

The PPPL Highlights for the week ending December 2, 2016 are as follows:

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

ITER Fabrication Department (H. Neilson):

Hutch Neilson has been appointed to the ITER Fabrication Department Head position at PPPL.

Dale Knutson visited PPPL to consult with the ITER team on project management and team performance strategies. Dale's experience on other large DOE projects will be leveraged by the PPPL-based ITER team as the CD-2 baseline performance phase begins.

ITER Steady State Electrical Network (J. Dellas):

Power Transformers; The first of three shipping batches of the Group 1 and 2 transformers arrived at the ITER site on November 21. This first shipping batch includes the main bodies (tanks) of twelve oil-filled transformers that will step down the 22kV SSEN distribution voltage to 6.6 kV for powering the large ITER facilities loads such as cooling water pumps and cryoplant compressors.

ITER Diagnostics (R. Feder):

I&C: The effort to develop USDA Diagnostic Piping and Instrumentation Diagrams (P&IDs), Single-Line Diagrams, and cable collection lists continues, with only the WAVS package remaining to be submitted. The first WAVS package will be released in early December.

Upper Wide Angle View VIS-IR Cameras: TNO has begun mirror cleaning R&D. Several experiments produced very informative and useful results especially in the area of setup issues, mirror material, gas types, and energy deposition. General Atomics achieved improved IOT imaging performance (and relaxing tolerance budget). Maximum allowable optical surface deformation requirements and sub aperture plots were received and evaluated.

Upper Port 11 and 14 Integration: DSM support frame design has been modified to accommodate new GDC isolation box design. This in turns requires that the DSM electrical connector be moved and placed it close to the Closure plate.

Diagnostic RGA (DRGA): We received a test report for the long-cable QMS RGA being developed for us by Hiden Analytics. (The long-cable unit is being developed to mitigate

radiation dose issues with COTS RGAs). The results indicate that this proof-of-concept unit will work. The unit will be delivered in December.

Toroidal Interferometer and Polarimeter (TIP); A spreadsheet has been developed to assess the alignment margin for all of the TIP channels, based on the strategy that external mirrors are actuated to establish and maintain alignment of the lasers on the retroreflectors. Based on this analysis, if the list of identified positional uncertainties of the retroreflectors relative to the E9 plug is complete and correct, somewhat smaller vacuum windows would still provide adequate range of alignment.

NSTX-U RECOVERY PROJECT (R. HAWRYLUK):

At the NSTX-U Team meeting, a presentation was given describing the approach taken to analyze the extent of condition and develop a comprehensive action plan.

A kick-off meeting was held this week with the NSTX-U recovery team that will assemble the DVVR documents for the Magnets scope. The System Design Description (SDD) template was defined for the team and an effort to populate the TF section was initiated by the team. The plan for collecting as-built documentation was also discussed and resources were identified to assist in the collection of as-built documentation. A PF1A PDR kick-off meeting was held with the team of persons who will contribute to the design review package. An outline of topics was discussed, along with personnel assignments on each topic. Work was initiated on a report that will present findings and recommendations concerning a proposed path forward for the PF1A/B/C coils.

The NSTX-U centerstack is in its stand in the High Bay Area. Centerstack metrology documenting the tilt of the TF inner conductors and OH coil with respect to the centerstack casing has been completed. The upper ceramic break assembly has been removed from the vessel, and electrical insulation tests (hi-pots and meggers) were performed this week. Preparations to remove the lower ceramic break are in progress. Commissioning of the coil winding facility continued with testing of the taping machines and VPI system leak checking. Three spools of conductor for the PF1A coil have been delivered. The PF1-AL mandrel welding has been completed and, final machining will start this coming week. The Field Coil Power Conversion (FCPC) Test Stand is being prepared for magnetic testing of an ITER diagnostic component to be conducted during the week of December 12. Upon completion, the Test Stand will be configured for power testing of PF Inner Coils beginning with the original PF1aL

The rebuilding of two neutral beam (NB) ion sources started in the NB decon facility and clean room. The LHe Refrigerator procurement process continues with an evaluation of status planned next week; plans for a PDR continue in parallel.

NSTX-U RESEARCH (J. MENARD):

The NSTX-U Team Meeting was held on December 2 at PPPL. The NSTX-U team was updated on the reorganization, on-going outage activities, and the near and longer term plans.

ITER & TOKAMAKS (R. NAZIKIAN):

DIII-D (R. Nazikian):

Six PPPL contributions were presented at the DIII-D Long Range Planning workshop on December 1-2. Presentations by R. Goldston and A. Bortolon focused on the physics of detachment and the use of powders, solids, liquids and vapors in affecting detachment at low upstream density. The potential for testing a variety of materials via the PPPL powder dropper was discussed. Shaun Haskey presented results from the main ion CER system showing that core neutral density measurements are possible from impact excitation with the neutral beam. He emphasized the importance of a multi-institutional multi-diagnostic approach to address the challenge of neutral measurements and modeling. R. Nazikian presented a talk on the advantages of the super H-mode pedestal for core edge integration and argued for a research program focused on developing stationary high pedestal pressure regimes. N. Logan emphasized the importance of upgrading the 3D coils for optimizing plasma discharges and B. Grierson presented a talk on the need for an aggressive plan to realize the promise of the TTF “Predict First” initiative. As the name implies, Predict First is a new paradigm for performing experiments by which integrated modeling is used to plan experiments.

Vendors have been selected for the fabrication of four new neutral beam pole shields sets for the DIII-D Tokamak. They have previously fabricated two similar pole shields back in 2014, which were successfully installed and operated in DIII-D. The project leader I. Zatz of PPPL held a kick off meeting on November 29 with the vendor. Delivery is planned for May 2017.

A. Nagy continues to lead the steerable 210 neutral beam design work. Bellows prototype plates were assembled. Initial testing has been completed and a hydraulic system test is underway. A successful CDR on seismic supports was held. The FDR for the bellows plates is rescheduled for next week.

The neutral beam controller (NBLCS8) began high power testing. Noise on the ground plane has affected some of the components and plans are being developed to shield the components and use fiber optics to transmit signal.

International (R. Maingi):

R. Maingi visited UT-Knoxville and ORNL to continue planning of the EAST PMI collaboration. The need and plan for several meetings regarding controlled sample exposures and IR thermography were identified, and an action plan for analysis of tiles from EAST was developed in conjunction with Brian Wirth and Steve Zinkle (UT-K). In addition steps for SOLPS analysis of EAST lithiated discharges were identified with John Canik and Jeremy Lore (ORNL).

ADVANCED PROJECTS (H. NEILSON):

In the Wendelstein 7-X divertor scraper project, six new graphite tiles were delivered to PPPL in mid-November. The tiles were manufactured by MWI, Inc. of Rochester, NY to replace tiles that were damaged during subsequent shipping and handling. Negotiations with a commercial supplier for the final processing step, namely bakeout of the tiles under clean vacuum conditions, are currently in progress.

Stellarators (D. Gates):

This week a Nature Communications article entitled “Confirmation of the topology of the Wendelstein 7-X to better than 1:100,000” was published in which S. Lazerson was a contributing author. This work highlights results from Lazerson's involvement in the W7-X flux surface mapping campaign last year. This work also highlights the role of the trim coil system in the W7-X experimental campaign. The quantitative measurements made in the paper could not have been made without the utility of the trim coils.

On November 29 David Gates participated in a mock review for the Physics Review Board of the Canadian Natural Science and Engineering Research Council - Canada's federal funding agency for university-based research. The purpose of the mock review was to prepare for the actual review process and discuss the rating criteria for the agencies annual Competition week to be held in Ottawa in February. Dr. Gates is in the second year of a three year term on this committee.

On November 30, a community document on Stellarator Research Opportunities was released for general comment. The announcement was included in the monthly eNews of the USBPO and the report itself was posted on the USBPO website [here](#). The report is the product of a series of community meetings organized by the National Stellarator Coordinating Committee the first of which was held on February of 2016, and hosted by MIT. The NSCC is chaired by David Gates and co-chaired by Prof. David Anderson of the University of Wisconsin.

Fusion Energy Systems Studies and Next Step Activities (C. E. Kessel):

G. H. Neilson, P. Titus, T. Brown, C. Kessel, D. Mikkelsen held a conference call with the Korean DEMO design group (NFRI) to discuss progress on various work scopes. K. Im reported the new timeframe and scope for the K-DEMO study, indicating a five year slowdown in light of recent ITER schedule shifts. They will continue with pre-conceptual design from 2017-2021, and begin conceptual design in 2022. S. Kwon presented scoping studies of the divertor comparing RAFM steel and CuCrZr as heat sink materials in combination with tungsten monoblocks, and with water cooling. In addition, the geometry of the coolant flow was explored to handle the nonuniform heating on the divertor target. J. Park reported on detailed neutronics analysis to find the shutdown dose rate and irradiation damage through the tokamak and in a port plug, showing the doses rates are very high at the first wall, but vary significantly in the divertor. T. Brown reported new layout/design work for the OB and IB blanket structural support, and introduction of heating and current drive. D. Mikkelsen and C. Kessel briefly presented their plans for helicon current drive analysis, and time-dependent simulations of the K-DEMO plasma.

THEORY (A. BHATTACHARJEE):

On November 21 Lee Ricketson (Courant Institute, New York University) presented a Theory Seminar on sparse grid techniques for particle-in-cell (PIC) schemes. The PIC method has long been the standard technique for kinetic plasma simulation across many applications. The downside, though, is that quantitatively accurate, three-dimensional (3-D) simulations require vast computing resources. A prominent reason for this complexity is that the statistical figure of merit is the number of particles per cell. In 3-D, the number of cells grows rapidly with grid resolution, necessitating an astronomical number of particles. To address this challenge, Ricketson and co-workers suggest the use of sparse grids: by a clever combination of the results from a variety of grids, each of which is well resolved in at most one coordinate direction, similar accuracy to that of a full grid is obtained, but with far fewer grid cells, thereby dramatically reducing the statistical error. Results from test cases were presented that demonstrate the new scheme's accuracy and efficiency. Limitations of the approach and, in particular, its need for an intelligent choice of coordinate system were discussed.

COMMUNICATIONS & PUBLIC OUTREACH (A. ZWICKER):

Communications (L. Bernard):

An article about S. Lazerson's role in measuring the fidelity of the Wendelstein 7-X magnetic field was written by J. Greenwald, and was featured in the science news section of the U.S. DOE Office of Science web site. It was posted in Newswise and EurekAlert.

J. Greenwald's story on the Laboratory's proposed explanation of the source of fast magnetic reconnection was posted in Newswise and EurekAlert.

DIRECTOR'S OFFICE (C. AUSTIN):

On November 30, Dr. Ralph Izzo, Public Service Enterprise Group, presented a colloquium entitled, "Overview of Domestic Electric and Gas Markets".

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