



The PPPL Highlights for the week ending December 21, 2019, are as follows:

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

Recovery (J. Galayda):

CAMAC — The Maintenance and Run Prep (M&RP)-driven computer-aided measurement and control (CAMAC) replacement project decommissioned crate #40 in the D-Site pumphouse. This component of the plant control and monitoring system used to provide operators the ability to control and monitor the cooling water pumps. The replacement, based on Programmable Logic Controller (PLC) technology, enabled the Instrumentation and Controls team to decommission 40-year-old CAMAC hardware and provide a modern, maintainable solution to support operations without significant changes to procedures.

NSTX-U Test Cell — The BOA subcontractor mobilized this week to begin installation of the NSTX-U test cell shielding.

Neutral Beam Injection (NBI) Duct Shield FDR — A final design review (FDR) was held Dec. 16 to review the final design of the shielding plates for the neutral beam injection (NBI) duct and to assure that this design meets proper requirements. The FDR showed the design's progression since the Sept. 18 conceptual design review (CDR) and reported the chit resolutions completed since the CDR.

HTT/HTP Vessel Side Water and Helium Connection Line FDR — An FDR was held Dec. 17 to review development of the NSTX-U center stack heat transfer tube (HTT) and heat transfer plate (HTP) water and helium interconnection design since the studies presented at the Nov. 2018 final design review, and to confirm the final design leading to the procurement and manufacturing/rework phase. This second FDR presented the design of the water and helium interconnection from the HTT/HTP to outside of the machine core structure umbrella structure.

Passive Plate Tile Preload and Grafoil Compression Determination Peer Review — A peer review was held Dec. 17 to review the test and analysis of the passive plate reload in order to recommend the right level of torque to apply for new tile installation. After a design verification and validation review (DVVR), a variety of issues arose with respect to bakeout that prevented achievement of the required 350 degrees Celsius per the GRD. Passive plate tile preload was investigated to address the bakeout KPP issue.

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Magnet Recovery Project FDR — A final design review was held Dec. 18 to review progress on the remediation of issues brought up during the April 2018 preliminary design review. The scope included the Aquapour grounding wire, painting the OH ground plane, and the upper TF bundle water fitting inspection and water leak management. New design improvements were part of this review and included wrapping Kapton on the upper G10 bulkhead and adding a new dam with duct seal to ensure water leaks won't bridge tubes.

VVHW Recovery Field Scope FDR — A final design review for the first half of the VVHW recovery field scope was held Dec. 19 to review the detailed inspection results, design improvements, implementation procedures, relevant structural analysis, and detailed design of tooling. This was to address the remaining design verification and validation review (DVVR) chits from an earlier preliminary design review. A second FDR will be held for the second half of this scope at a later date.

PF Coil Fabrication Schedule — Project personnel met with J.-L. Lancelot, the president of Sigmaphi, to discuss measures that Sigmaphi will take to prevent further schedule slippage. Lancelot gave assurance that extended work hours will be authorized for qualified personnel to maintain or, if possible, advance the schedule. He also agreed to assess the availability of critical spare parts for the coil winding machines and take steps to ensure that work will not be interrupted for lack of spare parts. The vacuum integrity test of the reassembled PF1A mandrel was underway on Dec. 19. Pump-down was going smoothly. As of Dec. 19, the PF1B mandrel had arrived in France and was awaiting release from French Customs.

Component Fabrication — The project team is launching efforts to have key components fabricated that are needed for NSTX-U reassembly. Competitive bids are being evaluated for the hundreds of graphite tiles that will be installed in the machine, and the project team is drawing up detailed plans to begin the fabrication of machine core structures — many of these will be made right here at PPPL by the Laboratory's technicians.

Research (S. Kaye):

G. Verdoolaege (Ghent University, Belgium) concluded a two-week visit to PPPL to work with S. Kaye on finalizing the draft paper on the updated international H-mode database, and to work with A. Diallo on ELM research.

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The paper titled, “Exploring the Regime of Validity of Global Gyrokinetic Simulations with Spherical Tokamak Plasmas” by Y. Ren, et al. was published in *Nuclear Fusion*. The paper shows that while first-principle model, gradient-driven gyrokinetic simulations provide decent agreement in ion thermal transport with a set of NBI-heated NSTX, they are not able to explain the observed electron thermal transport variation in a set of RF-heated L-mode plasmas, where a factor of 2 decrease in electron heat flux is observed after the cessation of the RF heating. Identifying the regime of validity of the gradient-driven assumption is essential for first-principle gyrokinetic simulations to more confidently predict the confinement performance of ITER and future magnetic confinement devices.

U.S. ITER FABRICATION (H. NEILSON)

ITER Diagnostics team members A. Basile and H. Neilson traveled to the project site in St. Paul-lez-Durance, France, to participate in preliminary design reviews (PDR) of important port integration projects. The scope of port integration is to provide the mechanical support, shielding, and other services for diagnostics assigned to a given port on the ITER tokamak. At a PDR, it is expected that requirements should be defined, design compliance with the requirements should be shown, and schedules and risks for implementation should be identified. Basile served as a reviewer for Equatorial Port 8 while Neilson chaired the PDR of Upper Ports 2 and 8. Both of these ports are based on standard port structure, shielding, and interface design concepts developed by the Russian and the ITER Central Teams, and which the U.S. has adopted for its own port integration responsibilities. Both reviews found that the teams have successfully adapted these concepts to their ports, customizing as necessary to accommodate the hosted diagnostics. It was found, however, that the design maturity of hosted diagnostics, including the Upper Visible and Infrared Camera system, a U.S. responsibility, lags that of port designs, so it is not possible to evaluate whether diagnostic performance requirements can be satisfied within the design envelopes being established. As port designs mature and move into fabrication, the constraints imposed on diagnostics may put their performance at risk.

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ITER & TOKAMAKS (R. NAZIKIAN)

DIII-D (B. Grierson)

Research:

N. Logan gave a seminar to ASDEX Upgrade (AUG) scientists introducing the Generalized Perturbed Equilibrium Code (GPEC) and demonstrating a typical workflow using the OMFIT interface to analyze and optimize the application of 3D field coils in AUG. The attendance included AUG researchers interested in stability calculations for scenario optimization, resonant plasma response optimizations for ELM suppression, and predictions of the neoclassical toroidal viscosity for experimental application as well as theoretical benchmarks against Max Planck IPP non-ambipolar transport models. The reception of GPEC was enthusiastic and researchers have already begun to apply the code at AUG and contribute improvements for interfacing with AUG data. In addition to AUG and PPPL, GPEC is also publicly available and used at DIII-D, KSTAR, and COMPASS.

International PMI and FES LM PFC Development Program (R. Maingi):

R. Maingi and Z. Sun conducted experiments with the PPPL impurity powder dropper and granule injector on EAST. ELMs were suppressed with boron injection as before, and the threshold boron injection rate for ELM suppression was shown to increase with injected power. In collaboration with L. Wang, neon gas injection was added to enhance power exhaust with suppressed ELMs.

A second experiment using boron powder injection with reversed grad-b drift — i.e., down — was conducted. ELMs were suppressed above a critical boron flow rate, as with grad-b drift up, and power exhaust was substantially enhanced. A weak, low-frequency mode was also observed during the ELM suppression phases.

ADVANCED PROJECTS (D. GATES)

Stellarators (D. Gates):

N. Pablant traveled to ITER in Cadarache, France, to participate in a two-day diagnostic preliminary design review (PDR) as an expert panel member. The review was for the XRCS-Survey spectrometer, a broad-range spectrometer covering an energy range from 100eV to 10keV. This is a first plasma diagnostic with a primary purpose of monitoring impurity influx and density. Pablant was asked to join the panel for his expertise on X-ray spectroscopy and experience in developing X-ray spectrometers on LHD and W7-X. The XRCS-Survey spectrometer is being developed by ITER India and led by S. Varshney.



THEORY (S. HUDSON)

M. Churchill attended the NeurIPS 2019 machine learning conference in Vancouver, Canada, Dec. 9-14, and presented a paper titled, “Deep convolutional neural networks for multi-scale time-series classification and application to disruption prediction in fusion devices.”

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER)

Communications (L. Bernard):

The Office of Communications posted three press releases to the PPPL website. One focuses on PPPL physicists V. Geyko and N. Fisch receiving a patent for a novel design that could increase the efficiency and reduce toxic emissions from gasoline-fueled internal combustion engines that power millions of cars and trucks around the world. The second focuses on research by PPPL physicists R. Nazikian and Q. Hu into an innovative new model that can serve as the basis for predicting the suppression of edge-localized modes in DIII-D. The third introduces the 2020 Science on Saturday series. The first talk in the series will be “Visual Perception and the Art of the Brain,” by Sabine Kastner, a professor of psychology and neuroscience at Princeton University. All news releases were also posted to the *EurekAlert* and *Newswise* press release distribution services.

DIRECTOR’S OFFICE (S. COWLEY)

J. Menard hosted a PPPL Computational Strategic Plan Development meeting Dec. 17-18. The meeting gathered helpful findings, comments, and recommendations from six external reviewers.

On Dec. 20, PPPLers participated in the annual PPPL photo shoot, followed by the annual State of the Laboratory (SOL) address by Laboratory Director Steven Cowley. The SOL included announcement of the recipients of the Kaul Foundation Prize for Excellence in Plasma Physics Research and Technology Development, and the Distinguished Engineering Fellow award, as well as other Laboratory awards. The event ended with celebratory refreshments in the lobby.

This report is also available on the following web site:

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