Safety System for the Six-Supermodule Prototype of the Hall A Electromagnetic Calorimeter

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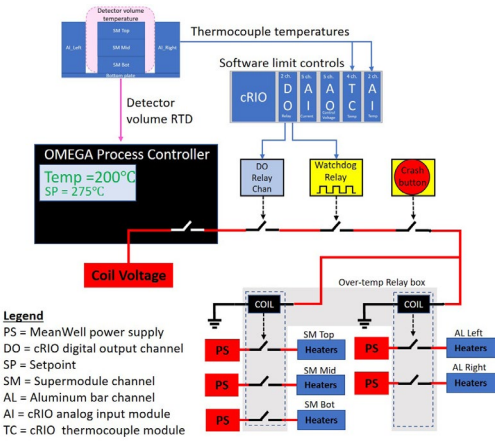
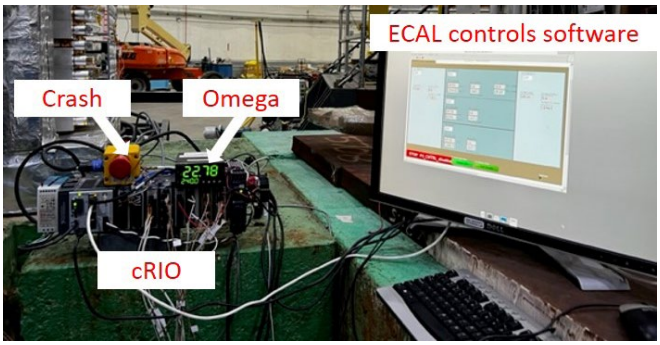
This note presents the features of the safety system developed to prevent overheating of the six-supermodule test stand of the Hall A electromagnet calorimeter.

The designed and developed safety system that prevents overheating of the six-supermodule prototype has an Omega process controller (OPC), LabVIEW software [1], a watchdog relay, and a crash button, any of which can interlock the five MeanWell power supplies [2] by removing the coil voltage and thereby opening the relay contacts to the two relays inside the over-temperature relay box, Fig. 1a. Figure 1b shows the system in the Hall.



(a)



(b)

FIG. 1. (a) Schematic of safety system. (b) Safety system in the Hall.

Via an RTD, the OPC monitors the detector volume's temperature T_{DV}, which if > 275°C, interlocks the power supplies; the interlock can be cleared only locally [3].

The LabVIEW software monitors the thermocouples of the five heater channels, Fig. 1a. Figure 2 shows the PID user interface. If any thermocouple's measured surface temperature T_{ST} is > 300°C, the software triggers, via a digital output (DO) channel, a non-latched interlock (one which, when the temperature is back in range, automatically restores power). T_{ST} is greater than T_{DV} because the temperatures on the surfaces near the heaters are higher than the temperature of the detector volume. Additionally, the cRIO's internal watchdog software continuously monitors the control program, and if the control program unexpectedly stops, sets all control voltages to 0.6 V and opens the relays, interlocking the power until an operator clears the interlock.

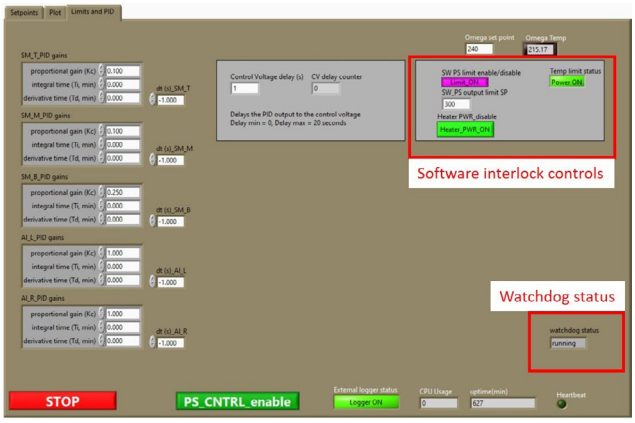


FIG. 2. Limits and PID tab of the control software with the software interlock controls and watchdog indicator boxed in red.

The watchdog relay monitors a relay channel on the cRIO's DO module that is toggled by the Boolean heartbeat signal from the control software. The watchdog relay uses a non-latched interlock on the power supplies if the heartbeat signal is missing for more than 30 seconds.

When engaged, the crash button, Fig. 1a, interlocks the power supplies. To disengage the interlock and resume operations, the crash button must be rotated clockwise.

The safety system is functioning as expected.

[1] M. McMullen, et al., *Control and Monitor Software for the Prototype Heaters of Hall A's Six-Supermodule Electromagnetic Calorimeter*, DSG Note 2023-47, 2023.
[2] M. McMullen, et al., *ECal Power Supply Tests*, DSG Talk 2023-11, 2023.
[3] M. McMullen, et al., *ECal Heater Controls and Instrumentation*, DSG Talk 2023-12, 2023.