SoLID Solenoid
Liquid Level Controls and Monitoring

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LHe and LN2 Level Controls Overview

Hardware

- LM-510-12 Liquid Level Meter
- Voltage Output Controller
- Instrumentation Rack #1
- 1756 IF-16 ADC Mod.
- 1756 OW-16I Relay Mod.

- 1756-L72 PLC Controller

Software

- HMI Server Controls & Monitoring
- EPICS CSS-BOY Screen
- EPICS Data Archiver
- FT VIEW HMI Screen (Client)
- FT VIEW Data Archiver

Power control signal
Signal Readout and Control
Ethernet Network
Data transfer

Hall A Subnet
Instrumentation Specifications

- **Sensors**
  - LH$_{e}$ Level Probe: 3DA-038-105-CF
    - 15.25” active sensing length
  - LN$_{2}$ Level Probe: NL-053-111-CF
    - 21” active sensing length

- **Liquid Level Meter**
  - Model: Cryomagnetics LM-510-12
    - Dual Sensor readout option
    - Two analog outputs (10 V and 4–20 mA options)
    - Two relay outputs to control auto filling
    - Local control and monitoring

- **Line Voltage Controller Module**
  - Two output channels to control 120–220 VAC power

- **PLC System**
  - Controller: 1756-L72
  - ADC Module: 1756-IF16
  - Relay Module: 1756-OW16I
Controls - PLC programming

• PLC performs the following:
  – Readout of liquid level values
    ▪ ADC module configured and scaled to read 0–20 mA signal
    ▪ Readouts critical, especially during cooldown of solenoid
    ▪ Values used as PID controller process variable input to control valves
  – Monitors signal readout faults
    ▪ Each ADC module allows individual channel fault detection
  – Controls power cycling of liquid level meter device
    ▪ Assigned one relay channel to provide 5 VDC to line voltage controller module, which controls 120 VAC supply to liquid level meter device
  – Transfers data to HMI and EPICS systems
    ▪ Signals monitored and controlled from HMI and EPICS screens
Controls - PLC programming

- PLC readout and fault detection for LHe and LN$_2$

Start

- Read LHe sensor: Ch-8
- Read LN$_2$ sensor: Ch-9
  - YES: Read value out of set limits?
    - YES: Set LL_He_Error and LL_N2_Error Boolean tag to 1
    - NO: Set LL_He_Error and LL_N2_Error Boolean tag to 1
  - NO: Set LL_He_Error and LL_N2_Error Boolean tag to 1

- Read ADC module Ch-8 and Ch-9 fault bits
  - YES: Store Boolean values for each sensor
    - YES: Set LL_He_fault and LL_N2_fault = 1
    - NO: Set LL_He_fault and LL_N2_fault = 0
  - NO: Set LL_He_fault and LL_N2_fault = 0

End
Monitoring - HMI screens

Expert Liquid Level Screen pops up when user clicks a liquid level figure on CCR screen.
CCR Liquid Levels screen provides detailed information and power cycle control for the liquid meter.

Cryo Control Reservoir – Expert HMI screen allows monitoring of liquid levels installed in LN$_2$ and LHe reservoirs.
Task Status

• Programming tasks to control and monitor LHe and LN$_2$ levels
  – PLC code is complete
  – HMI screens are complete
    ▪ Testing in progress

• Documentation
  – Wiring drawings to show connections of sensors in progress
  – Control diagram is complete

• Hardware tasks
  – Liquid level meter, probes, PLC system, and voltage controller are in hand
  – Installation and wiring for sensors is pending
Conclusions

DSG is contributing proactively to complete tasks required to control and monitoring of liquid levels.
Thank You