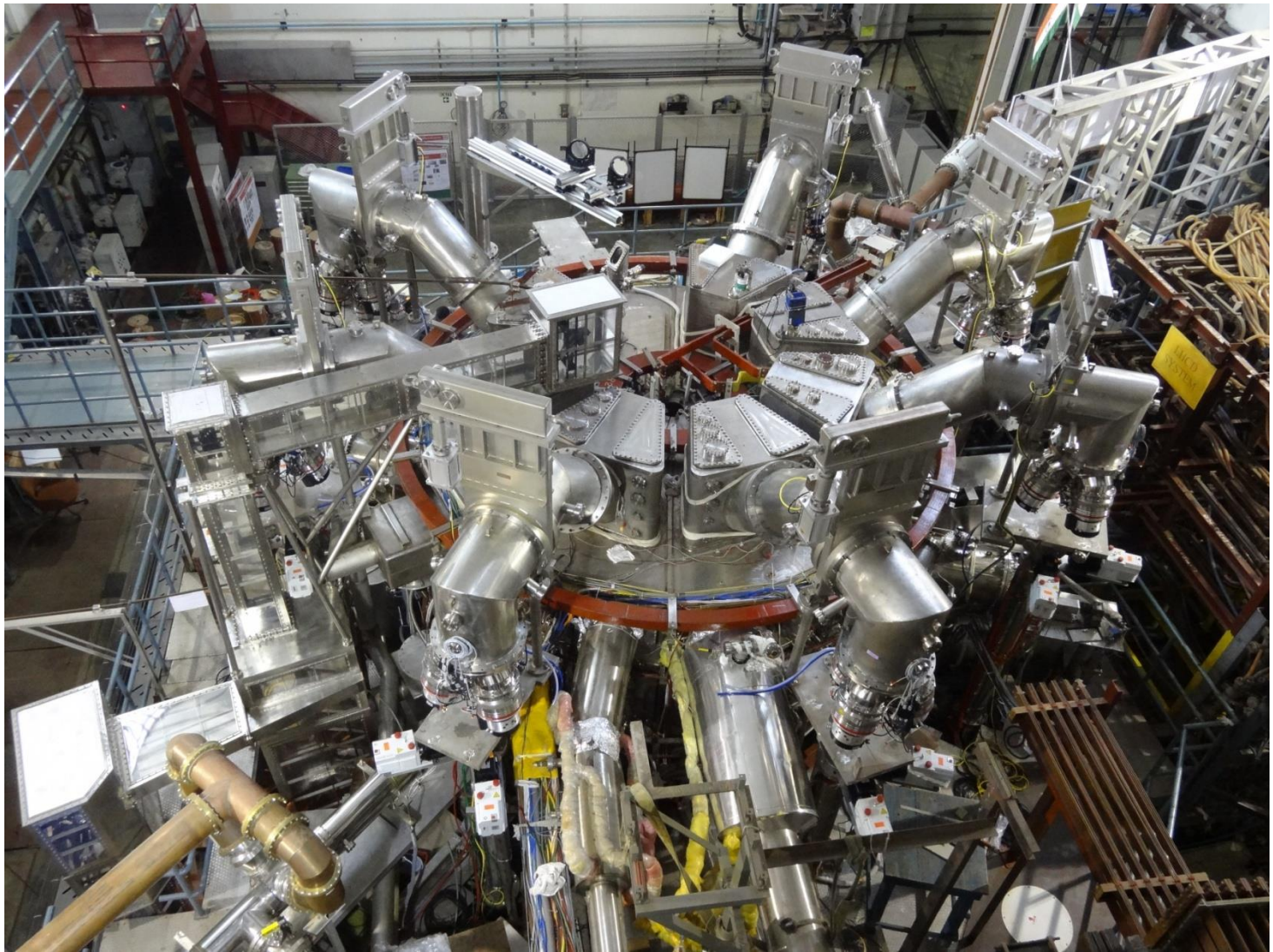
First Operational results with SST-1 Superconducting Magnet System & Cryogenics System

Subrata Pradhan *on behalf of SST-1 Team*

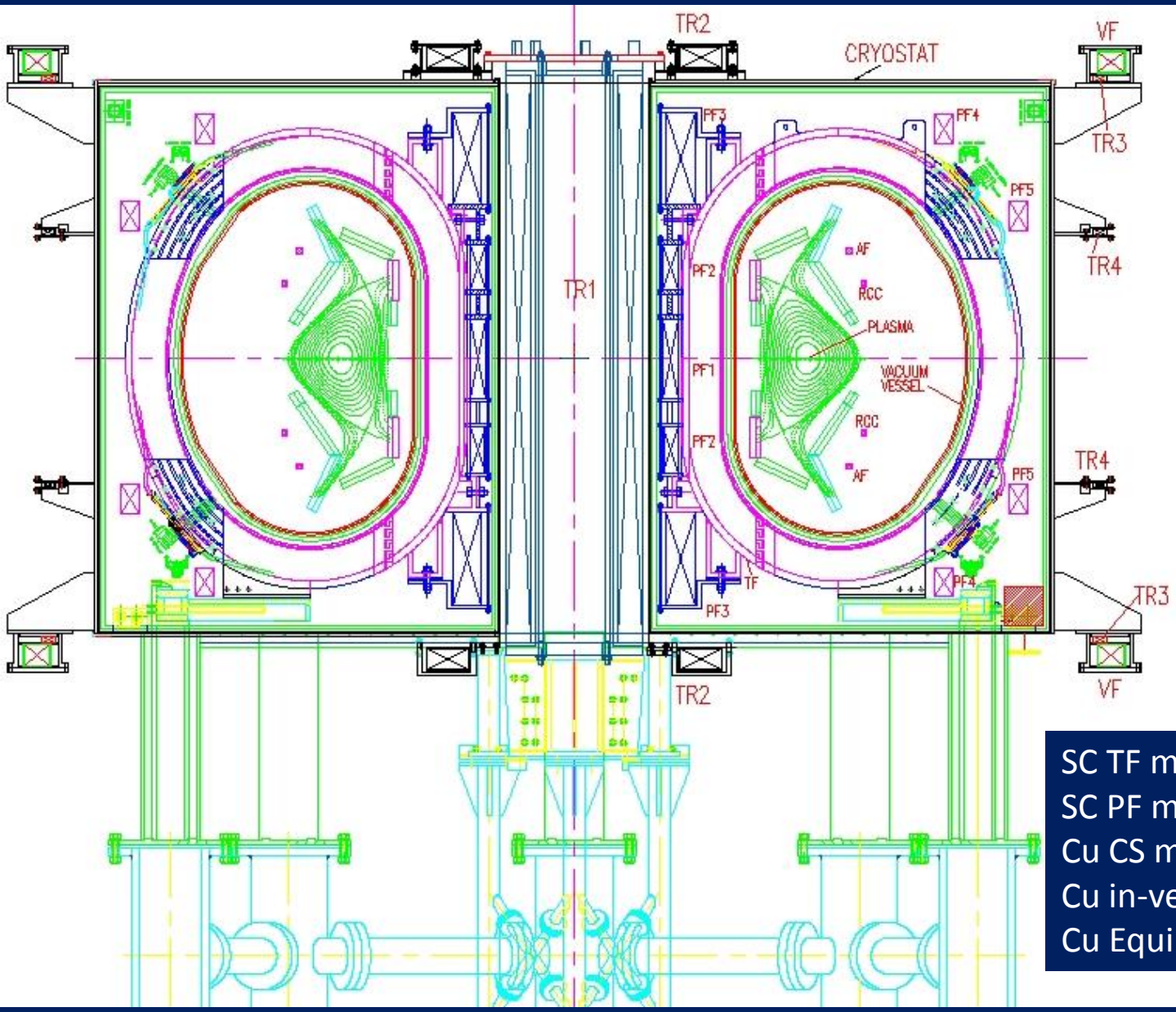
Institute for Plasma Research

Thu-AF-OR 13, Jul 10, 1400 hrs

Steady State Superconducting Tokamak (SST-1) is a First Generation Experimental Tokamak indigenously developed and commissioned at Institute for Plasma Research



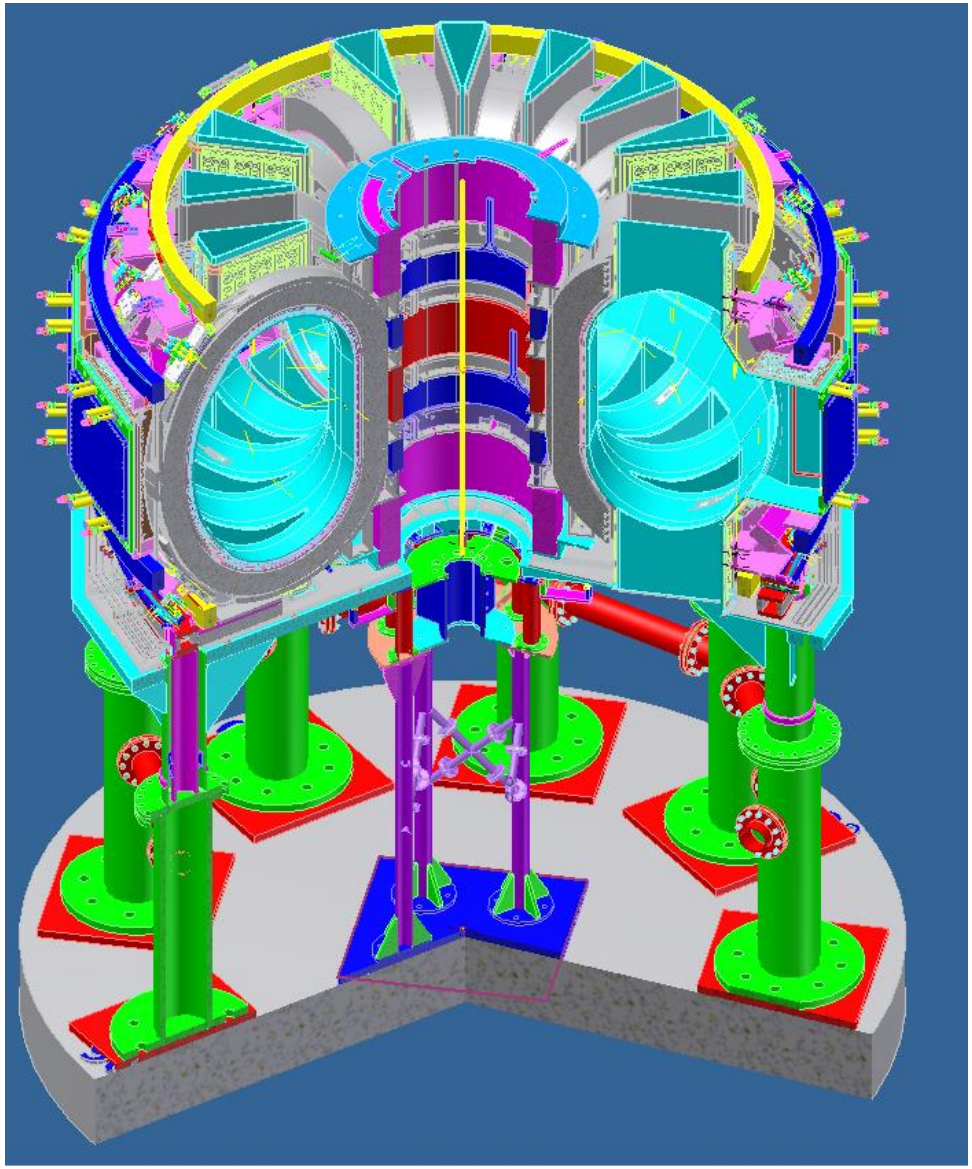
Cross sectional View showing SST-1 Magnet System (TF, PF, Central Solenoid & Compensating Magnets and Equilibrium Magnets)

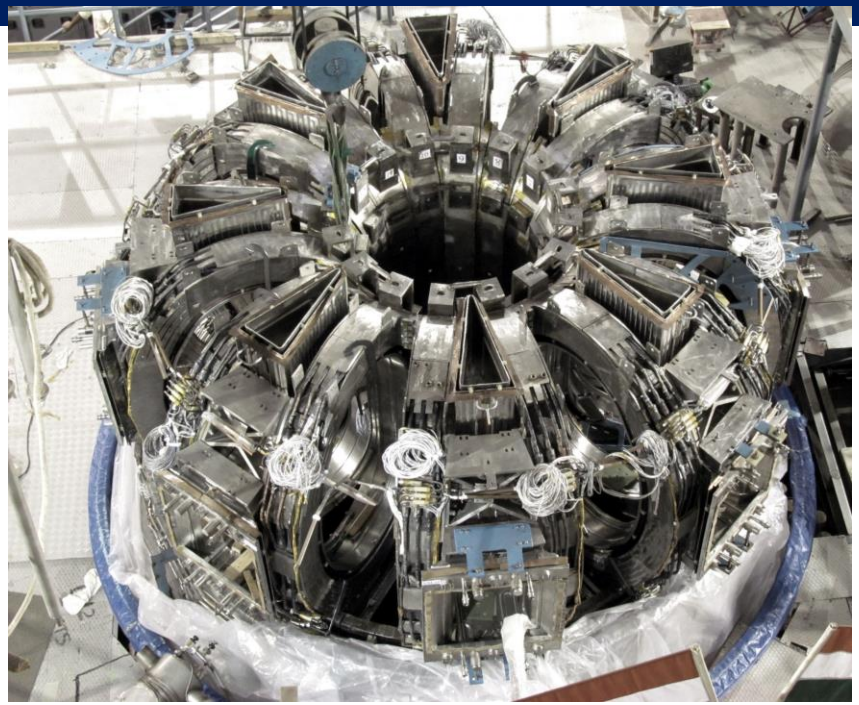


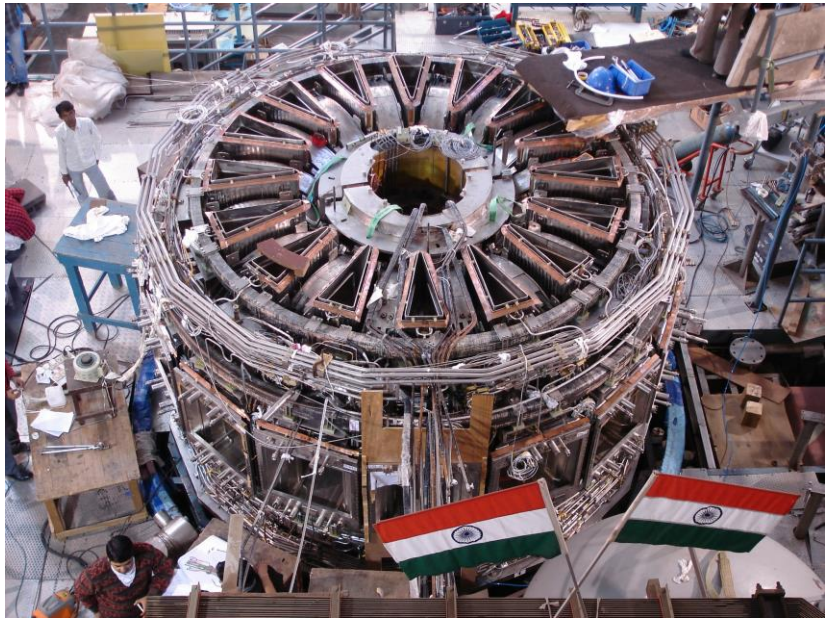
SC TF magnets: 16
SC PF magnets: 09
Cu CS magnets: 07
Cu in-vessel Mag.: 04
Cu Equil. Mag.: 02

SST-1 TF & PF magnets are superconducting (NbTi) whereas all other magnets are resistive (Cu)

SST-1 MAGNET SYSTEM



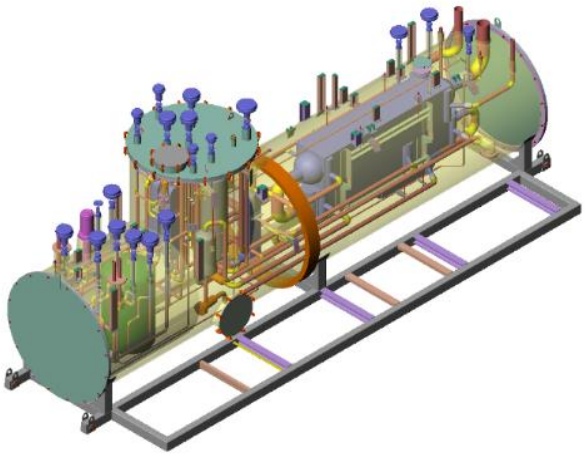


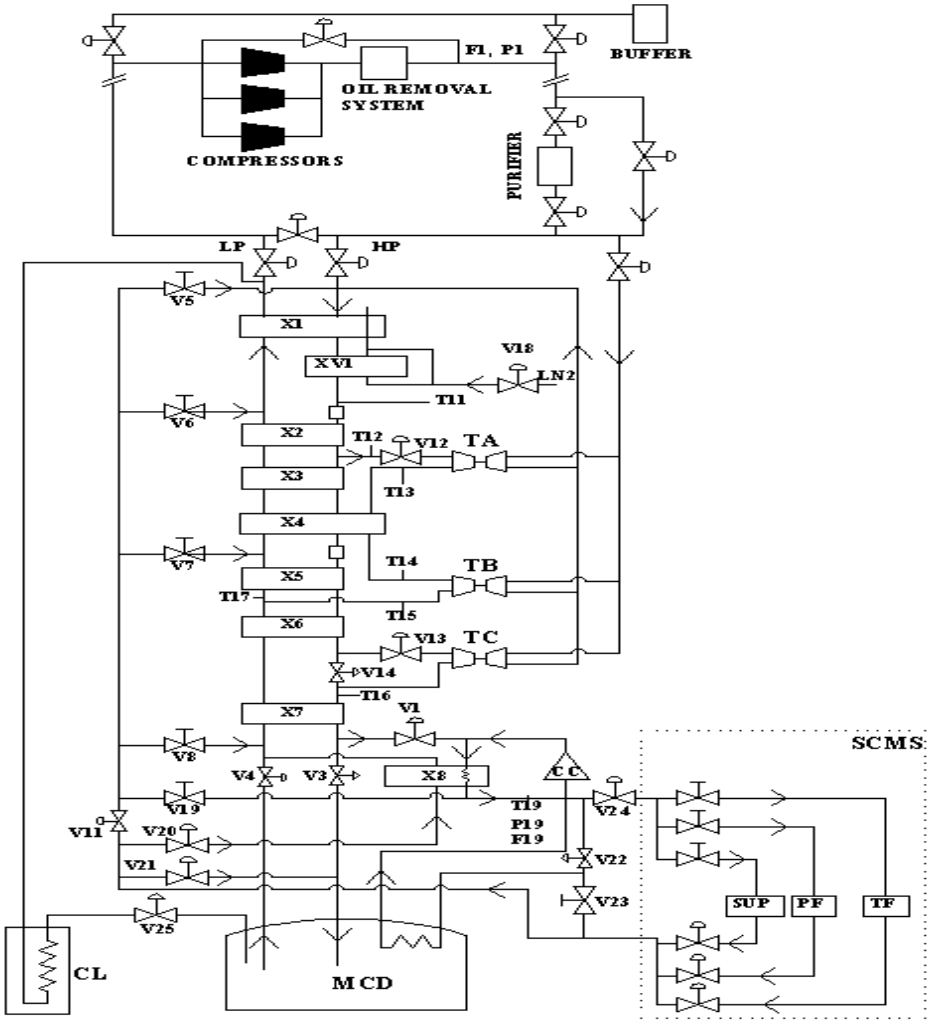


SST-1 Cryogenic System (1.3 KW)

Different Components of HRL

- Compressor Skids
- Oil Removal System
- Online Purifier
- Cold Box
- Main Control Dewar (MCD)
- Integrated Flow Distribution & Control System (IFDCS)
- Current Leads (CL)
- Current Feeders system (CFS)





Important sub-systems of SST-1 Cryogenics System

Helium Screw Compressors Station

Oil Removal System

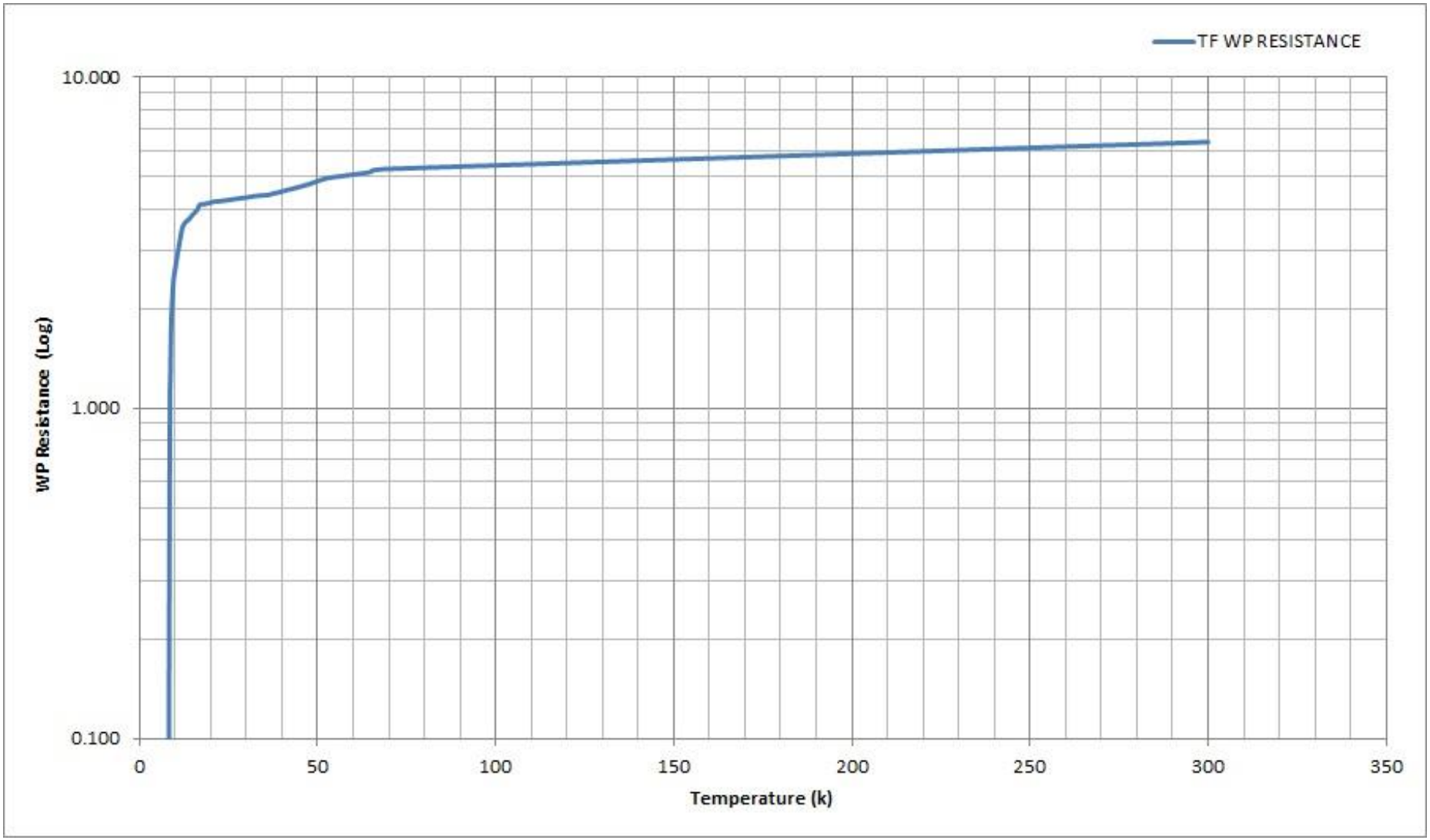
Main Purifier

Helium cold-box and MCD (2500 L)

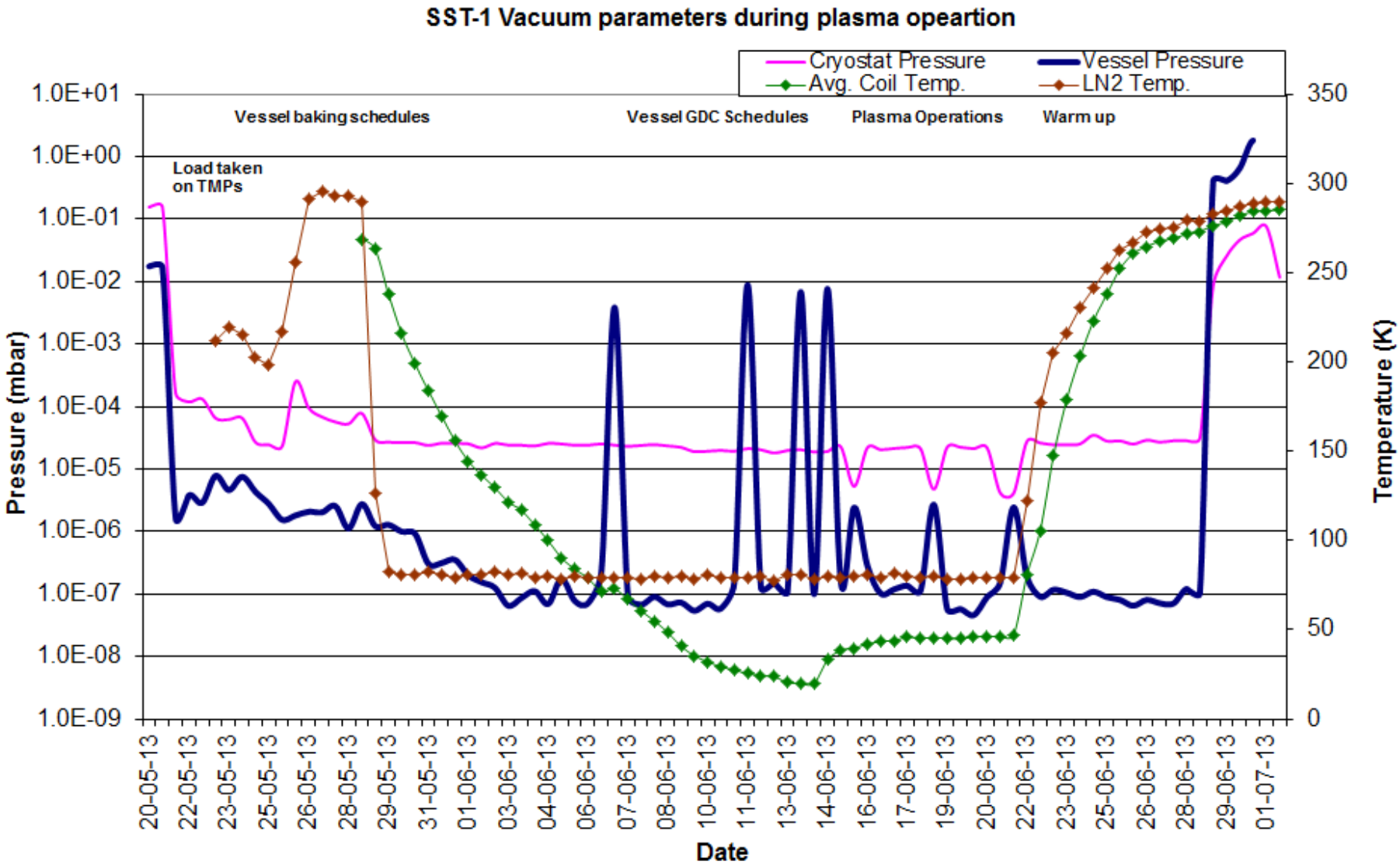
IFDC cold Helium distribution

LN2 Sub-cooler Dewar

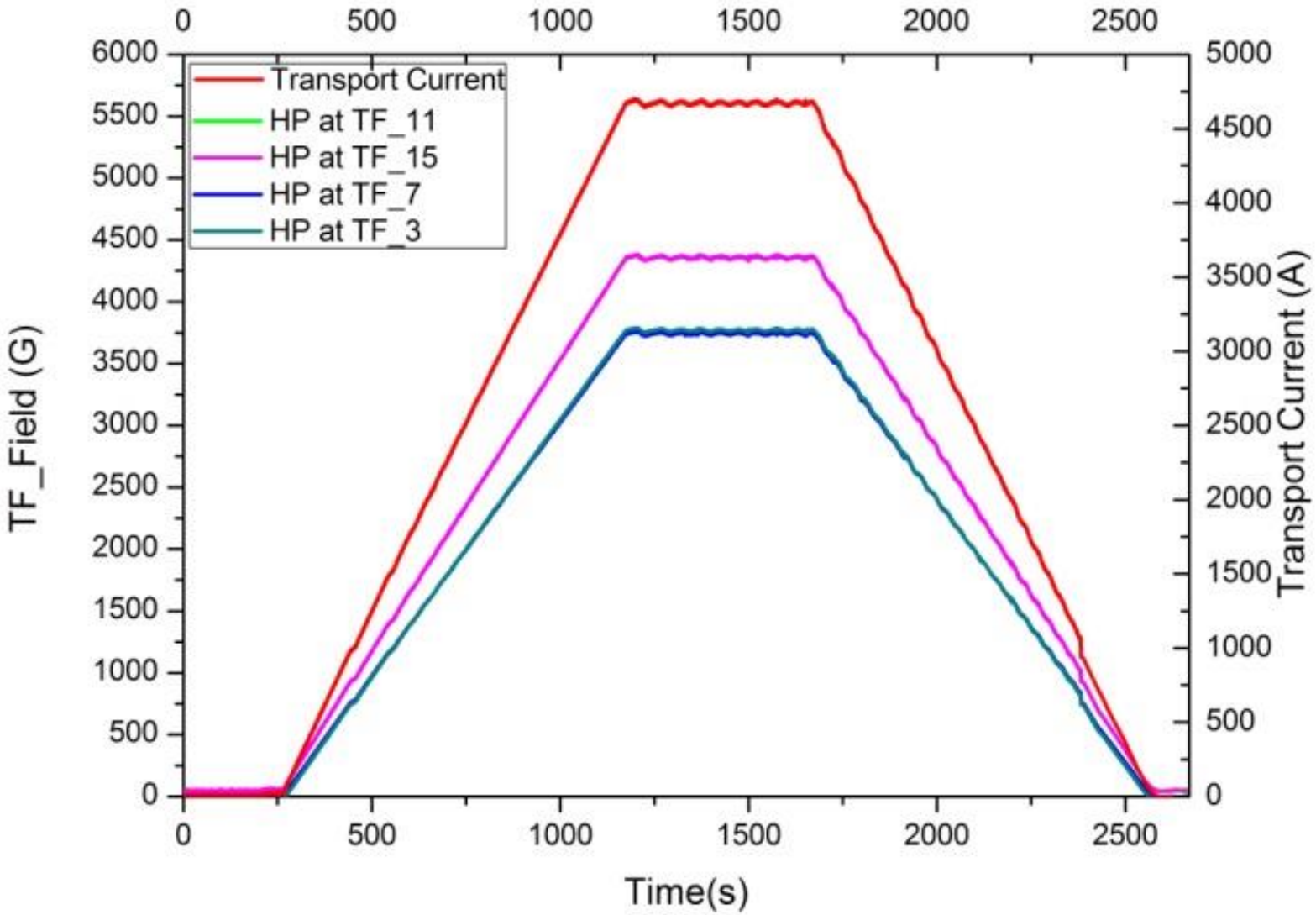
Engineering validations: Magnets & Cryogenics sub-systems



Cryostat & Vacuum System of SST-1



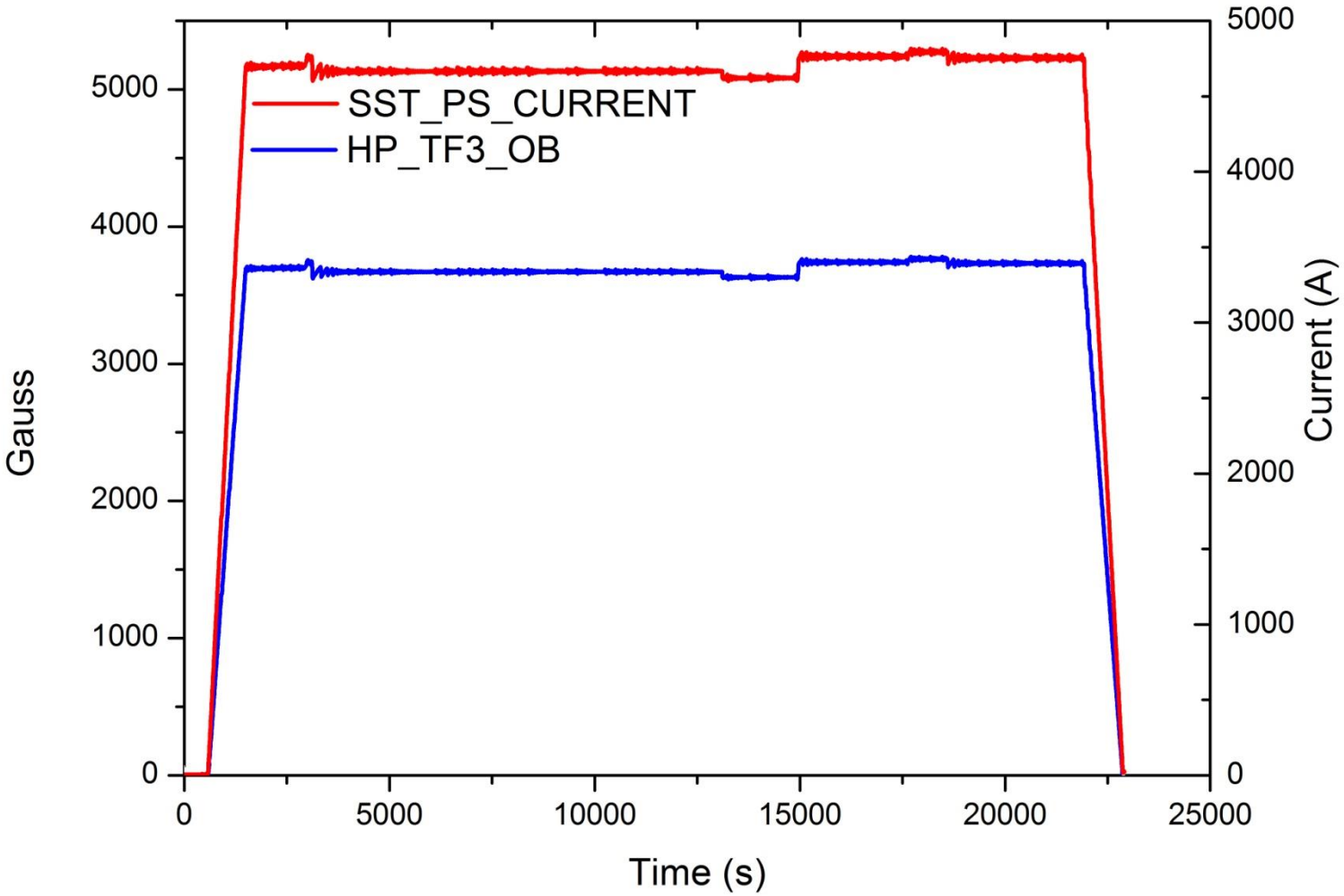
SST-1 TF 1.5 T operation



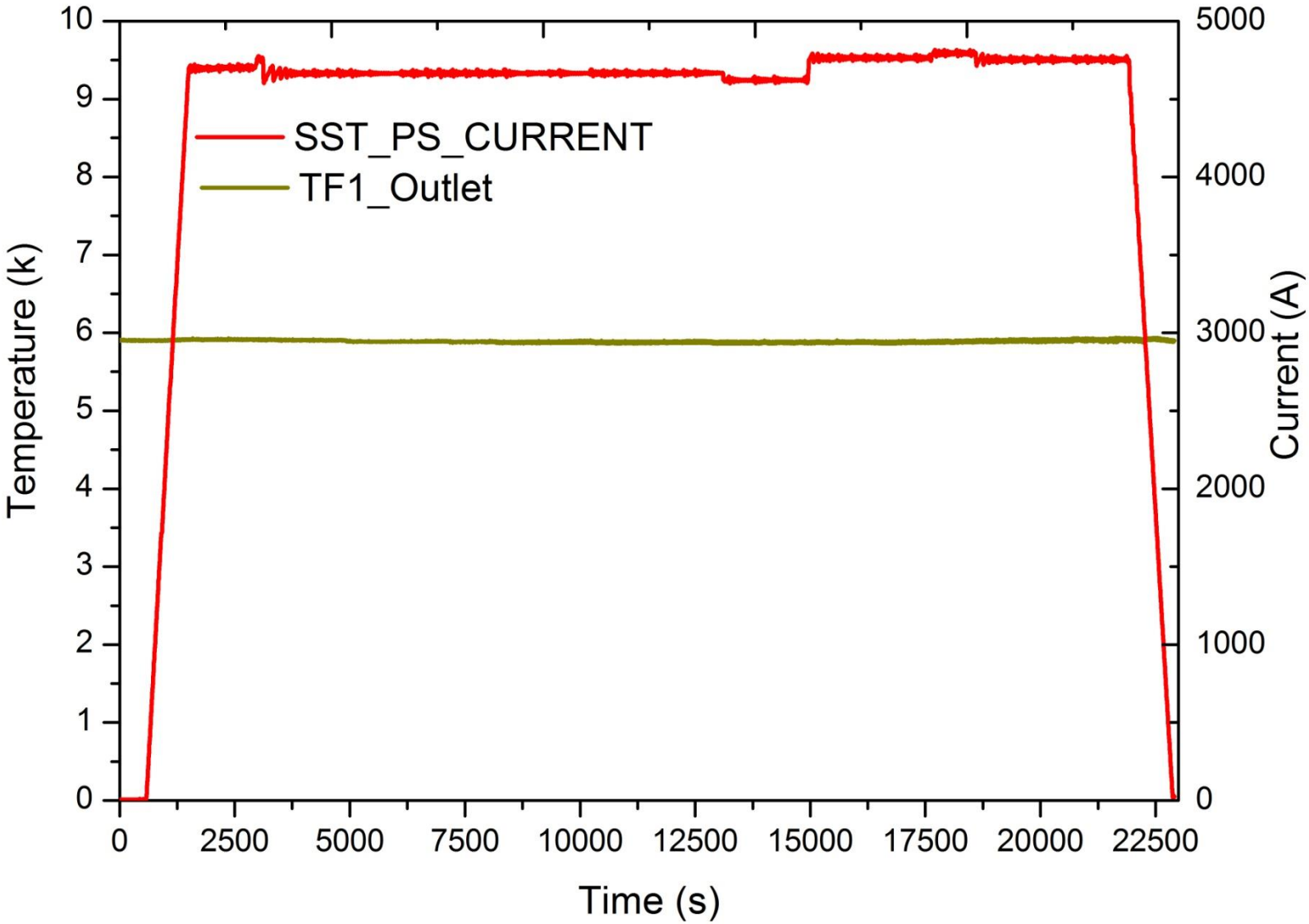
Significant First Time Achievements

- Long Pulse operation of TF magnets @ 1.5 T (at plasma centre) for 20000 s or more.
- TF magnets operation up to 2.0 T with Two Phase cooling
- Cold gas cooled Current Lead operations at 1.5 T instead of liquid helium.

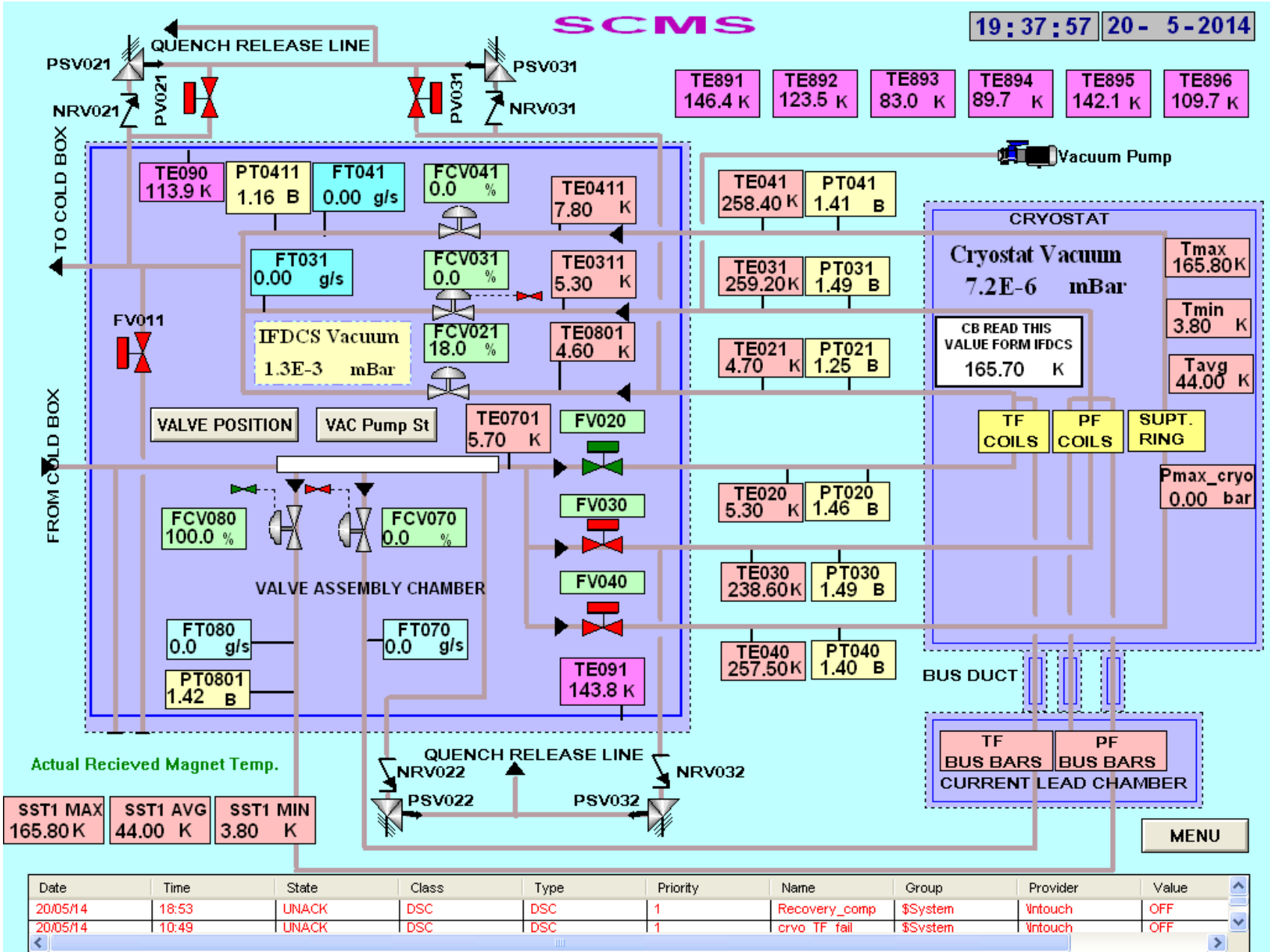
Magnetic field profile with Long duration TF magnet current in Two Phase coolingcharge



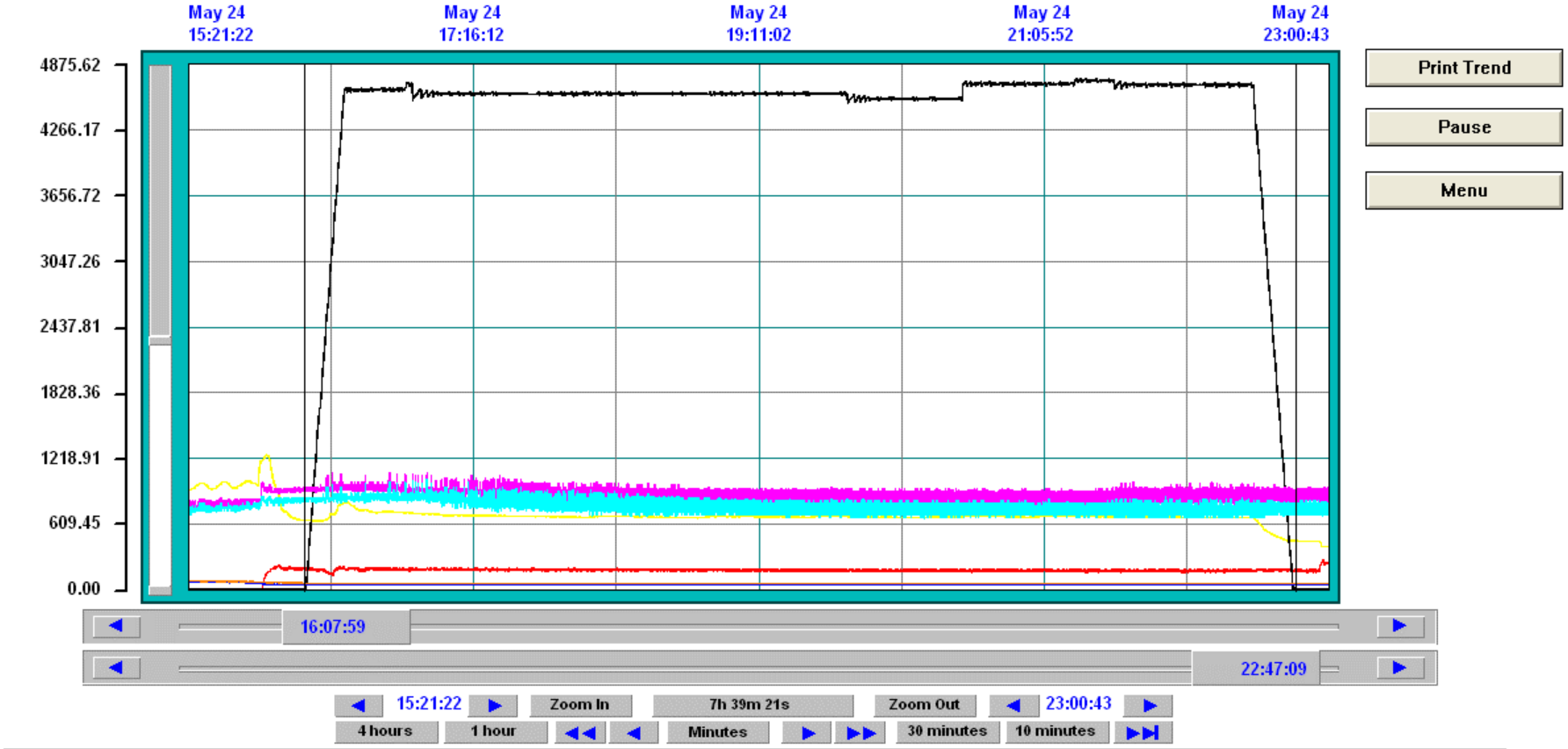
Temperature stability with Long TF magnet currents in Two Phase Cooling



The SST-1 Helium system supporting the Two Phase Cooling

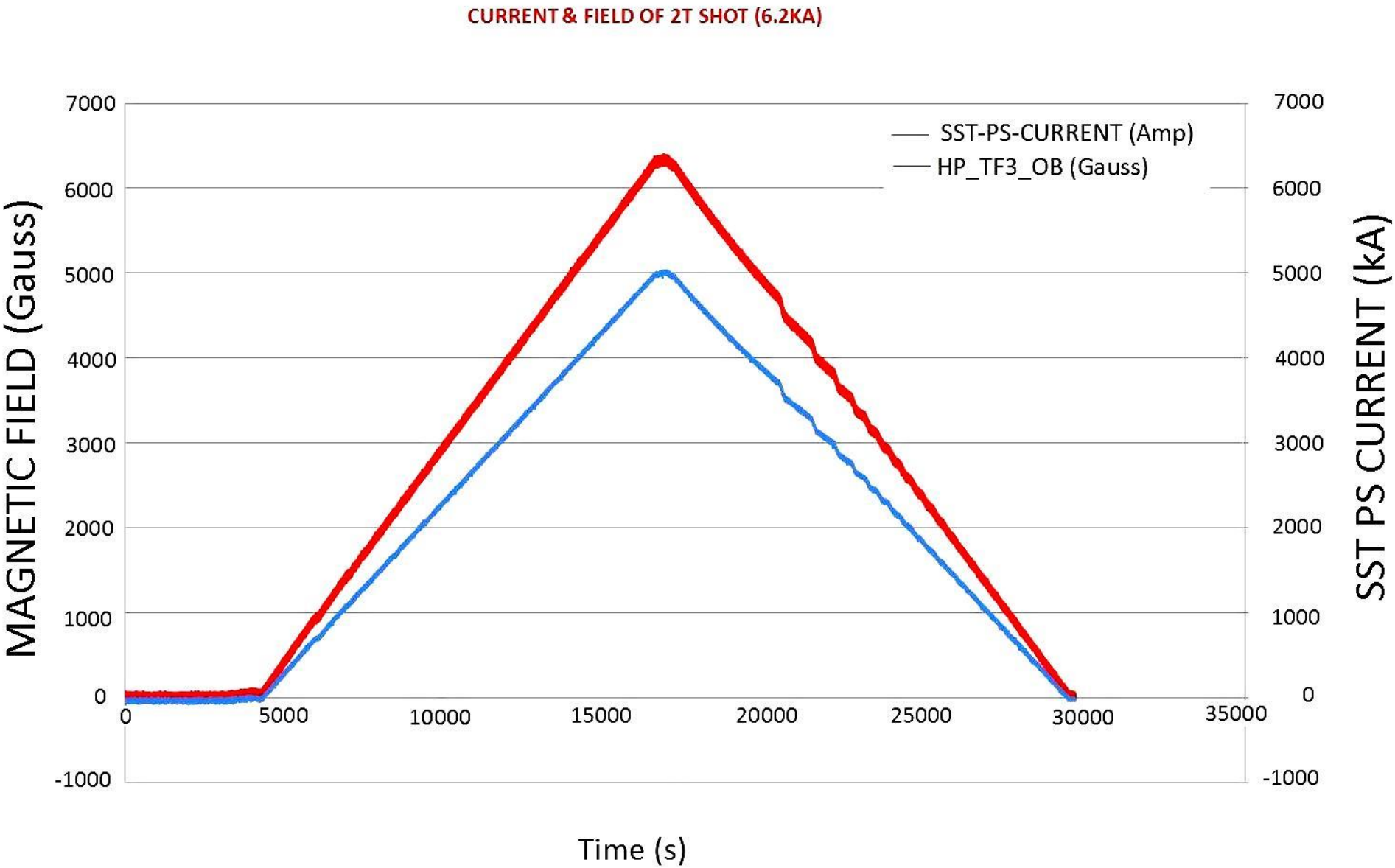


Typical Long TF Flattop of 20,000 Seconds @ I = 4750 A / 1.5 T

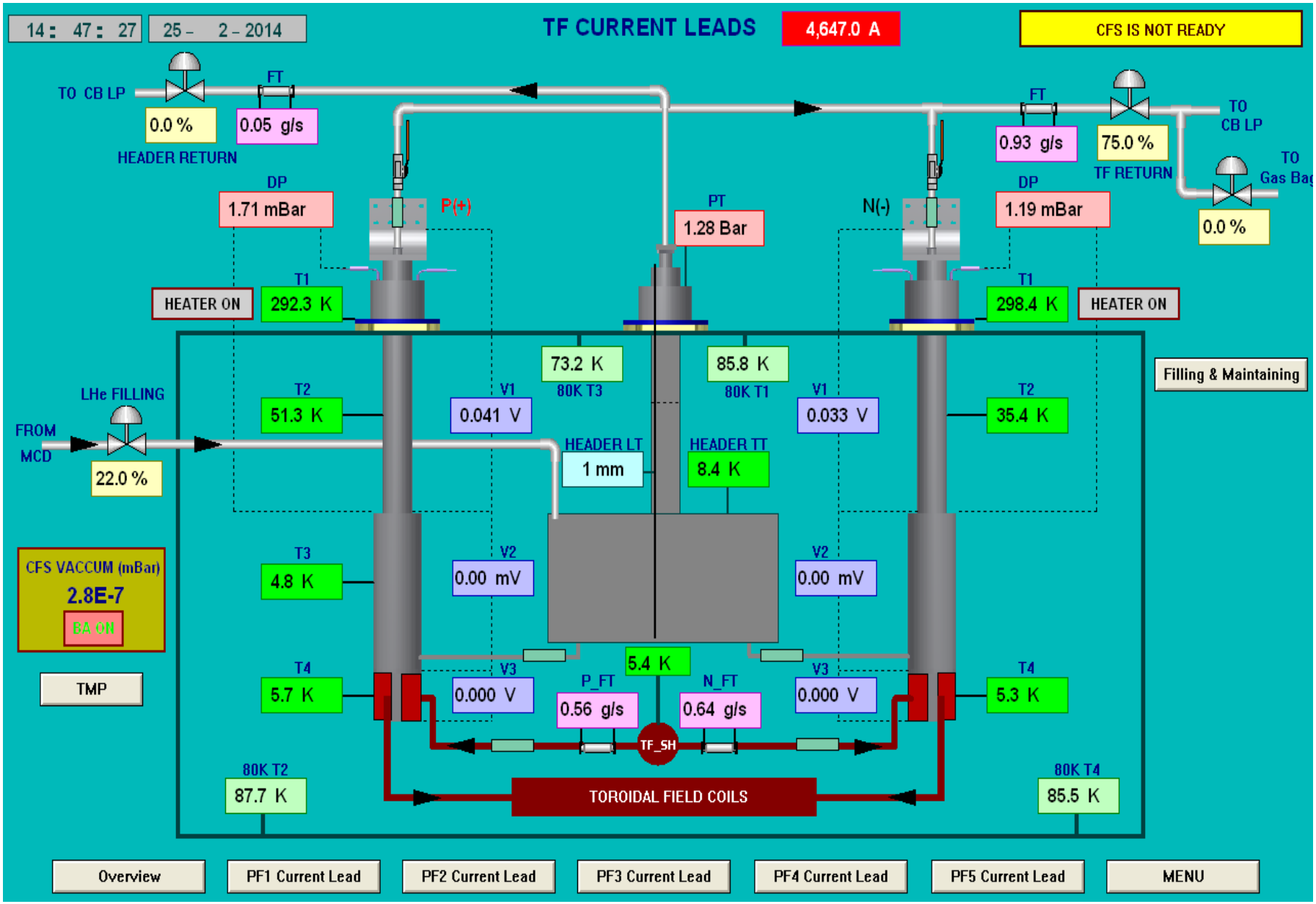


Tag Variable	Max	Min	Average	Max Range	Min Range	Value at Left Slide	Value at Right Slide	Rate (K/Hr.)
TF_N_T2	30.20	18.50	25.68	325.00	4.00	24.60	18.55	-0.909
LHE_HDR_L	21.40	12.80	18.18	1016.00	0.00	19.10	18.30	-0.120
TF_N_T2	30.20	18.50	25.68	325.00	4.00	24.60	18.55	-0.909
CFS_CURRENT	4761.00	1.00	4447.99	10000.00	0.00	2.50	1.00	-0.225
TF_N_T4	5.60	5.30	5.49	325.00	4.00	5.53	5.43	-0.015
TF_N_FT	0.76	0.53	0.61	7.00	0.00	0.65	0.59	-0.009
TF_P_FT	0.72	0.46	0.54	7.00	0.00	0.59	0.51	-0.013
TF_P_T4	5.90	5.60	5.75	325.00	4.00	5.85	5.75	-0.015

2 T in TF with Two-phase helium

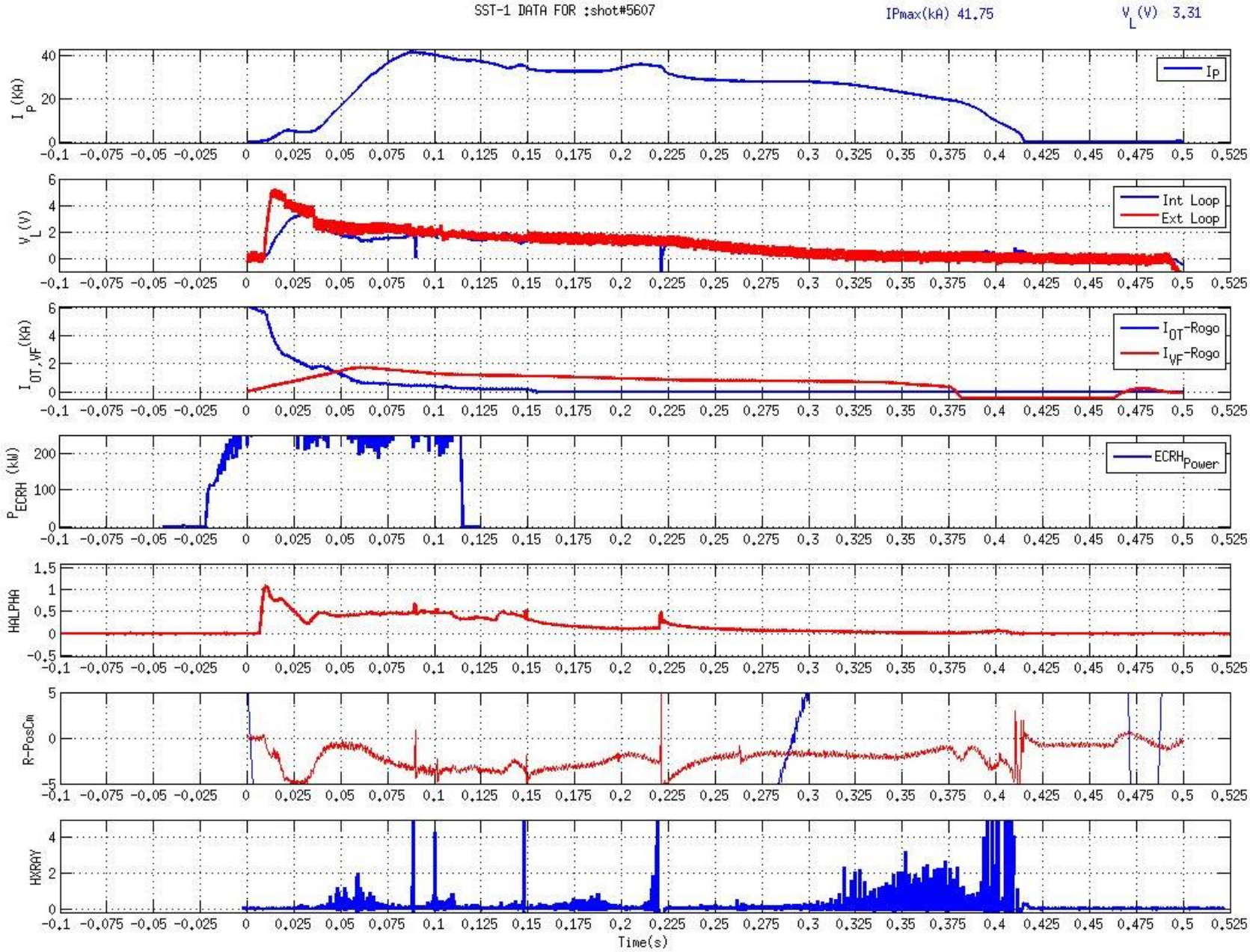


TF CL operating with gas cooled CLs @ 4.7kA

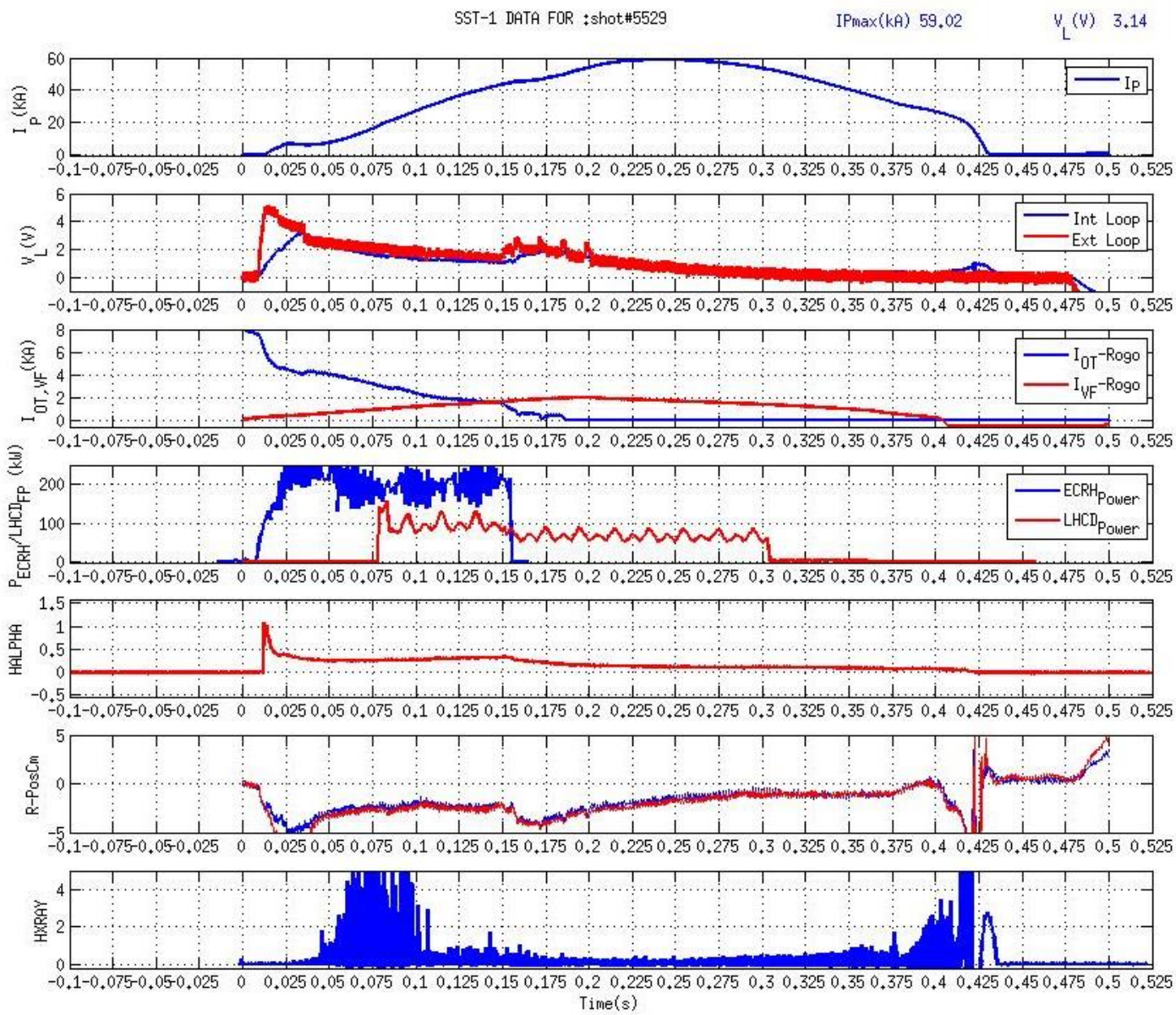


Reliable SC Magnet System and Cryogenic System of SST-1 has helped towards conducting reliable physics experiments in SST-1

Plasma Experiments at 0.75 T



Plasma Experiments at 1.5 T



Acknowledging my SST-1 Team

Jai Hind