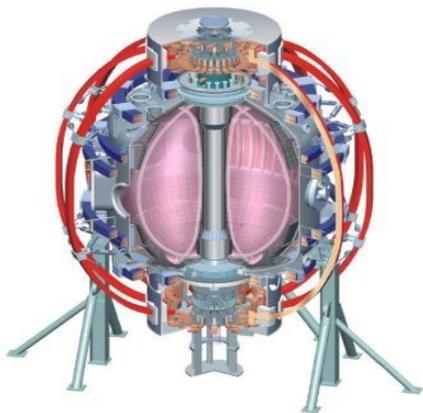


COE and Machine Operations

College W&M
 Colorado Sch Mines
 Columbia U
 CompX
 General Atomics
 INEL
 Johns Hopkins U
 LANL
 LLNL
 Lodestar
 MIT
 Nova Photonics
 New York U
 Old Dominion U
 ORNL
 PPPL
 PSI
 Princeton U
 Purdue U
 SNL
 Think Tank, Inc.
 UC Davis
 UC Irvine
 UCLA
 UCSD
 U Colorado
 U Illinois
 U Maryland
 U Rochester
 U Washington
 U Wisconsin

Ray Camp

- * Responsibilities
- * Daily Startup Activities
- * Typical Shot Sequence
- * Machine/Vacuum Tech Operations
- * COE Operations



Culham Sci Ctr
 U St. Andrews
 York U
 Chubu U
 Fukui U
 Hiroshima U
 Hyogo U
 Kyoto U
 Kyushu U
 Kyushu Tokai U
 NIFS
 Niigata U
 U Tokyo
 JAEA
 Hebrew U
 Ioffe Inst
 RRC Kurchatov Inst
 TRINITI
 KBSI
 KAIST
 POSTECH
 ASIPP
 ENEA, Frascati
 CEA, Cadarache
 IPP, Jülich
 IPP, Garching
 ASCR, Czech Rep
 U Quebec

COE Responsibilities

- Safe operation of NSTX-U
 - Personnel Safety
 - Equipment Operation within established limits
- Coordinating the various groups to achieve the above
 - Machine Technicians
 - Health Physics
 - Physics Operator/Session Leader
 - Diagnostics
 - ESU
 - Engineering (PCEIC, Grounding, OIT)

Machine/Vacuum Techs - Daily Startup



- * Hi-pot the inner and outer vessel
- * Configure the gas injection system and check pumping systems
- * Configure diagnostics as required
- * Kirk keys at appropriate stations for operations
- * Ensures the experimental areas (TC, TCB gaged area and VCR/CSR) clear of personnel (search and secure) and set the loops
- * Informs the COE that the machine and test cell are ready for operations
- * Runs typically 30 minutes of helium GDC prior to fiducial plasma

COE Daily Startup



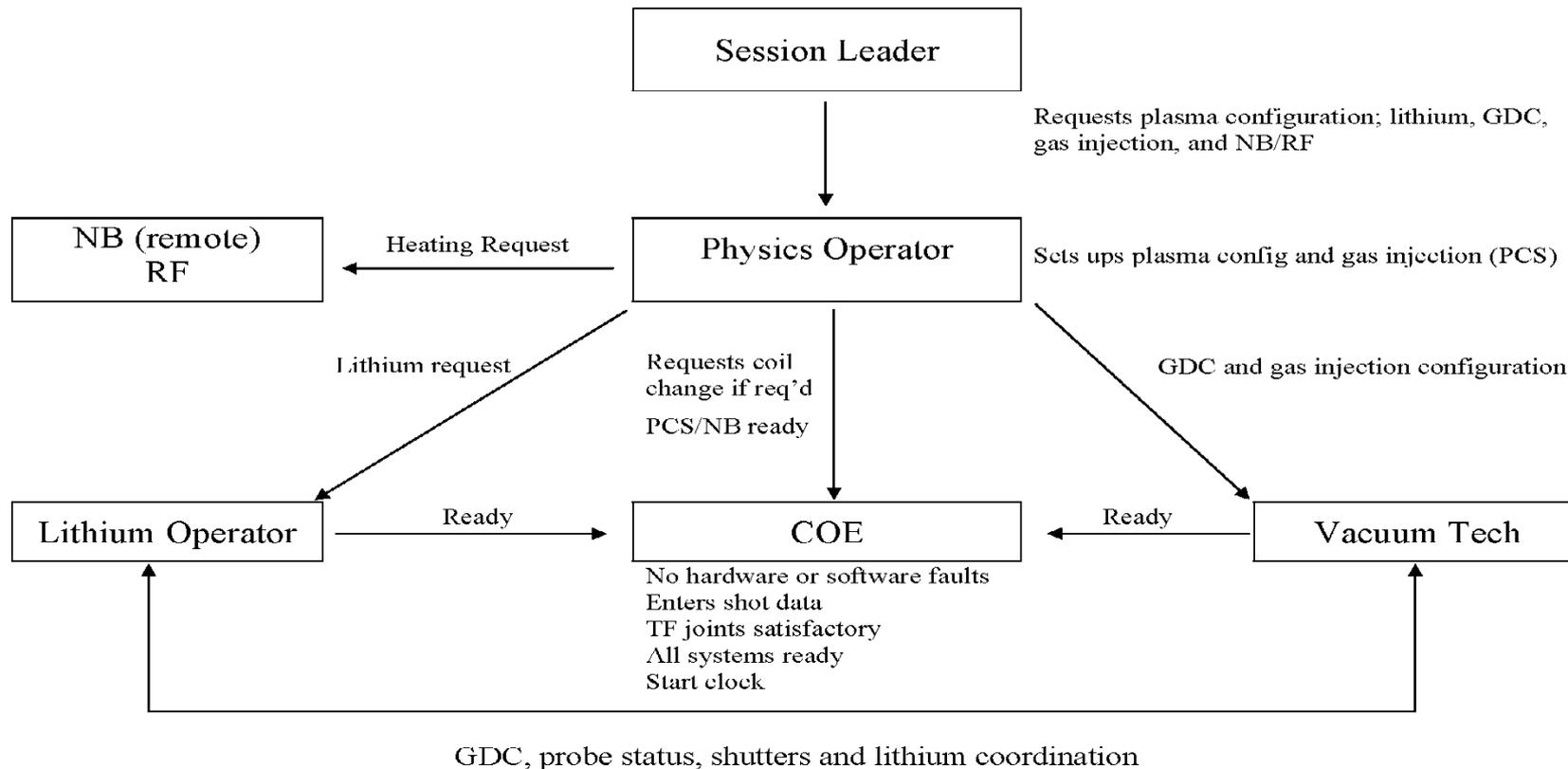
- * Instructs water systems and MG to startup at 7 am
- * Starts up various programs:
 - EPICS
 - Energy monitor
 - Scope pages
 - Database for shot statistics
- * Runs clock cycle to test acquisition and EPICS are OK
- * At 7:30 test cell is cleared and closed up and COE requests the Safety Lockout Device (SLD) be pressurized by FCPC
 - SLD supplies air to the Safety Disconnect Switches (SDSs) in the FCPC area so that the line and ground switches can be configured

COE Daily Startup (cont)



- * Supplies enable and arming permits to NB and RF(ECH)
- * FCPC performs a hi-pot of the coils separately and the coils and rectifiers together
- * Hi-pot values entered in database and checked for typical values
- * PCEIC starts PSRTC/DCPS and Runs two coil only test shots at 50% and 100% current levels
- * Runs fiducial plasma discharge and hands over plasma operations to the Physics Operator and Session Leader (usually between 8 and 8:30 am)

Typical Shot Sequence



Vacuum Tech / Between Shot GDC

Glow Discharge Cleaning (GDC)

SYSTEM STATUS: GDC STOPPED, Normal GIS, >SETPOINT, Ctrl Room

TOTAL GDC TIME: 40.0 MIN

GDC PROCESS PARAMETERS: Bay K, Bay J Lwr, Bay J Up, Lower Dome, SET FEV VOLTAGE (95 V, 100 V, 85 V, 85 V), SET GDC TIME PERIOD (0.0 MIN)

GDC/CLOCK SYNC MODE SELECT: GDC Only, Plasma Ops with GDC & Litr, GDC with TMB, Plasma Ops with Litr, Plasma Ops with GDC, Shut Down

GDC STARTUP: 1 NB TIV (CLOSED), 2 SHUTTERS / TIVs (GDC CONFIG), 3 Ion Gauge (OFF) 0.25, 4 Gas Injector (Bay K, Bay J Lwr, Bay J Up, Lwr Dome), 5 GIS Control (Armed, Steady)

GDC SHUTDOWN: 1 Probes (OFF), 2 Flow (STOPPED), 3 GIS Mode (PLASMA CONFIG) TIMED, 4 GDC Injector (OFF), 5 Ion Gauge (ON), 6 RGA (PLASMA CONFIG), 7 Filaments / Bias (ON), 8 Shutters / TIVs (PLASMA CONFIG), 9 GDC Complete

- * Enters:
 - Operating mode (lithium and operations or operations only)
 - Time period per SL or PO
 - Pressure (typically 2.5 mT)
 - Gas/injector (typically helium from injector #3 at Bay J mid-plane but may use #1 at the top of Bay K this run)
- * Ensures shutter configuration is correct
- * GDC runs and shuts down automatically
- * PLC cog may assist until interlocks and timing between GDC and LITER are developed
- * GDC time usually decreases with increased lithium use

Vacuum Tech Lithium Operations

GS55.adl

GS55 BAY F LITER-1 Probe Motion Control Shot 136452
20-JAN-10 09:33:18 Shot Time -140

GIS Directory AV258 Error! SMC Axis 'C' Detail
LITER 1 & 2 Status

1.04 Present Position (inch)
Stopped Axis in-motion Status

Bay F Top

HOME (1.04)
Ltr1 NOT Home

[15.00 - 15.33]
Ltr1 NOT Parked

Operating Mode Disabled Enable Disable

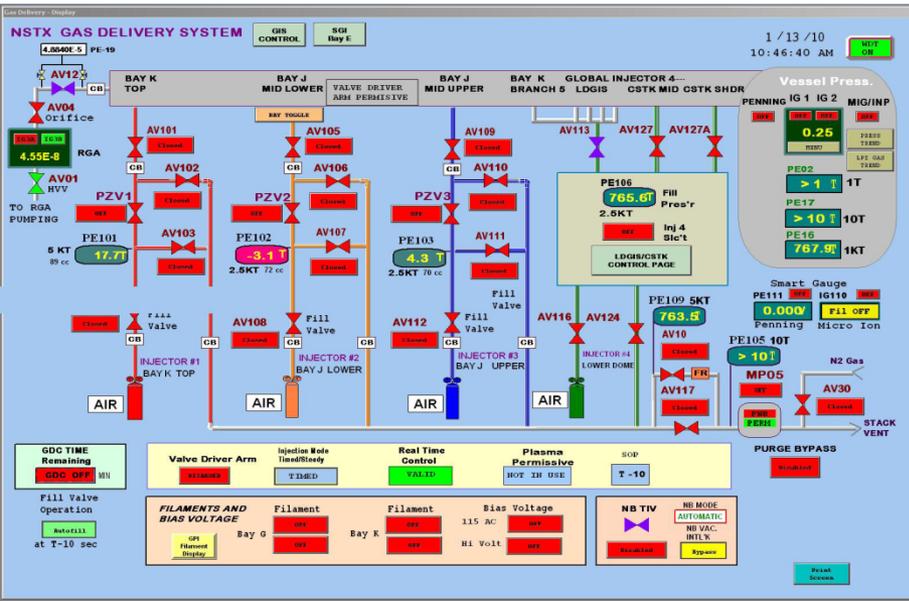
Auto Movement Configuration
PLC Control Mode Disabled Enable Disable
Parked Pos. 15.1 Operate Pos. 22.2
Position Request from PLC ToParked

Manual Control
Target Position (1-22.2) 15.10 Inhibit Move
Present Position 1.04 Stop
Presets Park Home
Operate SW E-Stop E-Stop Clear

Rev 8 19May2008 ps

- * Controls and monitors the operation of the two LITER probes from EPICS pages - Home, parked and operate
- * Co-ordinates GDC and LITER probe operation with lithium operator and COE to get requested between shot lithium and GDC

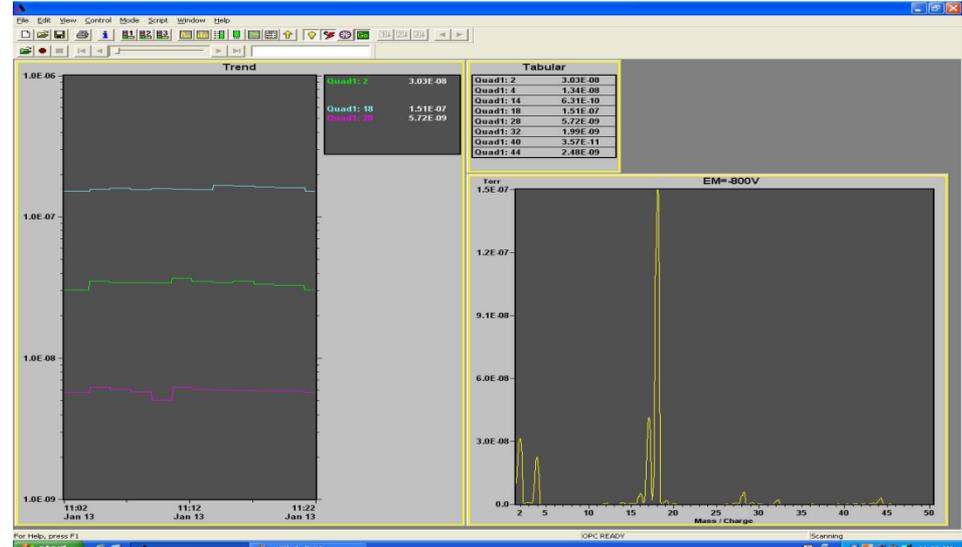
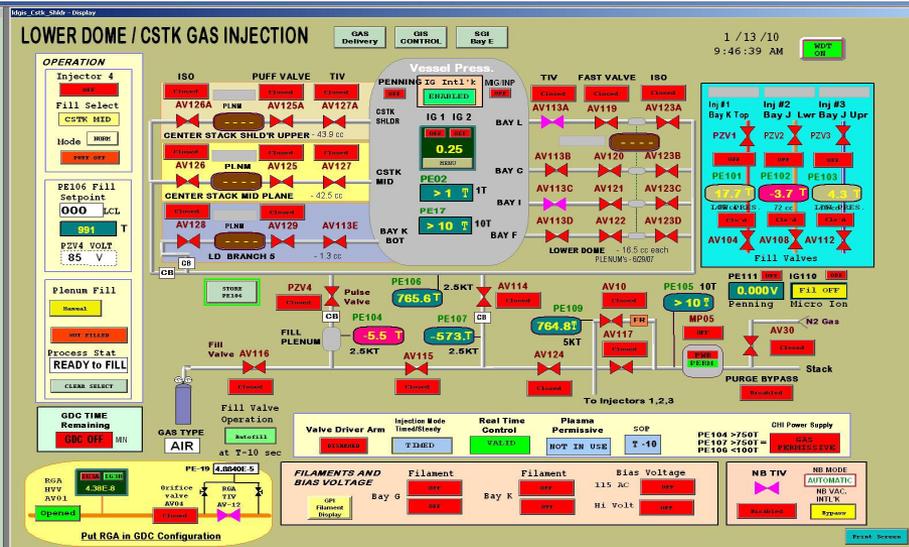
Vacuum Tech – Gas Injection



- * Fills high field side center stack injections systems (and lower dome injector if needed) to requested pressure per PO

- * Controls SGI (PLC and EPICS based) and other EPICS gas injection systems at request of cogs and with concurrence of SL

- * Monitors vacuum conditions



COE Panels



LHS panel status:

- Test cell status
- Loop status
- E-Stop status
- Permit to pressurize/vent the SLD
- Enable and arm permits to FCPC for configuring TF/PF/CHI line and ground SDSs
- Reset hardwired faults

RHS panel status:

- Provides final arm for FCPC/NB/RF(ECH) after systems are ready
- E-Stop alarm and acknowledge
- E-Stop button and resets
- Enable and arming permit for NB and RF to configure

COE Operations

The image displays four screenshots of COE control panels:

- PC02.adl:** Shows a grid of status indicators for various components (PF1AU through TF). Each component has 'OPEN' and 'CLOSE' buttons and status indicators (e.g., 'opened', 'closed').
- PC_RIS.adl:** Titled 'RIS/Halmar/GndFlt Page', it shows a table of status for components like TF, PF2L, OH, PF3U, and PF3L. It includes 'RIS I2T Value' and 'RIS I2T Status'.
- PC03.adl:** Titled 'PC03', it shows a similar grid of status indicators for components like PF1AU through TF, with 'All Closed' at the bottom.
- PC05.adl:** Titled 'NSTX HCS STATUS MONITOR', it shows a table of status for components like PS PERM, SDS PERM, LVL 1 FAULT, LVL 3 FAULT, LVL 4 FAULT, and AUX FAULT. It also includes a 'SPA' section with 'ACP SU1CUR1', 'ACP SU2CUR1', 'ACP SU2CUR2', 'ACP SU8CUR1', and 'ACP SU8CUR2'.

- * Monitors configuration of the FCPC SDS and ground switches.
- * Gives permissive to FCPC to make configuration changes by placing the switch on the COE panel to configure
- * Monitors fault conditions and resets faults when systems are satisfactory

COE Operations

- * Monitors ACP for faults and resets when satisfactory
- * Lower right corner is a summary page of the status of a various systems
- * Sets minimum clock cycle, (NB interlock 2.5 minutes) and starts clock when all systems and personnel are ready

ACP Monitor
 Shot # 186451
 Shot Time -140
 OH RepRate Limit **600** Sec.
 PC43 PC46

Module	OH	CONJECT	OH	FF15	FF15	FF15	FF15
STATE	NOT MATED	NOT MATED	LAUNCH LOAD				
B7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TF	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OH	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 2	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PF MOD 10	N/A	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
 1) LIGHTED ALARMS ARE ACTIVE.
 2) CONDITIONS IN GREEN COLOR PP/CH FAULTS
 3) CONDITIONS IN BLUE COLOR OH FAULTS
 4) CONDITIONS IN RED COLOR TP FAULTS
 5) CONDITIONS IN BLACK ARE FOR INFO ONLY.

Clock Control Page
 Shot # 136451
 Shot Time -140
 Load CAMAC
 Time since T(0) 9730 56
 Time to NB Sync -71
 Not_Waiting

Seconds
 SOC -140
 PSC -130
 TC(-60) -120
 PPC -10
 SPP -3.000
 TC(0) -1.0
 T(0) 0.0
 TC(+D) 0.00100
 T(0) 2.0
 R(0) 3.5
 EOC 310

SGI Probe not Retracted. See Total Cycle (poke selection)
 300 450 600
 750 900 1050

Mode HPP
 SingleShot
 ync_With_NI
 START STOP
 Single Shot Continuation
 Stop at EOC
 Continue at EOC

CAMAC Hardware Loaded
 Related Displays

NSTX Water System Alarms
 Shot # 136451
 Shot Time -140

Return Manifold Return Pressure **OK**
 Tank Level **OK**
 Conductivity **OK**

Temp. Switches **OK**
 PE3AU PE3CU PE3AU PE2AU PE1AU TE1A OH4X OH3X OH2X OH1X

PE/TE Supply Manifold (Low Press.)
 Supply Water Temp. **OK**
 LP Supply Press. **OK**
 Dew Point Trip **OK**
 Dew Point Alarm **OK**
 Dew Pt. Low/Failure (future)
 OH Supply Manifold (High Press.)
 HP Supply Press. **LOW**

Misc. Alarms
 FCPC Permissive **Inhibit Closed**
 Coll/CHI Pwr Sup GND Switch **VV Normal Grounded**
 CHI Mode **OK**
 Inner/Outer VV GND Status **114 Alarm**
 PLC Remote/24V loss **OK**
 PLC Counter Value **114 Alarm**
 Bakeout Alarm from PLC

PLC Commands
 Reset
 ModeChg
 Normal

COE Operations Page
 Shot # 136451
 Shot Time -140

Composite Status
 PC05 pcd41 WS03
 RIS pcd43 WS06
 WS pcd44
 spa1 spa2 spa3
 acp1 acp2 acp3

Rep Rate
 Total Cycle 450 sec
 ACP RepRate 600 sec
 RIS I2t Pot 93 %
 Ion Gauge Torr
 Water System
 Max OH Out 12 degC
 Interlk Sipt 17 degC
 MAX Temp
 Center Stack 29
 Outbd Divtrr 21
 Vac Vessel 19

ECH Monitor FW52
 Klystron Rack Pwr **Power Off**
 ECH Ctrl **OK**
 HIS Status **No E-Stop**
 ECH Mode **Power Off**
 ECH HV Intlk **Not Ready**
 ECH Crowbar **Armed**
 ECH VSWR/Arc Def Latch **Normal** **Clear**

GDC
 SET min
 LEFT min

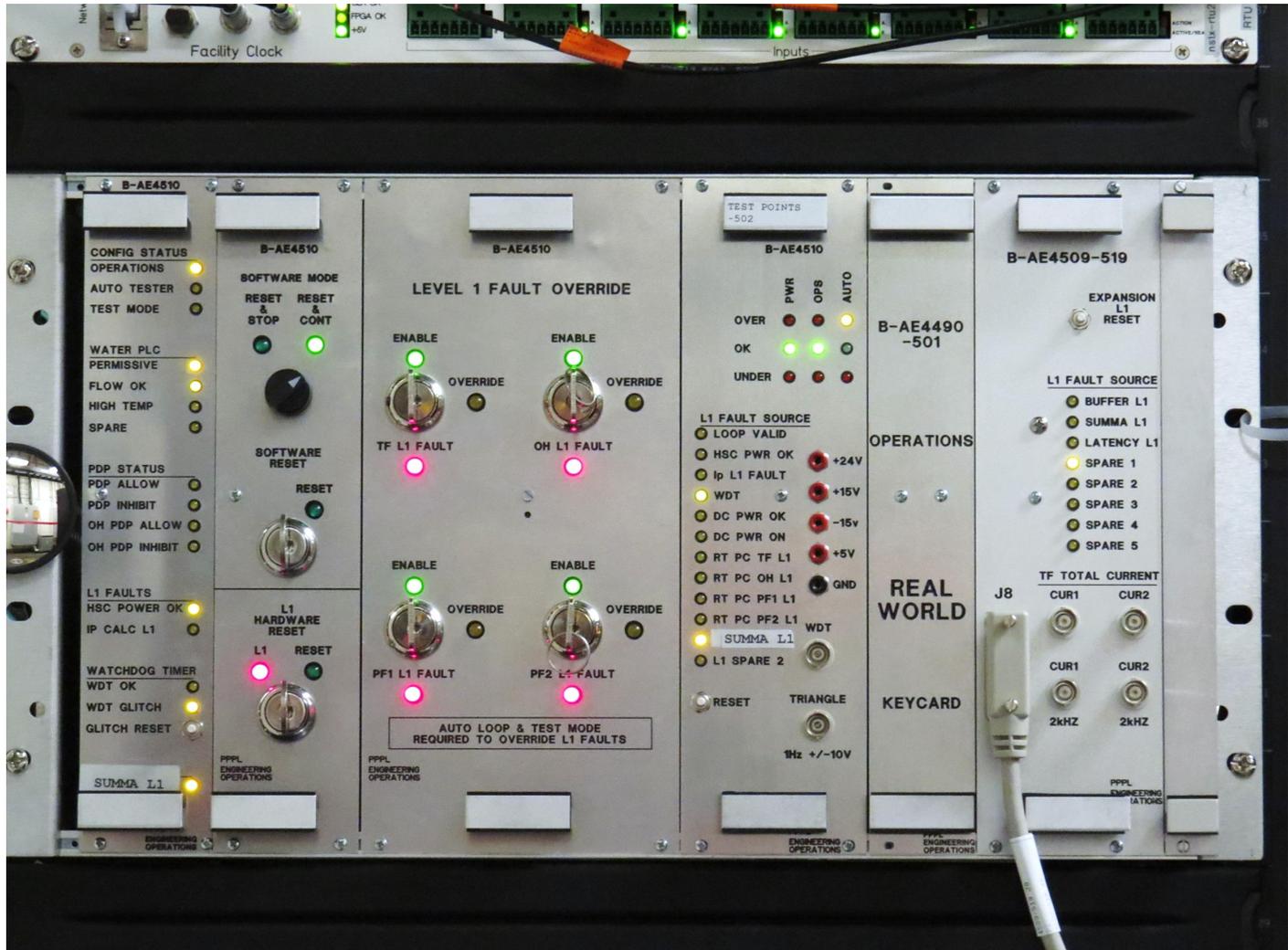
GFM

EPICS
 Top Menu CAMAC IOC PLC
 CE00 CH02 CH03 CH04

FCPC Perm **Inhibit**
 Coll/CHI GND **Closed**
 CHI Mode **VV Normal**
 In/Out VV GND **Grounded**

Legend
 XX good
 XX bad

DCPS



Controlled Access and Shutdown



Controlled Access

- FCPC, NB, RF, CHI shutdown and safed
- FCPC then vents the SLD
- Machine tech obtains the SPA kirk key from the transfer station on 2nd floor of FCPC
- Machine techs let personnel into the test cell once all systems are safed (HP may be first)
- Activity is monitored by machine techs and search and secure is performed before exiting the test cell and loop is set



Shutdown

- All systems safed (FCPC, MG, NB, RF and MPTS) and SLD vented
- Cool down LITER probes (couple of hours)
- Kirk keys back at test cell door
- Place test cell in Free Access (typically 10-15 minutes after last shot)

Conduct of Operations

- At the Controls Area
- Health Physics
- Stubborn COE
- Communications
- Emergencies and Off-normal Events