Recovery after power failure, Albanova Nanolab.

Indroduction

On Friday 2017-09-29, at about 19:30 there was a complete power outage for 4-5h. This is a short description of how to start up all systems in the Nanolab when the power is back.

Warning!

It is no use going into the lab during power outage, there is nothing to do. In fact all ventilation is stopped, there is a clear hazard to walk around in the lab in complete darkness. Wait until the power is back until you take action.

Start-up

Some systems restarts automatically when the power returns, the systems in the AFM-lab, the Raith 150 EBL system, the Eurovac deposition system. Please note that at the time of this writing, no systems in the Nanolab are running on UPS.

Startup Issues

1. The FEI Nova 200 SEM/FIB system could not be started. Service had to be called and a power supply had to be replaced. A service technichian started the different pumps in correct order.
2. The cryo pump on system AJA 2 needed to be regenerated after the power failure. The cryo pump started automatically when the power came back, the chamber then had a low (bad) vacuum. This was not discovered until Monday (2017-10-02) and the pump was stopped. By then the cold head was warm and water condensed onto the pump. After this the regeneration was done. However no harm seem to have been made to the cryo pump.

Problems found

- Alarm on the ventilation monitor in the process room.
- Alarm on the water cooling system.
- Low pressure on the damping table for FEI/FIB and ebeam.
- No ventilation into the e-beam room.
- System completely down FIB, Sputnik, AJA1, Edwards, Ar/O2 etcher, Cryo Etcher,
- System ON: Eurovac, all AFM
- Intermediate status:
    - E-beam was pumping and the gun was at good pressure.
    - The computer for pattern generator was switched off.
    - AJA2 the cryo pump was on but was not regenerated which caused the cold head to warm up.

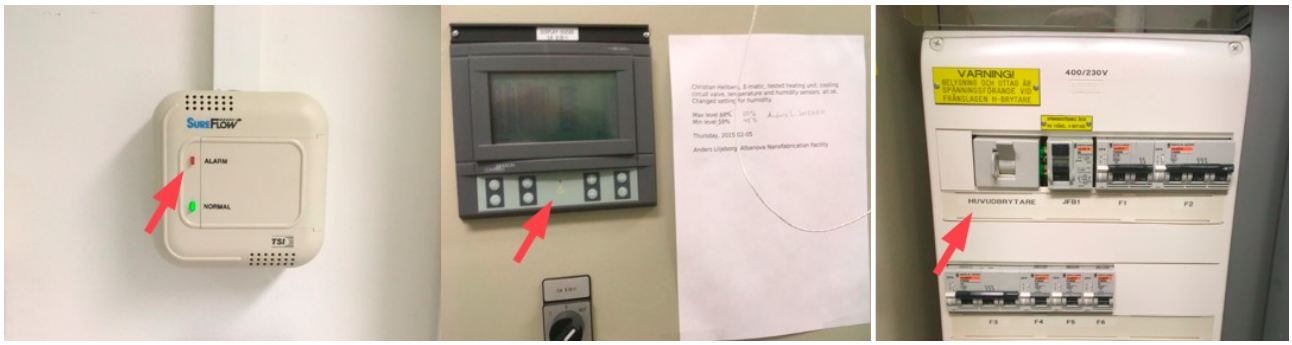
Please check with Albanova central service persons, Viktor Mannervik for Albanova general and Lasse Johansson (COOR Service Management). The ventilation, central nitrogen and the compressed air has to be in order for almost all systems to be started and operate properly.

FEI Nordic support organisation can be reached at 08 5792 9063, support.nordic@fei.com.

Raith GmbH support can be reached at +49-231-95004-499, exchange +49-231-95004-0.

Details how the problems were solved

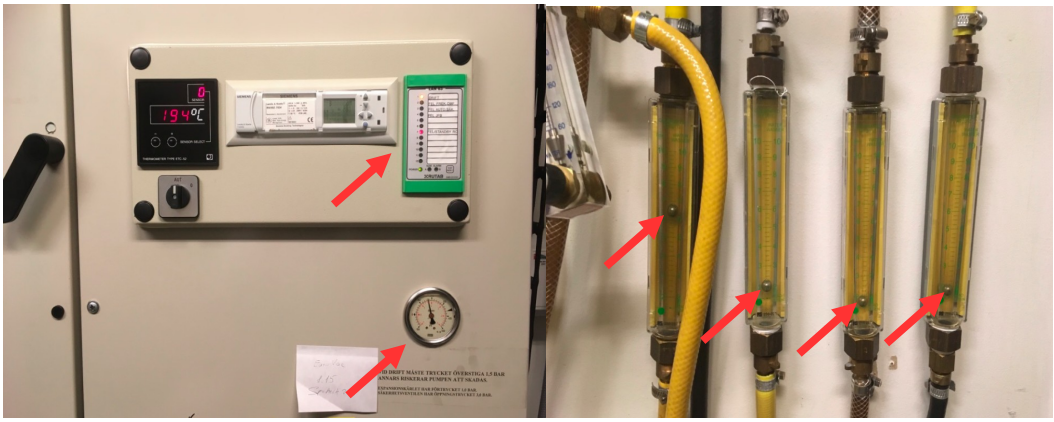
Alarm concerning the ventilation in the process lab:



This was solved just by switching off and on the main switch on the controller. The controller is located in the small room between the AFM lab and the Deposition lab. The controller cabinet in the center picture must be opened to reach the mains switch (right picture).

There are several wall-mounted units for sensing air-flow in the labs and service spaces. These will sound an alarm until reset. One such unit is shown in the picture to the left above. Slide the lid the the right (might have to use a screwdriver) and press button ”Reset” to silence the alarm. This is usually normal after a power failure. Help was provided by Lasse Johansson (Skanska, sitting in the Coor Facilities Management office on floor 1).

Alarm on the water cooling system



This is the cooling water unit in the service for the Ebeam and the Deposition labs. The controller usually shows an alarm (silent), it does not stop after a reset (red arrow to the top left).
Water pressure should be about 2 bars, within range of 1.5 – 2.5 bars. The flowmeters shown to the right should have the indicated flows at normal operation. This cooling water unit is servicing the AJA1, the Sputnik, the Eurovac and the FEI Nova 200 SEM/FIB.

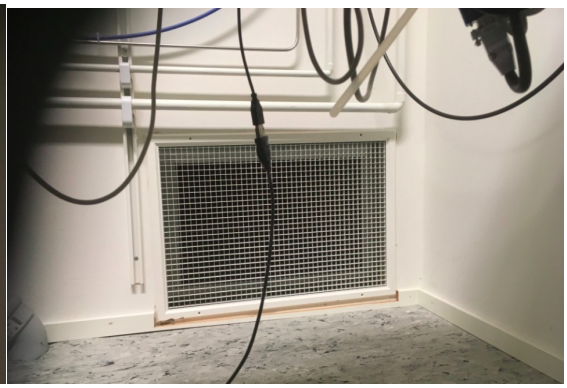
Other cooling water units are located in the service corridor of the Process lab, they have a simpler controller unit, that normally should show no alarm.

Low pressure on the vibration damping table for FEI/FIB and Ebeam

The vibration isolating platforms for the Raith 150 EBL and the FEI Nova 200 SEM/FIB are driven by an air compressor outside of the Nanolab. The compressor is located on floor zero of the Albanova main building. The incoming pressure should be around 9 (7?) bars, this can be regulated with the black knob on the underside of each control unit.

If the pressure is low it means that the compressor is down, service personel in Albanova must be contacted to start the compressor (Lasse Johansson, Coor Facilities Management office on floor 1).

No ventilation into the ebeam room



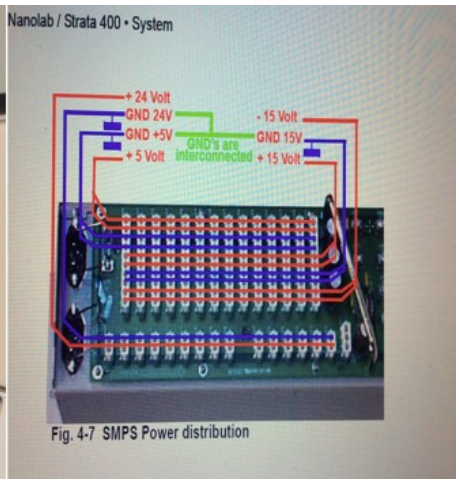
Check if the ventilation controller is on. The ventilation unit is located in the Ebeam-service room. Switch on if it is off.

Check to see if air is moving under the FIB table (a draft). If not, this is a problem outside of the Nanolab and Albanova service personel must be contacted.

Restart the controller if there is no ventilation or if the temperature is too high. If it is still too high after some time, it may be necessary to decrease the temperature setpoint. Lasse Johansson checked the flow into the room from his central control computer, but couldn’t see any problems. He also checked the compressors for the air tables, and they were also working properly. The pressure should apparently be around 7 bar.

Starting FEI Nova 200 SEM/FIB

A short description can be found here:
http://www.nanophys.kth.se/nanophys/facilities/nfl/feinova200/manual/FEI_Nova_200_maint_instr.pdf



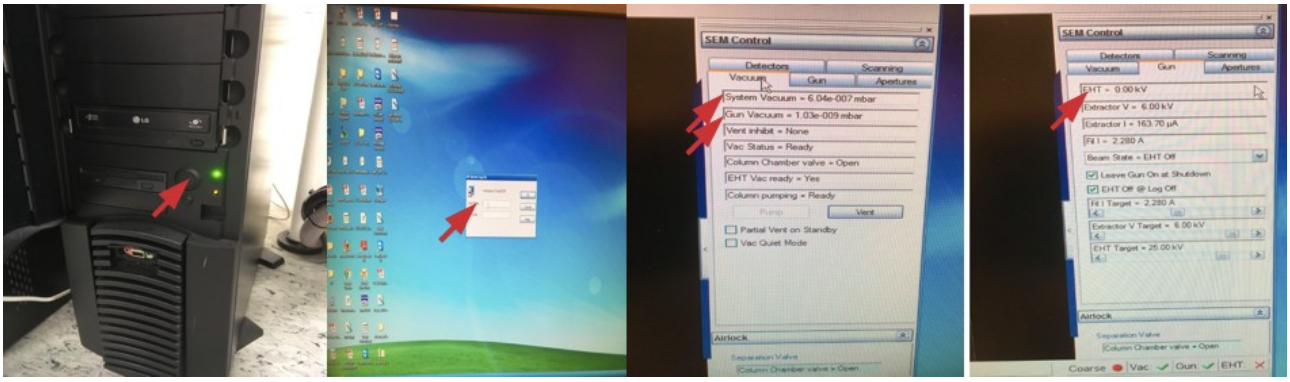
Normally the system can be started with the front panel button indicated in the picture to the left. One press and the button should be illuminated.

After this particular power outage this did not work due to a broken power supply. First the fuses of the power supply were checked, four automatic fuses and two slo-blo fuses, see center picture. The power distribution is shown in the documentation, and can be checked with a volt meter from the back of the tall electronics cabinet. This should be done by a skilled person, since it is very difficult to reach this electronics board. Usually it is best to call FEI service, phone numbers are in the paper documentation at the system (Jonas Appelfeldt, Mikael Nordenkvist, FEI Service).

Starting the Raith 150 EBL system

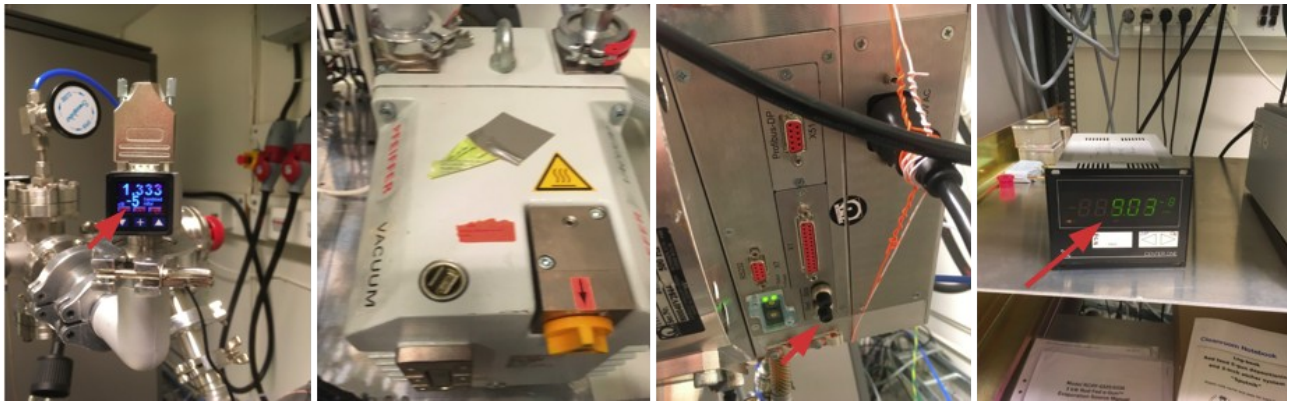
A short description can be found here:
http://www.nanophys.kth.se/nanophys/facilities/nfl/manual/Ebeam_maint_instr.pdf

The system recovered partly when the power came back. The left (SEM) computer was on. The right (EBL control) computer had to be turned on.



Log on to left computer, check vacuum of main chamber and gun chamber. If vacuum is ok ($1x10^{-9}$ for gun chamber, < 4-5 x 10^{-6} for main chamber), start the gun and the EHT. Run the Gun monitor logger for a couple of hours with EHT at 25 kV to check stability.

Sputnik system start procedure



- Check the vacuum level in the main chamber (pic. 1).
- Check that the primary pump located in the service room is ON (pic. 2).
- We had vacuum pumped by the backing pump in the system (about 10^{-1} mBar) and then we could start the turbo by pressing the “start” button (pic. 3).
- Check that the pressure in main chamber gauge indicator is going down and reaches 10^{-7} mBar in few minutes (pic. 4).
- **Please note!** The turbo pump does not have a controller to check the speed and power. You need to check the vacuum and hear the noise from the pump.

AJA1 Sputter starting procedure

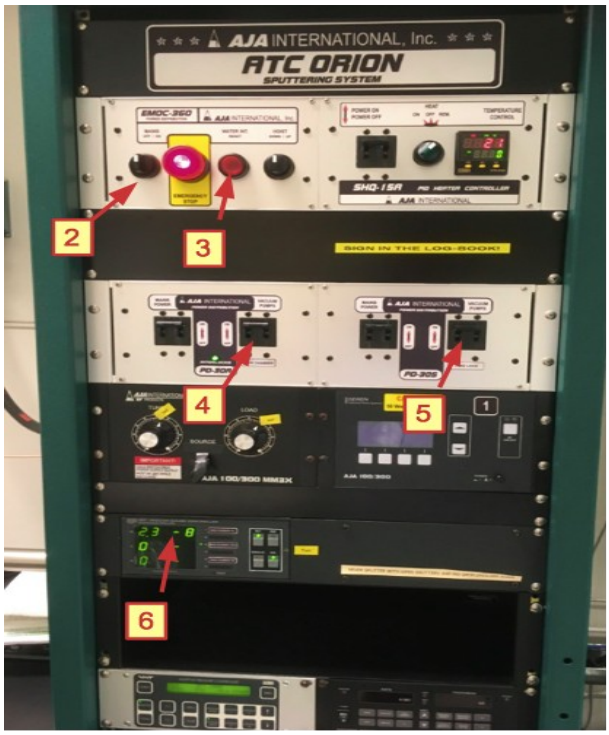
Very important note!

When the power fails, the system automatically closes the main valve between the turbo and the main chamber.

This valve must be open before starting the pumps.

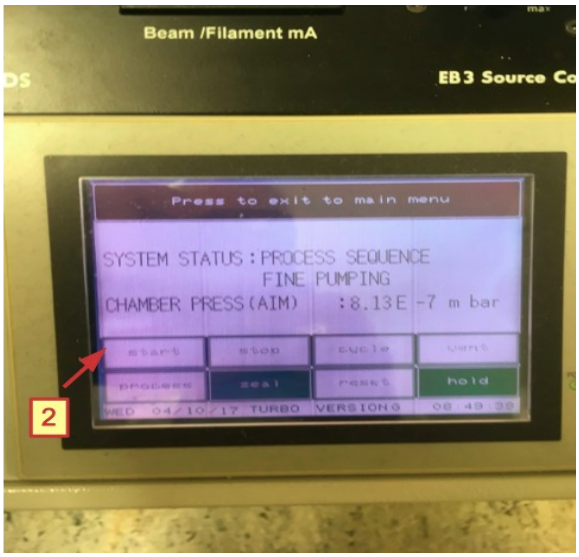
- Start the controlling software on the laptop and **open the valve from the software**.
- You have to **switch off and then on** the system from the main button ON/OFF (2)
- Reset the water interlock if it is blue (3).

- Start the turbo for the main chamber with the switch on/off (4) and the load lock pump (5).
- Wait and check that the pumps reach full speed by checking into the controller on the bottom left side of the system.



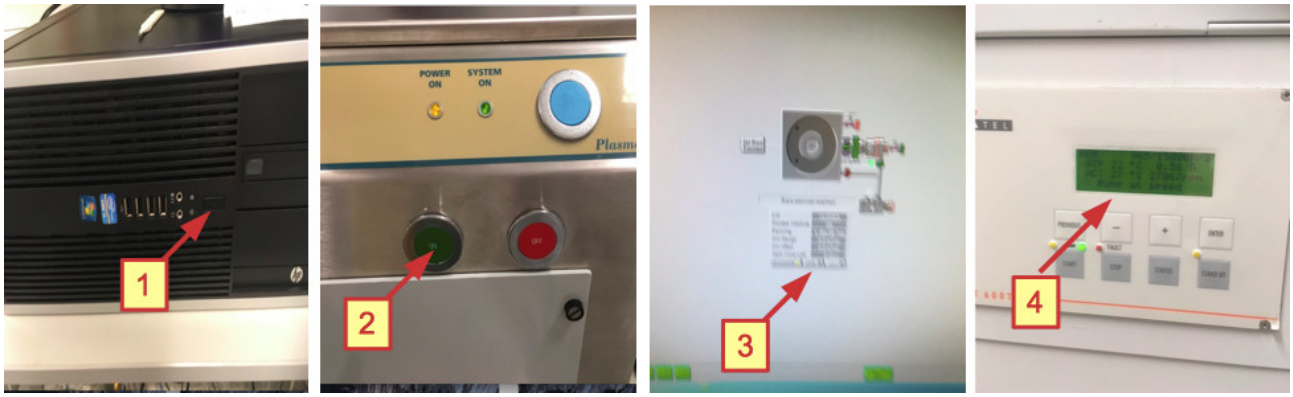
When the pump is at full speed the gauge controller pressure of the main chamber (6) starts to be active and we can see the pressure go down. After this you need to go in the software and start the bakeing of the chamber from the program. You can use the system after 12 h when the vacuum is in the range of the 10^{-8} Torr.

Edwards system startup



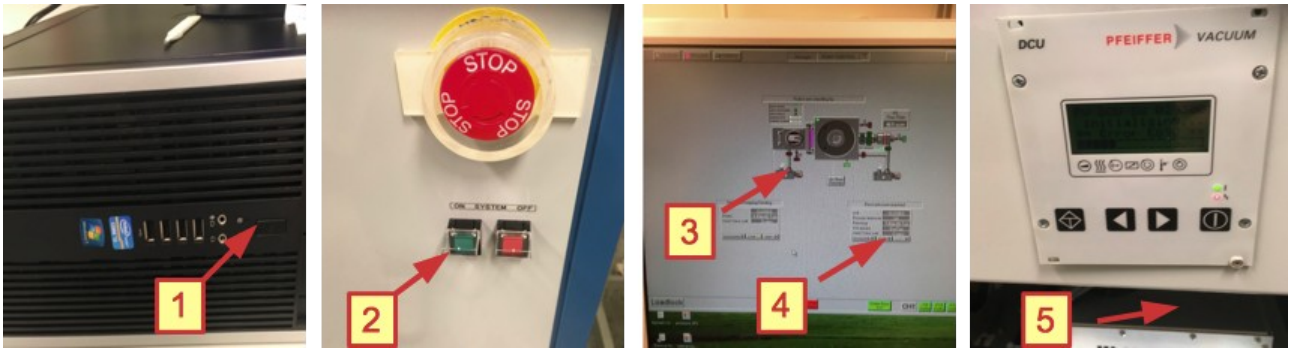
In order to start the system you need to press the Reset bottom (1) if is blue. Then you follow the screen controller START and PROCESS. After few minutes you may see the pressure into the system in range 10^{-7} mBar.

Oxford Plasmalab 80 Ar/O_2 etcher start up



- Start the computer first (1).
- Switch on the system from the ON green button (2).
- Start the software with the user/passwd OPT/OPT.
- In the software Press STOP, then EVACUATE (3).
- When the system is ready there is the message "*Base pressure reached*" , the pump indicator is green and say "*at speed*".
- Check the turbo pump controller (4), there should be a message "*Pump at speed*" and 75 krpm speed of pump.

Oxford Plasmalab 100 Cryo RIE etcher startup

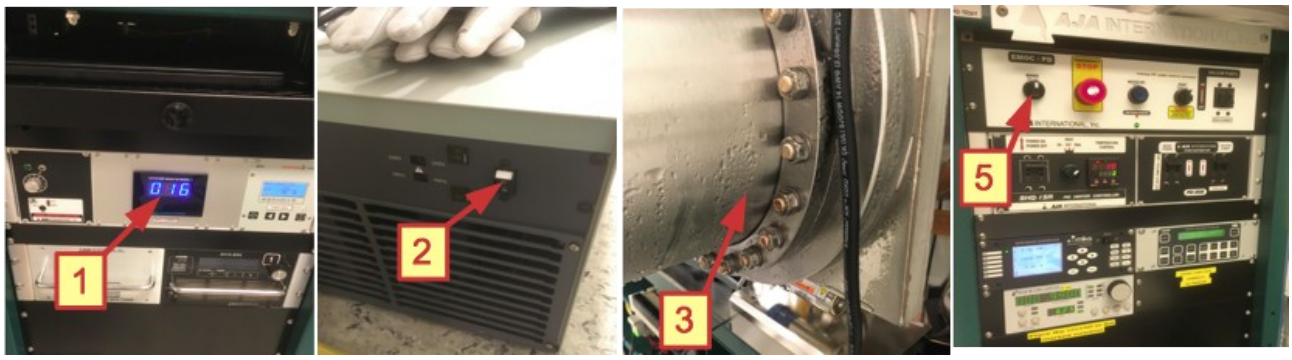


- Start the computer (1).
- Start the system from the main button green(2).
- Start the software by using the user/passwd OPT/OPT.
- Pump the load lock (3) by going into service mode and click on the pump symbol.
- Exit service mode.
- You need to switch ON the turbo controller (5) on the back side (reach underneath the right side of the front panel to find the switch).
- Click "Evacuate" (4) to start pumping the main chamber.

- The primary pump starts to work and at some point the turbo starts to “accelerate”.
- This procedure can take few minutes until the gauge is warming up. When the system is ready you have the message “*Base pressure reached*” , the turbo pump indicator is green and says “A*t speed*”. Note that the controller of the turbo is broken and does not show the speed of the pump.

AJA 2 Sputter startup

In case of power failure you need to check the temperature of the cryo pump (1). Typical temperature is around 16-17 K. If the temperature is higher you may need to regenerate the pump, there is a special procedure to pump and flush with nitrogen. It is recommended to stop the compressor which is located in the service corridor behind the sputtering system (2). The compressor restarted automatically when the power came back. But if the pump is not regenerated the cold head can heat up because there is too much gas to pump which causes condensation (3) and *there is a risk of damage to the cryo pump.*



For regeneration the cryo pump must be at room temperature:

- You flush with nitrogen for 30 min.
- Stop the venting with nitrogen
- Pump with an external turbo pump, 2-3 h.

Repeat this cycle 3 times. The valve between cryo and chamber must be closed during this procedure.

After regeneration is complete, the system has to be started for normal operation:

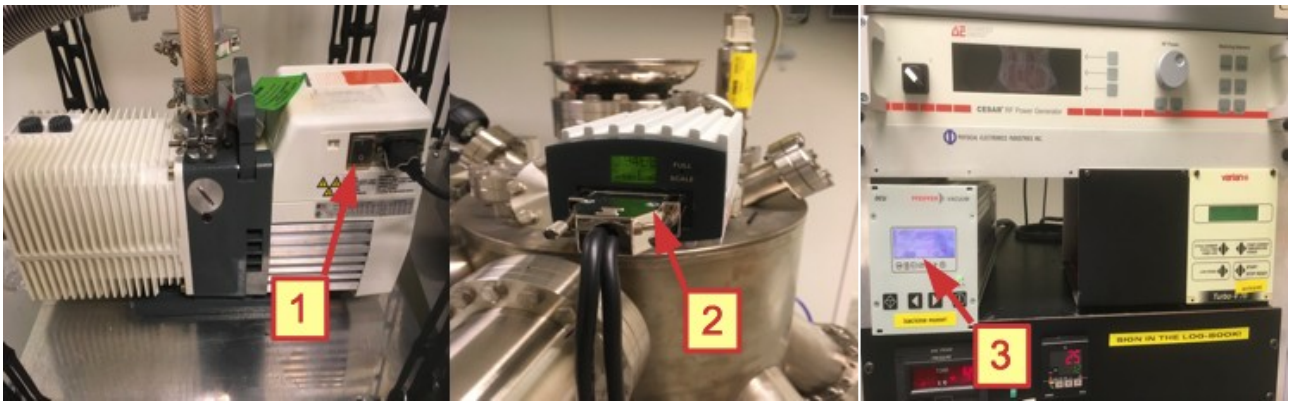
- Let the Cryo pump cool down to about 16-17 K
- Close valve between main chamber and Cryo pump.
- Open the transfer valve between loadlock and main chamber.
- Pump the main chamber with the load lock turbo overnight.
- During the pumping; heat the chamber to 200°C with the sample rotation on to evaporate the water.
- After 12 h stop the heating of the main chamber.
- Wait 2-3 h for the chamber to cool.
- Close transfer valve between main chamber and loadlock.
- Open valve between main chamber and Cryo pump.
- Pressure should go down to $3x10^{-8}$ Torr after overnight pumping.

Since the heating of the chamber (bakeing) also transfers some heat to the cryopump, it could be better to **first** bake the chamber, **then** do the regeneration and cool down of the cryopump.

Eurovac system startup

Eurovac system was operational when checked after power was restored. The system started up by itself without any problem.

Procedure to start up manually



- Start the primary pump (1) located in the service room behind the system.
- Check on the pressure controller (2), wait until $1x10^{-1}$ mBar is reached.
- Start the turbo from the control panel (3).
- If there is no leak in the chamber the pressure should go down to 10^{-6} mBar in a few minutes.
- In order to have a good vacuum, pump for about half a day.