



The PPPL Highlights for the week ending August 15, 2020, are as follows:

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

**Recovery (J. Galayda):**

**Management** — The project manager has issued a memo detailing work planning/control of technical aspects of project activities. The memo outlines standard operating procedures designed to ensure that all workers in the field are made aware of activities scheduled for the day. Adherence to this routine will ensure that work packages are complete and ready to execute.

**Coils** — Sigmaphi is on vacation until Aug. 17. Two coils (PF1C#1 and PF1A#2) shipped to PPPL on July 30 are at JFK airport and will be delivered this week to PPPL. PF1B#2 vacuum pressure impregnation (VPI) preparations were completed, and the VPI will be conducted on Aug. 25. PF1C#2 metrology was completed and the paperwork is being reviewed at PPPL while Sigmaphi is on vacation. The coil will be shipped upon Sigmaphi's return. In addition, spare coil preparations will begin upon the return of Sigmaphi to their shop.

**Center Stack Casing (CSC)** — Machining continues in Camden, New Jersey, on the center stack casing. The current phase of machining was completed in Camden and the CSC will be shipped to Turtle Creek to attach the collar pieces on each end. The CSC will be returned to Camden in late August for more machining. In addition, vacuum testing of two of the spare bellows was successfully performed at PPPL; they will 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 and PF1C capping flanges for the sling supports. In South Carolina, Carolina Fabricators first articles and production of PF1A sling parts continued, and a partial shipment is in QC inspection. G. J. Oliver finished radiograph inspection and resumed final machining of the welded parts of the PF1C supports. Additional procurement activities to award contracts for the remaining MCS components neared completion.

**IVPS** — On-site activities to install power to the vacuum pump and perform mechanical installations of the vacuum system components will resume upon approval in late August.

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**Personnel Safety System (PSS)** — Proposals for the installation of the NSTX-U personnel safety system conduit system were received and are currently undergoing a technical review. The anticipated award for this important subcontract is Sept. 1.

**NSTX-U Oxygen Deficiency Hazards (ODH) Balance of Plant PDR** — A preliminary design review (PDR) was held Aug. 11 to review the design and installation plans of all equipment and cabling to upgrade existing oxygen deficiency hazard monitors and ventilation systems covering the NSTX-U test cell, gallery, and cryogenic areas. The design review addressed the updated requirements, hardware design, system safety considerations, and overall system configuration.

## **Research (S. Kaye):**

The fortnightly ST40 collaboration meeting was held on Aug. 7 among ST40 researchers and collaborating researchers from ORNL, PPPL, Columbia University, and University of Washington. P. Thomas of Tokamak Energy (TE) reported that the ST40 divertor and divertor diagnostics were installed and the machine was ready to close. Discussions were held concerning the structure of the ST40 EFIT tree so it could be accessed for setting up TRANSP runs, developing additional projected ST40 scenarios for fast ion instability assessment, and how remote participation in experiments would be facilitated. For the last topic, it was decided that a smaller group of researchers from both TE and other institutions, with experience in remote experiment participation, would develop and identify the necessary capabilities.

## **ITER PROJECTS (H. NEILSON)**

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

The Laboratory submitted an exhaustive structural integrity report of the LFSR in-vessel antenna assembly. The report by PPPL engineer W. Syed documents a series of structural analyses in line with the system load specifications, to demonstrate a) that the mechanical design of the LFSR in-vessel assembly is compliant with the structural assessment criteria stipulated by the chosen design codes and standards under various loading conditions, and b) can survive the number of plasma pulses foreseen to be produced over the ITER operational lifetime. The document contains a summary of failure modes, an overview of structural assessment criteria, an overview of the load combinations, and structural assessments related to each failure mode and load combination. The report concludes that the in-vessel components of the LFSR system meet the intended requirements of form, fit and function, and that full compliance to the in-vessel structural design criteria has been verified.

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The LFSR team completed a review of a draft manufacturing & inspection plan (MIP) that was submitted by General Atomics for the project's manufacturing development program. When approved, the MIP will serve as the roadmap for developing the critical manufacturing and inspection processes for the LFSR in-vessel assembly.

## **Equatorial Port 3 Integration — EP03 (A. Basile):**

An EP03 integration meeting with Central Team counterparts reviewed the status of tenant systems and identified integration issues. Recent concept changes in the glow discharge cleaning system have improved integration possibilities. On the other hand, space conflicts on the closure plate are impacting the Motional Stark Effect (MSE) windows and requires a strategy for resolution compatible with MSE measurement requirements. In-vessel component clashes with MSE will also require attention. EP03 integrates tenants from multiple ITER parties, including the U.S., Chinese, Russian, and European Domestic Agencies, as well as the Central Team.

## **ITER & TOKAMAKS (R. NAZIKIAN)**

### **DIII-D (B. Grierson)**

#### *Research:*

The paper titled, "Wide operational windows of edge-localized mode suppression by resonant magnetic perturbations in the DIII-D tokamak," by Q. Hu, R. Nazikian, B. Grierson, N. Logan, D. Orlov, C. Paz-Soldan, and Q. Yu has been published by *Physical Review Letters* (<https://doi.org/10.1103/PhysRevLett.125.045001>) and a [press release](#) generated. In this paper, narrow and wide "windows" of ELM suppression are explained by the density dependence of resonant field penetration at the pedestal top and captured by nonlinear two-fluid MHD simulations. As the plasma density is lowered, the threshold for field penetration decreases and ELM suppression will occur over a wider range of  $q_{95}$ . At sufficiently low density, multiple magnetic islands can form near the top of the pedestal producing continuous and wide  $q_{95}$  windows of ELM suppression. High toroidal mode number RMPs ( $n=4$ ) are predicted to achieve RMP ELM suppression at substantially higher pedestal pressure in DIII-D.

The paper titled, "Observations of wall conditioning by means of boron powder injection in DIII D H-mode plasmas," by A. Bortolon has been accepted for publication in *Nuclear Fusion*. The experimental results show that injection of modest quantities of boron powder in tokamak plasmas produces beneficial effects by reducing wall recycling and impurities. The effective growth of a boron-rich film on the divertor wall was confirmed through analysis of material samples exposed to plasmas with injection of isotopically



enriched boron. This new wall conditioning technique can effectively complement the hazardous glow discharge boronization to extend the lifetime of the boron-rich films, without requiring interruption of machine operation.

### **ADVANCED PROJECTS (D. GATES)**

#### **Stellarators (D. Gates):**

D. Gates gave a short presentation at the ARPA-E BETHE kickoff meeting which was held virtually Aug. 11-12. The purpose of the meeting was to socialize the plans and goals between the recipients of the recently completed "BETHE" funding round from ARPA-E and the broader fusion community. Gates, who is Principal Investigator of one of the funded activities, identified the project team members and described the goals of the project which is entitled, "Stellarator Simplification using Permanent Magnets." The project aims to demonstrate the technical ability to use permanent magnets to make the required magnetic fields required to provide the 3D shaping for a stellarator. All of the other projects funded by BETHE gave similar talks. The meeting also included several panel discussions regarding issues that fusion will face on the road to commercialization.

M. Slominski, a SULI student working under N. Pablant, has completed his internship with PPPL. Slominski started working with Pablant in May 2020 using the X-ray ray tracing code XICSRT to produce a raytracing model for the W7-X Ar 17+ impurity channel, as well as to validate novel crystal geometries with the XICSRT code. Slominski recently gave a presentation on his work entitled, "XICSRT: Ray-tracing code for high energy density physics applications," at the SULI poster session last week. Slominski plans to present this work in a poster at this year's APS-DPP meeting in Nov. Slominski's work during this SULI term, specifically the validation of a mesh crystal optic within XICSRT, has provided an important step in validating the XICSRT code. This validation has made possible the further exploration of a new family of XICS crystal geometries proposed by M. Bitter, which will be used in future XICS systems to improve the wavelength resolution and total photon throughput of these systems.

### **COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)**

#### **Communications (L. Bernard):**

The Office of Communications posted two press releases to the PPPL website this week. The first focused on research by scientists at PPPL and General Atomics who have developed a model that for the first time accurately reproduces the conditions for the suppression of a particular type of plasma instability in the DIII-D fusion facility. The



second reported on a July 27-30 workshop aimed at introducing underrepresented students, including Black, Hispanic, LGBTQ+ and female students in their first or second year of college, to plasma physics, giving them an opportunity to network, and encouraging them to apply for internships at PPPL that could lead to careers in plasma physics and fusion sciences. These press releases were also posted to the *Newswise* and *EurekaAlert* press release distribution services,

A. Zwicker and L. Bernard attended a meeting on Aug. 11 of the Council of Fusion Communications, an organization formed to help disseminate information about fusion energy to a wide audience. Among other topics, the group discussed promotion of the FESAC report on the development of a long-range strategy that is expected by the end of the year.

#### **DIRECTOR'S OFFICE (S. COWLEY)**

Laboratory leadership has been communicating ongoing updates to staff regarding the COVID-19 virus and PPPL.

C. Ferguson participated in the Project Management Advisory Board Meeting on Aug. 11.

C. Ferguson participated in the National Laboratory Chief Operations Officers (NLCOO) weekly conference call on Aug. 11.

S. Cowley, M. Zarnstorff, and J. Menard participated in the ARPA-E BETHE Kickoff webinar on Aug. 11.

J. Menard participated in the virtual National Laboratory Chief Research Officers (NLCRO) summer meeting Aug. 12-13.

S. Cowley participated in the Academic and Administrative Managers Group (AAMG) meeting on Aug. 13.

**This report is also available on the following web site:**

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