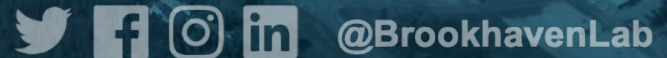




# TAKE FIVE for Safety- Update on sPHENIX Review

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# What are the hazards of isobutane?

- Extremely Flammable gas under pressure
- Can form explosive mixtures in air
- May displace oxygen



# Safety Analysis

Reducing the risks of introducing isobutane:

Hazard: Oxygen Displacement (ODH)

- Negligible - (Low Volume), ODH Controls for Cryogenics

Hazard: Flammable/Combustion

- Lower Explosive Limit (LEL) 1.8% Concentration
- Can be mitigated

# Risk Reduction Strategy

Dilute the isobutane below 10% of the LEL

$$Q = \frac{403 * SG * ER * K * 100}{MW * LEL * B}$$

$$Q_{K(10)} = 24 \frac{ft^3}{min}$$

**Q** = airflow volume (CFM)

**403** = constant

**100** = constant

**SG** = Specific Gravity

**ER** = Evaporation rate per minute—sometimes **W** is used to represent Evaporation Rate

**K** = K factor (sometimes referred to as safety factor,  $S_f$ )

**MW** = Molecular Weight

**LEL** = Lower Explosive Limit of substance

**B** = Temperature adjustment factor (Less than 250° F = 1, Greater than 250° F = .7)

# New Controls for Isobutane

- 4 Clean Air Supplies (2 at the north and 2 at the south) supplying 950 CFM (measured)
- Isobutane Line bonded to less than 10  $\Omega$  to ground
- Mass Flow Controller (Connected to existing PLC)
- Solenoid Valve (AV/I1) – Configured to Fail-Safe & isolate upon alarming conditions and less than required monitored airflow.
  - Scenarios that will be programmed for isolating the isobutane supply include:
    1. Bore Dehumidifiers  $\sum N > 100$  CFM &  $\sum S > 100$  CFM – (The sum of the air flow from both the 2 North Fans and 2 South Fans must be above 100 CFM for either pair)
    2. Ceiling VESDA HSSD – Smoke Detected
    3. Bore VESDA HSSD – Smoke Detected
    4. Bore Isobutane Detected
    5. Gas Mixing House Vent Fan Fail
    6. Isobutane Shed Vent Fan Fail
    7. Gas Mixing House Isobutane Detected
    8. >5.5% isobutane in the gas mixture
    9. Gas Mixing House Emergency Stop button.

# Emergency Response (DRAFT)

Low Level (5%) Alarm – If Flammable Gas Detection 5% LEL Warning report the alarm to the MCR, and inform the Gas System Expert. Gas expert confirms the unit is reaching correctly with a hand held LEL monitor a foot away from the wall mounted unit. IF confirmed, they will then look for a leak in the system with a high sensitivity flammable gas sniffer.

High Level (20%) Alarm – If Flammable Gas Detection 20% LEL Alarms, then evacuate and tape off affected area with Danger tape, report the alarm to the MCR who will call x2222 for Fire Department response, and inform the Gas System Expert. Flammable Gas will already be turned off automatically with our 20% lel alarm. This should be confirmed by the expert. The reading in the gas house will be verified with a hand held meter to be 20% (confirm our system is working properly.). Once confirmed, the Gas system expert will go over a plan to find the leak and then fix it. Fire Department responders will ensure that the area is properly controlled and will verify that concentrations have restored to safe levels before restarting the system.



# Update on Experimental Review Process

- AESRC walkthrough of the Isobutane distribution system was conducted at 11:00 today
- Focus areas included system hardware and monitoring, emergency response, procedure updates, labeling.
- An Action List to be compiled and provided to sPHENIX
- Action List is to be completed before isobutane is introduced to system.