

NSTX-U Weekly Report (July 20, 2012)

NSTX-U is in the Upgrade Project outage in FY 2012

The paper “Overview of the physics and engineering design of NSTX upgrade” has been published by J. Menard (PPPL), et al. in Nuclear Fusion **52**, 083015 (2012). The paper describes scoping studies for a range of ST energy confinement assumptions that have been performed for NSTX Upgrade with a goal of determining the performance requirements to achieve a factor of 3–6 reduction in collisionality, support tests of 100% non-inductive current ramp-up and sustainment, and assess confinement, stability, and heat-flux scaling and mitigation at increased magnetic field and plasma current while also providing sufficient flat-top duration for profile equilibration. The scoping studies indicate that a factor of two increase in plasma current, toroidal field, and NBI auxiliary heating power, a factor of three increase in ohmic solenoid flux, and a quintupling of the flat-top duration are sufficient to achieve the Upgrade goals. These performance objectives can be achieved with the combination of a new centerstack and a second more tangentially injecting NBI. Systematic free-boundary equilibrium calculations have been performed to assess the PF coil current requirements to support the higher plasma current and access to high beta, and substantial engineering analysis and design has been performed for the structural reinforcements needed to handle the increased electromagnetic loads. In addition to the ex-vessel structural enhancements, the new centerstack incorporates numerous design improvements. The more tangential NBI requires a significant modification to the NSTX vacuum vessel through the addition of a radially offset port cap and also requires considerable test-cell floor space and relocation of equipment. The paper is downloadable from: <http://iopscience.iop.org/0029-5515/52/8/083015/> (J. Menard)

A scoping study of SOL heat transport, divertor radiation, and pedestal profiles in the snowflake divertor configuration was performed at the DIII-D tokamak. Vlad Soukhanovskii (LLNL) traveled to General Atomics, where in collaboration with Egemen Kolemen (PPPL) and colleagues from LLNL and GA he carried out a half-day experiment. Asymmetric snowflake-minus and snowflake-plus configurations were obtained and maintained for up to 3 s using the previously developed scenario, and the shape was optimized for divertor and pedestal profile measurements. High core confinement was maintained in the snowflake divertor discharges. Divertor infrared thermography showed a significant reduction of the peak divertor heat flux in the snowflake phase (with respect to the standard divertor configuration). Divertor imaging and spectroscopic diagnostics indicated that the divertor strike points remained attached during the snowflake phase. A density scan was performed to study the detachment threshold, MARFE formation, and impact of cryo-pumping on the snowflake divertor configuration. Pedestal profiles were documented and will be analyzed in detail. (V. Soukhanovskii)

Engineering Operations (A. von Halle, C. Neumeyer)

NSTX Upgrade construction activities continued this week with the removal of an outer TF coil with a known water leak, and the replacement with a sound coil. The planned cutting of the NSTX vessel to install the bay J-K cap and port extension for the 2nd neutral beam has been put on hold to address non-conformances in the fabrication of that cap and extension. The assemblies have been deemed usable pending some PPPL rework of those parts, which is now in progress. Additional welding on the cap and extension is expected to take 1-2 weeks, but vessel

cutting will be able to proceed as soon as initial measurements and trial fit-ups have been performed. Field preparations and installation of cutting shields for the removal of the umbrella legs has been completed. First cuts for the installation of temporary vessel supports have been completed. The coil fabrication facility has completed the insulation taping of the fourth inner TF conductor. On neutral beams, the lift fixture for the second beam-line was installed, and a lift of that box to remove the TFTR legs was successfully performed. Water lines are being welded in place on the calorimeter for that beam-line.

Access to the NSTX test cell will be available only through previous arrangement with the Upgrade Work Control Center.