

NSTX Weekly Report (August 13, 2010)

FY 2010 NSTX plasma operations

Planned: Total - 15 run weeks (Base - 14 run weeks, ARRA - 1 run week)

Total completed – 8.44 run weeks and 1567 plasma shots

Completed: Base – 7.43 run weeks and 1396 plasma shots

Completed: ARRA -1.01run week and 171 plasma shots

The paper "Triggered confinement enhancement and pedestal expansion in high confinement mode discharges in the National Spherical Torus Experiment" by R. Maingi, et. al., was accepted for publication in Physical Review Letters. The paper reports observation of a new high performance regime in discharges in the National Spherical Torus Experiment, where the H-mode edge 'pedestal' temperature doubles and the energy confinement increases by 50%. The spontaneous transition is triggered by a large edge-localized mode, either natural or externally triggered by 3-D fields. The transport barrier grows inward from the edge, with a doubling of both the pedestal pressure width and the spatial extent of steep radial electric field shear. The dynamics suggest that 3-D fields could be applied to reduce edge transport in fusion devices." (R. Maingi, ORNL)

Run Coordination (E. Fredrickson, S. Sabbagh - Columbia University)

Monday 8/9/10: After a delayed start due to some issues with Lithium Evaporator (LITER) operation, XP1059 Liquid Lithium Divertor (LLD) Commissioning (Kugel) started at about 2pm. The goal was to produce steady, Edge Localized Mode (ELM)-free plasmas with the outer strike point 65 – 68 cm. By 5 pm, target plasmas were achieved with relatively long pulse, and sufficient confinement to allow NBI to be dropped to 3MW.

Tuesday 8/10/10: This run of XP1059 LLD commissioning (Kugel) aimed to understand operation of the LLD after loading with a significant amount of lithium compared to its nominal capacity. Greater control of discharge reproducibility and duration occurred after additional lithium deposition by the LITER system was stopped, and plasmas were operated with LLD heaters off. LLD bulk temperature remained 160-180°C sustained by plasma heating of the LLD. The characteristics of the low triangularity target plasma of XP1059 were compared to standard high triangularity plasmas.

Wednesday 8/11/10: XP1059 LLD commissioning (Kugel) was completed. Relatively ELM-free operation was re-established with the outer strike point at $R = 68\text{cm}$. High triangularity fiducial plasmas were then run to determine if pumping effects were still observed. Over 35 H-mode plasmas were run up to this point without additional lithium deposition and no He glow – a new, favorable result attributable to lithium loading of the LLD. XP1001 LLD pumping (Soukhanovskii) continued after XP1059. As this XP started, a macroscopic piece of lithium was observed on the lower inner divertor plate, which led to short pulse duration, insufficient for the XP to meet objectives.

Thursday 8/12/10: XMP64 (Mueller) was run to eliminate the lithium deposit on the inner divertor that was hampering normal operation. The inner divertor was conditioned significantly, allowing operation of both low and high triangularity target plasmas. XP1059 LLD commissioning (Kugel) followed, with the objective of placing the outer strike point on the LLD and reevaluating conditions. With no additional lithium deposition after approximately 100 shots, an increase in plasma density was observed. However, the increase was sufficiently small that a reduction in gas fueling was sufficient to counteract it.

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

NSTX plasma operations continued this past week on a set of experiments intended to characterize the pumping and recycling characteristics of the Liquid Lithium Divertor (LLD) and the surrounding lower divertor surfaces. An extended period of lithium evaporation had been performed over the previous weekend to provide the needed lithium inventory on the LLD plates. Vacuum conditioning of the HHFW antennas was performed in the off-shifts.

Access to the NSTX test cell will be restricted during plasma operations this coming week. Access is expected to be available each evening.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

- Liquid Lithium Dvertor (LLD)
 - The LLD was resistively heated to 220°C to support XP1059, and then operated in the unheated, plasma auto-heated mode to support XP1059, and XP1001.
- Lithium Evaporators (LITER)
 - The LITER-F1 unit was refilled with 87 g of lithium, and the LITER-K2 unit was refilled with 80.7 g of lithium.
 - The High Bay, LITER Fill Stands were outfitted with larger pumping ports, and a pumpcart with a Residual Gas Analyzer (RGA) for monitoring outgassing components during bakeout.
- Lithium Powder Droppers
 - The pump down of the two installed Droppers is in progress.

Diagnostic Operations (R. Kaita)

R. Kaita visited the Department of Physics and Astronomy at the Johns Hopkins University. He discussed ideas for new diagnostics with members of the Plasma Spectroscopy Group. They have been performing soft X-ray measurements on NSTX since the earliest days of the project.