Detector Support Group Report

Tuesday, April 26, 2016

Amrit Yegneswaran

Contents

Introduction: Genesis

- **DSG formed January 2014.**
  - Initial staff from Hall B and Hall D.
  - In all, 12 staff members.

- **DSG reports to Dr. Patrizia Rossi.**

Fortiter in re, suaviter in modo.

- **First convening of DSG: March 13th, 2014.**

  DSG Meeting Minutes – 3/13/14

  DSG members introduced themselves.

  Patrizia stated the scope and responsibilities of the group.

Introduction: Charge

- **Support tracking detectors in halls B and D.**
  - DC and SVT
  - FDC and CDC

- **Expanded Scope.**
  - Shortly after first meeting, Patrizia advised DSG to:
    - Support any detector and/or magnets in halls B and D.
    - Set priority to be Hall D and CLAS 12 upgrade.

Introduction: Staff

Antonioli, Mary Ann

Arslan, Sahin

Bonneau, Peter

Eng, Brian (Deputy)

Campero, Pablo

Hoebel, Amanda

Jacobs, George

Leffel, Mindy

Lemon, Tyler

McMullen, Marc

Sitnikov, Anatoly

Introduction: DSG Capabilities

- Design
  - SVT, Magnet electronics, DC electronics, DC stringing and assembling, Gas Systems, Hardware Monitoring System, CCTV system, Slow Controls Systems
- Instrumentation
  - SVT, DC, Gas Systems, CCTV System, Magnets, Hardware Monitoring System, Slow Controls Systems
- Operations
  - SVT, DC, CCTV System, Hardware Monitoring System

Introduction: DSG Capabilities

- Electronics
  - *Design and Development* of test stations and fixtures for detector instrumentation and power supplies, multilayer PCBs, flex boards, *test and measurement* of electronic components and instruments, *fabrication* of equipment, *programming* PIC microcontrollers, FPGAs
- Hardware
  - Wire-bonding, Soldering, Cable and component fabricating, Optical fiber polishing, 3-D printing, Machining
- Software
  - C, C++, Python, JAVA, ROOT, Data basing software (SQLite and Oracle), Mathematica, GEANT, Adobe CS6, EPICS, AutoCAD, NX (solid modelling), PLCs, LabVIEW, PIC Microcontrollers , Xilinx, Altera

Introduction: Contributions to Hall B

- **Silicon Vertex Tracker**
  - All phases: from design to operations
- **Drift Chambers**
  - Fabrication, instrumentation, testing, gas system, and operational support
- **Central Time of Flight**
  - PMT amplifier boards (~100), disassembly and reassembly
- **Low Threshold Cerenkov Counter**
  - Mirror testing, Winston Cone Testing, Testing program, analysis, gas system, leak check, and documentation
- **High Threshold Cerenkov Counter**
  - Prototype gas system
- **Gas System**
  - DC, LTCC, HTCC, SVT, MicroMegas, RICH, Forward Tagger
- **Torus and Solenoid Magnets**
  - Testing PLC codes
- **HDICE**
  - RF cable, RF Box, Rotation of Target Polarizatiion, Mathematica upgrade
- **MicroMegas**
  - Gas System
- **RICH**
  - Gas System and assembly aspects

Introduction: Contributions to Hall D

- **PLC programs**
  - Solenoid, Pair Spectrometer, BCAL, FCAl, CDC, FDC, Start Counter
- **Solenoid**
  - PXI based Fast DAQ System
- **Pair Spectrometer**
  - Power Supply, Cabling, added temperature monitoring
- **BCAL**
  - Voltage and environmental monitoring, added new heartbeat code
- **FDC**
  - Implemented gas system alarms
- **CDC**
  - Implemented gas system alarms
- **FCAL**
  - HV supply debugging
- **Start Counter**
  - Implemented heartbeat code
- **Tagger**
  - Debugged HV reset issues
- **Target**
  - Configured/tested temperature set-point alarm
- **Slow controls**
  - Tested magnet vapor-cooled lead flow controls
  - Voltage tap tag data basing in EXCEL
- **Gas System**
  - Programmed controls for pressure flow system

Introduction: Conclusion

- Diverse contributions to halls B and D.
  - Design, Instrumentation, Operations, Electronics, Software, and Hardware

- Staff exceptionally talented, *d*ynamic, *s*killed and *g*ifted.

Group loves the work

and

loves to work and contribute as a team.

Current Projects
I. Hall B Gas System

Team: DSG

- Designing, developing, and implementing Gas System in Hall B.
  - DC, SVT, LTCC, HTCC, MicroMegas, RICH, and Forward Tagger

- Designing, developing, and implementing Gas System in EEL and in TEDF for testing detectors .

Hall B Gas System: Generic Layout

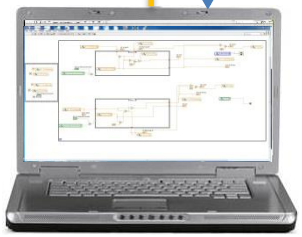
Network switch

Gas Flow Control and Monitoring

LabView Code

Gas Flow Monitoring

LabView Code



PC with LabView Software

NI 9035 cRIO

GUI Controls

Sensor signal

Gas Controls Interface chassis

MFC power

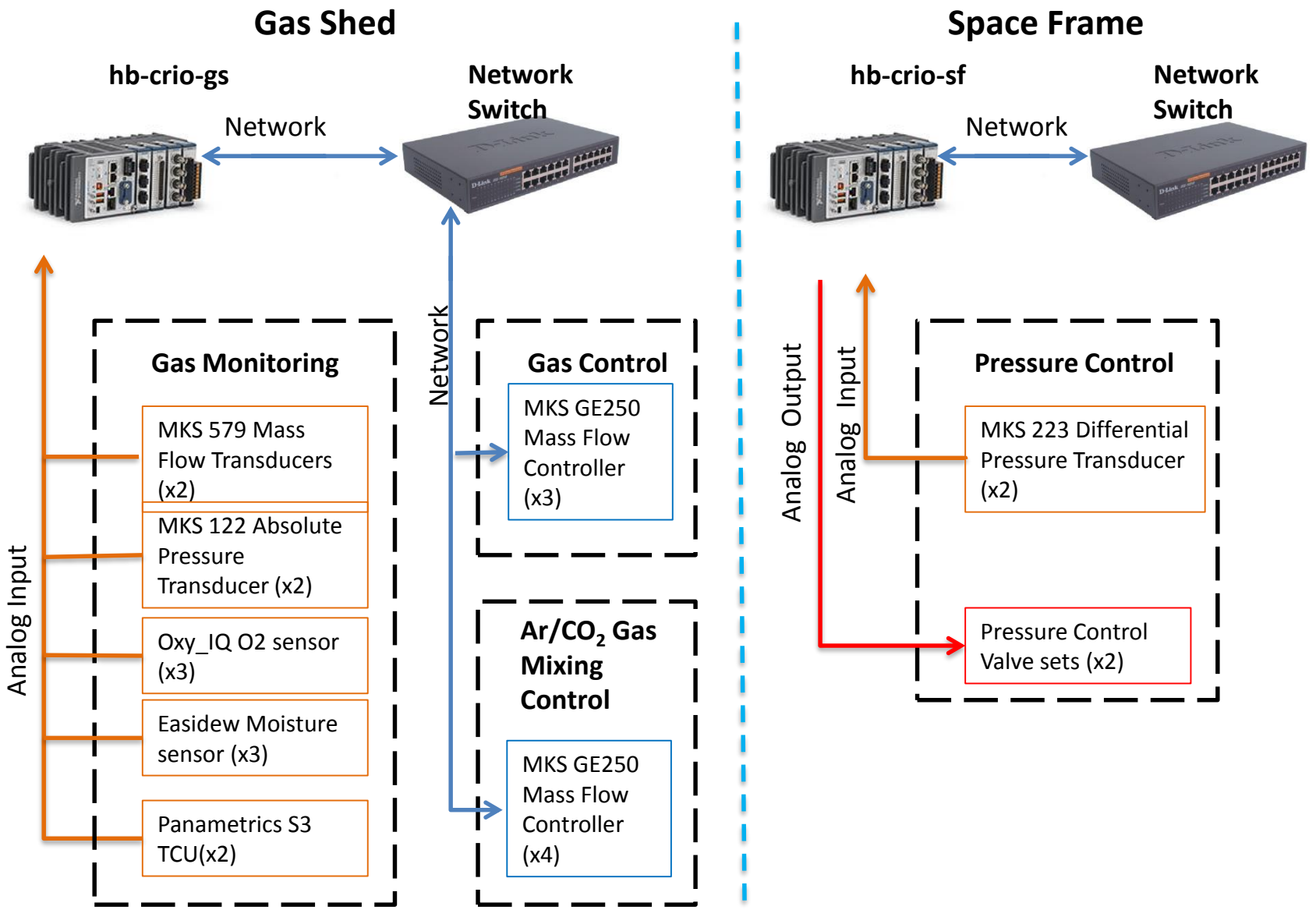
MKS GE50/250 Mass Flow Controller

Sensor signal

Sensor power

System sensor

Hall B Gas System: DC Gas Controls

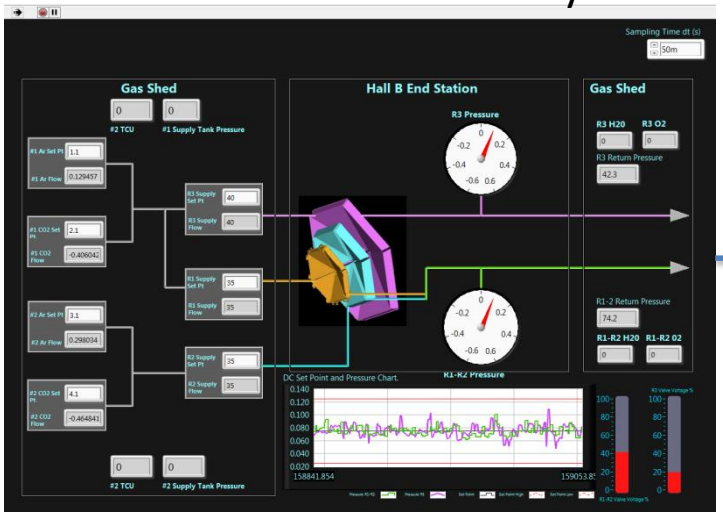


Hall B Gas System: Layout

National Instruments compact RIO DAQ and controls.

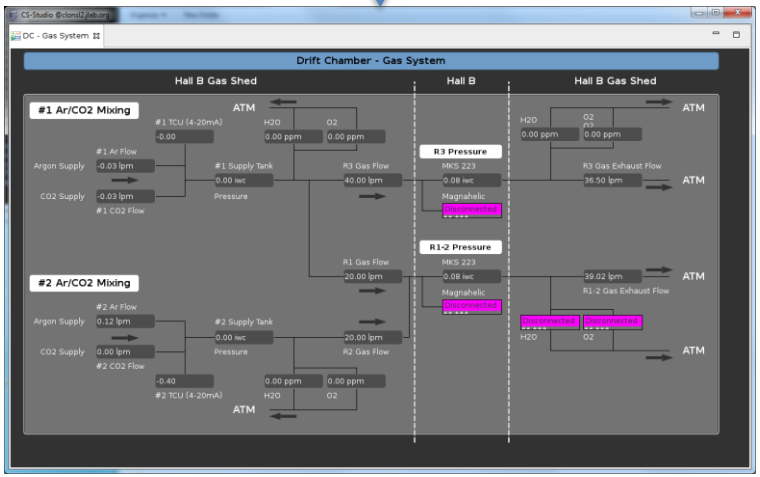
1. Hall B's gas system controlled by three individual setups. (GS, SF, FC)
2. Setups work in concert over slow controls network (160).
3. Provide *operational control* in Hall B gas shed and *monitoring data* to EPICS system in counting house.

Custom controls interface chassis with touchscreen monitor



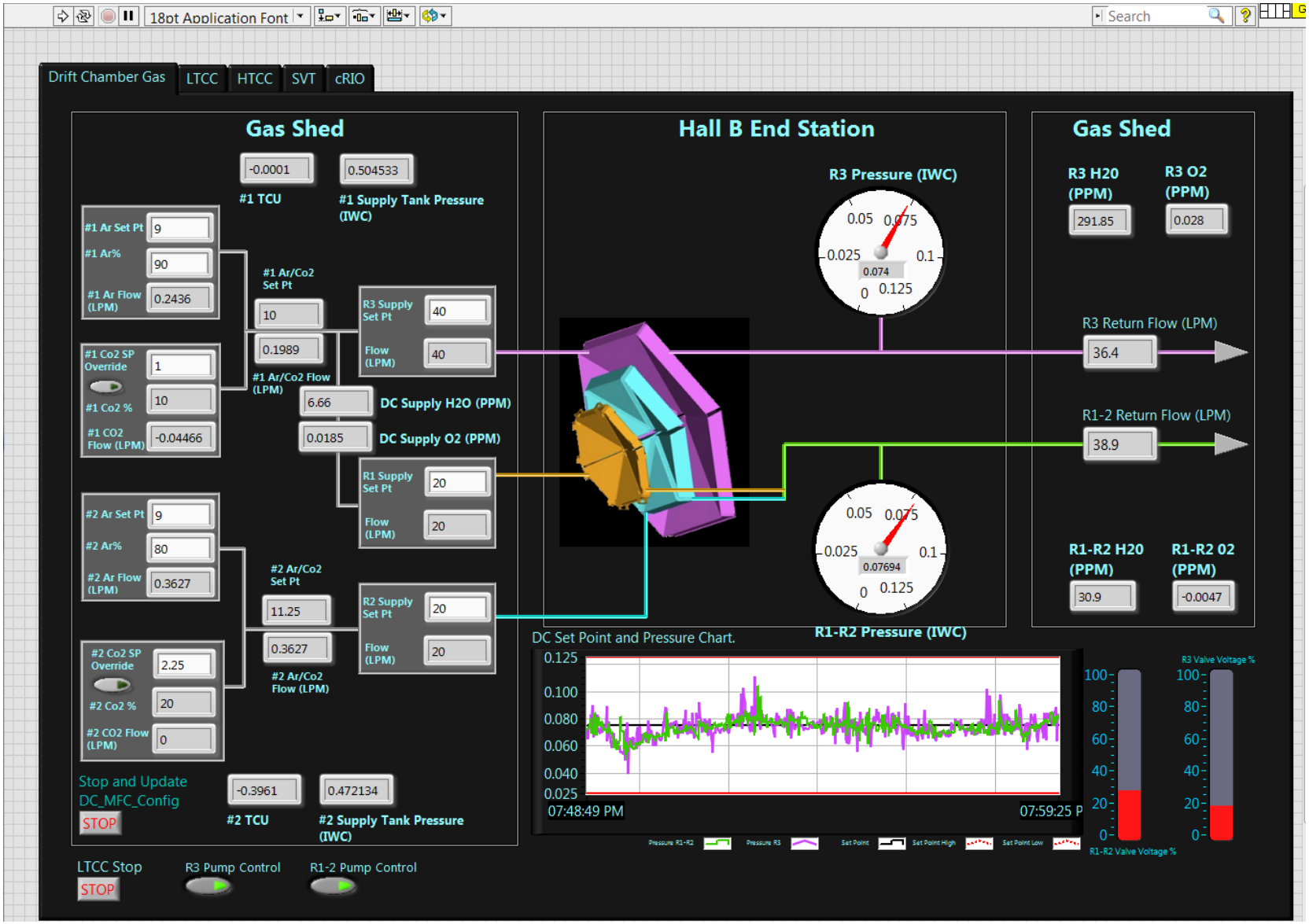
National Instruments LabView software in gas shed.

Process Variable to EPICS

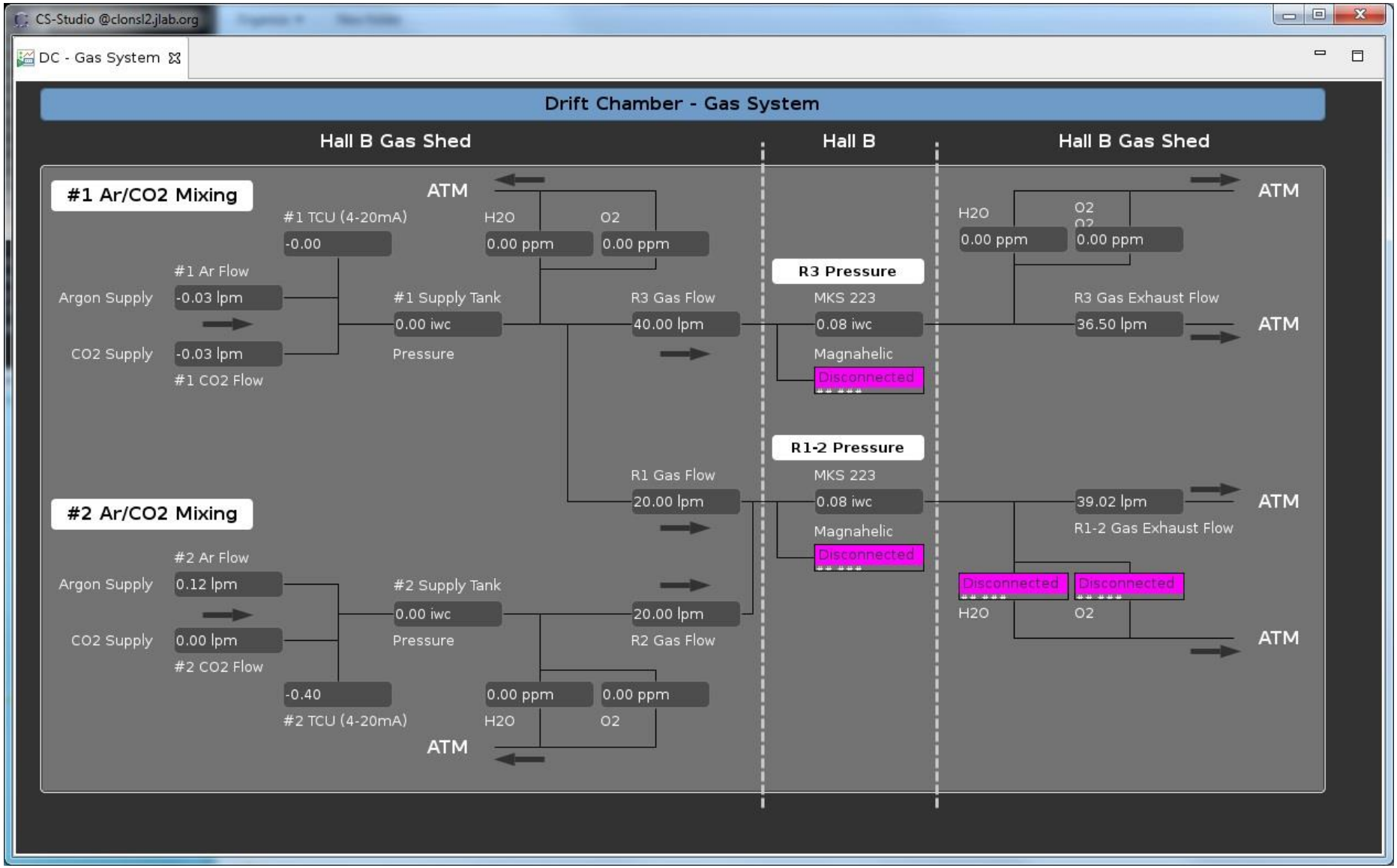


EPICS monitoring screen in counting house.

Hall B Gas System: DC Gas Controls GUI



Hall B Gas System: DC Gas EPICS Monitoring Screen



Hall B Gas system: Status

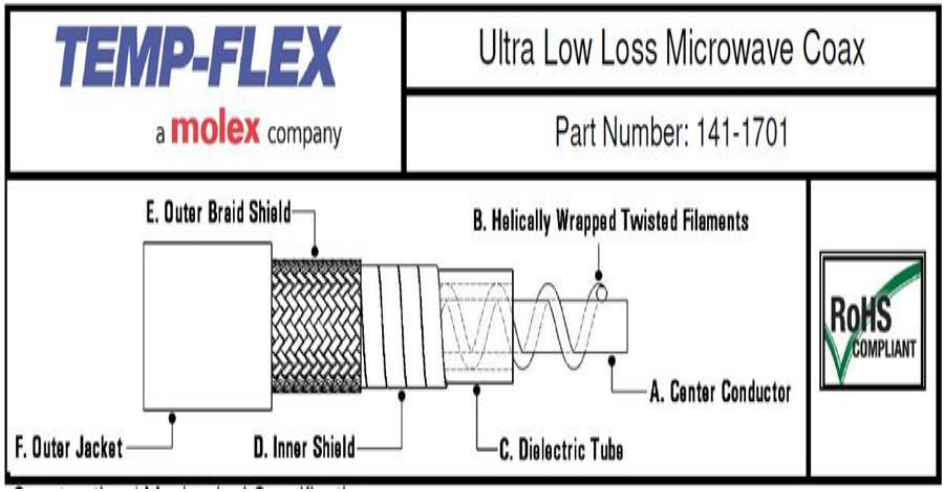
#	Location	Detector	Gas	Hardware		Software	Deployed	Tested
				Piping	Instrumentation			
1	Hall B	DC	Ar/CO_2	X†	✓	✓	✓	X
2		HTCC	N_2	X†	X	✓	✓	X
4		LTCC	C_4F_{10}	X†	✓	✓	X	X
5		SVT	N_2	X†	X	✓	✓	X
6		RICH	N_2	X††	X††	X††	X††	X††
7		MicroMegas	Ar, C_4H_{10}, C_2H_6, Ne††, CF_4	X††	X††	X††	X††	X††
8		Forward Tagger	N_2	X	X	X	X	
9	EEL	SVT	N_2	✓	✓	✓	✓	✓
10		MicroMegas V.1	Pre-mix Ar/C_4H_{10}	✓	✓	N/A	N/A	N/A
11		Micromegas V.2	Mix Ar/C_4H_{10}	X	X	N/A	N/A	N/A
12		Forward Tagger	N_2	✓	✓	N/A	N/A	N/A
13	TEDF	HTCC	N_2	✓	✓	✓	✓	✓

† Waiting on Hall B Engineering. †† Waiting for more information.

Current Projects
II. HDICE
Peter, Brian, Mary Ann, Mindy, Sahin, Anatoly

Hardware

- Researched flexible air core RF cables, tested, and terminated them with “N” plugs.



- Designing and fabricating RF Attenuation/Switching box

Current Projects
II. HDICE

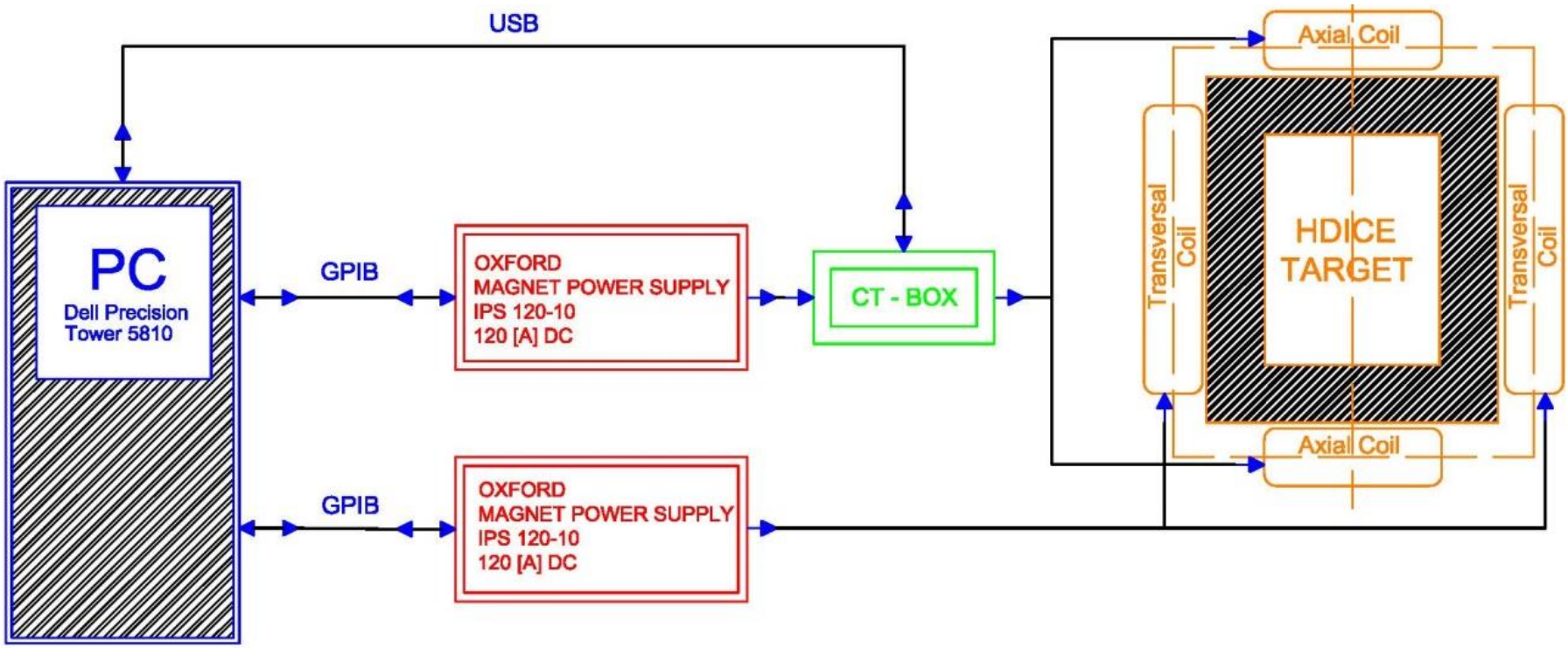
Peter, Brian, Mary Ann, Tyler, Amanda, Pablo

Software

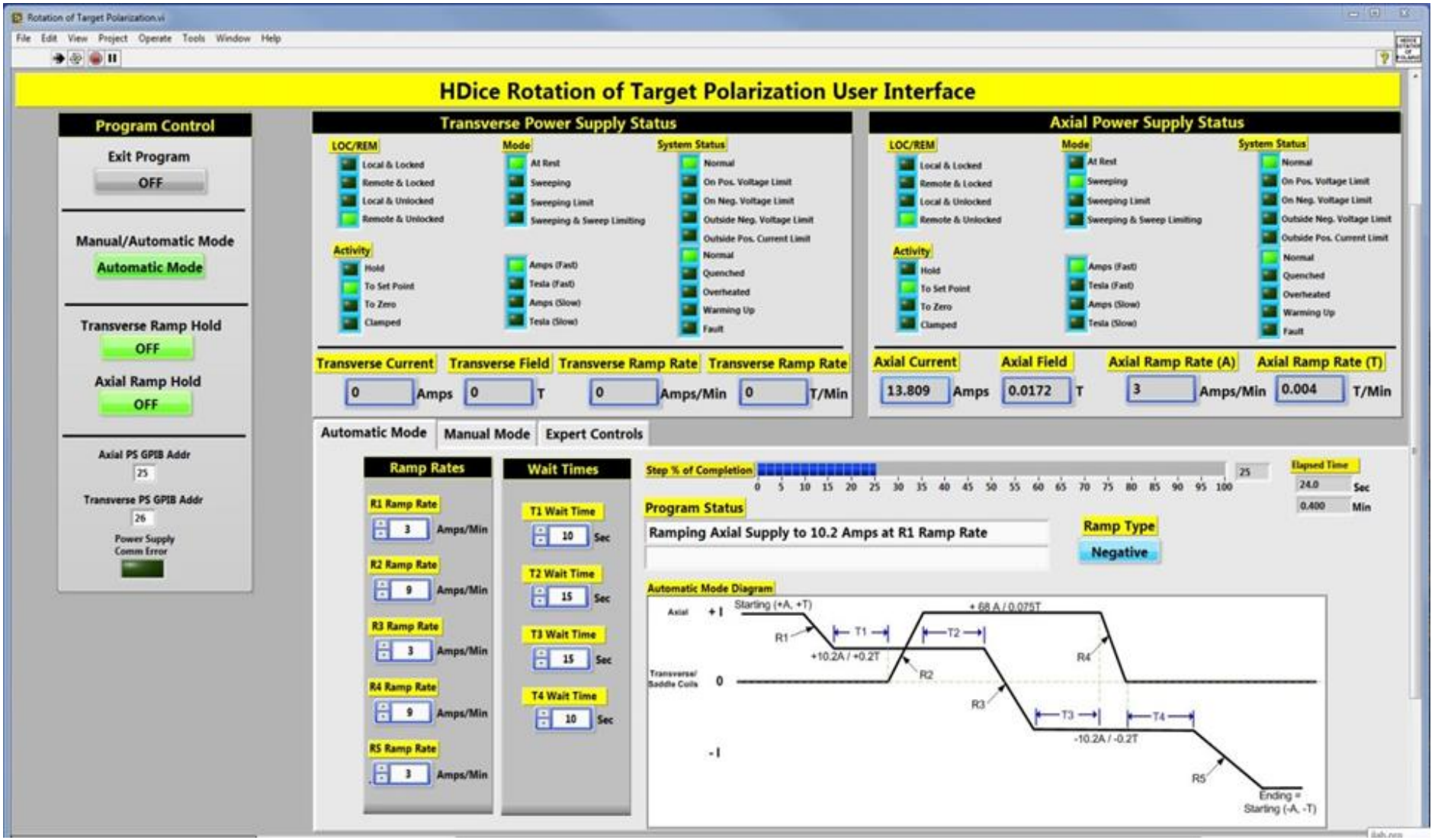
- Development of rotation of target polarization program.
- Design and development of calibration system for measuring current.

HDICE: Rotation of Target Polarization Setup

- Hardware configuration schematic

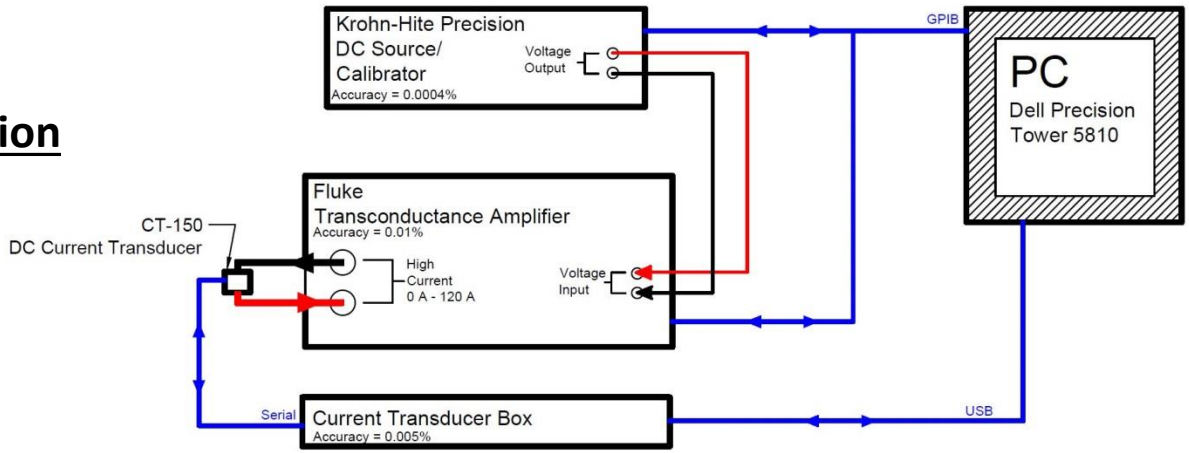


HDICE: Rotation of Target Polarization GUI

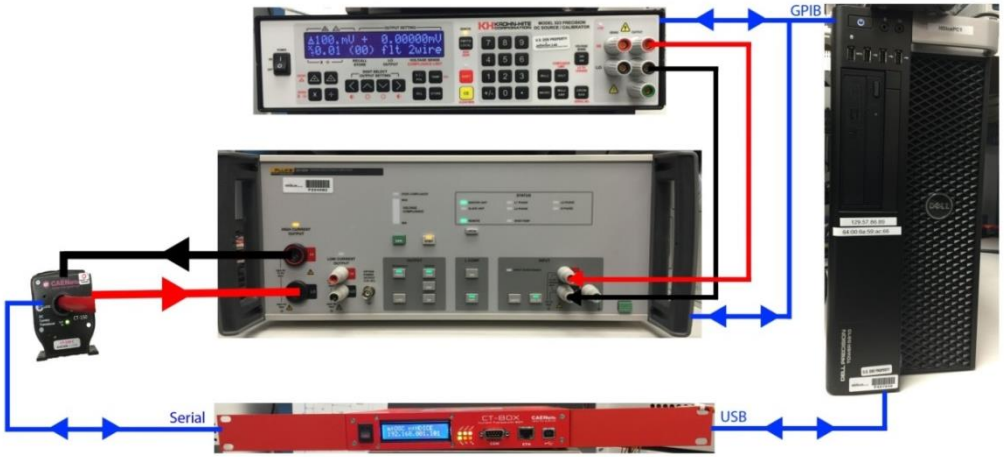


HDICE: Current Transducer Box Calibration Setup

- **Abstraction**



- **Realization**



Linear fit of data using Mathematica: $I_{Meas.} = 0.99997\ I_{Set} + 0.00268$; $(I_{Set} - I_{Meas.})/I_{Set} \rightarrow 0.00003$ for Iset >> 0.0028

Current Projects
III. Hall D Solenoid

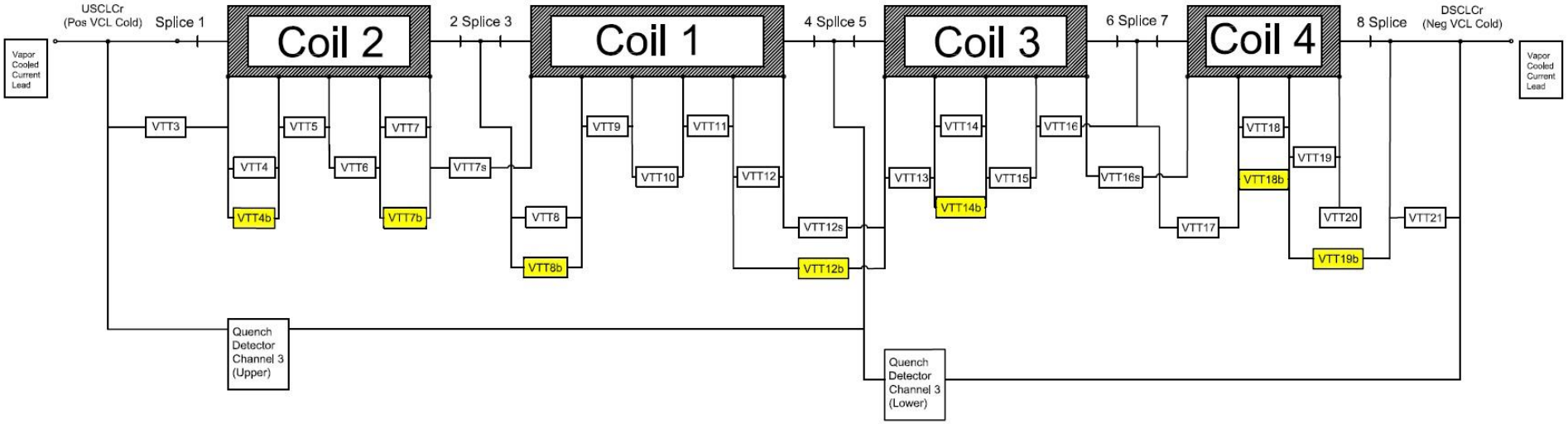
Peter, Brian, Tyler, Amanda, Pablo

- Databased in SQLite, Excel voltage tap measurements of solenoid coils.

- PLC Support
  - Documenting PLC system.
  - Generated Allen Bradley report.
  - Verifying report with existing hardware.

Hall D Solenoid: Voltage Tap Tags

- Voltage Tap Tag Schematic



Hall D Solenoid: Excel

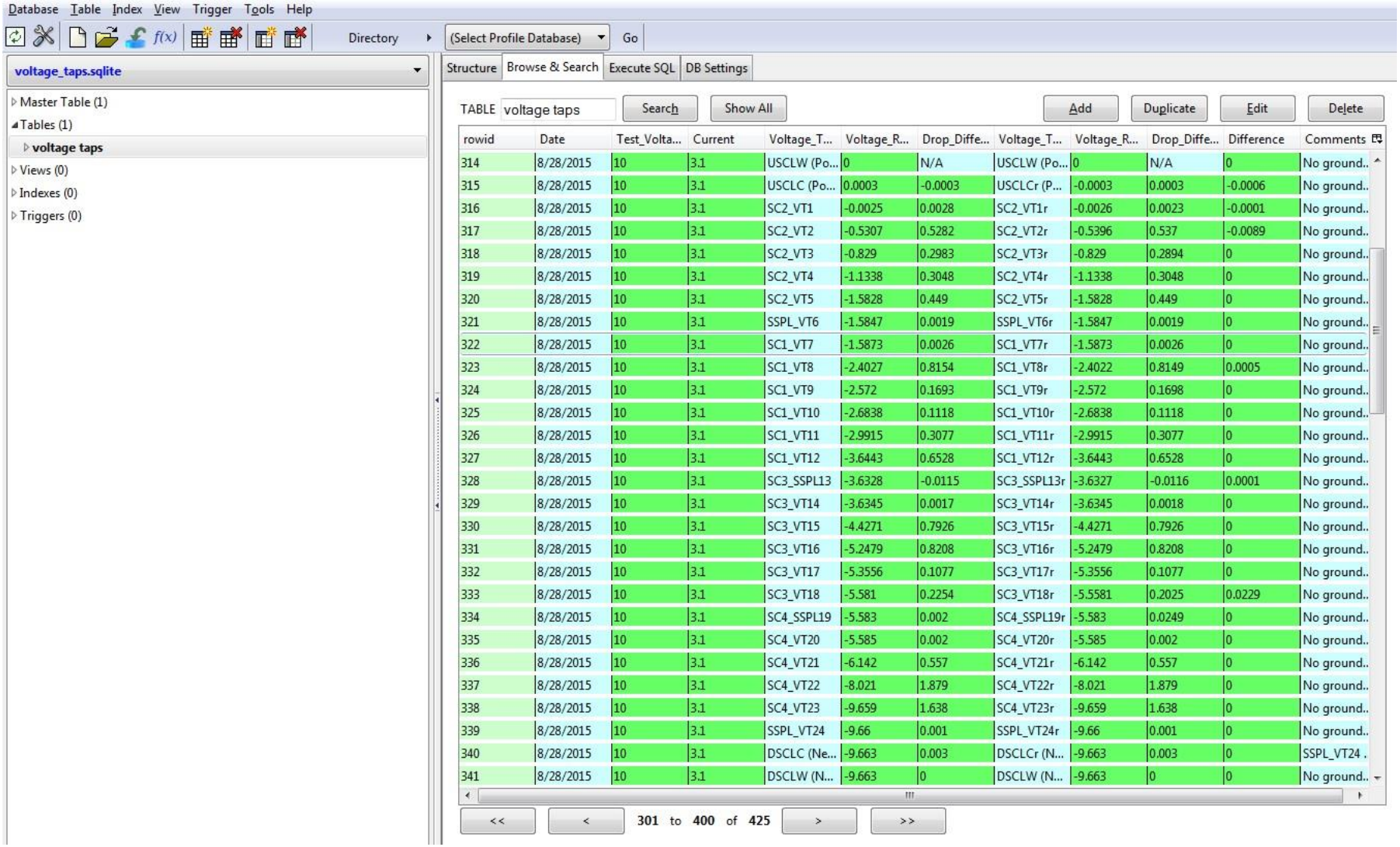
- Voltage Tap Measurements

Voltage Drop Readings on Voltage Taps

	Date	12/3/2015			Date		Voltage
	Voltage	5.0V			Voltage		Tap Pairs
	Current	0.3A			Current		
	Voltage Tap designation	Voltage Reading	Drop Difference	Voltage Tap designation	Voltage Reading	Drop Difference	Difference
	Measurements @ Current Limiting Resistor Boxes			Measurements @ Voltage Taps Test Box			
	USCLW (Pos. VCL Warm)	2.8046		USCLW (Pos. VCL Warm)	2.8044		-0.0002
			-0.0245			-0.0256	
	USCLC (Pos. VCL Cold)	2.8291		USCLCr (Pos. VCL Cold)	2.8300		0.0009
			0.0001			0.0009	
Coil 2	SC2_VT1	2.8290		SC2_VT1r	2.8291		0.0001
			0.3388			0.3294	
	SC2_VT2	2.4902		SC2_VT2r	2.4997		0.0095
			0.1683			0.1779	
	SC2_VT3	2.3219		SC2_VT3r	2.3218		-0.0001
			0.1874			0.1877	
	SC2_VT4	2.1345		SC2_VT4r	2.1341		-0.0004
			0.2760			0.2763	
	SC2_VT5	1.8585		SC2_VT5r	1.8578		-0.0007

Hall D Solenoid: SQLite Database

- Voltage Tap Database in SQLite



Hall D Solenoid: PLC Support

Peter, Brian, Mary Ann, Tyler, Amanda, Pablo

- PLC Chassis 1 layout
  - Generated from Allen Bradley report

Chassis 1		Slot 0	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9
	Power Supply 1756-PA72	Iso. 24 V Sequ. of Events Input 1756-IB16ISOE	Iso. 24 V Sequ. of Events Input 1756-IB16ISOE	Analog Input 1756-IF16	Analog Input 1756-IF16	Analog Input 1756-IF16	Analog Input 1756-IF16	Analog Input 1756-IF16	Analog Input 1756-IF16	Analog Input 1756-IF16	EtherNet /IP 1756EN2T
Bit/Channel 00		Spare	Spare	VTT #1	SC1_TP1	SC1_SG1	VTT #9	SC2_TP1	SC2_SG1	VTT #17	
Bit/Channel 01		MPS Relay 1 Phase Detector	Fast Relay 1 Vacuum SUM	VTT #2	SC1_TP2	SC_1SG2	VTT #10	SC2_TP2	SC2_SG2	VTT #18	
Bit/Channel 02		MPS Relay 2 A/C Overcurrent	Fast Relay 2 LHe Liquid Level	VTT #3	SC1_TP3	SC1_SG3	VTT #11	SC2_TP3	SC2_SG3	VTT #19	
Bit/Channel 03		MPS Relay 3 Water Flow	Fast Relay 3 DS Lead Flow	VTT #4	SC1_TP4	SC1_SG4	VTT #12	SC2_TP4	SC2_SG4	Spare	
Bit/Channel 04		MPS Relay 4 Overtemp String	Fast Relay 4 US Lead Flow	VTT #5	SC1_TP5	SC1_SG5	VTT #13	SC2_TP5	SC2_SG5	Spare	
Bit/Channel 05		MPS Relay 5 Slow Dump SUM	Fast Relay 5 DSCL Temp	VTT #6	SC1_TP6	SC1_SG6	VTT #14	SC2_TP6	SC2_SG6	Spare	
Bit/Channel 06		MPS Relay 6 Ground Fault	Fast Relay 6 DSCLr Temp	VTT #7	SC1_TP7	SC1_SG_T	VTT #15	SC2_TP7	Spare	Spare	
Bit/Channel 07		MPS Relay 7 CEBAF Panel	Fast Relay 7 USCL Temp	VTT #8	SC1_TP8	SC1_SG_B	VTT #16	SC2_TP8	Spare	Spare	
Bit/Channel 08		MPS Relay 8 Fast Dump SUM	Fast Relay 8 USCLr Temp	Spare	SC1_TCR1	Spare	Spare	SC2_TCR1	Spare	Spare	
Bit/Channel 09		MPS Relay 9 E-Stop / Doors	Fast Relay 9 DSCL Voltage	Spare	SC1_TCR2	Spare	Spare	SC2_TCR2	Spare	Spare	
Bit/Channel 10		MPS Relay 10 Main Contactor	Fast Relay 10 USCL Voltage	Spare	SC1_TCR3	Spare	Spare	SC2_TCR3	Spare	Spare	
Bit/Channel 11		Slow Relay 1 VT Cable Intlck	Fast Relay 11 PLC Fast Dump	Spare	SC1_TCR4	Spare	Spare	SC2_TCR4	Spare	Spare	
Bit/Channel 12		Slow Relay 2 Cable Interlocks	Fast Relay 12 Quench Detector	Spare	SC1_TCR5	Spare	Spare	SC2_TCR5	Spare	Spare	
Bit/Channel 13		Slow Relay 3 PLC Watchdog	Fast Relay 13 Refigerator Monitor	Spare	SC1_TCR6	Spare	Spare	SC2_TCR6	Spare	Spare	
Bit/Channel 14		Slow Relay 4 PLC Slow Dump	Spare	Spare	SC1_TCR7	Spare	Spare	SC2_TCR7	Spare	Spare	
Bit/Channel 15		Spare	Spare	Spare	SC1_TCR8	Spare	Spare	SC1_TCR8	Spare	Spare	
		Wiring Schematic Page - 0110	Wiring Schematic Page - 0120	Wiring Schematic Page - 0107	Wiring Schematic Page - 0111	Wiring Schematic Page - 0112	Wiring Schematic Page - 0108	Wiring Schematic Page - 0114	Wiring Schematic Page - 0115	Wiring Schematic Page - 0109	

Current projects
IV. Hall B Magnets

Peter, Brian, Tyler

1. ✓ Test power supply PLC code with Danfysik Power supply.
2. Define/develop EPICS screen(s) for power supply status/control
3. Define/develop Cryo-EPICS screens for Distribution Can and Torus Service Tower.
4. ~~Solenoid Bore Heater control (out of scope work ☹)~~
5. ~~Define/develop EPICS screen for Solenoid Bore Heater Control (out of scope work ☹)~~
6. Coordinate checkout of Distribution Box PLC program after Distribution Box installation.

Current Projects: Conclusion

I. Hall B Gas System work progressing well.

1. PAC (cRIO) based controls and monitoring system has been developed and is being tested for:
    1. DC, LTCC, HTCC, SVT
2. Concerned about:
    1. Delays due to work coordination with Hall B Engineering
    2. Lead time for gases C_4F_{10} and Ne
    3. RICH, MicroMegas, Forward Tagger
        - No equipment purchased

II. HDICE work demanding, aggressive schedule.

1. Request for components for one rack end of Sept. 2016.
    - ✓ RF cable search and secure completed.

III. Hall D Solenoid support going smoothly.

IV. Hall B Magnet support work proceeding as well as it can.

1. Work Schedule decided by Ruben Fair of magnet group.
    - ✓ Test power supply PLC code with Danfysik Power supply.

DSG is Dynamic Skilled and Gifted