

**Homework:**

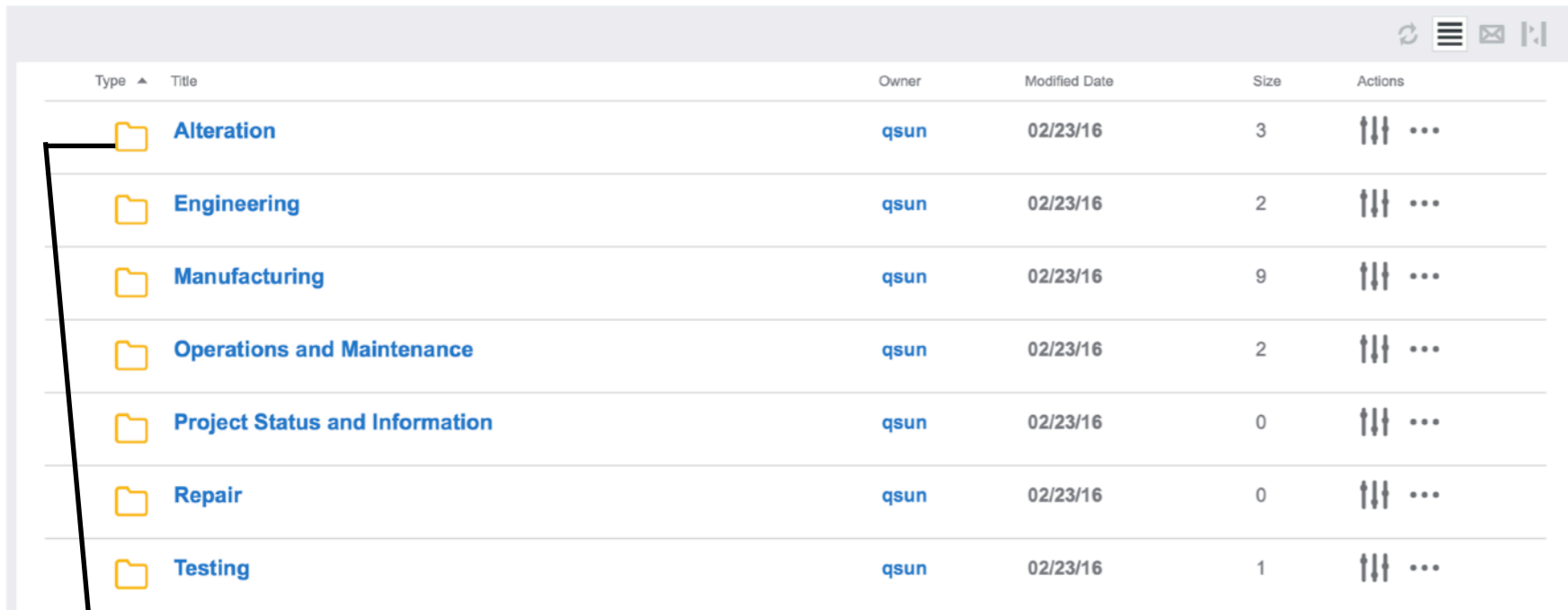
**A few slides on Flammable  
Gas System**

**June 5th, 2026**

**Hypernuclear ERR2**

# Existing Hall C Pressure System

PS-PHY-XX-001 Hall C HMS Wirechamber Ethane-Argon Gas System



Type	Title	Owner	Modified Date	Size	Actions
Folder	Alteration	qsun	02/23/16	3	↑↑↑ ...
Folder	Engineering	qsun	02/23/16	2	↑↑↑ ...
Folder	Manufacturing	qsun	02/23/16	9	↑↑↑ ...
Folder	Operations and Maintenance	qsun	02/23/16	2	↑↑↑ ...
Folder	Project Status and Information	qsun	02/23/16	0	↑↑↑ ...
Folder	Repair	qsun	02/23/16	0	↑↑↑ ...
Folder	Testing	qsun	02/23/16	1	↑↑↑ ...

## SHMS Chamber Gas System

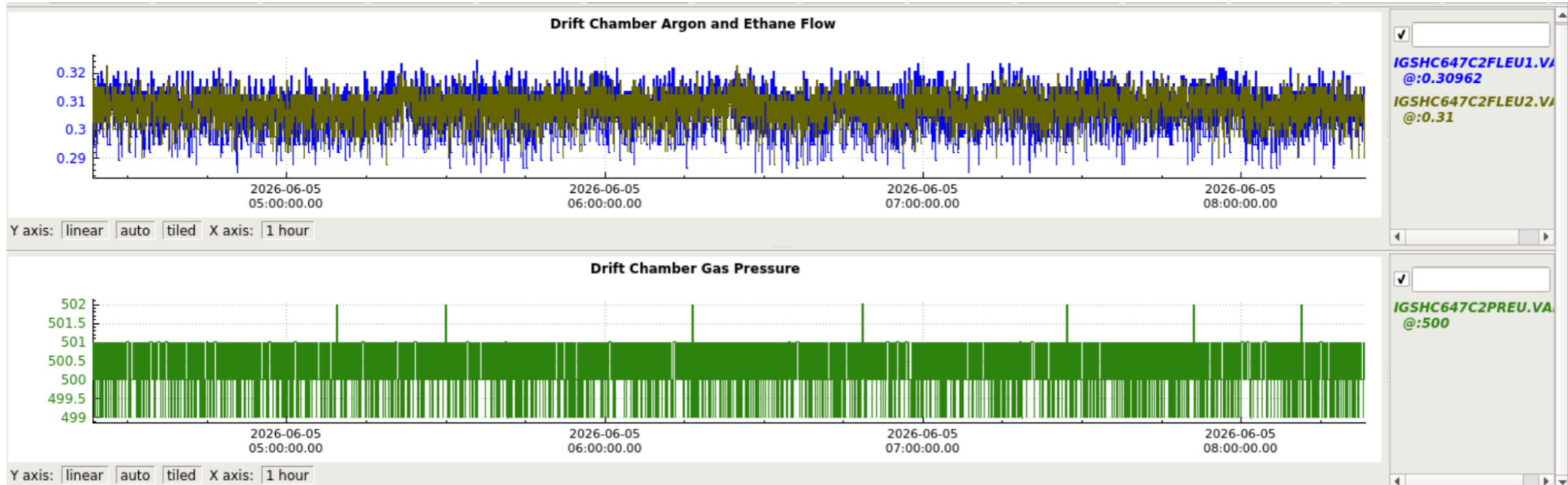
This is a new system, and the only portion of the Hall C Chamber Gas System that is subject to ASME B31.3-2012 code.

It is comprised of two American BOA Inc.'s PARRAP metal hoses (1/2" diameter, 321 stainless steel braid material) and Sandvik Materials Technology's 316/316L stainless-steel tubes (1/2" diameter, 0.049" thickness) extending from the pivot region in Hall C (where it is tied to a legacy gas distribution line from the Hall C Gas Shed), runs along the SHMS carriage into the SHMS detector hut. The line terminates at the valve right before a gas distribution panel similar to Fig. 2.

## Strategy for Hypernuclear

- Add “alteration” to existing system, similar to what was done for the SHMS.
- Consult with Thomas LaPointe on flammable gas mitigations next week
- Have DA approve ODH and flammability calculations, plumbing, and installation plan

# Note on Flow Rates



- Hall C currently is running at 600 cc/min
- Flow rates for hypernuclear < 600 cc/min



# Existing Calculations

The gaseous ethane volume of one full T200 tank at STP is 411.5 cubic feet. The volume of Hall C to the crane height is greater than 970,000 cubic feet (55 ft high x 3.14 x (75 ft radius)<sup>2</sup>). If the entire volume of one tank was dispensed into a hypothetical plume occupying 5% of that volume (> 48,000 cubic feet), we would have an ethane concentration in that plume of only 0.8%, a factor of 3.75 below the minimum flammability ratio of 3.0%. At the maximum possible pure ethane flow rate of 0.1 SCFM (2.75 SLM), such a plume would take 2.8 days of continuous flow to develop.

# Existing Calculations

## 5 Analysis of Special or Unusual Hazards

The only hazard associated with this system that might be considered special is the storage and use of flammable gas, although this is a topic completely addressed in the ESH&Q Manual.

Flammable gas system hazard classification at JLab is based upon the hydrogen equivalent combustion energy contained in the gas present within each separable part of the system. For ethane, the threshold volume that would promote a system to Hazard Class-1 is 50 standard cubic feet.

In the Hall-C system there are five geographical zones. The volume of gas contained in each one is calculated in Tabs. 1, 2, 3, 4, and 5. Note that, in keeping with the worst-case scenario analysis, the volumes shown are *total* volumes for each device. That is, they represent the maximum amount of ethane potentially present in the event that a multi-component failure allowed the system to deliver 100% ethane for a long period of time. Normally, and in the event of any *reasonably-foreseeable* failure mode, only a fraction of the gas volume would be ethane.

- **Zone 1:** This is an outdoor area isolated from any obvious ignition sources, and the volume of ethane present is well below 16,666 ft<sup>3</sup> (the ethane volume threshold for outdoors Class-2). Therefore, this area is classified as an **Outdoors Class-1** installation.
- **Zones 2,3,4,5:** The volume of ethane in zones 2, 3, 4, and 5, taken either separately or together, is below the 50 ft<sup>3</sup> threshold, thus these zones are all **Class-0** installations.

Zone 1: Outdoors Gas Bottle Rack and Manifold	
System Component	Volume (SCF)
Two industry-standard 410 cubic foot ethane bottles	820
Misc. tubing, valves, regulators (max)	0.5
<b>Total</b>	<b>820.5 ft<sup>3</sup></b>

Table 1: Outdoors Gas Volume Calculation

Zone 2: Hall-C Gas Shed	
System Component	Volume (SCF)
≈ 50 feet of 1/4" OD Metal Tubing and Misc. plumbing at < 45psig: $V < \pi r^2 l P = (\pi)(0.125^2)(50)((1/12 \text{ ft/in})^2)(4 \text{ atm})$	0.07
Mixing bubbler and alcohol buffer tank (at 9 psig)	< 1
≈ 20 feet of 1/2" Plastic Tubing (at 9 psig) $V < \pi r^2 l P = (\pi)(0.25^2)(20)((1/12 \text{ ft/in})^2)(1.6 \text{ atm})$	0.04
<b>Total</b>	<b>&lt; 1.2 ft<sup>3</sup></b>

Table 2: Hall-C Gas Shed Gas Volume Calculation

Zone 3: Experimental Hall C not including the shield houses	
System Component	Volume (SCF)
2 each, ≈ 300 feet 1/2" OD Supply Tube, 9 psig $V = 2 \times (300)(0.25^2)(\pi)((1/12 \text{ ft/in})^2)(1.6 \text{ atm})$	1.3
2 each ≈ 300 feet 1" OD Exhaust Tube, 0 psig $V = 2 \times (300)(1^2)(\pi)((1/12 \text{ ft/in})^2)(1 \text{ atm})$	3.3
<b>Total</b>	<b>4.6 ft<sup>3</sup></b>

Table 3: Hall-C General Area Gas Volume Calculation

[https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-114656/gas\\_SOP\\_Apr2015.pdf](https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-114656/gas_SOP_Apr2015.pdf)