

Weekly

HIGHLIGHTS



The PPPL Highlights for the week ending July 15, 2016 are as follows:

U.S. ITER FABRICATION (C. NEUMEYER):

Steady State Electric Network (SSEN):

Uninterruptible Power Supply (UPS) system and DC Distribution: The proposal submittal period is closing and the evaluations will begin this coming week. A draft version of an Arrangement document that transfers procurement of the associated battery banks to the ITER Organization was prepared. The objective is to sign the two contracts and the Amendment prior to the end of FY2016 so that U.S. ITER can obligate the funds.

Power Transformers: Shipment of Lot #1 and Lot #2 oil-filled units (eight @ 35MVA and four @ 7MVA) from the Schneider Electric factory near Istanbul, Turkey was postponed until August 24 because the ITER Organization has not been able to make ready the temporary oil retention pits that are required during storage. At the time of writing it appears that the failed coup attempt in Turkey will not impact shipping plans.

6.6kV Switchgear: Shipment of the remaining 110 cubicles in Lot #3 and #4 from the Schneider Electric factory in Manisa, Turkey, is scheduled for July 29. Inspection of packaging by our subcontract QC inspector that was supposed to take place on July 12-13 was postponed to July 19-20 due to unavailability of the inspector due to an injury. As soon the inspection is completed, PPPL can sign the shipping release and can declare completion of the last of the DOE SSEN performance plan milestones for FY2016. At the time of writing it appears that the failed coup attempt in Turkey will not impact shipping plans.

Baselining: Preliminary versions of the cost, schedule, risk register, cost uncertainty and advanced procurement plan were submitted to the U.S. ITER project controls office.

Diagnostics:

Project and Administrative Notes and Highlights: This week the ITER Diagnostics and Port Plug team was focused on getting revised cost and schedule plans in to the project controls team. New engineering team members will be coming on board through PPPL new-hires and internal candidates.

Upper Port Wide Angle View Vis-IR Cameras (UWAVs): Review of Scientific Instruments has accepted for publication the paper “Upper Wide-Angle Viewing System for ITER (RSI-HTPD MS# C-16185-1.2.31R).” The authors are: Charles Lasnier, Adam McLean, Anthony Gattuso, Raymond O’Neill, Matthew Smiley, J. Vasquez, R. Feder, M. Smith, B. Stratton, D. Johnson, A. Verlaan, and J.A. Heijmans.

Equatorial Port 9 Integration and DSM Engineering: A video conference with Major Tool and Machine was held to discuss possibilities for procuring e-beam weld engineering expertise for fabrication of EP09, UP11 and UP14 port plug DSMs. Major Tool is receptive to providing this service which will provide a manufacturing justification for the PDR level designs. A face-to-face meeting with Major Tool is planned later this month.

NSTX-U (M. ONO):

The NSTX-U Team Meeting was held on July 15 at PPPL. The NSTX-U team was updated on the ongoing PF 1A blockage issue and the restart of plasma operations and the run plan for FY2016 and beyond. The meeting material is available on the web at: http://nstx.pppl.gov/DragNDrop/NSTX_Meetings/Team_Meetings/2016/2016-07/.

NSTX-U plasma operations remained on hold this past week during recovery from the PF1aU coil water leak. A low temperature (< 90°C) electrical bake of the center stack to dry residual water was completed, and vessel/coil system insulation tests (hi-pots) performed. All coils were able to withstand rated Voltages, but the TF system’s electrical leakage was higher than seen in earlier tests. This was believed to be due to trapped moisture at the base of the center column. A nitrogen purge was established at the bottom of the center column, and dramatic reductions in the electrical leakage are being recorded. This will continue until former levels of TF electrical resistance are restored. The PF1aU coil will not be used for the remainder of this year’s run campaign, and plasma operations will resume with the new XMP-155 (L-mode development w/o PF1aU) to assess the use of PF2 for similar plasma shape control. Arrangements are being made to have the PF1aU coil analyzed and replaced during the upcoming outage. In parallel with the drying work this week, good progress was made on the commissioning of new capabilities. The Material Analysis Particle Probe (MAPP) automated remote position control was tested as a final step in sample exposure and analysis capability for plasma operations. Pre-operational testing of the Lithium Evaporator (LITER) probes has been completed, and all systems are ready to support the lithium fills of the probes. The MGI, the MAPP diagnostic, and the LITER probes are all ready to support NSTX-U plasma operations. Also this week, conditioning of the six neutral beam ion sources continued, and the vacuum conditioning of the HHFW antennas was completed. The HHFW Antenna/RF systems are now ready to tune into a plasma.

The mid-plane and the lower divertor MGI valves were successfully commissioned in nitrogen, helium, and neon at the full operating pressure planned for the FY2016 experiments. The system is now ready to support plasma operations.

The first machined high-Z tile was received from the vendor for examination. All of the dimensions of the features were well within specifications, and the surface finish exceeded requirements. The surface hardness was tested, and the absence of any effects due to heating from the electrical discharge machining (EDM) process was verified. The vendor was thus instructed to proceed with the remainder of the tile machining.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

A prototype heterodyne receiver for the low-field-side ECE-Imaging upgrade on DIII-D was delivered for testing earlier this week. The low-noise receiver circuit is a complete system-on-chip integrated assembly, including low-noise amplifier, mm-wave double-balanced mixer, x6 multiplication of the local oscillator, and intermediate frequency amplifiers on a single GaAs die. Adapted from commercial E-band telecommunications and active imaging technology, this chip not only increases diagnostic capability, but at less than \$400 per unit also reduces cost by replacing more than \$5k worth of discrete components. Furthermore, this solution will allow the diagnostic to be powered by a single frequency synthesizer source operating at less than 15 GHz, eliminating the need for backward wave oscillator sources and the nearly 20 meters of corrugated waveguide. The upgraded ECE-Imaging diagnostic is expected to provide new data with lower noise levels and therefore clearer images of edge-localized modes and other instabilities in the edge of DIII-D plasmas. G. Kramer visited DIII-D this week to work on fast ion transport in steady state plasmas and on the analysis of MIR data. D. Mauzey, new student intern since July 1, has produced a new LGI dropper design in collaboration with S. Gibson, student intern since June 1. This continues the work performed by Peter Fisher, former student intern.

C-Mod (W. Guttenfelder and C. Kessel):

W. Guttenfelder and C. Kessel traveled to MIT July 13-15 to lead an experiment on Alcator C-Mod titled "Transport and turbulence validation at high beta and low rotation." ITER-like H-mode discharges with $\beta_N=1.8-2.2$ were achieved using 4-4.5 MW of ICRF power at low field (2.7 T). Full profile data was measured using Thomson scattering and crystal imaging X-ray spectroscopy. PCI and polarimeter fluctuation data were also acquired. These discharges will be used to validate the quantitative impact of electromagnetic effects on transport at ITER-like beta values through the use of gyrokinetic simulations coupled with synthetic diagnostic calculations.

International (R. Hawryluk):

R. Hawryluk attended a workshop at JET regarding the proposed internationalization of the JET program. This proposal would enable the ITER members to work together on a wide range of experiments on the JET facility if JET operation were extended.

F. Poli visited the ITER Organization on July 11-13. She has reported on PPPL progress on the HCD analysis within the contract on EC power management. She met with the HCD department and with the Science and Operation Department to discuss the use of RF and NBI as actuators. Focus was on the use of IC and EC for sawtooth control and of EC for NTM control. She presented TRANSP simulations with real time feedback of NTMs and discussed the implications

of this analysis on the required precision in the detection of the island, on the accuracy of real-time magnetic equilibrium reconstruction, and priorities in the decisional trees for shared actuator control applications.

ADVANCED PROJECTS (H. NEILSON):

S. Lazerson presented a poster entitled “Predictions of neutral beam deposition and energetic particle loss in W7-X” at the European Physical Society Conference on Plasma Physics, held July 4-8 in Leuven, Belgium. In this work the BEAMS3D code was used to calculate neutral beam deposition in the Wendelstein 7-X (W7-X) stellarator. Comparison with analytic pencil-beam calculations showed agreement with respect to a peaked outboard deposition pattern and estimates of neutral beam shine-through. However, the BEAMS3D code predicts a larger population of particles born on the inboard side of the device. While not affecting the macroscopic shine-through, this does suggest that beam based diagnostics will have greater signal in the core region. Progress on loss calculations was also presented.

THEORY (A. BHATTACHARJEE):

On July 6, a paper by P. Bhat, F. Ebrahimi, and Eric Blackman entitled “Large scale dynamo action precedes turbulence in shearing box simulations of the magnetorotational instability” was published online in Monthly Notices of the Royal Astronomical Society (MNRAS), <http://mnras.oxfordjournals.org/cgi/content/abstract/stw1619>. “Large-scale dynamos are routinely found to be associated with sustenance of magnetorotational instability (MRI) turbulence in direct numerical simulations of MRI unstable systems. Until now, the study of large scale dynamos in MRI shearing box simulations have focused primarily on modeling cycle periods in the large scale fields after the onset of turbulence. In this paper, the nature of MRI large scale dynamo action in the shearing box simulations is analyzed in a new way. Through computational and physics analysis, we show the presence of exponential growth of large scale fields in the early MRI growth phase, before turbulence ensues, thus highlighting that turbulence is not essential for the large scale field growth. To provide a more complete picture for large-scale dynamo action, we employ two independent planar averaging procedures, horizontal (x-y) averaging commonly performed in previous shearing box MRI studies and vertical (y-z) averaging motivated by the global cylindrical simulations, respectively. In contrast to previous studies restricted to horizontal averaging, the presence of large scale fields when vertical averaging is employed instead, is demonstrated. Vertical averaging also allows for monitoring the evolution of the large scale vertical field and a feedback from horizontal low wavenumber MRI modes is found to provide a clue as to why the large scale vertical field sustains against turbulent diffusion in the nonlinear saturation regime. The large scale fields obtained from vertical averaging are found to compare well with global simulations and quasilinear analytical analysis from a previous study by Ebrahimi and Blackman (2016). Potential implications of these new results for understanding the large scale MRI dynamo saturation and turbulence are discussed.”

OFFICE OF ACADEMIC AFFAIRS (N. FISCH):

On July 12, Q. Teng, PhD candidate in the Program in Plasma Physics, successfully defended the thesis proposal to explore, “A Thermo-resistive Tearing Mode Model of Density Limit in Tokamaks.” The thesis advisors are: R. White, D. Gates, and N. Ferraro.

This report is also available on the following web site:

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