



The PPPL Highlights for the week ending January 23, 2015, are as follows:

U.S. ITER FABRICATION (D. JOHNSON):

A little more than a week after the first HV substation transformer arrived at the ITER site in France, the second unit is now ready to ship from Hyundai in Korea, pending approval of Release for Shipment Package by the US ITER Project.

Some changes in the Control Account Managers for US ITER diagnostics were made this week. ORNL engineer Van Graves will be the CAM for the residual gas analyzer (RGA) system, PPPL's N. Allen and A. Basille will assume CAM roles for the core imaging x-ray diagnostic and the equatorial port plug #9, respectively.

Responses were provided to DOE PSO on comments on the Request for Proposals for the ITER MSE design subcontract, and revisions to the associated Statement of Work are underway.

Piping and Instrumentation Diagrams, Single Line Diagrams and Cable Diagrams for the US ITER diagnostics were prepared by the IO in the conceptual design phase. Work has begun, by Bill DeVan at the US ITER Project, to update these documents based on advancing preliminary designs. DeVan intends to work with CAMs at PPPL and PPPL subcontractors doing the designs, in order to bring these documents up to date.

NSTX (M. ONO):

NSTX-U is in the Upgrade Project outage in FY14. NSTX Upgrade construction activities continued this week and are highlighted in the Engineering section below.

The Conference Report on the International Symposium on Lithium Application for Fusion Devices by Giuseppe Mazzitelli (EURATOM-ENEA, Frascati, Italy), Y. Hirooka (NIFS, Japan), J. S. Hu (ASIPP, China), S.V. Mirnov (TRINITI, RF), R. Nygren (SNL, USA), Shimada (JAEA, Japan), M. Ono (PPPL, USA), and F.L. Tabares (EURATOM-CIEMAT, Spain) was published in Nuclear Fusion 55 027001 (2015) and is now available at <http://stacks.iop.org/0029-5515/55/027001>.

Preparations for plasma operations in the NSTX-U configuration continued. Operational tests of the D-Site Motor generator Set #1 continued, and the set has been successfully run up and cycled to 90% of its maximum speed (more than needed to resume NSTX-U operations). Arrangements have been made to complete balancing of the set this coming week. The four lithium evaporators

LITERS and lithium lifters have been moved to the CS High Bay shop for re-commissioning. A design review of new Gas Injection System control electronics was held this week, and procurement of parts is now in progress. Installation of fire protection systems for the new deuterated trimethylboron (dTMB) injection system continued, and installation of the Multi-Pulse Thompson Scattering (MPTS) diagnostic flight tubes continues.

Access to the NSTX test cell will be available only through previous arrangement with the Upgrade Work Control Center.

ITER & TOKAMAKS (R. HAWRYLUK):

DIII-D (R. Nazikian):

On January 19, the LGI supported an experimental day devoted to exploring operational methods to access super H-mode pedestal conditions. The LGI, deployed in four plasma discharges, was able to deliver 0.9 mm granules at an average frequency of approximately 80 Hz, achieving consistently near 100% ELM trig efficiency. The resulting ELM paced H-mode showed an increase of pedestal density and decrease of pedestal temperature. Overall, the pedestal pressure evolution towards the high values characteristic of super H-mode remained similar to the reference discharge with the Edge Harmonic Oscillation. This promising outcome suggest that the high pedestal pressures on par with super H-mode can be maintained in a small, triggered ELM regime. Alessandro Bortolon also presented a Friday Science Meeting talk recently on the results of the LGI on DIII-D.

G. Kramer visited DIII-D this week to participate in the analysis of microwave imaging data. Various improvements to the system have enabled, for the first time, the detection of density fluctuations from core Alfvén eigenmodes in DIII-D using the Microwave Reflectometer imaging diagnostic. This diagnostic accomplishment will enable further study of these instabilities, particularly in q_{\min} steady-state scenario being explored at DIII-D where ECE emission is cutoff.

M. Okabayashi participated in experiments aimed at the avoidance of mode locking of neoclassical tearing mode (NTM) at high plasma pressure. This was successfully demonstrated recently in DIII-D by injecting Electro-Magnetic torque using 3D field feedback control. The rotating 2/1 NTM was routinely synchronized to the 3D applied field before onset of locking. The mode rotated with a very low frequency in the range of a few tens of Hz. In spite of frequent internal MHD activity, the plasmas with a slowly-rotating 2/1 NTM avoided major disruptions.

ADVANCED PROJECTS (D. GATES):

In a continuing effort to optimize stellarators for turbulent transport S. Lazerson has successfully implemented fully parallel linear calculations of TEM growth rates into STELLOPT with the help of the GENE code. A recent run on the Hydra cluster (located at IPP) allowed linear growth rates to be calculated for NCSX in under 30 seconds. A demonstration run of the STELLOPT code utilizing 900 cores on the cluster allowed over 1000 equilibria to be calculated and evaluated in only a few hours. A collaboration with H. Mynick, Josefine Proll (IPP-Greifswald),

and Joe Talmadge (University of Wisconsin) is underway to extend this work to ETG turbulence calculations. The ability to run parallel codes inside the already parallel STELLOPT optimizer is also allowing for inclusion of energetic particle calculations in the optimization loop.

A paper entitled "Three dimensional equilibrium reconstruction on the DIII-D device" by S. Lazerson was published this week in Nuclear Fusion. The reconstruction uses the VMEC equilibrium code within the STELLOPT suite of codes and is governed by fit to magnetic diagnostics, measured coil currents, Thomson scattering, charge-exchange spectroscopy and MSE polarimetry.

THEORY (A. BHATTACHARJEE):

On January 22, F. Ebrahimi presented a theory seminar on extended MHD studies of magnetic reconnection in NSTX/NSTX-U: Macroscopic reconnecting current-driven and flow-driven instabilities constitute the core of many currently relevant problems in fusion plasmas, as well as in astrophysical plasmas. First, I will start with the magnetic reconnection process during Coaxial Helicity Injection (CHI) in NSTX. Magnetic reconnection, which energizes many processes in nature, has been shown to have a fundamental role in the plasma start up and current formation in NSTX/NSTX-U. Formation of an elongated Sweet-Parker current sheet and a transition to plasmoid instability has for the first time been predicted by simulations of a large-scale toroidal fusion plasma in the absence of any pre-existing instability. Consistent with theory, fundamental characteristics of the plasmoid instability are demonstrated through resistive MHD simulations of transient CHI experiments in the NSTX. Simulations have been performed in a realistic geometry with a toroidal guide field and using experimental NSTX poloidal coil currents. The requirements for full flux closure in NSTX-U, as obtained in the simulations, will be presented. Second, the role of reconnecting-tearing/flow-driven instabilities in momentum transport will be discussed. Examples of validation exercises for momentum transport in other applications, including RFP and astrophysically relevant laboratory plasmas, will then be presented. Plans for studies of disruption due to core MHD activity at high-beta regimes in NSTX-U will be discussed.

On January 19, L. Zakharov gave a talk to the DIII-D Physics Seminar in General Atomic on "Theory of VDE and associated Hiro, Evans and halo currents". The theory of VDE is now consistent with the observations and measurements of toroidal asymmetry in both plasma current and diamagnetic signals. It has a rigorous formulation in the form of compact Tokamak MHD (TMHD) equations with a straightforward implementation into numerical schemes. The 2-D VDE-code based on TMHD, developed recently in PPPL, is at the final stage of interfacing with the EAST tokamak environment and diagnostics. The difference between the theory introduced Hiro and Evans currents with the notion of "halo"-currents, originated in 1991 in discovery on DIII-D of the currents to the plasma facing tiles, was explained.

ENGINEERING AND INFRASTRUCTURE (M. WILLIAMS):

NSTX Upgrade (R. Strykowski, E. Perry, L. Dudek, T. Stevenson):

Management: The Final Readiness for Operation Review (ROR) report has been received from the review committee. There are no substantive changes from the review closeout slides. Corrective action items identified at the review are currently being reconciled. Planning discussions started with DOE on the CD4 project closeout review.

Construction: Leak checking of the vacuum vessel has been completed and all vacuum leaks have been resolved. Welding of the flange for the new upper umbrella lid is in progress. Final installation of all Poloidal Field, Ohmic Heating and Coaxial Helicity Injection buswork and hoses inside the umbrellas is underway and should be completed in a few days. Installation of the TF bus will follow. Rework of the center toroidal field lead extensions for the upper umbrella continues in the shops. Re-connection of the TIV and shutter cables has been started. Electrical work on the MPTS diagnostic and the MOVs continues. Fabrication of the gas delivery piping continues.

CS Upgrade: A decision was made to replace the umbrella OH hoses with conductive metal braided hoses to meet the pressure and temperature requirements. The transition to an insulating break will be made just outside the umbrella. A sample hose was received and insulated with kapton and silicone. The assembly then passed a 17.5kv hi pot test. A hydrotest of the assembly is scheduled for Friday second shift. CTD started fatigue testing the 3x4 50% offset mockup to 15,000 cycles. The preliminary test data as it is taken is being sent to PPPL.

NBI Upgrade: TVPS and vacuum vessel leak checking continued with fixed seals and improved vacuum conditions noted. Turbomolecular pumps have been operated with programmable logic controls and the pretesting is in progress. Services work remaining includes a platform step and elephant trunk stack stations and work is scheduled to complete by start of scrub in February. NBI DI water system repair on the piping on the MER mezzanine continues. Power testing of M/Rs continues. Final controls work and troubleshooting continues. Concrete work on the N gallery shield wall was completed. The gates and beams will be attached, when appropriate. Progress continues on BL PLC software pages. Cryogenics system Helium gas operations continues and sufficient inventory is on hand and loaded to operate both beamlines. Development of Neutral Beam procedures continues and nears completion.

Digital Coil Protection System: Testing continued in preparation for support of dummy load testing. Errors on PCS, spike glitches on RTC outputs at the Firing Generator end, and a DCPS code bug were investigated. DCPS has been fixed and rebuilt; the concomitant PTP rerun is in progress. RTC was rebuilt and will resume further testing. Work continues on the DCPS buffer chassis implementation. Consideration of parameter tree development to support Pre Testing Procedures, dummy load, ISTP, and CD4 continues with progress on dummy load currents and I2t settings. Work continues on the procedure for setup and daily startup of the DCPS system.

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

ESH&S hosted a visit to PPPL by Marty King, safety manager at GA and DIII-D in San Diego, California. Mr. King toured the NSTX and TFTR Test Cells, the PEARL laboratories and several other locations, and had discussions with several subject matter experts on safety training, promotion of safety culture, the STOP Program and NSTX-U operations, among other topics.

OFFICE OF COMMUNICATIONS (K. MACPHERSON):

J.J. DeVoe and J. Greenwald took part in a DOE “pitch slam” with editors of Discover Magazine on January 13.

Greenwald wrote and distributed a news release stating that the U.S. Patent and Trademark Office had granted a patent to engineers at PPPL and the USDA for a novel technique for pasteurizing eggs in the shell. The DOE Office of Science tweeted the news release and made it the lead item in the Science Headlines section of the Office of Science homepage. Several of Greenwald's stories also appeared in DOE Pulse and the ITER Newslines.

DIRECTOR’S OFFICE (C. AUSTIN):

On January 20, Professor Jeffrey Freidberg, Massachusetts Institute of Technology presented a colloquium entitled, "Who Will Save the Tokamak - Harry Potter, Arnold Schwarzenegger, Shaquille O'Neal, or Donald Trump?"

On January 21, Dr. Kenneth Hill, Princeton Plasma Physics Laboratory, presented a colloquium entitled, "Development of High Resolution X-Ray Spectroscopy at PPPL".

PUBLICATIONS:

Mazzitelli, G. (EURATOM-ENEA, Frascati, Italy); Hirooka, Y. (NIFS, Japan); Hu, J.S. (ASIPP, China); Mirnov, S.V. (TRINITY, RF); Nygren, R. (SNL, USA); Shimada (JAEA, Japan), Ono, M. (PPPL, USA), and Tabares, F.L. (EURATOM-CIEMAT, Spain), “Conference Report on the International Symposium on Lithium Application for Fusion Devices,” Nuclear Fusion 55 027001 (2015), <http://stacks.iop.org/0029-5515/55/027001>

Lazerson, S., "Three dimensional equilibrium reconstruction on the DIII-D device," Nuclear Fusion.

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