2.0 The RTPC Gas Supply System

The Radial Time Projection Chamber gas system performs the following functions;

* Gas supply to the Drift Monitor System, DMS, and RTPC GEM, Gas Electron Multiplier
* Monitors the absolute pressure inside the RTPC
* Monitors the differential pressure between the DMS and RTPC
* He4 purge supply for the Buffer volume (Legacy Hall B He Gas System)

- Monitors the absolute pressure in the helium Buffer volume between the target and RTPC

2.1 Gas System Layout

The RTPC, gas supply system delivers pre-mixed gas, 20% CO2 in He, to the RTPC detector and Drift Monitor System, DMS, gas volumes. The pre-mix gas cylinders are located at the Hall B target gas pad behind the counting house. Gas is delivered via a stainless steel gas line that runs from the target gas pad to the Hall B space frame.

Gas flow to the RTPC and DMS gas volumes is metered by a mass flow controller. Gas flows first to the DMS, Drift Monitor System, which measures the electron drift speed in the gas mix. Gas then flows to the RTPC, Real Time Projection Chamber, which tracks particles emitted from the target. Gas exits the RTPC and is vented to atmosphere.

He4 gas is used to purge the Buffer volume between the CO2 target and RTPC ground plane. A manual flow meter is used to adjust flow. An oil filled bubbler is used to maintain pressure and prevent back flow of air into the Buffer volume.

2.2 Gas System Components and Connections

RTPC gas is supplied in high pressure, 2000 psi, pre-mix cylinders of 20% CO2 in He, each containing 220 SCF. Pressure regulators reduce the gas supply pressure to 15 psi for the mass flow controller. Flow limiting orifices limit gas flow in case of component failure.

The He4 purge gas is supplied in high pressure, 3000 psi, cylinders each containing 220 SCF. Pressure regulators reduce the gas supply pressure to 15 psi for the manual flow meter with valve. Flow limiting orifices limit gas flow in case of component failure.

The gas system components are all mounted on a compact panel to afford portability for testing at W&M and the EEL prior to hall installation.

Pressure gauge, PI1, indicates the gas pressure at the inlet of the mass flow controller at the valve panel on level 1 space frame in Hall B.. The valve panel isolation valve, MV7, is used to isolate the gas supply from the gas panel for maintenance.

The mass flow controller, MFC1, meters flow to the DMS and RTPC volumes. An absolute pressure transducer, PT1, monitors the absolute pressure inside the RTPC detector volume. A differential pressure transducer, PT2 monitors the differential pressure between the DMS and RTPS gas volumes.

The DMS can be isolated and bypassed using the manual valves, MV3, MV4, and MV5. A check valve, CV1 limits pressure in the DMS volume to 1 psi in case of human error.

The option of a second or alternate gas supply is provided by a tee connection and isolation valve, MV6.

Gas for the He4 Buffer purge is supplied from the Legacy Hall B He gas distribution system.. The He4 gas cylinders are located at the Hall B Gas Shed, Bldg. 96B. Manual flow meter, FM1, is used to adjust He4 gas flow to the Buffer volume. Pressure gauge PI2 indicates the He gas supply pressure and manual valve MV8 is used to isolate the He4 supply.

The oil filled bubblers act as a check valve to prevent backflow of air into the system while maintaining the desired detector pressure and providing a visual indication of gas flow.

The exhaust line directs the exhausted 20% CO2 in Helium gas to atmosphere outside of the hall or into the hall dome above the space frame.

2.3 Controls and Instrumentation

A National Instruments cRio is used to control the MFC and read back the gas system flow and pressure signals.

These signals are available on EPICS.

- RTPC Gas Flow

- RTPC Absolute Pressure

- DMS-RTPC Differential Pressure

- Buffer Absolute Pressure

2.4 Description of the Gas System Panel

2.5 Construction of the Gas System Panel

3.0 Gas System Operation

3.1 Gas System Initial Start-up

Step 1 - Verify all gas system components, gas lines, RTPC detector and DMS volume are connected as shown in the gas sytem P&I diagram.

Step 2 - Verify proper valve lineup for start up in the following order;

1) Close or check closed MV1, MV2, MV4, MV6, MV9, and MV10

2) Open or check open MV3, MV5, MV7, and MV8

3) Close the flow meter valve on FM1

4) Open the gas cyclinder valves and set the pressure regulators to 15 psi

5) Open MV1, MV2, MV9, and MV10

Step 3 - Set the flows on MFC1 and FM1

Step 4 - Purge the detector and DMS volumes at 100 sccm to 250sccm for ~90 min before turning on the HV

Step 5 - Once the purge is complete, reduce the detector and DMS flows for data taking

3.2 Flow and Pressure Controls

Detector gas flow control – Adjust the setpoint of MFC1 to increase or decrease gas flow

He buffer gas flow control – Adjust FM1 control valve to increase or decrease flow

RTPC gas volume pressure control – To increase pressure, add oil to the RTPC exhaust gas bubbler. To decrease pressure, remove oil from the bubbler.

He buffer pressure control - To increase pressure, add oil to the buffer exhaust gas bubbler. To decrease pressure, remove oil from the bubbler

3.3 How to Bypass the DMS

The DMS can be bypassed as follows;

1) Open MV4

2) Close MV3 and MV5

3.4 Optional Gas Supply

1) Close MV7

2) Attach gas source to MV6

3) Control gas flow using the optional controls