Upgrade to the LTCC Gas Controls

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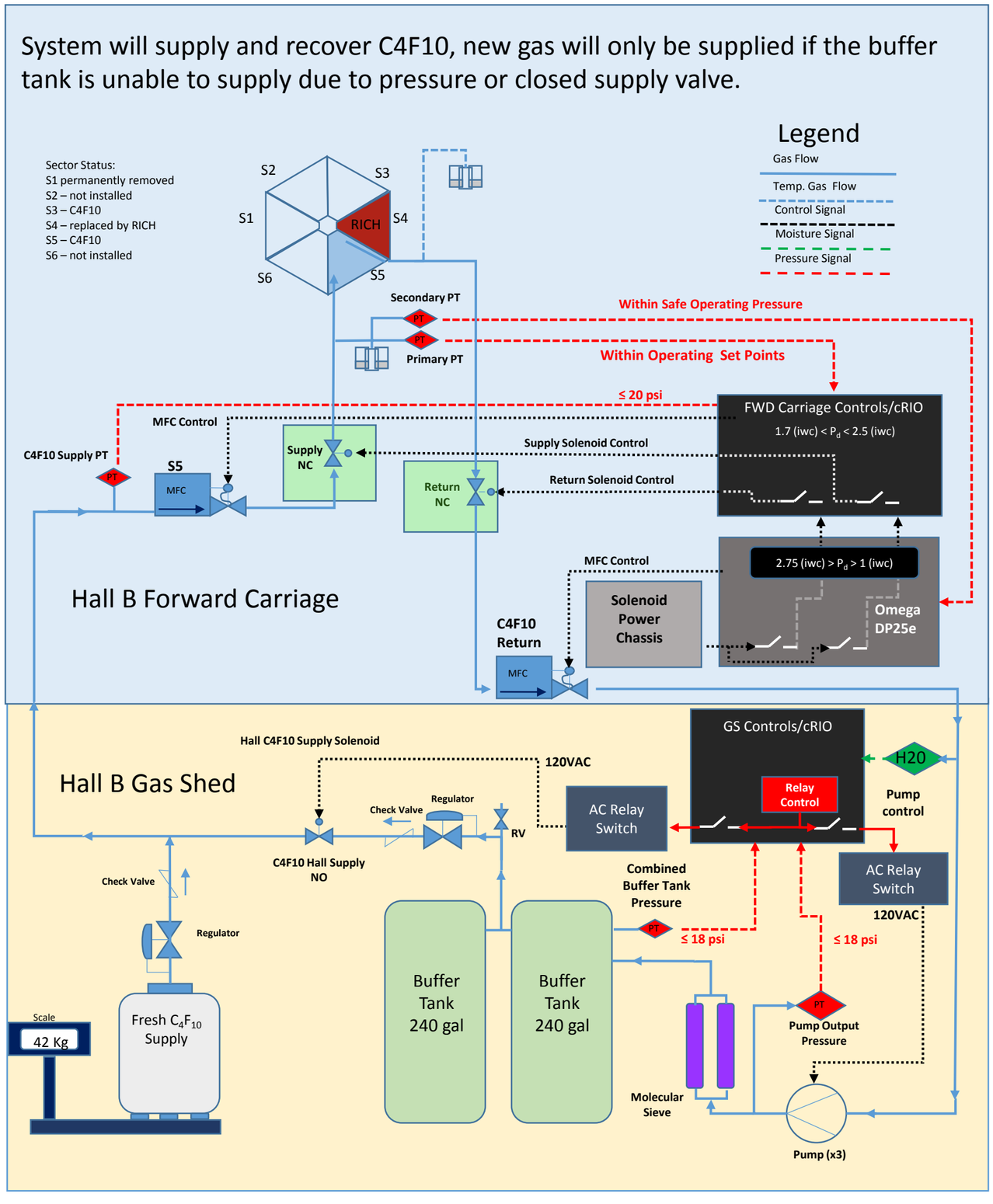
LTCC Controls System Update

- New hardware installation and configuration change
  - Updated control power for solenoids (Solenoid Power Chassis)
  - Added new transducers
  - Added pump controls
  - H_2O sensor
  - Implemented new controls logic and interface software
  - New Forward Carriage GUI
  - Updated Gas Controls GUI (Gas Shed)
- Reconfigured operation of safety system
  - Omega DP25e process controllers are independent safety system
  - Hall B Gas Controls software is operational control
- Completed functionality and initial system testing

LTCC C_4F_{10} Supply and Recovery System

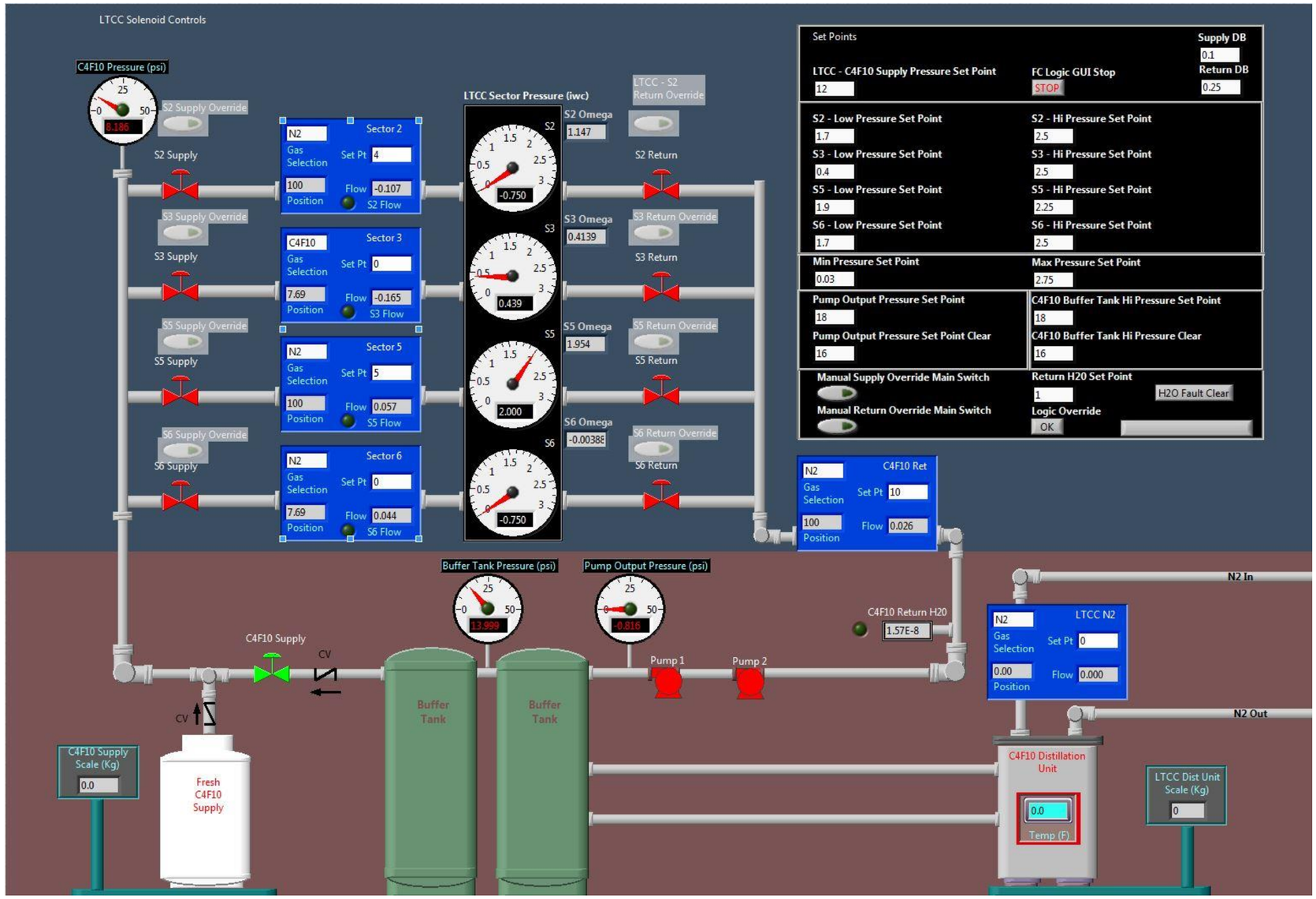
- First stage of upgrade, which includes Supply and Recovery of C_4F_{10}
- Sector solenoids and pumps are controlled by LTCC logic software from Forward Carriage
- C_4F_{10} is supplied from buffer tanks unless they are empty
- If buffer tank pressure is less than 4 psi, fresh C_4F_{10} tank becomes supply. **This would indicate a loss of gas from the system.**

System will supply and recover C4F10, new gas will only be supplied if the buffer tank is unable to supply due to pressure or closed supply valve.



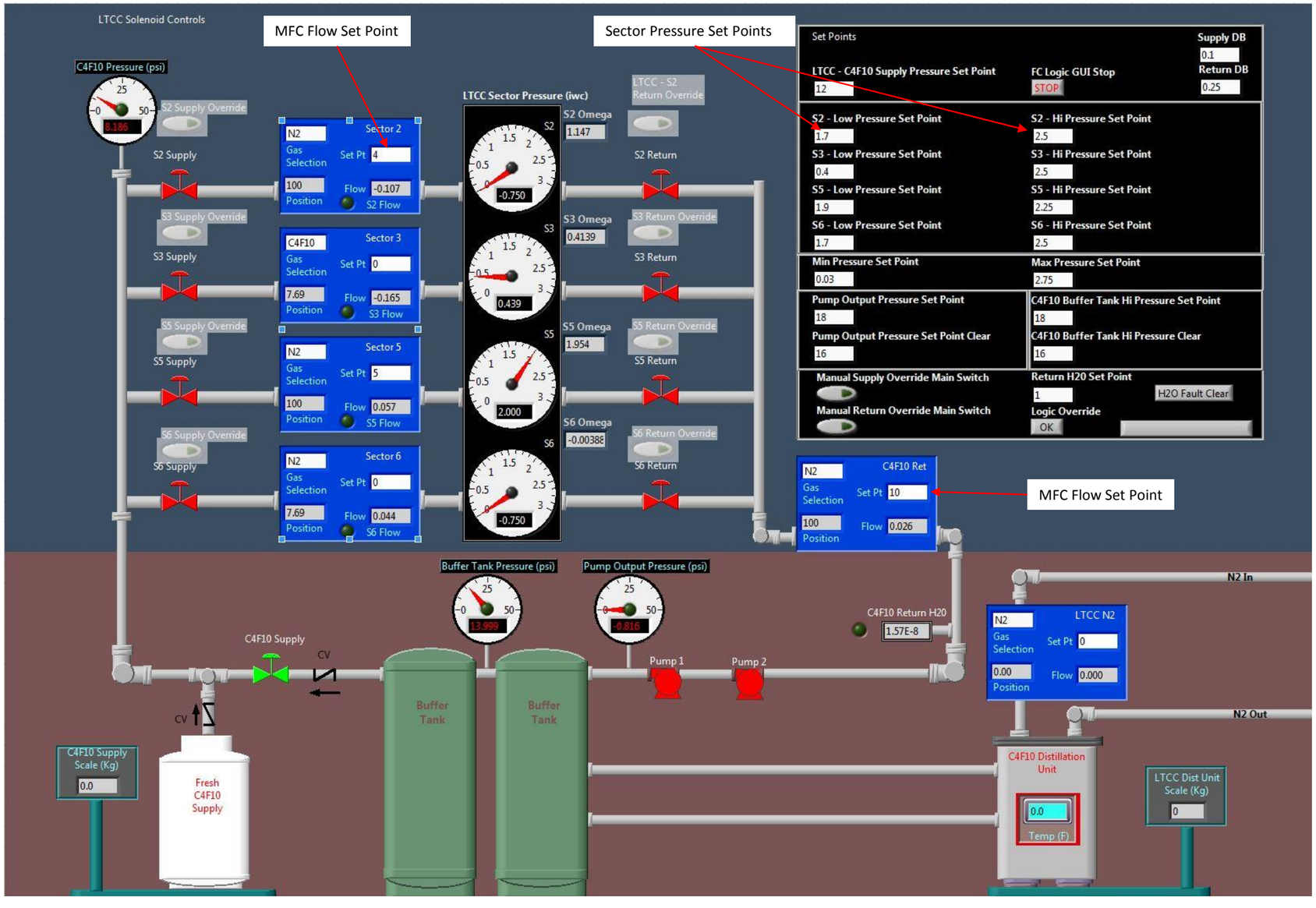
LTCC Solenoid Controls GUI

- GUI is displayed on FC cRIO monitor
- Main gas controls GUI tab has been updated with same features
- Upper portion represents Forward Carriage equipment
- Lower portion represents Gas Shed equipment



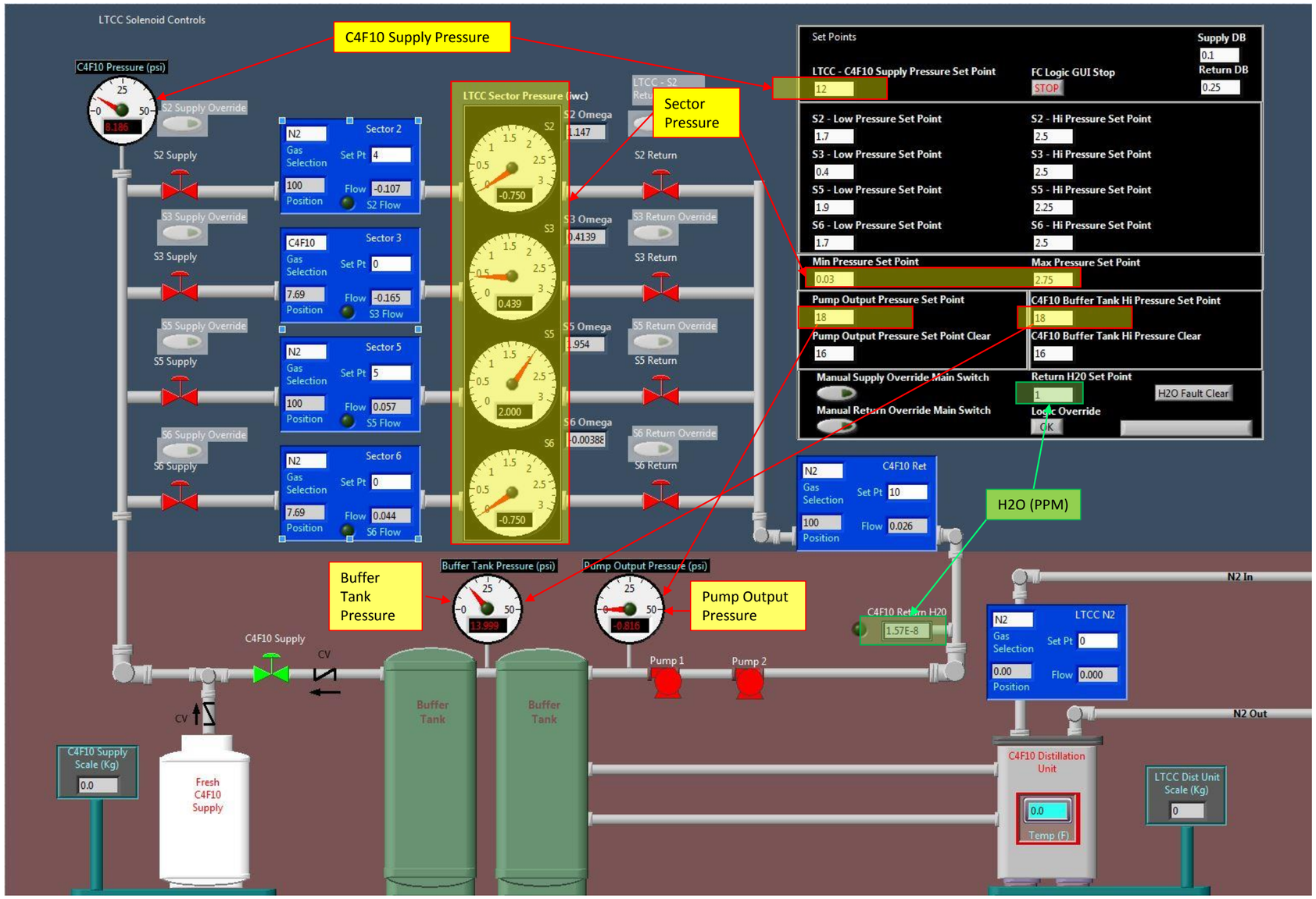
LTCC Solenoid Controls GUI, cont.

- Operator enters initial set points for pressure, flow, gas type, and H_2O content
- Operational set points: low pressure is 1.7 wc (fills to 1.8 wc per deadband set point)
- High pressure is 2.5 wc (returns down to 2.25 wc per deadband set point)

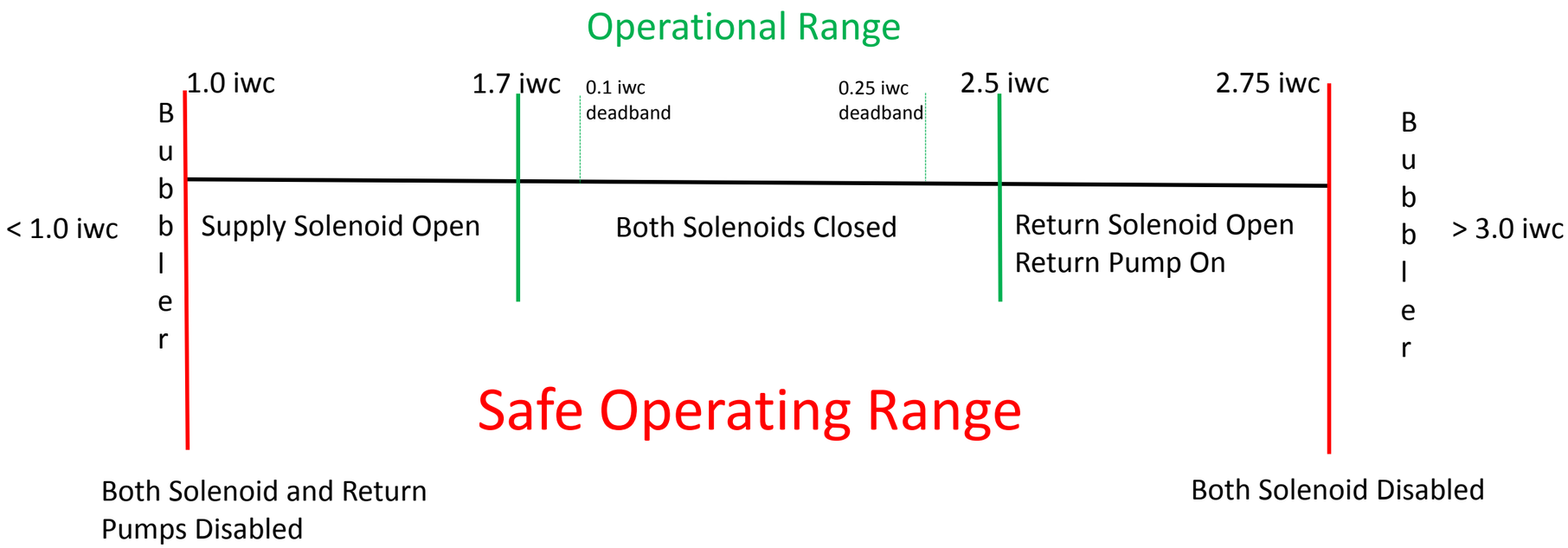


Controls System Interlocks

- C_4F_{10} overpressure closes all sector supply solenoids
- Sector under minimum pressure (1.0 wc) closes both sector solenoids and shuts off all pumps.
- Sector over maximum pressure set point (2.75 wc) closes both sector solenoids
- Either buffer tank or pump output over pressure closes all return solenoids and shuts of all pumps
- H_2O sensor out of range closes C_4F_{10} supply solenoid

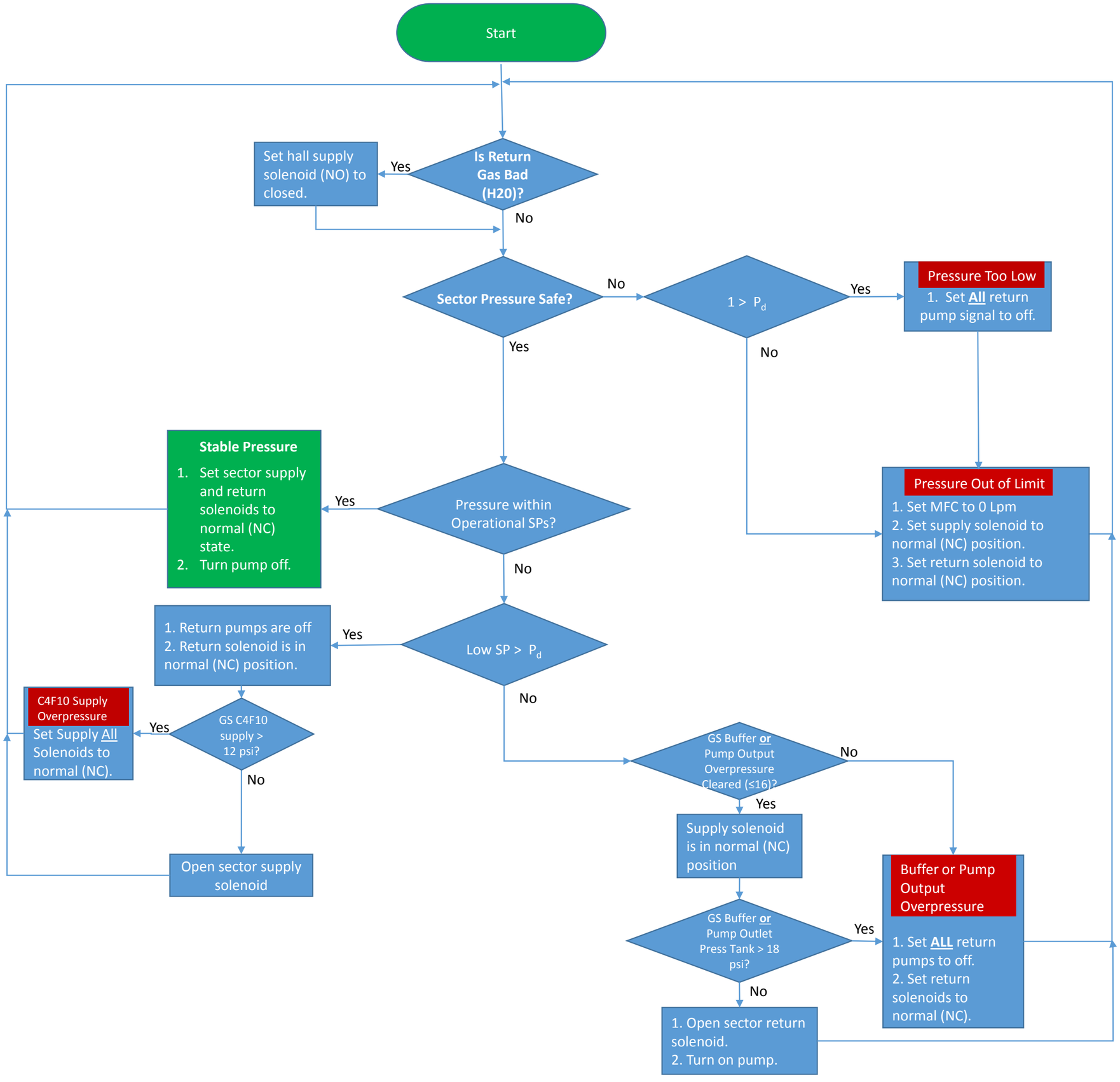


Operational Range vs. Safe Operating Range



- System is designed to keep pressure between operational set points (green lines)
- When pressure is outside of operational pressure, appropriate solenoid opens and pumps engage (if appropriate)
- If system pressure is outside of safe operating range (red lines), both solenoids close and pumps are secured (if pressure is < 1 wc)
  - At that point, passive pressure controls protect sector (bubbler)

LTCC Solenoid Logic (Single Sector)



Conclusion

- DSG has upgraded LTCC gas controls to operate as supply and recovery system
- Functionality test completed
- Operational test was conducted from 1/14 to 1/22
  - **System performed as expected**