NSTX-U Milestone R(18-2)

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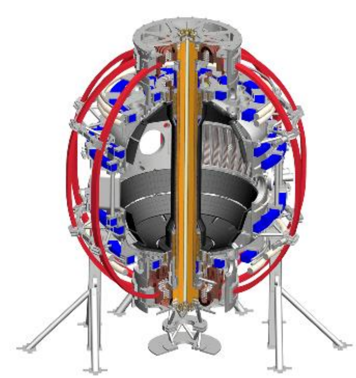

PPPL

Goal: address uncertainty in material performance and diagnostic integration

- PPPL Engineering closely examining two performance limitations in PFC redesign:
  - Material failure due to stress-limited tile designs
  - Discharge degradation due to temperature-enhanced material ablation (e.g. carbon or other impurity blooms)

- Ability to field and interpret diagnostics could enable PFC monitoring and NSTX-U physics studies
  - DivSOL and M&P TSG diagnostics affected by PFC changes
  - Need to develop appropriate diagnostic set in case PFC monitoring is deemed necessary

Milestone goal achieved with three major components

1. Testing of PFC materials and designs
   - High-heat flux (HHF) testing, even to destruction (e.g. e-beam test)
   - Evaluation of high-temperature plasma-surface interactions (e.g. Li-compound decomposition in lab or linear plasma)

2. Redesign of boundary diagnostics and actuators
   - Tile-based diagnostics need redesign in “Mardenblock” scheme (e.g. thermocouples, probes)
   - Spectroscopic and IR thermography interpretation complicated by PFC spatial scales

3. Assess and develop diagnostic set needed to effectively monitor performance of the PFCs
   - Utilize HHF testing to generate internal temperature and stress/strain states
   - Evaluate impact of B/Li coatings on diagnostic effectiveness

FY(18-2): Evaluate Recovery project PFC operational limits and develop integrated diagnostic plan for experimental operations

- The NSTX-U Recovery Project is developing new plasma-facing components (PFCs) for use in the divertor of NSTX-U. The extreme conditions of the NSTX-U divertor make it possible to stress even graphite surfaces to the material limits leading to the possibility of component failures. In addition, the complex, mixed-material environment of the NSTX-U due to the use of boron and lithium wall conditioning techniques creates significant uncertainties in the monitoring of the PFCs. To assist in planning for initial and high-performance operations, it is advantageous to determine the design limits that will ensure reliable operation. It is also necessary to assess and redesign several edge-plasma diagnostic systems that must integrate with the new PFC designs. The goals of this milestone will be accomplished in three major components: 1) testing of stress-limited PFC design features (even to destruction) and evaluation of high-temperature plasma-surface interactions that might result in operational temperature limits , 2) redesign of boundary diagnostics and actuators affected by PFC design, and 3) assessment and development of the technical and engineering basis needed to effectively monitor the performance of the PFCs based on experimental test results.