The PPPL Highlights for the week ending April 24, 2015, are as follows:

U.S. ITER FABRICATION (D. JOHNSON):

The second HV Substation Transformer arrived at Fos du Mer in France, where it will be stored temporarily until the final two units arrive at port. This is so that all three units can be transported together over land to the ITER site.

The USITER Diagnostics Project will hold the first Diagnostics I&C workshop on June 16-17 at the USITER offices in Oak Ridge, Tennessee. There are many aspects to the planning, design and implementation of instrumentation and software for ITER diagnostics. Challenges range from qualification of electronics in high radiation fields to compliance with ITER documentation requirements. The June workshop will bring the diagnostic community together to discuss these issues and develop common efficient approaches. There will also be attendance from IO and other DA I&C engineers and diagnosticians.

K. Hill finished a written analysis and report for Neutron and Gamma Survivability of X-ray Crystals. Results from previous studies show that crystals will withstand fluence levels roughly two orders of magnitude above what ITER expects to see in its lifetime, with little effect to the X-ray measurement. The CIXS team also visited Princeton University main campus to inspect a facility that could be used of magnetic field testing of the X-ray detector electronics.

Initial numerical analyses indicates that ~25mm of soft iron in a close-fitting cylinder is required around an individual diagnostic RGA sensor (horizontal, radial orientation in port cell) to limit its magnetic field exposure to 5mT (actual limit TBD) in EP11. LP12 is a worse case for this sensor orientation. Analyses in that port are continuing, but it may require 30mm or more.

NSTX (M. ONO):

A review paper entitled “Recent progress on spherical torus research” by Masayuki Ono and Robert Kaita (PPPL) was published online in Physics of Plasmas 22, 040501 (2015) on April 15. The paper reviews the scientific progress made by the worldwide ST research community during the NSTX-MAST mega-ampere-ST era (i.e., 2000 – 2014). It also covers the program elements of the on-going upgrades to the NSTX and MAST facilities as well as the ST contributions to the fusion energy development path. The AIP Publishing LLC has made available the manuscript, as part of on-going commitment to increase the visibility and impact, for a period of 30 days following its publication online. It may be accessed via the link: http://scitation.aip.org/content/aip/journal/pop/22/4/10.1063/1.4915073.

As indicated in the Engineering Operations report below, the integrated systems test procedure (ISTP) single coil pulses are also of value for magnetic calibration purposes. The polarity of all new magnetic sensors on the center stack has been determined and adjusted based on these pulses, and sensors calibrations are beginning. The magnetic reconstruction codes LRDFIT and EFIT have both been used, and are providing critical information for required troubleshooting. While the ISTP is being run from the dedicated power supply control software, additional codes are required in order to provide coil current control during plasma operations. These codes are being tested in the background during ISTP pulses, in order to ensure that they will be ready when called upon.

Preparations for NSTX-U plasma operations continued this week with the completion of the vessel center-stack bake, and the configuration of the field coil power supplies for the testing of the NSTX-U magnets. Coil cooling water system flow switches have been calibrated, power system interlocks and coil polarities have been verified, and electrical insulation tests (Hi-Pots) of all coils and bus work have been completed. Integrated system power testing is now in progress for the TF, OH, PF3U/L, PF5, & PF1CU/L coils, and magnetic diagnostics are being calibrated. Preparations are underway to perform a resistive load test of the Coaxial Helicity Injection (CHI) system capacitor bank.

The PPPL Safety Certificate defining the limitations and conditions for NSTX-U experimental operations has been approved.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

B. Grierson and S. Haskey worked with the CER team to successfully upgrade the edge main ion system on DIII-D from four to eight channels. This upgrade was enabled by new CCD cameras delivered to DIII-D as part of a DOE early career award. The edge channels cover the region from the top of the pedestal to the SOL region. New data will be obtained with the system when DIII-D restarts in FY15 for physics experiments. This upgrade completes the early career milestone for FY15 to upgrade the edge main ion system to eight channels.

A paper was published in Physics of Plasmas titled “Nonlinear hybrid simulation of internal kink with beam ion effects in DIII-D” by Wei Shen, G. Y. Fu, Benjamin Tobias, et al.. In this work, hybrid simulations with the global kinetic-magnetohydrodynamic (MHD) code M3D-K were carried out to investigate the interaction of internal kink modes with beam ions. Linear simulation results with kinetic effects of beam ions show that a fishbone-like mode is excited with mode frequency of about a few kHz. The nonlinear simulations show that the fishbone-like mode transitions at low frequency to a saturated kink mode with a small but finite mode frequency. These results are consistent with the experimental observation of saturated kink modes of finite frequency observed between sawtooth crashes.

E. Kolemen, S.L. Allen, B.D. Bray, M.E. Fenstermacher, D.A. Humphreys, A.W. Hyatt, C.J. Lasnier, A.W. Leonard, M.A. Makowski, A.G. McLean, R. Maingi, R. Nazikian, T.W. Petrie, V.A. Soukhanovskii, E.A. Unterberg published in Journal of Nuclear Materials

[doi:10.1016/j.jnucmat.2014.11.099] and article entitled "Heat flux management via advanced magnetic divertor configurations and divertor detachment." The snowflake divertor (SFD) control and detachment control to manage the heat flux at the divertor was successfully demonstrated at DIII-D. Results of the development and implementation of these two heat flux reduction control methods was presented. The SFD control algorithm calculates the position of the two null-points in real-time and controls shaping coil currents to achieve and stabilize various snowflake configurations. Detachment control stabilizes the detachment front fixed at specified distance between the strike point and the X-point throughout the shot.

International Collaborations (R. Hawryluk):

F. Poli attended the ITPA-IOS meeting in Barcelona, Spain. She reported on the implementation of a pedestal model in time-dependent simulations, using a lookup table based on EPED1 and a fitting procedure, which can be used both in analysis and predictive model.

ENGINEERING AND INFRASTRUCTURE (M. WILLLIAMS):

NSTX Upgrade (R. Strykowsky, E. Perry, L. Dudek, T. Stevenson):

On April 24, at approximately 12:21 PM, PPPL ESU responded to alarms from the NSTX-U experimental area. An active water leak from the NSTX-U was observed. The technical staff discovered that several of the Ohmic Heating (OH) coil's external cooling paths were damaged, all at the top end of the OH coil. Additionally, indications of electrical arcing were observed in the vicinity of the water leaks. Initial inspection showed no additional damage to the OH or other coil systems. The OH cooling water system was isolated, stopping the leaks. An investigation into the cause is underway and plans to repair the systems are in progress.

NSTXU Management: The Integrated System Testing (ISTP) has been completed with the successful test of the TF, OH, and PF coil sets. Documentation to support a CD-4 closeout review are currently being finalized.

Construction: The Gas Injection System and Glow Discharge System are ready for operations. The TIV/Shutter airlines needed for CD4 have been hooked up. The MPTS platforms at bays F and L have been completed and put into service. The design for the MPTS exit side electrical systems has been completed enough that installations can begin. Final installations of the MPTS exit window and dump box have been completed. Installation of the MPTS exit side tube crosses is in progress.

OFFICE OF COMMUNICATIONS (K. MACPHERSON):

A story about L. Rasmussen’s synthetic muscle developed with the help of PPPL scientists appeared as a front page story in the Times of Trenton on April 12 and on the Princeton University website and in more than 20 other publications and websites.

ENVIRONMENT, SAFETY, HEALTH (J. LEVINE):

Celebrations were held for Earth Week on April 22-23. This included Green Machine Awards presentations, a showing of the movie "The Burden"; Unicor Electronics collection, a presentation by Diane Landis, Executive Director of Sustainable Princeton, a Colloquium by Jeanne Herb of the Edward J. Bloustein School of Planning and Public Policy of Rutgers University on Efforts in New Jersey to Prepare for Climate Change, and a PPPL site cleanup by volunteers.

BEST PRACTICES, EXTERNAL AFFAIRS, & SITE SECURITY (J. DELOOPER):

A. Zwicker gave a lecture on "Science Literacy in the Present Day" to an audience of approximately 100 at the Present Day Club in Princeton.

LEADERSHIP POSITIONS:

Hawryluk, R., Chair, Readiness Review Panel for JET DT campaign.

PUBLICATIONS:

Ono, M.; and Kaita, R., "Recent Progress On Spherical Torus Research," Physics of Plasmas 22, 040501 (2015)

Shen*, W.; Fu, G.Y.; Tobias, B.; Van Zeeland, M.; Wang, F; and Sheng, Z-M; "Nonlinear Hybrid Simulation Of Internal Kink With Beam Ion Effects In DIII-D," Physics of Plasmas 22, 042510 (2015); http://dx.doi.org/10.1063/1.4917341

Kolemen, E.; Allen, S.L.; Bray, B.D.; Fenstermacher, M.E.; Humphreys, D.A.; Hyatt, A.W.; Lasnier, C.J.; Leonard, A.W.; Makowski, M.A.; McLean, A.G.; Maingi, R.; Nazikian, R.; Petrie, T.W.; Soukhanovskii, V.A.; Unterberg, E.A.; "Heat Flux Management Via Advanced Magnetic Divertor Configurations And Divertor Detachment," Journal of Nuclear Materials doi:10.1016/j.jnucmat.2014.11.099

This report is also available on the following web site:
http://www.pppl.gov/publication-type/weekly-highlights