260-L LAr System Progress Report

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Lab Safety

- COVID level in Suffolk County is still at HIGH and expected to be in the same level in the next weeks
- Please follow COVID protocol wearing face mask
- Watch out for the summer students and interns
- Take the additional trainings required for all employee Ethics and Privacy by 9/2; Active shooter training by 9/30

Plumbing for filling

260

relief valve

Hose Vent

GetterMax233

13X

Hose Vent

Supply

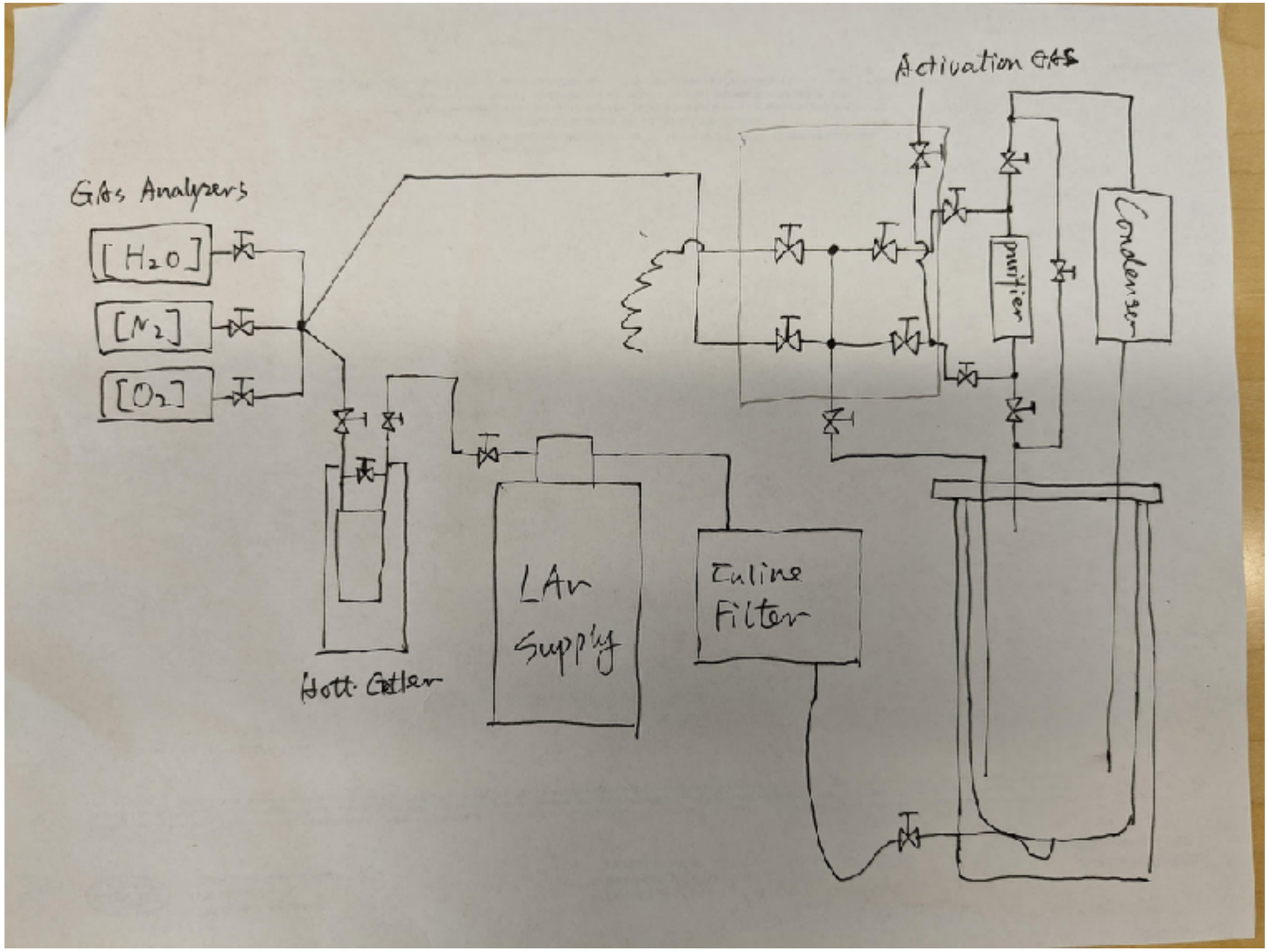
LAr IN

Hose Vent/Pump

relief valve

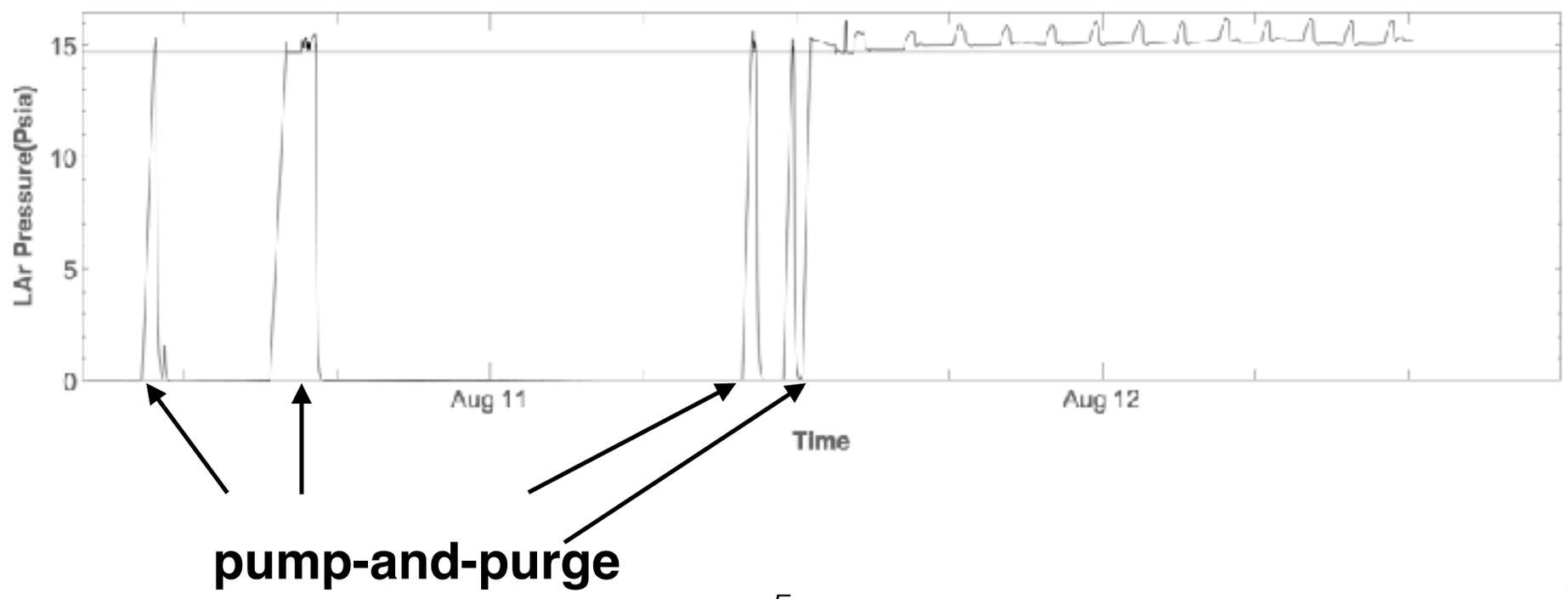
Activation Gas IN

Plumbing for sampling



Filling Preparation

- **260-L system pump-and-purge**
  - The main dewar+ullage condenser+purifer volumes are pump-and-purged 4 times before filling
- **Filling hose(downstream of inline filter) flush**
  - The hose between inline filter output and main dewar are flushed with GAr flow from the main dewar for ~3 hours in total (Not pumped)
  - Pump failure at the last pumping stage at with 0.2 psi residual pressure(~0.05 psi with the pressure transducer when pump down to ~10E-4 Torr)
  - Pump cannot even powered on after the failure, accidentally fixed on the next day. Still malfunctioning randomly
- **Filling hose (upstream of inline filter) flush**
  - Upstream of inline filter purged with Ar vapor from the supply dewar

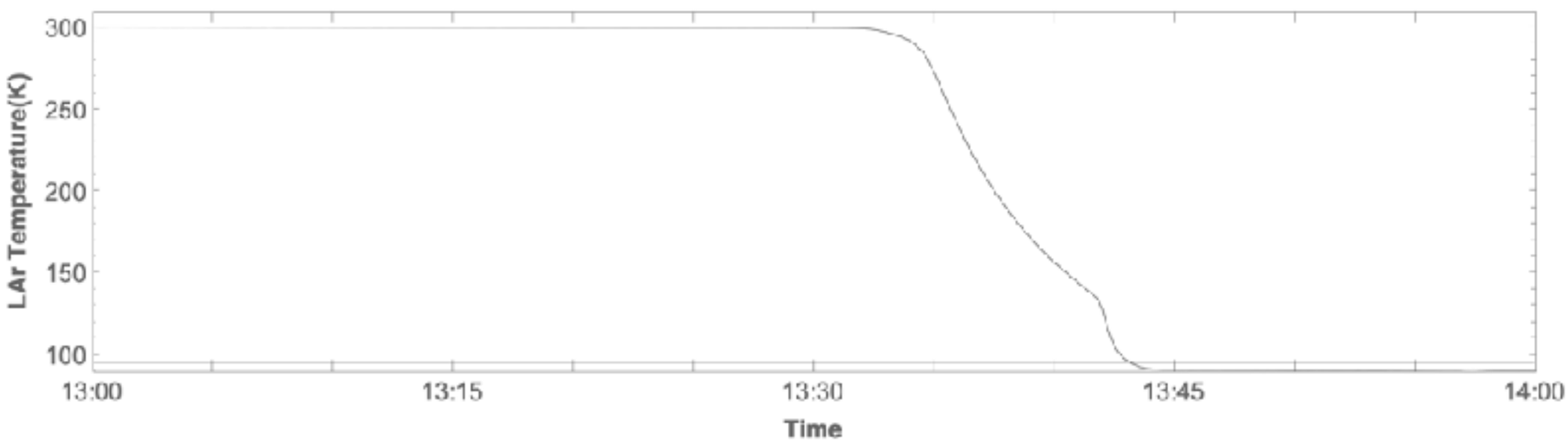


Filling Preparation

- **Sampling tubing from gas panel**
  - It is known that the plumbing has been flowed with extremely high humidity gas at the beginning stage of the activation with moisture analyzer saturated
  - The full length of the tubing from the gas panel to the joint at the analyzer wrapped with heating tape
  - Due to the length of 20+ ft, 3 individual heating tapes installed to cover the full length, each controlled with a variable transformer
  - The section of tubing was baked to ~80 C for 2 hours with GAr flow to the gas panel vent
  - It seems to be insufficient by the later observation

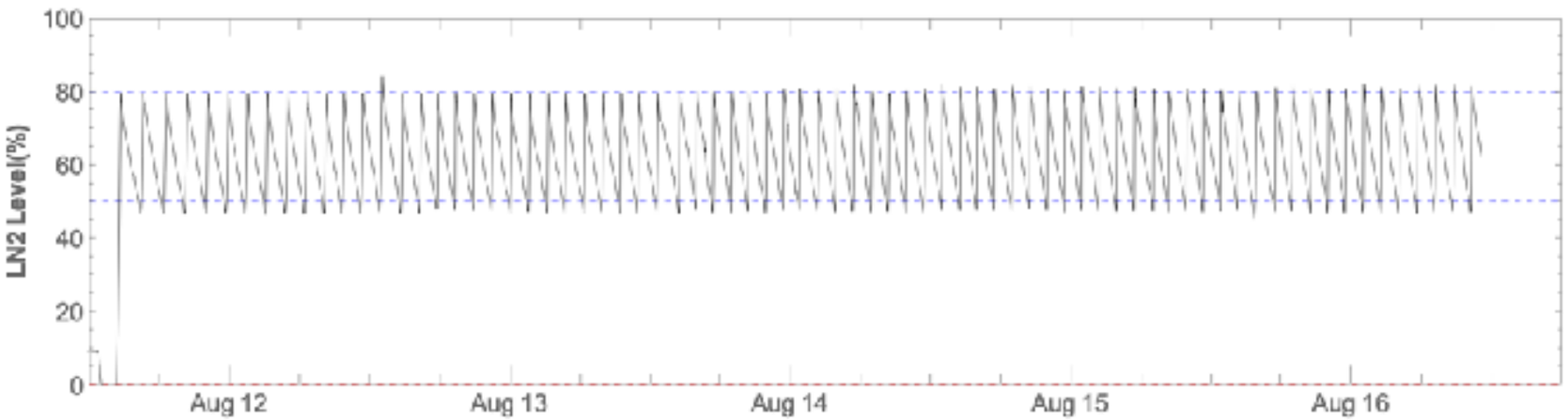
260 L System Filling

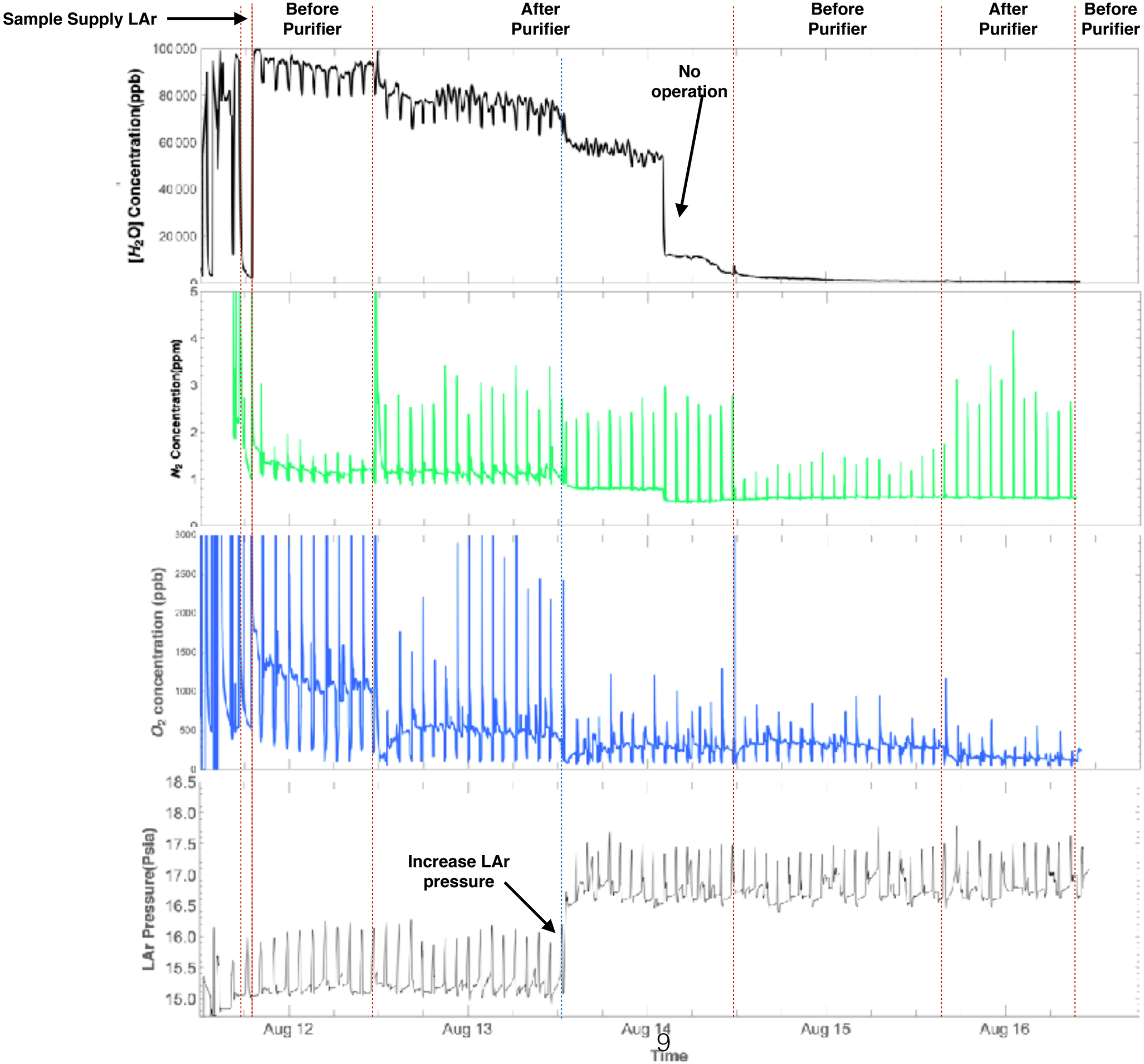
- **260-L System filled with LAr passing inline filter**
  - It was found both of the capacitance level gauge and press differential level gauge are not functioning properly
    - The calibrated coaxial cable with the capacitance level gauge was replaced with an unlabeled shorter cable
    - Differential level gauge is not output voltage signal
  - LAr level readings can be indirectly tell with the RTD temperature probe with 6 RTDs in equal intervals
    - LAr immersed the first 2 RTDs, lower than the 3rd one
    - LAr is estimated to filled 30% of the dewar height
- The level gauges needs to be fixed in the future run

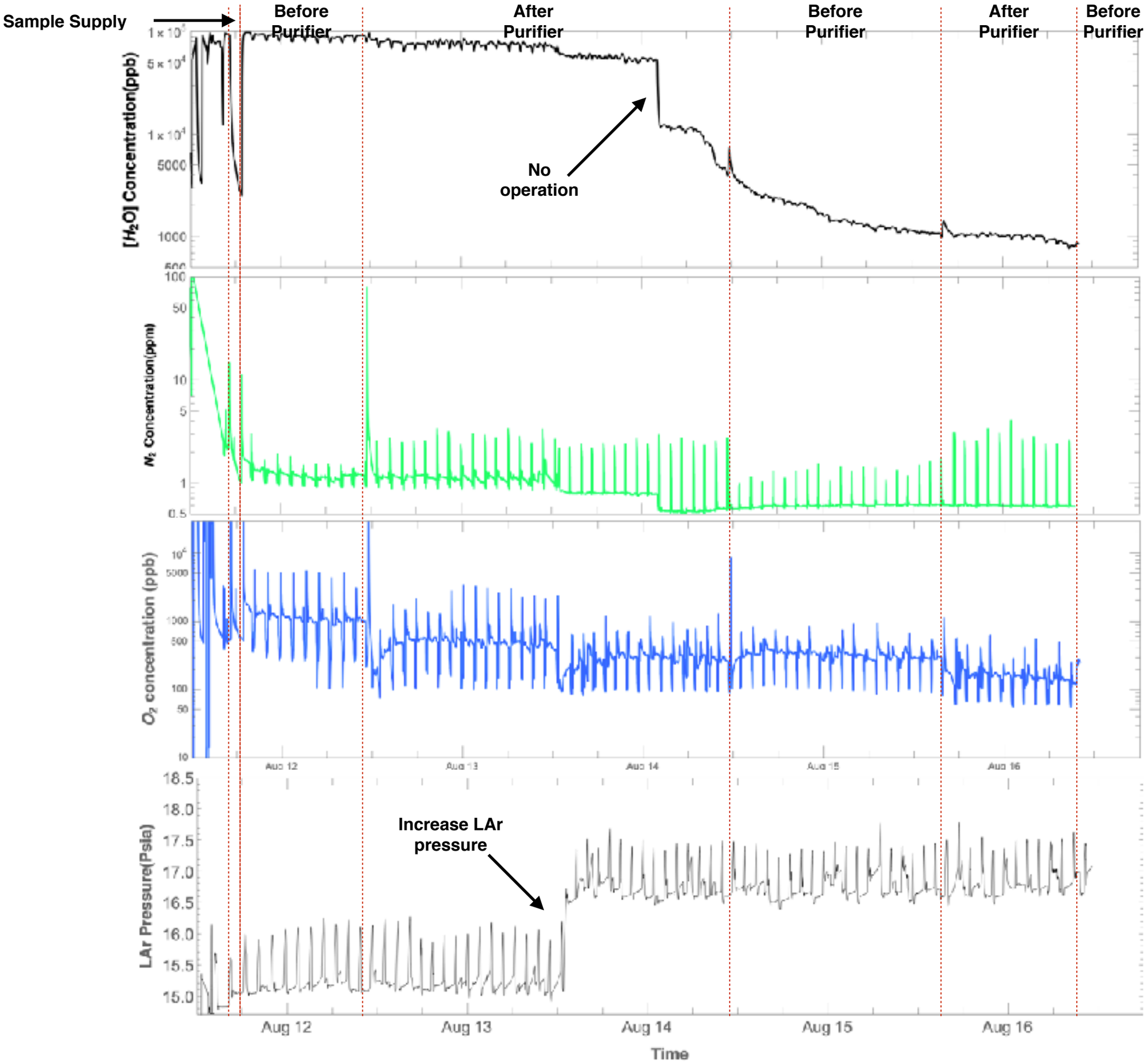


260-L Cryogenic Operation

- **Cryogenic operation running smoothing for 6 days**
  - Continuous batch fill between 80-50% of condenser volume
  - Filling cycle is about every 1.75 hrs
  - LN2 supply from the 6000 gallon tank
  - Refilling time of LN2 portable dewar is about 20-30 mins
    - Two refills have been conducted
    - 2 portable dewars refilled each time to save LN2
  - 6000-gallon LN2 tank boiling off is very low, still ~40 Psig pressure after the recent refill (Relief pressure is 50 psig)




Sample Supply LAr
Before Purifier
After Purifier
Before Purifier
After Purifier
Before Purifier
No operation
[H2O] (ppb)
[N2] (ppm)
[O2] (ppb)
LAr Pressure (Psia)
Increase LAr pressure
Aug 12
Aug 13
Aug 14
Aug 15
Aug 16
Time



[H2O] (ppb)

[N2] (ppm)

[O2] (ppb)

LAr Pressure (Psia)

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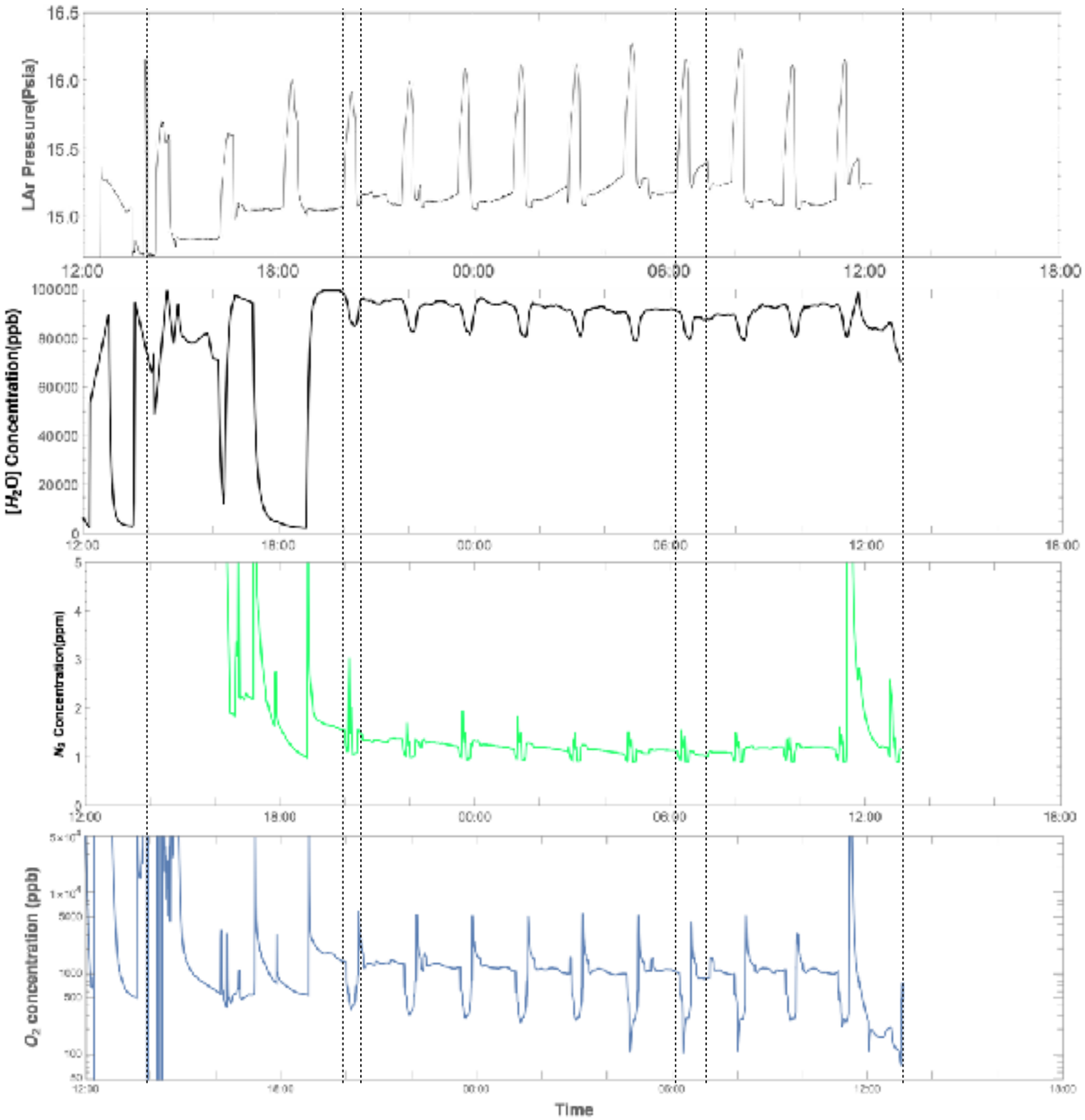
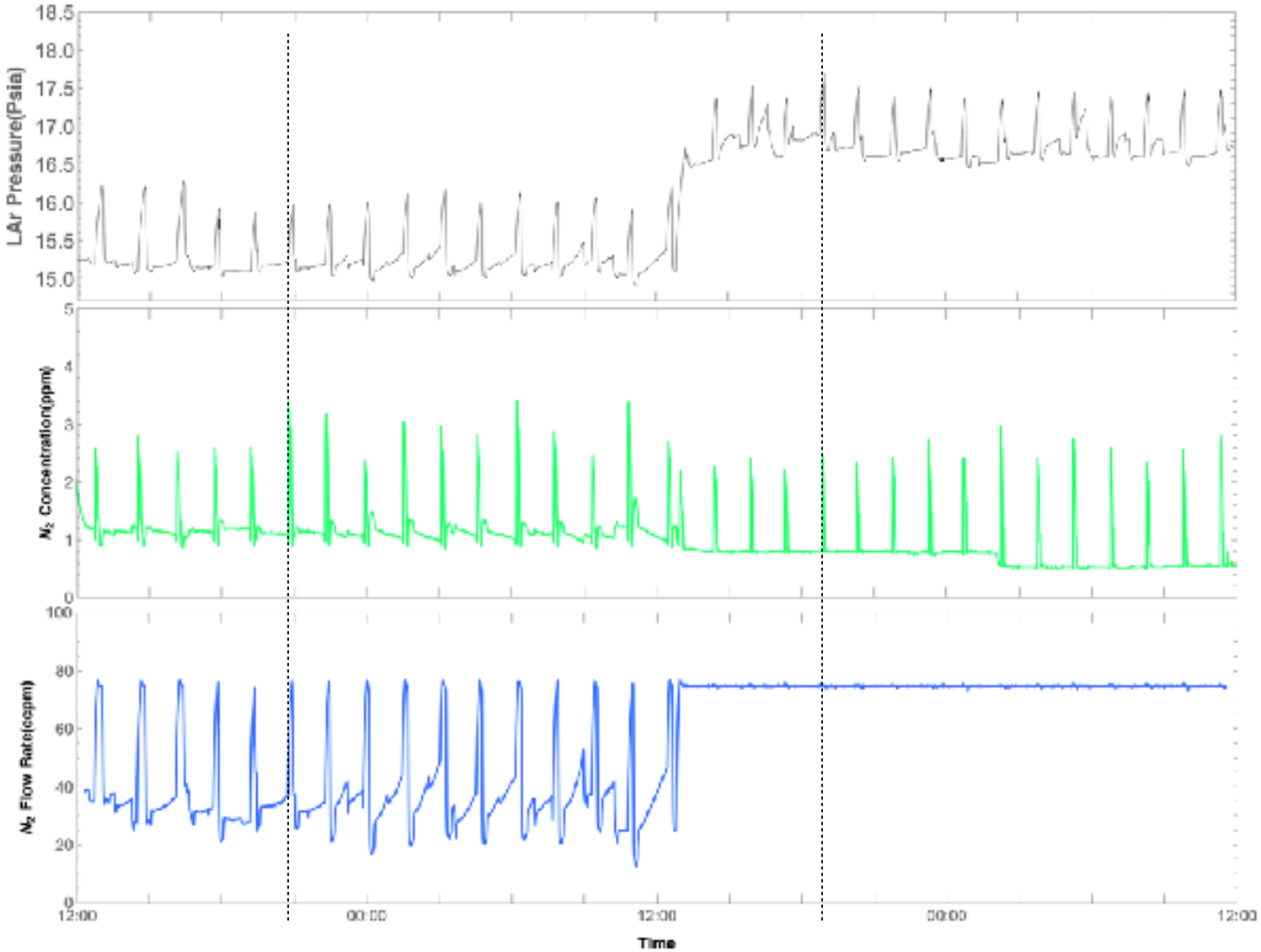
Gas analyzer readings with periodic variation



N2 analyzer reading with flow rate

- **N2 analyze requires a very small flow rate 75 cc per meter**
  - It was found with system run with ~15.2 psia, the N2 flow rate is below the require flow rate
  - Increase the LAr pressure to increase the flow rate to 75ccpm
  - N2 reading stabilized to a constant, except for the spike at the filling
  - The flow rate on reading on when sampling with the tube in LAr is almost 0, <1 ccpm



Summary of observations

- The commercial Ar supply quality from this delivery is slightly worse than others
  - [H2O]~1 ppm, [O2]~600 ppb,[N2]~0.8 ppm
- The impurity concentrations after fill is high after fill from line filter
  - [H2O]~90ppm, [O2]~1.0 ppm, [N2]~1.0 ppm
- The impurity concentrations improved with time
  - [H2O]~800 ppb, [O2]~100-200 ppb,[N2]=0.6 ppm
- N2 analyzer reading stabilized to a constant with required sample gas flow rate 75 ccpm achieved

Lesson Learned

- Gas panel + all fresh tubings should be baked
- The baseline contamination level of the system should be measured before filling
- Should implement plumbing flush system to keep the analyzers at baseline readings
- Orifice size of the liquid sampling tube is too small to maintenance sufficient flow rate for gas analyzers
- The new 260L system with large volume and fresh plumbings has less fault tolerance than the 20L system

Equipment to be replaced/fixed

- **Equipments to be replaced**
  - Vacuum pump 10+ yrs old should be replaced.
- **Malfunctioning equipments**
  - Differential liquid level-gauge is not responsive to level change
    - Need to order a replacement
  - Capacitance LAr level-gauge readings are incorrect
    - The calibrated coaxial cable was missing
    - Inquiring with the manufacture for new calibration or new probe+cable
  - LAr heater damaged in the heating test before filling
    - Should use mechanic connection for cables instead of soldering
    - Going to order a new one from KHV

Next Steps

- **Cryogenic operation**
  - Running for another week
  - Baking the sampling tube
  - Refill with LAr through inline filter with residual LAr
  - Warm up
- **Filter regeneration**
  - The inline filter needs to be regenerated next
- **Tubing baking system implementation**
- **Analyzer flush system**
- **Get the replacement parts**
  - New heater from KHV
  - New diff-level gauge
  - New or re-calibrate capacitance level gauge
- **Revise operating procedures**