

Weekly

HIGHLIGHTS



The PPPL Highlights for the week ending February 22, 2020, are as follows:

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

Recovery (J. Galayda):

PF Coils — Coil winding is nearing completion at Sigmaphi in France for the first two coils (PF1A and PF1B lower coils). PF1A is having final lead stem ground wrap and G11 installed. Vacuum pressure impregnation (VPI) equipment is being readied to start VPI of these coils. Metrology and leak checking for the PF1C mold is complete. The PF1A#2 mold metrology is complete, and leak checking is ongoing. Both winding lines are prepared to accept new mandrels to begin winding the third and fourth coils.

Center Stack Casing — Welding of the center stack casing (CSC) assembly continues at the Turtle Creek facility near Pittsburgh. The assembly has been tack-welded together and final welding passes are being laid. A solid blind flange was C-clamped to the upper diverter flange to act as a heat sink as a means of controlling distortion across the edges of the upper diverter flange during the welding process.

In-Vessel Shutter Material Modification Peer Review — A peer review was held Feb. 19 to evaluate the updated disruption loads and the proposed material change necessary to qualify the in-vessel shutters. The outer vessel Ultra-Soft-X-Ray (USXR) and lithium evaporator (LITER) diagnostics were also assessed during this peer review.

BUS Work FDR-2 — An FDR-2 (final design review) was held Feb. 19 to assess the final design of the PF1A and 1B coil terminal support structure, PF1A and 1B bus bars, and the bus support structures. This also included the upper and lower regions of the inner PF replacement coils as well as the bakeout bus and bus supports.

Platform Extension FDR — A final design review was held Feb. 20 to assess the design of the platform on the 119' level of the test cell, located at the west wall. The platform has lost space because the bakeout power supplies have been moved to that platform. In order to regain access to mount equipment to the west wall, the platform had to be redesigned and extended.

Plasma-Facing Components (Graphite Tiles) — A contract was awarded to MWI (Rochester, New York) this week to fabricate graphite tiles for the recovery project. Raw graphite previously purchased by PPPL will be shipped to MWI in the coming days. Work will begin as soon as PPPL reviews WMI's manufacturing plans.

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D-Site Preparation — A working group under T. Jernigan was charged with developing a detailed plan for preparing D-Site for the construction/reassembly phase of recovery. The group was charged with drawing up plans for accommodating personnel that will be relocated at D-Site, space for material and equipment staging, and sub-component assembly activities.

Research (S. Kaye):

Members of the Coaxial Helicity Injection (CHI) team traveled to the QUEST spherical tokamak facility, Kyushu University, Japan, from Jan. 27 to Feb. 14 to deploy and test a new transient CHI hardware on QUEST: J.A. Rogers (Jan. 27-Feb. 7); R. Raman (Feb. 3-14), University of Washington; and M. Ono (Jan. 27-Feb. 7), PPPL. The first week was spent on installing a new in-vessel CHI specific poloidal field coil inside the QUEST vacuum vessel and testing a similar duplicate coil outside the QUEST vessel using a capacitor bank-based power supply. Because of the unoptimized (for CHI) divertor PF coils on QUEST, previous studies had indicated the need for such a coil to test the biased electrode CHI configuration on QUEST in which the electrode is biased with respect to the high-field side vessel wall on QUEST. During the second week, the in-vessel coil was first commissioned in air and then tested under vacuum by operating it during CHI pulses and was found to work reliably without issues. During the third week, much progress was made toward the development of a viable transient CHI scenario using this new coil. First, suitable field line configurations that are largely immune to absorber arcs were developed. This was followed by the generation of a successful transient CHI plasma using the injector flux generated by the in-vessel coil. Work is now in progress to deploy a suitable gas manifold that can provide a more uniform gas distribution compared to the present single toroidal location. The CHI engineering systems and the new coil operated with 100% reliability with no issues. Participating members of the QUEST team, including a number of students, provided dedicated support during the quite-productive CHI campaign.

U.S. ITER FABRICATION (H. NEILSON)

The Laboratory, together with partner General Atomics (GA) of San Diego, California, have this week launched a manufacturing development activity that will take a vital step in the preparation to manufacture the in-vessel antenna assembly for the ITER Low Field Side Reflectometer (LFSR). In this activity, GA will manufacture a test assembly that incorporates the most technically risky fabrication and inspection processes that will be involved in fabricating the LFSR assembly. The GA team will construct the assembly using materials and welding procedures that conform to ITER requirements for in-vessel



components. They will develop and test procedures for installing microwave horns into their support structures that are compatible with achieving the strict aiming tolerances required for measurement performance. The GA team has engaged Martinez and Turek, Inc., of Rialto, California, as a partner in the project.

ITER & TOKAMAKS (R. NAZIKIAN)

DIII-D (B. Grierson):

Research:

N. Logan gave a seminar entitled, “Harnessing the Multi-Modal Response to 3D Fields to Optimize Tokamak Performance” at Lawrence Livermore National Laboratory this week. The seminar drew a full capacity attendance and was well received. The presentation sparked interest and led to conversations with many LLNL researchers interested in the impact of 3D MHD on edge physics, footprints, particle transport and future machine design.

International PMI and FES LM PFC Development Program (R. Maingi):

P. Rindt, formerly of Eindhoven University of Technology and now EURO-Fusion, presented a liquid-metal plasma-facing component (PFC) seminar titled, “Power handling, additive manufacturing and conceptual design of a DEMO liquid metal diverter.” The seminar covered Ph.D. thesis work on the ability of a flowing liquid lithium system using 3-D printed tungsten tiles as a PFC substrate to exhaust both high steady state ($\sim 15 \text{ MW/m}^2$) and transient heat pulses (0.3 GJ/m^2 over 1 ms at 100 Hz) without damage in the MAGNUM-PSI device. The seminar also included development of a liquid tin PFC concept for a European DEMO. Designs based on these concepts should be developed for tokamaks, e.g. LTX-beta and NSTX-U.

THEORY (S. HUDSON)

M. Churchill presented a CSML Machine Learning lunch on Feb 14. entitled, “Deep convolutional neural networks for multi-scale time-series classification in fusion devices.”

A. Scheinberg gave a talk at SIAM 2020 (Seattle, Washington,) on Feb. 15 entitled, “Taking the Plasma Physics Code XGC to Summit and Beyond with Kokkos/Cabana.”



COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Science Education (A. Zwicker):

On Feb. 21 and 22, the Science Education Department hosted the annual U.S. Department of Energy New Jersey Regional Middle and High School Science Bowls. With the help of about 50 volunteers from PPPL, Princeton University and other institutions, 16 middle school teams and 32 high school teams competed in a quiz-show style competition answering questions on science- and math-related topics. The winner of the middle school competition was a team from Princeton Charter School, and the high school winner was a team from Ridge High School in Basking Ridge, New Jersey.

Communications (L. Bernard):

The Office of Communications posted three news stories to the PPPL website. The first describes 10 highlights over the past 10 years featuring five research breakthroughs and five key developments that provide quick insight into the breadth of research and development at PPPL – from fusion to astrophysics to nanotechnology. The second announces that PPPL is hosting the U.S. Department of Energy New Jersey Regional Science Bowl on Feb. 21 and 22. This is the 27th year that PPPL has hosted the event. The third reports on new research showing that particle beams shot from satellites could help map Earth's magnetic field. The stories were also posted to the *Newswise* and *EurekaAlert* press release distribution services.

DIRECTOR'S OFFICE (S. COWLEY)

S. Cowley participated in the Oxford Physics Advisory Board meeting in Oxford, United Kingdom, Feb. 16-18.

This report is also available on the following web site:

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