

NSTX Weekly Report (October 8, 2010)

FY 2011 NSTX plasma operations started on October 4, 2010

Planned Run Weeks: TBD

Run Weeks Completed: 0.63 run weeks and 124 plasma shots

- The 4th quarter and final report for the FY 2010 Joint Research Target on Scrape-off layer (SOL) thermal transport was submitted to the Department of Energy. Each facility contributed an experimental section, and several appendices on modeling and draft papers were also included. A common experimental observation across the three facilities was that the divertor heat flux contracted with increasing plasma current, with the weakest dependence in EDA H-mode in C-Mod, and the strongest in ELMy H-mode in NSTX. In addition, there was no strong dependence of the heat flux width on toroidal field or loss power into the scrape-off layer, provided the SOL plasma is in the high recycling or sheath limited heat transport regimes. The need to understand the I_p dependence was highlighted for improved projections to ITER. (R. Maingi, ORNL)

- Members of the NSTX team attended the 26th Symposium on Fusion Technology (SOFT) in Oporto, Portugal on September 27 – October 1, 2010. L. Roquemore made a contributed presentation entitled “Techniques for Injection of pre-characterized dust into the scrape off layer of fusion plasmas.” D. Mansfield gave an invited talk entitled “Fifteen Years of Lithium Conditioning on Fusion Devices: an Overview” at the Satellite Meeting on Liquid Metal Application on Fusion Science. R. Kaita also attended the conference and discussed plans with organizers of the “2nd International Workshop on Lithium Applications for Fusion Devices” to be held at PPPL next spring. (R. Kaita)

- A paper "Quiet periods in edge turbulence preceding the L-H transition in NSTX", by S.J. Zweben, R.J. Maqueda et al, has been published in Physics of Plasmas **17**, 102502 (2010). This paper describes the discovery of transient quiet periods in the edge turbulence in NSTX, which correlated with local reversals in the direction of the poloidal turbulence flow and flow shear. The observed quiet period frequency of ~ 3 kHz was roughly consistent with an evaluation of the GAM frequency for NSTX and with a calculation of the zonal flow frequency in NSTX by the Lodestar SOLT code. Although new to NSTX, these results are generally consistent with recent experiments and theory concerning the zonal-flow-drift-wave interaction in tokamaks. (S. J. Zweben)

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

Monday, Oct. 4, we had a brief delay in startup, and then started Vlad Soukhanovskii's XP1050. In XP 1050 “Radiative divertor with impurity seeding and lithium pumping”, divertor heat flux reduction and detachment with injection of deuterated methane into the divertor were studied for the first time in NSTX. The experiment provided initial explorations for radiative divertor scenarios for the NSTX- Upgrade. Deuterated methane was injected in 0.9 MA, 4 MW high-triangularity lower single null H-mode discharges with grad-B drift directed toward the lower X-point. Signs of the outer strike point partial detachment (i.e., heat flux reduction, increased recombination, decrease of ion flux) appeared in several steady-state H-mode discharges. Carbon divertor emission was increased by up to 50 %, while core carbon density did not significantly increase with gas seeding. In the second part of experiment, deuterated

methane was injected into a steady-state “snowflake” divertor configuration. Carbon radiation was again increased by up to 50 % in methane-seeded “snowflake” divertor discharges w.r.t. to the those without impurity seeding, while very low divertor heat flux and H-mode confinement were maintained.

Tuesday got off to a late start again due to coil protection circuit and PCS issues. We began Yang Ren’s XP1037 about 11:45 am. The experiment was to study scaling of transport and high-k turbulence with collisionality. By changing the plasma current and toroidal field, the local collisionality was varied by about a factor of three. XP1037 was completed by 3:15pm. In the last part of the day we moved on to Devon Battaglia’s XP1029 on scaling of L-H power threshold with triangularity. Target plasmas were developed, but further refinement of the L-H threshold is required.

Wednesday we ran Bay K LITER at 40mg/minute for about 30 minutes before the run. We then ran Stefan Gerhardt’s XP1006 to demonstrate high non-inductive fraction plasmas. Good, high poloidal beta plasmas at 500kA and 600kA were obtained. Then vertical stability was studied first in the fiducial, and then a higher aspect ratio ($R/a \approx 1.67$) plasma. The plasmas were surprisingly stable. In the afternoon we returned to Wayne Solomon’s XP1042 to study momentum generation and confinement. Machine performance was good throughout most of afternoon, but there was some degradation in performance in the last few shots.

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

NSTX plasma operations for FY11 began this past week with a set of experiments utilizing lithium evaporation, neutral beam heating, and Resistive Wall Mode (RWM) feedback via the Switching Power Amplifier (SPA) driven error field control coils. A spare lithium evaporation (LITER) probe has been refilled, and is ready to be installed when needed. The commissioning of a hot air system proposed to be used to heat the four LLD plates continued, and is expected to be ready to use later this month. Also this week, an External Independent Review (EIR) of proposed NSTX upgrade cost/schedules was conducted, and engineering of possible molybdenum tile designs for the inboard lower divertor was started.

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 Divertor (LLD)

- A successful test of one, 6KW plate air heating unit was performed with an assembly consisting of a bellows, ceramic break, 2 thermocouples, heater tapes and insulation enclosed in a stainless steel container. The assembly was pressurized and easily heat cycled six times between $\sim 200^{\circ}\text{C}$ and $\sim 520^{\circ}\text{C}$. The assembly was held at the higher temperature for ~ 15 minutes. Room temperature pressure applied to assembly varied between ~ 46 psig and ~ 67 psig ($\sim 46, 52, 56, 67, 62$ psig). The assembly was leak checked at the end of the test and was leak tight.

- All four 6KW heater units were mounted on the heater stand, but not yet connected to the vessel.
- Work is in progress on fabrication and assembly of a manifold board to facilitate air supply connections
- Lithium Evaporators (LITER)
 - The LITER-K2 unit supported operations but encountered a shutter malfunction restricting its use to depositions applied before plasma operations
 - LITER-K1 was reloaded with 76.5 g of lithium.
- Molybdenum Inner Divertor Tiles
 - The prototype molybdenum plate and mating graphite assembly was completed.
 - A preliminary failure effects analysis for the low-cycle-fatigue of 0.5" TZM grade molybdenum plate has indicated that the candidate plate fastening methods should be able to keep the plate surface stresses during pulsed power deposition, below the 400MPa level beyond which temperature fatigue becomes a concern.
- Lithium R&D
 - Consultation was provided on NSTX lithium operating procedure to the EAST lithium research program (IPP, Hefei, China).

Diagnostic Operations (R. Kaita)

- L. Chousal of the University of California at San Diego visited PPPL to repair and upgrade components for the UCSD fast reciprocating probe for edge plasma measurements on NSTX.