

ECAL Heater Controls Update

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and the Detector Support Group
December 14, 2023

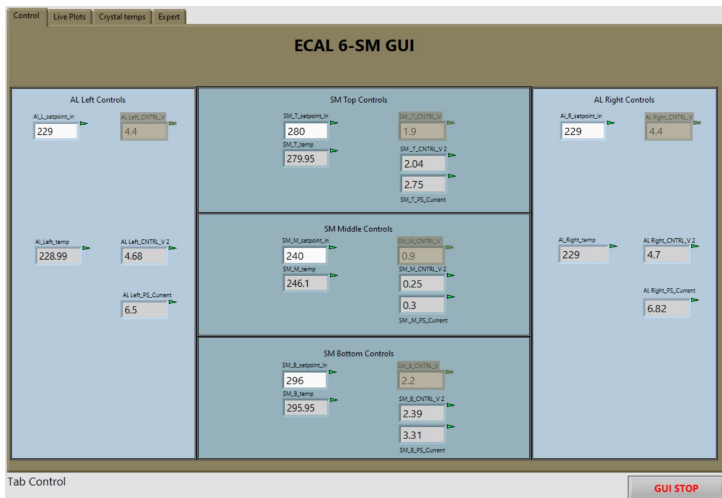
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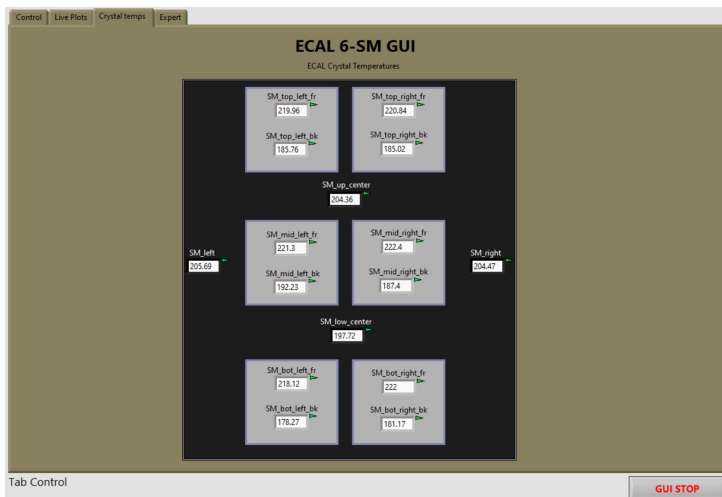
ECAL Prototype Heater Controls

- ECAL update
 - **System was operational from September to November**
 - Charge of ~56 cb since 2023-09-01 installation
 - Test stand operation to resume in spring of 2024 with light guide cooling
- Issues
 - The cRIO was damaged during the run, but remained operational (possible radiation damage)
 - Reset must be done locally
 - Can not connect via NI-MAX (measurement and automation explorer)
- Solutions
 - DSG procured an expansion chassis for hall instrumentation and will install the new cRIO in the Counting House
 - Software will be out of the radiation area
 - New bunker location for power supplies, expansion chassis, and Omega
- In progress
 - Development of disconnect chassis
 - EPICS monitoring

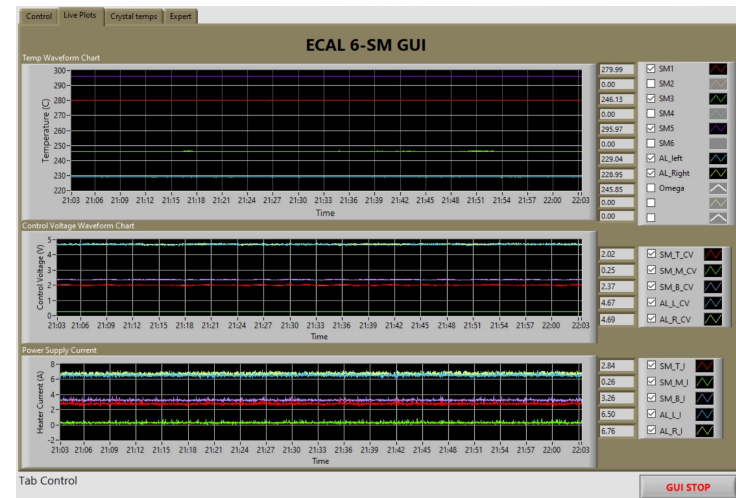
ECAL Prototype: Controls and Monitoring



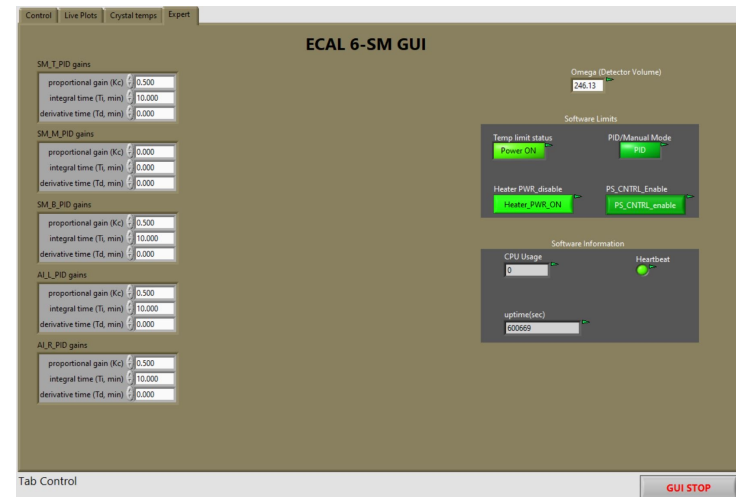
Controls tab: Setpoints and readback of temperature, control voltage, and current



Crystal temps: Readback of thermocouples on the crystal surfaces (fronts and backs, sides)

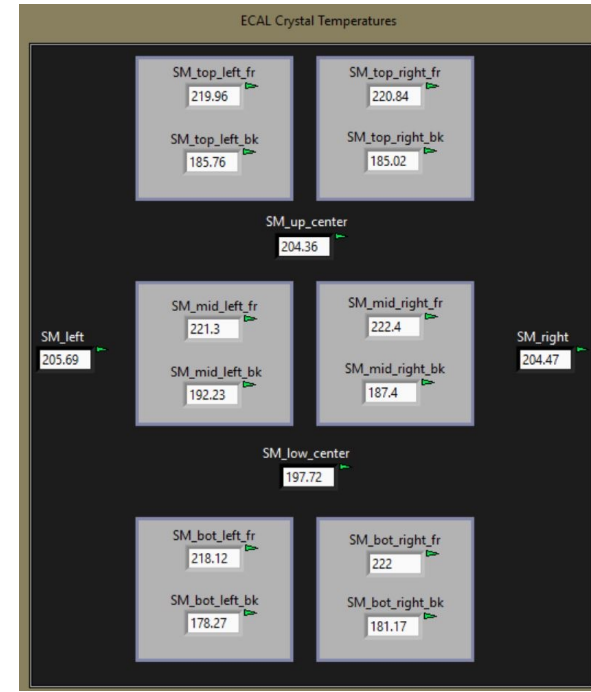
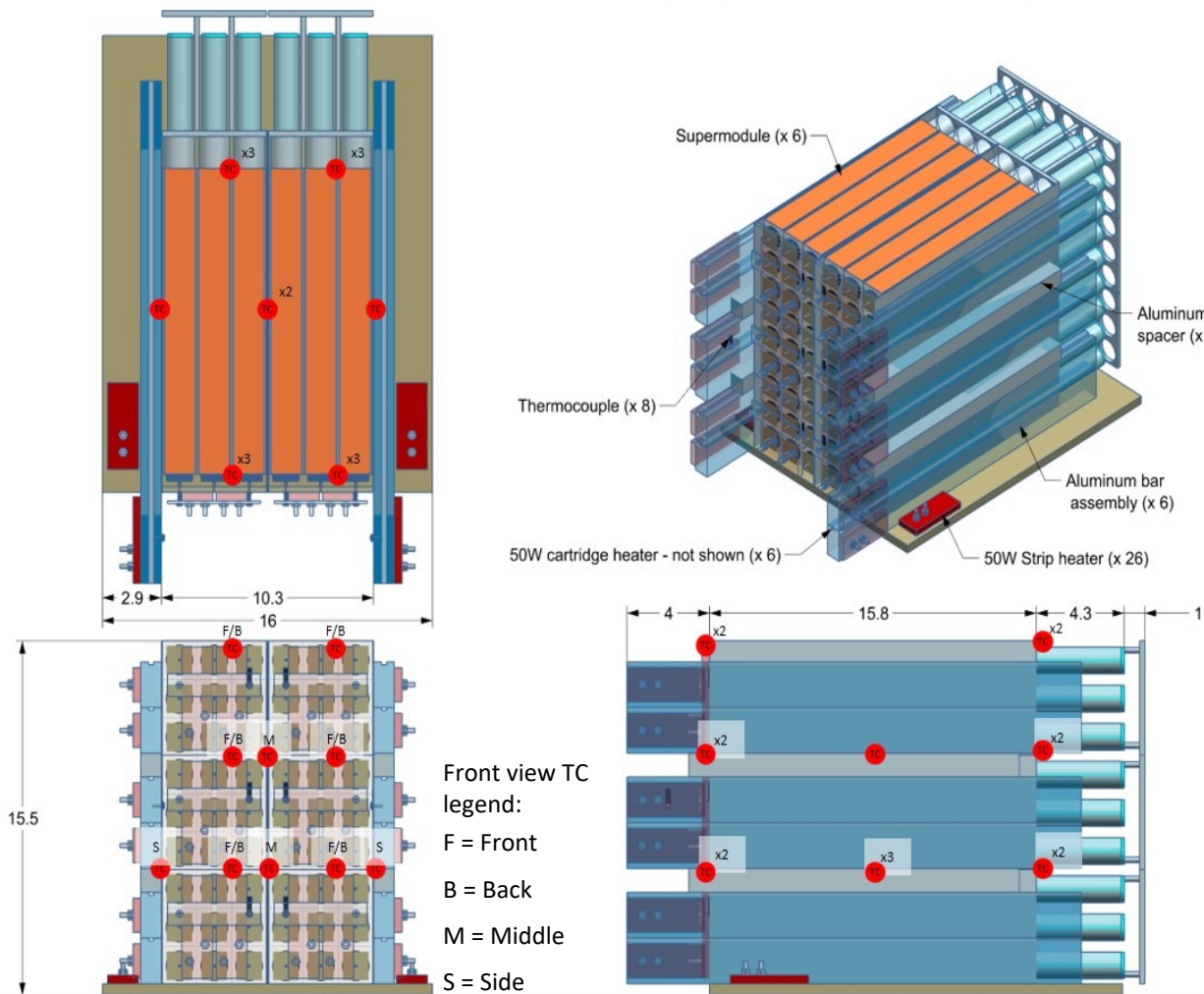


Live plots: 1 hour plot of control temperatures, voltages, and current



Expert: PID settings, software limit and output enable/disable

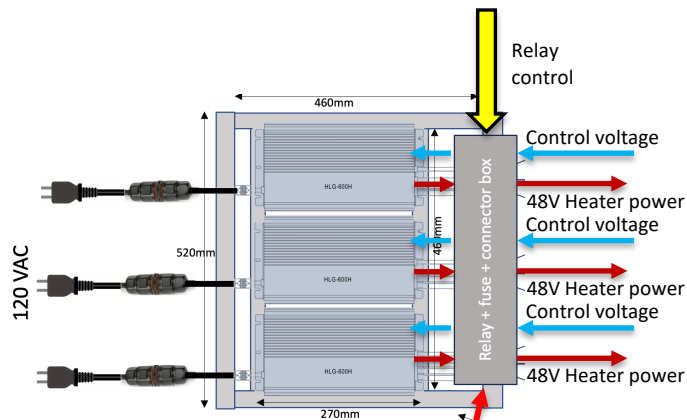
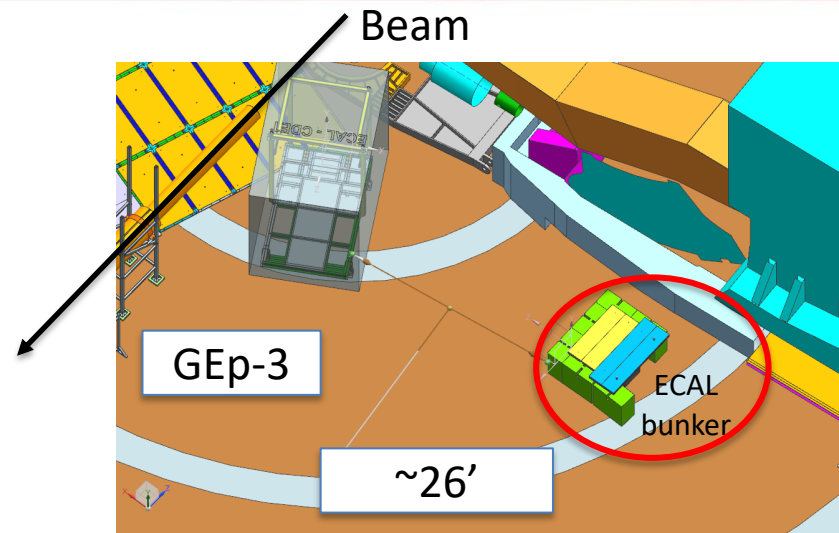
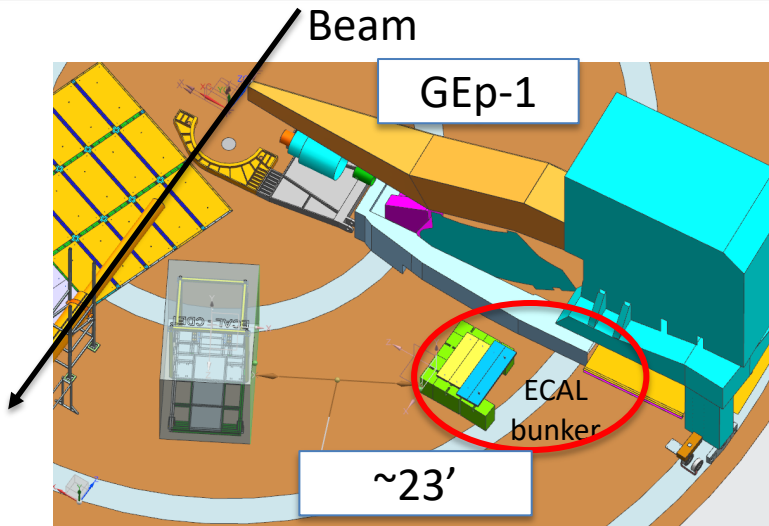
ECAL Prototype: Crystal Temperature Monitoring



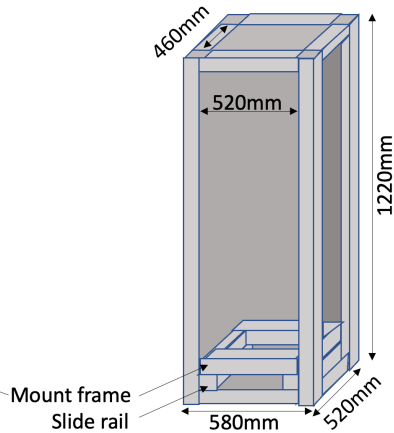
Thermocouple readout on the GUI

16 crystal surface thermocouple locations

Full System Installation Plan



New DSG power supply
disconnect and monitoring chassis

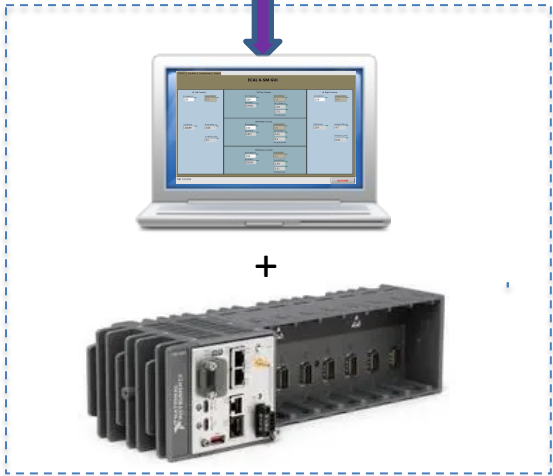
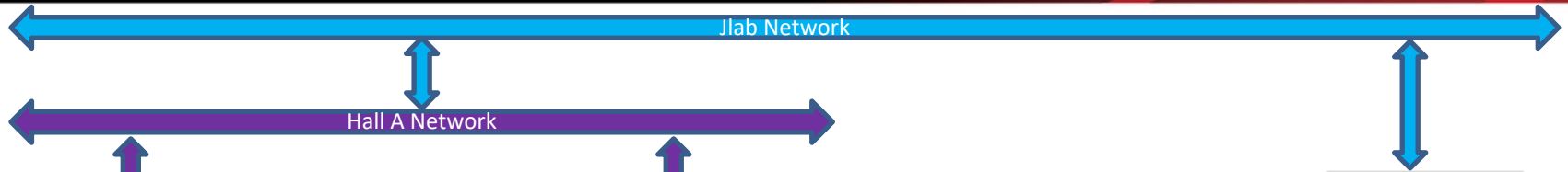


Radiation shielding bunker rack (x2)

- 24 power supplies
 - 48 total
- Three power supplies per power disconnect and monitoring chassis
 - 16 total

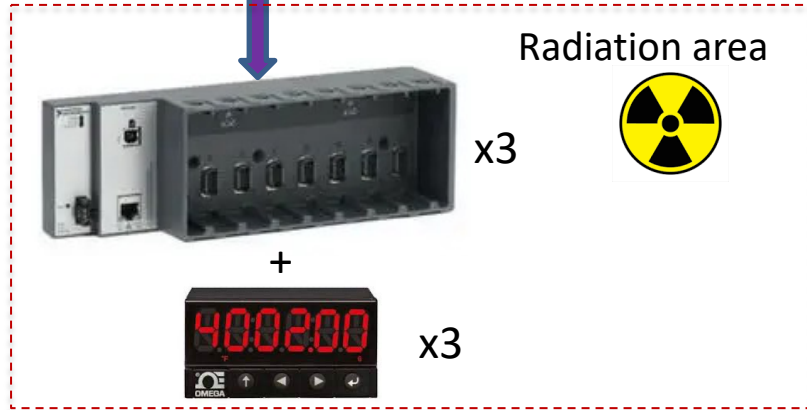
Note: DSG will not fabricate any 48-V cables

Controls System Location Plan



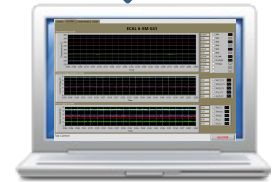
Hall A Counting House

- 1 cRIO NI-9045 (controls software)
- Dedicated laptop on Hall A network



Hall A End Station

- Three cRIO NI-9149
 - controls
 - crystal and light guide temperatures
 - safety relay controls
- Omega CN8DPT (x3 over-temp controls)



Remote monitoring and control via the ECAL heater controls GUI

- Relocating NI-9045 to the Counting House removes the controls software from radiation damage
- The expansion chassis (NI-9149) is installed in the new bunker
 - Further from the beam
 - Less components to fail
 - Smaller cost of replacement

System Instrumentation: Controls Thermocouples

Heater controls 48 channels

31 supermodule zones

- Six supermodules
- Two strip heaters (50 W per heater)
- One thermocouple (+one spare)
 - One thermocouple cable
- One power supply (600 watts)
 - One power supply control cable

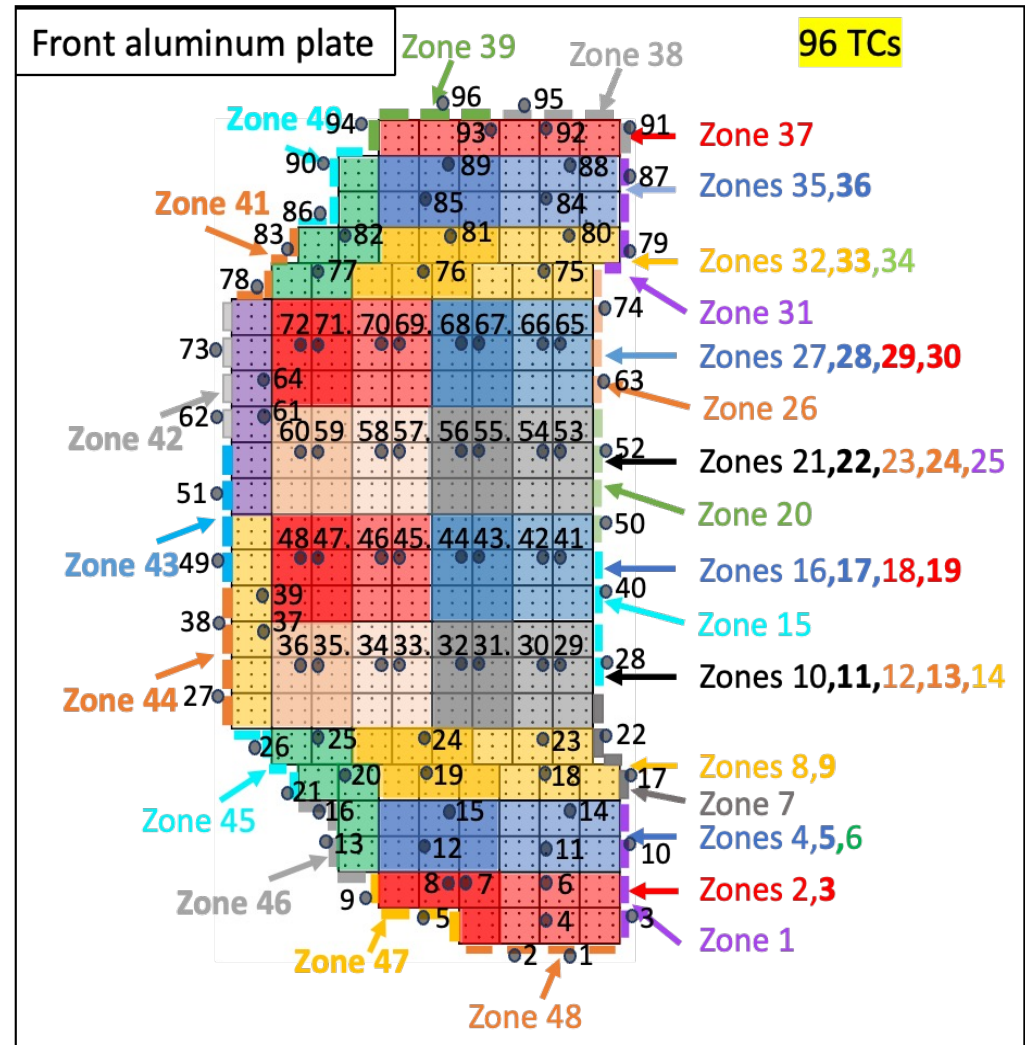
17 aluminum bar zones

- Four aluminum bar assemblies
 - Two strip heaters (50 W per heater)
 - One cartridge heater (50 W)
- One thermocouple (+one spare)
 - One thermocouple cable
- One power supply (600 W)
 - One power supply control cable

48 Safety relay channels

- cRIO expansion chassis
- Six relay modules

Indicates DSG cable fabrication



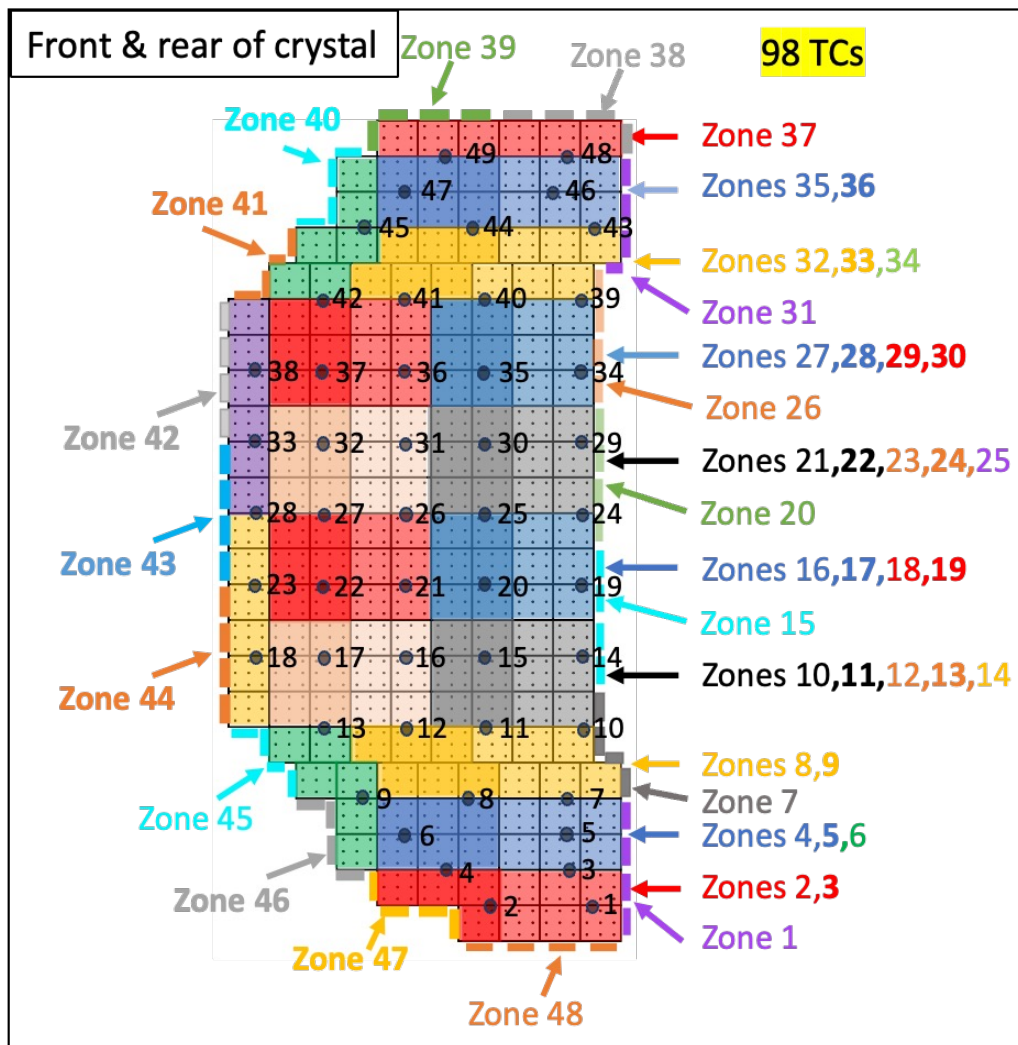
System Instrumentation: Crystal Thermocouples

Crystal monitoring

98 channels

- 48 front thermocouples
- 48 rear thermocouples
- Two ambient thermocouples
- cRIO expansion chassis
- 98 thermocouple extension conductors
- Seven thermocouple modules

Indicates DSG cable fabrication



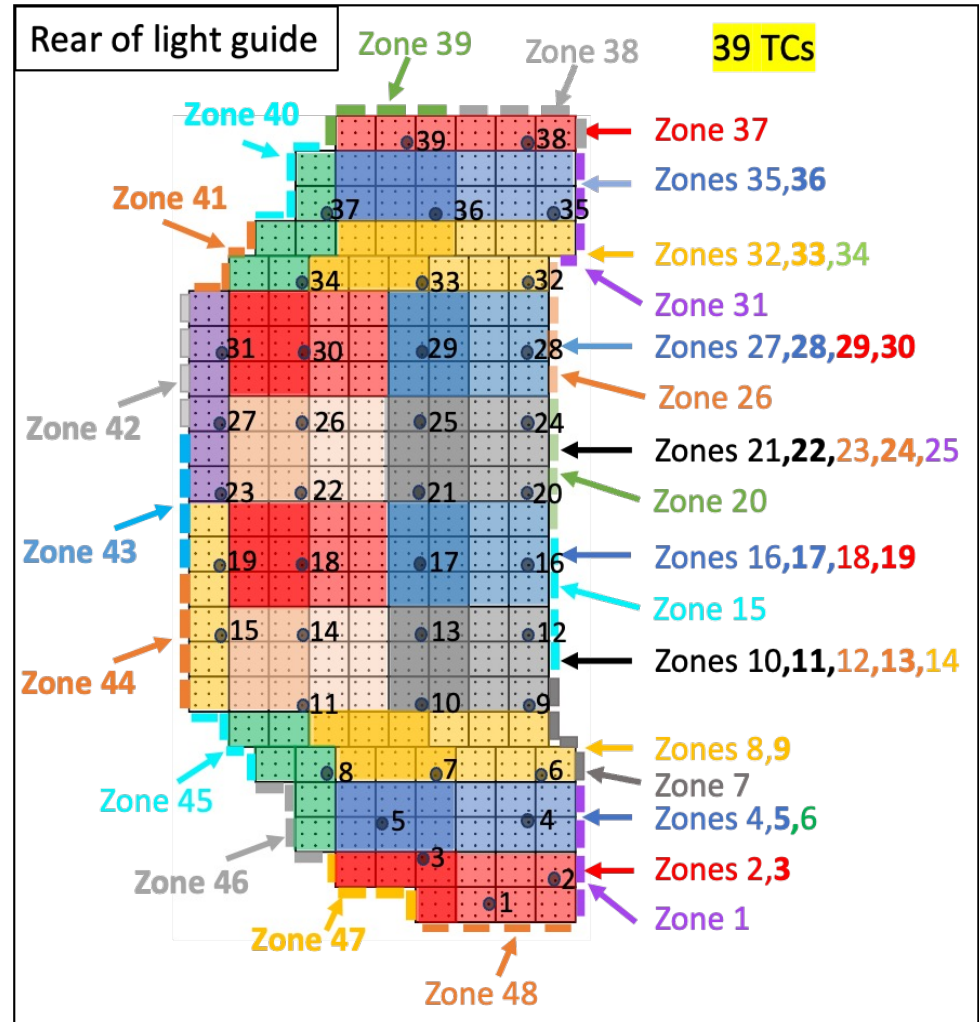
System Instrumentation: Light Guide Thermocouples

Light guide monitoring

39 channels

- 39 front thermocouples
- cRIO expansion chassis
- 39 thermocouple extension conductors
- Three thermocouple modules

Indicates DSG cable fabrication



DSG Controls Work

- Develop power disconnect and monitoring chassis
 - Level 1 disconnect for power supplies
 - Safety relays
 - Need to purchase
 - Relay modules to control ~50 channels
 - One cRIO expansion chassis
 - Six cRIO relay modules
 - Current monitoring
 - Channel fusing
- Procure temperature monitoring cRIO and modules
 - Two cRIO expansion chassis
 - 10 cRIO thermocouple module
- Develop, procure, and fabricate controls cables
 - 48 control voltage (2-conductor, one per channel)
 - 48 relay coil control (2-conductor, one per channel)
 - ~190 channels of thermocouple extensions (multiconductor, mass termination...TBD)

Conclusion

- The test stand was operational and received ~56 cb of charge from September to November
 - **Controls software performed without issue**
 - Test run to be extended in Spring of 2024
- cRIO will be relocated to the Counting House to reduce effect of beam radiation
 - Expansion chassis will be installed in the hall
- DSG is developing a power supply disconnect and monitoring chassis
- DSG will fabricate controls, thermocouple, and relay cables