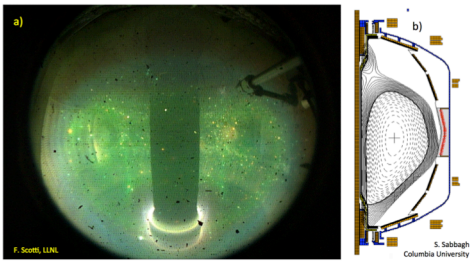
NSTX-U Facility and Project Plans

S. P. Gerhardt[1], J. Menard[1], M. Ono[1], and the NSTX-U Engineering, Operations and Research Teams

[1]*Princeton Plasma Physics Laboratory, PO Box 451, Plainsboro, USA*
Lead-author e-mail: sgerhard@pppl.gov

The construction of NSTX-Upgrade has concluded, and the final preparations for research operations are underway. This upgrade to the NSTX facility was motivated by the desire to study plasmas with significantly lower collisionality, very high non-inductive current fraction, and high divertor power fluxes with innovative divertor geometries, among other goals. In order to achieve these aims, the central magnet assembly has been replaced with coils sufficient to provide 1 T toroidal field (0.55 T on NSTX), plasma currents up to 2 MA, and more flexible divertor geometry. Additionally, a 2nd neutral beam system, containing three neutral beam sources and capable of injecting up to 7.8 MW of total power at 100 keV, has been installed. This neutral beam system has significantly larger tangency radius than the otherwise identical 1st beamline, providing larger neutral beam current drive for non-inductive sustainment. Significant steps in these engineering projects will be described in this talk.

The completion of the neutral beam upgrade was demonstrated by the successful operation of a neutral beam source at 45 kV on 5/11/2015. Completion of the center-stack upgrade project was demonstrated by the generation of approximately 100 kA of plasma current on 8/10/2015. Plasma currents up to 140 kA were achieved in subsequent operations; note that a full vacuum-vessel bakeout was not performed for these first plasmas. Highlights of these operations will be described, including first lessons learned about the operation of the new facility.



a) Image and b) poloidal flux plot for 120 kA plasma from NSTX-Upgrade.

The NSTX-U team is now transitioning to completing preparation for research operations. This involved a final round of coil testing, diagnostic calibrations, and vessel bakeout, culminating in an operations restart in early October. A detailed sequence of experiments has been developed to bring on the full capabilities of the facility. These commissioning steps, as well as diagnostics upgrades and first plasma results, with be described.

In the longer term, significant additions to the NSTX-U facility are envisioned. The long term facility plan calls for converting all PFCs to high-Z materials. As a first step, the tiles on the horizontal divertor targets will be replaced with TZM molybdenum after the first run campaign. In later years, a 28 GHz gyrotron is planned in order to provide electron heating during the start-up phase, furthering the goals of fully non-inductive current ramp up. A lower divertor cryo-pump is under design, to provide density control for long-pulse scenarios. Finally, a set of in-vessel off-midplane 3D field coils is being designed. This will dramatically expand the capabilities of NSTX-U for RWM control and RMP & NTV studies. The motivation and status of these facility upgrades will be described.