NSTX-U Weekly Report (January 8, 2016)

FY 2016 NSTX plasma operations
Operation Targets: Total - TBD
Completed: 1.26 run week and 116 plasma shots

A press release has been published this week in Science Daily on the modeling of non-inductive ramp-up for NSTX-U by Francesca Poli (PPPL) and it can be accessed at the link http://www.sciencedaily.com/releases/2016/01/160105102214.htm.
The work highlighted in the release has been published recently in the Nuclear Fusion journal and shows the advantages of using electron cyclotron heating to increase the electron temperature and improve the absorption of High Harmonics Fast Waves (HHFW). (F. Poli)

R. Maingi, M. Jaworski, and R. Majeski of PPPL visited DIII-D and presented a series of liquid metals seminars. Maingi's talk was "Lithium and liquid metal studies at PPPL", Jaworski presented "NSTX-U upgrade plan for liquid-metal plasma facing components", and Majeski presented "Lithium walls and enhanced tokamak performance." The talks spurred substantial discussion and interest. (R. Maingi)

Run Coordination (J. Menard, S. Gerhardt)

A full bottle boronization was done on 1/4/2016. Data was also collected via XMP108 (TMB sequencing in support of XP1505 , Skinner et al) regarding coating thicknesses at various places in the machine via quartz microbalances. MAPP XPS measurements of surface composition showed the first indications of carbon migration and boron oxidation.

Significant progress was made on XMP101 (Breakdown Optimization, Battaglia, et al) on 1/5/2016 and 1/6/2016. A stable and reproducible breakdown and current ramp scenario with an OH pre-charge of 8 kA has been developed. A 20 kA pre-charge scenario, capable of ultimately producing longer plasma pulses, has also been developed, through more tuning is required. This 8 kA scenario was used to support most subsequent

Significant progress was also made on XMP126 (Ip and R control, Muller et al) and XMP105 (Vertical Control Checkout, Boyer et al) on 1/6/2016 and 1/8/2016. Stable innerwall discharges with plasma currents of 500 kA were developed, with good plasma current and radial position control. These discharges were then elongated, and vertical control optimization started, using neutral beam heating on the second day. Different configuration of the vertical position observer were tested, as were different values of the vertical position control gains. Divertor coils were also used for the first time on 1/8/2016, resulting in further elongating of the plasma crosss ection. In general, vertical control proved challenging in these L-mode plasmas, and will continue to be a the focus of attention.

A few discharges were also taken towards XMP132 (Automatic Discharge Shutdown Commissioning, Gerhardt, et al) on Jan 6th. These commissioned the newly written PCS automatic disruption detector algorithm; loss of OH control (hitting the set limit), loss of vertical control and loss of plasma current control were demonstrated to initiate a termination of the plasma discharge. Changes were successfully triggered in the plasma current controller, the plasma shape controller, and the vertical position controller.

Following the successful execution of an NBI operation procedure OP-NSTX-22 on 1/6/2016, XMP127 (Neutral Beam Checkout, Boyer, et al) was started on 1/7/2016. Individual shots with each of sources 1a, 1b, 1c, and 2c were taken, qualifying these for sources for subsequent plasma operations. This XMP will be revisited when sources 2a and 2b are ready for injection to the plasma. This XMP also demonstrated automatic shutoff of the neutral beams from PCS when an imminent disruption was detected.

With XMP127 finished, discharges were taken for XMP107 (Neutron Calibration Transfer, Darrow, et al). These were the first NSTX-U shots taken with full deuterium plasma fuelling; all previous discharges had helium fuelling during the plasma pulse. A number of good 1 and 2 source discharges were taken, providing initial data used to transfer the neutron calibration from count mode to current mode.

Finally, on Jan. 8, four additional magnetics calibration shots were run under XMP106 (Magnetics Calibrations, Myers et al).

Engineering Operations (A. von Halle, P. Titus)

NSTX-U plasma operations resumed this week after the first vacuum vessel boronization using the new deuterated trimethylboron (dTMB) injection system on Monday January 4th, 2016. Several Experimental Machine Proposals (XMP's) have since been performed to evaluate machine performance after boronization, and have been successful in improving plasma elongation and vertical control as well as optimizing OH pre-charge. Four of the neutral beam ion sources were qualified for experimental use with injections into in-vessel armor, and neutral beams were subsequently injected into NSTX-U plasmas for the first time since the upgrade. NSTX-U switched from helium to deuterium fueling to perform a calibration of neutron production during beam injection. The Plasma Control System (PCS) successfully demonstrated controlled plasma ramp-down for losses of plasma position control as well as the ability to turn-off the neutral beams. The PF1A coils were also used this week for diverted plasma operation, and the fast magnetics are recording a variety of MHD modes. While vacuum conditioning HHFW antennas, an electrical fault in RF Power Supply #5 damaged the Nichrome resistor assemblies of the crowbar circuit. The cause of the fault is being investigated, and repairs are being made. All six RF sources will remain off-line until work is complete. Also this week, a peer review of design concepts for the proposed new inner diverter tile thermal insulation was held.

The NSTX-U Test Cell will be in restricted access this coming week during plasma operations. Access will be available during the evening shifts for approved work.