

NSTX-U Weekly Report (June 24, 2016)

FY 2016 NSTX plasma operations

Operation Targets: Total – 18 run weeks

Completed: 9.66 run weeks and 1016 plasma shots

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

NSTX-U plasma operations resumed this past week after completing a prescribed set of combined field test shots and inspections as a final verification of the PF coil lead supports. Operations this week included experiments on plasma inner gap control, H-mode access and diverted shape control utilizing neutral beam injection, and error field correction utilizing the Resistive Wall Mode (RWM) coils driven by the Switching Power Amplifier (SPA) system. All six neutral beam ion sources were conditioned at an average 90kV. Protective relaying upgrades to the upstream switchgear of the RF sources has been completed, and all six RF sources are operational. Vacuum conditioning of the High Harmonic Fast Wave (HHFW) antennas has resumed. Lithium evaporator (LITER) probes have been relocated such that the F2 & K2 probes are now mounted on the Fill Stand to undergo lithium testing/prep for filling, and the F1 & K1 probes are on the vessel for pre-operational testing. Arrangements are being made to vacuum bake the probes this weekend. Also this week, Laser alignments of the Diagnostic Neutral Beam were performed, as well as a neon glow for diagnostic calibrations. Data was collected from the recently installed FISO outer leg bending strain gauges. Two sets of three legs were monitored. In each group a new leg and two old legs were selected. The stable signals yielded strains with magnitudes consistent with predictions. There some erratic signals which are being investigated by swapping connections to the signal conditioner. The strain gauge measurements are part of efforts to build confidence that the new and old outer legs are acceptable for increased toroidal field.

The NSTX-U Test cell will be in restricted access this coming week during plasma operations. Limited access is expected to be available for approved work on second shift.

Run Coordination (J. Menard, S. Gerhardt)

A series of magnet-only test shots were taken on 6/20/2016, in order to assess coil motion using the newly deployed web-cam system. Some small motion on the PF-2L flexible bus cables and RWM cables were observed, and these were remedied on the subsequent morning. A large part of the afternoon was spent at the PPPL Safety Forum

On Tuesday 6/21/2016, the remaining coil-only test shots were taken, followed by a controlled access for a final round of coil and bus inspections. The latter part of the day was spent finishing XMP-154 (Inner Gap Control Checkout). In this XMP, the gains and weights used in the new algorithm for controlling the gap between the plasma and center stack were tuned. Control of diverting time, tracking of different inner gap targets, and actively limiting the plasma late in a shot were demonstrated.

The morning of 6/22/2016 was dedicated to XMP-153 (Control development for early H-mode access). The first task was to integrate inner gap control into the H-mode scenario. This control tool made progress in maintaining a diverted shape that is independent of the timing of

the LH transition. Neutral beams were in great shape and provided routine injection with three beams at about 2MW each. Routine H-mode access was achieved, however an issue was identified in controlling drsep at the time of diverting, which is important for H-mode access.

Following these activities, shots were taken towards XMP-141 (Early ramp-up error field correction, C. Myers). During this XMP, pre-programmed error field correction was turned on very early in the discharge (5-10 ms) at various phases and amplitudes. Interesting asymmetries in the core rotation and the density were observed, indicating that the required error field correction early in the discharge may differ from the required flattop error field correction as established by XP-1506. Additional discharges to explore this trend are planned.

Wednesday 6/23/2016 was dedicated to continuing XMP-141 (Early ramp-up error field correction, C. Myers). Three additional error field correction scans were conducted. First, the core rotation asymmetry observed on 6/22 was reestablished, further supporting the hypothesis that the required ramp-up error field correction differs from the required flattop error field correction. Second, in order to investigate the possible role of the OH coil in producing the error fields, the core rotation asymmetry scan was repeated at a different OH pre-charge (8 kA vs. 20 kA). A similar (but possibly weaker) asymmetry was observed in the core rotation during this second scan. Finally, a traditional ramping-current compass scan was conducted in the 8 kA OH pre-charge scenario. This compass scan produced an inferred flattop error field that is very similar in amplitude and phase to the flattop error field determined by previous compass scans conducted in the 20 kA scenario. This result indicates that the OH coil is not likely to be the source of the flattop error field, and that further experiments are required to identify the error field source.

A Ne glow discharge session was run the evening of 6/23/2016, to calibrate the CHERS diagnostic.

About two hours was spent toward XMP-153 (Improved control for H-mode access) on Friday 6/24/2016. A few tasks were completed to establish a DN shape at the time of diverting. The issue appears to be associated with starting X-point control with finite current in the PF2 divertor coils. The cause of this behavior of the control system is under investigation, but a scenario was established where the discharge diverted into the requested DN shape.

An initial set of nine shots was then taken on Friday 6/24/2016 for XMP-114, "CHERS analysis with modulated NBI". A good set of data has been obtained for the first step of the XMP, requiring scenarios with 1 source modulated from NB line #1 and with combinations of 2 sources from NB line #1 (one modulated and the other one steady ON). The next steps in the XMP requires more reliable operation of sources from NB line #2, including modulation.

Experimental Plasma Operations (S. Gerhardt, R. Kaita)

John Caughman and Cornwall Lau from ORNL visited NSTX-U this week. They performed diagnostic tests on the microwave electronics for the SOL reflectometer. The system is ready to acquire raw data. They also participated in HHFW vacuum conditioning. (R. Perkins, PPPL)

Work continues to prepare the MSE-LIF system for operation. Beam-into-gas calibrations of the diagnostic neutral beam were performed, and spectra were obtained and analyzed for the 10

planned sightlines. Doppler shift measurements estimated from the spectra were used to do interference filter selections for the detector assemblies, and optical assemblies for detectors were completed. Data acquisition hardware and a test APD were installed in the NSTX-U mezzanine. Testing and shakedown of software and hardware for the data acquisition is ongoing. The MSE-LIF laser system has also been successfully aligned through the diagnostic neutral beam acceleration grids and onto the beam dump. (Y. Sechrest, Nova Photonics)