



The PPPL Highlights for the week ending June 13, 2020, are as follows:

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

Recovery (J. Galayda):

ESAAB Approval — PPPL received the signed Critical Decision Equivalent 3b (CDE-3b) document, which was approved by Harriet Kung on June 8. This is a major milestone and it paves the way to proceed with the remainder of NSTX-U Recovery Project procurement and construction.

Coils — Sigmaphi coil fabrication continued this week, and final paperwork was completed to allow the shipping of the PF1B lower coil early next week. The PF1A lower coil underwent testing, and the PF1A upper coil flags were brazed onto the coil. Mold preparation for the PF1C lower coil progressed, and the winding of the PF1C upper coil was 50% completed.

Center Stack Casing (CSC) — The machining of the center stack casing continued on two shifts at the Holtec facility in Camden, New Jersey. This phase of machining will continue through July 7, when the CSC will be shipped to Turtle Creek to attach the collar pieces on each end. It will then be returned back to Camden on July 20 for more machining into August.

Machine Core Structure (MCS) — Many fabrication activities continued at the three facilities currently making sling parts. Precision Boring in Michigan continued to machine sling component parts and preload parts for the sling assembly. In addition, the PF1A and PF1B capture and common flanges and PF1C capping flanges for the sling supports were fabricated. In South Carolina, Carolina Fabricators fabricated first articles for PF1A sling parts. Also, G. J. Oliver began machining the welded parts of the PF1C supports. Additional procurement activities to award contracts for the remaining MCS components neared completion.

Preparation for Resumption of PPPL Site Work — The Recovery Project team is working closely with the Laboratory on preparing to resume work onsite. These activities include the development of supplemental JHAs and necessary changes to work plans and procedures to protect our workers from exposure to COVID-19. The Recovery Project is planning for and will monitor the gradual ramp-up of work after the Laboratory is authorized to enter Stage 2 of the *PPPL COVID-19 Resumption of Onsite Work Plan*.

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Research (S. Kaye):

The formal review of the NSTX-U five-year research plan collaborator diagnostic proposals was held June 9-11. The NSTX-U team was given 11 homework questions about the research plan on June 9 and presented the answers to those questions on June 10. A short debrief of the review will be given by NSTX-U FES program manager J. King at the weekly magnetic fusion physics meeting on June 15 at 1:30 p.m.

U.S. ITER FABRICATION (H. NEILSON)

Computer-Aided Design (CAD) model and drawing submissions for the final design review of the Low Field Side Reflectometer in-vessel antenna assembly are almost complete. The CAD model of the assembly has been uploaded to the ITER CAD database, Enovia, and almost all of the system's 51 drawings have been signed and approved by U.S. ITER. The modeling and drawing efforts have been led by PPPL engineers M. Duco, T. Edgemon, and M. Messineo. In addition, recently completed design documents include the Design Compliance Matrix, reports documenting design-basis electromagnetic and computational fluid dynamics calculations, and remote handling task definitions.

The Electron Cyclotron Emission (ECE) team has completed the initial layout of the in-vessel optical components in the newly configured diagnostic shield module (DSM), reflecting the change information provided by the Central Team design group. The PPPL team has identified the need for some position adjustments and component design modifications to clear some interference conditions. Evaluation of modification options is in progress, incorporating input from the central team and partner University of Texas at Austin.

The Laboratory's ITER Diagnostics responsibilities included design integration for four diagnostic ports, including Equatorial Port 09 (EP09). An initial working meeting was held to discuss integration of U.S. "tenant" diagnostics Toroidal Interferometer Polarimeter (TIP) and Electron Cyclotron Emission (ECE) into EP09. Resource needs and assignments were discussed. Outreach to the EU's ITER Diagnostics team responsible for a third tenant, Equatorial Wide Angle Viewing (EWAV), is planned.

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ITER & TOKAMAKS (R. NAZIKIAN)

DIII-D (B. Grierson):

Research:

Four presentations connected to the PPPL DIII-D collaboration have been selected for IAEA oral presentations: “Gyrokinetic simulation in realistic divertor geometry reproduces density pump-out and enhanced electron heat confinement in tokamak edge plasma under resonant magnetic perturbations,” by R. Hager; “Role of resonant magnetic field penetration in ELM suppression and density pump-out in DIII-D ITER-like plasmas,” by Q. Hu; “Quasi-symmetric error field correction in tokamaks,” by J.-K. Park; and “Implementation of Artificial Intelligence (AI)/Deep Learning Disruption Predictor into a Plasma Control System,” by W. Tang.

Three nominations for invited talks connected to the PPPL DIII-D collaboration have been selected for the 2020 APS-DPP conference: “Integrated two-dimensional quasilinear modeling of fast ion relaxation,” by V. Duarte; “Main-ion thermal transport in high performance DIII-D edge transport barriers,” by S. Haskey; and “Predicting operational windows of ELMs suppression by resonant magnetic perturbations in the DIII-D and KSTAR tokamaks,” by Q. Hu.

ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates)

This week, N. Pablant gave the presentation for the impurity transport session at the 20th Coordinated Working Group Meeting (CWGM), held virtually over Zoom. The CWGM was created to facilitate coordination between different groups and experiments working on stellarator physics, and especially to coordinate joint experiments between different stellarator devices. This year’s CWGM was originally expected to be held in Kyoto, Japan at the end of March, but was moved to a virtual format due to current travel restrictions. Pablant serves as the coordinator and session leader for the impurity transport topic. In the current virtual format, each session leader presents an overview of current progress and ongoing actions taken from all of the contributors to that session. The overview that Pablant presented was made up of eight mini-talks that were prepared by researchers from labs around the world that work on stellarator research, including contributions with primary authors from the U.S., Japan, Germany, Spain, Poland, and Ukraine. The talk was well attended and an extended discussion was held to discuss further collaborations. D. Gates serves as one of the members of the organizing committee for the CWGM.

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After completing Phase 1 of a field work proposal in support of the COMPASS-Upgrade PDR, PPPL will support detailed design and analysis leading to an FDR. COMPASS-Upgrade is an essentially new replacement for the COMPASS device at the plasma physics institute (IPP) of the Czech Republic's Institute of Plasma Physics (IPP). It is a cryogenic copper machine with a major radius of .89m, with 5 Tesla at the plasma centerline, and 2MA plasma current. It is intended to develop ITER-relevant plasma densities and high power fluxes in the divertor region. The entire vacuum vessel is planned to reach 500C. This provides opportunities to investigate edge physics and liquid metal divertor concepts. The machine borrows from many of the engineering features of Alcator C-Mod.

Many engineering analysis tasks are common to COMPASS-Upgrade and NSTX-U. NSTX-U engineers provided analysis approaches for electromagnetic diffusion in the TF coil, disruption simulations and specifications, and global thermal analyses. The newly approved scope builds on participation by P. Titus in the CDR and PDR review panels, and a visit by the COMPASS Team to PPPL in late 2018. Engineers supporting the PDR effort included A. Brooks, P. Titus, H. Zhang, and J. Fang. Moving toward the FDR, the PPPL role includes support for IPP engineers and taking lead responsibility for a few of the analysis tasks needed for the FDR. The engineering support task has been carried on in parallel with other collaborations. Field error analyses for COMPASS-Upgrade have been proceeding under the direction of J. K. Park of PPPL. NSTX-U magnetic diagnostics, capable of surviving NSTX-U bake-out temperatures have been tested by COMPASS engineers for application in their 500C vessel. COMPASS uses helium-gas-cooled copper magnets but they have many design and analysis concerns similar to the coils being built for NSTX-U. Leading the COMPASS-Upgrade effort from the Czech Republic are R. Panek (IPP Director) and P. Vondracek.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. Bernard):

The Office of Communications posted two news releases to the PPPL website this week. The first described that Elizabeth Paul, a physicist at the University of Maryland, won a Princeton University Presidential Postdoctoral Research Fellowship and will be joining the Department of Astrophysical Sciences at Princeton. Paul, at the University of Maryland, developed a groundbreaking method for optimizing magnetic confinement stellarator fusion facilities. The second story described PPPL's engineering design activity on several plasma diagnostic systems for ITER, the international fusion experiment now



under construction in France. Both stories were sent to *Newswise* and *EurekAlert* press release distribution services.

DIRECTOR'S OFFICE (S. COWLEY)

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

On June 12, S. Cowley participated virtually in the National Laboratory Directors Council (NLDC) COVID-19 Coordination conference call.

This report is also available on the following web site:

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