

MICE Coupling Coil Test System Data Acquisition System

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Instrumentation Required for Testing the MICE Coupling Coil

- The Solenoid Test Facility will require the following instrumentation for measurement & control:
 - Temperature (Platinum and Cernox RTDs)
 - Liquid Level
 - Pressure
 - Flow
 - Power Lead Voltages
 - Superconducting bus Voltages
- The MICE Coupling Coil may require the following instrumentation for measurement & control – needs to be defined by LBNL:
 - Temperature (Cernox RTDs)
 - Strain Gauges
 - Coil Segment Voltages
 - Coil Heaters
 - Coil Current

Data Acquisition & Controls For Testing the MICE Coupling Coil

- Slow Scan System –
 - Use DMMs, current sources, and MUXs to measure relatively slow signals from instrumentation such as temperatures (RTDs), liquid levels, pressures, flows, etc.
 - Similar to the slow scan systems used to test superconducting magnets in IB1



Keithley 37061
Six-Slot Switch
& DMM



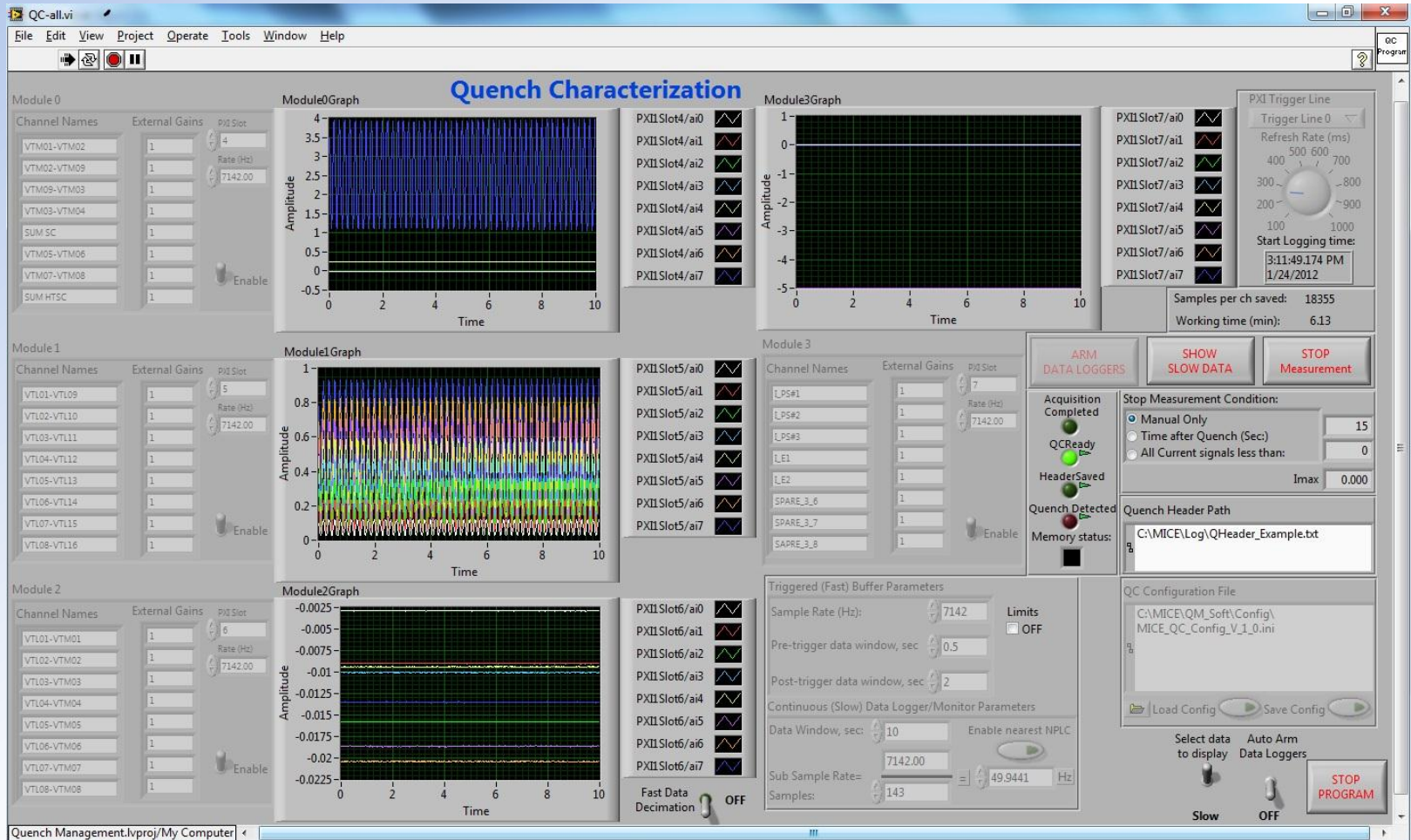
Data Acquisition & Controls For Testing the MICE Coupling Coil

- Quench Characterization (QC) – Fast Logger DAQ
 - Uses data loggers that can sample up to 10kHz
 - Saves a user specified window of data triggered by a quench
 - Similar to the QC systems used in IB1 as well as the system that was fabricated for the upcoming MICE spectrometer test
 - Can analyze the data with an Analysis tool
 - Matlab Based application
 - Can save data in ASCII format for use with preferred analysis tools
- Slow Logger System –
 - Uses the QC data loggers to continuously log the data from 32 channels at rates between 0.1Hz and 100Hz
 - Limited by disk space and bandwidth
 - Can log data continuously from all 32 channels at 5Hz for up to ~12 hours
 - QC will still be armed to capture triggered data in the event of a quench
 - Data monitoring is displayed on the front panel
 - Can analyze or export the logged data with an Analysis tool



Quench Detection & Characterization
DAQ Rack for the MICE Spectrometer
Solenoid

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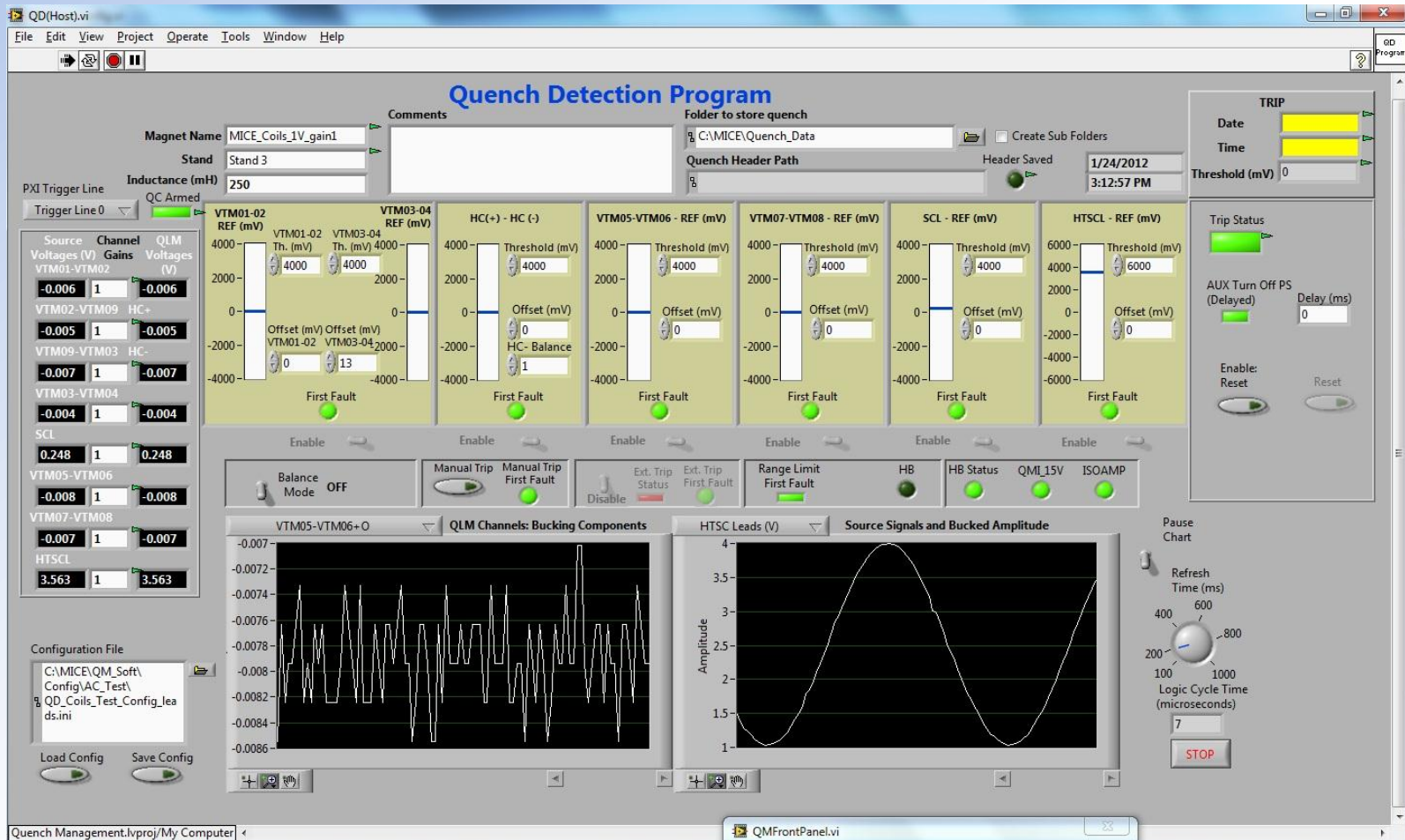
Quench Characterization Front Panel – Slow Logger Data Displayed

Data Acquisition & Controls

For Testing the MICE Coupling Coil

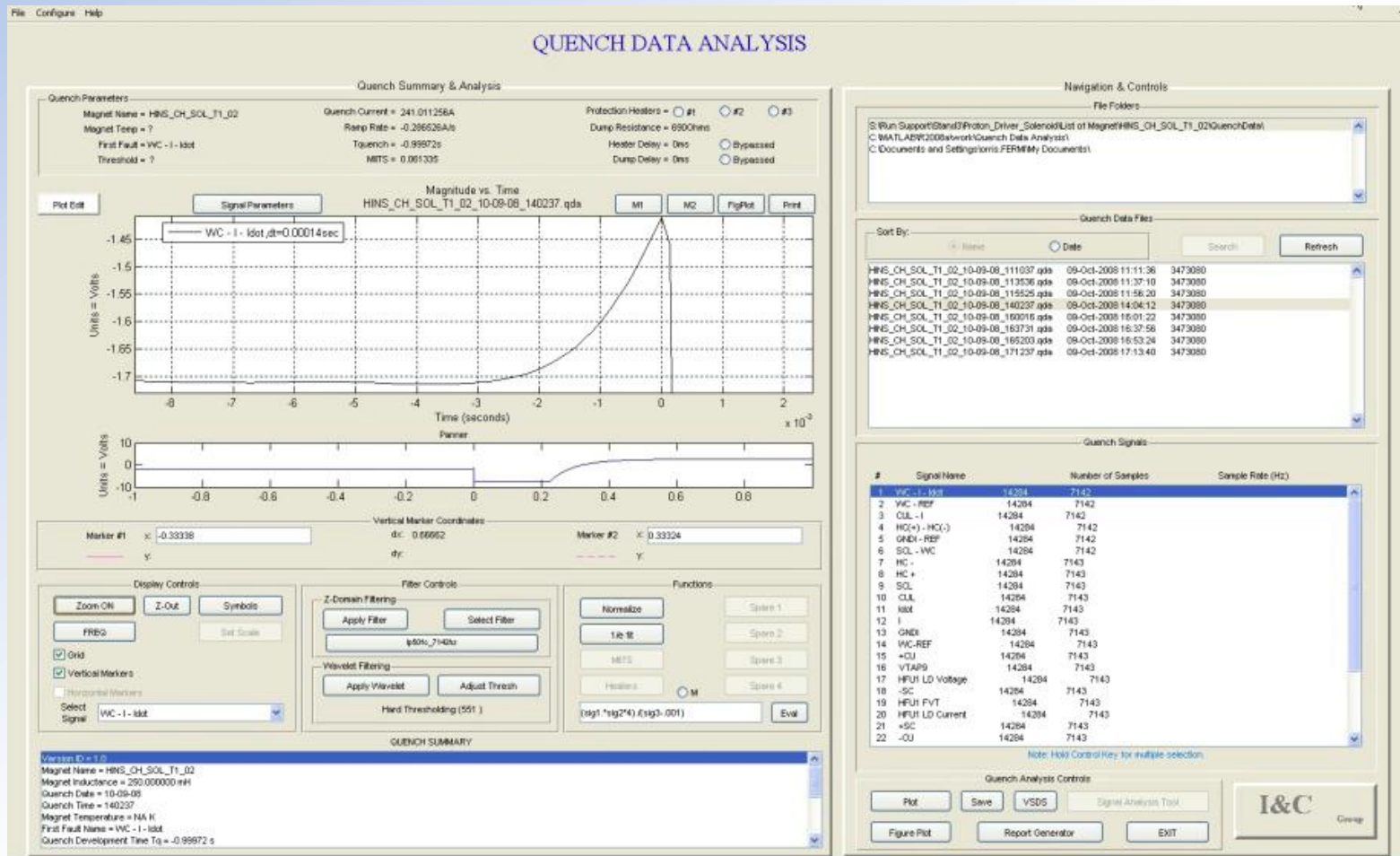
- Quench Detection & Protection –
 - Active quench detection/protection will only be used for the superconducting bus and current leads. The coil will be passively protected by cold diodes and resistors and by “quench back”.
 - The active quench detection system is based on National Instruments FPGA, similar to the systems used to test superconducting magnets on two of our test stands in IB1 and the system that was fabricated for the upcoming MICE spectrometer test.
 - This system also provides control of coil quench heaters if required
 - The coil heater requirements need to be defined by LBNL

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Quench Detection Front Panel

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Quench Data Analysis Tool -- can now load slow logger data

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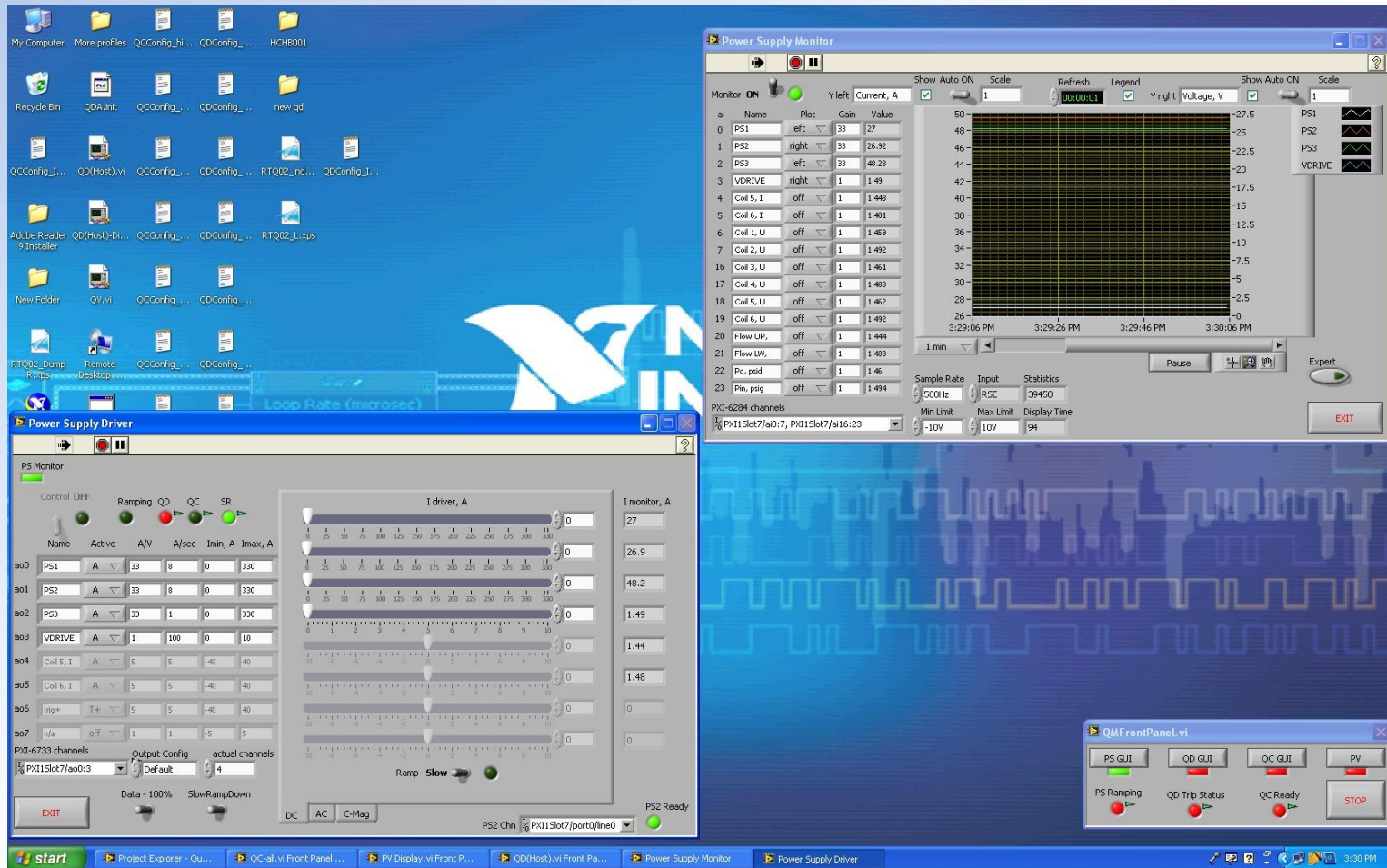
- Cryo Controls –
 - Will use National Instruments Realtime with FPGA
 - Similar to the system we built for the SELVA Coil Winding machine – PID controls
 - Will require PID control for 3 cryo valves

Data Acquisition & Controls

For Testing the MICE Coupling Coil

- Power Supply Control –
 - A 300 A, 20 V supply from American Magnetics will be supplied by LBNL for this test
 - What are the requirements for a user control interface of the power system?
 - An existing power supply control system designed for testing superconducting magnets in IB1 can be used
 - Provides analog drive signals and gate (enable) signal
 - Can control power supplies ramp via front panel
 - Capable of driving power supplies following a ramp profile
 - » A Ramp Profile Generator program is also available
 - Or can use GPIB Control using functions provided with the Power Supply
 - May have to generate a new GUI
 - Power System Personnel and Equipment Interlocks –
 - ETS system – hardwired interlocks for personnel
 - Based on systems used in IB1 – emergency trip, door interlock, etc
 - FPGA-based interlock system for equipment
 - Based on systems used in IB1 – emergency trip, etc.
 - Can couple to the power system interlocks

Data Acquisition & Controls For Testing the MICE Coupling Coil



Power Supply Control GUI

Summary

- The DAQ & Controls to be used for the MICE Coupling Coil test at Fermilab are based on existing systems designed and built for testing magnets in the Fermilab Technical Division's Magnet Test Facility
- The Quench detection and quench characterization system will be similar to the system that was fabricated for the upcoming MICE spectrometer test but will also require cryo controls, slow scan, and power supply control
- The Power Supply and energy absorber are provided by LBNL
- Some definition of instrumentation requirements are needed
 - These are listed in Ruben's document "MICE Coupling Coil, Coil Assembly Test Requirements"