Weekly HIGHLIGHTS

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

The PPPL Highlights for the week ending March 7, 2020, are as follows:

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

Recovery (J. Galayda):

NSTX-U All-Hands Meeting — The Recovery Project held an all-hands meeting on March 4 to recount project milestones and to lay out a roadmap as the project prepares to transition to operations.

- PPPL Director S. Cowley began the assembly by speaking of the pivotal role NSTX-U will play in fusion energy and the continued support the Recovery Project has received from the DOE. Cowley also spoke about the new research building and facilities coming to PPPL.
- Program Manager L. Hill recounted the myriad number of design reviews successfully completed by Recovery Project researchers, engineers, and staff. Hill also spoke about the project's successful and important partnership with the procurement office and the continued drive and focus on staffing and hiring.
- Program Director J. Galayda spoke at length on the importance of personnel safety and safe operations. During his presentation, Galayda encouraged personnel to ask for what they need to safely complete their work and to look out for each other on the job.
- Deputy Director S. Gerhardt talked about some of the key components of research done for the Recovery Project and highlighted work done on the vessel bus work, plasma-facing components (PFCs), and the new personnel safety system (PSS).
- NSTX-U Research Head S. Kaye outlined the next five-year plan and research goals for the project.

NSTX-U Final Design — This week, a peer review was held to finalize the design for the passive plates shunt. In addition, the final phase of the bus support final design review (FDR) was held. These last reviews cap 137 conceptual, preliminary, final, and peer reviews that have been completed over the last two years. Pending the completion of the project FDR later this month, the NSTX-U Recovery Project has reached the 100% final design milestone. This reflects the contributions of the entire project team and paves the way to fully transition to the construction phase of the project.

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NSTX-U Project FDR — The Recovery Project continued plans and preparations this week for its upcoming final design review (FDR), scheduled for March 17-19. This review, including responses to recommendations, will mark the completion of the NSTX-U design.

Center Stack Casing (CSC) — Final welding of the main center stack assembly continued at the ORT/Holtec Turtle Creek facility during the week. The CSC is expected to be shipped to the Holtec facility in Camden next week for machining to achieve PPPL tolerances.

Coils — Coil preparations, including pre-VPI electrical testing, were completed for the PF1A coil. The mold for PF1B was leak-tested in preparation for VPI at Sigmaphi in France. In addition, the winding of PF1A#2 began and PF1C winding line preparations neared completion.

HTT/HTP — The heat transfer plate and associated parts were completed and tested at the Hollis Line facility in New Hampshire. These components will be shipped to PPPL later in the week.

NSTX-U Test Cell (NTC) — Installation of the NTC labyrinth roof blocks was completed on March 3; this work marked the conclusion of installation of all NTC shielding. On March 5, Health Physics Division personnel performed the DT neutron generator test which verified the effectiveness of the newly installed shielding; the report for this test is being prepared. Next week, PPPL workers and BOA subcontractors will close out the NTC shielding work. The newly installed labyrinth is now complete with access door, lighting, and fire sprinklers.

Research (S. Kaye):

S.-K. Kim, a Ph.D. student from Seoul National University, visited PPPL Feb. 24-March 3 for collaborations on 3D MHD physics and validations in KSTAR. He introduced his work at the Magnetic Fusion Science meeting on March 2 with a talk entitled, “MHD modeling of the effect on n=2 RMP on peeling-ballooning mode in KSTAR.” The talk explained the importance of non-linear coupling between edge MHDs and applied RMPs for ELM-crash suppression, in addition to the RMP-driven pedestal transport. N. Logan and J.-K. Park worked with him to include neoclassical 3D transport effects in JOREK, and N. Ferraro talked with him about the possible future benchmark with M3D-C1 on RMP response simulations. Kim and Y.-S. Na also offered useful instructions and examples of KSTAR kinetic EFITs to a group of US-KSTAR collaborators through several meetings and video conferences, as the main developers of the kinetic EFIT tool (called GEFIT) available in NFRI.

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U.S. ITER FABRICATION (H. NEILSON)

Remote handling (RH) is an important consideration in the design of ITER diagnostic equipment such as the Low Field Side Reflectometer (LFSR) in-vessel antenna assembly. Following an assessment of failure probabilities, it was determined that the highly loaded, water cooled components closest to the plasma must be compatible with removal and installation using RH tools and procedures. Based on that determination, an analysis of the RH tasks and the RH compatibility of the design has been performed. Components that will interface with the RH equipment, namely the antenna block assembly (ABA), the retainers and fasteners where the ABA attaches to the port structure, the pipe joints in the water cooling manifold, and the joints connecting the antennas to the waveguide transmission lines, have been designed in conformance with ITER RH guidelines and in cooperation with the ITER RH group. Reports describing the compatibility of these components with RH tooling, the removal and installation tasks, and the plant requirements were issued for internal review by PPPL engineer G. Paraiso.

A novel NASA-developed material, a reinforced aerogel composite, has attracted the interest of the ITER Diagnostics Division as a possible solution for fire insulation in crowded spaces near the diagnostic ports. The Laboratory is exploring possibilities for testing and for procuring the material in quantity, should it be found to be a viable solution.

This week, PPPL hosted a meeting with the developers and technology transfer officials at NASA Glenn Research Center in Cleveland. ITER colleagues explained the requirements, and a plan for further action was developed.

ITER & TOKAMAKS (R. NAZIKIAN)

ITER-JET (M. Podestà, F. Poli):

A. Teplukhina visited the Culham Center for Fusion Energy in Oxford (UK) from Feb. 24 to March 6. She worked with the EUROfusion M18-11 task working group on integrated modeling of JET plasma discharges with ion cyclotron and neutral beam heating and current drive. She presented and discussed recent TRANSP modelling efforts on the particle balance sensitivity studies for deuterium and mixed hydrogen-deuterium plasma discharges. She worked together with the OMFIT/TRANSP group at JET to improve the workflow for magnetic equilibrium reconstruction with EFIT++, including the fast ion pressure profile calculated in TRANSP.

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ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates)

A PPPL press release highlighting a recent publication from N. Pablant on the Wendelstein 7-X stellarator has gotten wide media coverage. The article, written by J. Greenwald, has been picked up by at least 35 different science new outlets or aggregators and has also received attention on social media platforms (Facebook, Twitter, Instagram, and Reddit). The article has been translated into Spanish, French, and Chinese and posted to international science news sites. The paper, published in *Nuclear Fusion*, currently has an Altmetric Attention Score of 81, which puts it in the top 5% of all research outputs scored by Altmetric. The original press release can be found here:

https://www.pppl.gov/news/2020/02/design-w7-x-fusion-device-enables-it-overcome-obstacles-scientists-find.

F. Nespoli attended the first Impurity Powder Dropper workshop in San Diego on Feb. 27 and 28. He presented the results from the first experiments performed on LHD using the PPPL-designed-and-built IPD. New possible research lines related to the use of IPD were discussed.

Nespoli traveled to San Diego March 2-6 where he worked on the calibration of the Impurity Powder Dropper (IPD) with the PPPL IPD team (A. Bortolon, A. Nagy, F. Effenberg). Calibration curves, necessary for the interpretation of experimental results, were obtained for powders of different materials: boron, boron nitride, carbon microspheres.

THEORY (S. HUDSON)

E. Feibush presented, “Python Programming Techniques” in a mini-course sponsored by PICSciE, the Princeton Institute for Computational Science and Engineering. The presentation emphasized the elements of the Python language and how to continue learning Python. Attendees completed several in-class programming exercises using computers in the Princeton University Digital Learning Laboratory and their personal computers. Teaching assistants were A. Lu and B. Yao.

This report is also available on the following web site:

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