NSTX-U Weekly Report (August 14, 2015)

NSTX-U is in the Upgrade Project outage in FY 2015

After the completion of an integrated systems test procedure (ISTP), on August 10, 2015, in shot 201085 NSTX-U achieved a 100kA test plasma satisfying the CD-4 key performance parameters (KPP) threshold of 50kA necessary for completion of the NSTX Upgrade Project. We also have preliminary EFIT equilibrium reconstructions that confirm the plasma current and plasma shape consistent with the camera images. This achieves an important first step toward resuming research operations and using the new capabilities of NSTX-U. We want to say a profound 'thank you' to all the engineering, technical, project management, operations, research, FES, PSO, and other staff members who helped achieve this important milestone. The dedication, hard word, and sacrifice of the NSTX-Upgrade team during the design, analysis, fabrication, assembly and testing has led up to this occasion. It took over 250 people, 574,000 hours, over the last 5+ years to bring this project to bring the construction project to this culminating achievement! (J. Menard, M. Ono, and R. Strykowsky, PPPL)

The NSTX-U Team Meeting was held on August 14, 2015 at PPPL. The NSTX-U team was updated on the ISTP and CD-4 KPP plasma operations. An updated schedule toward research operation and the research program plan were also discussed. The meeting material is available on the web at: http://nstx.pppl.gov/DragNDrop/NSTX_Meetings/Team_Meetings/2015/2015-08/ (M. Ono, J. Menard, PPPL)

The paper “Midplane Neutral Density Profiles in the National Spherical Torus Experiment” by D. P. Stotler (PPPL) et al. was published in Phys. Plasmas 22, 082506 (2015). Atomic and density data in the outer midplane of NSTX are inferred from tangential camera data via a forward modeling procedure using the DEGAS 2 Monte Carlo neutral transport code. Simulations of 12 time slices in 7 NSTX discharges produce molecular densities near the vacuum vessel wall of 2 to 8.e17 m^-3 and atomic densities ranging from 1 to 7.e16 m^-3; neither has a clear correlation with other parameters. The sensitivity of the simulated camera image and neutral densities to uncertainties in the data input to the model as assessed. The simulated camera image is sensitive to the plasma profiles and virtually nothing else. The neutral densities at the vessel wall depend most strongly on the spatial distribution of the source; simulations with a localized neutral source yield densities within a factor of two of the baseline, uniform source, case. The uncertainties in the neutral densities associated with other model inputs and assumptions are < 50%. (D. Stotler)

Run Coordination (J. Menard, S. Gerhardt)

The following two experimental machine proposals (XMPs) were successfully carried out this week (D. Battaglia, PPPL):

XMP-100 “Demonstration Plasma for CD4” was completed on Monday, August 10. This XMP demonstrated plasma operation on NSTX-U and satisfied the CD-4 KPP milestone of achieving a plasma discharge with a plasma current greater than 50 kA. In total, eleven plasma attempts were made, with the maximum plasma current increasing with each discharge. The final discharge of the day achieved a maximum plasma current of 109 kA in about 25ms. Magnetic equilibrium reconstructions using the upgraded magnetic measurements were in excellent

agreement with camera images of the plasma boundary and the vacuum compensated plasma current measurement.

XMP-131 "Increase the CD-4 Plasma Current" was run in the two days following XMP-100. Sixteen plasma shots were taken with the maximum plasma current improving to 140kA and the duration of the discharge increasing to 45ms. The XMP improved the vertical centering of the plasma at breakdown, the growth of the plasma following breakdown, and documented the impact of gas fueling on the initial plasma current ramp rate. Initial spectroscopy measurements indicated that carbon and oxygen were the dominate impurities, with very little nitrogen. This is expected with a good vacuum quality and unbaked carbon first-wall tiles.

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

Fast camera imaging of CD-4 plasma was supported by Filippo Scotti (LLNL). He set up and operated two fast cameras that imaged the upper divertor region and the entire plasma ("Plasma TV"). Color camera images showed evidence of lithium and carbon emission in the plasmas, and a significant amount of dust particles.
https://drive.google.com/open?id=0B8cMCtGehn7mfktScVVMc0UtQ0tOVlotMWlBeTVUS1lhbFJ4LXVteVJEV1E5eTVvVUlWNGM. (V. Soukhanovskii, LLNL)

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

The NSTX-U CD-4 Plasma was achieved on Monday, August 10th with 100kA discharge. A machine proposal, XMP-131, to adjust the up/down bias on the plasma via the PF3 coils was then performed, successfully increasing the plasma current to 140kA. Phase 2 of coil integrated system testing has now started with initial 500A test shots on PF-2U/L, PF-1aU/L, and PF-4. Coil Protection Test Trips are now being performed per the Integrated System Pest Procedure (ISTP-001). Coil polarity /magnetic diagnostic continue in parallel with the ISTP. Preparations of the Multi-Pulse Thompson Scattering (MPTS) diagnostic Lasers for the upcoming Rayleigh/Raman scattering calibration also continued this week.

Access to the NSTX-U Test Cell is expected to be available this coming week. Access must be arranged through Work Permits approved by the D-Site Shift Supervisors.