NSTX Weekly Report (Dec. 18, 2009)

FY 2010 NSTX plasma operations
Planned: TBD run weeks
Completed: 0 run week and 0 plasma shot

• S. Kaye attended the 8th IEA meeting on ITPA Joint Experiments, which was held on Dec. 15 and 16, 2009 in Daejon, Korea. The meeting was attended by ITPA Topical Group Chairs and Program Leaders, or their designates, to discuss, accept and, where appropriate, commit to the Joint Experiments and Activities proposed by the various ITPA groups for 2010. (S. Kaye)

• J-W. Ahn (ORNL) presented a talk at the ITPA pedestal group meeting at UCSD, San Diego, Dec. 14-17: "Divertor heat and particle flux profiles during ELMs and applied 3D fields in NSTX." (R. Maingi, ORNL)

• A progress report on the General Atomics NSTX DOE grant was submitted to DOE on the following three research areas: The NSTX Plasma Control by D. Humphreys, A. Welander, M. Walker; The NSTX H-Mode Edge Pedestral Stability by T.H. Osborne; and the NSTX RMP Coil Modeling by T. E. Evans. A brief summary of the report is attached below. (R. Le Haye - General Atomics):

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

The NSTX outage continued this week with the completion of connections to the vacuum feed-throughs for the new Liquid Lithium Divertor (LLD), and the calibration of the CHERS diagnostic. The exterior of the vacuum vessel and attached equipment are being prepared for the upcoming pump-down and bake in January. Also this week, testing continued on a set of new lithium evaporator (LITER) probe motion drives.

The NSTX test cell will remain in free (card reader) access until the start of the holiday break this coming week.

Research Operations (M. Bell)

Boundary Physics Operations (H. Kugel)

• Liquid Lithium Divertor (LLD)
- The mechanical installation of the LLD plate segments and the intergap graphite diagnostic tiles was completed.
- All LLD plate and diagnostic cable connections to the vacuum feedthroughs were completed.
- The LLD controls Preliminary Test Procedure (PTP) started. Resolution of heater isolation issues identified during this work started.
- The National Environmental Policy Act (NEPA) Form was revised for LLD lithium amounts and submitted for review.
- The Safety Assessment Document (SAD) was revised for LLD lithium amounts and submitted

for review.

• LLD Diagnostics
-A lens was received for the divertor viewing spectrometer.
-A Requisition was submitted for the divertor camera filters.

Diagnostic Operations (R. Kaita)

• The pre-run calibrations were completed, including spatial measurements for the midplane and divertor bolometer arrays. Checks of the CHERS, PCHERS, ERD, and FIDA arrays indicated that their views were unchanged from the beginning of the outage, and intensity ("white plate") calibrations were performed for them. Faulty connections for magnetic sensors were also identified and repaired.

Diagnostic Upgrades (B. Stratton)

• The Final Design Review (FDR) for the mechanical part of the installation of the MSE-LIF diagnostic was successfully held on December 9.

• The in-vessel alignment and spatial calibration of the Beam Emission Spectroscopy diagnostic was completed on December 12.

NSTX Collaboration Activities:

• A progress report on the General Atomics NSTX DOE grant was submitted to DOE on the following three research areas (R. Le Haye - General Atomics):

The NSTX Plasma Control - Plasma control topical efforts in the NSTX task since April 2009 have included updating of relevant control modeling codes, application of 3-D modeling infrastructure, and continued development of nonrigid plasma models. Application of the TokSys picture frame representation to modeling the NSTX passive plates has begun, and a validation process to compare the 3-D calculations with explicitly axisymmetric calculations was completed. Key modeling codes were upgraded to allow generation of NSTX plasma response models for isoflux/rtEFIT control assessment and design. In particular, models of isoflux control points and X-point response to PF coil currents can now be produced for NSTX equivalently to the detailed DIII-D models previously supported. All of these efforts support the broader goal of implementing a model-based multivariable decoupling shape controller on NSTX in the current project grant period. (D. Humphreys, A. Welander, M. Walker)

The NSTX H-Mode Edge Pedestral Stability - A number of NSTX discharges were analyzed for edge stability using the pedestal analysis toolkit. In particular the results of the Lithium wall coating experiments were analyzed. With Lithium coating long ELM free periods appear accompanied by improved energy confinement. The toolkit was used to produce equilibrium for edge stability analysis of pre-Lithium ELMing discharges and ELM free post–Lithium discharges. This analysis indicates improved edge stability in the post-Lithium discharges as a result of broadening of the pedestal density profiles. This behavior of the density profiles later confirmed with reflectometer measurements of the pedestal density profiles. ELITE stability

analysis of ELMing cases indicates that the edge peeling-ballooning mode growth rates are typically significantly below the usual threshold value of ½ the ion diamagnetic frequency. The ½ ω_{*I} threshold shows good consistency with results from higher aspect ratio tokamaks such as DIII-D. This difference reflects a possible unfavorable aspect ratio effect and has yet to be understood from theory. (T.H. Osborne)

The NSTX RMP Coil Modeling - Modeling of n=6 resonant magnetic perturbation (RMP) fields produced by a set of upper and lower Front Surface Primary Passive Plate (FSPPP) RMP/RWM coils being considered for installation inside the NSTX vacuum vessel has been completed. In these studies, the coils were configured for various toroidal phase difference using a series of NSTX plasma shapes and q profiles. Chirikov overlap parameter profiles were calculated with a 1 kAt current in both the upper and lower FSPPP-RMP/RWM coils. One engineering parameter used for designing RMP ELM suppression coils is the width of the edge stochastic layer. This width is determined by calculating the radial difference between where the Chirikov overlap parameter falls below 1 and the separatrix. In DIII-D a correlation has been found between RMP ELM suppression and stochastic layer widths equal to or greater than 0.16 in normalized poloidal flux. In high elongation NSTX plasmas with q95 = 7.16, both the up-down symmetric (even parity) and up-down asymmetric (odd parity) coil configurations give stochastic layer widths exceeding the 0.16 DIII-D figure-of-merit. Studies of the stochastic layer width in NSTX were done with q95 values ranging from 5.5 to 13 and it was found that the width to the stochastic layer could be kept larger than 0.25 by changing the up-down symmetry of the FSPPP coils or by changing the toroidal phase difference between the upper and lower FSPPP-RMP/RWM coils as q95 changes. These results indicate that the FSPPP-RMP/RWM coil will be a promising tool for studying RMP ELM suppression over a very broad range of q95 values and will be uniquely suited for maintaining ELM suppression over a wide range of q profiles by dynamically tracking changes in q95 during the evolution of the discharge. This is particularly important for ITER since it is expected that L-H transitions will take place during the initial current ramp-up phase. It is also important for developing RMP ELM suppression scenarios with much broader q95 ranges than have been achieved in DIII-D using the n=3 I-coil. (T. E. Evans)