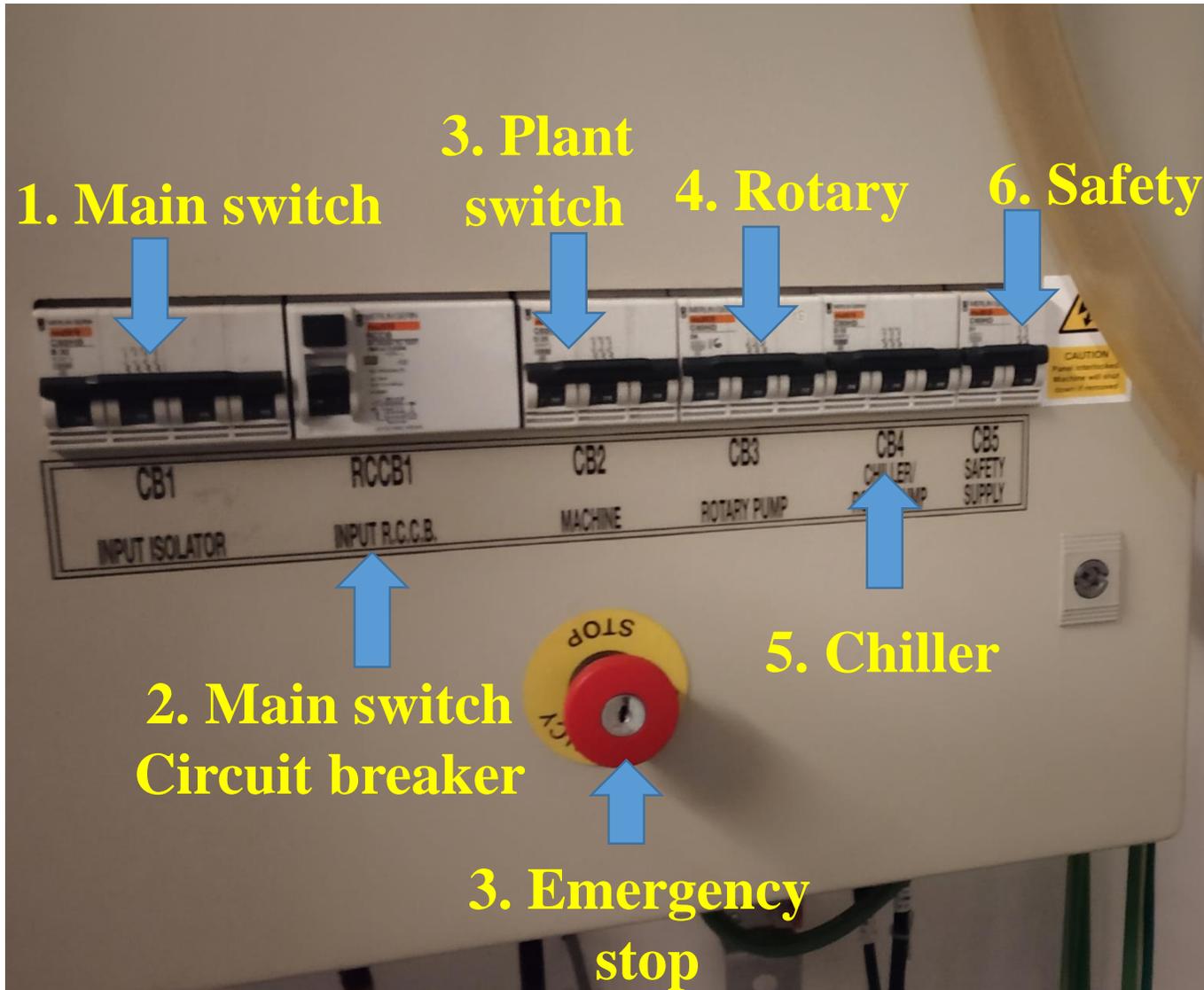


Procedure to operate STSRIE system

By Amita

Step 1

Starting of the STSRIE system



Check points:

1. The required Gas cylinders are filled and on.
2. Cooling water flow is unhindered.

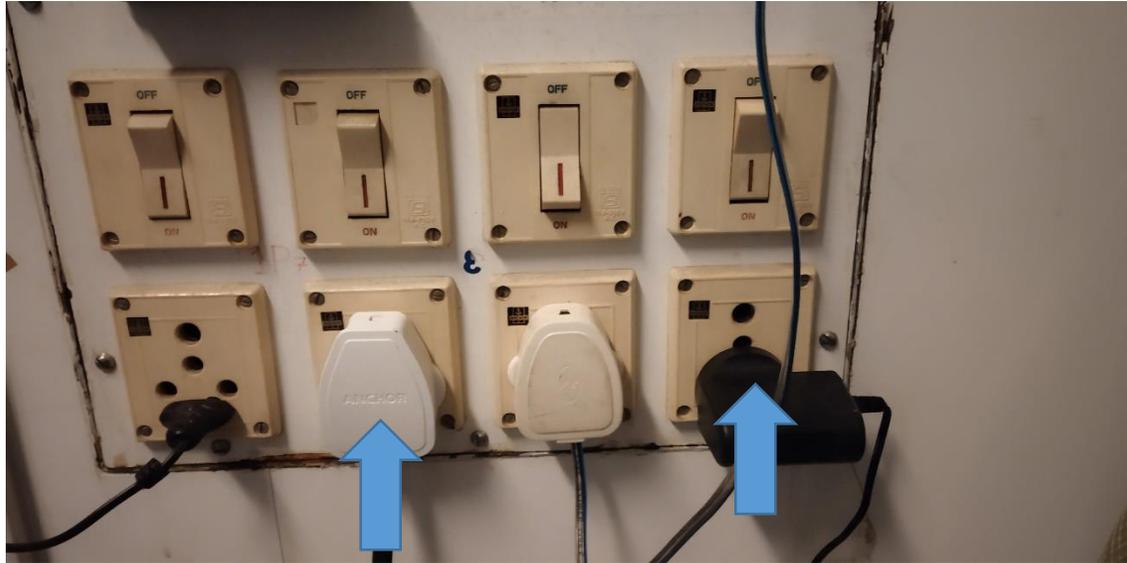
Order of turning on power switches:

1. Main Switch
2. Main switch circuit breaker
3. Plant switch
4. Rotary power switch
5. Safety switch

Emergency stop is used in case of hazards.

Step 2

Starting of the PC for system interfacing



**1. Extension
Switch**

**2. LAN
Switch**

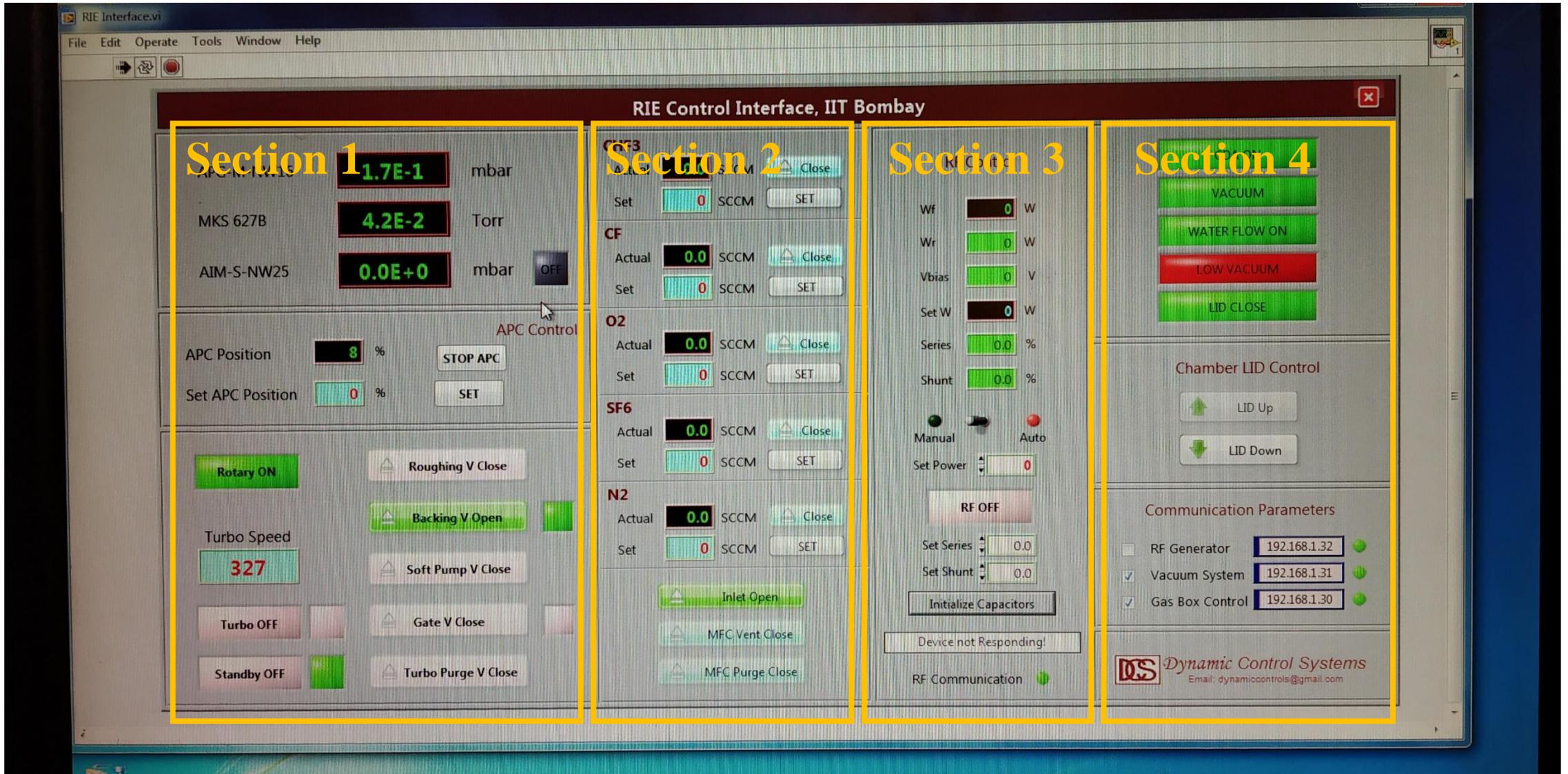


Extension: Always on

Order of turning-on :

1. Extension switch
2. LAN switch

Start the CPU and once PC is started, launch the RIE interface software



Step 3

Water flow check and PC-Plant interfacing

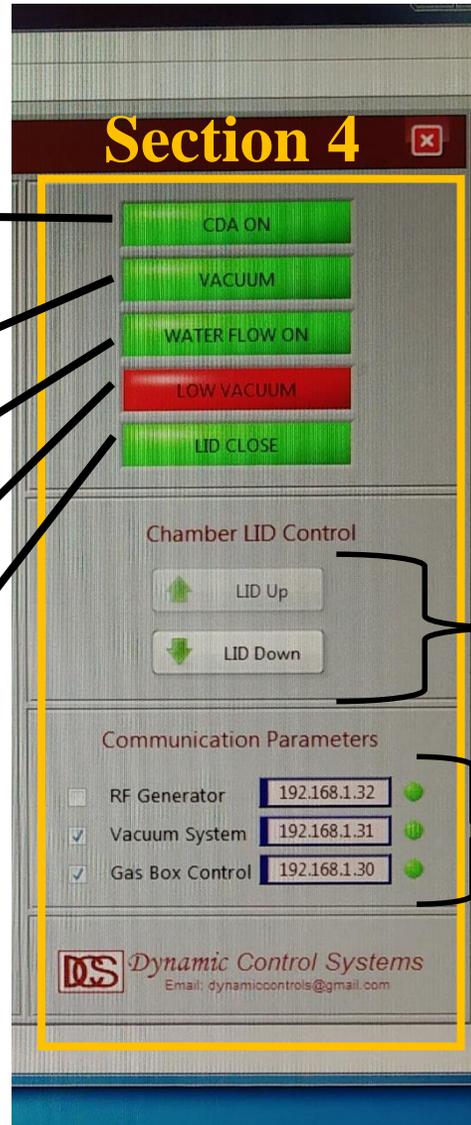
CDA: Compressed dried air flow
Red: Interrupted
Green: Working

Red: Chamber is in 1 ATM
Green: Chamber is in vacuum

Red: Water flow off
Green: Water flow on

Red: Low vacuum
Green: High vacuum

Red: Lid is open
Green: Lid is closed



ToDos:

1. Tick on RF generator to connect with the PC with RF Gen.
2. Tick on Vacuum system to get chamber pressure status in the PC.
3. Tick on Gas Box Control to control gas flow from the PC.

As soon as the connection is made, plant will be interfaced with PC

To move the Lid up/down

**RF generator
Vacuum system
Gas box interface**

Check points after ToDos:

1. CDA On
2. Vacuum
3. Water flow On
4. Low Vacuum
5. LID close
6. Main Switch

Step 4

Starting of the Plant



Plant On

Emergency stop

Start the plant by pressing the plant on button

Loading of the sample

Section 2

CHF3 Gas flow control

CF4 Gas flow control

O2 Gas flow control

SF6 Gas flow control

N2 Gas flow control



Live gas flow value

Closing of the gas flow

Setting of the gas flow

Set Gas flow value

To load the sample:

1. Vent the chamber by clicking on MFC vent

MFC Vent: Purging of the chamber

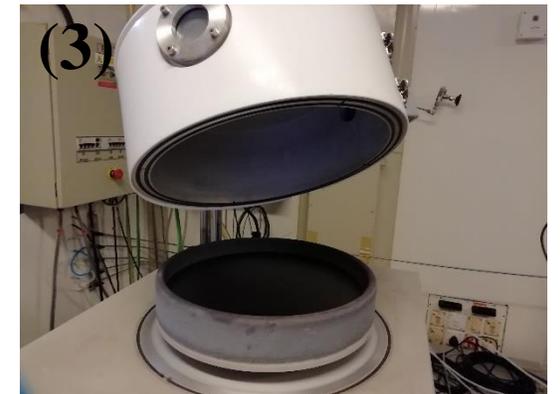
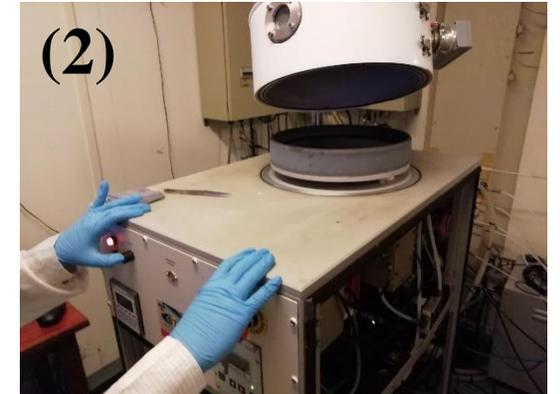
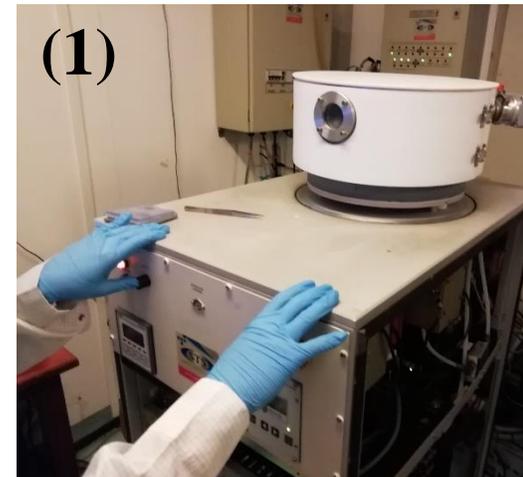
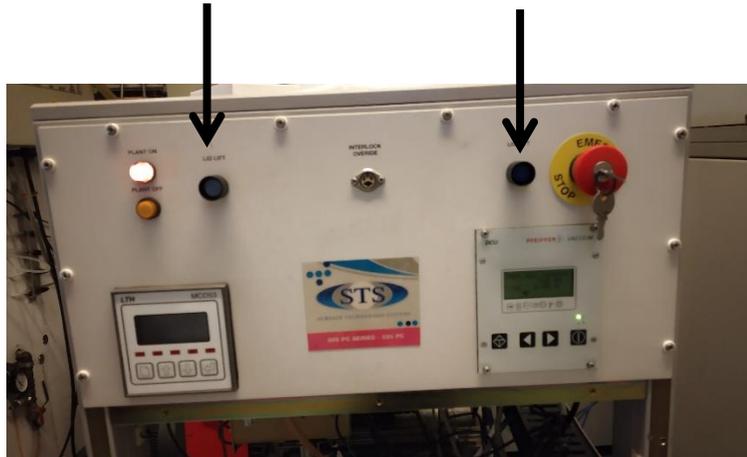
Step 5

Loading of the sample

To load the sample:

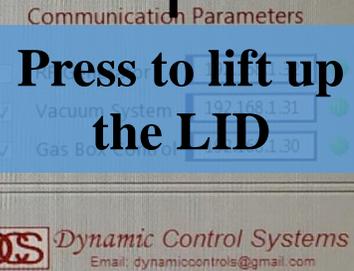
1. Once the chamber is vented, the “vacuum” tab will turn red and will show “atmosphere”.
2. Press the LID Up button to open the chamber. As you press the Lid Up button, message will pop up saying press the white LEDs on the plant to lift the lid.
3. “LID close” button will turn red.

White LEDs to be pressed to lift the LID up



LID opened

Section 4

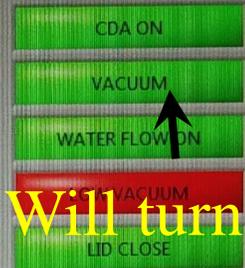


Loading of the sample

To load the sample:

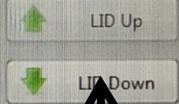
1. Place the sample on the chuck, press the LID down button and press the white LIDs simultaneously to bring the LID down.
2. Once LID is closed, "LID close" button will turn green

Section 4



Will turn red

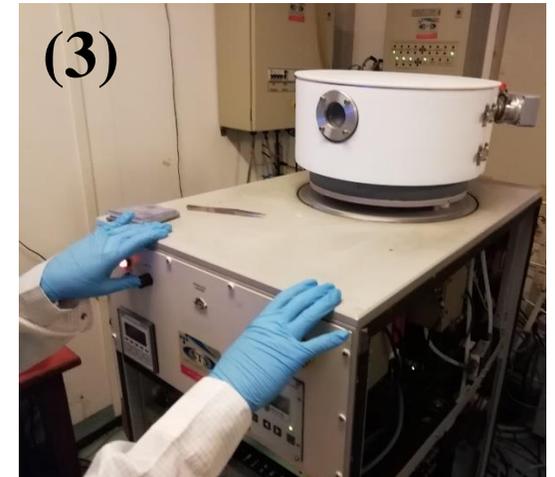
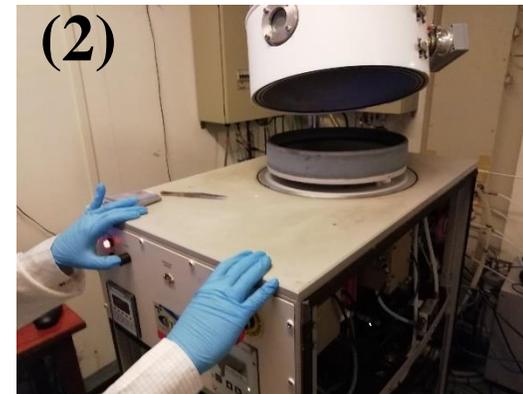
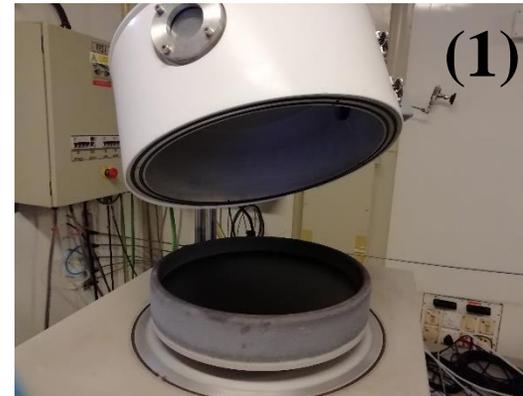
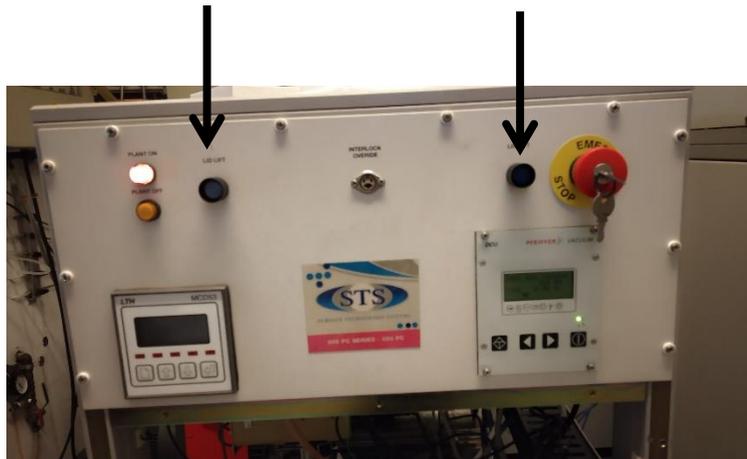
Chamber LID Control



Communication Parameters

Press to bring down the LID

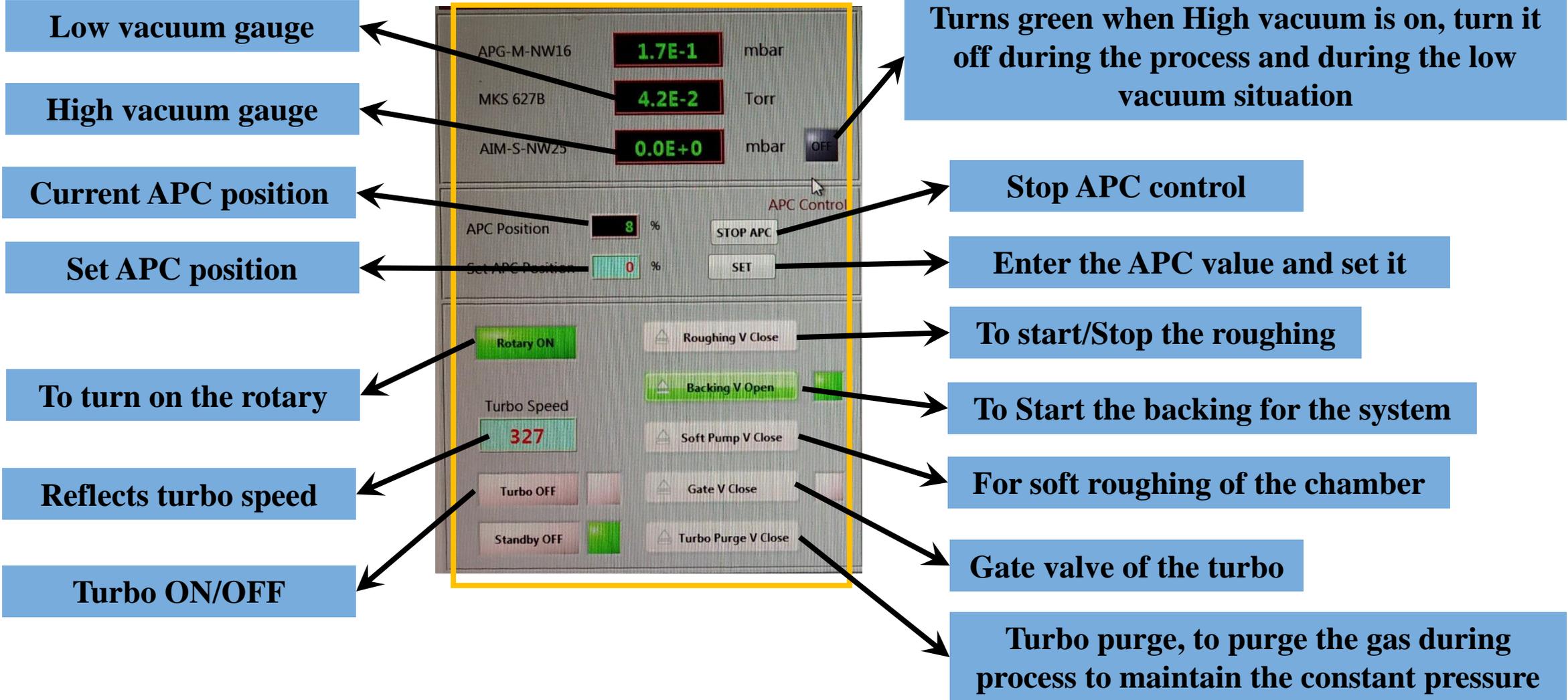
White LEDs to be pressed to bring the LID down



LID Closed

Creating the Initial Vacuum in the chamber

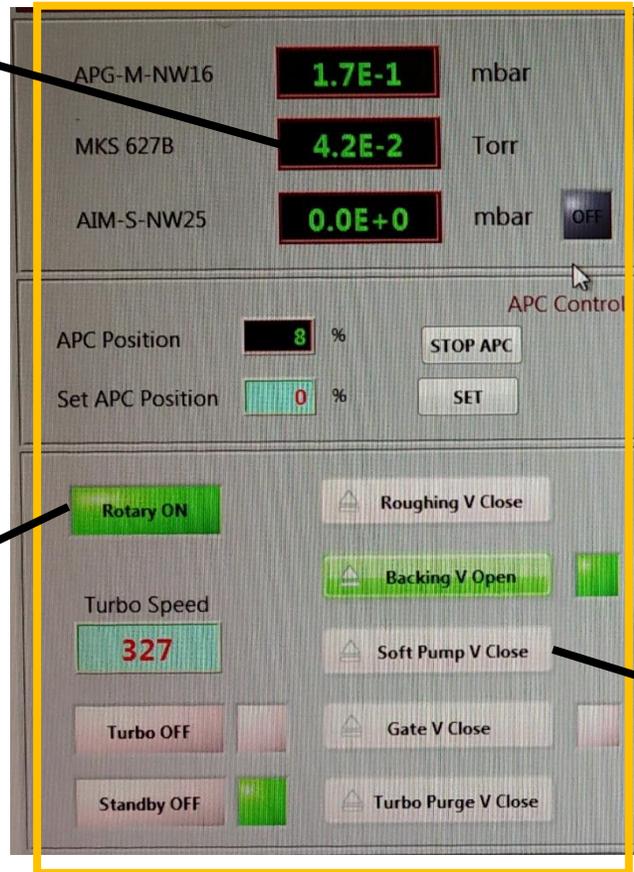
Section 1



Step 6

Creating the Initial Vacuum in the chamber

Section 1



Low vacuum gauge

High vacuum gauge

Current APC position

Set APC position

(1) To turn on the rotary

Reflects turbo speed

Turbo ON/OFF

Steps

1. Once lid is closed, start the rotary pump.
2. Start the soft roughing of the chamber
3. Wait up till the chamber pressure drops to $2.9e-1$ Torr in the low pressure measurement gauge.

Soft pumping is to ensure sample does move in the chamber.

To start the backing for the system

For soft roughing of the chamber (2)

Gate valve of the turbo

Turbo purge, to purge the gas during process to maintain the constant pressure

Step 7

Creating the Initial Vacuum in the chamber

Section 1

The screenshot shows a control panel with the following elements:

- Low vacuum gauge:** APG-M-NW16, reading $1.7E-1$ mbar.
- High vacuum gauge:** MKS 627B, reading $4.2E-2$ Torr.
- Current APC position:** AIM-S-NW25, reading $0.0E+0$ mbar.
- APC Control:** APC Position is at 8%, Set APC Position is at 0%. Buttons for STOP APC and SET are visible.
- Rotary ON:** A green button.
- Turbo Speed:** A digital display showing 327.
- Turbo OFF:** A red button.
- Standby OFF:** A green button.
- Valves:** Buttons for Roughing V Close, Backing V Open, Soft Pump V Close, Gate V Close, and Turbo Purge V Close.

Annotations on the left side of the image:

- Low vacuum gauge
- High vacuum gauge
- Current APC position
- Set APC position
- To turn on the rotary
- Reflects turbo speed
- Turbo ON/OFF

Steps

1. Close the soft roughing valve.
2. Start the roughing to create base pressure for the turbo.
3. Wait for chamber pressure to drop till $5e-2$ Torr.

To start/Stop the roughing (1)

To Start the backing for the system

For soft roughing of the chamber

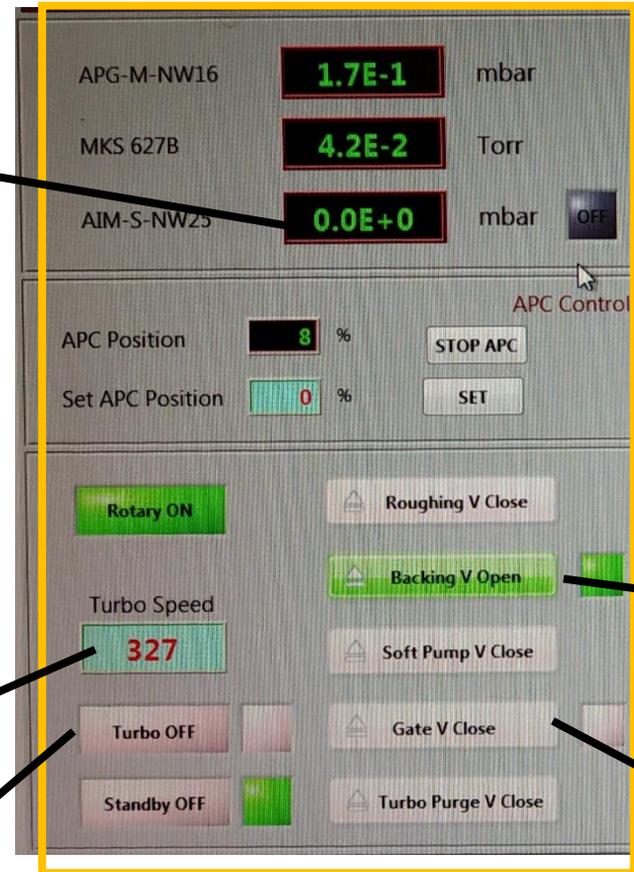
Gate valve of the turbo

Turbo purge, to purge the gas during process to maintain the constant pressure

Step 8

Creation of high Vacuum in the chamber

Section 1



Low vacuum gauge

High vacuum gauge

Current APC position

Set APC position

To turn on the rotary

Reflects turbo speed

(2) Turbo ON/OFF

Steps

1. Close the roughing valve and start the backing.
2. Turn on the turbo and wait for its speed to rise up till 550.
3. Open the gate valve to connect the turbo to the process chamber.
4. Wait for chamber pressure to drop till $2.9e-4$ mbar.

Once the vacuum in the chamber crosses $\sim 5e-3$ mbar the high vacuum pressure gauge becomes active.

To Start the backing for the system (1)

For soft roughing of the chamber

Gate valve of the turbo (3)

Turbo purge, to purge the gas during process to maintain the constant pressure

Click here to go to the process page

1. Click on edit to set the process recipe

Edit

Open

Save

Save As

7. Save the recipe

8. Start the process

Start Process

5. Set the gas stabilization time (max 1 min)

00:01:00

00:00:41

Emergency abort

Abort

RIE Control Interface, IIT Bombay

Process Configuration Parameters

Recipe Name

Si_etch

Chamber Process Pressure (mbar)

5.0E-3

2. Select the gases required and set the flow

<input type="checkbox"/>	CHF3	10.0	SCCM
<input checked="" type="checkbox"/>	CF	40.0	SCCM
<input checked="" type="checkbox"/>	O2	9.0	SCCM
<input type="checkbox"/>	SF6	0.0	SCCM
<input type="checkbox"/>	N2	0.0	SCCM

3. Set the APC to 70%

APC Angle 70 %

RF Forward Power 200 W

4. Set the RF power as per the need

Process Duration 00:02:00

6. Set the process duration

Current Process Status

APC Valve 67 %

Rough Vacuum Gauge 2.4E-4

ALL OK

GAS Parameters

CHF3	0.0	SCCM
CF	40.3	SCCM
SF6	0.0	SCCM
O2	8.6	SCCM
N2	0.0	SCCM

RF Parameters

Forward Power	0	W
Reflected Power	0	W
Vbias 2	2	V
Power Set	0	W
Series	12.2	%
Shunt	68.8	%

Recipe Start Time 12:49:32

Elapsed Time 00:00:18

Current Time 12:49:50

Wait Time for Gas Stabilization !

Step 9

Preparing for the process

NOTE: Now, we do not need it, we set the process recipe in the process page.

Section 1



- Steps**
1. Once the base vacuum of $2.9e-4$ mbar has reached in the chamber, close the APC by 70% or as per the pressure requirement in the process chamber.
 2. Open the turbo purge valve to purge excess gases from the chamber during the process. *Once the gas flow is on, the chamber pressure will increase, one has to manually close the high vacuum gauge.*

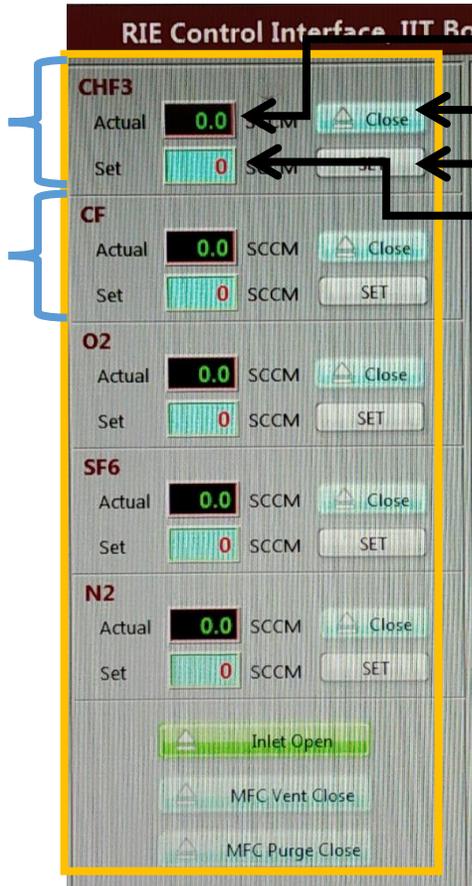
Step 10

Starting the gas flow

NOTE: Now, we do not need it, we set the process recipe in the process page.

Section 2

- CHF3 Gas flow control
- CF4 Gas flow control
- O2 Gas flow control
- SF6 Gas flow control
- N2 Gas flow control



- Live gas flow value
- Closing of the gas flow
- Setting of the gas flow
- Set Gas flow value

Steps

1. Set the flow value for desired gases (e.g. CHF3:10sccm and CF4:50sccm).
2. As soon as the gas flow starts the chamber pressure will increase, once that happened, one has to manually close the high vacuum pressure gauge.

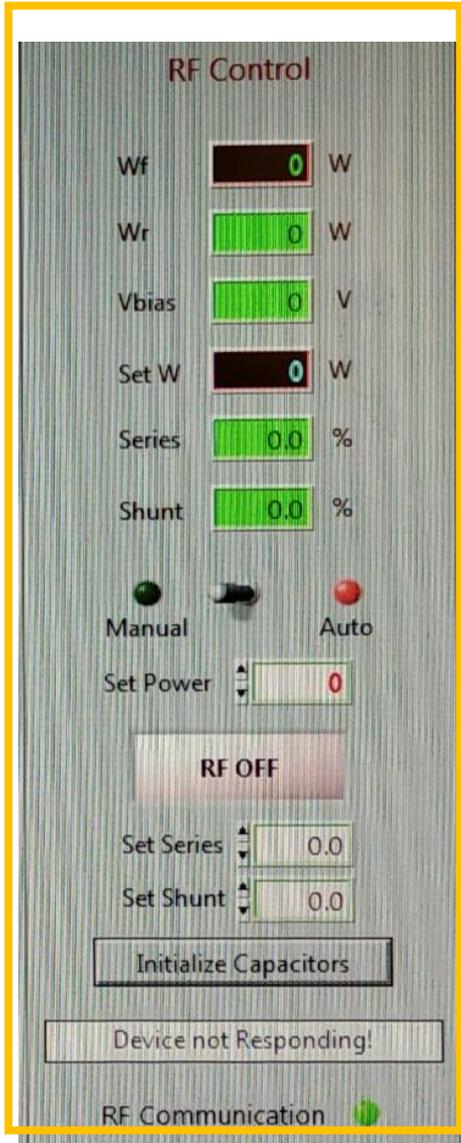
The maximum gas flow allowed for all the gases is 50sccm.

Step 11

Starting of the plasma

NOTE: Now, we do not need it, we set the process recipe in the process page.

Section 3



Forward power

Reflected power

DC Voltage bias

Set power

Series capacitance

Shunt capacitance

Setting of required power (1)

RF power ON/OFF (2)

PC-Plant interface status

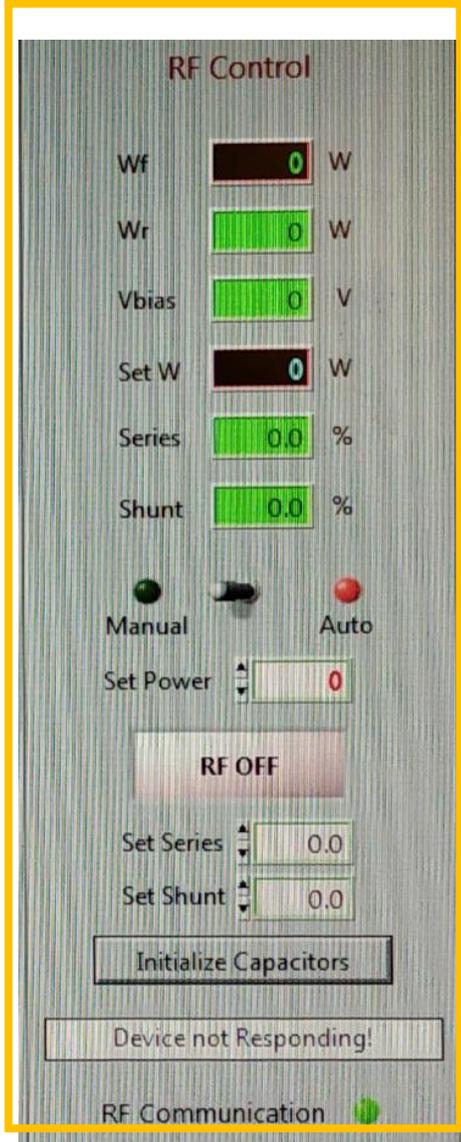
Steps

1. Set the desired power in “set power” block and enter.
2. As soon as one presses enter, “set W” and RF power source will reflect the same value. If not accepted, PC-plant interface status will show “command not accepted”. In such scenario reset the RF connection and enter the value again.
3. To reset the RF connection, un-tick and tick back the “RF connection” in section 4.
4. Once command is accepted, be ready with the timer and start the RF power : “RF ON”

Step 12

Stopping the plasma

Section 3



Forward power

Reflected power

DC Voltage bias

Set power

Series capacitance

Shunt capacitance

Setting of required power (1)

RF power ON/OFF (2)

PC-Plant interface status

NOTE: Now, we do not need it, we set the process recipe in the process page.

Steps

1. Once the process is done, switch off the RF power: "RF Off"
2. Set the power value to "Zero": type zero and press enter.

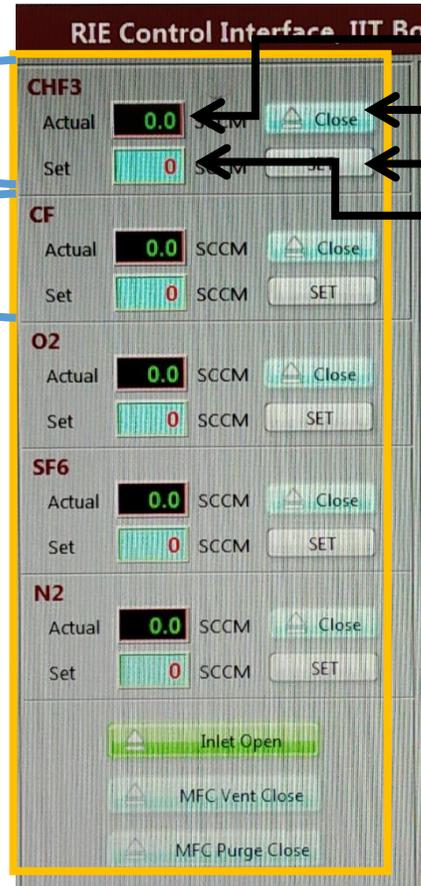
Step 13

Stopping the gas flow

NOTE: Now, we do not need it, we set the process recipe in the process page.

Section 2

- CHF3 Gas flow control
- CF4 Gas flow control
- O2 Gas flow control
- SF6 Gas flow control
- N2 Gas flow control



- Live gas flow value
- Closing of the gas flow
- Setting of the gas flow
- Set Gas flow value

Steps
1. Set the flow value to “Zero”.

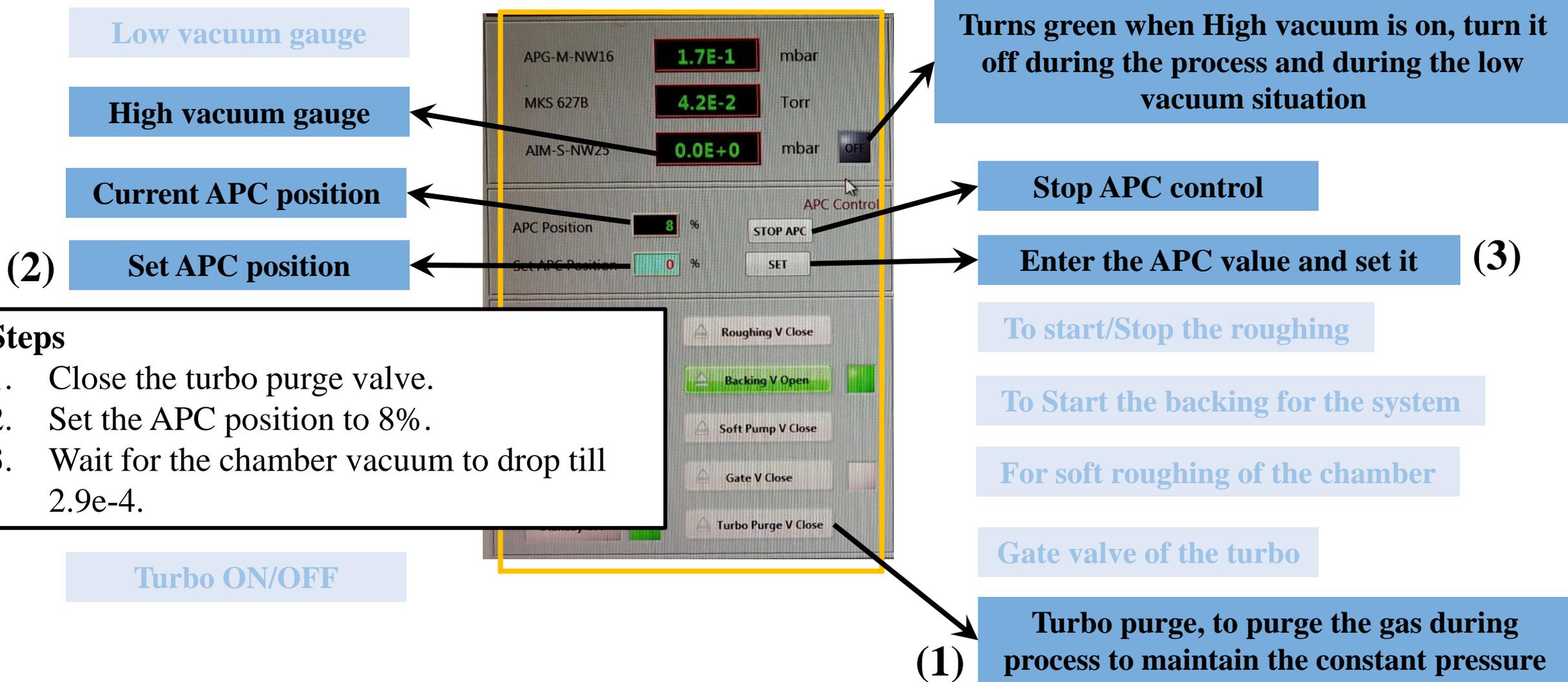
MFC Vent: Purging of the chamber

Step 14

Retaining the high vacuum in the chamber

(Ideally this is done automatically right after the process is completed. If not then one must follow this step)

Section 1

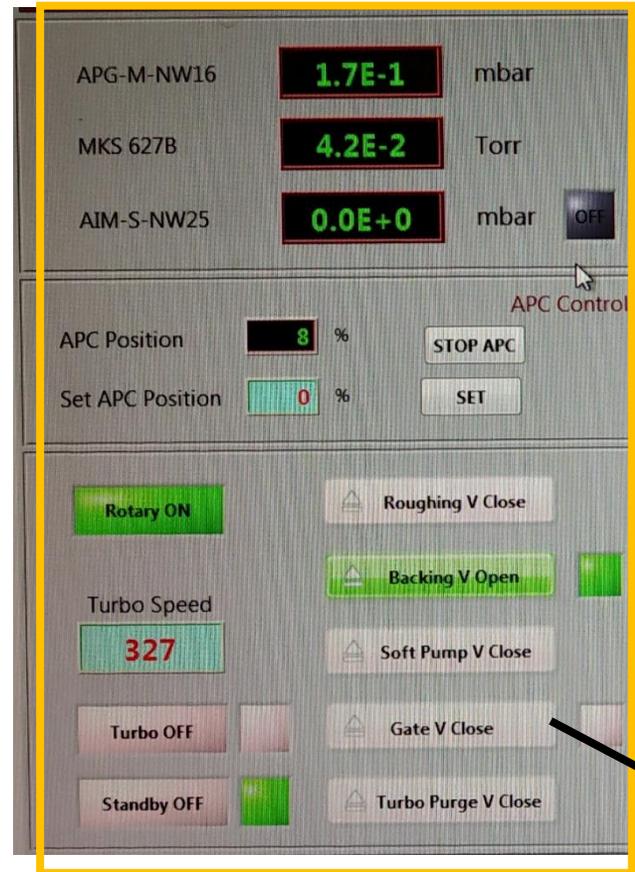


- Steps**
1. Close the turbo purge valve.
 2. Set the APC position to 8%.
 3. Wait for the chamber vacuum to drop till $2.9e-4$.

Step 15

Unloading of the sample

Section 1



Low vacuum gauge

High vacuum gauge

Current APC position

Set APC position

To turn on the rotary

Reflects turbo speed

Turbo ON/OFF

Turns green when High vacuum is on, turn it off during the process and during the low vacuum situation

Stop APC control

Steps

1. Close the gate valve so that the chamber can be vented.

To Start the backing for the system

For soft roughing of the chamber

Gate valve of the turbo

Turbo purge, to purge the gas during process to maintain the constant pressure

Step 16

Venting the chamber and unloading of the sample

Section 2

CHF3 Gas flow control

CF4 Gas flow control

O2 Gas flow control

SF6 Gas flow control

N2 Gas flow control



Steps

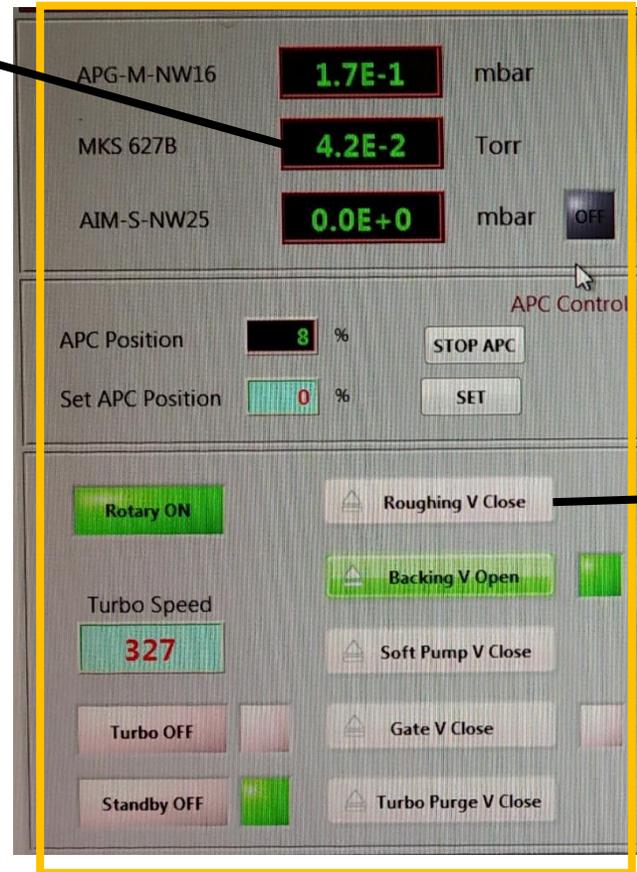
1. Vent the chamber by clicking on MFC vent.
2. Open the chamber following instructions given in [Slide 8](#).
3. If another sample to be loaded, place the next sample in the chamber and close the chamber using instructions given in [Slide 9](#)

← MFC Vent: Purging of the chamber

Step 17

Turning off of the system

Section 1



Low vacuum gauge

High vacuum gauge

Current APC position

Set APC position

To turn on the rotary

Reflects turbo speed

Turbo ON/OFF

Steps

1. If further process is needed to be done repeat the instruction from [Slide 11](#) onward.
2. If not, start the roughing of the chamber. (soft roughing is not required as there is no sample in the chamber)

To start/Stop the roughing

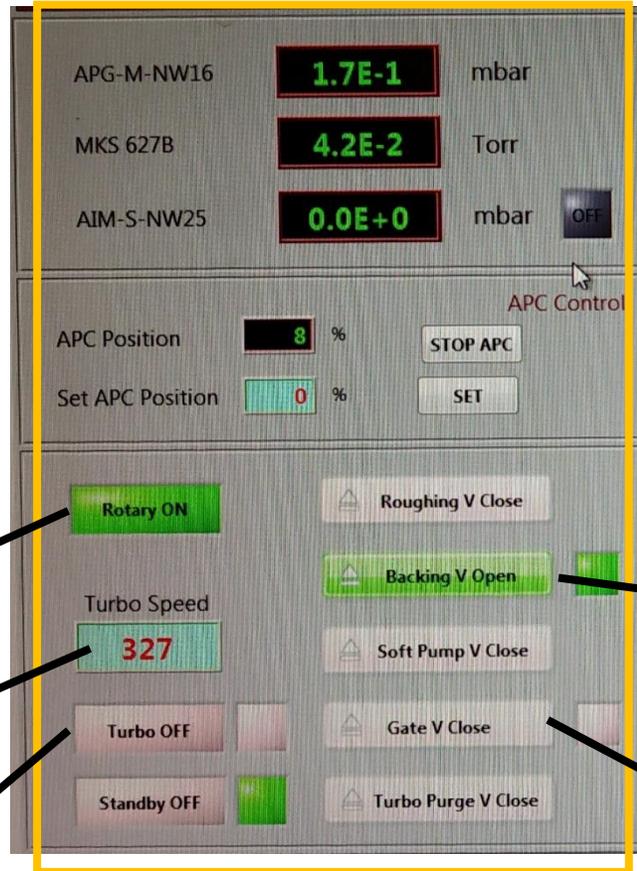
3. Wait for chamber pressure to drop till $5e-2$ Torr.
4. Create high vacuum in the chamber using instructions given in [Slide 13](#).

Turbo purge, to purge the gas during process to maintain the constant pressure

Step 18

Turning off of system

Section 1



Low vacuum gauge

High vacuum gauge

Current APC position

Set APC position

To turn on the rotary

Reflects turbo speed

(2) Turbo ON/OFF

Turns green when High vacuum is on, turn it

Steps

1. Close the gate value.
2. Stop the turbo: "Turbo stop" and wait for the speed to drop till 0.
3. Stop the backing valve.
4. Stop the rotary pump.

To start/Stop the roughing

To Start the backing for the system (3)

For soft roughing of the chamber

Gate valve of the turbo (1)

Turbo purge, to purge the gas during process to maintain the constant pressure

Step 19

Stopping of the plant and the software

Press here to stop the software

Plant OFF

Steps

1. Turn off the plant.
2. Turn off the software.
3. Shut down the PC.

RIE Interface.vi
File Edit Options Tools Window Help

RIE Control Interface, IIT Bom

APG-M-NW16 **1.7E-1** mbar
MKS 627B **4.2E-2** Torr
AIM-S-NW25 **0.0E+0** mbar OFF

APC Control
APC Position **8** % STOP APC
Set APC Position **0** % SET

Rotary ON
Turbo Speed **327**
Turbo OFF
Standby OFF

Roughing V Close
Backing V Open
Soft Pump V Close
Gate V Close
Turbo Purge V Close

CHF3
Actual **0.0** SCCM Close
Set **0** SCCM SET

CF
Actual **0.0** SCCM Close
Set **0** SCCM SET

O2
Actual **0.0** SCCM Close
Set **0** SCCM SET

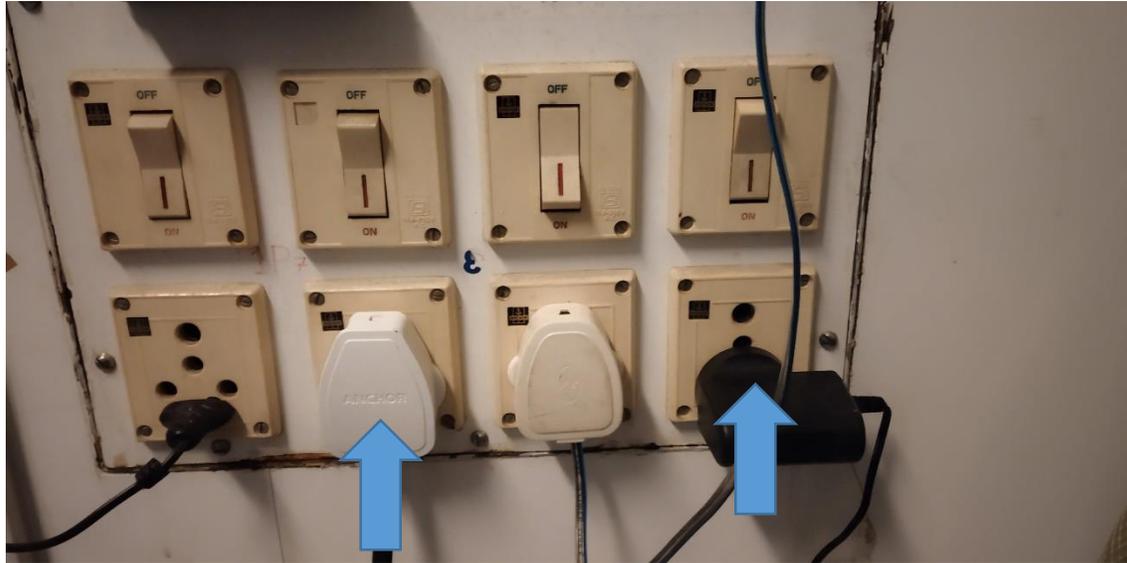
SF6
Actual **0.0** SCCM Close
Set **0** SCCM SET

Gas Box Control **192.168.1.30**

D.S. Dynamic Control Systems
Email: dynamiccontrols@gmail.com

Step 20

Stopping of the PC for system interfacing



**1. Extension
Switch**

**2. LAN
Switch**



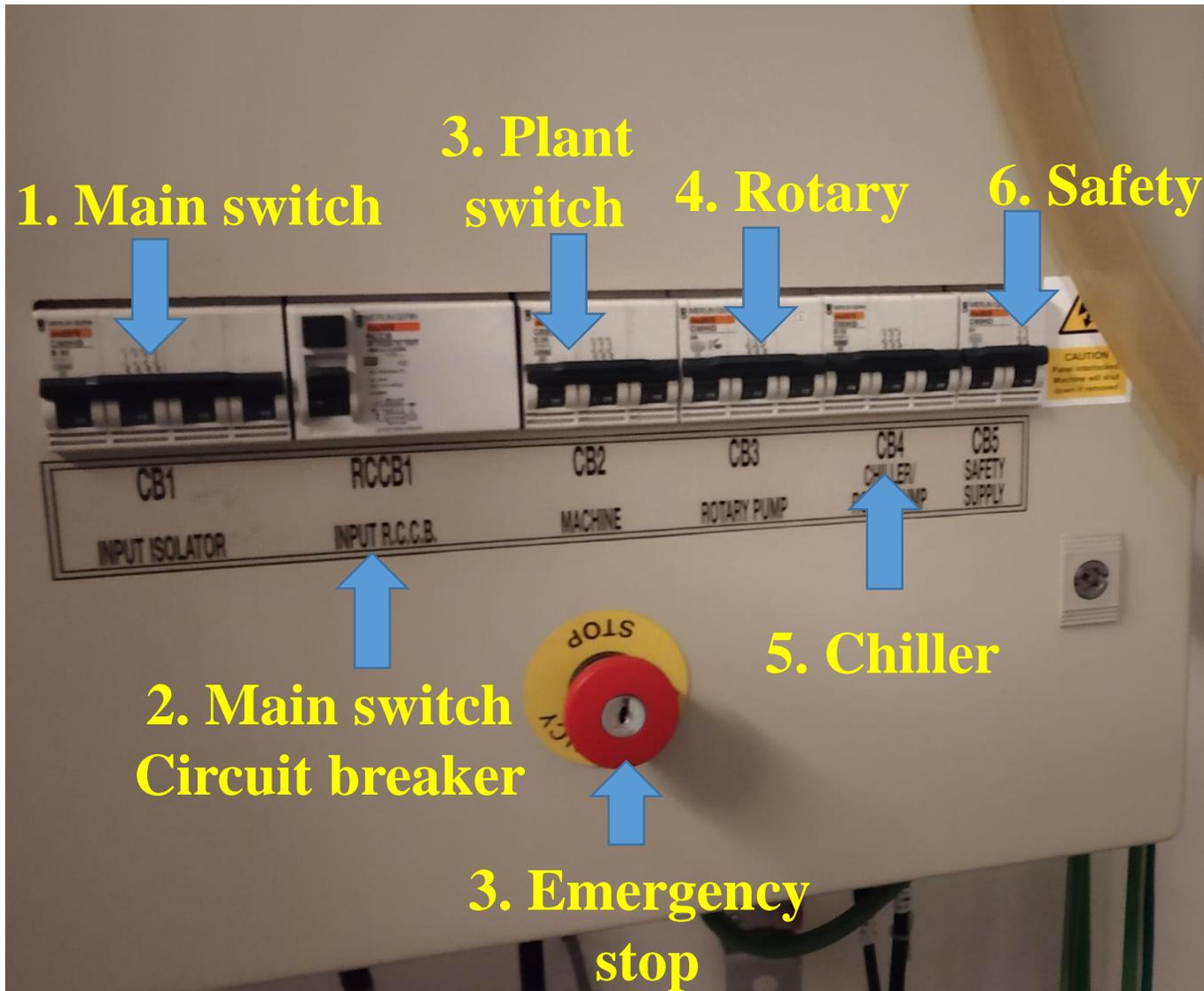
Extension: Always on

Order of turning-off :

1. Extension switch off
2. LAN switch off

Step 21

Stopping of the STSRIE system



Order of turning off power switches:

1. Safety switch
2. Rotary power switch
3. Plant switch
4. Main switch circuit breaker
5. Main Switch
6. Close the used gas cylinder knob