

The Hall B MVT Gas Mixing System

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The Hall B MVT Gas Mixing System

- Mixing System location will be in the Bldg. 96B gas shed
- System produces
 - Mixture 1 - 10% C₄H₁₀ in argon
 - Mixture 2 – 10% C₄H₁₀ 10% CF₄ in argon
- MKS Mass Flow Controllers, MFCs, will be used to mix the gasses
- The MFCs are controlled by the cRIO controller
- Mixed gas pressures are monitored by an MKS absolute pressure transducer
- Mixed gas pressure will be automatically controlled by adjusting the MFC flows
- Mixed gas flows into the Hall in temperature controlled piping

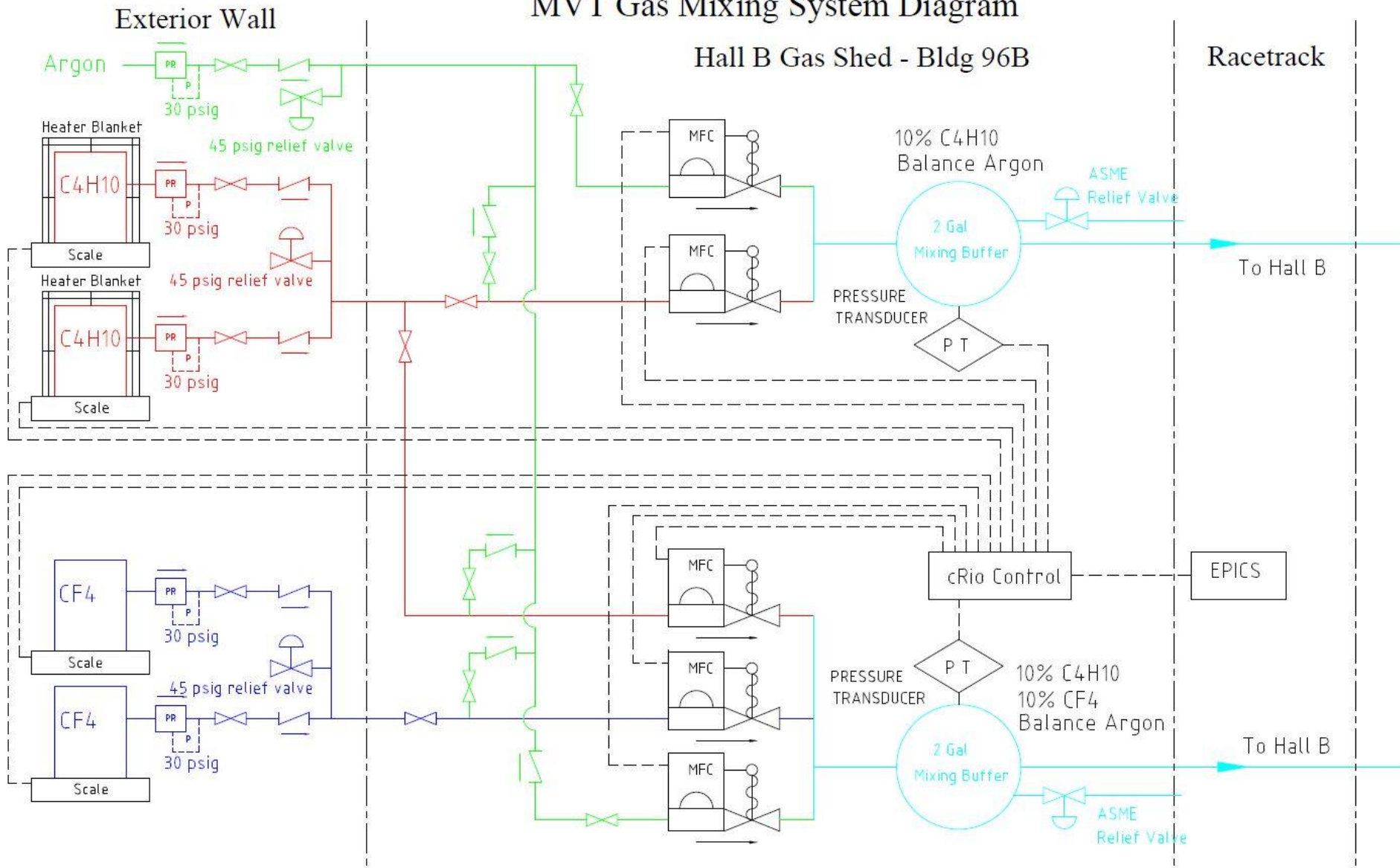
Design Goals in System Operation

- Prevent detector damage due to improper gas mixture
- Minimize required operator actions
- Minimize human errors
- Automate system startup and shutdown
- Prevent HV operation with improper gas mixture
- Prevent flow of flammable gas mixtures during maintenance or down times
- Monitor fill levels of CF_4 and C_4H_{10} liquid gas cylinders
- Adjust system operating parameters via GUI
- Integrate with EPICS and alarm handler

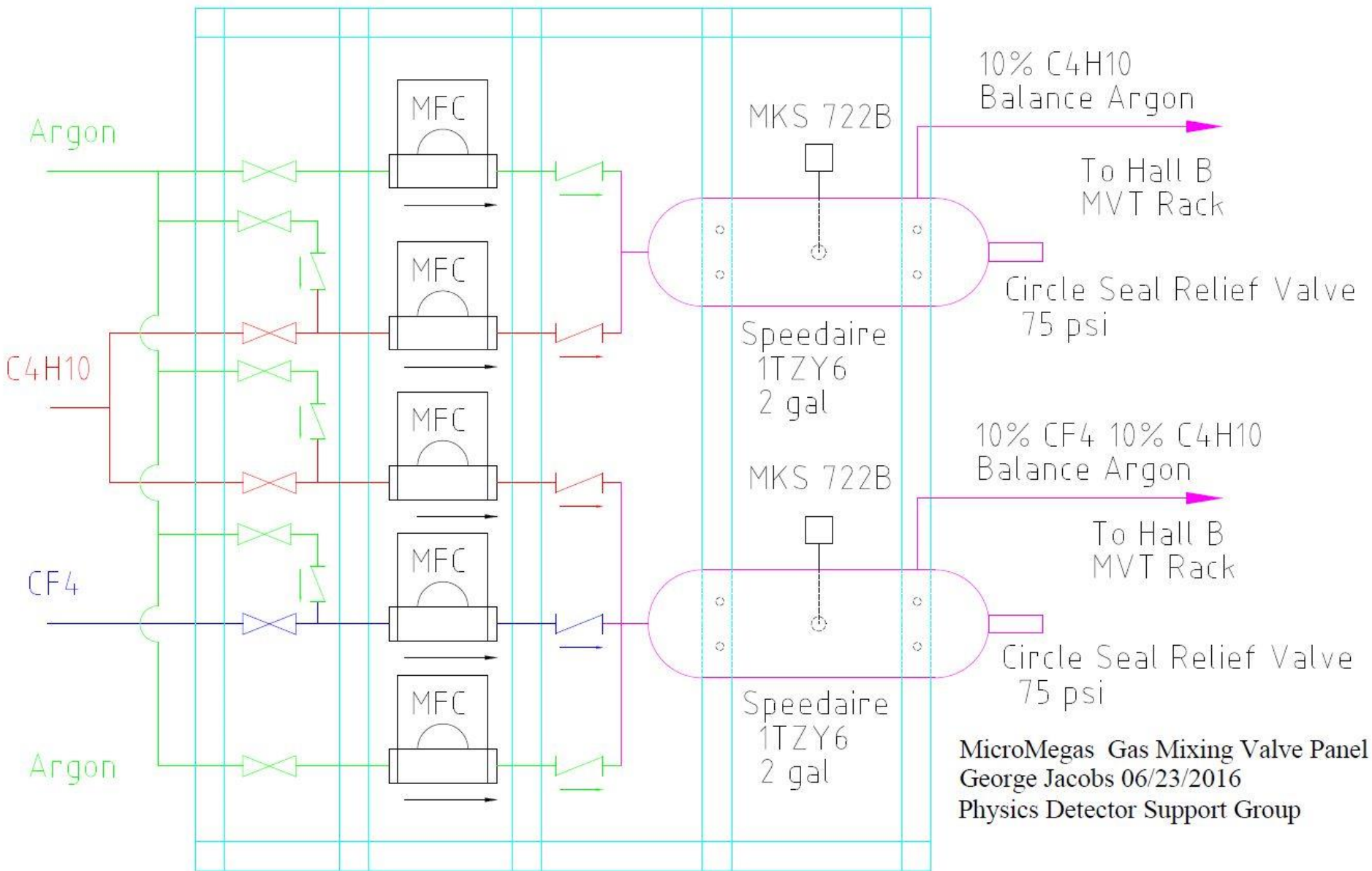
Mixing System Details

- Pressure system requirements apply
- cRIO controls
- EPICS monitoring and alarm handler
- Uses two pre-existing 300 ft long, temperature controlled, ½” stainless steel tubing running between gas shed and Hall B Level 1 Space Frame
- Isobutane is a flammable gas
- Trained operators needed to replace C_4H_{10} and CF_4

MVT Gas Mixing System Diagram



MicroMegas Gas Shed Valve Panel



MicroMegas Gas Mixing Valve Panel
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The System Startup Sequence

- When System Startup Button is clicked, cRIO program runs startup program
 1. Argon purge initiated – C_4H_{10} and CF_4 MFCs closed
 1. Argon MFCs flow at 650 sccm and 325 sccm
 2. Argon purge
 1. 156 liters total flow for MIX1 and 78 liters total flow for MIX2
 3. Mixed gas purge
 1. 78 liters total flow for MIX1 and 39 liters total flow for MIX2
 4. Finally, cRIO program switches to normal mixing and pressure control operation

Mix 1 Pressure Control

- Mix 1 – 10% C₄H₁₀ in argon
- Pressure monitored by MKS absolute Baratron transducer
- Line pressure 12-16 psi
- Normal detector flow 750 sccm
 - Flow rate varies between 400-900 sccm
 - @ 16 psi flow is reduced to 400 sccm
 - @ 12 psi flow is increased to 900 sccm
 - @ 17.2 psi flow is turned off
- Purge flow of 1000 sccm
 - Flow rate varies between 500-1500 sccm
 - @ 16 psi flow is reduced to 500 sccm
 - @ 12 psi flow is increased to 1500 sccm
 - @ 17.2 psi flow is turned off

Mix 2 Pressure Control

- Mix 2 – 10% CF₄ 10% C₄H₁₀ in argon
- Pressure monitored by MKS transducer
- Line pressure 12-16 psi
- Normal detector flow 250 sccm
 - Flow rate between 200-300 sccm
 - @ 16 psi flow is reduced to 200 sccm
 - @ 12 psi flow is increased to 300 sccm
 - @ 17.2 psi flow is turned off
- Purge flow of 325 sccm
 - Flow rate between 200-400 sccm
 - @ 16 psi flow is reduced to 200 sccm
 - @ 12 psi flow is increased to 400 sccm
 - @ 17.2 psi flow is turned off

The System Shut Down Sequence

- When the System Shut Down Button is clicked, cRIO runs shut down program
 - 1) Argon purge is initiated – C_4H_{10} and CF_4 MFCs closed, argon MFCs flow at 650 sccm and 325 sccm
 - 2) Argon purge
 - 1) 156 liters total flow for MIX1 and 78 liters total flow for MIX2
 - 3) Then cRIO program turns off argon purge and turns off all MFCs

Integration with FT and Saclay PLC

- Current gas distribution system in Hall requires manual flow adjustments and operation of valves in distribution racks for system start, purge, and shut down
- Mixing System startup sequence automation
- Mixing System purge automation
- Mixing System shut down sequence automation
- Automatic Mixing System shut down in case of large downstream leak
- EPICS signals from Saclay PLC for EPICS GUI
- Total gas flow signals for mixing system optimization

Critical Path Includes

- Purchase components
- Fabricate and install gas shed valve panel
- Fabricate and install scales and regulators for C₄H₁₀ and CF₄ cylinders
- Fabricate and install controls chassis and cables
- Run SS tubing in gas shed to connect valve panel to temperature-controlled lines to Hall B
- Run SS tubing in Hall B to connect temperature-controlled lines to MVT and FT gas panels
- Develop cRIO controls
- Test cRIO controls
- Test with Saclay and FT Gas Distribution Systems

Conclusion

- Current detector gas distribution system is manpower intensive and requires manual valve operation and flow adjustment for system startup, purge, and shut down
- Further controls development required to automate detector gas distribution equipment in Hall
- Estimated time for gas mixing system completion once all components are purchased is ~4 months
- Hall B gas shed location for flammable gas mixing system requires approval