

Controls and Monitoring Screens for SoLID Solenoid Neck Temperatures

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This note describes the development of the Human Machine Interface (HMI) and Control System Studio-Best OPI Yet (CSS-BOY) screens to display temperature sensors located in the SoLID solenoid's neck.

Monitoring the temperature sensors located in the neck of the solenoid is critical. HMI and CSS-BOY SoLID Solenoid Neck Temperature screens were developed to monitor temperature values in real time for the safe operation of the solenoid.

Based on drawings made in 1986 by the magnet manufacturer Oxford Instruments [1], an isometric view of the neck, Fig. 1, was developed with the NX12 computer-aided design program [2]. Advanced NX12 features were used for the isometric view so that in the HMI and CSS-BOY screens, a smooth, transparent view would be displayed.

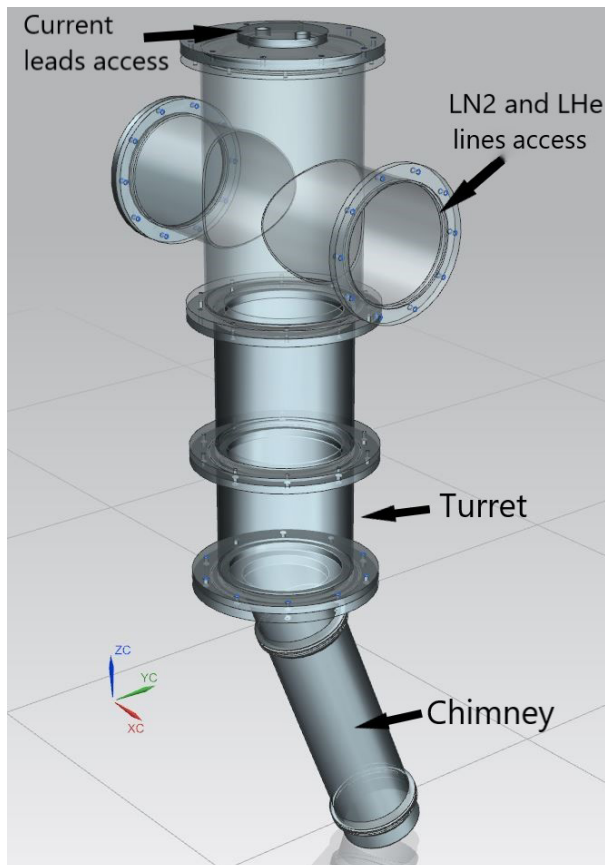


FIG. 1 Isometric view of the neck.

The neck comprises a turret and chimney, an angled cylinder case. Together, these connect the cryo control reservoir to the magnet cryostat and allows access for current leads from the power supply to the magnet coils and for the connection of helium and nitrogen supply and return lines to the coil shell and the radiation screens.

The three-dimensional model of the neck was inserted as an image file into the HMI and CSS-BOY screens. Indicator lines point to the sensor locations. The HMI screen, Fig. 2, was developed with FactoryTalk View. The CSS-BOY screen, Fig. 3, is based on the HMI screen and was developed with Control System Studio software [3]. The basic functions of the screens are to display temperature sensor values and alarms, which occur when readout faults for temperature sensors are present.

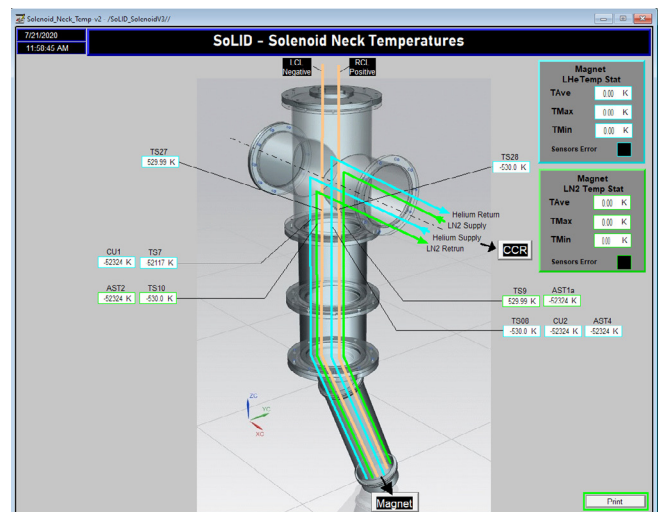


FIG. 2. SoLID Solenoid Neck Temperature HMI screen.

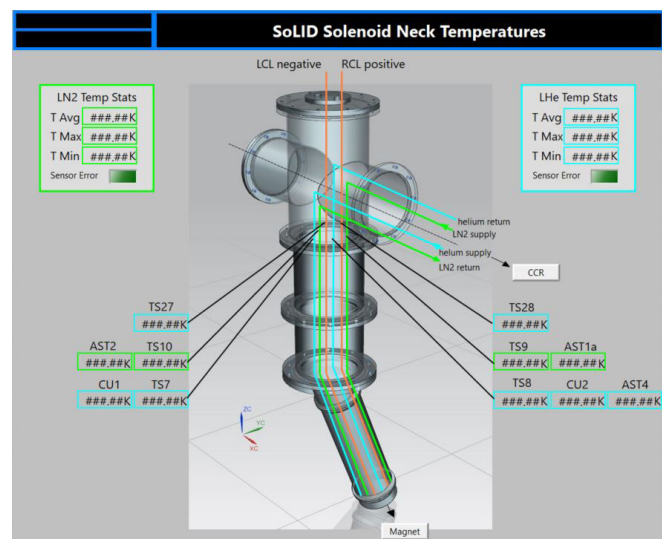


FIG. 3. SoLID Solenoid Neck Temperature CSS-BOY screen.

Each indicator on the HMI screen shows the value of a PLC tag associated with a temperature sensor readout. Indicators on the CSS-BOY screen show values of the EPICS process variables (PVs) that are associated with the PLC tags shown on the HMI screen. The indicators are configured to blink red when a fault is present, which could be when the resistance measured for a temperature sensor is out of range or the channel of the ADC module in the PLC has an error. The labels used for each indicator on the screens are the original names given for the temperature sensors by Oxford Instruments.

The two boxes in the upper corners of the screens show helium and nitrogen temperature statistics from the magnet. LED indicators in the boxes blink red when any of the temperature sensors located in the magnet or the neck has a fault.

Both screens have buttons to allow navigation to other screens, labelled CCR to open the *Cryo Control Reservoir (CCR)* screen and Magnet to open the *SoLID Solenoid Coil Shell and Radiation Shield Temperature* screens [4].

The HMI screen is tested by reading the actual values from the PLC in the *running* mode since the HMI system is linked to the PLC. Temperature values and faults are read from the PLC and can be monitored in real time for each indicator on the screen. To test error conditions, *test* PLC tags are used and values are changed without affecting the PLC system. Indicators' values, blinking features, screen format and navigation buttons are tested by running FactoryTalk SE Client [5], which connects to the HMI server and allows real time monitoring to make the test more effective.

The CSS-BOY screen is tested by using local PVs generated by a script that runs in the CSS environment and allows for realistic input and output data for the screen [6].

To conclude, both HMI and CSS screens are ready to be implemented.

- [1] *Operating Manual for Cleo II Superconducting Magnet*, Oxford Instruments LTD, Oxford, England, 1987.
- [2] P. Campero, et al., *Two-dimensional and Three-dimensional Models of SoLID Magnet's Structural Components*, DSG Note 2020-24, 2020.
- [3] M. A. Antonioli, *Generating CSS-BOY Screens*, DSG Talk 2020-20, 2020.
- [4] P. Campero and Mary Ann Antonioli, et al., *HMI and CSS-BOY Screens for SoLID Magnet Coils and Radiation Shield Temperatures*, DSG Note 2020-25, 2020.
- [5] P. Campero, et al., *Steps to Install and Run the HMI System*, DSG Note 2020-21, 2020.
- [6] T. Lemon, et al., *Test Operator Interface Creator Program*, DSG Note 2020-23, 2020.