PRINCETON PLASMA PHYSICS LABORATORY
WEEKLY highlights

PPPL
U.S. DEPARTMENT OF ENERGY

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

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

Steady State Electric Network (SSEN):

Uninterruptible Power Supply (UPS) system and DC Distribution: Preparation of the RFPs is underway. Sample contract review by U.S. ITER ORNL is complete. The package will now be sent to PNNL for review, then DOE PSO. Forecast issue date is April 29.

Power Transformers: Lot 3 is fully ready to ship except that the Release for Shipping (RFS) document package is still a work in progress. The shipping date had to be postponed to May 3 because the ITER site is not available to receive deliveries the prior week. But there is still ample float with respect to the milestone. Note that the delivery of this this shipment (by June 15) is an important ITER Council and PEMP milestone, and progress is still well ahead of schedule. Factory Acceptance Testing (FAT) of the Lot 1 and Lot 2 transformers was successfully completed this week.

Diagnostics:

Low Field Side Reflectometer (LFSR): The latest neutronics analysis for ITER equatorial port 11, run by the port integrators, Russian Federation Design Agency (RFDA), indicates a high level of radiation dose rates, which is traced back to the first Diagnostic Shield Module (DSM1) housing LFSR. The PPPL design team is working with RFDA to address this issue through modifications. R. Feder was approved for travel to visit and work with the EP11 integration team to try to resolve some of these issues in June.

Electron Cyclotron Emission (ECE): The Hot Source design team at UT at Austin is scheduling a peer review in the fall of 2016. Hot Source design is scheduled to be frozen by summer. PPPL is continuing ECE-DSM design, and pursuing parallel approach for shutter mirror actuation: (1) procurement of piezo electric actuator is currently underway with the target to start thermal and magnetic field performance testing in summer. Special mock-up mirror and test fixture are designed; (2) simultaneous push rod mechanism is designed, this mechanism uses conventional mechanical approach for shutter mirror actuation with mechanical feedthrough at the back plate. Special push rod attachment was proposed to fix the mirror in operational position to reduce stresses from EM and structural loads.

During the week of April 4-8, G. Taylor attended the Joint Workshop on Electron Cyclotron Emission (ECE) and Electron Cyclotron Resonance Heating (ECRH) (EC-19) in Gandhinagar,

India. He presented a talk entitled “Update on the status of the ITER ECE diagnostic design.” EC-19 is a bi-annual meeting that covers the research areas of electron cyclotron wave theory, ECE, ECRH, electron cyclotron current drive, experiments on various Tokamaks and Stellarators and technology associated with ECE and ECRH. Following the EC-19 meeting he visited the Institute fort Plasma Research in Gandhinagar where he meet with members of the Indian ITER ECE diagnostic design team for discussions and planning. The ITER ECE diagnostic is being jointly designed by the U.S. and India.

Toroidal Interferometer and Polarimeter (TIP): At General Atomics (GA), a laboratory prototype interferometer/polarimeter has been in operation since last summer. Noise floors were determined with probing and reference legs confined, up to now, on an optical table. Recently, the lasers were directed and returned on a long beamline prototypical of the 120-path length of the longest sampling chord on ITER. The systems operate in this mode, but with higher noise. Efforts are now underway to optimize operation in this more realistic mode of operation.

NSTX (M. ONO):

A FY2016 NSTX-U plasma operations update: The department has completed 7.23 run weeks and 748 plasma shots. The total operation target is 18 run weeks.

R. Maingi, M. Jaworski, and R. Majeski of PPPL presented a sequence of talks at Oak Ridge National Lab. Maingi’s talk was entitled “Lithium and Liquid Metal Studies at PPPL: An Introduction,” Jaworski’s talk was entitled “NSTX-U upgrade plan for liquid metals PFCs,” and Majeski’s talk was entitled “Lithium walls and enhanced tokamak performance.” Collaborative discussions with the fusion energy and materials divisions were held, as were lithium related PMI experiments on Proto-MPEX.

J. Terry (MIT) visited PPPL to discuss plans for the MIT collaboration on the gas-puff imaging diagnostic on NSTX-U. The planned 90-channel fiber array offers 2-MhZ sampling and complements the existing camera based GPI analysis.

The midplane MGI assembly was installed. The lower MGI assembly passed its high-pot test on the bench. The roughing pump for the Zeus/LoWeus/Mona Lisa UV spectrometers was installed. That assembly is now being pumped by the turbo/roughing pump combination.

A mockup of the waveguide run for the FIReTIP and High-k diagnostics has been installed between the east wall of the NSTX-U Test Cell to the vicinity of the vacuum vessel.

NSTX-U has completed the first of a two-week maintenance period, which includes the warm-up and regeneration of the neutral beam LHe cryoplant.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

S. Haskey has been working with L. Stagner (UC Irvine) on including a new release of the FIDASIM code in OMFIT. The FIDASIM code is used to forward model the main ion CER measurements on DIII-D and calculate corrections to the apparent main ion temperature and velocity due to cross-section, geometry, and halo effects. Stagner has implemented several enhancements in the new version of the code, which significantly improve the forward modeling capability for the main ion CER system. The new version of the code is also an order of magnitude faster, significantly increasing the speed at which the main ion CER analysis can be performed.

ADVANCED PROJECTS (H. NEILSON):

The Laboratory is conducting LDRD-funded studies focusing on stellarator physics and engineering advances since NCSX was designed and the expectation of important new results coming from Wendelstein 7-X in the coming years. It is expected that these new developments would set directions for a new U.S. stellarator initiative. The chosen LDRD tasks–in improved coils, turbulent transport optimization, divertor design, and QA/QH comparison– are aligned with the consensus conclusions of the stellarator research needs workshop that was held at MIT in February, and benefit from collaboration with universities including Wisconsin, Maryland, and Auburn. A recent highlight has been the progress made in scoping a divertor for a quasi-axisymmetric stellarator pilot plant. Calculations by the University of Wisconsin using field line tracing and transport simulation (with the EMC3-EIRENE code) have identified a divertor configuration which appears to be compatible with a liquid-metal target concept. PPPL stellarator machine configuration studies have adopted straight outer-leg modular coil designs (developed in an earlier LDRD study) and are now focused on divertor configuration design. A liquid metal target may offer advantages in terms of power handling capability and divertor lifetime.

THEORY (A. BHATTACHARJEE):

On April 14, T. Stoltzfus-Dueck (Princeton) presented a theory seminar on parallel electron force balance and the L-H transition: “In a popular description of the L-H transition, energy transfer to the mean flows directly depletes kinetic energy from turbulent fluctuations, resulting in suppression of the turbulence and a corresponding transport bifurcation. However, electron parallel force balance couples nonzonal velocity fluctuations with electron pressure fluctuations on rapid timescales, comparable with the electron transit time. For this reason, energy in the nonzonal velocity stays in a fairly fixed ratio to electron thermal free energy, at least for frequency scales much slower than electron transit. In order for direct depletion of the energy in turbulent fluctuations to cause the L-H transition, energy transfer via Reynolds stress must therefore drain enough energy to significantly reduce the sum of the free energy in nonzonal velocities and electron pressure fluctuations. At low k, the electron thermal free energy is much larger than the energy in nonzonal velocities, posing a stark challenge for this model of the L-H transition.”

DIRECTOR'S OFFICE (C. AUSTIN):

On April 13, Professor Sonja Schmid from Virginia Tech presented a colloquium entitled, "Inherently Risky Designs? The History of Soviet Nuclear Reactors and the Notion of Safety."

This report is also available on the following web site:
http://www.pppl.gov/publication-type/weekly-highlights