

supernemo



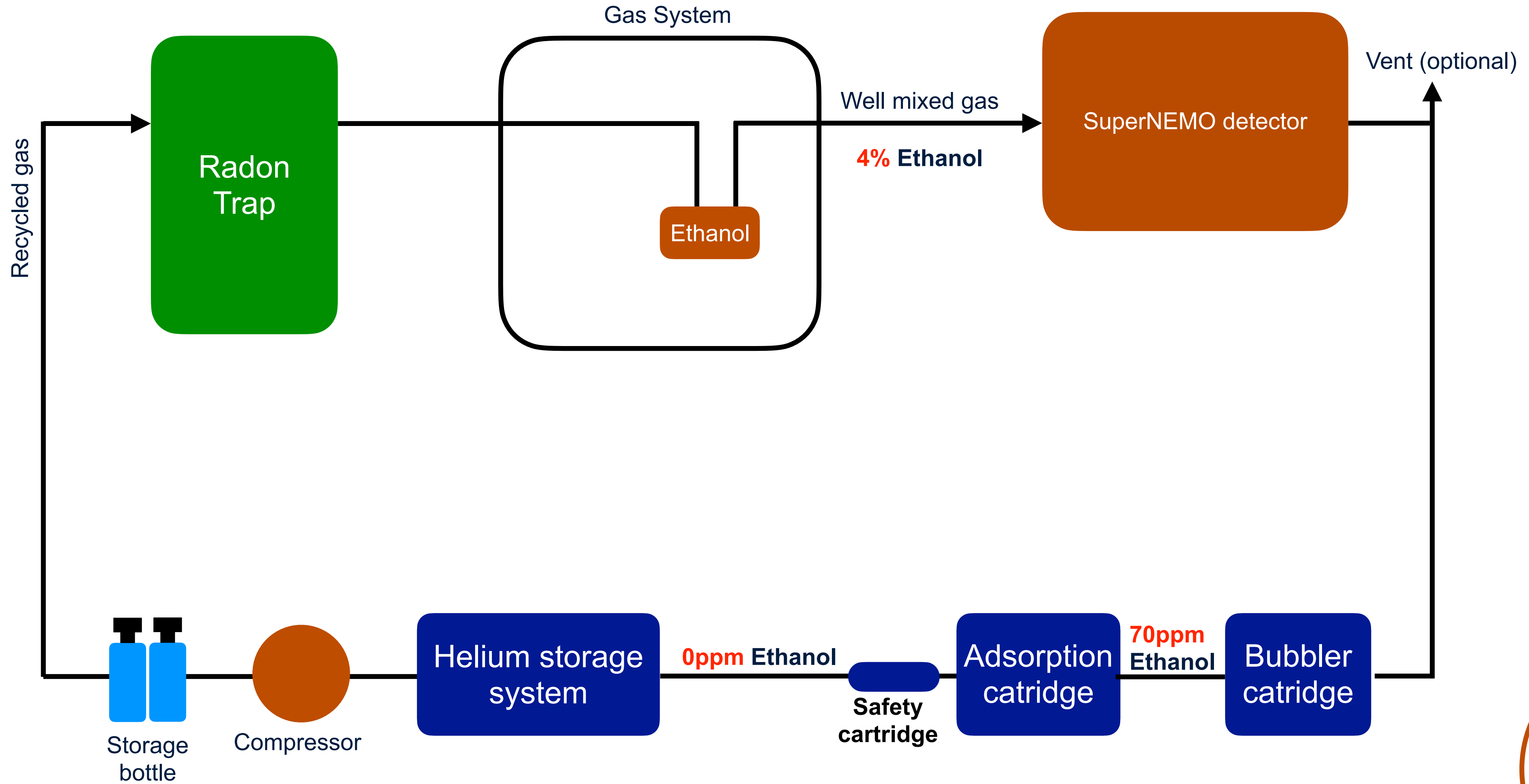
collaboration

# Update on helium recycling system

Elvis Penghui Li

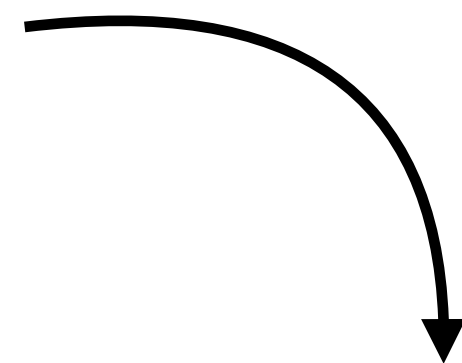


# The SuperNEMO helium recycling

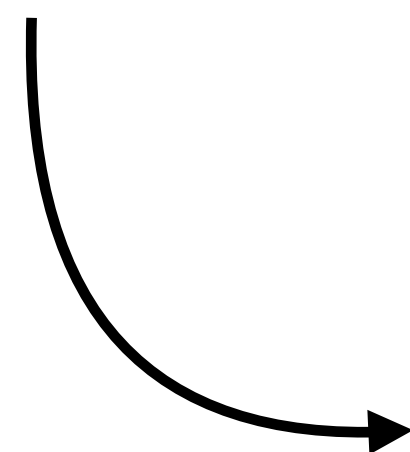


# Timeline of Helium recycling project

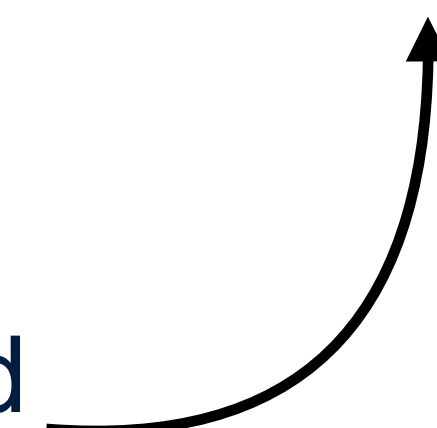
**2014** Start to have this idea



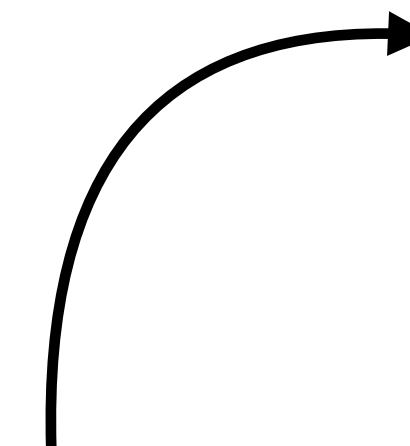
**2021** Proposal with ATEKO



**2023** ATEKO Proposal cancelled  
Edinburgh System proposed



**2023** Edinburgh System cancelled



**2024** Home-made system proposed

**2024** June System under construction at CPPM

**2024** September Mechanical system ready at LSM

**2025** March CM System installed at LSM

**2026** Feb system successfully running

**Delay due to compressor paperwork**



# Timeline of Helium recycling project

**THANKS to everyone who have worked on this project !!!!!**

Especially thanks for Hichem, Jose, Manu, Cheryl, Sam, Jean-Lou and Andrea. Also thank you Rasti for the BEAUTIFUL compressor! This project could not been happening without your help and support



# Frimley 2026

- Started the compressor **Jan 2026**
- CMS and gas remixing **built** and **tested**
- Problem with **air** leaking into compressor bottle
- Started recycling on **Jan 8**
- Successfully recovered **85%** of exhaust gas



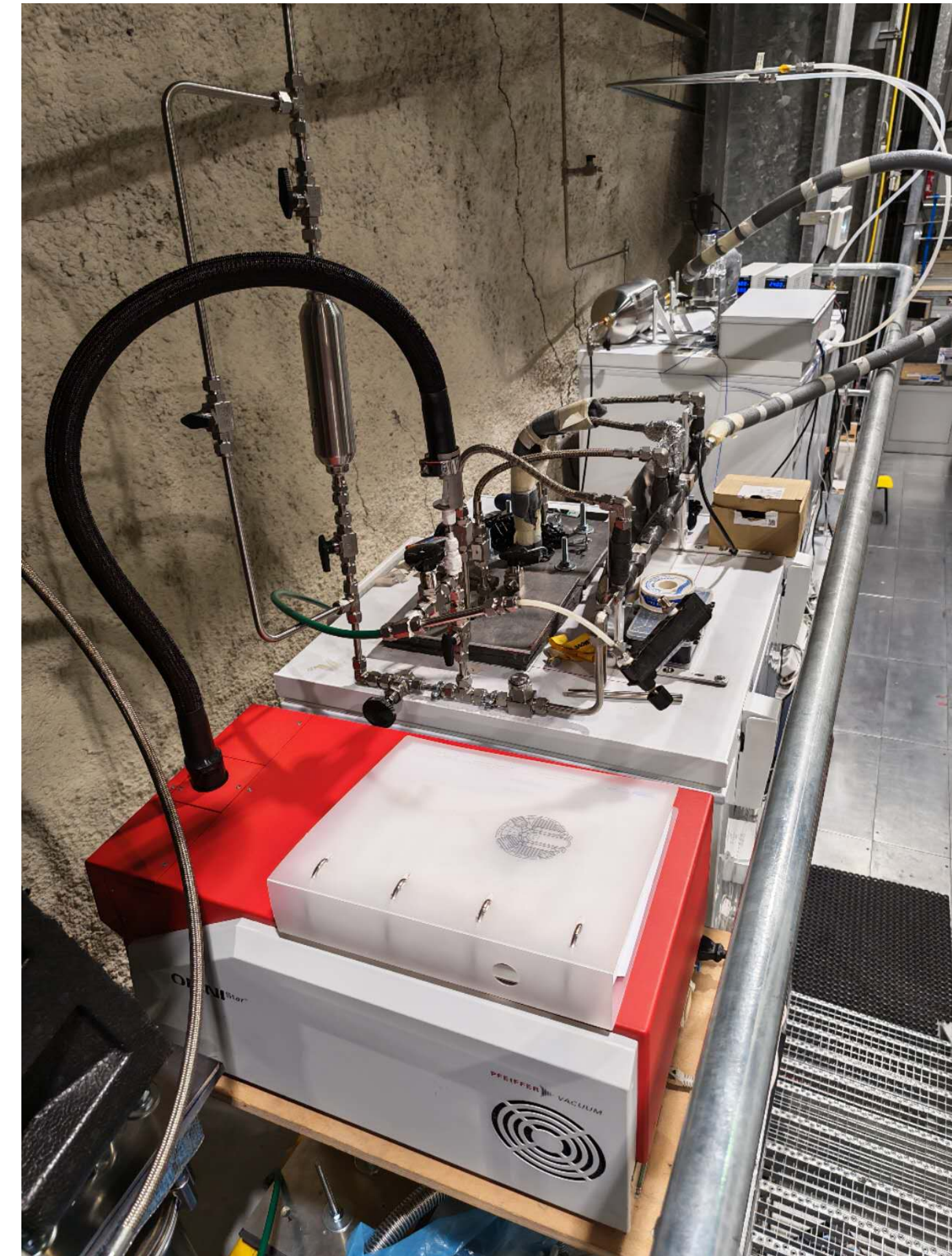
# Update on helium recycling

## Feb “After Frimley”

Successfully recycled with 75% efficiency

Compressor problem fixed

Recycling 75% does leave enough overpressure in the detector, decided to downgrade the efficiency



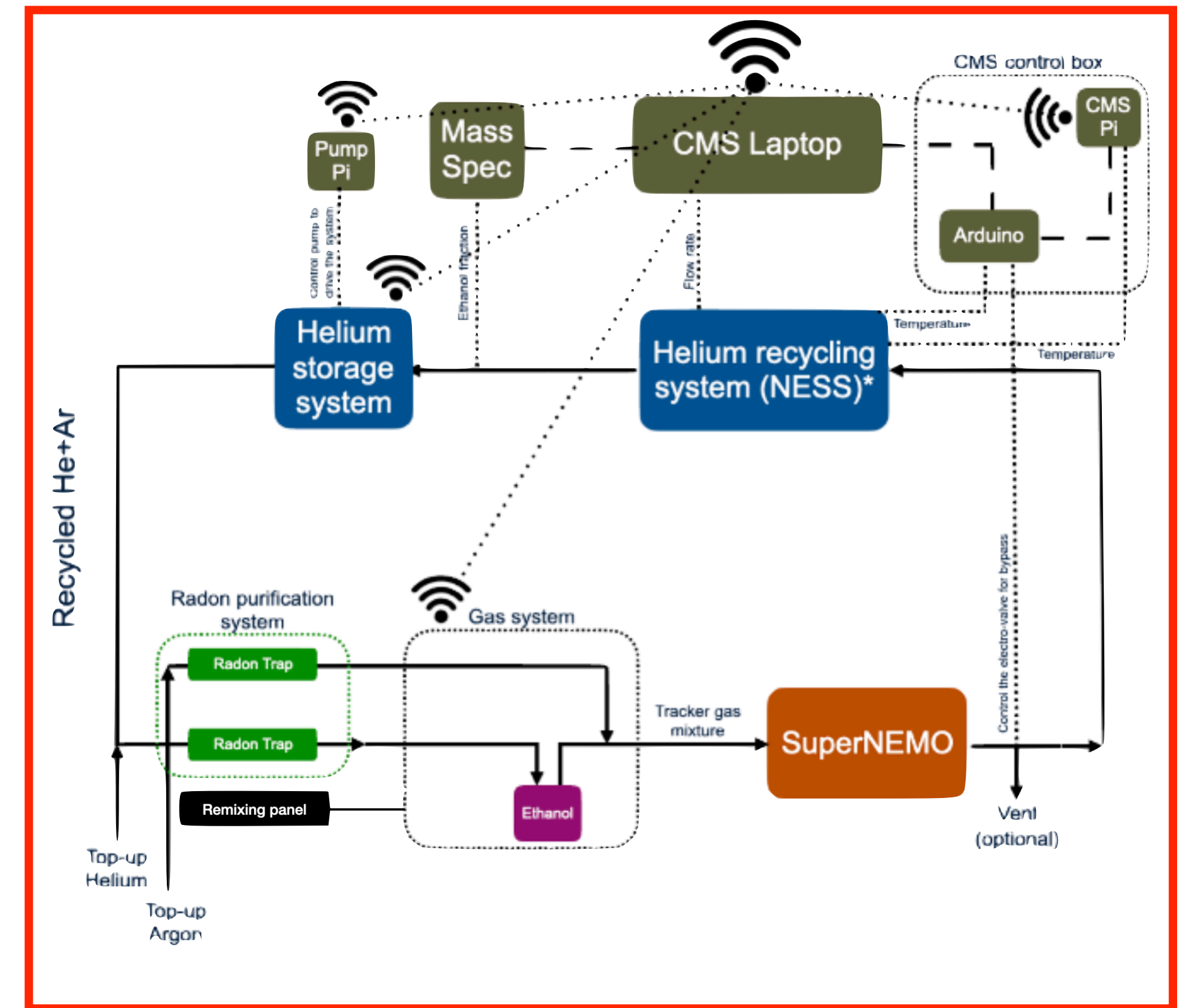
# March "Planned power cut"

Informed by LSM for the operation start and end time

First power cut for Helium recycling, the driving pump and compressor will be affected

Decided to fully shut off the system before and recovery after

## Affected Area



Thanks Hichem, Christine, Andrea and Cheryl for staying up in the night for the operation, BIG BIG commitment



# March “Compressor filter saturated”

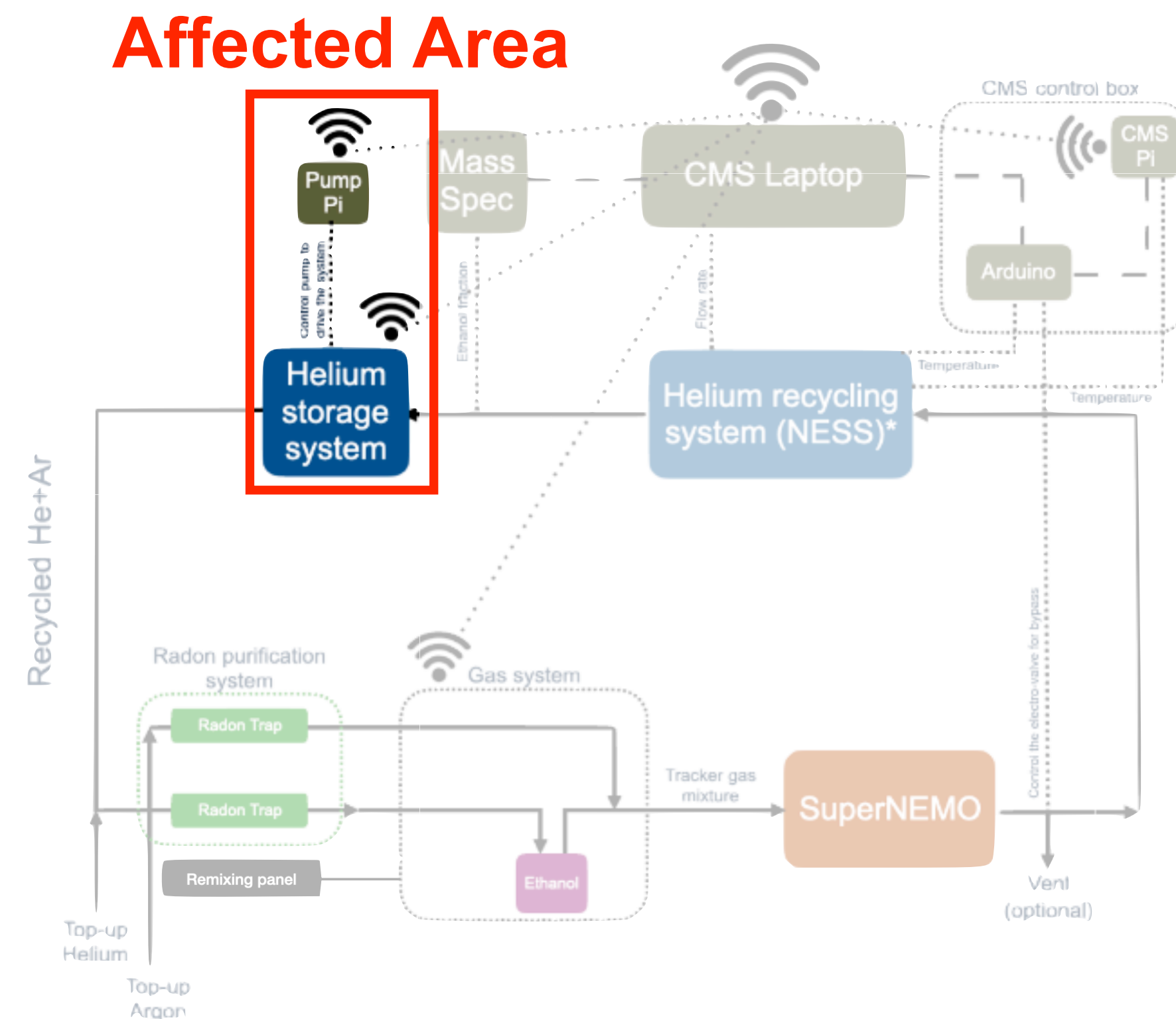
Compressor compression: ~20mins, 3 compressions per day

Impurity filter in compressor saturated with no replacment

System was shut down until Bauer came on site for replacement and training

Each filter ~70 hours of life time ~2monthes

Jean lou know how to change it now



# March "Power cut"

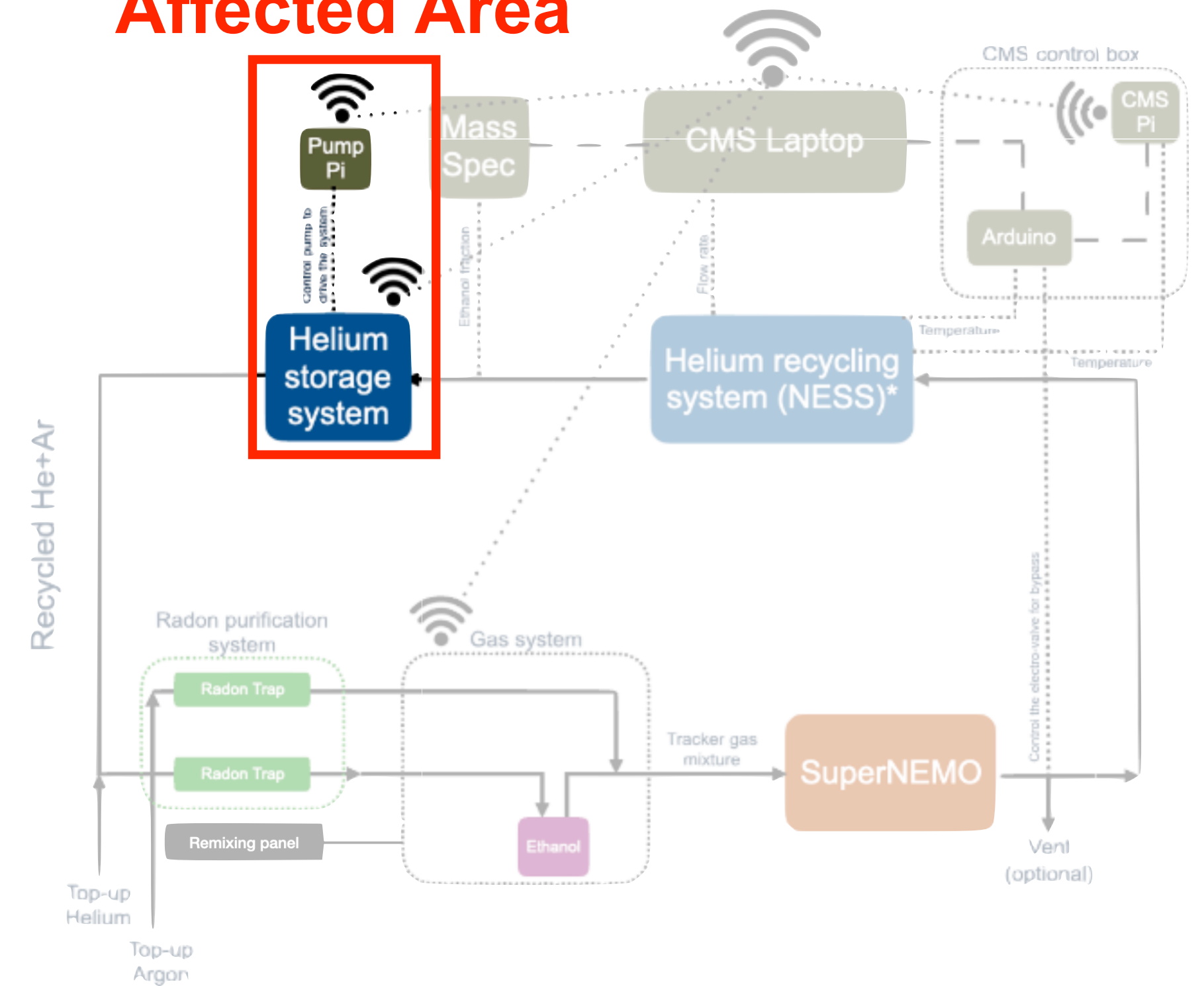
Planned power cut again

Shut down and recovery before and after

Multiple power cut afterwards due to instability

Restarted couple of times and probably messed up compressor (power cut during compression)

## Affected Area



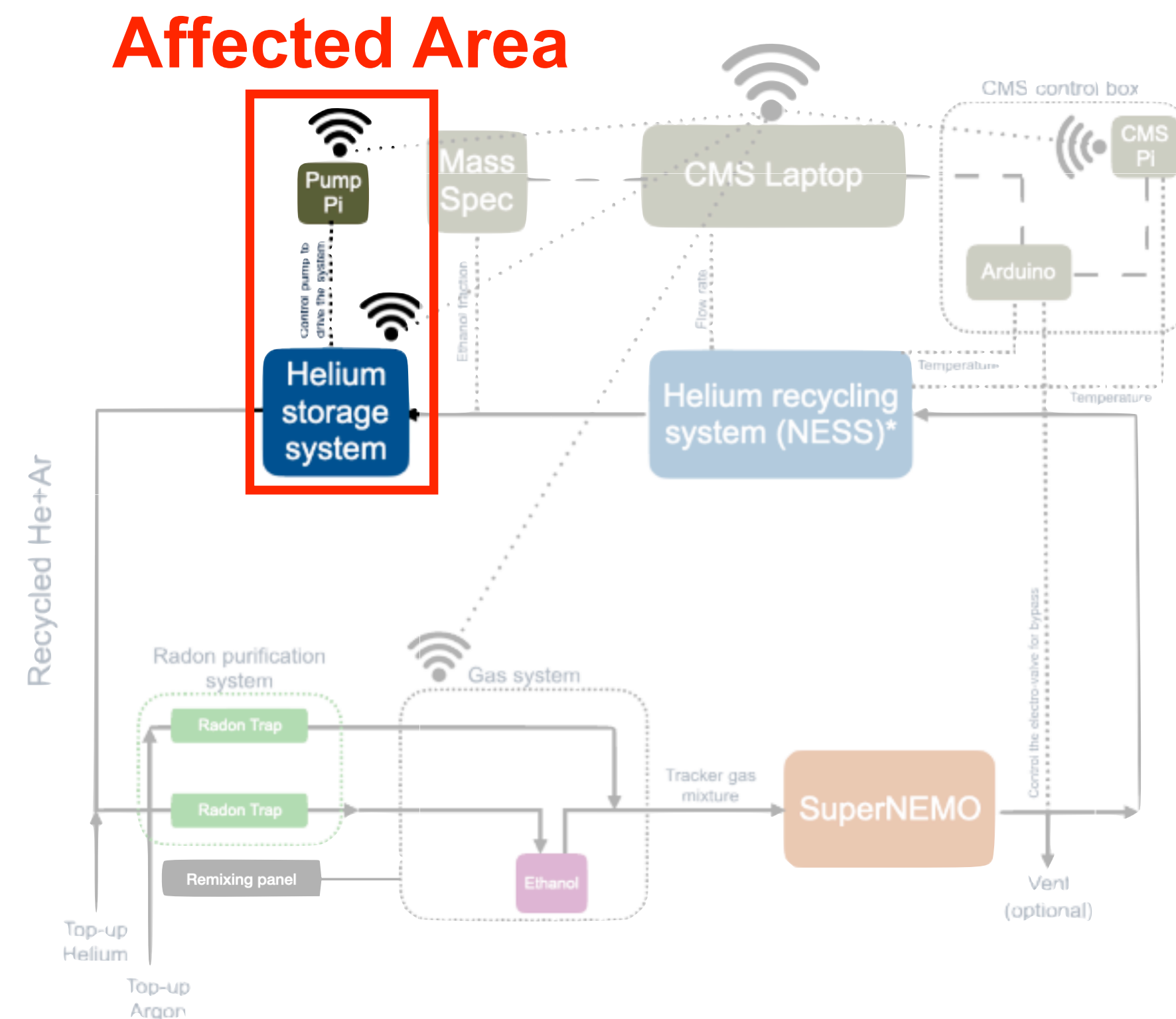
# March “Compressor went crazy”

End of March, the compressor went crazy and didn't stop after empty the balloon

Lots of lubricant oil and air got into the system and the detector(Only air)

Damage suspected from the power cut before

**We brought the system back after completely cleaning early April**



# Update on helium recycling

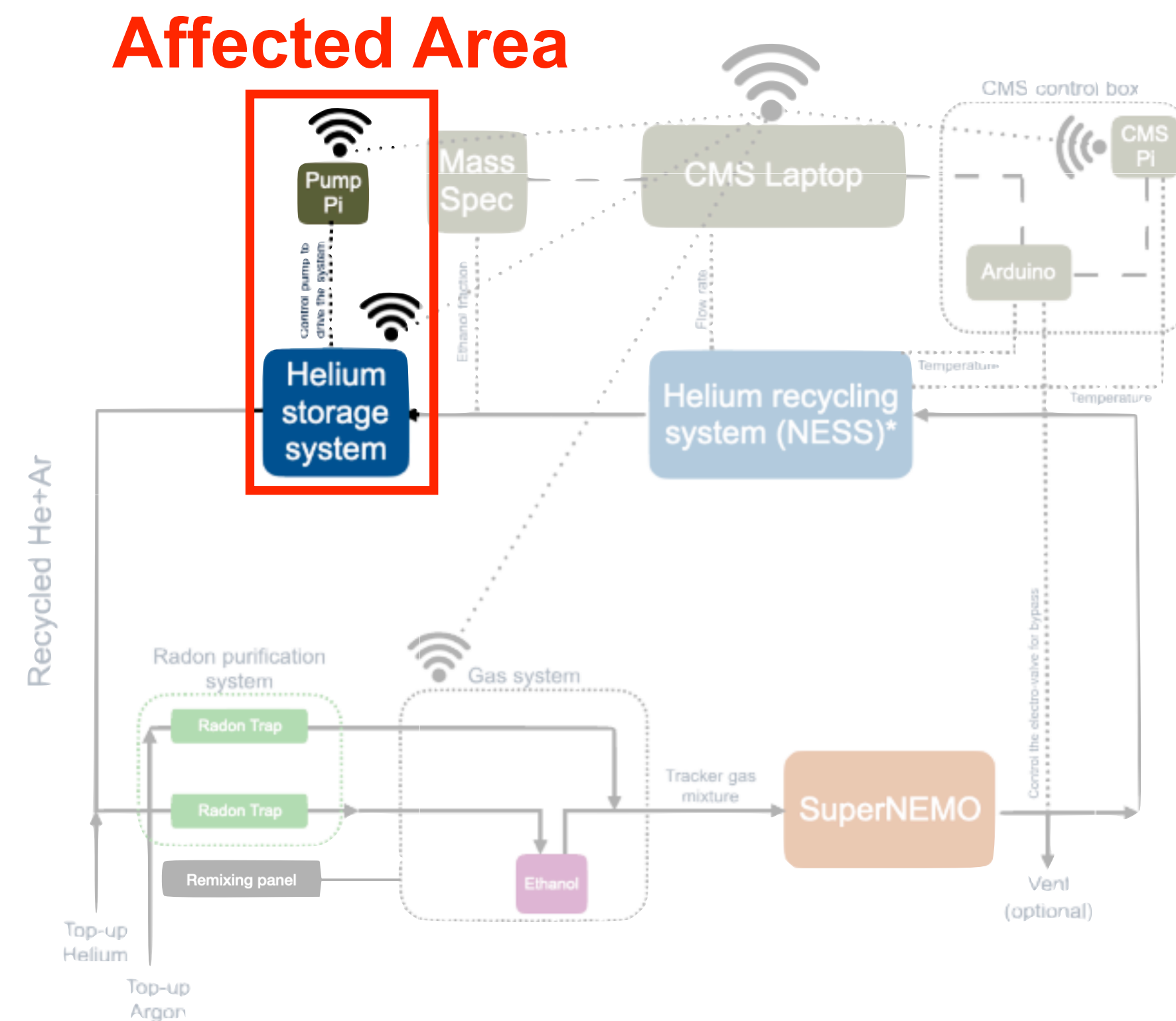
**April is a peaceful month**



# May “Compressor filter saturated again”

Impurity filter in compressor saturated again after 70hrs o compression time

System was shut down until Jean-Lou come back from vacation for a replacement operation (3days)

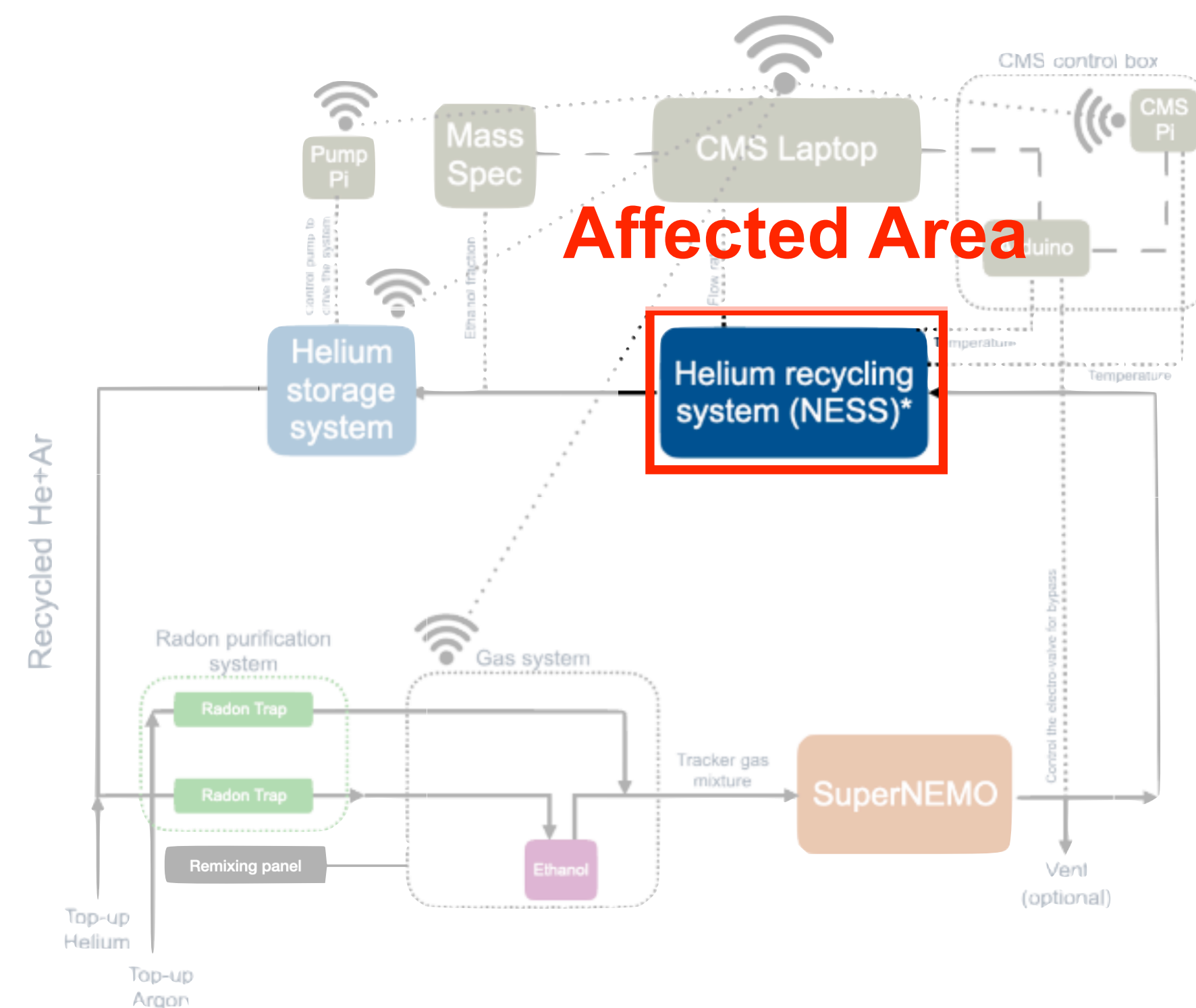


# May “Cartridge saturation”

Main cartridge saturated on 27.May, means the retention time for the main cartridge is ~83 days with 10L/min flowrate

Mass spec didn't react to it -> **Fixed**

After inspection, no ethanol breach was found (due to safety cartridge)

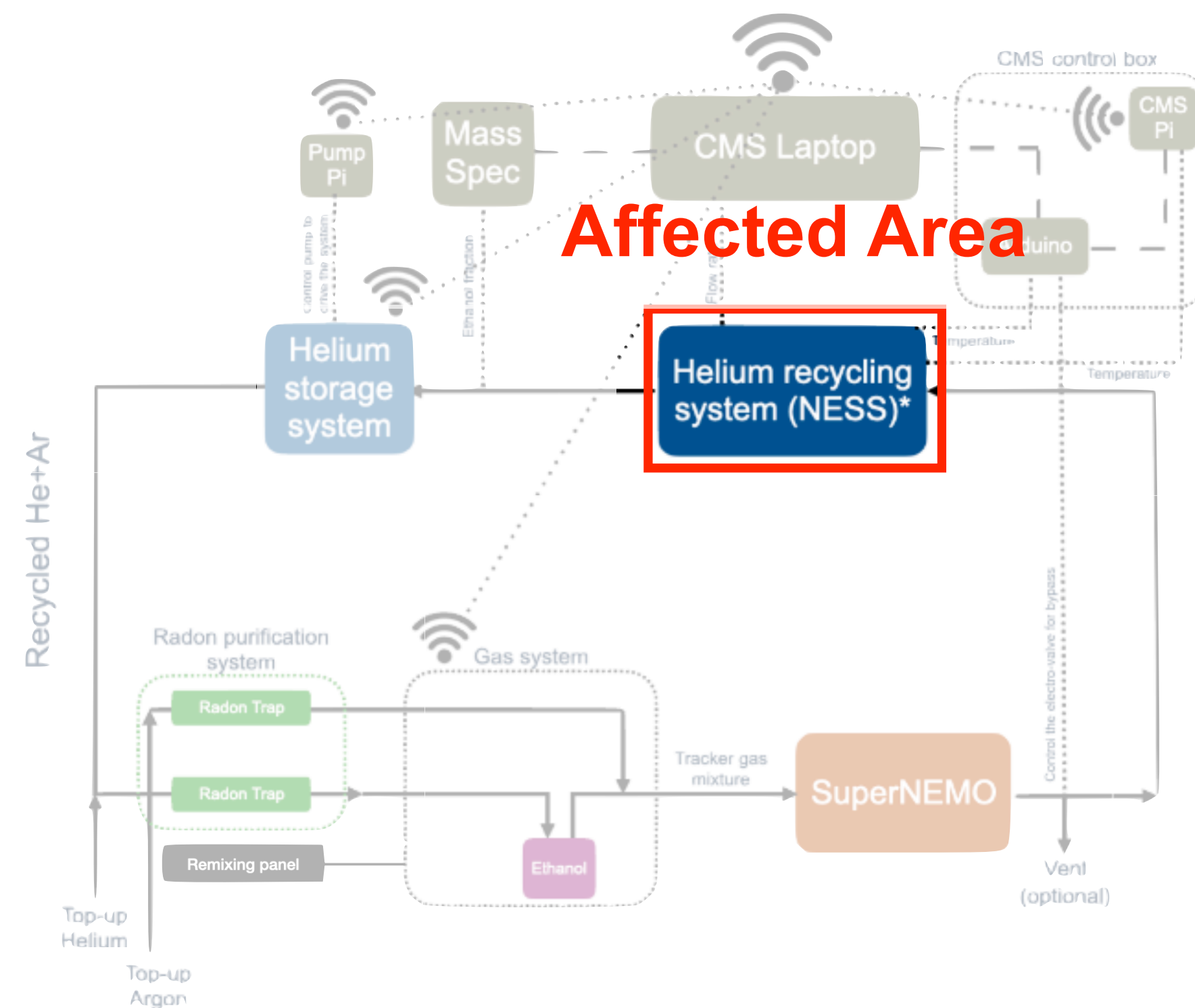


# May “LSM didn’t open the valve to ethanol tank”



LSM staff forgot to reopen the valve after collecting the ethanol

Luckily nothing disastrous happened



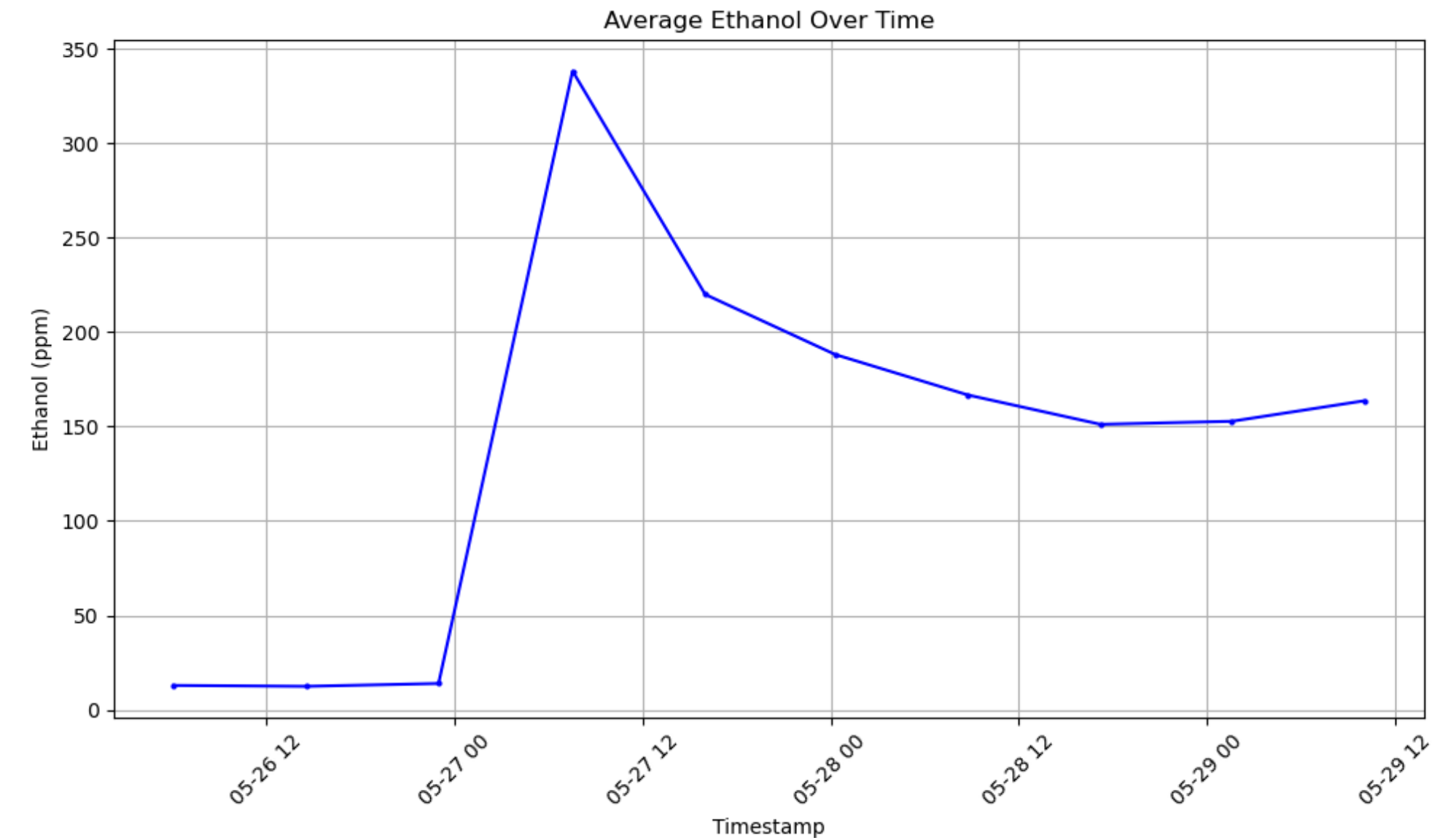
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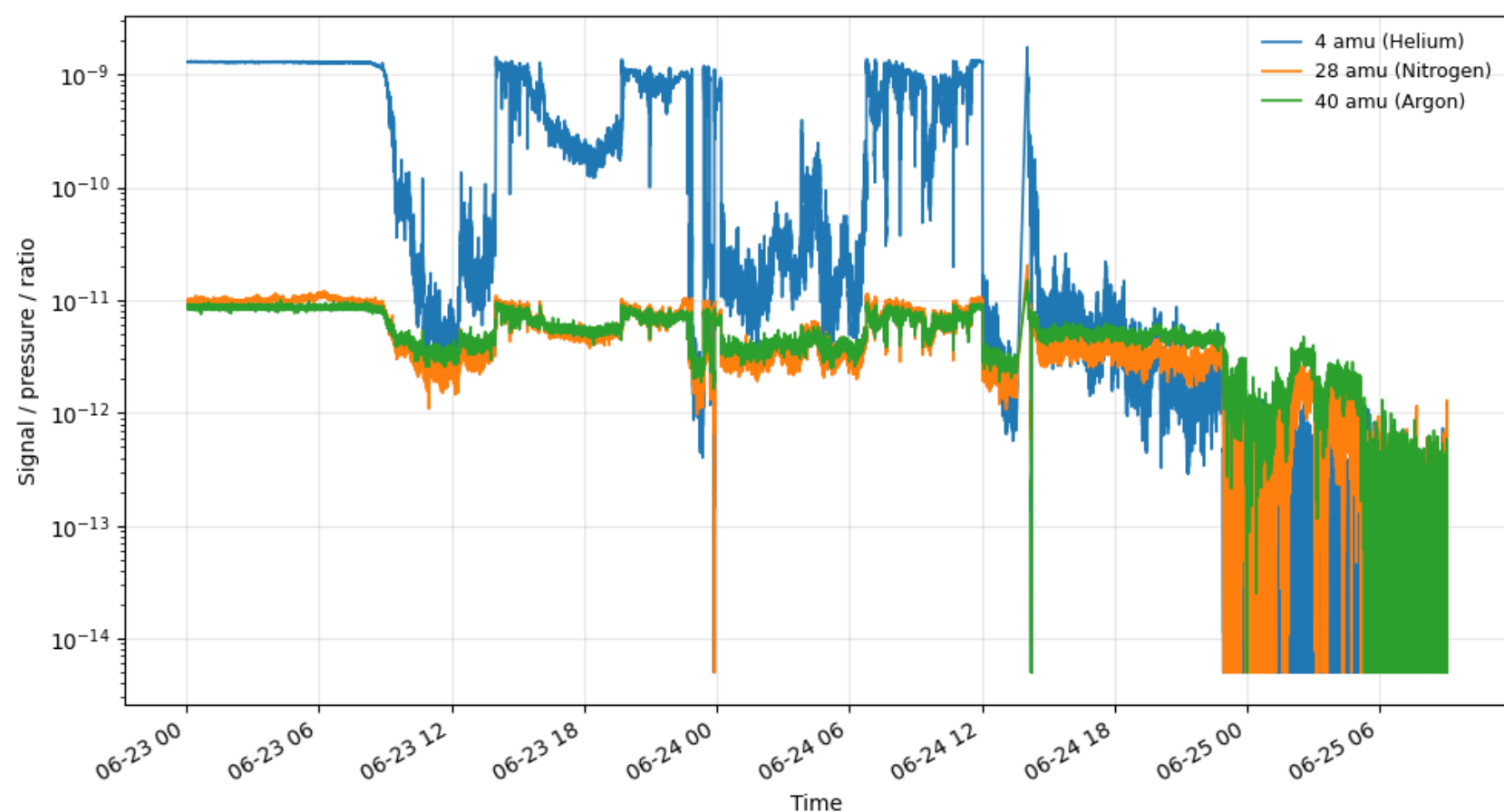
Mass spec reading max at ~400ppm , which shouldn't be more than 70



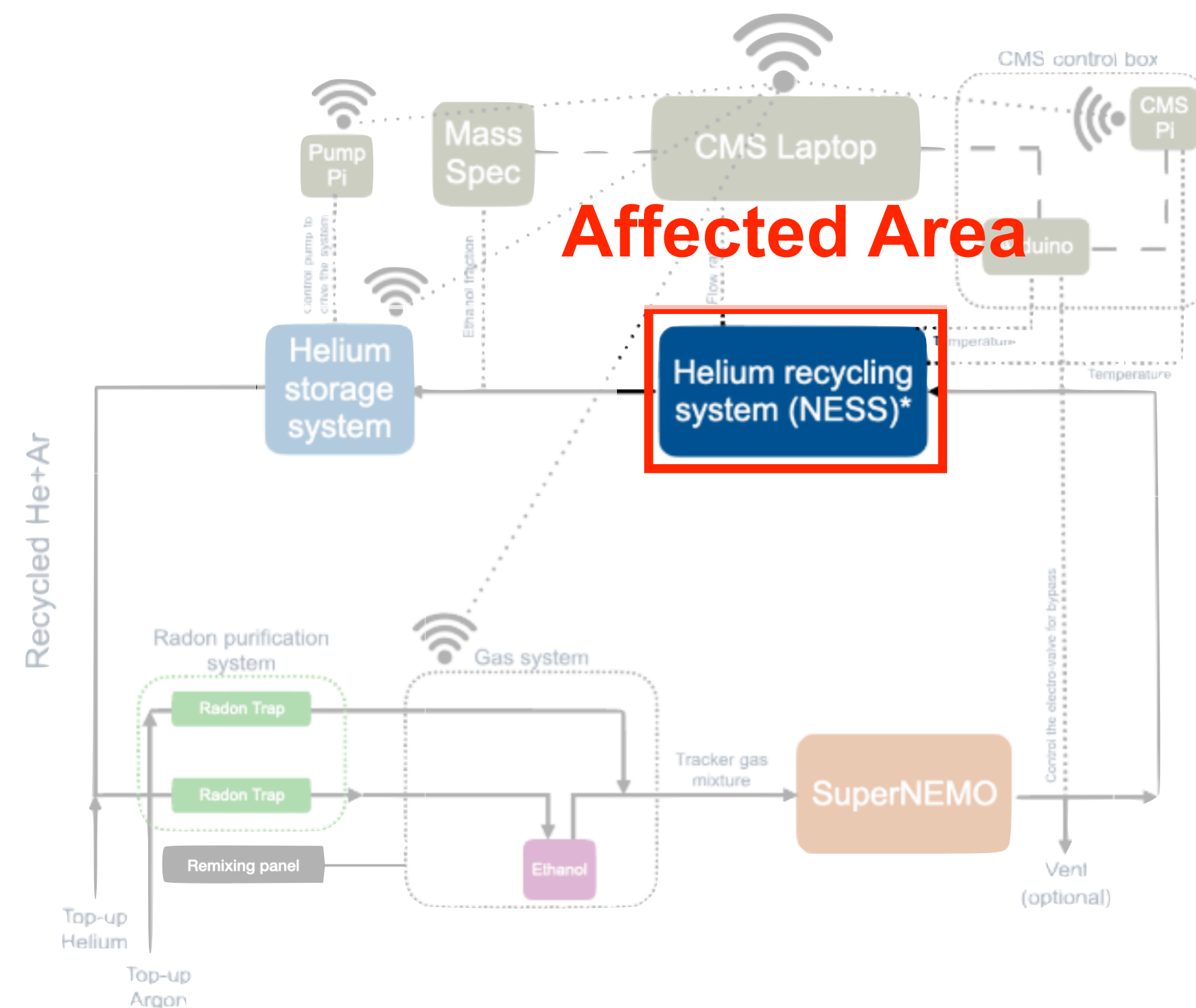
# June “mass spec problem”

June 23, the mass spec started to show weird result from the measured gas

Appears to be problem from the mass spec

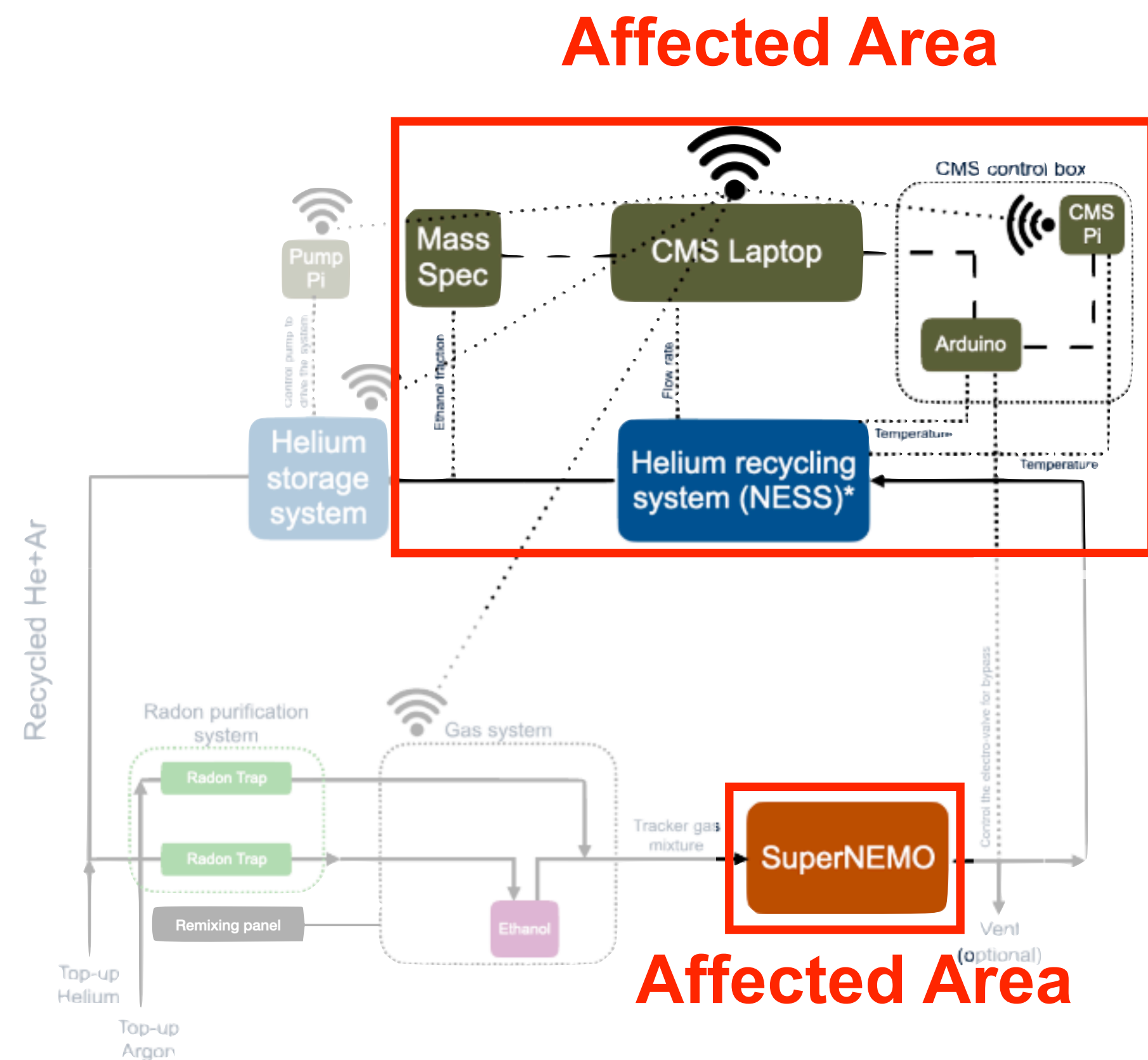


**Pfeiffer contacted**  
**Currently running without mass spec (with caution)**



# June "VACUUM CLEANER"

DAMIC connected a vacuum cleaner  
caused a power shortage  
Affected full tracker and half of helium recycling  
Fully recovered afterward



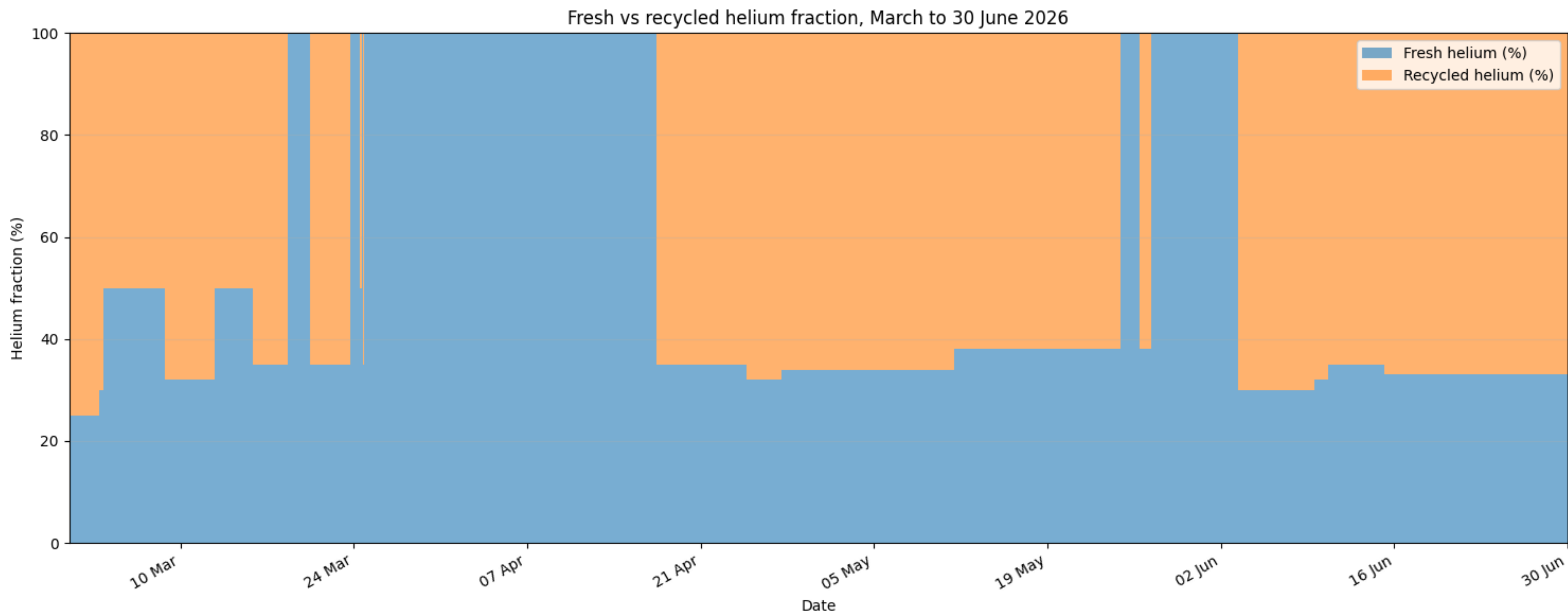
# Normal maintenance we did

Balance of recycled-fresh helium to ensure gas cycling



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Balance of gas passing primary bubbler to ensure gas is correctly mixed

3 other normal planned power cuts were managed



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Balance of recycled-fresh helium to ensure gas cycling

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# Upcoming duties for shifters on NESS

## Daily task for Shifter:

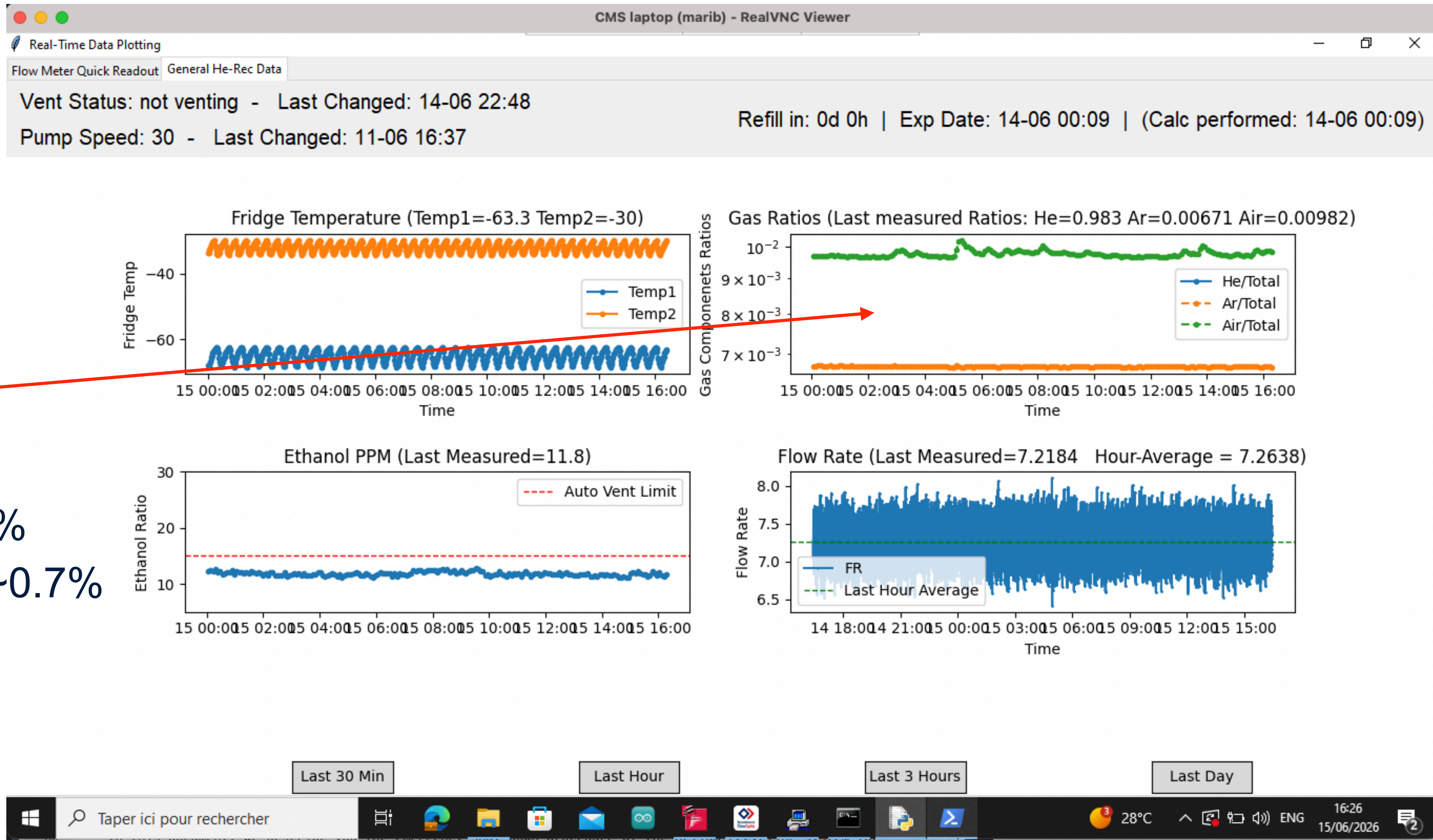
Check CMS-GUI (fridge temperature, air/ethanol fraction, pump flow )

In case of anomaly : Alert helium recycling expert  
(**Hichem, Elvis, Cheryl, Xalbat, Manu(not now)**)





# Upcoming duty for shifters on NESS



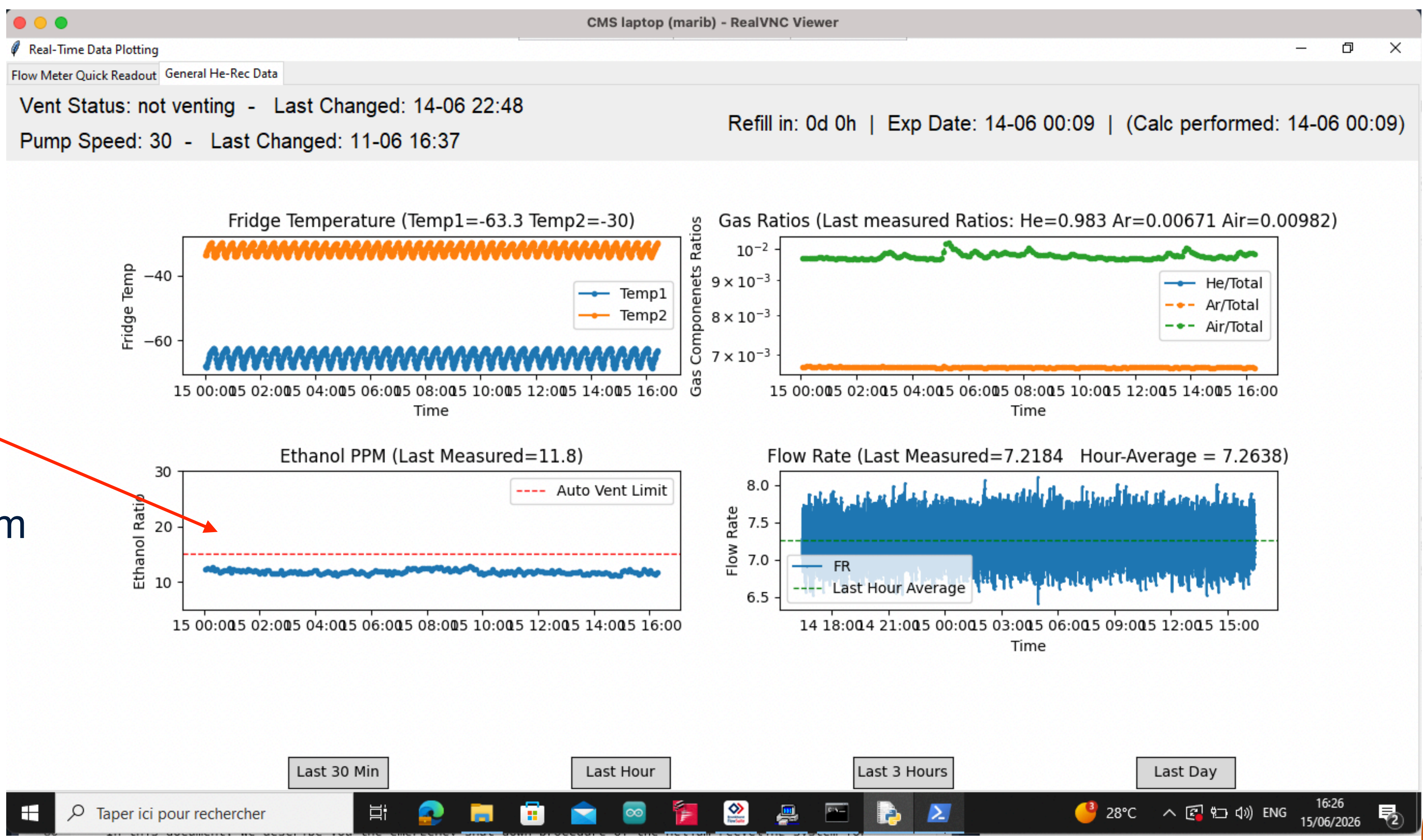
## Gas Ratio

Air should be ~1%  
 Ar should show ~0.7%

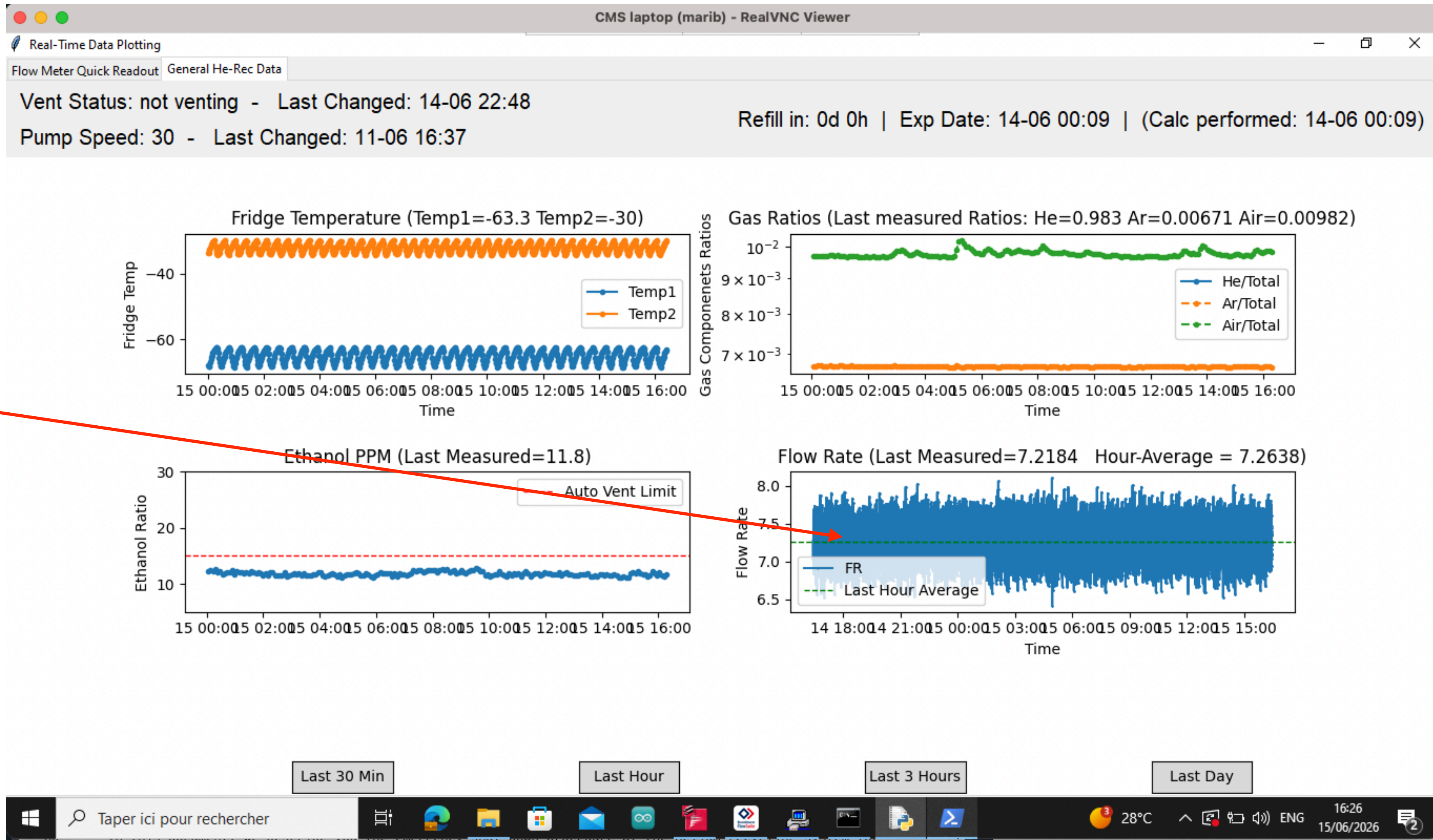


# Upcoming duty for shifters on NESS

**Ethanol  
PPM**  
Normally < 15ppm



# Upcoming duty for shifters on NESS



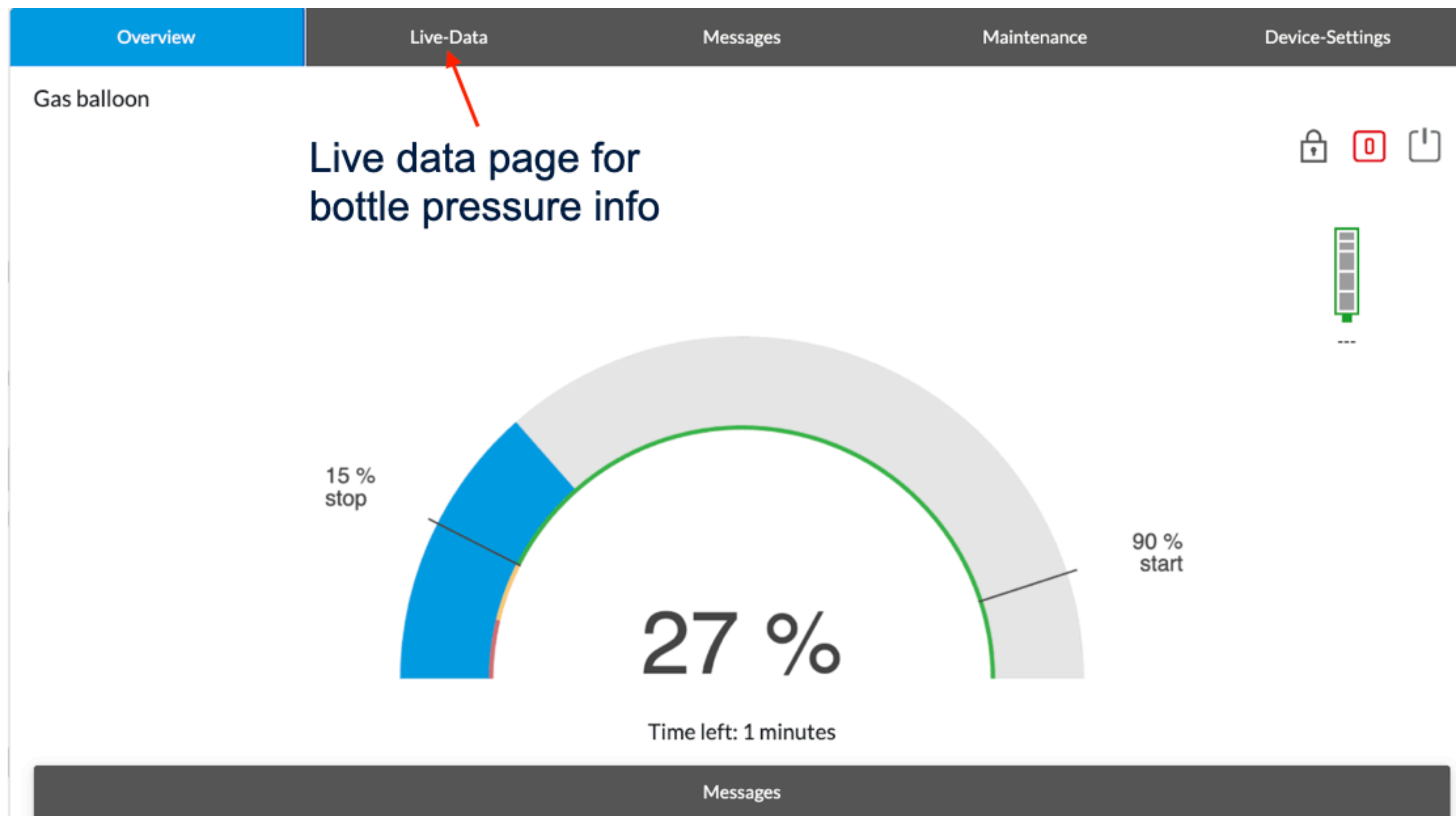
# Upcoming duty for shifters on NESS

## **Weekly check for Shifter:**

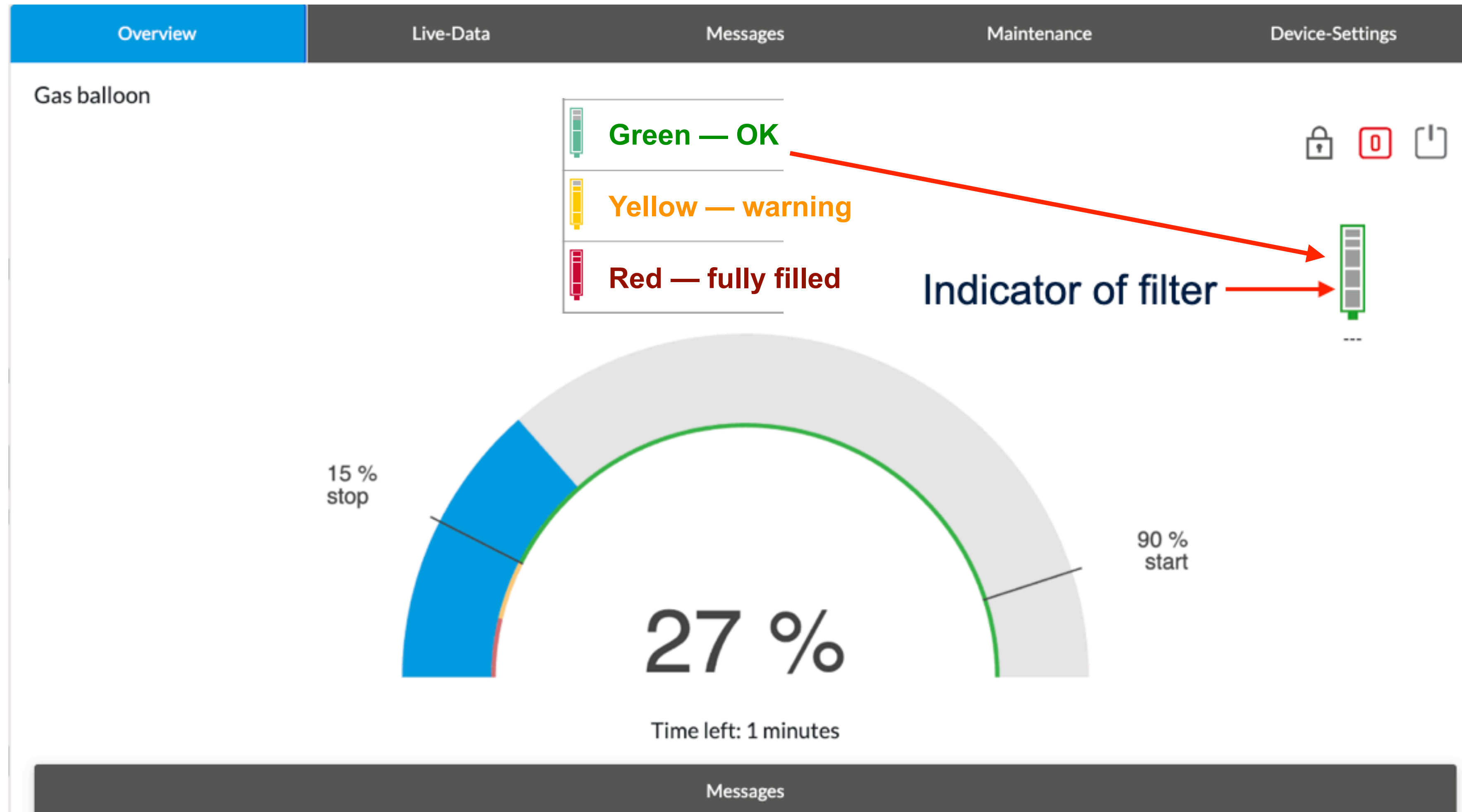
Check B-Cloud for recycled bottle pressure and filter status



# Upcoming duty for shifters on NESS



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# Upcoming duty for shifters on NESS

## **Weekly check for Shifter:**

Check B-Cloud for recycled bottle pressure and filter status

**In case of warning: Alert expert to arrange a replacement, then check once per day**



# Thanks to Hichem

As a summary I would like to say:

Thank you so much Dr. Hichem Tedjditi, for all of your contributions to this system (◉•◡•◉) >



# Actual summary

## Here is the actual summary:

It's been a chaotic 4 months, but helium recycling managed to survive.

We now have a plan for most scenarios

We are confident with the system

We need help from the shifters!



