COE and Machine Operations

Ray Camp

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

Session Leader

Requests plasma configuration; lithium, GDC, gas injection, and NB/RF

Physics Operator

Sets up plasma config and gas injection (PCS)

GDC and gas injection configuration

Lithium Operator

Heating Request

lithium request

Ready

Requests coil change if req’d
PCS/NB ready

Vacuum Tech

Ready

COE

No hardware or software faults
Enters shot data
TF joints satisfactory
All systems ready
Start clock

GDC, probe status, shutters and lithium coordination
* 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
* One of four PLC controlled diagnostic shutter pages

* Can be operated manually or programmed for automatic actions in different modes of operation such as plasma operation, GDC and shutdown

* Diagnostic TIV page which is controlled in a similar manner as the shutters
Vacuum Tech Lithium Operations

* 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

- 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.
*Monitors ACP for faults and resets when satisfactory

*Lower right corner is a summary page of the status of various systems

*Sets minimum clock cycle, (NB interlock 2.5 minutes) and starts clock when all systems and personnel are ready
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 2\textsuperscript{nd} 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