Weekly HIGHLIGHTS

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

The PPPL Highlights for the week ending September 26, 2020, are as follows:

NSTX-U RECOVERY (J. GALAYDA) AND RESEARCH (S. KAYE)

Recovery (J. Galayda):

Coils — Of the five coils (PF1B#1, PF1C#1, PFC#2, PF1A#1, and PF1A#2) at PPPL, two have passed low-power electrical tests on site and the remaining three are being tested. In France at Sigmaphi, PF1B#2 was shipped on Sept. 24. In addition, the PF1C-S (spare) completed vacuum pressure impregnation (VPI) and is curing. Winding was completed for coil PF1A-S, and PF1B-S neared completion of winding the second of two layers.

Center Stack Casing (CSC) — The CSC is in Camden for the final eight weeks of finish machining. Additionally, welding of the organ pipes occurred at Turtle Creek, along with welding of the mockup bellows to flange. In addition, post-machining vacuum testing of all of the trimmed spare bellows neared conclusion at PPPL so they could be sent to ORT/Holtec for installation.

Machine Core Structure (MCS) — Many fabrication activities continued at the three facilities currently making sling parts. Precision Boring in Michigan continued fabrication of the PF1A and PF1B capture and common flanges. The PF1C capping flanges for the sling supports were packaged and awaited disposition of two NCRs prior to shipping in a few days. In South Carolina, Carolina Fabricators' production of PF1A sling parts continued, with shipment of the lower parts scheduled for Oct. 1. Also, G.J. Oliver added components to the machined PF1C supports and will ship the supports out for coating in the near term, with delivery of the lower PF1C support scheduled for the end of the month. Additional procurement activities to award contracts for the remaining MCS components neared completion. The on-site mockup activities continued and will wrap up in the next two weeks, with the output to be incorporated into assembly procedures. PF1B lower slings were welded together, with PF1A lower slings to follow.

Neutron Diagnostic Mechanical FDR — A final design review (FDR) was held Sept. 22 to review the final mounting fixture design for the fission chamber, mechanical support, and cable route from neutron detectors in the NSTX-U test cell to the gallery. The scope of the FDR included a review of all the mechanical related design issues for the NSTX-U neutron diagnostics system modifications.

Research (S. Kaye):

The following NSTX-U papers were published on line at AIP conference proceedings for the 23rd Topical Conference on Radiofrequency Power in Plasmas: "3D full wave fast wave modeling with realistic antenna geometry and SOL plasma" by N. Bertelli, et al.

(https://doi.org/10.1063/5.0013580) and "Modeling of solenoid-free start-up using 2nd harmonic electron cyclotron heating and current drive in QUEST" by M. Ono, et al (https://doi.org/10.1063/5.0013966). The first paper reports the significant advancement of our ability to model and to understand how RF waves interact with the scrape-off-layer (SOL) plasma by simulating the full-torus 3D SOL plasma together with the antenna and core plasma. The second paper describes a grid-based ECH ST/tokamak start-up model to describe the discharge evolution from the initial open field line configuration with pressure driven currents to a ECCD driven tokamak closed field configuration. These conference proceedings are peer reviewed as described here: https://aip.scitation.org/apc/organizers/peerreview

ITER PROJECTS (H. NEILSON)

The ITER Diagnostics team presented a series of briefings to U.S. ITER management, explaining in detail the team's recently submitted estimate to complete its design work and delivery of first-plasma hardware. Project leaders described the scope of each project and the division of responsibilities between PPPL and partner organizations. They explained the estimating methodology, assumptions, and risks that affect the estimates. The team has gained experience and actual cost data in the ITER design documentation and review process since CD-2 was approved, and presentations showed how that information has influenced the current estimates.

Upper Wide Angle Viewing — UWAV (M. Smith):

The UWAVS team met with Port Integrators, working to resolve interface definitions and issues. The team started defining the interfaces for the Upper Port 17 front end custom integration. With the support of ORNL Instrumentation and Control (I&C) engineers, the UWAVS team has begun updating the 2D diagrams as a step to define key interfaces for port integrators. The UWAVS team, with the support of PPPL's Plant I&C group, continues to work on defining the I&C and CODAC connection information requested by the Central Team. Lastly, the team started investigating alternative methods for shutter actuation, including piezo ceramics, electrostrictive ceramics and shape memory alloys as actuation drivers.

Equatorial Port Integration — EP03/09 (A. Basile):

Equatorial port diagnostic shield module design for U.S. Ports 03 and 09 is proceeding on the basis of a generic design that has been developed for ITER's two first-plasma ports. The design uses small boron carbide (B_4C) blocks arranged in trays as a modular, customizable shield concept. Central Team colleagues clarified the structural role played by these trays and the adaptation required in localized areas where the shield material

must be replaced by diagnostic components. A complete list of interface sheets has been developed, providing a framework for launching the work of design integration between the port structures and tenant diagnostics.

Low Field Side Reflectometer — LFSR (A. Zolfaghari, S. Shirey):

The LFSR team presented a report of progress by partner General Atomics in the development of weld samples and weld inspection techniques as the U.S. technical highlight for the monthly meeting with the Central Team Diagnostics Division. The design compliance matrix for the in-vessel antenna assembly, documenting compliance with all applicable system requirements, was approved. CAD models of LFSR equipment in the EP11 interspace and port cell regions were formally updated, the result of a close collaboration between PPPL engineer M. Duco and Russian counterparts.

ITER & TOKAMAKS (R. NAZIKIAN)

DIII-D (B. Grierson):

Research:

Experiments supporting the 2020 Joint Research Target (JRT) were executed on DIII-D in the Core-Edge Integration Task Force. ITER-like RMP ELM-suppressed H-mode plasmas were studied by injecting a wide range of impurities into the plasma from helium to tungsten, including multiple intermediate-Z impurities. Gas valves, the MIT laser blow-off (LBO), and the PPPL impurity injector were used to deliver impurities to the plasma. Comprehensive impurity measurements and turbulent fluctuations were documented. The obtained data sets will represent one of the most comprehensive studies of impurity transport performed to date and will enable new core-edge integration analysis.

International EAST (F. Poli):

A paper by W. Choi, et al. titled, “Initial TRANSP simulations of lower hybrid heating and current drive in EAST” has been published in AIP conference proceedings (https://doi.org/10.1063/5.0014245) as a part of the 23rd Topical Conference on Radiofrequency Power in Plasmas. The paper discusses results from the analysis of EAST experiments with LH waves at 2.45 GHz and 4.6 GHz with TRANSP and GENRAY/CQL3D.

Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY

U.S. DEPARTMENT OF ENERGY

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. Bernard):

The Office of Communications posted three press releases to the PPPL website. One reported that an international group of researchers led by physicists at PPPL has developed a technique that forecasts how tokamaks might respond to magnetic errors. The second notes that The American Nuclear Society has bestowed its distinguished Nuclear Historic Landmark designation on the Tokamak Fusion Test Reactor. The landmark designation marks the second high honor received by PPPL in recent years. The third press release reports that Hyeon Park, a renowned Korean physicist who developed a key diagnostic system for fusion plasmas while a principal researcher at PPPL has won the prestigious 2020 Subramanyan Chandrasekhar Prize for Plasma Physics. The award from the Division of Plasma Physics of the Association of Asia Pacific Physical Societies (AAPS-DPP) honors Park for unprecedented new physics results through his original and pioneering works in fusion plasma diagnostics, which has produced an essential diagnostic tool for tokamaks fusion facilities throughout the world. The stories were also posted to the *Newswise* and *EurekAlert* press release distribution services.

L. Bernard participated remotely in the National Laboratories Chief Communications Officers (NLCCO) monthly meeting on Sept. 24.

DIRECTOR'S OFFICE (S. COWLEY)

C. Ferguson virtually hosted the Director's Review of PPPL's Critical Infrastructure Recovery and Renewal (CIRR) Project Sept. 22-24.

M. Zarnstorff and J. Menard participated virtually in the National Academies Fusion Pilot Plant Panel Meeting on Sept. 23.

J. Menard participated virtually in the Review panel for the final report of the physics section of the China Fusion Engineering Test Reactor (CFETR) engineering design project on Sept. 24.

J. Menard, S. Cowley, and C. Ferguson participated virtually in the DOE Laboratory Facilities of the Future Workshop on Sept. 24.

This report is also available on the following web site:

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