Hall B RICH Gas Interlock Systems

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Summary

There are two gas interlock systems for Hall B RICH- one designed to monitor the air cooling and the other to monitor the flow of nitrogen. The RICH electronics are sealed inside of the detector and use LV and HV power, creating a heat load. Air cooling was chosen to remove heat in order to prevent damage to the electronics or nearby detectors. Nitrogen was chosen to reduce humidity inside of the detector to ~1.8% for aerogel usage.

Hardware & Software Description

The gas interlock systems are based on the National Instruments CompactRIO (cRIO) Programmable Automation Controller (PAC) platform. cRIO is a reconfigurable embedded control and acquisition system. The cRIO system's hardware architecture includes I/O modules, a reconfigurable field-programmable gate array (FPGA) chassis, and an embedded controller. The cRIO integrated dual-core controller runs on a LabVIEW Real Time Linux operating system.

Summary of Hazards Monitored

The air cooling and nitrogen purge systems monitor key detector parameters. If the monitored signals are outside of pre-programmed limits, the air cooling system shuts off voltage to the electronics and the nitrogen purge system sets off an alarm.

The signals monitored for air cooling include:

- Air flow
- Detector internal temperature
- Detector internal humidity
- Pressure inside ASME tank
- Air compressor power status

The signals monitored for the nitrogen include:

- Nitrogen flow
- Detector internal humidity

Air Cooling System

The RICH air cooling system prevents severe damage or fire. Clean, dry, room-temperature air will be supplied by high capacity air compressors to cool the electronics. Two compressors will be used in parallel to charge a 240 [gal.] capacity air tank. The tank should contain enough air to remove latent heat from the electronics in the case of a power outage. In the event of a cooling system fault, the interlocks will cut off power to, and prevent energizing of, the electronics.

There are three air cooling circuit interlocks

- Air compressor operation- minimum one compressor operating (and/or).
- Minimum air pressure in tank- pressure in air tank must be > TBD [psi].
- Minimum cooling air flow- flow to RICH must be > TBD [slm].

Air Cooling System Circuit Diagram

Figure 1 shows the diagram of the cooling system with power supply interlocks.

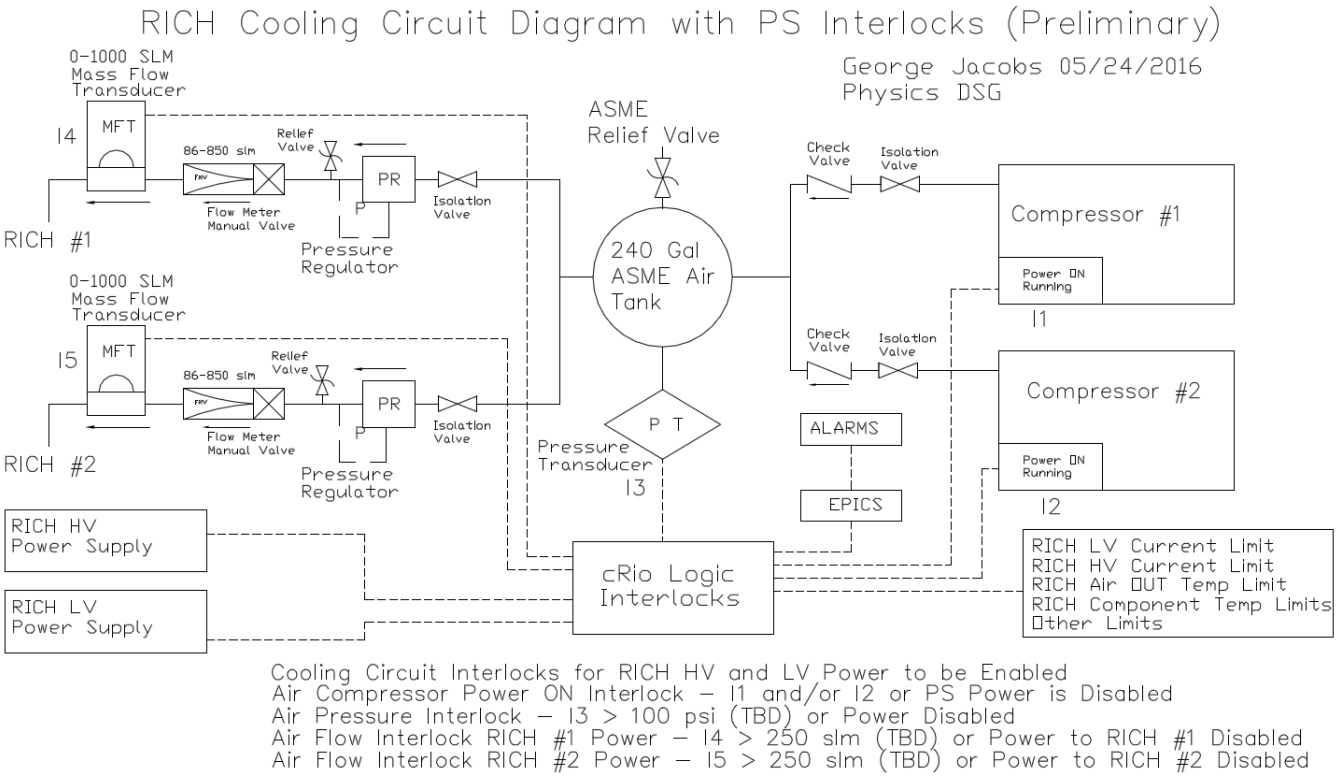

Figure 1. Cooling circuit diagram with power supply interlocks for RICH.

Nitrogen Purge Gas System

The aerogel used in the RICH detector requires *very* dry air (~1.8% humidity) in order to perform properly. The nitrogen purge gas system provides cool gas (~___C) at low humidity levels.

Nitrogen Purge Gas System Diagram

Figure 2 shows the diagram of the nitrogen purge gas system, to be located on the Forward Carriage.

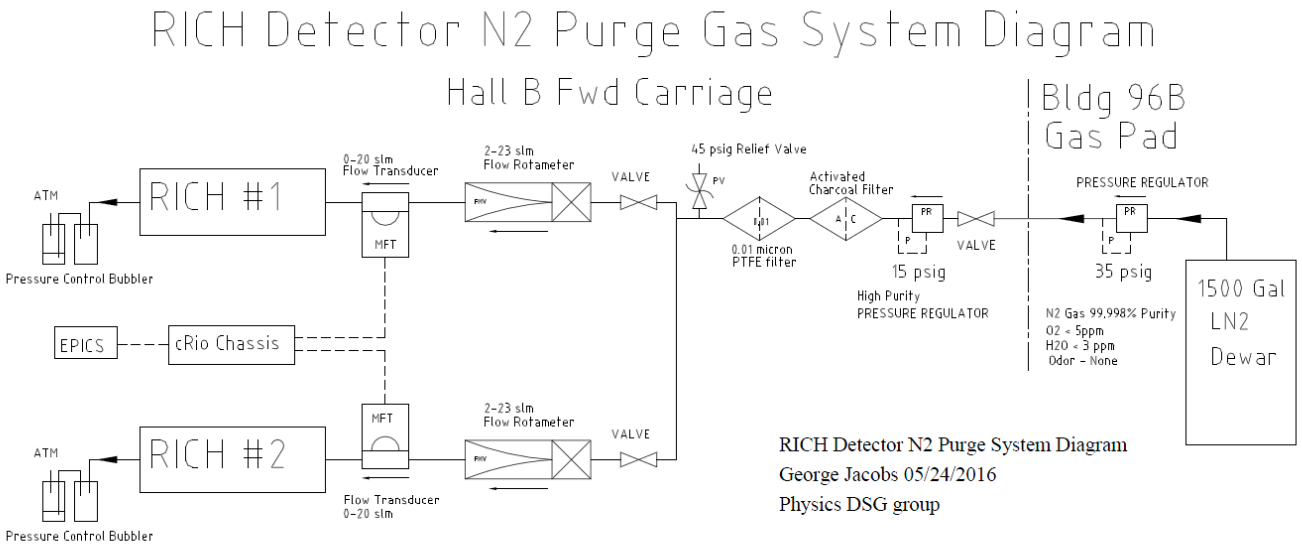

Figure 2 Nitrogen purge gas system diagram for RICH, to be located on Forward Carriage.

Number of Signals Monitored and Outputs

Table 1 details the type and number of signals monitored for the air cooling system. Table 2 details type and number of signals monitored for the nitrogen purge system.

Signal Name	Number of Channels	Input / Output	Description
Detector Internal Temperature		RTD Inputs	Measures detector temperature
Detector Internal Humidity		Analog Inputs	Measures humidity levels at electronics
Air Cooling Flow		Analog Inputs	Measures air cooling flow (external from compressors)
Air Cooling Temperature		Analog Input	Measures air cooling temperature (external from compressors)
HV/LV Crate Disable		TTL Outputs	Signals to power supply controllers to ramp down LV & HV
Compressor 1 Status			Reads status of Compressor 1 (On/Off)
Compressor 2 Status			Reads status of Compressor 2 (On/Off)

Table 1

Signal Name	Number of Channels	Input / Output	Description
Detector Internal Humidity		Analog Inputs	Measures humidity levels at aerogel
Nitrogen Flow		Analog Inputs	Measures Nitrogen flow

Table 2

Gas Interlock Systems Trip Levels

The Gas Interlock Systems are designed to monitor the detector and electronics for temperature, humidity, and pressure conditions that may harm the components. Table 3 details the trip levels for the air cooling system.

Monitored Value	EPICS Alarm (Trip) Level	EPICS Type	Hardware Interlock System Trip Level.
Detector Internal / Ambient (Over Temp)			
Detector Internal / Ambient (Over Humidity)			
Air Flow (Under Flow)			
ASME Tank Pressure (Over Pressure)			
Compressor 1 Power Status (On/Off)			
Compressor 2 Power Status (On/Off)			

Table 3

Table 4 details the trip levels for the nitrogen purge system.

Monitored Value	EPICS Alarm (Trip) Level	EPICS Type	Hardware Interlock System Trip Level.
Detector Internal / Ambient (Over Humidity)			
Nitrogen Flow (Under Flow)			

Table 4