Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY
U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending June 30, 2018, are as follows:

NSTX-U RECOVERY AND RESEARCH (J. MENARD)

Recovery:

Magnets — The Everson Tesla, Inc. (ETI) prototype coil has been sectioned, and the sectioned pieces are undergoing electrical breakdown testing. Vacuum pressure impregnation (VPI) of the Sigma Phi prototype coil began with resin impregnation of the coil on June 27. PPPL's prototype coil has completed field coil power conversion (FCPC) full-power testing and all additional electrical tests, and is currently undergoing sectioning in the C-Site motor generator shop. Tesla Engineering started ground wrap on June 28, with pending installation into a mold. VPI is scheduled for the week of July 4.

Plasma Facing Components (PFCs) — Outboard divertor rows 3, 4, and 5 moved into significant variant analysis this week, along with 3-D model test fit-ups with the passive plate interface. High-heat-flux regions also moved toward 3-D printed models and then forward to trial fit-up with diagnostics and diagnostic wire ways. Center stack first wall tile pull testing nears completion, and testing showed consistent results. These results will be applied to an ANSYS analysis that will be used to verify results and tile adjustments. Except for tensile tests, Material property testing is almost complete. Tensile testing samples have been produced by the PPPL machine shop, and PMIC has received them and is moving ahead. PFC tile material purchase continues into procurement after a successful material selection peer review.

Polar Region — The team is in preparation for the polar region PDR scheduled for July 13, and they continued working with project controls on the WAF/ Primavera update. All upper polar region (UPR) Maxwell FEA's are completed, and the mechanical FEM is ready for use.

Center Stack Casing to OH/TF — Parts for the OH/TF bundle trial fit-up to the casing continued fabrication this week. The mock diagnostics and the microtherm insulating blankets were fully installed.

Neutral Beams — The NBI source shop has refurbished the clean room, completed its assembly, and successfully passed leak checks. The beam group also completed assembly of a spare ion source; the source is being prepared for hydrostatic and electrical testing.

Operations / Power Systems — Motor Generator #1, the FCPC coil test stand, the cooling water system, and associated rectifiers became operational this week and successfully completed testing as expected.

Central Instrumentation & Controls (CI&C) — A final design review (FDR) of the computer automated measurement and control (CAMAC) replacement job for phases 1 and 2 was successfully completed on June 26. CI&C supported the prototype PF coil test without any issues, and CI&C recovered from an unplanned power outage on Thursday morning, June 28.

U.S. ITER FABRICATION (H. NEILSON)

The Low Field Side Reflectometer (LFSR) design team continued completing input data package deliverables in preparation for a preliminary design review (PDR) later this year. In a briefing for the U.S. ITER federal project director on June 26, diagnostics team lead H. Neilson reviewed recent progress toward PDR readiness: 1) agreement with the Central Team (IO-CT) diagnostics unit on requirements applicable to LFSR;
2) agreement with IO-CT fire safety experts on an insulation strategy to limit the maximum fire temperature for U.S. equipment to below 200 degrees Celsius; and
3) submission of an LFSR team work plan to the U.S. ITER project office leading to a U.S. PDR readiness review in September.

ADVANCED PROJECTS (H. NEILSON)

Stellarators (D. Gates):

S. Lazerson gave an invited oral presentation at the 45th IEEE International Conference on Plasma Science entitled, "Overview of the first Wendelstein 7-X divertor experimental campaign." The presentation reviewed major results from the recent OP1.2a experimental campaign, including measurements of error fields, divertor load symmetrization, achievement of high densities by pellet injection, and the achievement of a stellarator world record triple product. He also highlighted the value of the U.S. contributions to the W7-X experimental program.

ITER & TOKAMAKS (R. Nazikian)

DIII-D (B. Grierson):

Research: Four PPPL scientists have been selected for invited talks at the 2018 APS-DPP meeting in Portland, OR: N. Logan, Z. Wang, B. Grierson, and E. Kolemen have been selected to present invited talks based on their DIII-D research.

The paper, "Investigation of the role of pedestal pressure and collisionality on type-I ELM divertor heat loads in DIII-D," by M. Knolker et al, was accepted for publication in the journal *Nuclear Fusion*. The paper describes a non-dimensional collisionality scan conducted on DIII-D to test a new model for ELM energy densities (Eich, NME 2017)

and study the influence of pedestal pressure and collisionality on ELM sizes. The scan reveals no explicit pedestal pressure dependence of the ELM energy densities. While collisionality does not play a decisive role, the ratio of heating power to the power over the L-H-threshold is identified as an important empirical scaling parameter. Using linear stability calculations with the ELITE code, ELM energy densities are shown to scale inversely with to the most unstable linear mode number before the ELM crash. M. Knolker is a graduate student of H. Zohm working with the PPPL DIII-D group and advised by A. Bortolon, B. Grierson, and R. Nazikian.

THEORY (A. BHATTACHARJEE):

A theory seminar titled, "Machine-learning driven correlation studies: multi-band frequency chirping at NSTX," was presented by B. Woods from the University of York. The abstract and presentation are available on the theory website: https://theory.pppl.gov/news/seminars.php?scid=1&n=research-seminars

The paper "Investigation of the short argon arc with hot anode. I. Numerical simulations of non-equilibrium effects in the near-electrode regions," by A. Khrabry, I. D. Kaganovich *et al.* was recognized by *Physics of Plasmas* as a high-performing paper for 2017-2018. The announcement is here: https://aip-info.org/1XPS-5PV5T-46C9NK1G8C/cr.aspx

ENGINEERING & INFRASTRUCTURE (V. RICCARDO)

The Engineering program description (https://bp.pppl.gov/plans/Eng_PD.pdf) has been issued. The purpose of this description is to provide clear and uniform guidance to those performing or assisting with engineering work at the Laboratory.

COMMUNICATIONS (L. BERNARD)

The Office of Communications posted one press release to the PPPL website. The story described the one-week course in plasma physics given to new student interns the week of June 11. The students, including 32 students in the Department of Energy's Science Undergraduate Laboratory Internships (SULI) program, attended lectures by experts at PPPL and from institutions from around the country. The story was also posted on the *Newswise* news release distribution service.

DIRECTOR'S OFFICE (R. HAWRYLUK)

On June 26, the Lab celebrated the creativity of the lab's inventors from fiscal year 2017 at the annual Inventor Recognition Reception. Fifty-six inventors generated 30 invention

disclosures, two patent applications, and one issued patent. We thank all of those who continue to support our core value of innovation.

The PPPL Publications Office hosted representatives from DOE's Office of Scientific and Technical Information (OSTI). The OSTI team presented a three-day series (June 25-27) of demonstrations and Q&A sessions to help PPPL researchers manage reporting requirements for PPPL research products, specifically new requirements for PPPL-developed code and software. More than 30 PPPL researchers participated in these sessions and successfully created the first set of PPPL code records using the demonstrated platform, “DOE Code.”

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