NSTX PAC-29 Charge Questions

January 26-28, 2011
Conference Room LSB-B318, PPPL

We ask the NSTX Program Advisory Committee to address the following two questions:

1) Do the proposed research priorities and milestones for the FY2011 and 2012 run campaigns exploit all feasible opportunities for new, major results prior to the Upgrade outage period?

   Further, do the priorities and milestones support needed preparation for the NSTX Upgrade?

2) Are the NSTX and NSTX Upgrade research plans well aligned with the OFES vision for fusion research in the coming decade – a vision emphasizing 4 research themes:

   I. Plasma dynamics and control
   II. Materials in a fusion environment and harnessing fusion power
   III. Validated predictive capability
   IV. 3D magnetic fields

The NSTX research priorities are expressed primarily through milestones defined by the Program with input from the NSTX research team. These milestones define the work to be carried out by the NSTX Research Team in the annual field work proposal (FWP) submitted to DoE.

To assist in answering charge question 1 above, the titles/goals of the Office of Fusion Energy Sciences (OFES) 3 facility joint research milestones and the NSTX Research Milestones for FY2011 and 2012 are provided below.

To assist in answering charge question 2 above, abbreviated/paraphrased definitions of the 4 OFES research themes are also provided below.

FY2011 Research Milestones:

Office of Fusion Energy Sciences (OFES) Joint Theory-Experiment Research Milestone:

"Conduct experiments on major fusion facilities to improve the understanding of the physics mechanisms responsible for the structure of the pedestal and compare with the predictive models described in the companion theory milestone."

NSTX Research Milestones:

- R(11-1): Measure fluctuations responsible for turbulent electron, ion and impurity transport
- R(11-2): Assess ST stability dependence on plasma aspect ratio and boundary shaping
- R(11-3): Assess very high flux expansion divertor operation
- R(11-4): Assess H-mode pedestal transport, turbulence, and stability response to 3D fields

FY2012 Milestones:

Office of Fusion Energy Sciences 3 Facility Joint Research Milestone:

"Conduct experiments on major fusion facilities leading toward improved understanding of core transport and enhanced capability to predict core temperature and density profiles."

NSTX Research Milestones:

- R(12-1): Investigate the relationship between lithium-conditioned surface composition and plasma behavior.
- R(12-2): Assess confinement, heating, and ramp-up of CHI start-up plasmas
- R(12-3): Assess access to reduced density and collisionality in high-performance scenarios
- IR(12-1): Investigate magnetic braking physics and develop toroidal rotation control at low collisionality *(incremental)*
- IR(12-2): Assess predictive capability of mode-induced fast-ion transport *(incremental)*

For more detail on the OFES and NSTX research milestones, please refer to the milestone text at the following URL:

http://nstx.pppl.gov/DragNDrop/Program_PAC/PAC/PAC-29/supporting_documents/NSTX_FY11-12_milestones_Jan12_2011.pdf

Four research themes from the OFES vision for fusion research in the coming decade:

I. Plasma dynamics and control

- Perform detailed measurement of underlying processes, connection to theory, developing an integrated understanding, and demonstration of advanced scenarios in tokamaks.

II. Materials in a fusion environment and harnessing fusion power

- Understand and control processes beyond the last closed flux surface, including the open field line plasma physics, the plasma/material science governing the plasma-surface interactions, and how these processes couple to define the closed flux surface boundary.

- Determine the fusion nuclear science facility (FNSF) geometry, determine the materials the FNSF will be made from and should test.

III. Validated predictive capability:

- Increase emphasis on validation of physics models that are incorporated in fusion simulation

- Increase confidence in extrapolating and improving the tokamak/ST in support of ITER, FNSF, and Demo

IV. 3-D magnetic fields

- Determine the optimum level of 3D field in toroidal magnetic configuration (continuum from tokamak to fully 3D stellarator) accounting for both physics and engineering complexity in the optimization.

  - Enhance the theory of 3-D equilibria, stability, and transport research
  - Increase emphasis in 3-D fields near-term on domestic facilities
  - Solicit theory/simulation proposals for bridging the gap between small and large topological variations from a tokamak, aiming for inclusion in fusion simulation

For more detail on the OFES vision and research themes, please refer to the presentation at the following URL:

http://nstx.pppl.gov/DragNDrop/Program_PAC/PAC/PAC-29/supporting_documents/APS-DPP_110810_FES_vision_EJS_for_UFA.pdf