Data Visualization for Analysis of the NCNR Cold Neutron Source

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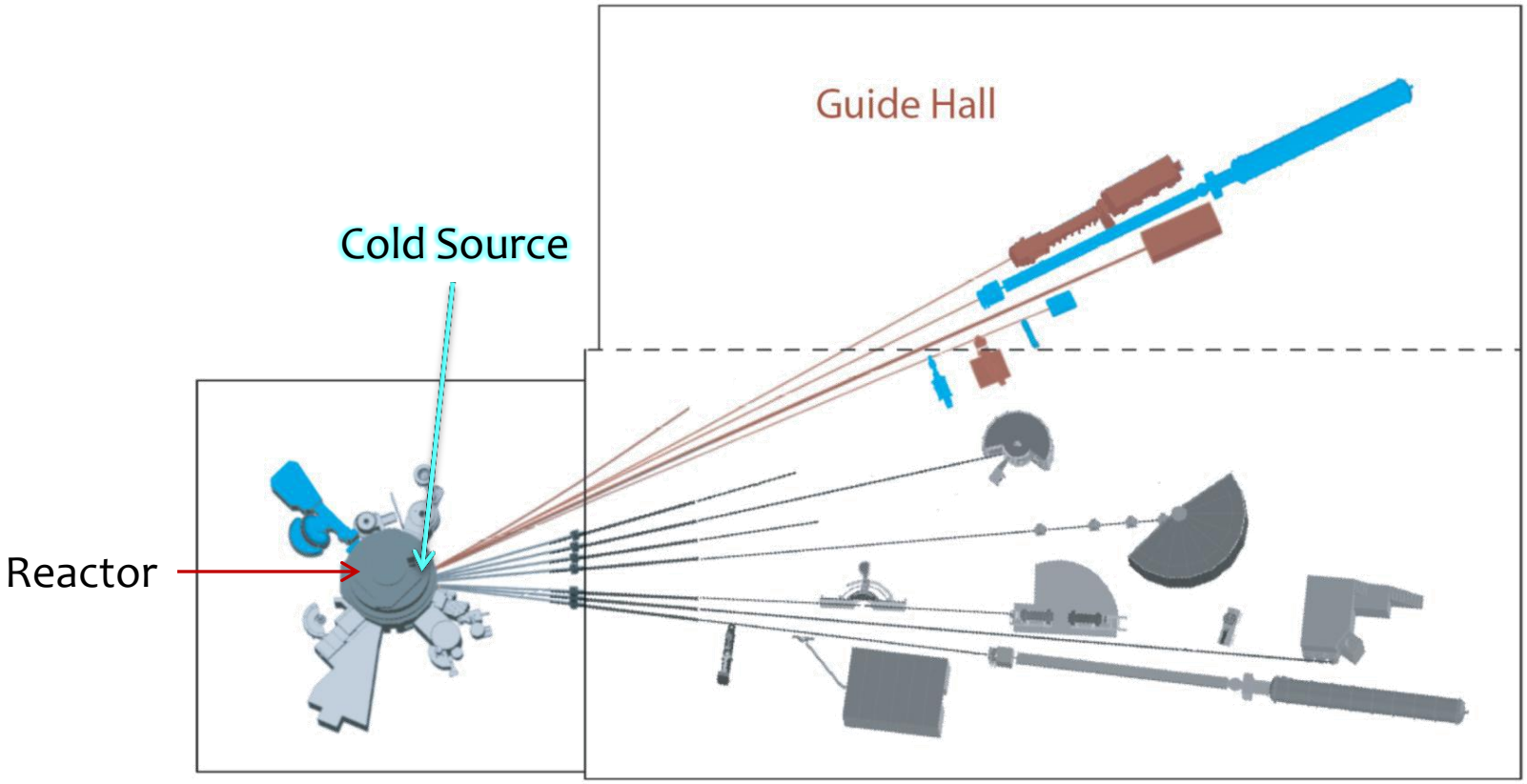
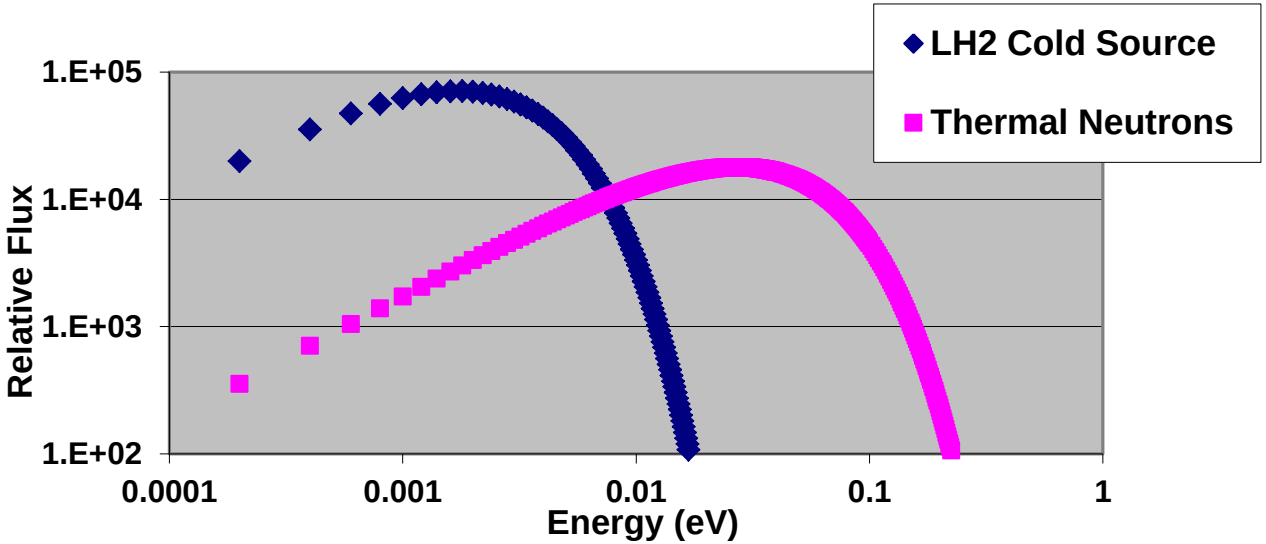
NCNR



NBSR

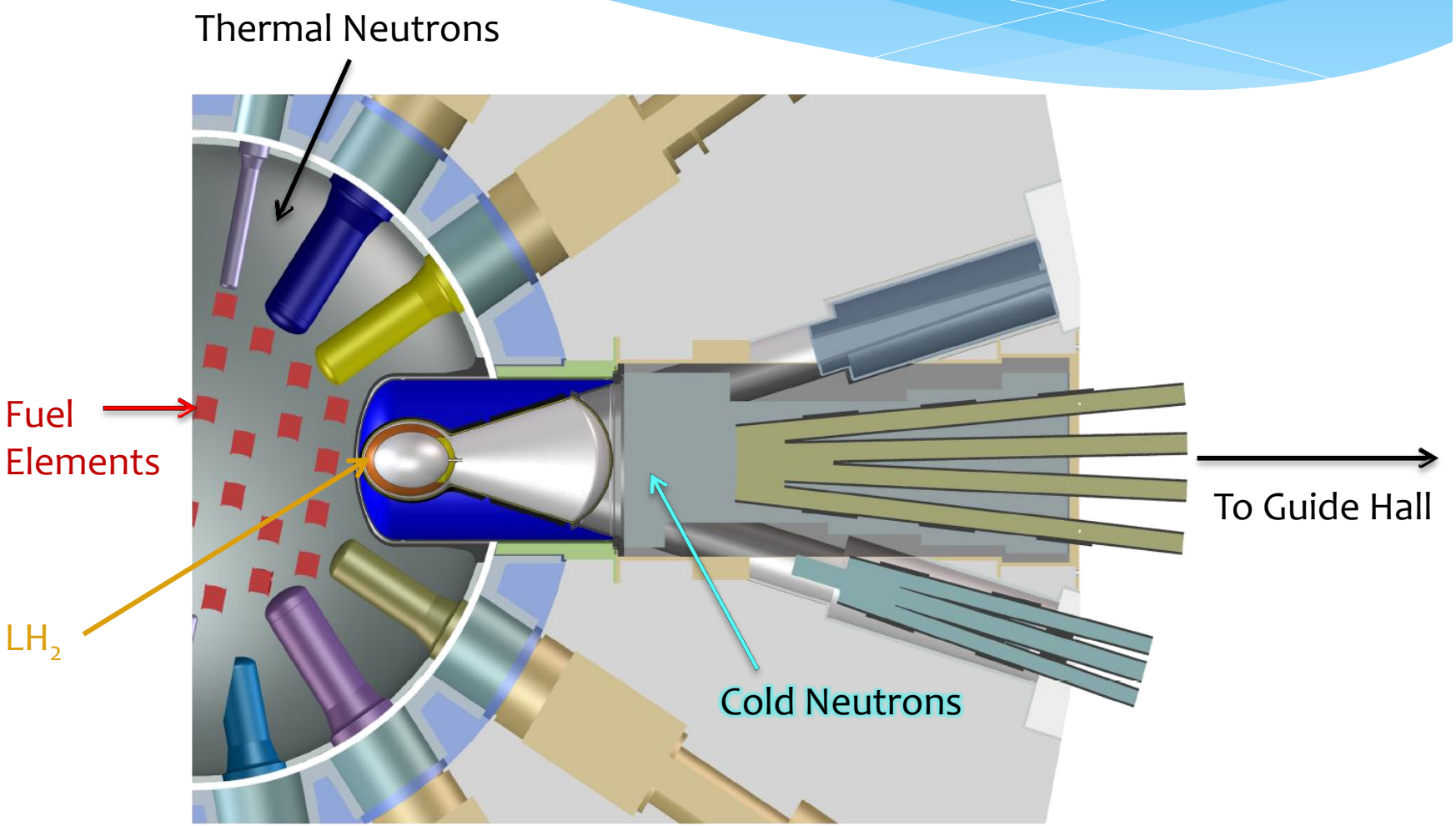
* Research reactor
* 20 MW
* Thermal neutron flux on order of 10^{14} n cm^{-2} s^{-1}
* Cold neutrons useful in experiments
  * Longer wavelength
  * Probe larger structures, smaller energy changes

Cold vs. Thermal Neutrons



Moderator Temperature (K)	Most Probable Energy (eV)	Wavelength (Angstroms)
315	.030	1.6
20	.002	6.4

Cold Neutron Source



Refrigerator

* System to cool helium to 14K
* Rated for 3500W heat removal
* Keeps cold source cold!
* Many active components need monitoring

PLC

* Programmable Logic Controller
* Operates cold source and refrigerator without human intervention
* Checks all sensors and controls valves
* Sends out alarm if necessary

Troubleshooting

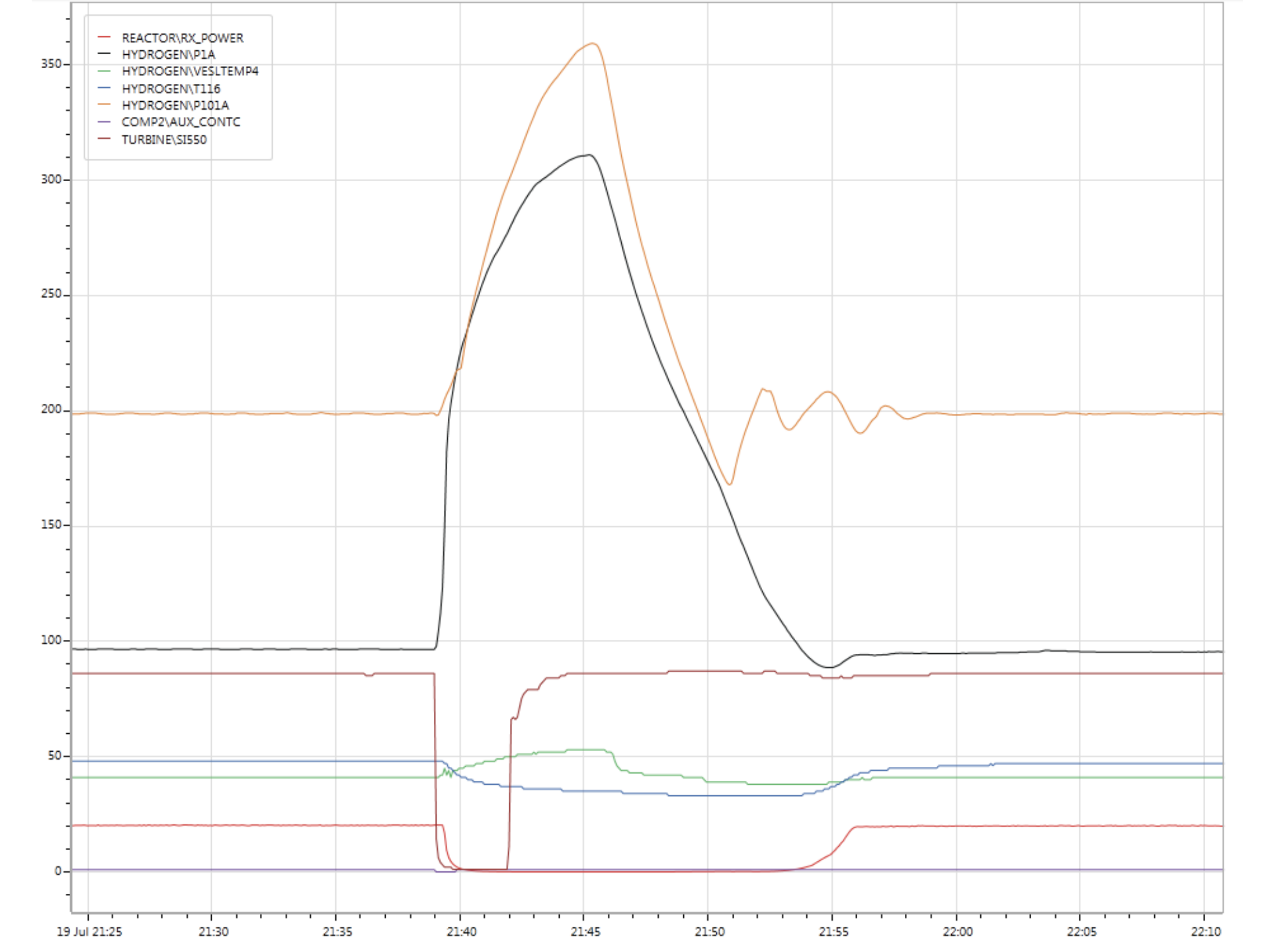
* Need logs to find problem source
* RSView can keep log of sensor readings
  * DBF format not easily accessible
* Default Trends viewer is limited
  * Pre-set time scale
  * Pre-set Y Axis scale
  * Pre-set sensor display
  * Cannot export data

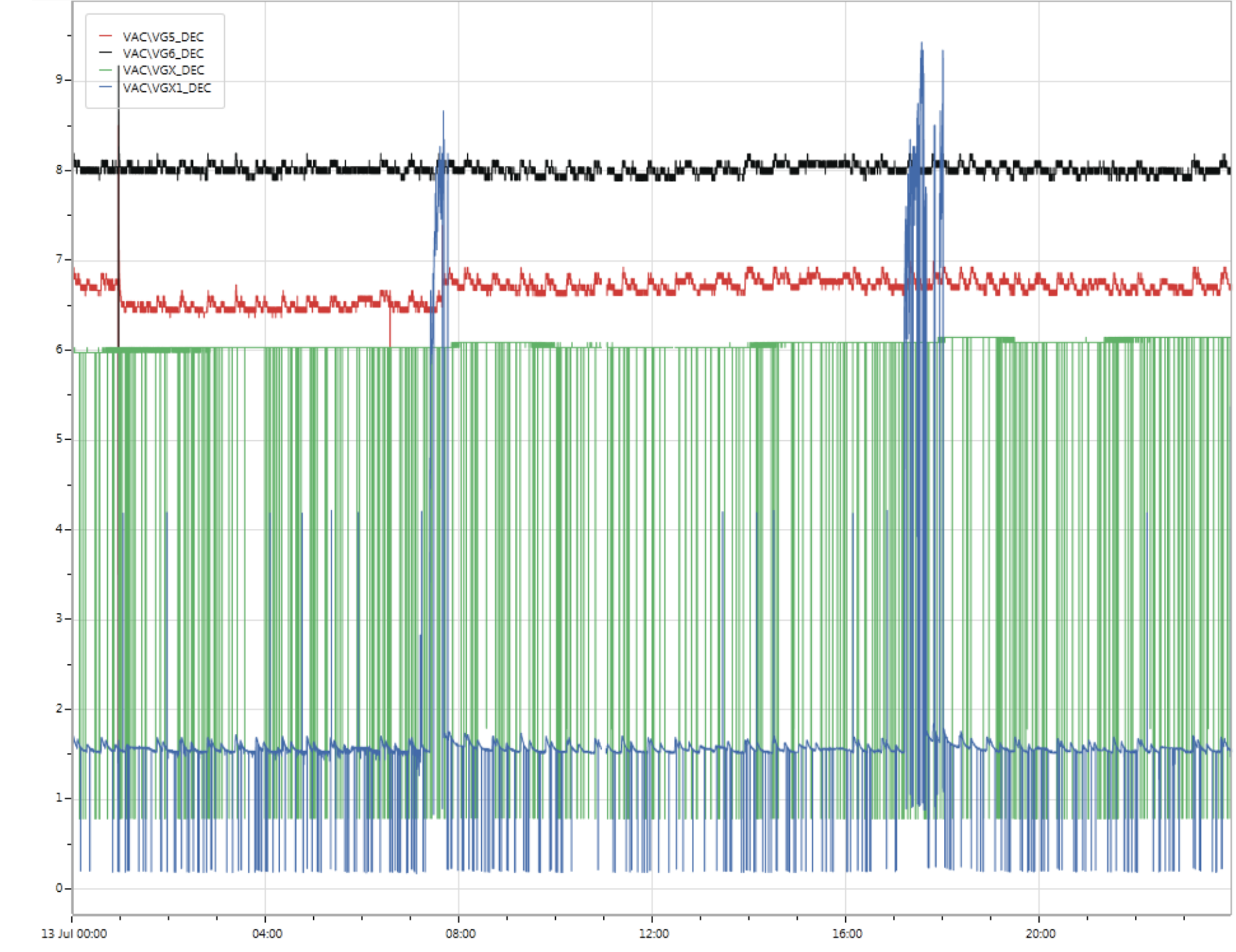
CSPlot

* Parses DBF file format
* Fully interactive chart
  * Mouse drag to set X and Y axes properties
  * Mouse scroll to zoom in
  * Series tracing
* Adding arbitrary sensors to chart
* Export of chart to Excel file
* Save reference to chart for record-keeping

CSPlot: Demo

* Reactor rundown
* Vacuum gauge noise reduction
* Used by cold source team to diagnose problems and evaluate efficiency of solutions


REACTOR\RX_POWER
HYDROGEN\P1A
HYDROGEN\VESLTEMP4
HYDROGEN\T116
HYDROGEN\P101A
COMP2\AUX_CONTC
TURBINE\SI550
350
300
250
200
150
100
50
0
19 Jul 21:25
21:30
21:35
21:40
21:45
21:50
21:55
22:00
22:05
22:10

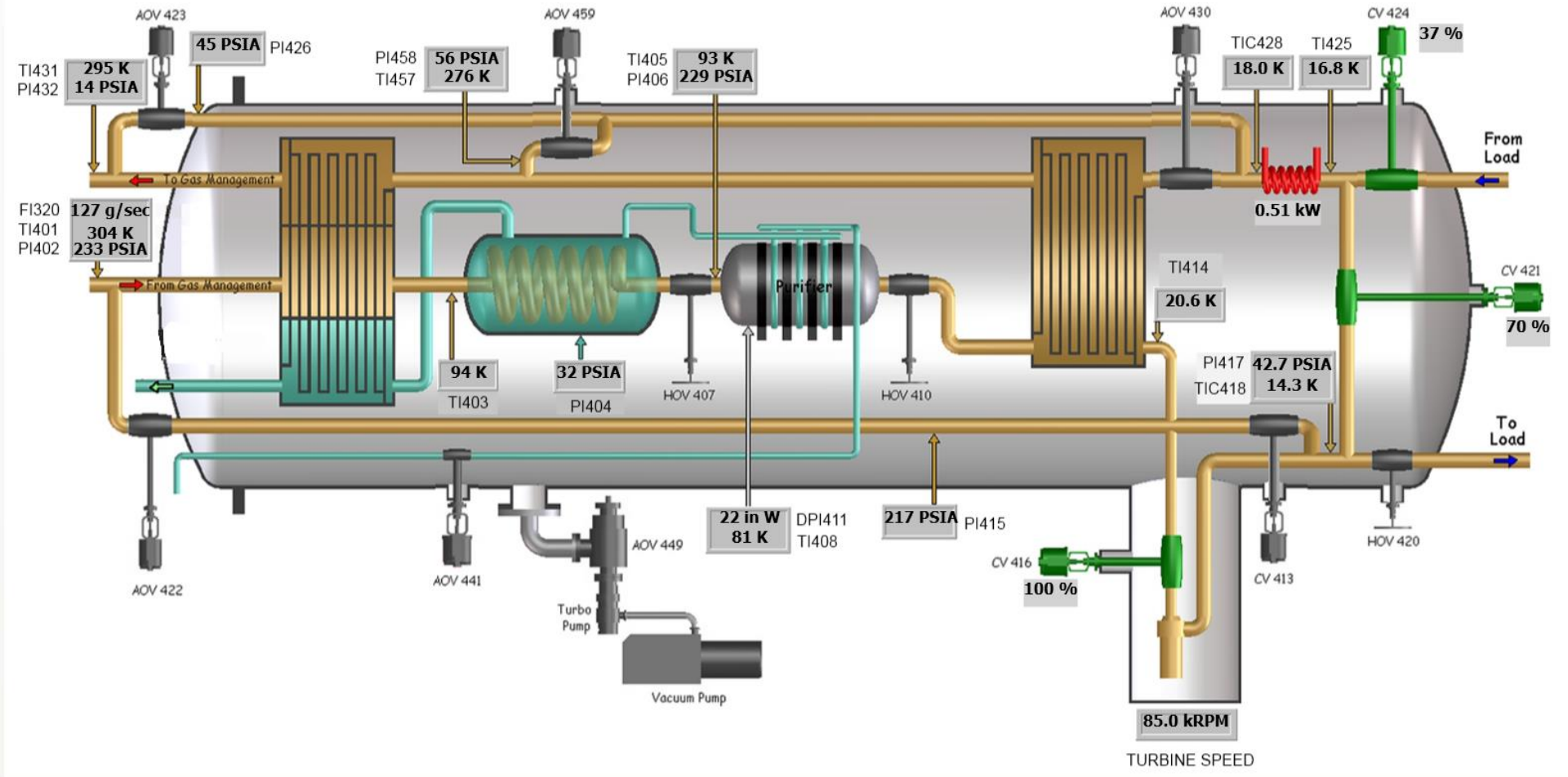

VAC\VG5_DEC
VAC\VG6_DEC
VAC\VGX_DEC
VAC\VGX1_DEC
9
8
7
6
5
4
3
2
1
0
13 Jul 00:00
04:00
08:00
12:00
16:00
20:00

CSScreens

* Allows monitoring of cold source via network
* Schematic view
* Matches layout of existing software
* Read-only

CSScreens: Demo

* Useful in checking the cold source is operational
* Currently used by reactor operators and cold source team


AOV 423
45 PSIA
PI426
TI431
PI432
295 K
14 PSIA
PI458
TI457
56 PSIA
276 K
AOV 459
TI405
PI406
93 K
229 PSIA
AOV 430
TIC428
18.0 K
TI425
16.8 K
CV 424
37 %
From Load
To Gas Management
FI320
TI401
PI402
127 g/sec
304 K
233 PSIA
From Gas Management
0.51 kW
TI414
20.6 K
CV 421
70 %
Purifier
94 K
TI403
32 PSIA
PI404
HOV 407
HOV 410
PI417
TIC418
42.7 PSIA
14.3 K
To Load
AOV 422
AOV 441
AOV 449
Turbo Pump
Vacuum Pump
22 in W
81 K
DPI411
TI408
217 PSIA
PI415
CV 416
100 %
CV 413
HOV 420
85.0 kRPM
TURBINE SPEED

Vacuum Pump

* Good vacuum is critical to cooling system
* Turbomolecular pumps have failed before
  * Overheating
  * Power surges
* Pump status -> PLC
  * Seal off failed vacuum pump

Vacuum Pump

* Inputs: Error (digital), Speed (analog)
* Outputs: On (digital), Control (digital)
* Wire connection to PLC
* Logic code added to PLC
* Control buttons added to RSView
* Prototype successful
  * Installation requires reactor shutdown

Acknowledgments

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