Weekly HIGHLIGHTS

PPPL PRINCETON PLASMA PHYSICS LABORATORY

U.S. DEPARTMENT OF ENERGY

The PPPL Highlights for the week ending January 20, 2017 are as follows:

U.S. ITER FABRICATION (H. NEILSON):

ITER Steady State Electrical Network (J. Dellas):

Power Transformers: All shipments have arrived at the ITER site. The IO has inspected the last shipping batch, which contains the accessories, and have provided a satisfactory preliminary inspection report.

6.6kV Switchgear: Final inspection reports received from IO reported no issues. The final delivery report for Lots 3 + 4 has been submitted for approval.

Reactive Power Compensators: Manufacturing at the Schneider Pringy, France, factory is ongoing. The factory acceptance tests for the first two lots have been completed.

Uninterruptible power supply (UPS) and DC Distribution: Coordination meetings for both contracts are ongoing to facilitate preparation of Release for Manufacturing (RFM) documentation packages. Preparations for UPS testing at two of the supplier's locations are in progress.

Low voltage distribution and sub-distribution panels: An arrangement which transfers to the IO central team the responsibility to procure, on behalf of U.S. ITER, this equipment as well as the UPS and DC Distribution batteries, has been signed.

ITER Diagnostics (R. Feder):

Diagnostic Residual Gas Analyzer (DRGA): We have received the Hiden "long cable" RGA system. It has been set up at on the test stand that was used earlier for DRGA R&D. We have run some scans and it appears to be working properly. Formal testing will follow.

ITER Analysis Team: A seismic load specification document has been developed. This document will be delivered to our subcontractors for Tokamak Complex component design analysis. Review by the IO of the equatorial port 09 load specification has been completed, and comments from the review are being addressed.

Low Field Side Reflectometer (LFSR): Meetings were held at the ITER Organization (IO) with The Russian Federation Domestic Agency (RFDA) on the design of LFSR diagnostic front end components to fit inside the equatorial port plug #11 (EPP11) being supplied by RFDA. Many

areas of design modifications and enhancements were identified including the possibility of eliminating the Doppler channel to alleviate crowding in EPP11.

Upper Wide Angle View VIS-IR Cameras (UWAVs): The General Atomic Upper Camera design effort continues. The Reliability Availability Maintainability and Inspectability (RAMI) draft report has been received. The mirror cleaning R&D effort continues and is on schedule for completion in March.

Equatorial Port 09: Discussions were held to review RFDA development of a piezo motor. This motor has been a candidate for actuation of ECE mirrors and continues to be evaluated alongside a vendor design and a conventional pneumatic mechanism. The EP09 port integration team has begun drafting a list of selection criteria and ranking to assist with this choice, which must be made during this PDR phase.

Upper Port Plugs (UPP11 and UPP14): Work has started to develop the Interspace Support Structure (ISS) concept for Upper Ports. This design will have bio-shield plug mounted on the ISS. Once design is sufficiently developed it will be shared with IO along with all the assumptions made for it.

I&C Integration: With the wide-angle viewing system (WAVS) P&ID having now been approved, at least the first versions of all USDA diagnostic P&IDs, single line diagrams (SLDs), and cable collection lists (CCLs) have been submitted for IO review.

NSTX-U RECOVERY PROJECT (R. HAWRYLUK):

The first Design Verification and Validation Review (DVVR), reviewing the NSTX-U Instrumentation and Control Systems, was held this week identifying many gaps or issues with the system that will be considered in the development of the corrective action plan. The next DVVR will be held on January 24, addressing the requirements for the integrated design.

Progress continues on the development of NSTX-U System Design Descriptions (SDD's), and drafts are being reviewed and updated.

In the test cell, the removal of the lower ceramic break was successfully completed, and the in-vessel floor is now being reinstalled. Preparations for the removal of the PF1BL coil continue.

Re-commissioning of the coil winding facility continued with the completion of the fabrication of parts for the coil winding brake skid, and the receipt of parts for the coil conductor payout rollers. The coil facility oven is being configured to support PF1A fabrication.

Internal temperature sensors in the cold box of the neutral beam liquid helium refrigerator were repaired and tested. Voith Hydro Reps are on site, and are making good progress on scheduled maintenance of the NSTX-U Motor Generator Upper and Lower Guide Bearings.

R. Hawryluk chaired the Max Planck Institut für Plasmaphysik Fachbeirat in Garching Germany, which reviewed their program.

ITER & TOKAMAKS (R. NAZIKIAN):

International:

R. Maingi presented a EURO-fusion seminar at JET titled "The use of impurity droppers to alter the edge plasma characteristics in tokamaks." There was substantial interest in the powder dropper capability, and a new collaboration is being discussed. Maingi also presented a seminar at ASDEX-Upgrade titled: "Lithium seeding for ELM suppression and granule injection for ELM triggering in EAST: Preliminary results." In addition a continuation of the collaboration on seeding of the edge plasma with impurities, e.g. boron nitride, was continued on AUG.

DIII-D:

B. Grierson has upgraded the OMFIT TRANSP module to include input profiles from the Osborne python Pedestal tools, which are popular for constructing ELM-syncronized profiles for detailed pedestal stability analysis. The capability increases the flexibility of TRANSP analysis for resolving the evolution of pedestal transport in the inter-ELM phase.

Dr. Yang Ren is visiting DIII-D from January 16 – January 27. Dr. Ren discussed with Dr. Luo of UC-Davis about ECEI data analysis and started to study ECEI data. He has also discussed with Dr. Rhodes (UCLA), Dr. Crocker (UCLA) and Dr. McKee (University of Wisconsin) about his NSTX-D3D experiment entitled “Study of collisionality dependence of ion- and electron-scale turbulence in advanced inductive hybrid scenario with ST-relevant q95 on DIII-D”. A discussion of the experimental proposal with a broader audience has been arranged.

A. Nagy is leading the LCS8 beam power supply control upgrade. Progress is being made on commissioning the first controller, however crowbar trips are still occurring in various operational configurations. Carl Pawley (HV Senior Engineer at GA) is troubleshooting the issues. Work has stopped on the other controllers until the final commissioning of the first unit and lessons learned review is held.

Two new powder dropper mechanisms were fabricated this week for integration into one powder dropper that can handle two types of materials such as lithium and boron nitride. The dual powder droppers will be mounted on a common base plate and tested to ensure sufficient vibrational isolation between the two units.

ADVANCED PROJECTS (H. NEILSON):

Stellarators (D. Gates):

D. Gates and N. Pablant joined the Coordinated Working Group Meeting (CWGM) at CEIMAT in Madrid, Spain held during January 18-20. The Coordinated Working Group is focused on the coordination of international experimental and theoretical stellarator research and is organized under the auspices of the IEA Stellarator/Heliotron Technology Collaboration Program. The meeting covers a broad range of topics. Novimir chaired the session on impurity transport and lead discussions about needs of the stellarator community and opportunities for collaborations. These discussions lead to the formation of three Joint Tasks to explore several outstanding

questions in stellarator impurity transport and one Joint Activity for collaborative development of impurity transport codes for 3D magnetic systems. Gates is a member of the organizing committee for the CWGM and helped select the joint action topics.

System Studies (C. E. Kessel):

C. E. Kessel participated in the Virtual Laboratory for Technology (VLT) conference call, and presented a brief summary of observations and technical highlights from the FNSF study, which is wrapping up. In addition, he described the next activity and kick-off meeting planned for February 2017 at DOE Headquarters. The call reviewed VLT highlights that were submitted, American Nuclear Society (ANS) Grand Challenges, and discussed the upcoming National Academy of Science study, and how the VLT could respond.

THEORY (A. BHATTACHARJEE):

A. Reiman presented a Theory Department Research and Review Seminar on January 20 titled "Resonant Pressure Driven Equilibrium Currents In and Near Magnetic Islands". The abstract is as follows: "In toroidal MHD equilibria, pressure can generally be regarded as constant on the flux surfaces. The regions near small magnetic islands, and those near the X-lines of larger islands, are exceptions. The variation of the pressure within the flux surfaces in those regions has significant consequences for the pressure driven current, and those consequences are strongly affected by the symmetry of the magnetic field if the field is invariant under combined reflection in the poloidal and toroidal angles. ("stellarator symmetry"). In non-stellarator-symmetric equilibria, the pressure-driven currents have logarithmic singularities at the X-lines. In stellarator-symmetric MHD equilibria, the singular components of the pressure-driven currents vanish. In contrast, in equilibria having p constant on the flux surfaces the singular components of the pressure-driven currents vanish regardless of the symmetry. In 3D MHD equilibria having simply nested flux surfaces, the pressure-driven current goes like $1/x$ near a rational surface, where x is the distance from the rational surface. To calculate the pressure-driven current near a magnetic island, we work with a closed subset of the MHD equilibrium equations that involves only perpendicular force balance, and is decoupled from parallel force balance. Two approaches are pursued to solve our equations for the pressure driven currents. First, the equilibrium equations are applied to an analytically tractable magnetic field with an island, obtaining explicit expressions for the rotational transform and magnetic coordinates, and for the pressure-driven current and its limiting behavior near the X-line. The second approach utilizes an expansion about the X-line to provide a more general calculation of the pressure-driven current near an X-line and of the rotational transform near a separatrix."

BUSINESS OPERATIONS (K. FISCHER):

PPPL submitted Project Data Sheets for eight new Laboratory Directed Research and Development (LDRD) projects to the DOE for concurrence. Including the budget for these projects, the total budget allocated to LDRD projects in FY2017 would be $3.6 million against the $4.0 million LDRD funding ceiling approved by DOE.

PPPL was included as a funded collaborator on two Small Business Technology Transfer (STTR) Phase 1 proposals submitted to NASA by Princeton Satellite Systems.

ENVIRONMENT, SAFETY, & HEALTH (J. LEVINE):

The annual surveillance audit of PPPL's ISO-14001 certified Environmental Management System (EMS) was conducted by an auditor from UL-DQS between January 17 and 20. There were no findings and only a few minor recommendations resulting from the audit. The auditor praised the Laboratory's commitment to environmental stewardship and identified a number of strengths in our EMS, including energy management, emergency management and communications.

OFFICE OF ACADEMIC AFFAIRS (N. FISCH):

N. Fisch attended the Workshop for the NSF/DOE Partnership in Basic Plasma Science and Engineering in Arlington, Virginia, where he gave an invited talk on January 9. The title of the talk was, "Some Opportunities in Rotating Plasma." The abstract of his talk reads: Rotating plasma can exhibit certain unusual effects. These effects can be exploited in a variety of plasma devices, including Hall thrusters, plasma mass filters, and fusion confinement devices. In pulsed devices, rotating plasma exhibits unusual heat capacity effects. A very promising but highly speculative possibility is to exploit rotation to achieve magnetic confinement in a plasma torus, but with minimal toroidal current.

Fisch gave a variation on this talk with particular emphasis on the opportunities in controlled nuclear fusion in a colloquium at ASIPP in Hefei, China on January 17. On January 19, he gave a departmental seminar titled, "Controlling Plasma with Waves," at the Institute of Physics of the Chinese Academy of Sciences in Beijing, China.

DIRECTOR'S OFFICE (S. ZELICK):

From January 16-20, M. Zarnstorff participated in the IPP Fachbeirat meeting, held in Germany.

On January 17, D. McComas and T. Brog traveled to Germantown, Maryland to update DOE FES management regarding our progress with NSTX-U and other critical PPPL events.

On January 18, Dr. Edward Ott, University of Maryland presented a colloquium entitled, "Chaotic Dynamics in the Physical Sciences".

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