NSTX Weekly Report (Apr. 9, 2010)

FY 2010 NSTX plasma operations
Planned: Total - 15 run weeks (Base - 14 run weeks, ARRA - 1 run week)
Completed: Base - 0.52 run week and 77 plasma shots
Completed: ARRA - 0.61run week and 105 plasma shots

The second quarter target for the FY2010 multi-facility Joint Research Target on scrape-off layer heat transport was achieved, as documented in the quarterly report (in collaboration with C-Mod and DIII-D staff) delivered to the DoE. In NSTX, preparation for operation with the newly installed liquid lithium divertor (LLD) tray continued, with first plasma in the FY achieved just before the end of the quarter. Much of the activity in the quarter focused on refinement of the past data analysis of the dependence of heat flux widths on flux expansion, heating power, and plasma current, as well as preliminary analysis of heat flux control with a "snowflake" divertor configuration. These results will be documented in articles at the 2010 PSI conference in May. (R. Maingi. ORNL)

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

The start-up Experimental Machine Proposal (XMP) continued Thursday through 1:00 pm Friday, April 2, 2010. The initial start of plasma operations had gone very well, and this last day and a half were to make improvements in plasma control for low triangularity plasmas needed in the first experiment planned for the 2010 campaign. By 1:00 pm Friday acceptable target plasmas for Experimental Proposal 1000 (XP1000) (800ms duration, >150kJ stored energy) were being produced.

XP1000, “Liquid Lithium Divertor Characterization”, began Friday afternoon and continued through Wednesday, April 7, 2010. First, the LLD, lithium-free, IR emissivity was measured by comparing signals from the Fast 2-Color IR camera, and Slow IR camera systems against the LLD thermocouples as the LLD temperature was raised from room temp to 220°C. Simultaneously, the LLD visible reflectivity was measured using the Phantom fast cameras. Then lithium depositions on the LLD with its temperature ranging from room temperature to 220°C were started using the LITER system at rates 20-40mg/min. When the LLD was heated above the lithium melting temperature (180°C), the outgassing of D increased significantly suggesting the effect of fuel and impurity accumulation from previous operations and the need for additional conditioning procedures. After the lithium deposition, reproducible, ELM-free H-mode discharges were obtained with outer strike points at major radii of R=0.35m (near center stack), R=0.50m (mid inner divertor) and R=0.63m (the outer divertor tile ring just inboard of the LLD and outboard of the CHI gap) during the current flattop. These ELM-free conditions were obtained using improvements in the outer strike point control algorithms, optimizing fueling in the early discharge, and reducing NB power as lithium deposition increased. LLD characteristics at temperatures up to 320°C were measured at these radii. Although slight reductions were observed in the central and edge densities, no significant net increase in pumping due to the LLD elevated temperatures of up to 320°C was observed, with strike points out to R=0.63m and the initial LLD surface conditions. These ELM-free discharges, however, exhibited noteworthy energy confinement times of up to 100 ms and reduced flux consumption early in these discharges. The effects of gettered surface impurities, and increasing the rate and

total lithium deposition on the LLD continued under investigation.

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

NSTX experimental operations continued this past week with lithium evaporation via the two LITER probes, Liquid Lithium Divertor (LLD) operation to 320°C, neutral beam injection, and TF fields to 5kG in support of the LLD characterization experiment. RGA data, scans of fueling and plasma strike point control, and various LLD plate temperatures were used in an ongoing effort to determine the pumping effectiveness of the LLD. Two new LITER probes have been filled with lithium and are being prepared to be switched into place on the NSTX vessel over the weekend.

Access to the NSTX test cell will be restricted during plasma operations this coming week. Access will be available after 5PM each evening.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

• Liquid Lithium Divertor (LLD)
- LLD plates were operated in the heated and unheated modes in support of XP1000.

• Lithium Evaporators (LITERs)
- LITER units F1 and K1 were used to deposit lithium on the LLD in support of XP1000.
- LITER units F2 and K2 were completed, delivered to the loading area, and loaded with 91g and 95g of lithium, respectively.

• LLD Diagnostics
- The Phantom cameras for visible wavelengths were operated in support of XP1000.
- Preparations were in progress to install fiberoptics for the divertor spectroscopy system.

Diagnostic Operations (R. Kaita)

• The Johns Hopkins University (JHU) Transmission Grating Spectrometer (TGS) is operational and routinely taking data for determining impurity behavior. The JHU Ultrasoft X-Ray (USXR) mid-plane arrays have been upgraded with extra diodes to provide 16 channels each. The arrays are operational with improved spatial resolution near the plasma edge.

• The XEUS short wavelength spectrometer from the Lawrence Livermore National Laboratory has begun measuring time-resolved, high resolution spectra of metallic impurities during NSTX discharges.