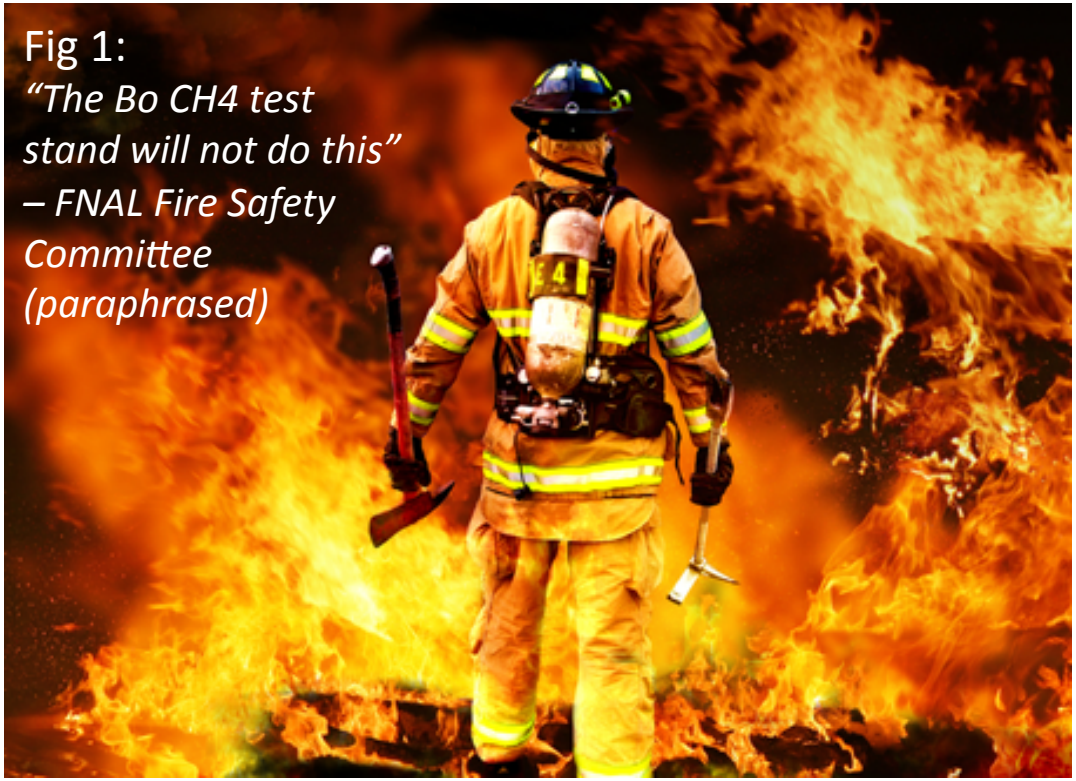
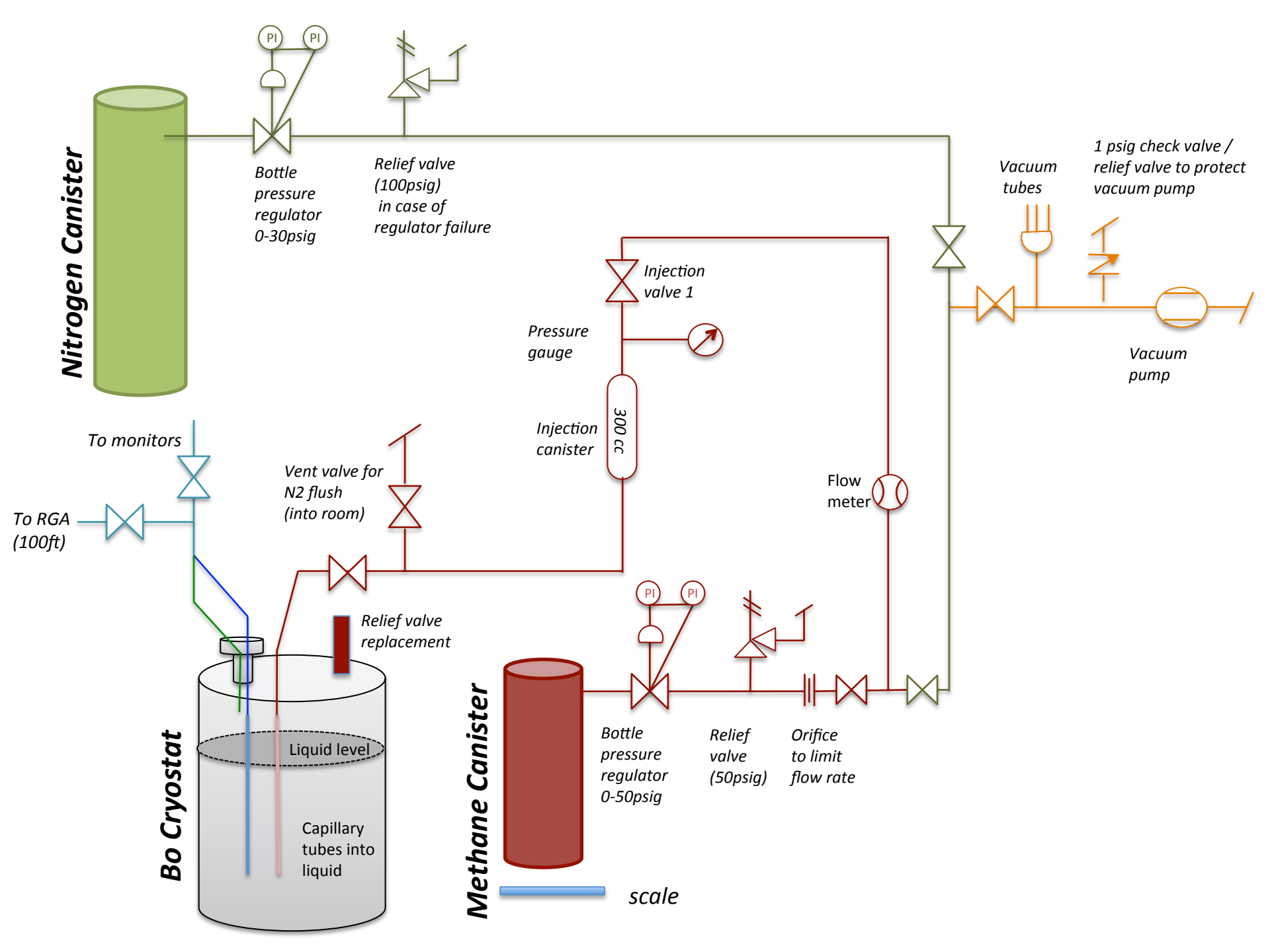
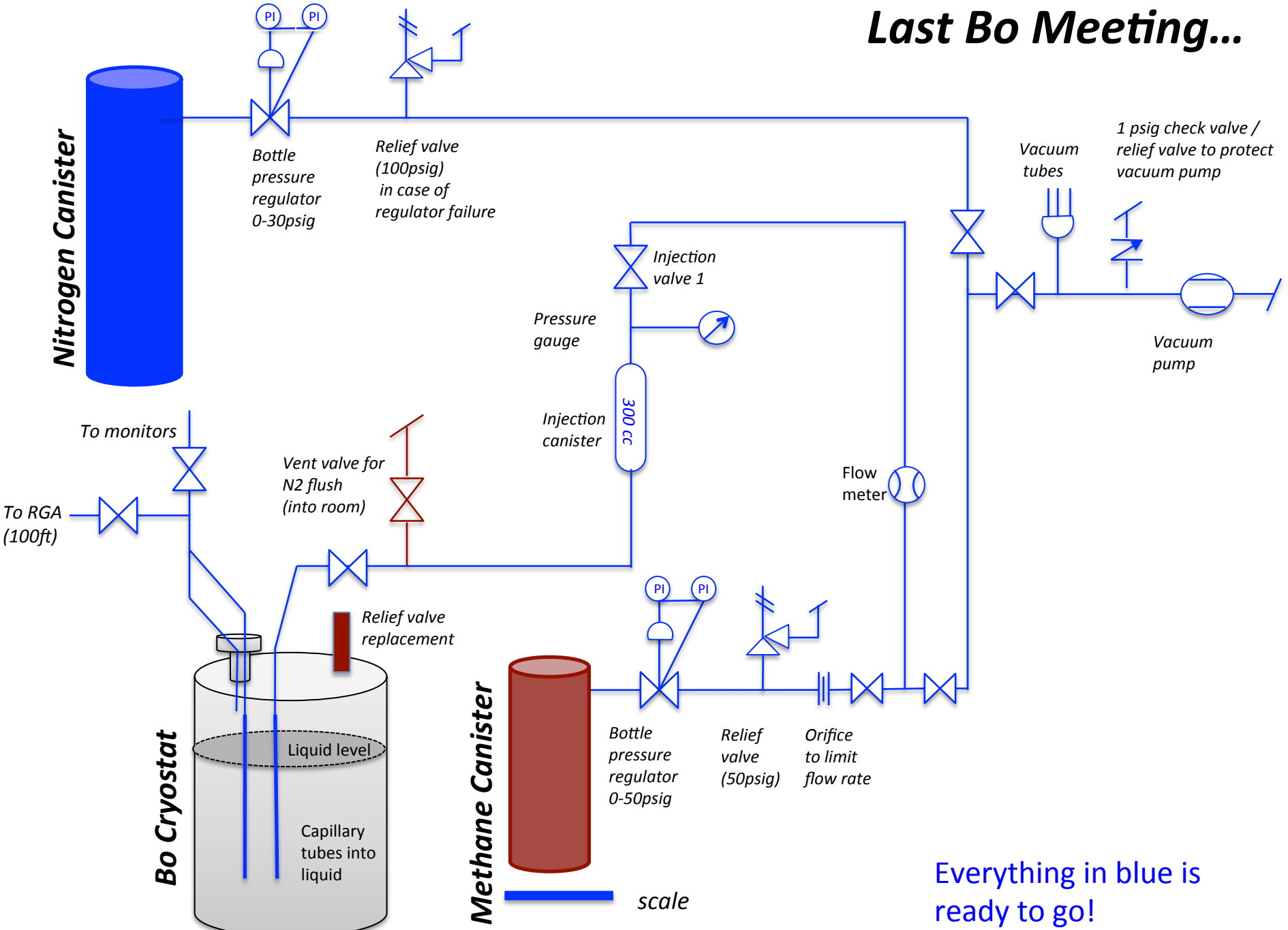
Preparations For Methane Analysis

Ben Jones




Nitrogen Canister
PI
PI
Bottle pressure regulator 0-30psig
Relief valve (100psig) in case of regulator failure
Vacuum tubes
1 psig check valve / relief valve to protect vacuum pump
Vacuum pump
Injection valve 1
Pressure gauge
Injection canister
300 cc
Flow meter
To monitors
To RGA (100ft)
Vent valve for N2 flush (into room)
Relief valve replacement
Bo Cryostat
Liquid level
Capillary tubes into liquid
Methane Canister
PI
PI
Bottle pressure regulator 0-50psig
Relief valve (50psig)
Orifice to limit flow rate
scale

Last Bo Meeting…



Everything in blue is ready to go!


WHEN CANISTER PRESENT
DANGER
FLAMMABLE LIQUIDS/GASES
no ignition sources

N2 Pressure Regulator (0-100psig)

N2 Relief valve (50psig)

N2 canister

Line selection valves

Vacuum line

Flow limiting orifice
(calibrated 200S SCFH methane)

CH4 bottle stand

CH4 supply line

CH4 Relief valve (50psig)

CH4 pressure regulator (0-60psig)

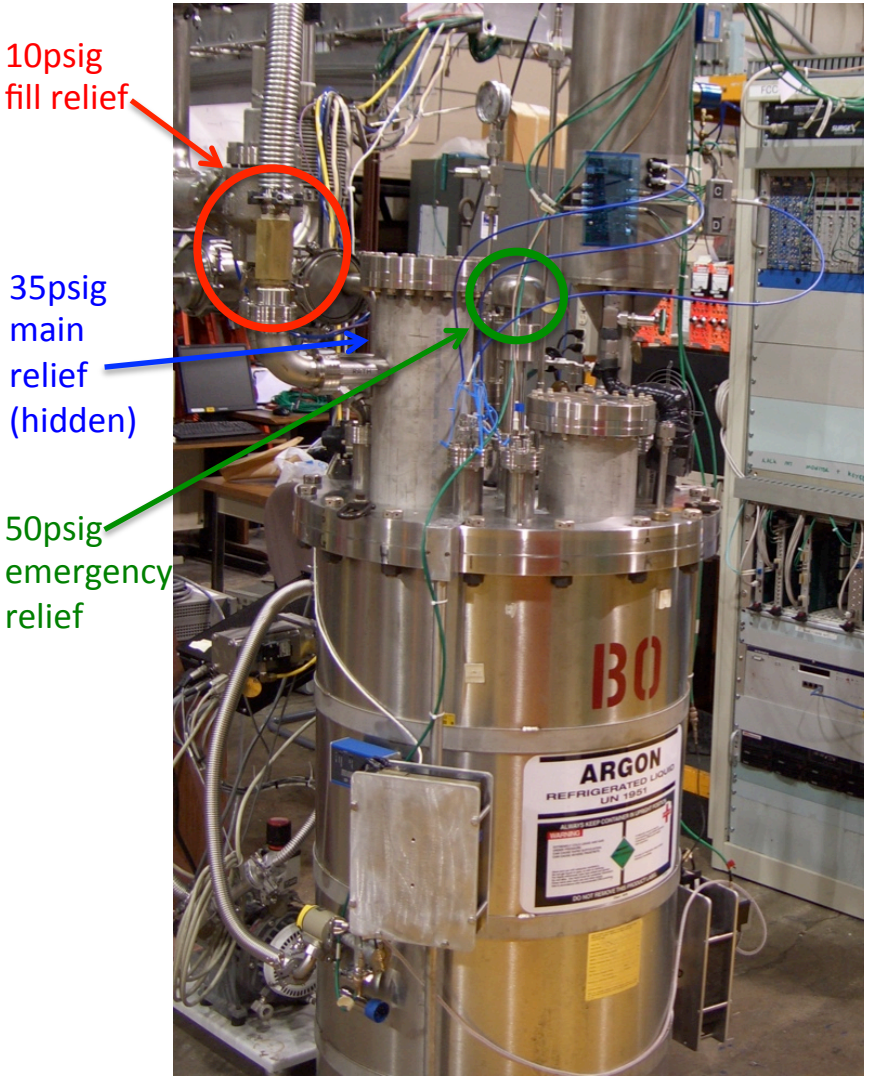
CH4 bottle connector

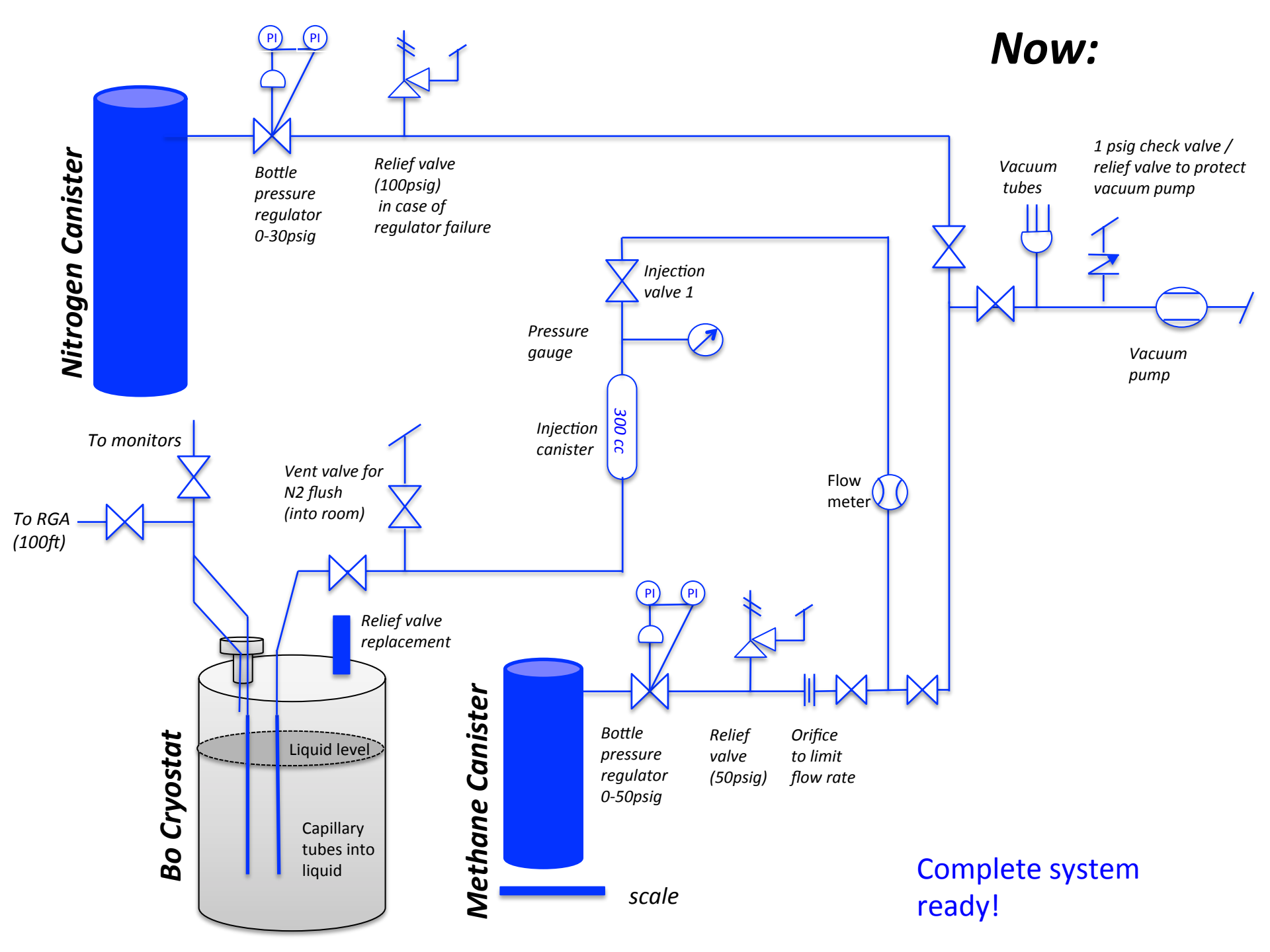
Vacuum pump

Scale

Relief Valve Adjustment

- When we had no condenser, pressure was controlled by allowing venting when overpressure through a 10psig relief valve
- Now we have a condenser we no longer want this. Especially if we want to bleed methane gas in at >10psi.
- However, we still need to vent head pressure during the argon fill.
- We will solve this by putting a valve upstream of the 10psi relief, which is to be opened only during the fill
- Bo also has a 35 psig main relief to vent, and a 50psig to room emergency relief to – so no safety feature is compromised
- Valve is in hand – but this type of valve is expensive ($400), so looking for other possible solutions.
- Geometry of valve (elbow) also requires vent piping work




Now:
Nitrogen Canister
PI
PI
Bottle pressure regulator 0-30psig
Relief valve (100psig) in case of regulator failure
Vacuum tubes
1 psig check valve / relief valve to protect vacuum pump
Vacuum pump
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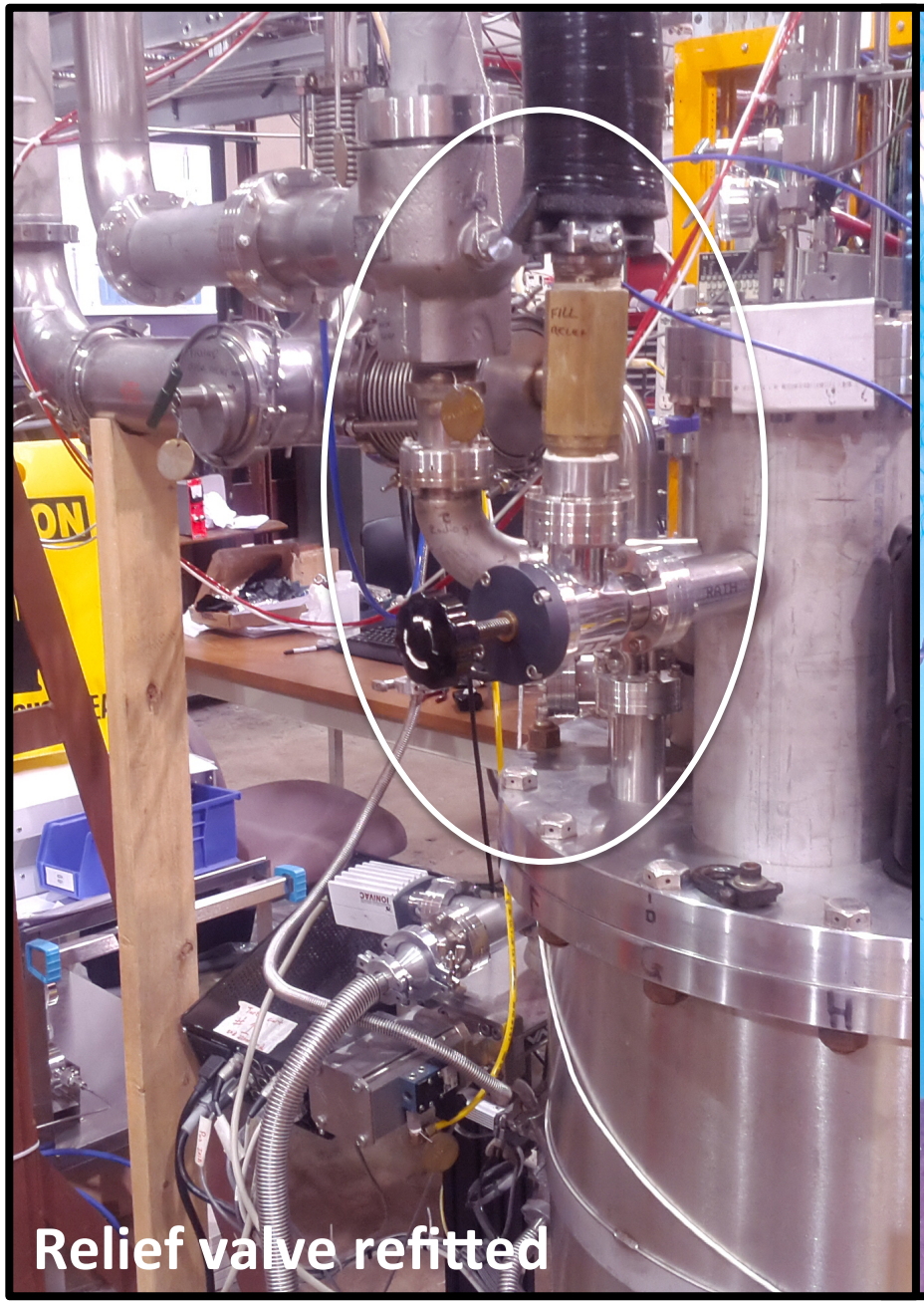
Capillary tubes into liquid
Methane Canister
PI
PI
Bottle pressure regulator 0-50psig
Relief valve (50psig)
Orifice to limit flow rate
scale
Complete system ready!


Relief valve refitted


Airgas
Company
Methane has arrived

Fire Safety Documentation for Bo CH_4 Injection System at PAB

Ben Jones, Massachusetts Institute of Technology

Introduction:

We have built a system to inject methane gas into liquid argon in the Bo cryostat at PAB. The system can be factorized into two parts: The Bo volume, which will at all times contain a nonflammable mixture of methane and argon, and the injection piping which contains pure methane and is hence a flammable gas system. The first section of this document describes the nonflammable system and the measures taken to ensure that its contents remain always a nonflammable mixture. The second section describes the injection piping system which is designed to be a Risk Class 0 flammable gas installation, in accordance with Fermilab's ES&H guidelines.

Figure 1: The Bo VST Test Stand and Injection System at PAB

Safety documentation went through ~4 versions, latest is at docdb 2577

Fire safety review after version 3 raised a few minor concerns, all addressed to fire safety committees satisfaction

Our “no bottles in place during welding” condition was relieved to a “no changing bottles during welding” condition. This makes life easier for us operationally.

New vent line was required, venting high into room and further from possible ignition sources

Operational Readiness Clearance

Methane Injection System for LAr Test Stand (Bo) at PAB

6/11/2013

AUTHORIZATION TO PROCEED WITH THE ATTENDED OPERATION OF THE METHANE INJECTION SYSTEM FOR LAr TEST STAND (BO) at PAB

REVIEWED AND APPROVED BY:	**DATE**
Particle Physics Division Head Comments/Exceptions:	6/11/2013
Particle Physics Senior Safety Officer Comments/Exceptions:	6/11/2013
Committee Chair Comments/Exceptions:	6/11/2013
Submitted By: Methane Injection System Representative	06/11/13

SIGNED ORC FOR ATTENDED OPERATION OF METHANE INJECTION LINE

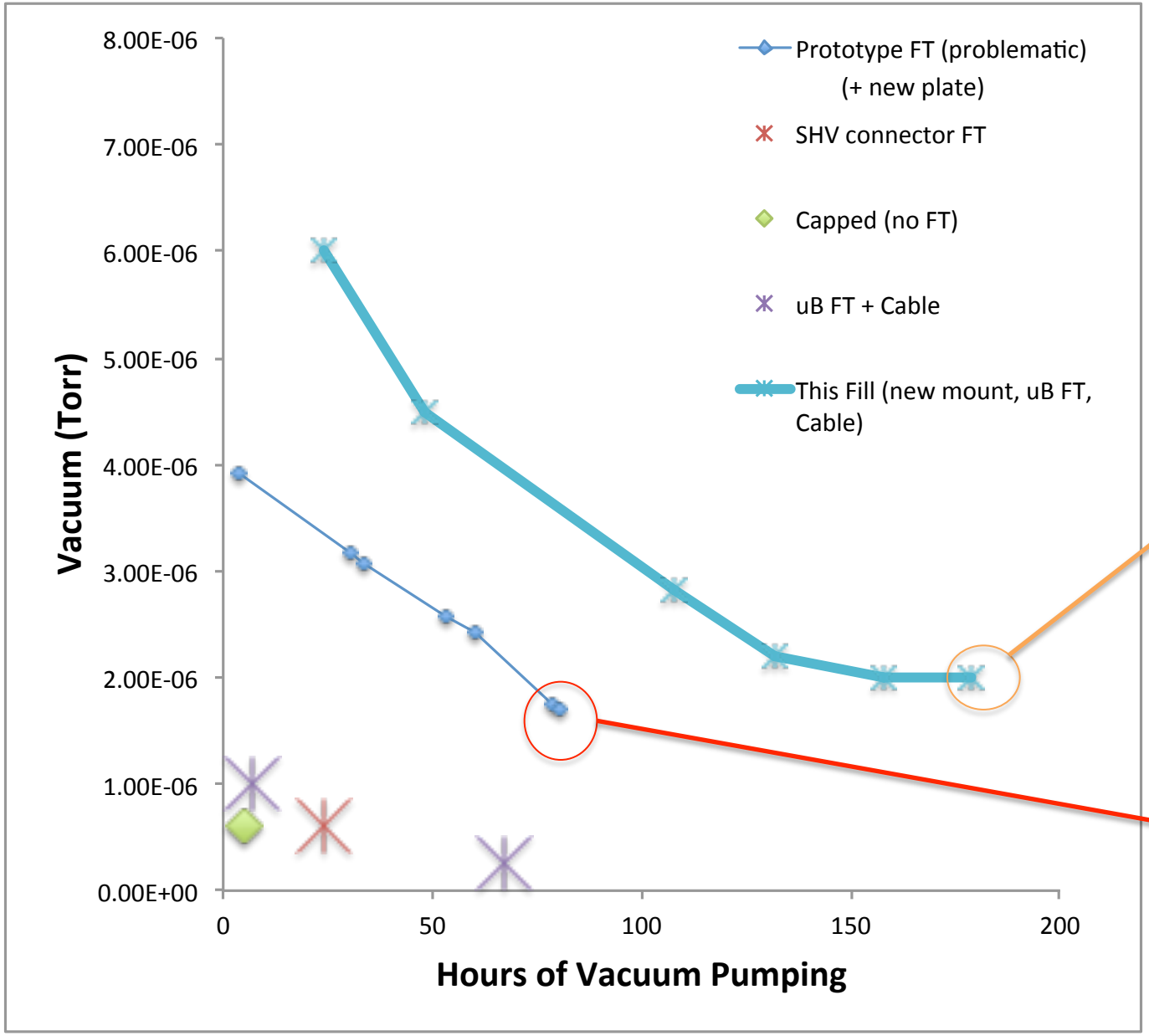
Procedural Points

- **IMPORTANT: I specify in the documentation that methane may not be injected into Bo or vented from the fill line except under direct supervision from either myself or Matt.**

- Important safety points:
  - Methane canister never changed during welding work
  - Mixture in Bo must always remain nonflammable. A sheet next to Bo is used to record every injection so we know the concentration
  - I specify that we will have a 60% safety margin and so never inject more than 6% by volume. This is 8 canisters so long as Bo remains near full.
  - After removing a methane canister the fill line must be flushed with N2 immediately, and never around welding or other ignition sources

Inside Bo

- Matt, Ami, Gabriel removed TPB plate and added 2 inch tube in MIT mount (next talk)
- A few issues have arisen subsequently:
  - Solid angle calculation shows that 2” tube has very little light expectation from alpha (borderline whether we will see anything >1pe).
  - Vacuum has not reached our preferred standard. Suspect large piece of acrylic in new mount is the culprit (next slide)
  - N2 condenser not properly reconnected leading to bursting its seals in 2 places during fill (now fixed)
  - 8 inch PMT cable was not strain relieved, and we lost the connection during fill (critical- need to re-open).



This run has large acrylic piece in PMT mount. We suspect outgassing water is preventing us reaching proper vacuum.

In this run had installed a new TPB plate. We saw unusually high water levels (80ppb) and low light yield (28 instead of 38PE).

Alazar Digitizer

- To achieve higher rates than the scope, and faster sampling speed the uB electronics, we decided to install one of MIT's Alazar digitizers on uboonepab02
- Not a trivial process: a few days of struggling with driver compatability, linux versions etc
- With the help of Eric and Gennadiy and Alazar tech support we updated the linux kernel on uboonepab02 to one which is a good match to some precompiled drivers
- Now drivers successfully installed, and I was able to run the example program supplied with the SDK
- We will need some kind of custom code to take data we want – I hope some of this can be ported from the code Lindley and I wrote for the MIT machines

Flow meter calibration

Over to Ami and Gabriel for a report on flow calibration for methane injection.