Integration, Installation and Infrastructure

of

ePIC Gas Systems

Prashanth (BNL)

About me

- **Physicist by training**, with extensive hands-on experience in particle detector **construction, commissioning, and operation**
- Since **2012**, have been fully dedicated to work at **IP6**
- Designed and built the **STAR sTGC Pentane+CO_2 gas mixing system**, with integrated safety infrastructure(including design and program PLC)
- Operated the **STAR TPC gas system**, maintaining stable and efficient performance
- Serving as **Operations Manager for the STAR experiment** for the past **two years**
- Collaborated closely with **BNL safety experts** to achieve safety approvals and ensure compliance

Charge

- Facilitate integration and Installation of ePIC gas systems at IP6
- Associate with building the gas systems
  - Designed the pfRHIC gas system
  - Willing to collaborate with other systems
- Building PLC based control and safety systems

Elke and Rahul, please advice me here?

ePIC Gas Systems

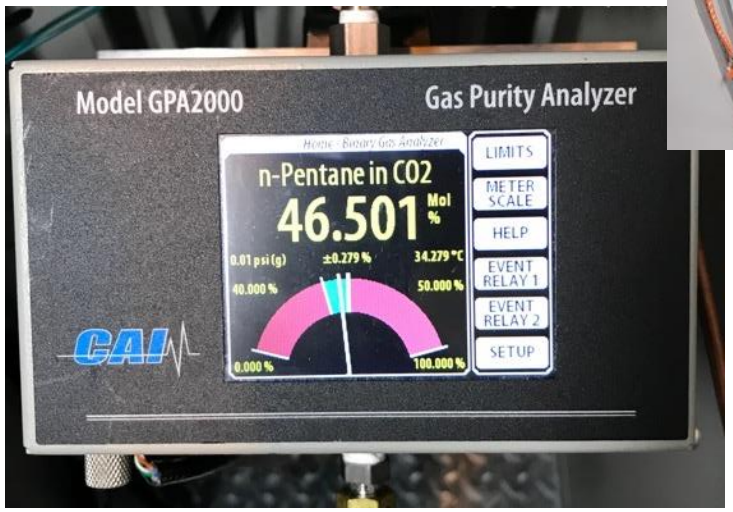
1. pfRICH
    1. Use dry N2
    2. Status: 80%+ design completed
2. hpDIRC
    1. Use dry N2
    2. Status:
3. MPGD
    1. Use Argon, CO_2, and isobutane (Gas mixer needed to be finalized?)
    2. Status:
4. dRICH
    1. Use dry Hexafluoroethane (C_2F_6)
    2. System is more complex than the others
    3. Status:

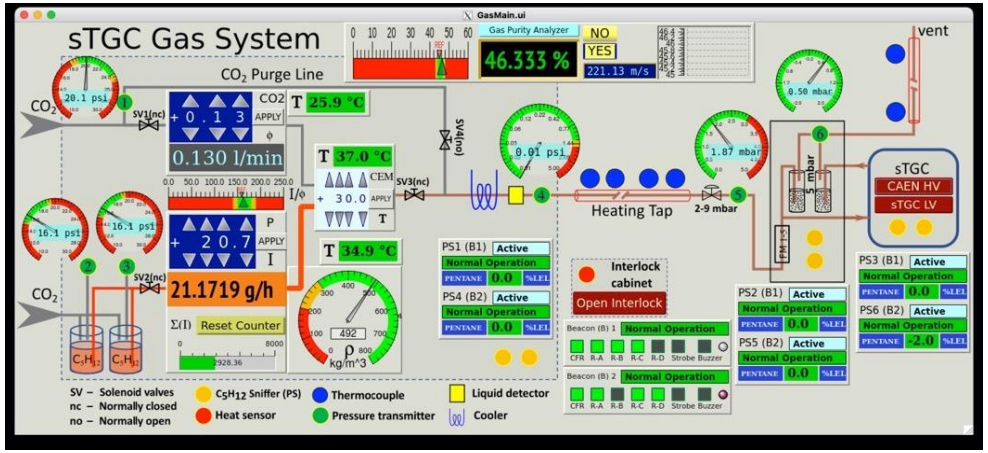
For the PDR in October, 80% design need to be completed

Is there are meeting dedicated for dRICH gas systems?

Backup

sTGC Gas system





pfRICH Gas System Requirements

Fundamental Requirements for the Gas System:

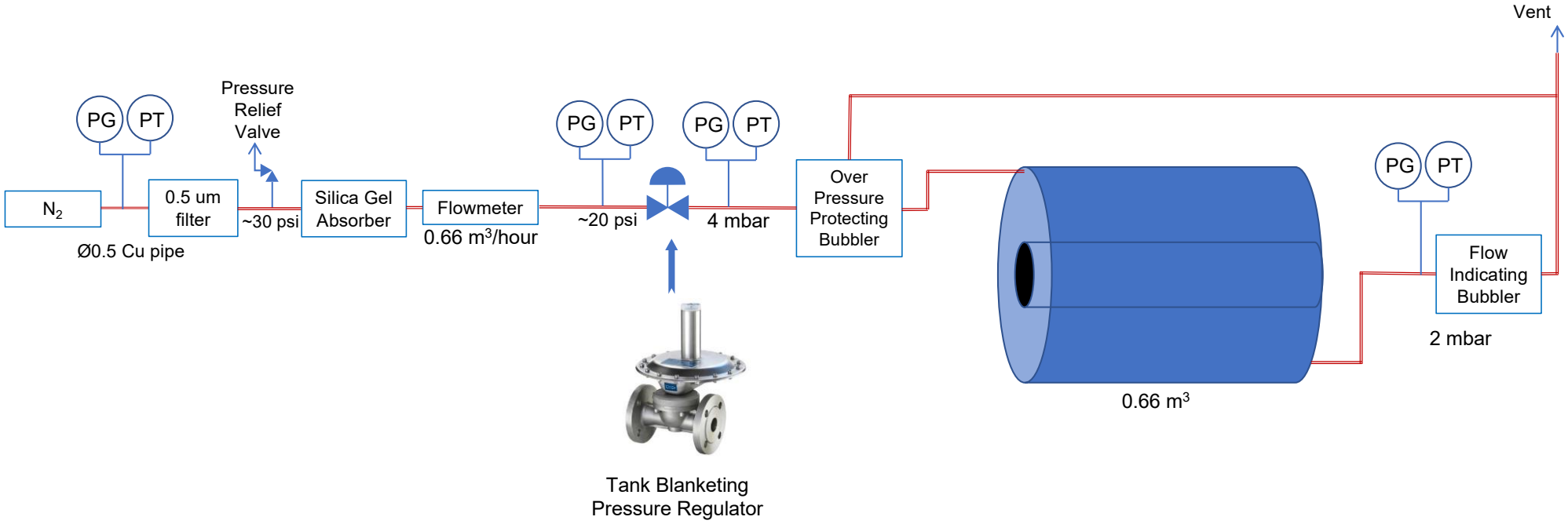
1.Control the moisture in the chamber by selecting a nitrogen source with the required moisture level.

2.Ensure the pfRICH chamber is reasonably gas-tight and maintained at a slight overpressure to prevent ambient air from leaking into the chamber.

Details follow.

1. **Nitrogen Gas Purity:** Use high-purity nitrogen (H_2O < 3 ppm) from cryogenic liquids or house nitrogen, based on availability.
2. **Moisture Control:** Install inline moisture traps after the source with service ports for maintenance.
3. **Overpressure Maintenance:** Maintain a small overpressure (~4 mBar) above atmospheric pressure to prevent air leaks into the pfRICH chamber.
4. **Pressure Regulation:** Ensure the overpressure inside the chamber adjusts with atmospheric pressure changes.
5. **Overpressure Protection:** Safeguard the pfRICH chamber from accidental overpressure.
6. **Gas Tightness:** Ensure the pfRICH chamber is reasonably gas-tight.
7. **Even Gas Distribution:** Distribute nitrogen evenly in the pfRICH chamber to avoid localized air pockets.
8. **Flushing Capability:** Enable the ability to flush the pfRICH chamber within a few hours for test beam studies, achieving one volume exchange per hour.
9. **Standby Gas Source:** Provide a standby nitrogen source in case the primary source fails or during cylinder exchanges.
10. **Flow Indicator:** Install a flow indicator (bubbler) before venting gas to the atmosphere to confirm gas flow through the chamber.
11. **System Flushing:** Design the gas system to allow flushing of piping and components by bypassing the chamber(to avoid contaminating the chamber).
12. **Particle Filtering:** Use a 0.5 μm particle filter after the gas source to remove dust particles introduced during gas source exchanges.
13. **Pressure Testing:** Pressure test the gas system to at least 1.5 times the operating pressure.
14. **Pressure Relief Valve:** Set a pressure relief valve next to the nitrogen source at 1.5 times the maximum operating pressure.
15. **Nitrogen Source Pressure Regulation:** Implement digital pressure outlet control to regulate pressure from the nitrogen source, ensuring smooth operation under various weather conditions and for low-pressure regulator operations.
16. **Mass Flow Controller:** Use a non-pressure-limiting digital mass flow controller for nitrogen flow.
17. **Monitoring and Troubleshooting:** Equip the system with pressure gauges and pressure transmitters for monitoring and troubleshooting. Archive critical readings such as chamber pressure and flow.

pfRICH Gas System



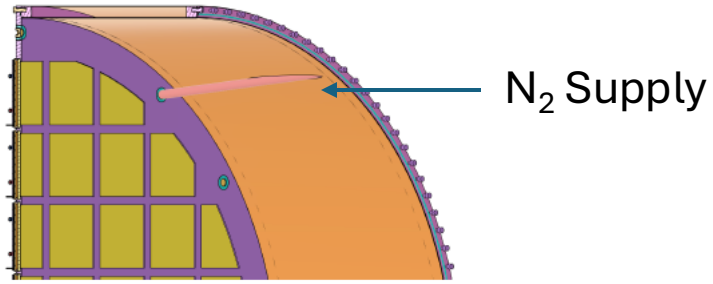


Figure 4.2: Illustration of one of the nitrogen supply tube.