The PPPL Highlights for the week ending March 14, 2020, are as follows:

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

Recovery (J. Galayda):

**NSTX U Test Cell** — BOA subcontractor 3BD completed wall repairs and painting of the NTC labyrinth. Powers Electric completed installation of the new lighting in the NTC labyrinth. Installation of the fire sprinklers and a new passage door into the test cell will complete the labyrinth construction.

**Coils** — The second set of coil winding has started at Sigmaphi. PF1A#2 is halfway through winding layer two, and PF1C#1 is halfway through winding layer one. The two wound coils are being prepared for vacuum pressure impregnation (VPI); the PF1A vacuum testing is complete and final testing of PF1B is almost finished.

**Center Stack Casing (CSC)** — The welding of the main components of the CSC was completed and the metrology data looks quite good. The CSC is being packaged for shipment to the Camden machining facility and machining is expected to start next week.

**HTT/HTP** — Hollis Line has completed the fabrication of the HTP and HTT components and shipped them to PPPL this week. All passed quality inspections, and cleaning is being performed prior to the shipping of the components to ORT/Holtec's facility in Pennsylvania. The components will be welded into the CSC upon its return from Camden.

**Virtual Office Facilitates Remote NSTX-U Recovery Project Work During Curtailment** — The project team has taken action to support off-site/remote continuation of most project activities throughout the period of curtailed activities at PPPL. This includes the participation of members of our team that come to us via our BOA subcontractors. Recovery management is fully committed to protecting the project’s most valuable assets and the PPPL staff and contractors that make up our team, while leveraging the Laboratory’s resources so that critical work can progress remotely. To this end, next week’s Final Design Review (FDR) is still on and will be conducted remotely, and preparations will continue similarly so that the CDE-3B Director’s Review will be held in early April, as scheduled. Other activities including procurement and preparation for NSTX-U Recovery reassembly and construction will also continue. A contact list for project personnel has been updated with cell phone numbers and posted at the head of the NSTX-U Recovery website to enable efficient reliable and efficient communication.
Research (S. Kaye):
Nothing to report

U.S. ITER FABRICATION (H. NEILSON)

A manuscript by the U.S. ITER Diagnostics team, “Preliminary design overview and performance assessment of the ITER low-field side reflectometer,” has been published online by the journal Nuclear Fusion. C. Muscatello of General Atomics (GA) was first author, while PPPL team members and others were co-authors. The paper presents the complete full-system design of the LFSR, corresponding to the design status at the November 2018 preliminary design review. The paper highlights the advances in the science and technology of microwave reflectometry for fusion plasmas, noting that the LFSR system combines, for the first time, the most advanced design features of existing installations and additionally includes the capability for real-time signal processing and analysis. The latter will enable the LFSR, which will measure the electron density profile in the outer layers of the ITER plasma, to be an active plasma control tool. The paper also describes the engineering solutions to some of the challenges encountered in the ITER application. A gaussian telescope is included in the transmission system in order to accommodate large (centimeter level) thermal displacements of the vacuum vessel relative to the building infrastructure. The paper is available at https://doi.org/10.1088/1741-4326/ab7e46.

The ITER Fabrication Department is moving forward to resume design work, suspended for several years, on U.S. diagnostic equipment to be installed after first plasma. Meetings with ITER Organization responsible officers have helped the PPPL team to assess the current design and integration status of the Electron Cyclotron Emission (ECE), Toroidal Interferometer-Polarimeter (TIP), and Motional Stark Effect (MSE) diagnostics. Retired Laboratory physicists D. Johnson and G. Taylor are supporting the re-planning, providing the benefits of their diagnostic knowledge and ITER experience to the Laboratory’s current ITER team.
ITER & TOKAMAKS (R. NAZIKIAN)

DIII-D (B. Grierson):

*Research:*

S. Haskey presented an MIT PSFC seminar titled, “Active spectroscopy measurements of the deuterium temperature, rotation, and density in the pedestal region of the DIII-D tokamak” ([link](link)). The seminar described recent experimental studies to determine the ion properties of the main-ions across the steep gradient region of the H-mode pedestal, motivated by understanding pedestal transport and validating neoclassical and turbulent transport models. Haskey described the principles of charge-exchange spectroscopy and advancements in synthetic diagnostic simulations and computation that has enabled routine main-ion charge-exchange measurements. Recent studies and dedicated experiments have resolved a historical curiosity in the ion power balance on DIII-D that can display a negative total ion power flow at the separatrix and have enabled improved comparisons with theoretical models.

THEORY (S. HUDSON)

A paper written by B. Sturdevant, S. Parker, C.S. Chang, and R. Hager titled, “Verification of an improved equation-free projective integration method for neoclassical plasma-profile evolution in tokamak geometry,” has been accepted by *Physics of Plasmas*. Sturdevant gave a seminar on March 2 titled, “An improved equation-free projective integration method for gyrokinetic profile evolution of tokamak plasmas.”

W. Fox and D. Schaeffer traveled to University of Rochester Laboratory for Laser Energetics to conduct an experiment, “Particle energization by magnetic reconnection in laser-produced plasmas,” at the OMEGA EP facility. The experiment was supported by the LaserNetUS program under Fusion Energy Sciences.

A. Reiman gave a research and review seminar at PPPL on March 3. The talk addressed the use of radio frequency (RF) current drive to stabilize large islands that appear in the plasma and threaten to cause disruptions. For large islands and high RF powers, a recently discovered nonlinear effect, RF current condensation, comes into play [Reiman and Fisch, Phys. Rev. Lett. 121, 225001 (2018)]. It can facilitate stabilization of islands and must be taken into account for proper aiming of ray trajectories for stabilization of large islands.
ENGINEERING (V. RICCARDO)

On March 10, PPPL staff volunteered at the annual New Jersey Science Olympiad held at Middlesex County College. Physicists D. Stotler and D. Elliot, and engineers S. Doskoczynski and B. Smith, ran an event called “Detector Building” at which students from high schools across the state competed in building and programming devices to measure temperature. The students’ ingenuity was on full display: solutions included Arduino and Raspberry Pi-based controllers, LED’s, buttons, and displays mounted on breadboards, and on-the-fly programming changes. The Science Olympiad organizers were very pleased with how smoothly the event ran, so much so they have already requested PPPL’s help to run it next year.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. Bernard):

The Office of Communications posted three news stories to the PPPL website. One reports that research by A. Nelson and others shows that injecting icy pellets of hydrogen into tokamaks can increase the plasma temperature more than puffing in hydrogen gas. The results, found during experiments using DIII-D, are encouraging for ITER. The second is a slide show celebrating the women of PPPL, honoring March as Women’s History Month. The third story reports that research by P. Holander and others shows that permanent magnets akin to those used on refrigerators could speed the development of fusion energy. In principle, such magnets can greatly simplify the design and production of fusion facilities called stellarators. These stories were also posted to the Newswise and EurekAlert press release distribution services.

DIRECTOR’S OFFICE (S. COWLEY)

Laboratory leadership and Dr. S. Faisal (PPPL doctor) have been communicating daily updates to staff regarding the COVID-19 virus. An all-hands virtual meeting was held on March 12 to discuss COVID-19 and answer questions from employees.

This report is also available on the following web site:

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