OPERATING MODES, CONTROLS AND INTERLOCKS

Spectrometer Solenoid Review

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Outline

o **Analysis of the operating modes (functional analysis)**

o **Interlocks**

o **Control systems**

o **Instruments, sensors and actuators**

Purpose of the exercise: convenient, safe and efficient operation of the system during all steps from its initial evacuation and cooldown to final warmup

Additional points of view

- **The wiring for cryogenic environment**

- **EMI control outside the cryostat will be discussed as well**

There are 12 main operating modes

Each of them puts distinct requirements to the instrumentation, interlocks and controls of the system

The operating modes may differ in scope from initial tests to the final long-term operation

The design of an efficient control system requires the contributions of the persons who will operate the system in the experiment

A full document is under work, in view of launching the process of designing the control system together with the parties involved
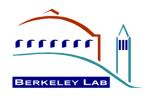
Analysis of the operating modes

The main operating modes are:

- Evacuation, outgassing of MLI, purging of helium circuits.
- Cooldown by LN2
- Evacuation and purge of nitrogen
- Cooldown by LHe
- Filling LHe into the cryostat after cooldown
- Stable standby operation with no current in any of the coils
- Ramp-up of current in the coils
- Training and quench recovery
- Stable operation with constant high current in one or more of the coils
- Slow ramp-down of the coil currents
- Fast ramp-down of the currents
- Warm-up of the cryostat

Magnet protection

- Coil quench detection

- Current lead protection

- Coil protection by crossed diodes

- Current supply interlocks

- Heater interlocks

Helium circuit protection

- Quench release valves and devices

- Cooling of current leads upon power failure

Automatic control loops

Manual controls

Data logging and retrieval ("slow controls")

User interface

Choice of control software and hardware

Temperature measurement and control

Pressure measurement and control

Helium level measurement

Flow measurement and control