



DSG NPS Status Update

Aaron Brown and the
Detector Support Group
February 16, 2022

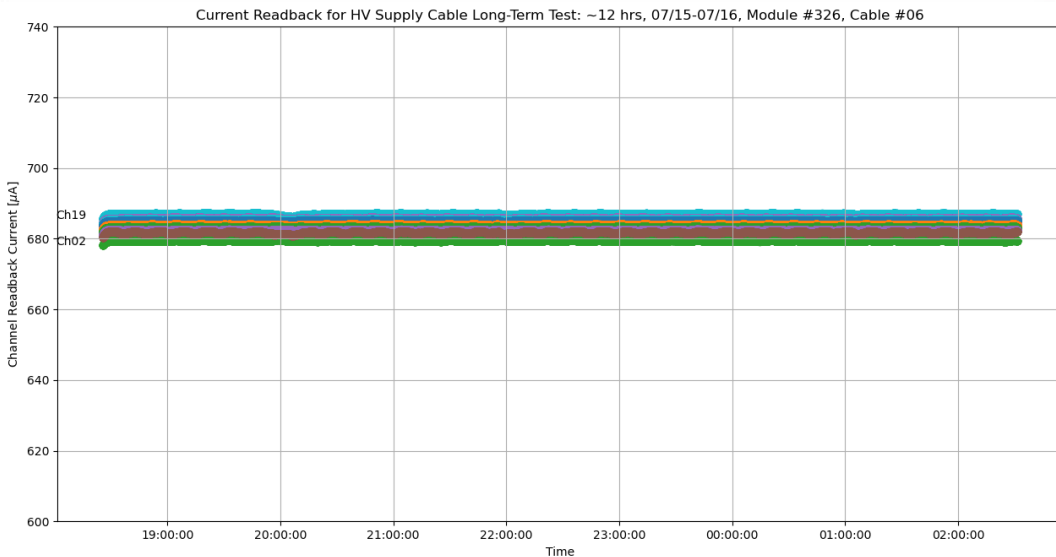
Contents

- Completed Tasks
 - High voltage supply cables
 - ESR film pre-shaping
 - Hardware monitoring LabVIEW program

- Current Tasks
 - Hardware interlock system
 - Layout
 - Signal monitoring
 - Software configuration
 - Ansys thermal analysis

- Conclusion

High Voltage Supply Cable



I vs. T for cable #6 long-term test (12 hrs.)

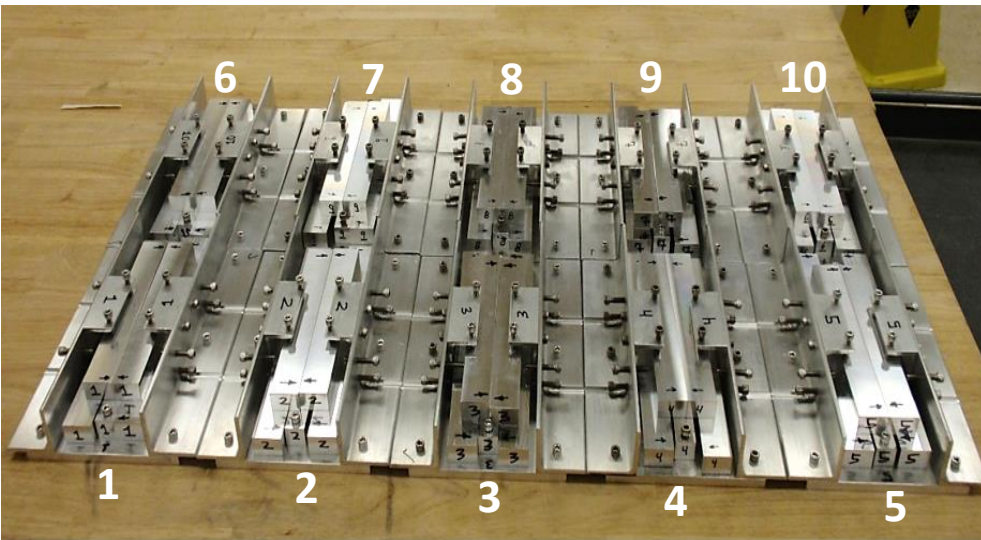
- Specified, procured, fabricated, and tested 40 high voltage supply cables



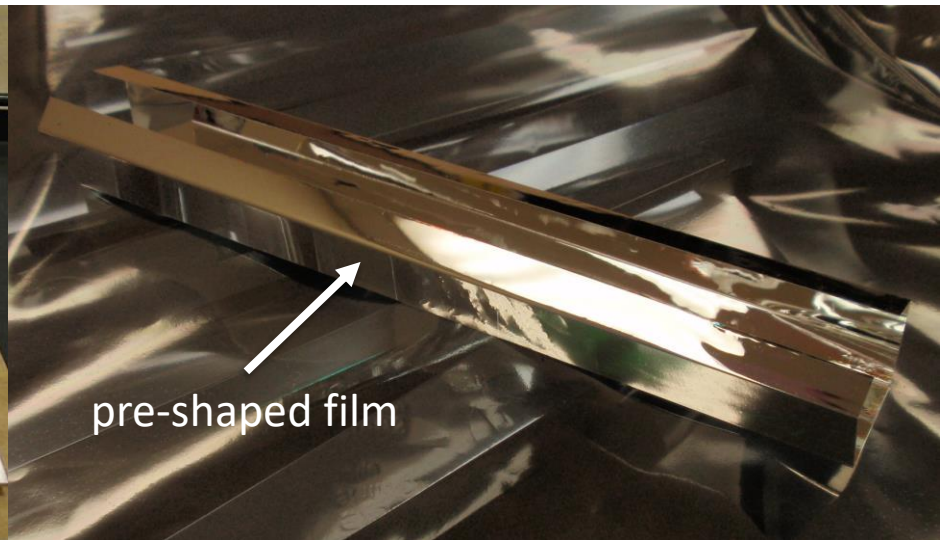
DSG hv supply cable load box



ESR Film Pre-shaping



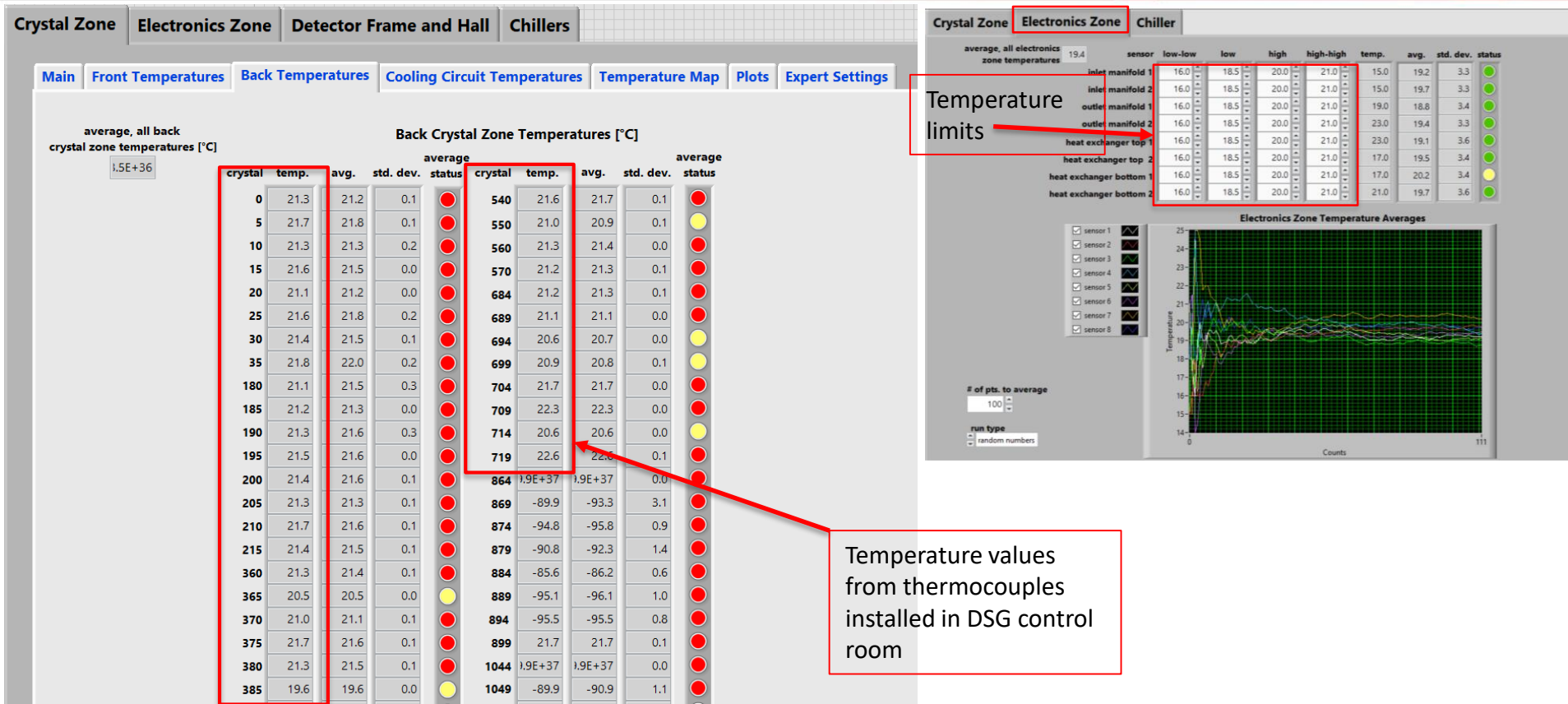
Ten jigs available



Finished product

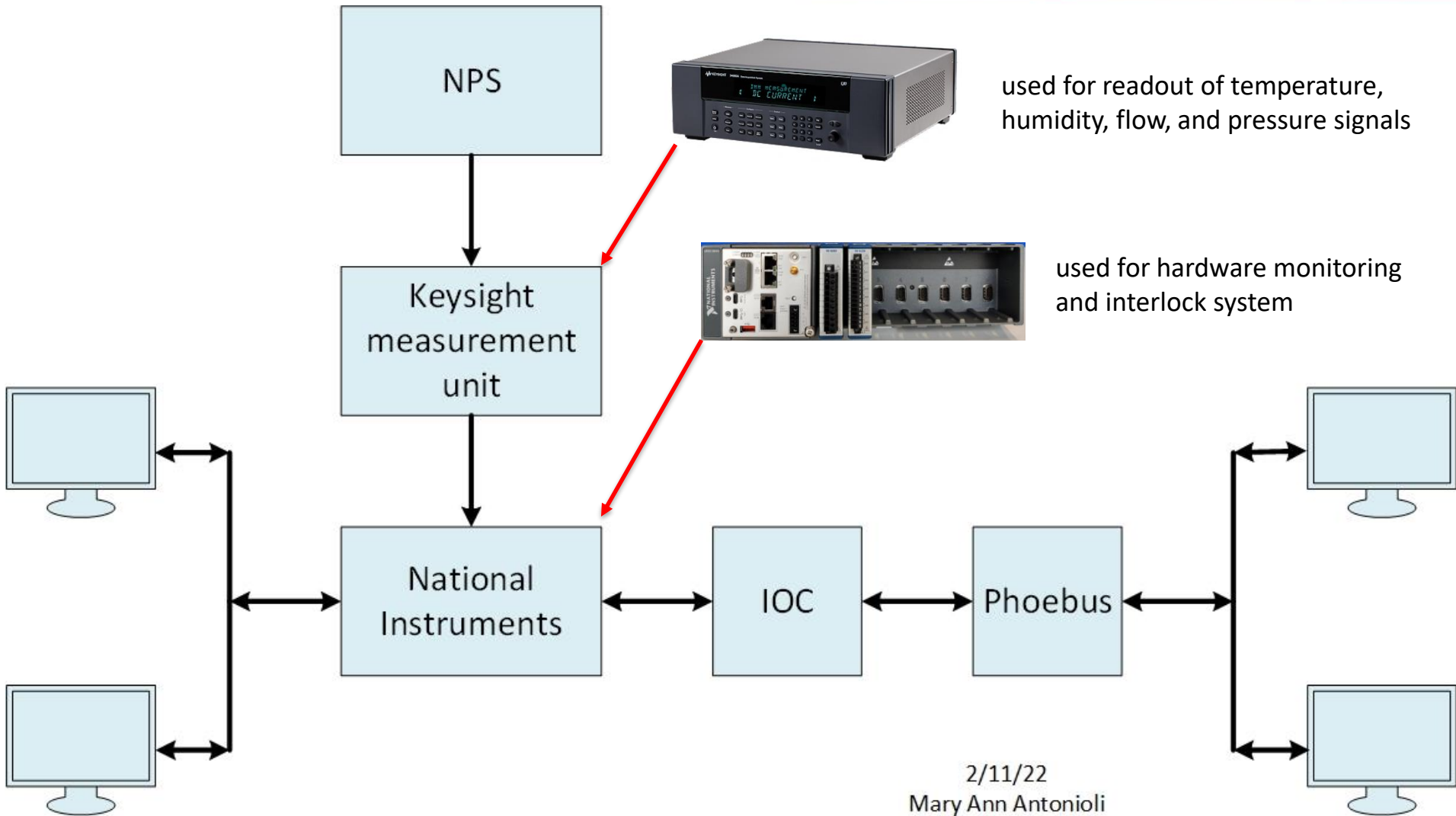
- Pre-shaped 600+ films

Hardware Monitoring LabVIEW Program

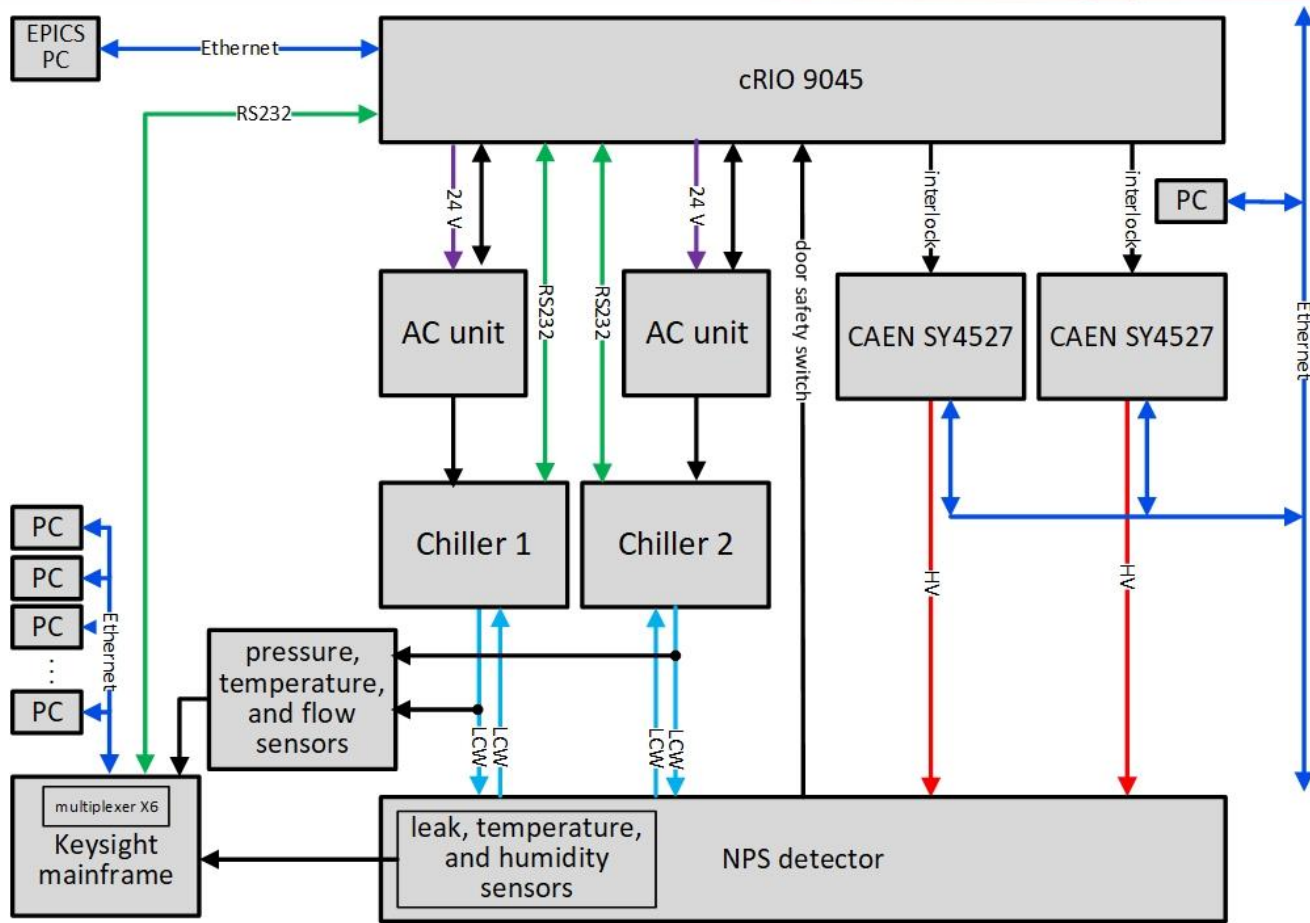


- Runs in parallel with LabVIEW hardware interlock program
- Uses shared network variables from *Keysight Scanning* hardware interlock LabVIEW subroutine

Hardware Interlock System Layout



Hardware Interlock System Layout - Details



NPS Hardware Interlock System
M. A. Antonioli
7/21/21

- Hardware interlock system layout [DSG Note 2021-15](#)

Signal Monitoring

Location	Signal Type	Qty	Sensor	Comments
Crystal Array	Temperature	112	Type K thermocouples	Within NPS crystal array (56 front - 56 Rear)
Crystal zone cooling circuit	Temperature	4	4-wire RTDs	Dual sensors on input and output coolant manifolds
Electronics zone cooling circuit	Temperature	4	4-wire RTDs	Dual sensors on input and output coolant manifolds
		4		Dual sensors on top and bottom heat exchangers
Detector internal frame	Humidity	20	Relative humidity (voltage output)	Dual humidity sensors in 10 locations
	Temperature	20	4-wire RTDs	Dual temperature sensors in 10 locations
In NPS frame	Switch on/off	2	Coolant leak sensor	Monitors for leaks in the cooling circuits
On frame access panel	Switch on/off	2	Contact micro switch	Protects personnel from HV when servicing
Chiller shielded enclosure	Voltage	1	N/A	Monitors humidity sensor power supply (+5V)
External ambient (Hall)	Temperature	2	4-wire RTDs	
	Humidity	2	Relative humidity (voltage output)	
External to chiller in radiation shielded enclosure	Coolant Temperature	1	Temperature (voltage output)	Monitors electronics zone chiller
	Coolant Pressure	1	Pressure (voltage output)	
	Coolant Flow	1	Flow (voltage output)	
External to chiller in radiation shielded enclosure	Coolant Temperature	1	Temperature (voltage output)	Monitors crystal array zone chiller
	Coolant Pressure	1	Pressure (voltage output)	
	Coolant Flow	1	Flow (voltage output)	

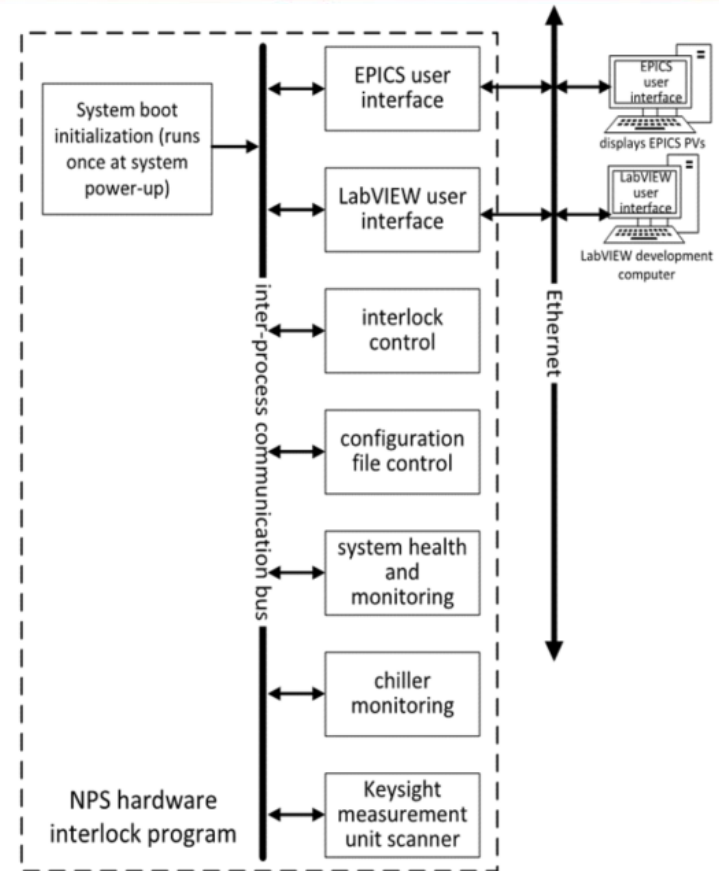
112	Total Type K thermocouples
34	Total RTD's
22	Total humidity sensors (voltage)
11	Total flow/pressure/other (voltage)

179 Total Signals

- Planned signal monitoring

Software Configuration

LabVIEW Subroutine Name
Device drivers for instrumentation (chiller monitoring, GPIB-RS232)
Chiller monitoring subroutines (Crystal & Electronics Zone chillers)
Temperature and humidity interlocks
Cooling system monitoring interlocks (temp, pressure, flow) (external from chiller)
Chillers interlocks
Coolant leak interlocks
Dew point interlocks
Door safety switch interlocks
HV interlock enable/disable logic
LV interlock enable/disable logic
Time over threshold (trip delay) & averaging for interlocks
LabVIEW user interface (HIS program)
LabVIEW user interface screens
System boot initialization routine
EPICS user interface
System health monitoring & test
Configuration file control
Error checking subroutines
Subroutine integration
Stand-alone real time program operation and system booting

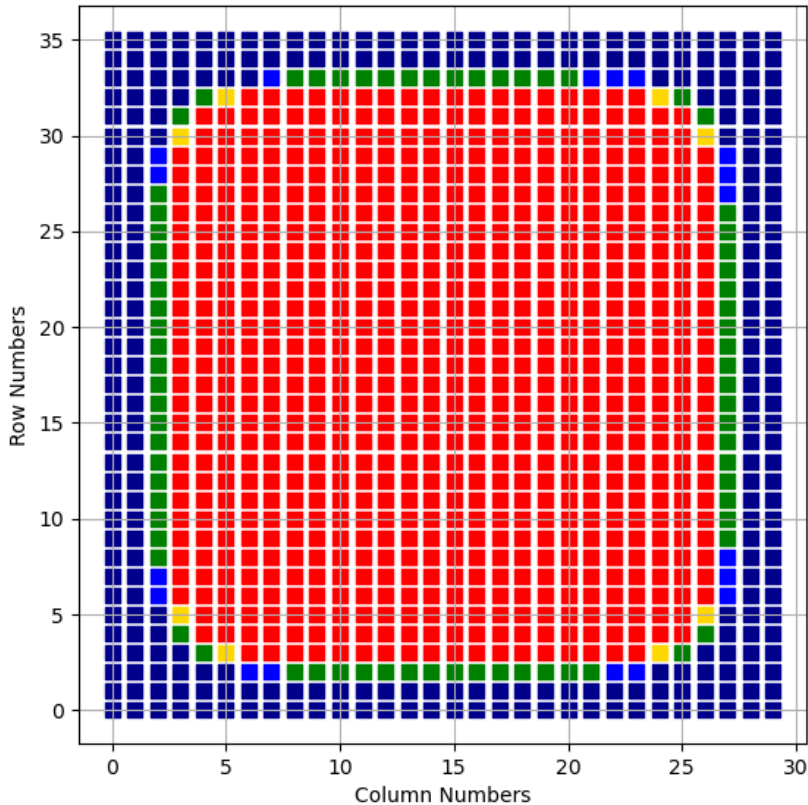


NPS Hardware Interlock Program Schematic
3/30/2021
M. A. Antonioli

- Parallel LabVIEW programs share signal data
- Subroutines check signal data against interlock limits and initiate trips

Ansys Thermal Simulation

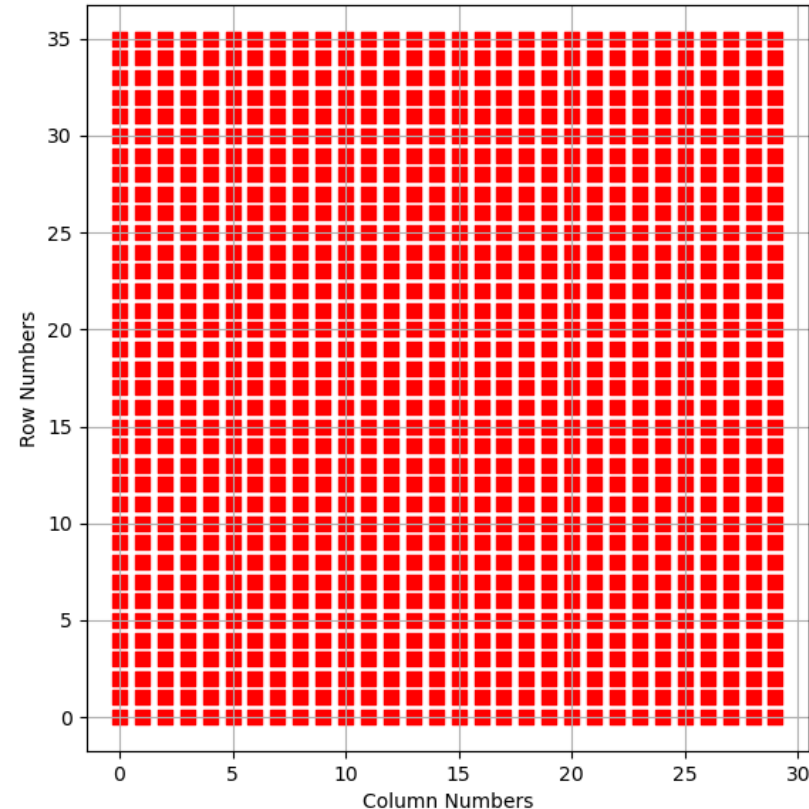
Crystal Face Temperatures (Front) -- 0.5 W



$T < 17.50^{\circ}\text{C}$
 $17.50^{\circ}\text{C} \leq T < 17.25^{\circ}\text{C}$
 $17.25^{\circ}\text{C} \leq T \leq 18.25^{\circ}\text{C}$
 $18.25^{\circ}\text{C} < T \leq 18.50^{\circ}\text{C}$
 $T > 18.50^{\circ}\text{C}$

- Ambient temperature = 22°C
- **Heat load = 0.5 W**
- Cu shell temperature = 10°C
- Python plot of just crystal face temp. probes
- **Central crystal temperature = 21.77°C**

Crystal Face Temperatures (Front) -- 0.5 W



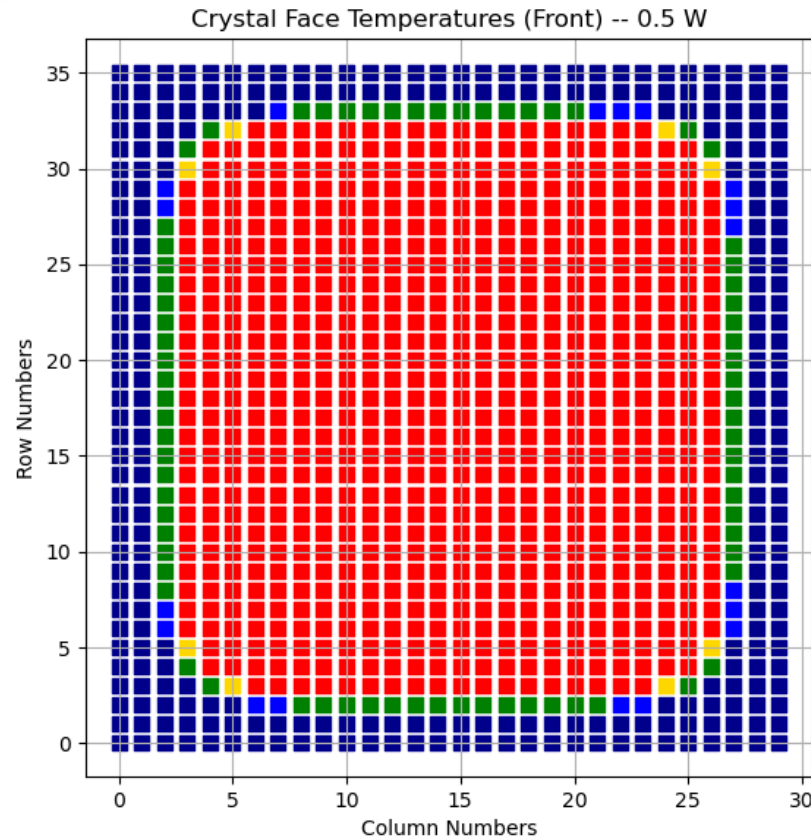
- Ambient temperature = 22°C
- **Heat load = 0.5 W**
- Cu shell temperature = 20°C
- Python plot of just crystal face temp. probes
- **Central crystal temperature = 21.98°C**

Conclusion

- DSG is contributing to all phases of detector development

Thank You!

Ansys Full-scale Model Simulation



- Ambient temperature = 22°C
- **Heat load = 0.5 W**
- Cu shell temperature = 10°C
- **Central crystal temperature = 21.77°C**
- Python plot of just crystal face temp. probes