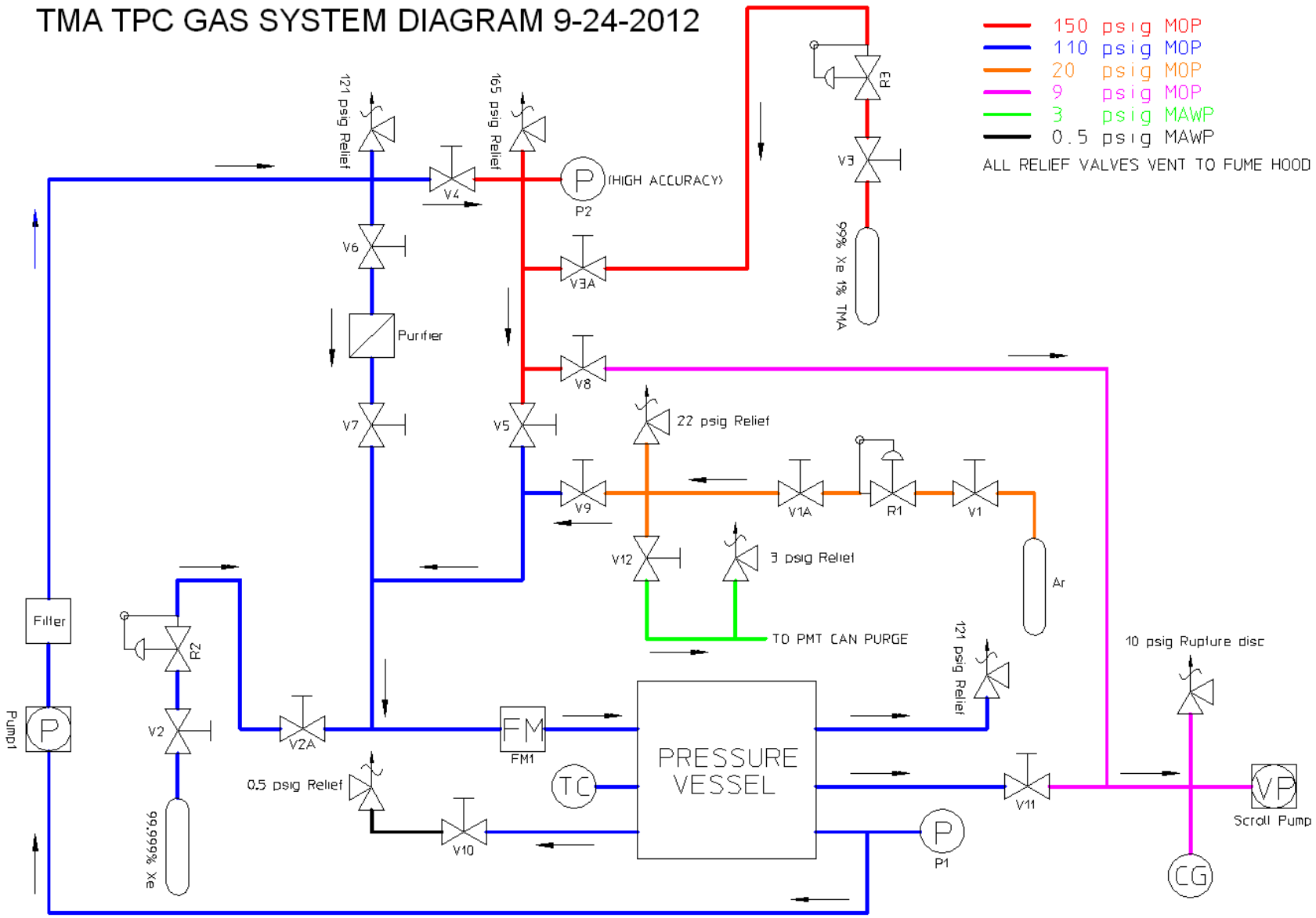
3. System fill with mix gas

The mixing volume is ~30ccs. This will fill very quickly. Set R3 with care and open V3A slowly to prevent exceeding the desired pressure.

a. V1 V1A **V2 V2A V3 V3A** V4 V5 **V6 V7 V8 V9 V10 V11 V12**
b. Close V4 and V5.
c. Open R3 two turns past engagement.
d. Open V8, then V3A.
e. Wait for CG to read <100 mtorr.
f. Close V3A and V8. Back off R3.
g. Open V3.
h. Adjust R3 to the mix gas fill pressure (in psig)
i. Very carefully open V3A.
j. When P2 reads the desired pressure, close V3A.
k. Close V3 and back off R3.
l. Open V4 and V5.
m. V1 V1A **V2 V2A V3 V3A** V4 V5 **V6 V7 V8 V9 V10 V11 V12**
n. Proceed to step 4.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V5
22 psig Relief
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V1A
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V1
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3 psig Relief
Ar
TO PMT CAN PURGE
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Filter
R2
V2
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FM
FM1
PRESSURE VESSEL
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V10
V11
P
P1
VP
Scroll Pump
CG
Pump1
99.999% Xe

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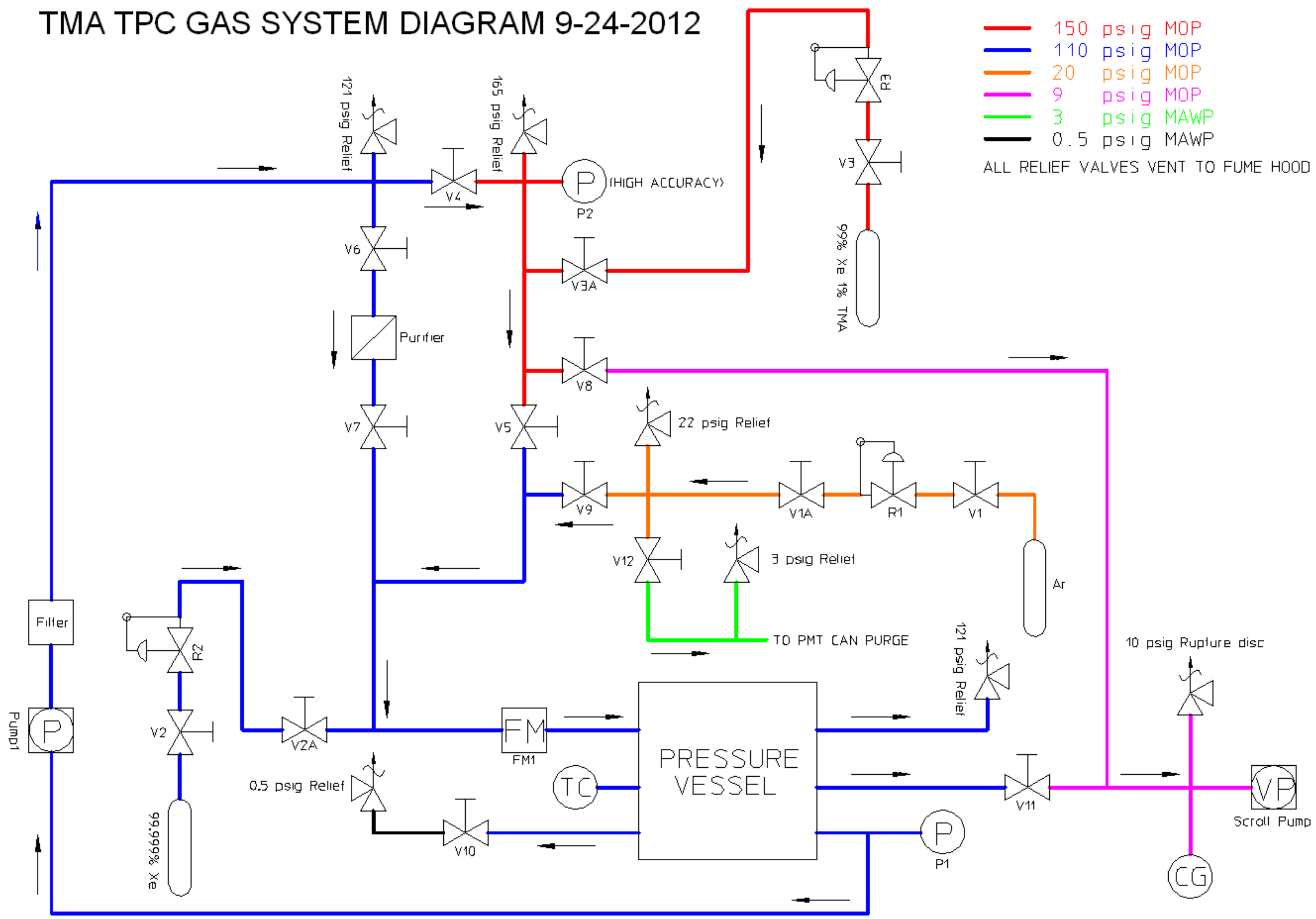
4. TPC operation

a. V1 V1A **V2 V2A V3 V3A** V4 V5 **V6 V7 V8 V9 V10 V11 V12**
b. Open V12 to give a slow flow through the PMT cans.
c. Turn on flowmeter FM1. Verify that V4 and V5 are open.
d. Start pump1 by turning the Variac knob to zero, then switching on Variac. Check that black pushbutton switch on pump base is also on. Set Variac to get desired flow rate, which is 1.5 SLPM nominal and 15 SLPM max for the cold getter:.
e. If mix gas is used, leave V4 and V5 open for at least 10 minutes.
f. Open V6 and V7.
g. Close V4 and V5
h. Adjust gas flow rate at FM1 as in step 4d.
i. V1 V1A **V2 V2A V3 V3A V4 V5** V6 V7 **V8 V9 V10 V11** V12
j. Proceed to step 5.



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9 psig MOP
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165 psig Relief
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P
(HIGH ACCURACY)
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R3
V3
99% Xe 1% TMA
V6
V3A
Purifier
V8
V7
V5
22 psig Relief
V9
V1A
R1
V1
V12
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Ar
TO PMT CAN PURGE
Filter
R2
V2
V2A
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FM1
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Pump1
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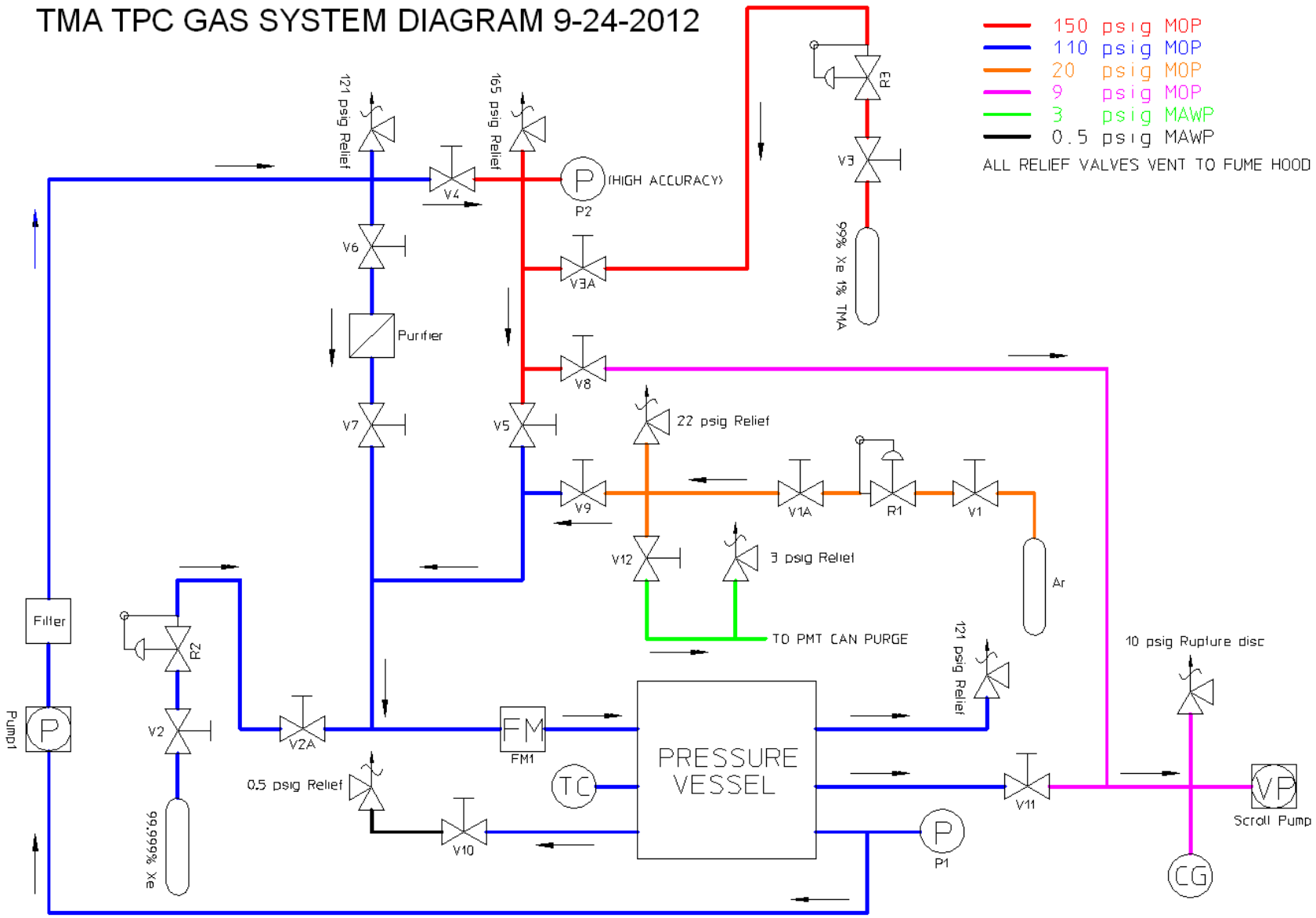
TC
V11
VP
Scroll Pump
V10
P
P1
CG
99.999% Xe

In operation, the procedures are sequential, unless otherwise indicated. There are steps inserted for checking valve status, **Valves** listed in **bold red** are **closed**; Valves listed in non-bold green are open.

5. TPC shutdown

a. V1 V1A **V2 V2A V3 V3A V4 V5** V6 V7 **V8 V9 V10 V11** V12
b. Stop pump1 by setting Variac knob to zero, then turning off Variac. Doing otherwise can damage the pump
c. Turn off FM1. Close V12.
d. V1 V1A **V2 V2A V3 V3A V4 V5** V6 V7 **V8 V9 V10 V11 V12**
e. Proceed to step 5.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FM1
PRESSURE VESSEL
TC
0.5 psig Relief
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V11
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P1
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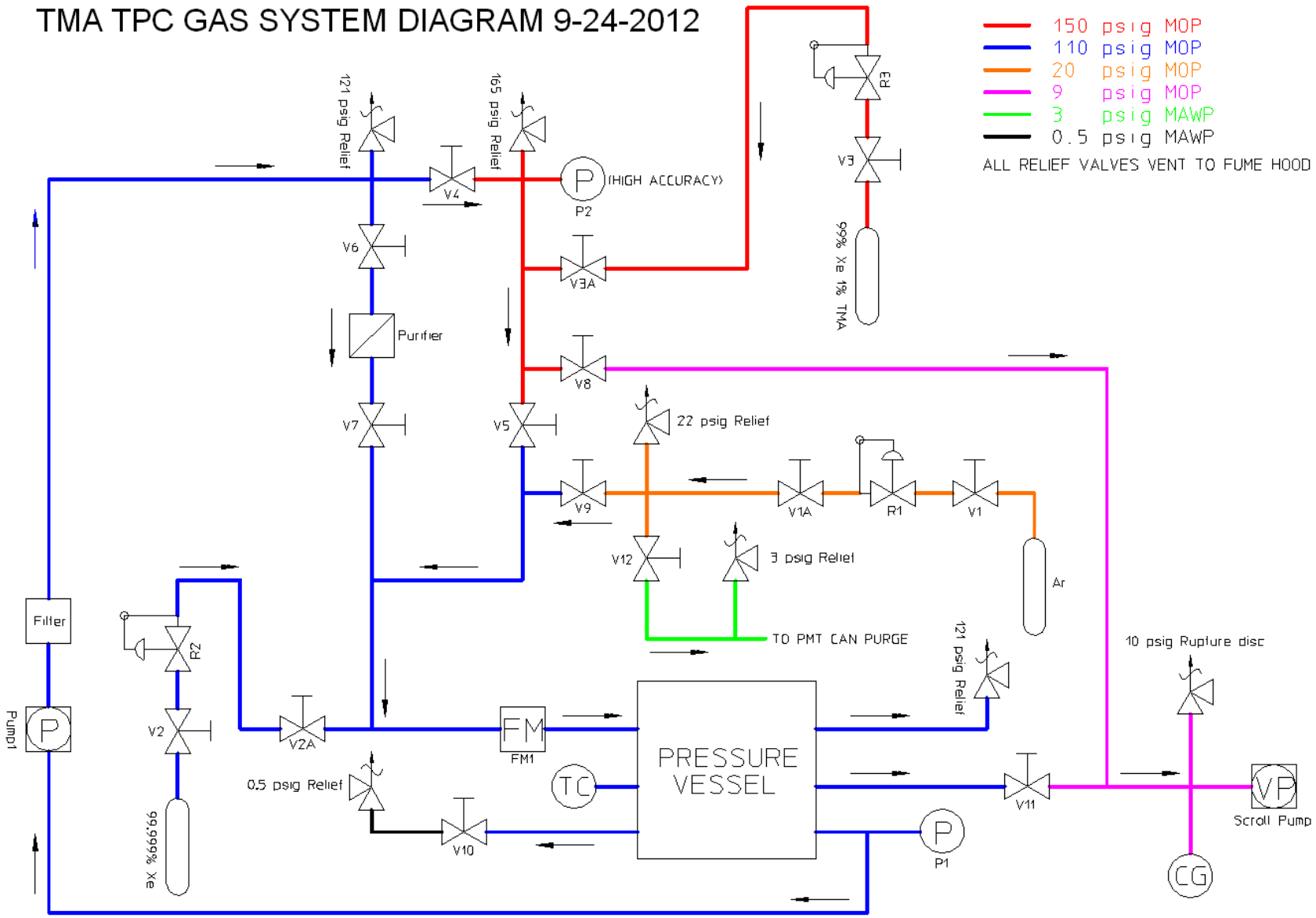
Scroll Pump
CG
Pump1
99.999% Xe

In operation, the procedures are sequential, unless otherwise indicated. There are steps inserted for checking valve status, **Valves** listed in **bold red** are **closed**; Valves listed in non-bold green are open.

6. System gas removal

a. V1 V1A **V2 V2A V3 V3A V4 V5** V6 V7 **V8 V9 V10 V11 V12**
b. Start the scroll pump. Open R3 two turns after engagement.
c. Open V3A, V4 and V5.
d. Open V10 just enough to cause the gas to bleed out the 0.5 psig relief. Stand back from the fume hood.
e. Once P1 < 17 psia, open V9.
f. Open V10 to obtain a slow flow for 2 minutes.
g. Close V9.
h. Once P1 < 17 psia, close V10.
i. When the convectron gauge reads < 100 mtorr, slowly open V8, then V11.
j. Pump for a minimum of 60 minutes.
k. Close V3A, V6, V7, V8 and V11.
l. Turn off the scroll pump
m. V1 V1A **V2 V2A V3 V3A** V4 V5 **V6 V7 V8 V9 V10 V11 V12**
n. Go to procedure 7.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R3
V3
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V7
V5
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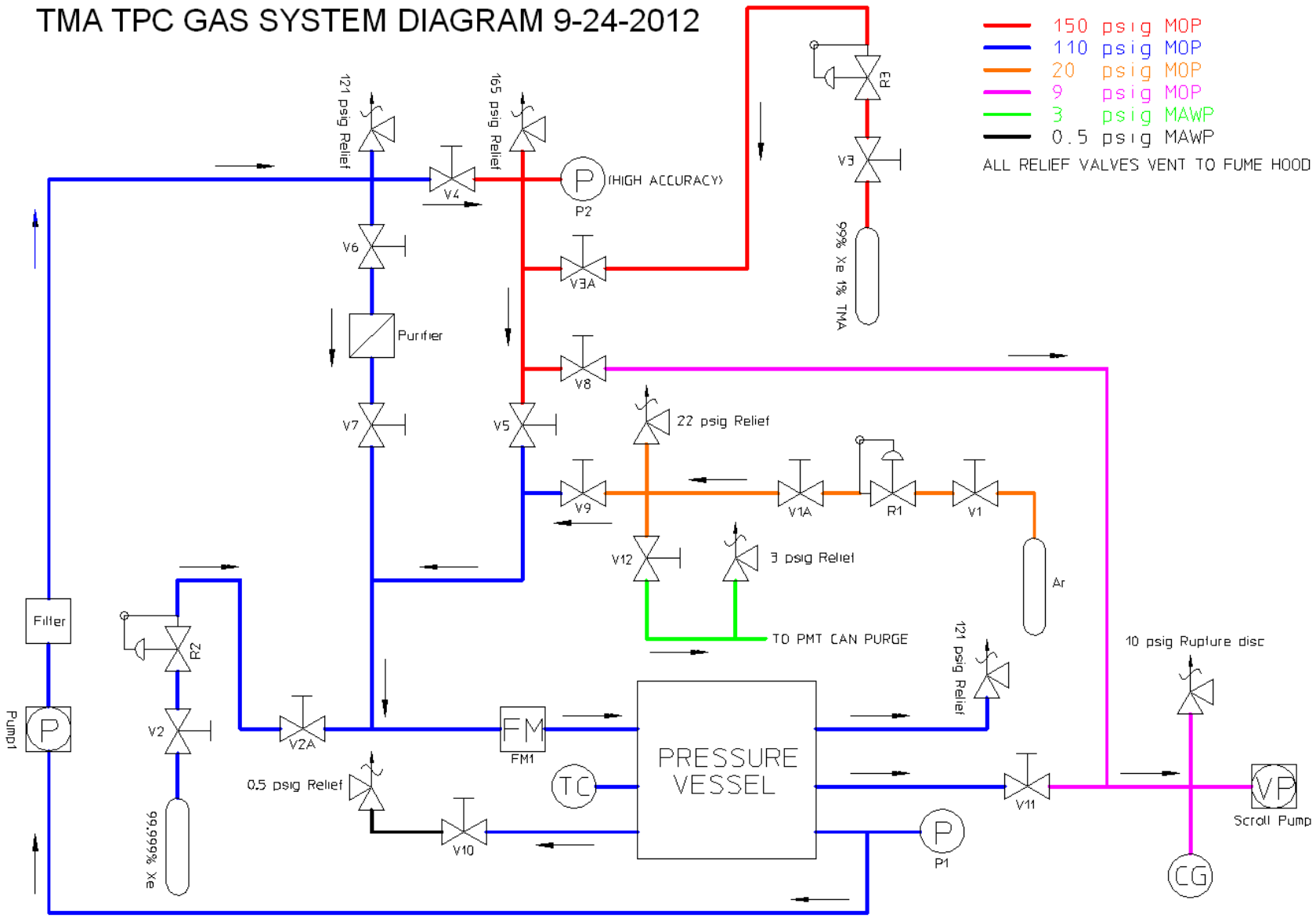
V9
V1A
R1
V1
V12
3 psig Relief
Ar
TO PMT CAN PURGE
121 psig Relief
10 psig Rupture disc
Filter
R2
V2
V2A
FM
FM1
PRESSURE VESSEL
TC
0.5 psig Relief
V10
V11
P
P1
VP
Scroll Pump
CG
Pump1
99.999% Xe

In operation, the procedures are sequential, unless otherwise indicated. There are steps inserted for checking valve status, **Valves** listed in **bold red** are **closed**; Valves listed in non-bold green are open.

7. TPC let-up from vacuum to argon.

a. V1 V1A **V2 V2A V3 V3A** V4 V5 **V6 V7 V8 V9 V10 V11 V12**
b. Set R1 to 15psig. Open V9.
c. Once P1 >17 psia, close V9.
d. Open V10 until the flow stops.
e. Close V1, V1A, V4, V5 and V10. Back off R1.
f. The system can now be opened safely.
g. **V1 V1A V2 V2A V3 V3A V4 V5 V6 V7 V8 V9 V10 V11 V12**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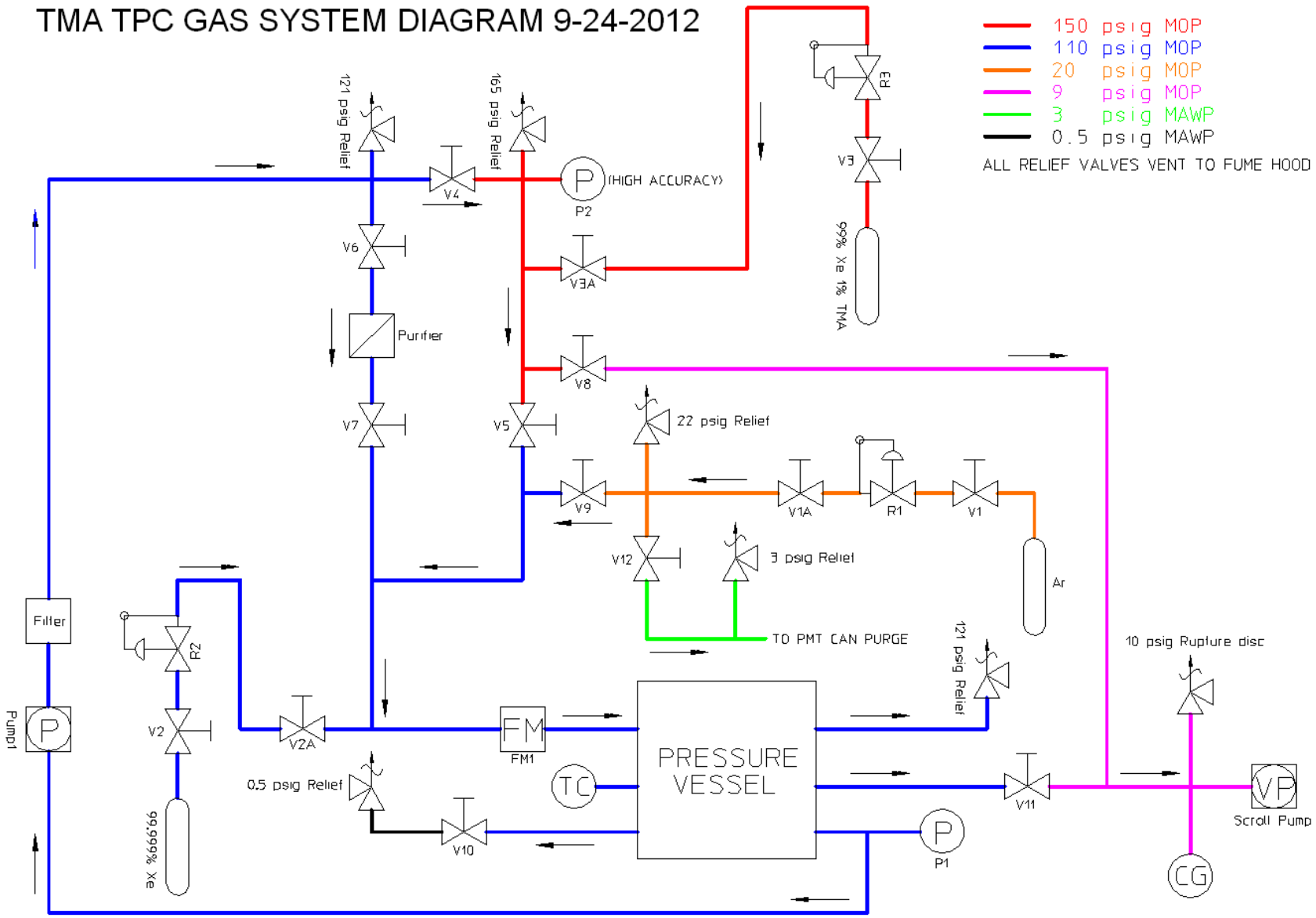
Scroll Pump
Pump1
V10
P1
CG
99.999% Xe

In operation, the procedures are sequential, unless otherwise indicated. There are steps inserted for checking valve status, **Valves** listed in **bold red** are **closed**; Valves listed in non-bold green are open.

8. Changing the Ar cylinder.

a. Close V9.
b. Close V1.
c. Open V1A and V12.
d. If the high pressure side of R1 is still under pressure, let it bleed down. Open R1 as required.
e. Back off R1.
f. Change the cylinder
g. If the TPC is not under pressure, you're done.
h. If the TPC is under pressure, complete the following before purging or letting up the system to Ar.
i. Close V1A.
j. Open V1. Set R1 to 15 psig. Open V1A
k. Open V12 to allow Ar to flow through the PMT cans for a minimum of 15 minutes before purging or letting up the system to Ar.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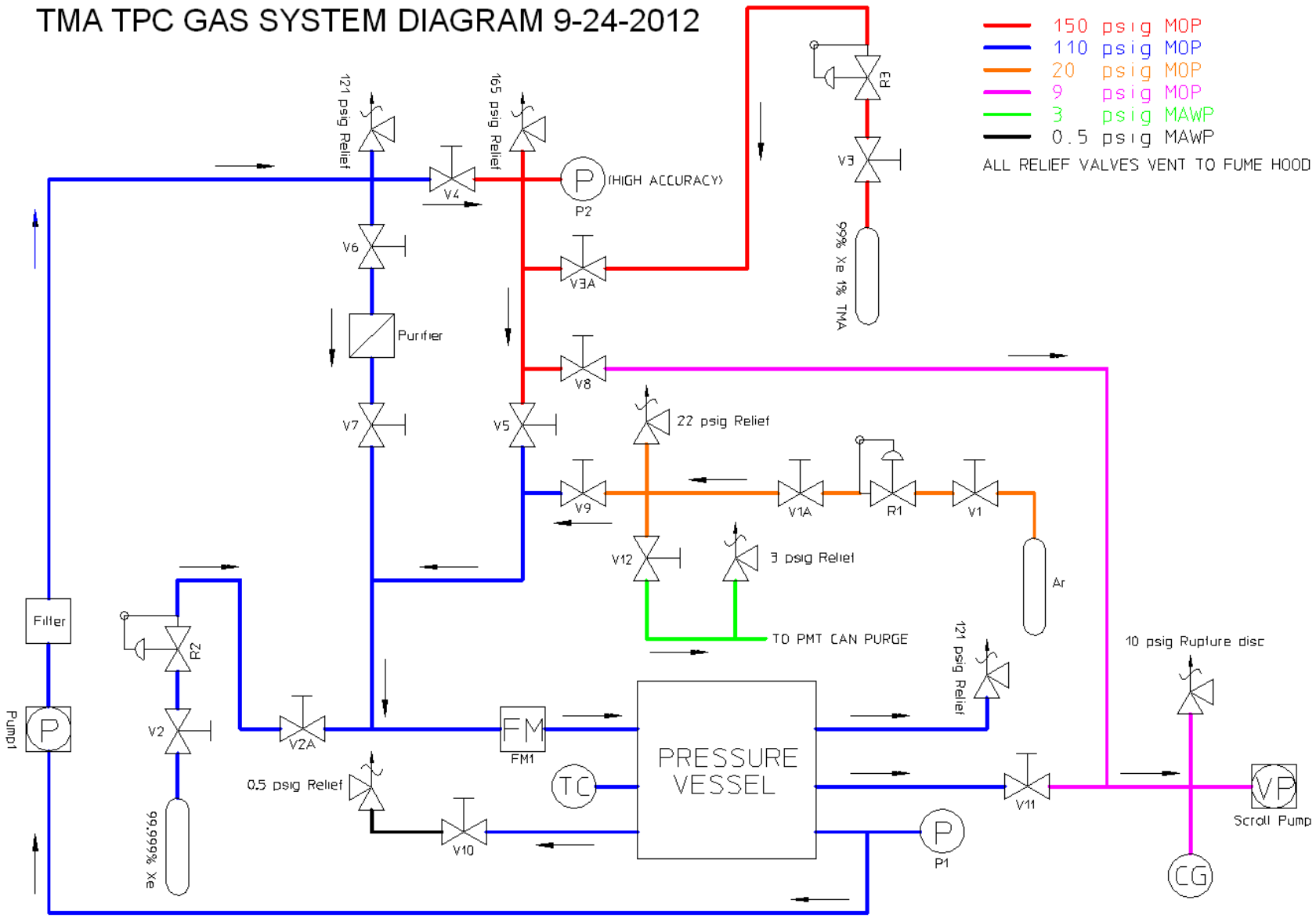
9. Changing the pure Xe cylinder.

This procedure should not be done with pressure in the system. There is no way to assure the purity of the gas between V2 and V2A without pumping through the chamber to V2. Check that P1 < 17 psia. Vent the system with V10 as required.

a. Close V2.
b. Open V2A.
c. If the high pressure side of R2 is still under pressure, let it bleed down. Open R2 as required.
d. Back off R2.
e. Change the cylinder.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V11
P1
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Scroll Pump
CG
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10. Changing the Xe - mix gas cylinder.

a. If pump1 is running, check that V6 and V7 are open.
b. Close V3, V4 and V5.
c. Open V3A.
d. If the high pressure side of R3 is still under pressure, let it bleed down. Open R3 as required.
e. Back off R3.
f. Put on latex or nitrile gloves.
g. Keep your head out of the fume hood. Slowly crack the regulator fitting where it attaches to V3.
h. Change the cylinder. Install the plug on the empty cylinder and leave it in the fume hood for at least 15 minutes before removing.
i. If the TPC is not under pressure, you're done.
j. Start the scroll pump.
k. Open R3 two turns after engagement.
l. When the convectron gauge reads < 100 mtorr, slowly open V8.
m. Pump for at least 60 minutes.
n. Close V8. Back off R3.