Weekly HIGHLIGHTS

The PPPL Highlights for the week ending February 10, 2018, are as follows:

NSTX-U RECOVERY AND RESEARCH (J. MENARD)

Recovery:

The first phase of the Office of Science's assessment of the NSTX-U Recovery Plans was held Feb. 6-8 at PPPL. The assessment generated many recommendations useful for preparing for a baselining review.

A peer review of the re-assembly plan for NSTX-U was held on Feb. 9.

The original NSTX-U PF1AL coil was tested using the new FCPC coil test-stand. Two types of fiber-optic strain gauges were used and both functioned well. These tests produced strain and coolant flow data. Analytical simulations of the test are being compared with the mechanical performance of the coil.

Fabrication of the PF1A prototype coil has commenced at PPPL utilizing the approved winding procedure. Two external vendors have also been approved to start fabrication of prototype coils.

Research:

NSTX-U researchers N. Bertelli and M. Ono visited the QUEST spherical tokamak at the Research Institute for Applied Mechanics (RIAM), Kyushu University, Fukuoka, Japan Feb. 5-9 to collaborate on the electron cyclotron current drive start-up experiments utilizing a 28-gigahertz gyrotron and related modeling. The gyrotron system with upgraded polarizer was conditioned and the power injection into the QUEST device has started. The new polarizer appears to operate without significant arc issues even at 230 kilowatts, which was the previously observed arc limit. N. Bertelli worked with R. Yoneda of Kyushu University on Fokker-Planck simulations for electron cyclotron startup plasma in QUEST. The CQL3D Fokker-Planck code has been tested on a QUEST local processor and the work is in progress. During the visit, they also discussed the QUEST/NSTX-U collaboration plans with K. Hanada (RIAM Director) and H. Idei (QUEST Director).

J. Nichols successfully defended his thesis titled, "Integrated Modeling of Plasma-Induced Material Migration in NSTX-U." The thesis focused on whole-device modeling of the evolution of the plasma-facing components in NSTX-U with comparisons to data obtained in the FY2016 run campaign, specifically spectroscopic diagnostics at Lawrence Livermore National Laboratory and the University of Illinois' surface-science diagnostic MAPP. The processes were modelled with the WallDYN mixed-material migration code,

the first usage of that code in the United States as well as the first application to a spherical tokamak. In addition, a novel thin-film model for describing wall-conditioning coatings was developed to better understand the evolution of NSTX-U plasma-facing components after boronizations. The final presentation and oral examination was chaired by B. Kaita; D. Stotler and D. Majeski served as thesis readers. Nichols was advised by M. Jaworski.

U.S. ITER FABRICATION (H. NEILSON)

Low field side reflectometer (LFSR): An important design decision was made on the cooling scheme of the LFSR plasma facing components. The design features a plate with milled cooling channels that are attached to the front surface by brazing the channel partitions and welding the perimeter. The adoption of this design paves the way for many design analyses, including neutronic, electromagnetic, and structural analyses, to go ahead for their final iterations in preparation for preliminary design review (PDR) of the LFSR diagnostic system scheduled for June 2018.

U.S. ITER Diagnostics Team Lead H. Neilson attended the annual ITER Diagnostics All Domestic Agencies meeting Feb. 6-8 at the ITER site in St. Paul-lez-Durance, France. The face-to-face meeting was arranged to provide an opportunity for the ITER diagnostic leaders from all seven parties, as well as the Central Team (CT) diagnostic staff, to share information and lessons learned from their work over the past year. The CT staff provided updates on numerous issues important to execution of Diagnostic Procurement Arrangements, including nuclear regulator surveillance of protection important activities, components with special safety functions, mirror cleaning, and port integration. In separate meetings between Neilson and CT staff, planning for the low field side reflectometer preliminary design review moved forward and numerous design-related questions were answered.

ITER & TOKAMAKS (R. Nazikian)

DIII-D (B. Grierson)

Research:

PPPL lead an experiment at the DIII-D National Fusion Facility this week that completed the separation of the power and rotation scaling of core error field penetration thresholds in low-torque H-mode plasmas relevant to ITER. The experiment completed a torque scan, including neutral beam torque in the counter-Ip direction in H-modes. Analysis of the results will contribute directly to the ITPA MHD MDC-19 joint experiment on error field threshold in low-torque plasmas.

PPPL's K. Erickson visited General Atomics to contribute to a number of plasma control projects with N. Eidietis (General Atomics), C. Rea (MIT) and B. Grierson (PPPL). Erickson created a common machine-learning filtering package shareable across multiple disruption prediction algorithms, improved the algorithm to indicate probability, developed working proof-of-concept for remote memory sharing over Infiniband, and began designs of the FRNN algorithm by J. Kates-Harbeck. Additionally, a number of key computational needs by PPPL scientists were identified for increased usage of the PPPL scientific computing cluster. As part of this effort, 15 GYRO simulations were run simultaneously through OMFIT on the PPPL cluster for uncertainty quantification analysis.

ADVANCED PROJECTS (H. NEILSON)

This week, D. Gates made a presentation titled, "Fusion Energy: Status and Role," to the Conversations about Environment, Responsible Energy and Life (CEREAL) group, which holds discussions over breakfast. The CEREAL group is organized by the Carbon Mitigation Initiative (CMI) as part of a series of activities and workshops which advance the CMIs approach of "bringing together scientists, engineers, and policy experts to design carbon mitigation strategies that are safe and effective as well as affordable." There were many attendees from diverse backgrounds and the discussion was lively.

PLASMA SCIENCE & TECHNOLOGY (P. EFTHIMION)

A paper by V. Nemchinsky and A. Khrabry titled, "Effect of polarization forces on carbon deposition on a non-spherical nanoparticle. Monte Carlo simulations," was published in *Physics of Plasmas*. The full paper is here: http://scitation.aip.org/content/aip/journal/pop/25/2/10.1063/1.5018200

ENVIRONMENT, SAFETY & HEALTH (J. LEVINE):

The Laboratory completed all outstanding items required for successful registration of our Environmental Management System (EMS) to the ISO-14001:2105 standard, and has received the certificate of registration for this standard. The Laboratory's successful completion of a registration transition audit and continued EMS certification meets the EMS transition requirements under DOE Order 436.1, EO13693, and the PEMP Notable for FY18.

SITE PROTECTION (F. WHITE)

This week members of ESU completed training with the newly implemented patient charting program, emsCharts, and also completed training on current SPD/ESU policies and procedure review.

Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY

U.S. DEPARTMENT OF ENERGY

COMMUNICATIONS (L. BERNARD)

The Office of Communications posted one story to the PPPL website. It focused on recent findings by PPPL scientists and collaborators working on China's Experimental Advanced Superconducting Tokamak. The group, led by R. Maingi, found that lithium powder can eliminate instabilities known as edge-localized modes when used to coat a tungsten divertor. The story was posted on the *Newswise* and *EurekAlert!* press release distribution services and on the Laboratory's website.

DIRECTOR'S OFFICE (R. HAWRYLUK)

On Feb. 7, W. Ayers of WMA Associates presented a colloquium entitled, "High power beta electron devices — beyond betavoltaics."

Phase 1 of the U.S. Department of Energy/Office of Science Assessment of NSTX-U Recovery Plans was held Feb. 6-8. The purpose of the meeting was to evaluate PPPL's proposed organization, capability, and means to execute NSTX-U Recovery plans and resume operations.

This report is also available on the following web site:

http://www.pppl.gov/publication-type/weekly-highlights