

Weekly

HIGHLIGHTS



The PPPL Highlights for the week ending December 5, 2020, are as follows:

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

Recovery (J. Galayda):

Management — The project team continues its preparations for the upcoming project reviews (director's review/cost estimate review, followed by a DOE independent project review).

Bus Supports — Water testing of the PF1B power cables was completed. Two cables failed at the fittings and PPPL worked with the vendor to correct the problem. The materials required for the PF extension and OH coax bus connection were inspected and prepared for fabrication of the supports in conjunction with the work packages.

Coils — Preparations for machining the six production coils continued at PPPL. Coil PF1B-S (spare) was shipped to PPPL from Sigmaphi on Nov. 20 and is at JFK airport pending delivery to PPPL. Coil PF1A-S (spare) was packed and awaiting shipping from Sigmaphi early next week.

Center Stack Casing (CSC) — The finish machining of the CSC in Camden, New Jersey, continued. Engineering oversight at Turtle Creek continued. At Turtle Creek, the bellows mockup welding found an issue with distortion that was reviewed in Engineering and by Holtec machining. Stud installation prototyping and organ pipe welding continued, with leak testing performed in concert to the completion of organ pipe welding.

IVPS — Installation of the pump and electrical and controls packages were approved for near-term installation. The pre-job brief will be scheduled for early next week.

Machine Core Structure (MCS) — Precision Boring in Michigan continued with fabrications. The capture and common flanges neared completion and fabrication began on fixture plates. In South Carolina, Carolina Fabricators continued production of PF1A sling base parts, with 27 parts completed. G. J. Oliver completed the upper PF1C support. The ceramic break flange was machined and fabrication began on the outer skirt forging. At PPPL, mockup activities were completed and lessons learned were reviewed and incorporated into assembly procedures. PF1B lower slings welding was completed and post-weld inspection and heat treating was started. Upper PF-1B sling fixturing was also started. The PF1C support was dimensionally checked and was moved into welding, cleaning, and testing.

Personnel Safety System (PSS) — Installation of the personnel safety system conduit began last week. The subcontractor was Electri Tech, Inc.

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Passive Plate Load Specifications Peer Review — A peer review was held Nov. 25 to review the load specification for the passive plate assembly. A number of as-built deficiency findings during the in-field in-vessel inspections for the helium tube support installation invalidated some of the assumptions used in the passive plate global model developed for the final design review (FDR) calculations. The review examined the analysis models used and re-evaluated the resultant transient electromagnetic loads developed on the passive plate assembly from plasma disruption, along with the revised calculation report required to qualify and document the load specification used for the passive plate reinforcement bracket design.

ITER PROJECTS (H. NEILSON)

Diagnostic Residual Gas Analyzer — DRGA (C. Klepper, ORNL):

In its investigation of optimum sampling configurations in the Equatorial Port 11 ex-vessel regions and agreement was reached with the port integrator to connect the sampling pipe to the vacuum extensions of two different diagnostics, for redundancy, in case either system has its isolation valves closed. Independent analyses by Klepper and IO counterparts showed that either configuration could meet response time requirements. The DRGA team will specify requirements for high-vacuum compatible surfacing for the main vacuum extensions of both diagnostics. These requirements will be documented in interface sheets. Discussions with ITER safety and vacuum groups concluded that all the EP11 DRGA flanges and valves can be single seal, as they are behind the isolation valves of the two spectrometers, and also a single-wall bellows can be used.

Diagnostic Team:

The team participated in the monthly meeting with the IO Diagnostics Division, reporting on several tasks addressing near-term deadlines. Overhead supports for TIP and LFSR transmission lines are being designed under the leadership of M.-A. de Loos. A design of the Upper Wide Angle Viewing system compatible with the unique upper port 17 port plug, proposed by project leader M. Smith, was accepted by IO and EUDA port integration leaders. An in-vessel configuration of mirrors, cooling, mirror cleaning, and shutters, compatible with equatorial port 1, is being developed under the leadership of A. Cohen. Diagnostics CAD leader M. Messineo reported progress in CAD data transfers between the U.S. team and IO. At an internal project meeting on Dec. 4, the team reviewed ambitious plans for advancing all our projects in 2021.

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ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates):

This past week, R. Lunsford presented, “Profile modification through boron carbide powder injection in W7-X” to the W7-X profiles topical group. The discussion focused on modifications observed to the electron temperature and density profiles resulting from powder injection from the Probe Mounted Particle Injector (PMP). These changes were drivers for transient elevations in both the ion temperature profile and the total plasma stored energies possibly due to the suppression of the ion temperature gradient instability. Discussion of alternate injection species and continued experiments during upcoming operational periods was also conducted.

F. Nespoli gave a presentation titled, “Dust injection simulator code for modeling of IPD experiments (and more)” at the bi-weekly Impurity Powder Dropper meeting on Dec. 1. The talk reports on the development of a new dust tracker code able to handle 3D, time-varying plasma backgrounds. Preliminary results are presented, where the effect of plasma turbulence on dust dynamics are investigated. Future plans include the modeling of powder injection experiments in 3D geometry such as LHD and W7-X, as well as investigating the effect of ELMs on dust grains dynamics.

A. LeViness, a third-year Ph.D. student working under D. Gates, presented her research “Fast particle optimization of a quasi-axisymmetric stellarator equilibrium” on Dec. 4 to the Topical Group for Fast Ions at the Max Planck Institute for Plasma Physics in Greifswald, Germany. In this work, which was done as a second-year theory project, she produced several equilibria with improved fast particle confinement for the PM4STEL project. These were obtained by minimizing deviations from quasi-axisymmetry on a single flux surface using the stellarator optimization code suite STELLOPT developed at PPPL, and improvements in fast particle confinement were confirmed using simulations in the guiding-center code BEAMS3D.

THEORY (S. HUDSON)

A paper titled, “Noether currents for Eulerian variational principles in non-barotropic magnetohydrodynamics and topological conservation laws” by A. Yahalom and H. Qin was published in *Journal of Fluid Mechanics*: <https://doi.org/10.1017/jfm.2020.856>. The paper calculated Noether currents for the Eulerian variational principle of ideal non-barotropic magnetohydrodynamics (MHD), and symmetry analysis was used to derive topological constants of the dynamics.



DIRECTOR'S OFFICE (S. COWLEY)

S. Cowley participated in a National Laboratory Director's Council (NLDC) Agency Review Team meeting on Nov. 30.

A virtual colloquium was presented on Dec. 2 by the University of Pennsylvania's Zahra Fakhraai titled, "Manipulating Time with Entropy."

D. Graves hosted a virtual research seminar on Dec. 3, which was presented by J. Vella, titled, "The Wide Application of Molecular and Equation of State Modeling: From Plasma-facing Materials to Gasoline / Oxygenate Blends."

J. Menard and M. Zarnstorff participated in the annual INFUSE workshop Dec. 1-2. The virtual workshop was sponsored by INFUSE and the DOE SC Fusion Energy Sciences Program and co-hosted with the Electric Power Research Institute (EPRI) and the Fusion Industry Association (FIA). The theme of the workshop was on planning and balance-of-plant resource identification enabling electric power generation from fusion reactors.

This report is also available on the following web site:

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